

# Use of Data for Planning and Monitoring of Development Programmes



## Training Course Material



INTERNATIONAL INSTITUTE FOR  
POPULATION SCIENCES, MUMBAI



United Nations  
Population Fund - India



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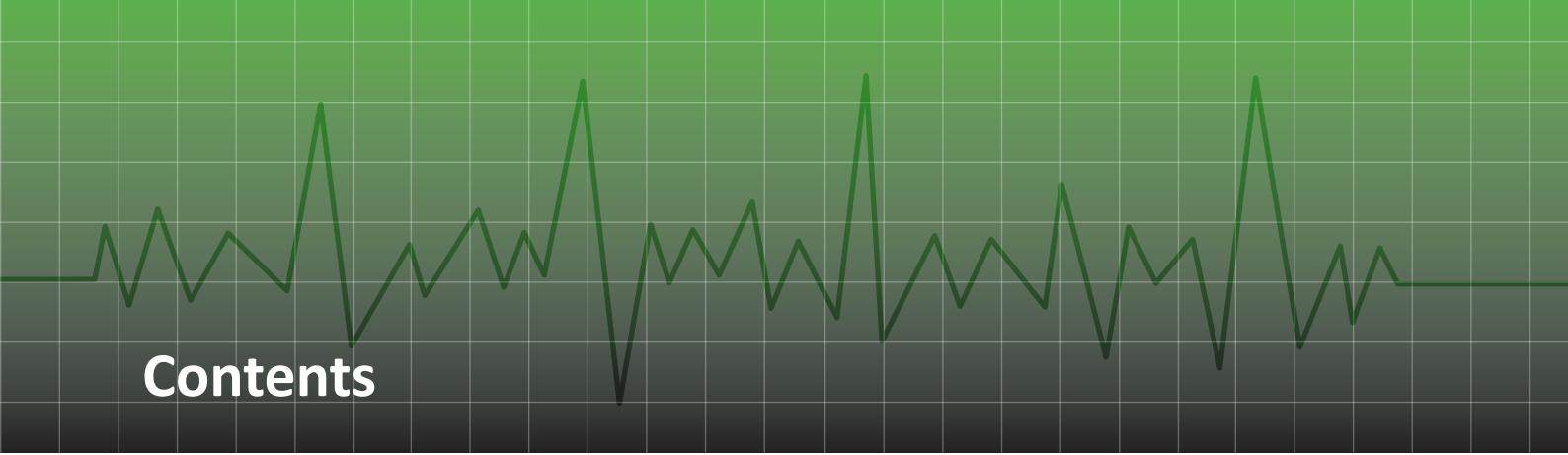


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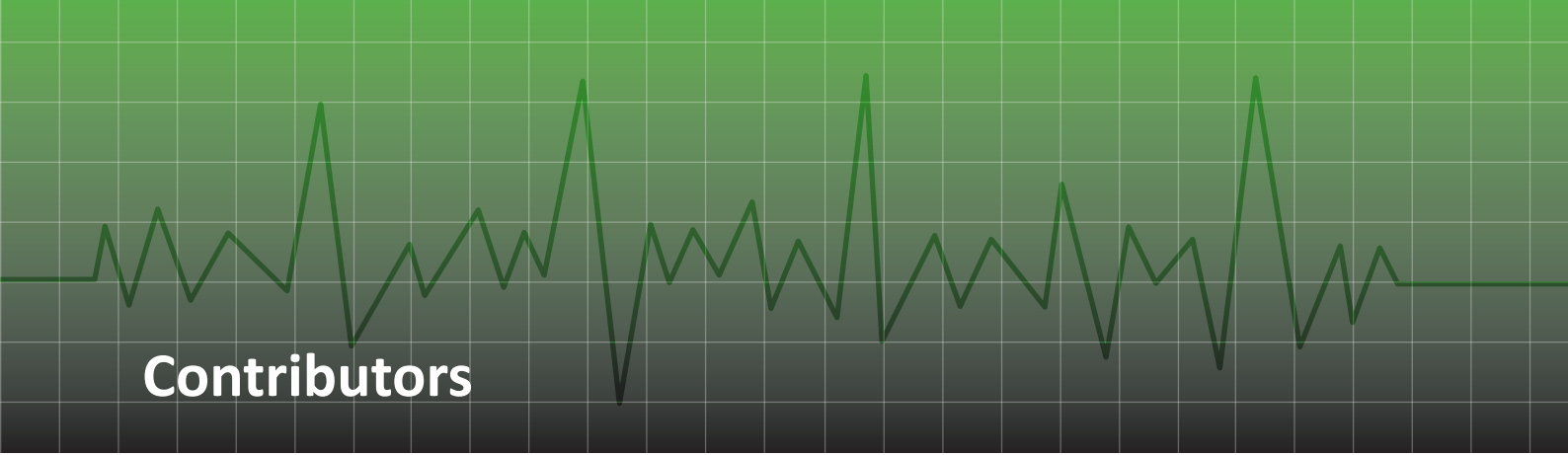




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# Foreword

With the introduction of 73<sup>rd</sup> and 74<sup>th</sup> Amendments to the Constitution of India, decentralisation and devolution of powers to the Panchayati Raj institutions have been emphasised. In order to facilitate the process, various attempts have been initiated and one of the essential components has been to develop an integrated district plan by addressing local development needs and requirements. In this context, the Planning Commission of India has prepared a manual on decentralised participatory integrated planning and intends to implement it in the districts that have been the recipients of the Backward Regions Grant Fund (BRGF).

In partnership with the Planning Commission of India, the rollout of decentralised integrated plans was planned in 35 BRGF districts across seven states – Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Orissa, Rajasthan and Uttar Pradesh – through a GOI-UN Joint Programme on Convergence with UNDP, UNICEF and UNFPA as the main partners.

To ensure that district planning is evidence-based and fits into the larger framework of the Convergence Programme, UNFPA embarked on building the capacity of statistical officials in the districts in the use of data for planning and monitoring of development programmes. To this end, UNFPA requested the International Institute for Population Sciences (IIPS), Mumbai to undertake capacity building programmes in collaboration with state-level partner institutions so as to enable institutionalisation of efforts.

This manual is a five-day capacity building programme covering methods and sources of obtaining data on various development sectors of demography, reproductive and child health, education, poverty, drinking water and sanitation. The last section on monitoring and evaluation sums up the amenable indicators or their proxies that can be monitored or tracked at the district level. The course design includes hands-on practice and software for estimating various indicators using indirect demographic techniques.

UN colleagues from the UN Resident Coordinator's Office, UNDP and UNICEF have provided valuable inputs in the finalisation of this manual. I am sure this manual will serve as a useful resource and reference for undertaking and replicating capacity-building exercises for evidence-based decentralised planning and monitoring of development programmes.



Frederika Meijer  
UNFPA Representative  
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# Acknowledgements

The objective of this hands-on training module is to provide a comprehensive background on basic demographic, health, social, sanitation and hygiene indicators and methods for computing these at the district level. With the 73<sup>rd</sup> and 74<sup>th</sup> Amendments to the Constitution of India emphasising decentralisation and local-level planning, training in use of data for planning and monitoring development programmes at sub-national level has become imperative. Skill enhancement of district-level officials responsible for planning, implementation and supervision of national flagship programmes, especially those who are dealing directly with data analysis and interpretation, has become a necessity.

Keeping this in view, the United Nations Population Fund (UNFPA), New Delhi entrusted the International Institute for Population Sciences (IIPS), Mumbai, with the responsibility of preparing a training manual and training mid-level district-level officials under a Government of India-UN Joint Programme on Convergence for seven states and select districts in those states. IIPS developed a five-day training module, ensuring that it covered basic elements of demographic techniques, education, poverty, water and sanitation programmes and monitoring and evaluation of national flagship programmes. The training programmes were conducted in collaboration with local training institutes with the objective of institutionalising the training programmes for future replication in other districts of the seven states.

I take this opportunity to thank the then Representative of UNFPA, Dr Nesim Tumkaya, for his vision and direction to take forward this district-level capacity-building endeavour. I am also very thankful to Prof P M Kulkarni, Jawaharlal Nehru University, New Delhi, for his valuable contribution in the conceptualisation of the contents, his encouragement for the preparation of this manual and his untiring involvement in all the workshops to bring out the manual in its present shape.

My special thanks are due to the team of subject experts comprising Dr K M Sathyanarayana and Dr Sanjay Kumar from UNFPA and Prof L Ladusingh, Dr Chander Shekhar, Dr K M Ponnappalli and Dr R B Upadhyay from IIPS who have not only worked day and night to complete this training manual but have also provided training in many states as resource persons. Prof Sayeed Unisa, Dr Usha Ram, Dr D K Mangal, Dr P R Deo, Mr Tej Ram, Dr P K Mahamallik and Prof M R Narayana have participated in many module development workshops and made valuable contributions that are duly acknowledged. The efforts of the research and finance officers and timely support of Mr Sushil Chaudhary from UNFPA for ensuring smooth implementation are also acknowledged. Last, but not least, the manual has gone through many rounds of revision as there were several learnings after each batch of training, and I thank all the trainees for their insightful feedback without which it would have been difficult to prepare such a practical-oriented manual. I am also thankful to the respective state government officials, state-level training institutes and state officials for their contribution and for organising the training programmes.

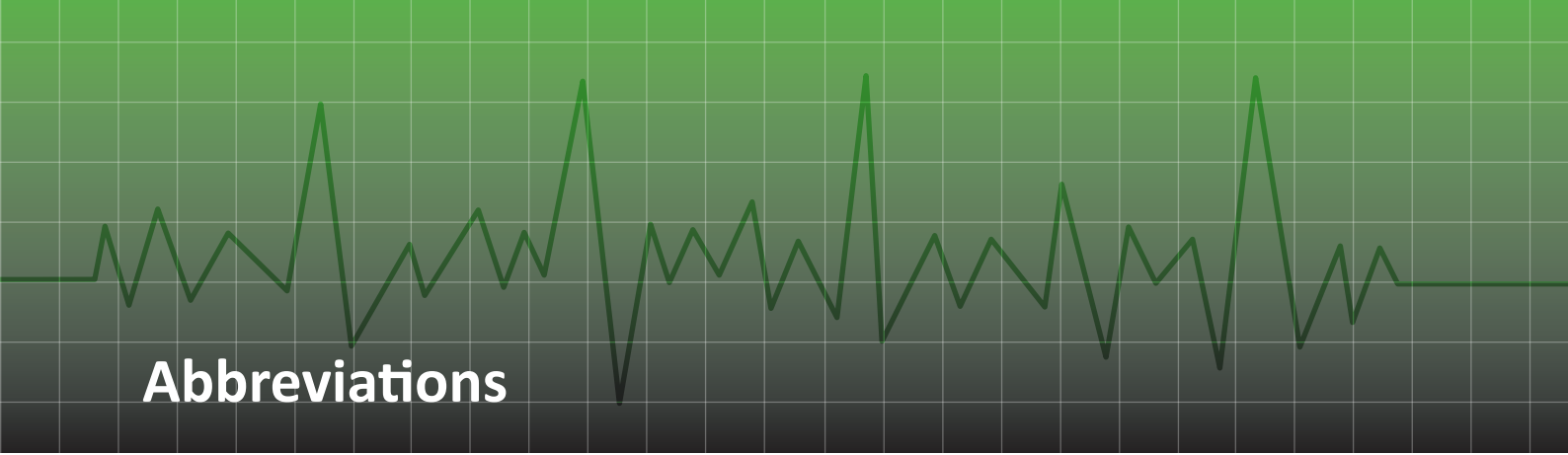
I also thank Marie Joneja and Navin K Joneja of Mensa Design (P) Ltd., New Delhi, for editing and designing the training manual as well as for organising the soft version containing chapters, presentations and practical exercises.



**Dr F Ram**

Director & Senior Professor





# Abbreviations

|       |                                                             |
|-------|-------------------------------------------------------------|
| AHS   | Annual Health Survey                                        |
| AIES  | All India Educational Survey                                |
| AISES | All India School Education Survey                           |
| ALR   | Adult Literacy Rate                                         |
| ANC   | Antenatal Care                                              |
| ANM   | Auxiliary Nurse Midwife                                     |
| APAC  | AIDS Prevention and Control                                 |
| ARWSP | Accelerated Rural Water Supply Programme                    |
| ASDR  | Age Specific Death Rate                                     |
| ASER  | Annual Status of Education Report                           |
| ASFR  | Age Specific Fertility Rate                                 |
| ASHA  | Accredited Social Health Activist                           |
| ASMR  | Age Specific Marriage Rate                                  |
| AUWSP | Accelerated Urban Water Supply Programme                    |
| AWW   | Anganwadi Worker                                            |
| AYUSH | Ayurved, Yoga and Naturopathy, Unani, Siddha and Homeopathy |
|       |                                                             |
| BPL   | Below Poverty Line                                          |
| BSS   | Behaviour Surveillance Survey                               |
|       |                                                             |
| CBR   | Crude Birth Rate                                            |
| CD    | Children Died                                               |
| CEB   | Children Ever Born                                          |
| CHC   | Community Health Centre                                     |
| CHW   | Community Health Worker                                     |
| CMIE  | Centre for Monitoring Indian Economy                        |
| CMIS  | Computerised Management Information System                  |
| CMR   | Child Mortality Rate                                        |
| COD   | Cause of Death                                              |
| COPD  | Chronic Obstructive Pulmonary Disease                       |
| CPR   | Contraceptive Prevalence Rate                               |
| CRS   | Civil Registration System                                   |
| CS    | Children Surviving                                          |
| CSO   | Central Statistical Organisation                            |

|             |                                                         |
|-------------|---------------------------------------------------------|
| DDWS        | Department of Drinking Water and Sanitation             |
| DEO         | District Education Office                               |
| DISE        | District Information System for Education               |
| DLHS        | District Level Household and Facility Survey            |
| DR          | Dropout Rate                                            |
| DWCD        | Department of Women and Child Development               |
| EmOC        | Emergency Obstetric Care                                |
| ENMR        | Early Neonatal Mortality Rate                           |
| FGD         | Focus Group Discussion                                  |
| FHW         | Female Health Worker                                    |
| FRU         | First Referral Unit                                     |
| FWYB        | Family Welfare Year Book                                |
| FYP         | Five-Year Plan                                          |
| GDI         | Gender Development Index                                |
| GDP         | Gross Domestic Product                                  |
| GER         | Gross Enrolment Ratio                                   |
| GFR         | General Fertility Rate                                  |
| GNM         | General Nurse Midwife                                   |
| GRR         | Gross Reproduction Rate                                 |
| HDI         | Human Development Index                                 |
| HIPC        | Heavily Indebted Poor Countries                         |
| HMIS        | Health Management Information System                    |
| HPI         | Human Poverty Index                                     |
| HRD         | Human Resource Development                              |
| HRP         | Headcount Ratio of Poverty                              |
| ICD         | International Classification of Diseases                |
| ICDS        | Integrated Child Development Services                   |
| IDIs        | In-Depth Interviews                                     |
| IDSMT       | Integrated Development of Small and Medium Towns Scheme |
| IDSP        | Integrated Disease Surveillance Project                 |
| IDUs        | Injecting Drug Users                                    |
| IEC         | Information Education and Communication                 |
| IFA Tablets | Iron Folic Acid Tablets                                 |
| IMIS        | Integrated Management Information System                |
| IMR         | Infant Mortality Rate                                   |
| IRDP        | Integrated Rural Development Programme                  |
| ISM&H       | Indian System of Medicine and Health                    |
| JNNURM      | Jawaharlal Nehru National Urban Renewal Mission         |
| JSY         | Janani Suraksha Yojana                                  |

|         |                                                        |
|---------|--------------------------------------------------------|
| LDCs    | Least Developed Countries                              |
| LFA     | Logical Framework Approach                             |
| LFM     | Logical Framework Matrix                               |
| LHV     | Lady Health Visitor                                    |
| MAC     | Mean Age at Child Bearing                              |
| MCCD    | Medical Certification of Cause of Death                |
| MCH     | Maternal and Child Health                              |
| MDG     | Millennium Development Goal                            |
| MDRI    | Multilateral Debt Relief Initiative                    |
| MHHS    | Mean Household Size                                    |
| MHRD    | Ministry of Human Resource Development                 |
| MHW     | Male Health Worker                                     |
| MICS    | Multiple Indicator Cluster Survey                      |
| MIS     | Management Information System                          |
| MMR     | Maternal Mortality Rate                                |
| MNP     | Minimum Needs Programme                                |
| MGNREGA | Mahatma Gandhi National Rural Employment Guarantee Act |
| MoHFW   | Ministry of Health and Family Welfare                  |
| MoRD    | Ministry of Rural Development                          |
| MPCE    | Monthly Per Capita Expenditure                         |
| MPI     | Multi Dimensional Poverty Index                        |
| MRP     | Mixed Reference Period                                 |
| MRS     | Model Registration Scheme                              |
| MTP     | Medical Termination of Pregnancy                       |
| NACO    | National AIDS Control Organisation                     |
| NCERT   | National Council of Educational Research and Training  |
| NDWM    | National Drinking Water Mission                        |
| NER     | Net Enrolment Ratio                                    |
| NFHS    | National Family Health Survey                          |
| NLM     | National Literacy Mission                              |
| NMR     | Neonatal Mortality Rate                                |
| NPE     | National Policy on Education                           |
| NPP     | National Population Policy                             |
| NRHM    | National Rural Health Mission                          |
| NRR     | Net Reproduction Rate                                  |
| NSSO    | National Sample Survey Organisation                    |
| ODA     | Official Development Assistance                        |
| OPHI    | Oxford Poverty and Human Development Index             |
| ORG     | Operation Research Group                               |
| ORS     | Oral Rehydration Solution                              |

|         |                                                                                               |
|---------|-----------------------------------------------------------------------------------------------|
| PCA     | Primary Census Abstract                                                                       |
| PCI     | Per Capita Income                                                                             |
| PFSB    | Percentage of First and Second Order Births                                                   |
| PHC     | Primary Health Centre                                                                         |
| PMR     | Perinatal Mortality Rate                                                                      |
| PNC     | Postnatal Care                                                                                |
| PNMR    | Post Neonatal Mortality Rate                                                                  |
| PPP     | Purchasing Power Parity                                                                       |
| PTR     | Pupil Teacher Ratio                                                                           |
| RBM     | Results Based Management                                                                      |
| RCH     | Reproductive and Child Health                                                                 |
| RGDWM   | Rajiv Gandhi Drinking Water Mission                                                           |
| RGI     | Registrar General of India                                                                    |
| RHIME   | Representative, Re-sampled, Routine Households Interview of Mortality with Medical Evaluation |
| RKS     | Rogi Kalyan Samiti                                                                            |
| RLF     | Replacement Level Fertility                                                                   |
| RR      | Retention Rate                                                                                |
| RTI     | Reproductive Tract Infections                                                                 |
| SBA     | Skilled Birth Attendant                                                                       |
| SCR     | Student Classroom Ratio                                                                       |
| SES     | Selected Educational Statistics                                                               |
| SMAM    | Singulate Mean Age at Marriage                                                                |
| SRB     | Sex Ratio at Birth                                                                            |
| SRS     | Sample Registration System                                                                    |
| SSA     | Sarva Shiksha Abhiyan                                                                         |
| STI     | Sexually Transmitted Infections                                                               |
| TAI     | Technology Advancement Index                                                                  |
| TBA     | Traditional Birth Attendant                                                                   |
| TFR     | Total Fertility Rate                                                                          |
| TLC     | Total Literacy Campaign                                                                       |
| TSC     | Total Sanitation Campaign                                                                     |
| U5MR    | Under-5 Mortality Rate                                                                        |
| UEE     | Universal Elementary Education                                                                |
| UIDSSMT | Urban Infrastructure Development Scheme for Small and Medium Towns                            |
| UNDIESA | United Nations Department of International Economic and Social Affairs                        |
| UNICEF  | United Nations Children's Fund                                                                |
| VHG     | Village Health Guide                                                                          |
| VHND    | Village Health and Nutrition Day                                                              |
| VHSC    | Village Health and Sanitation Committee                                                       |
| WHO     | World Health Organization                                                                     |

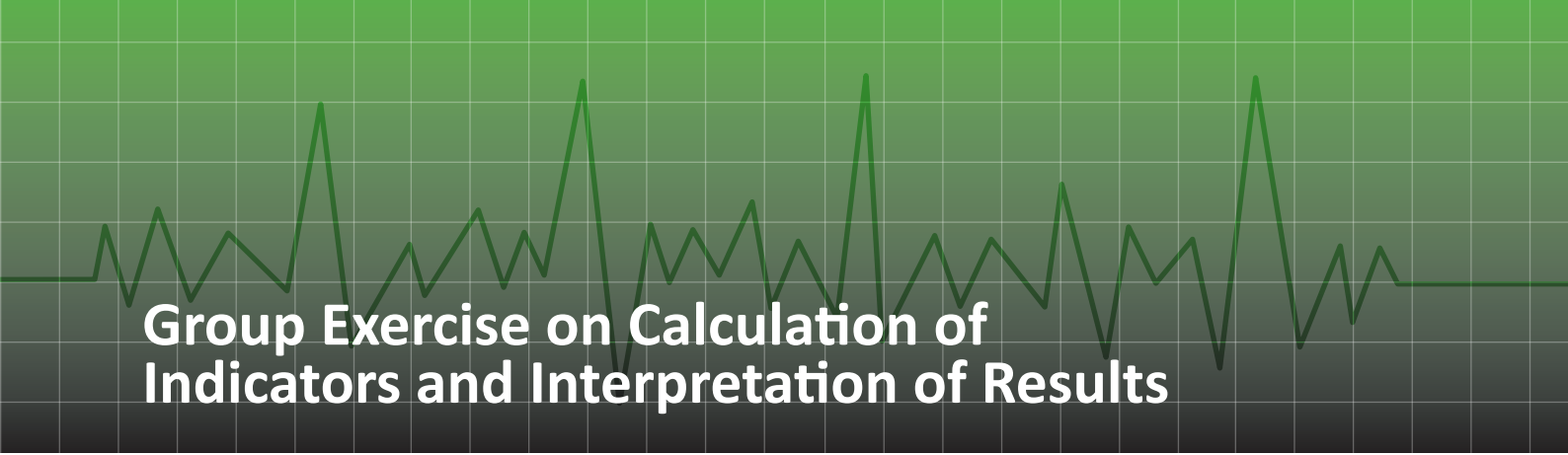
# Training Session Plan

| Day/ Time | 9:00 a.m.–10:30 a.m.                                                                |                                                   | 10:45 a.m.–12:00 p.m.                                                     | 12:00 p.m.–1:00 p.m.                    | 2:00 p.m.–3:30 p.m.                                           | 3:45 p.m.–5:30 p.m.                         |
|-----------|-------------------------------------------------------------------------------------|---------------------------------------------------|---------------------------------------------------------------------------|-----------------------------------------|---------------------------------------------------------------|---------------------------------------------|
| Monday    | 9:00 a.m. – 10:00 a.m.                                                              | 10:00 a.m. – 10:30 a.m.                           | Sources and Quality of Demographic and Health Data                        | Hands-on Exercise: Chapter 2            | Measures of Fertility and Mortality and Methods of Estimation | Hands-on Exercise: Chapter 3                |
| Tuesday   | Registration<br>(9:00 a.m. – 9:30 a.m.)<br>Inauguration<br>(9:30 a.m. – 10:00 a.m.) | Introduction and Expectations of the Participants | Hands-on Exercise: Chapters 4 & 5                                         |                                         | Introduction to Life Tables                                   | Hands-on Exercise: Chapter 6                |
| Wednesday | Interpolation, Extrapolation, Age Smoothing and Population Projections              |                                                   | Group Exercise on Computation of Indicators and Interpretation of Results |                                         | Group Exercise... (contd...)                                  | Drinking Water, Sanitation and Cooking Fuel |
| Thursday  | Reproductive and Child Health                                                       |                                                   | Hands-on Exercise: Chapter 9                                              |                                         | Levels of Living in India                                     | Hands-on Exercise: Chapter 8                |
| Friday    | Education                                                                           |                                                   | Tracking Indicators XI <sup>th</sup> Plan, MDGs                           | Preparatory Time for Group Presentation | Group Presentations                                           | Feedback and Closing Remarks                |

Lunch Break: 1:00 p.m.–2:00 p.m. Tea Break – Morning: 10:30 a.m.– 0:45 a.m. ; Evening: 3:30 p.m.–3:45 p.m.

**Note: For electronic copies of the chapters, presentations and exercises, please refer to the CD in this manual.**





# Group Exercise on Calculation of Indicators and Interpretation of Results

Carry out the following tasks for the district assigned to your group:

## 1. Construct the age-sex pyramid for projected population for 2011

(Source: UNFPA District Level Population Projection)

## 2. Fertility Indicators

- 2a. Calculate ASFR and TFR using census data.
- 2b. Calculate TFR (Indirect Method, using birth order statistics – census-F9).
- 2c. Calculate TFR (Indirect Method, using the indicator percentage of birth order 3 and above (v21) in DLHS report).
- 2d. Calculate CBR using census data or using CRS data and mid-year population.
- 2e. Calculate CBR (–using Reverse Survival Method and census data).

## 3. Mortality Indicators.

- 3a. Calculate CDR (If CRS data is available).
- 3b. Calculate probability of death before age 2 (using F-1 – children ever-born and F5 – Children surviving census data).
- 3c. Calculate Under-five mortality (Indirect Method).
- 3d. Construct the life table using SRS data and calculate the life expectancy at birth.
- 3e. Calculate infant mortality rate (using CRS death under age 1 and total live births for that year, if available, or indirect techniques).

## 4. Project Population

- 4a. Project district population as on 1 March 2016 by the Ratio Method.
- 4b. Project the population of any one state as on 1 October 2011 by the Exponential Method using population in 2001 and 2011 .

## 5. Programme Indicators using DLHS-3 Data

### *Calculate*

- 5a. Total number of pregnancies in your district , after adjusting 10% loss of pregnancy.
- 5b. Number of women requiring antenatal care (number of pregnant women).
- 5c. Number of IFA tablets required.
- 5d. Number of women requiring spacing method of family planning.

## 6. Indicators of Planning and Child Health

### *Calculate*

- 6a. Number of BCG vaccinations required in the current year.
- 6b. Number of DPT1/ DPT2/DPT3 vaccinations assuming 70% immunisation from public sector and 10% drop-out at each level.
- 6c. Number of children requiring assistance from ICDS scheme.
- 6d. Number of ORS packets required.
- 6e. Number of children who need and have received at least one dose of vitamin A.
- 6f. Number of children who need and have received measles vaccination?

## 7. Housing and Schooling

- 7a. Estimate expected number of households in 2011.
- 7b. Project the number of students in primary and middle level of education for the years 2011 and 2016.
- 7c. Estimate the expected number of teachers (considering 35-40 children per teacher) in 2011 and 2016.

# Introduction

## 1.1 Background

Planning for the overall development of the country is an important process and India has had the distinction of having pioneered development planning through five-year planning cycles for over six decades. While there has been impressive economic growth over the past few decades, improvements in the social sectors of education, rural development, health, water and sanitation etc., have not been commensurate with economic development. These findings are affirmed by the Government of India's Millennium Development Goals (MDG) Report 2007 wherein it is stated that despite good economic growth and improved fiscal situation, the country is not on track to meet goals pertaining to hunger, literacy and school attendance, malnutrition, gender equality, maternal health, sanitation and environment. The report recognised regional disparities within the country and emphasised the importance of focused equitable and holistic development-oriented growth.

India's Eleventh Five-Year Plan (2007–12) laid down specific MDG-oriented goals (*refer Appendix 1 for MDG and Eleventh Plan Goals*) for economic growth, poverty reduction and overall social development, with emphasis on removing regional disparities and improving service delivery, especially for disadvantaged groups such as women, children, Scheduled Castes/Scheduled Tribes (SC/ST) and minorities. The achievement of these goals depends on the provision of sufficient resources and their cost-effective utilisation, all contributing to direct improvement in the quality of life of the people.

With the emphasis on decentralised planning based on constitutional amendments, the district has become the primary unit of planning and monitoring development programmes. A bottom-up approach – from village to district – is being pursued, and it is expected that each village will have a village plan, which will then be aggregated into block and district plans. In order to put this philosophy into action, availability of administrative or service statistics data at local and district levels and appropriate denominators for converting data into indicators are very important. At present, the quality of available administrative data in terms of coverage and consistency is questionable. This has resulted in reliance on survey data rather than administrative data in the formulation of district plans. Surveys, usually designed to provide district estimates, have limited scope in sub-district planning. Hence, it is imperative to improve administrative data at all levels of the government system.

As a first step, the Planning Commission has compiled a manual to facilitate participatory integrated district planning. The manual mentions that participative district planning is multidimensional and needs to take numerous factors into account, the foremost being the duality between the constitutional and legal aspects of the framework that governs rural and urban local governments. Next in importance are the multiple administrative levels within the local government structure, the multiplicity of development sectors to be addressed (health, education, nutrition, sanitation, livelihood, etc.) with a number

### Notes

of funding sources (central, state, centrally sponsored, local, etc.) and an intertwined group of developmental and programmatic machinery, each seeking fulfillment of its own expectations from a district plan.

In brief, this manual summarises district planning as the process of preparing an integrated plan for the local government sector, taking into account available natural, human and financial resources. It covers sectoral activities and schemes at the district level and below and those implemented through local governments in the state.

This manual lists the following steps for the purpose of operationalisation:

- Preparation of district, block and *Panchayat* level vision documents that cover a 10–15 year span
- Preparation of participatory plan involving *Gram Sabha* from *Gram Panchayats* to *Zilla Parishad*
- Preparation of plans by Urban Local Bodies
- Consolidation of plans prepared by local bodies by District Planning Committees

The above-mentioned vision documents must be based on participatory assessment in the following areas:

**Notes**

- Agriculture and allied sectors
- Water sources
- Industries, especially traditional small-scale industries, including food processing
- Infrastructure, including power
- Drinking water and sanitation
- Literacy, school education
- Health and medical facilities
- Poverty reduction and basic needs
- Gender and children
- Social justice with regard to SC/ST, persons with disabilities, etc.

Once the vision plan document is completed, the next stage is to break it down into annual and five-year plans with quantitative, i.e., measureable, targets and goals pertaining to the above sectors.

**1.2 Data for Planning and Monitoring**

Given this framework and the emphasis of the Eleventh Five-Year Plan on social and gender inclusion, it becomes clear that disaggregated data related to population, health, education, drinking water and sanitation, agriculture etc. is essential for effective planning and monitoring of development programmes with the district as the unit of planning.

The administrative system collects and collates routine programme data in addition to data available from periodic surveys and statistical reports. So district data required for computation of planning and monitoring indicators are either readily available or have to be extracted from a combination of data sources using different techniques.

The process of computation of some indicators is simple and easy to comprehend, while in the case of others such as poverty, infant and child mortality rates and maternal mortality

ratio (IMR, CMR and MMR), it is difficult and therefore, indirect techniques or methods have to be used. Even here, one is not sure of getting correct district estimates for events that are rare. Administrative data, in terms of coverage and quality at the district level and below, has its own limitations. For instance, in education, the District Information System on Education (DISE) data provides information on private schools that are government-aided, while other private schools are not covered. One can safely use the data in rural districts, but it is difficult to use it in urban settings.

Likewise, in the health sector, administrative data is mainly restricted to coverage of public health institutions for major services, barring sterilisation, where information is available only from accredited private institutions. Since the majority of the health and reproductive health services are being provided by the private sector, it is difficult to get a comprehensive picture. However, tracking events and numerator analysis is possible with whatever public sector data is available in the health management information system.

To track events, it becomes important for a user to have appropriate denominators for calculating indicators and assessing the reliability of data before use. An attempt, therefore, is being made through this module to train and orient data users systematically on availability of different development data sets (administrative and survey), on how the inputs have to be calculated and used, what indicators need to be derived, how they have to be derived and later applied effectively for planning and monitoring of development programmes at the sub-national level.

This training course manual has 11 chapters. This (first) chapter is introductory; Chapter 2 is an overview of sources and quality of demographic and health data. Chapter 3 examines basic measures of fertility and mortality through direct and indirect estimations which are taught using illustrations from the district administrative and survey data. Interpolation, extrapolation and age smoothing that are prerequisites to population projections are covered in Chapters 4 and 5 respectively. Chapter 6 deals with life tables and estimating age-specific mortality, infant and child mortality and life expectancy at birth while, Chapter 7 covers reproductive and child-health indicators. Chapter 8 elucidates how to estimate poverty and measures of inequality through Gini's Coefficient, and also how to calculate human development and poverty indices. Chapter 9, on education, examines district education data and explains how education-based indicators are calculated. Chapter 10 gives a brief review of the national programmes on drinking water and sanitation, and by using data from various censuses and surveys, enables participants to calculate programmatic indicators. Chapter 11 sums up the amenable indicators or the proxies that can be monitored at the district level: the focus remains on tracking various flagship programmes. All examples illustrated in this manual are from **Madhya Pradesh** and its five selected convergence districts.

### 1.3 Capacity-building Objectives

Capacity building on 'Use of Data for District Level Planning' is a hands-on training manual for statistical officers and will equip them with skills to compute the key social, economic, demographic, health and education indicators. It will also familiarise them with undertaking validation checks by applying various techniques and using data from multiple sources.

The teaching pedagogy will be participatory and interactive, and the theoretical exercises will be followed by practical exercises using district data to the extent possible.

#### Notes

## 1.4 Outcomes

At the end of the five-day training workshop participants will be acquainted with:

- The different sets of data available from the district-level census
- Registration systems
- Surveys
- Administrative statistics and their limitations
- How to calculate, assess quality, compute and validate Eleventh Five-Year Plan/MDG indicators, or their proxies for programme planning and monitoring

## APPENDIX

### MDG Indicators Tracking at Sub-national Level (District) – an illustration

All indicators should be disaggregated by sex and area (urban/rural) as far as possible

| Millennium Development Goals (MDGs)                                                                                                              |                                                                                         |                                      |
|--------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|--------------------------------------|
| Goals and Targets<br>(from the Millennium Declaration)                                                                                           | Indicators for Monitoring Progress                                                      | Sources of Data                      |
| <b>Goal 1: Eradicate extreme poverty and hunger</b>                                                                                              |                                                                                         |                                      |
| Target 1.A: Halve, between 1990 and 2015, the proportion of people whose income is less than one dollar a day                                    | 1.1 Proportion of population below \$1 (PPP) per day <sup>a</sup>                       |                                      |
|                                                                                                                                                  | 1.2 Poverty gap ratio                                                                   |                                      |
|                                                                                                                                                  | 1.3 Share of poorest quintile in national consumption                                   |                                      |
| Target 1.B: Achieve full and productive employment and decent work for all, including women and young people                                     | 1.4 Growth rate of GDP per person employed                                              | District Statistics                  |
|                                                                                                                                                  | 1.5 Employment-to-population ratio                                                      | District Statistics and Publications |
|                                                                                                                                                  | 1.6 Proportion of employed people living below \$1 (PPP) per day                        |                                      |
|                                                                                                                                                  | 1.7 Proportion of own-account and contributing family workers in total employment       |                                      |
| Target 1.C: Halve, between 1990 and 2015, the proportion of people who suffer from hunger                                                        | 1.8 Prevalence of underweight children under five years of age                          | ICDS Service Statistics              |
|                                                                                                                                                  | 1.9 Proportion of population below minimum level of dietaryenergy consumption           |                                      |
| <b>Goal 2: Achieve universal primary education</b>                                                                                               |                                                                                         |                                      |
| Target 2.A: Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling         | 2.1 Net enrolment ratio in primary education                                            | DISE Statistics                      |
|                                                                                                                                                  | 2.2 Proportion of pupils starting Grade 1 who reach the last grade of primary education | DISE Statistics                      |
|                                                                                                                                                  | 2.3 Literacy rate of 15–24 year-olds, women and men                                     | Census and NSSO rounds               |
| <b>Goal 3: Promote gender equality and empower women</b>                                                                                         |                                                                                         |                                      |
| Target 3.A: Eliminate gender disparity in primary and secondary education, preferably by 2005, and in all levels of education no later than 2015 | 3.1 Ratios of girls to boys in primary, secondary and tertiary education                | DISE Statistics                      |
|                                                                                                                                                  | 3.2 Share of women in wage employment in the non-agricultural sector                    |                                      |
|                                                                                                                                                  | 3.3 Proportion of seats held by women in national parliament                            | Election Commission                  |

Contd. ...

| Millennium Development Goals (MDGs)                                                                |                                                                                                |                                                                      |
|----------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|
| Goals and Targets<br>(from the Millennium Declaration)                                             | Indicators for Monitoring Progress                                                             | Sources of Data                                                      |
| <b>Goal 4: Reduce child mortality</b>                                                              |                                                                                                |                                                                      |
| Target 4.A: Reduce by two-thirds, between 1990 and 2015, the under-five mortality rate             | 4.1 Under-five mortality rate                                                                  | Indirect; Annual Health Survey (AHS)                                 |
|                                                                                                    | 4.2 Infant mortality rate                                                                      | Indirect; AHS                                                        |
|                                                                                                    | 4.3 Proportion of one-year old children immunised against measles                              | DLHS 2002–04 & 2007–08, AHS                                          |
| <b>Goal 5: Improve maternal health</b>                                                             |                                                                                                |                                                                      |
| Target 5.A: Reduce by three-quarters, between 1990 and 2015, the maternal mortality ratio          | 5.1 Maternal mortality ratio                                                                   | Not possible at district level                                       |
|                                                                                                    | 5.2 Proportion of births attended by skilled health personnel                                  | HMIS, DLHS 2002–04 & 2007–08, AHS                                    |
| Target 5.B: Achieve, by 2015, universal access to reproductive health                              | 5.3 Contraceptive prevalence rate                                                              | HMIS (tracking of limiting method only), DLHS 2002–04 & 2007–08, AHS |
|                                                                                                    | 5.4 Adolescent birth rate                                                                      | DLHS 2002–04 & 2007–08, AHS and partly through HMIS                  |
|                                                                                                    | 5.5 Antenatal care coverage (at least one visit and at least four visits)                      | HMIS, DLHS 2002–04 & 2007–08, AHS                                    |
|                                                                                                    | 5.6 Unmet need for family planning                                                             | HMIS, DLHS 2002–04 & 2007–08, AHS                                    |
| <b>Goal 6: Combat HIV/AIDS, malaria and other diseases</b>                                         |                                                                                                |                                                                      |
| Target 6.A: Have halted by 2015 and begun to reverse the spread of HIV/AIDS                        | 6.1 HIV prevalence among population aged 15–24 years                                           | NFHS 2006–07 (State level)                                           |
|                                                                                                    | 6.2 Condom-use at last high-risk sex                                                           | BSS rounds at state level, NFHS 2006–07                              |
|                                                                                                    | 6.3 Proportion of population aged 15–24 years with comprehensive correct knowledge of HIV/AIDS | BSS rounds at state level, NFHS 2006–07                              |
|                                                                                                    | 6.4 Ratio of school attendance of orphans to school attendance of non-orphans aged 10–14 years | Not Available                                                        |
| Target 6.B: Achieve, by 2010, universal access to treatment for HIV/AIDS for all those who need it | 6.5 Proportion of population with advanced HIV infection with access to antiretroviral drugs   | CMIS, NACO                                                           |

Contd. ...

| Millennium Development Goals (MDGs)                                                                                                                                                                                                                               |                                                                                                         |                                                                              |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| Goals and Targets<br>(from the Millennium Declaration)                                                                                                                                                                                                            | Indicators for Monitoring Progress                                                                      | Sources of Data                                                              |
| Target 6.C: Have halted by 2015 and begun to reverse the incidence of malaria and other major diseases                                                                                                                                                            | 6.6 Incidence and death rates associated with malaria                                                   | HMIS, Causes of Death Survey at state level                                  |
|                                                                                                                                                                                                                                                                   | 6.7 Proportion of children under-five sleeping under insecticide-treated bed nets                       | HMIS of Malaria                                                              |
|                                                                                                                                                                                                                                                                   | 6.8 Proportion of children under five with fever who are treated with appropriate anti-malarial drugs   | HMIS of Malaria                                                              |
|                                                                                                                                                                                                                                                                   | 6.9 Incidence, prevalence and death rates associated with tuberculosis                                  | HMIS of TB                                                                   |
|                                                                                                                                                                                                                                                                   | 6.10 Proportion of tuberculosis cases detected and cured under directly observed treatment short course | HMIS of TB                                                                   |
| <b>Goal 7: Ensure environmental sustainability</b>                                                                                                                                                                                                                |                                                                                                         |                                                                              |
| Target 7.A: Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources<br><br>Target 7.B: Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss | 7.1 Proportion of land area covered by forest                                                           | Dept. of Agriculture and Statistics website                                  |
|                                                                                                                                                                                                                                                                   | 7.2 CO <sub>2</sub> emissions, total, per capita and per \$1 GDP (PPP)                                  | Pollution Control Board at district and state level                          |
|                                                                                                                                                                                                                                                                   | 7.3 Consumption of ozone-depleting substances                                                           | Pollution Control Board at district and state level                          |
|                                                                                                                                                                                                                                                                   | 7.4 Proportion of fish stocks within safe biological limits                                             | Dept. of Fisheries                                                           |
|                                                                                                                                                                                                                                                                   | 7.5 Proportion of total water resources used                                                            | Rajiv Gandhi Watershed Mission                                               |
|                                                                                                                                                                                                                                                                   | 7.6 Proportion of terrestrial and marine areas protected                                                | Dept. of Cosmography                                                         |
|                                                                                                                                                                                                                                                                   | 7.7 Proportion of species threatened with extinction                                                    | Dept. of Fisheries, Ministry of Environment and Forests, Bio-Diversity Board |
| Target 7.C: Halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation                                                                                                                                       | 7.8 Proportion of population using an improved drinking water source                                    | BDO Office                                                                   |
|                                                                                                                                                                                                                                                                   | 7.9 Proportion of population using an improved sanitation facility                                      | Total Sanitation Campaign, RGURM                                             |
| Target 7.D: By 2020, to have achieved a significant improvement in the lives of at least 100 million slum dwellers                                                                                                                                                | 7.10 Proportion of urban population living in slums <sup>b</sup>                                        | Ministry of Urban Development, Municipality Offices); NSSO                   |

Contd. ...

| Millennium Development Goals (MDGs)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Goals and Targets<br>(from the Millennium Declaration)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Indicators for Monitoring Progress                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Sources of Data |
| <b>Goal 8: Develop a global partnership for development</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                 |
| <p>Target 8.A: Develop further an open, rule-based, predictable, non-discriminatory trading and financial system</p> <p>Includes a commitment to good governance, development and poverty reduction – both nationally and internationally</p> <p>Target 8.B: Address the special needs of the least developed countries</p> <p>Includes: Tariff and quota free access for the least developed countries' exports; enhanced programme of debt relief for heavily indebted poor countries (HIPC) and cancellation of official bilateral debt; and more generous ODA for countries committed to poverty reduction</p> <p>Target 8.C: Address the special needs of landlocked developing countries and small island developing states (through the Programme of Action for the Sustainable Development of Small Island Developing States and the outcome of the twenty-second special session of the General Assembly)</p> | <p>Some of the indicators listed below are monitored separately for the least developed countries (LDCs), Africa, landlocked developing countries and small island developing States.</p> <p><b>Official Development Assistance (ODA)</b></p> <p>8.1 Net ODA, total and to the least developed countries, as percentage of OECD/DAC donors' gross national income</p> <p>8.2 Proportion of total bilateral, sector-allocable ODA of OECD/DAC donors to basic social services (basic education, primary health care, nutrition, safe water and sanitation)</p> <p>8.3 Proportion of bilateral official development assistance of OECD/DAC donors that is untied</p> <p>8.4 ODA received in landlocked developing countries as a proportion of their gross national incomes</p> <p>8.5 ODA received in small island developing states as a proportion of their gross national incomes</p> <p><b>Market access</b></p> <p>8.6 Proportion of total developed country imports (by value and excluding arms) from developing countries and least developed countries, admitted free of duty</p> <p>8.7 Average tariffs imposed by developed countries on agricultural products and textiles and clothing from developing countries</p> <p>8.8 Agricultural support estimate for OECD countries as a percentage of their gross domestic product</p> |                 |

Contd. ...

| Millennium Development Goals (MDGs)                                                                                                                                            |                                                                                                                                                    |                                    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
| Goals and Targets<br>(from the Millennium Declaration)                                                                                                                         | Indicators for Monitoring Progress                                                                                                                 | Sources of Data                    |
| Target 8.D: Deal comprehensively with the debt problems of developing countries through national and international measures in order to make debt sustainable in the long term | 8.9 Proportion of ODA provided to help build trade capacity                                                                                        |                                    |
|                                                                                                                                                                                | <b>Debt sustainability</b>                                                                                                                         |                                    |
|                                                                                                                                                                                | 8.10 Total number of countries that have reached their HIPC decision points and number that have reached their HIPC completion points (cumulative) |                                    |
|                                                                                                                                                                                | 8.11 Debt relief committed under HIPC and MDRI Initiatives                                                                                         |                                    |
|                                                                                                                                                                                | 8.12 Debt service as a percentage of exports of goods and services                                                                                 |                                    |
| Target 8.E: In cooperation with pharmaceutical companies, provide access to affordable essential drugs in developing countries                                                 | 8.13 Proportion of population with access to affordable essential drugs on a sustainable basis                                                     |                                    |
| Target 8.F: In cooperation with the private sector, make available the benefits of new technologies, especially information and communications                                 | 8.14 Telephone lines per 100 population                                                                                                            | Ministry of Information Technology |
|                                                                                                                                                                                | 8.15 Cellular subscribers per 100 population                                                                                                       | Ministry of Telecommunication      |
|                                                                                                                                                                                | 8.16 Internet users per 100 population                                                                                                             | Ministry of Telecommunication      |

<sup>a</sup> For monitoring country poverty trends, indicators based on national poverty lines should be used, where available.

<sup>b</sup> The actual proportion of people...non-durable material—Please refer to the original table available on the website [unstats.un.org](http://unstats.un.org/indicators/mdg/Host.aspx?Content=Indicators/OfficialList.htm). (<http://mdgs.un.org/unsd/mdg/Host.aspx?Content=Indicators/OfficialList.htm>)

The Millennium Development Goals and targets come from the Millennium Declaration, signed by 189 countries, including 147 heads of State and Government, in September 2000 (<http://www.un.org/millennium/declaration/ares552e.htm>) and from further agreement by member states at the 2005 World Summit (Resolution adopted by the General Assembly – A/RES/60/1, <http://www.un.org/Docs/journal/asp/ws.asp?m=A/RES/60/1>). The goals and targets are interrelated and should be seen as a whole. They represent a partnership between the developed countries and the developing countries “to create an environment – at the national and global levels alike – which is conducive to development and the elimination of poverty”.

## Eleventh Five-Year Plan Objectives

### 1. Income & Poverty

- Accelerate GDP growth from eight to 10 per cent and then maintain at 10 per cent in the Twelfth Plan in order to double per capita income by 2016–17.
- Increase agricultural GDP growth rate to four per cent per annum to ensure a broader spread of benefits.
- Create 70 million new work opportunities.
- Reduce educated unemployment to below five per cent.
- Raise real wage rate of unskilled workers by 20 per cent.
- Reduce the headcount ratio of consumption poverty by 10 percentage points.

## **2. Education**

- Reduce dropout rates of children from elementary school from 52.2 per cent in 2003–04 to 20 per cent by 2011–12.
- Develop minimum standards of educational attainment in elementary schools, and monitor effectiveness of education by regular testing to ensure quality.
- Increase literacy rate for persons of age seven years or above to 85 per cent.
- Lower gender gap in literacy to 10 percentage points.
- Increase the percentage of each cohort opting for higher education from the present 10 per cent to 15 per cent by the end of the Plan.

## **3. Health**

- Reduce infant mortality rate to 28 per 1000 live births and maternal mortality ratio to 1 per 100,000 live births.
- Reduce total fertility rate to 2.1.
- Provide clean drinking water for all by 2009 and ensure that there are no slip-backs.
- Reduce malnutrition among children in the age group 0–3 to half its present level.
- Reduce anaemia among women and girls by 50 per cent by the end of the Plan.

## **4. Women and Children**

- Raise the sex ratio for age group 0–6 to 935 by 2011–12 and to 950 by 2016–17.
- Ensure that at least 33 per cent of the direct and indirect beneficiaries of all government schemes are women and girl children.
- Ensure that all children enjoy a safe childhood, without any compulsion to work.

## **5. Infrastructure**

- Ensure electricity connection to all villages and BPL households by 2009 and round-the-clock power.
- Ensure all-weather road connection to all habitations with population of 1000 and above (500 in hilly and tribal areas) by 2009, and ensure coverage of all significant habitations by 2015.
- Connect every village by telephone by November 2007 and provide broadband connectivity to all villages by 2012.
- Provide homestead sites to all by 2012 and step up the pace of house construction for rural poor to cover all the poor by 2016–17.

## **6. Environment**

- Increase forest and tree cover by five percentage points.
- Attain WHO standards of air quality in all major cities by 2011–12.
- Treat all urban waste water to clean river waters by 2011–12.
- Increase energy efficiency by 20 percentage points by 2016–17.

# Source and Quality of Demographic and Health Data

## Learning Objectives

The main learning points in this Chapter include understanding:

- Various sources of demographic and health data
- Availability of data at various levels of disaggregation
- Assessment of quality of data before use
- Strengths and weaknesses of various data sets

## 2.1 Introduction

Demographic and health data are required for planning, programme implementation, monitoring and evaluation and also as research inputs. The data on components of population change, fertility, mortality and migration are important inputs for population projections<sup>1</sup>. A host of other data pertaining to reproductive health, immunisation, education, work participation, infrastructure, social group and age-sex composition are required for the formulation of new programmes. They are also needed for the monitoring and scientific evaluation of a number of ongoing programmes of the various ministries, and tracking the progress in achieving the Millennium Development Goals (MDGs).

The Census of India is one of the major sources of social, economic and demographic data. The Civil Registration System is a continuous source of data on births and deaths, but suffers from under-registration and deficiencies. The Registration of Births and Deaths Act, 1964 was enacted to promote and strengthen civil registration. Despite this statutory provision, the completion of the registration of births and deaths in several States/Union Territories (UTs) remains far from satisfactory. The Office of the Registrar General, India, initiated a scheme for the sample registration of births and deaths in India, popularly known as the Sample Registration System (SRS) in 1964–65 on a pilot basis and on a large-scale from 1969–70. Since then the SRS has been providing data on an annual basis at the state level. Besides the above sources, other large scale surveys, such as the National Family Health Survey (NFHS), National Sample Survey (NSS) and District Level Household and Facility Survey (DLHS), have been conducted periodically to provide basic reproductive and child health (RCH) indicators. They provide data at the state and district levels and these data sources are used for planning and monitoring central, state and district-level programmes. Reports based on the compilation of data from service statistics, including, Health Management Information System (HMIS); annual reports of the Department of Health and Family Welfare; Central Bureau of Health Intelligence (CBHI); and Rural Health Statistics; and Medical Certification of Causes of Death (MCCD) and Crime Statistics, provide information on an annual basis.

### Notes

<sup>1</sup> Pathak, K.B. and F. Ram, 1992, *Techniques of Demographic Analysis*, Himalaya Publishing House, Mumbai.

## 2.2 Population Census

A population census is a systematic enumeration of the resident members of a country at a particular point of time. It is conducted to collect information on age, sex, marital status, education, occupation, fertility, migration, rural-urban residence, working status and so on. The census is the largest population database and it is conducted every tenth year in India. The regular decennial census undertaking began from 1881 and has continued uninterrupted. The reference date for each census is March, midnight '00' hours. The Registrar General of India (RGI) is responsible for conducting and managing census operations. The results of census enumerations are published as tables and disseminated in the form of reports. Since 1991, the Census of India provides a soft version of the tables. The tables are grouped into distinctive series on the basis of content. These are described below in brief. A detailed list of tables is provided in Appendix 2.1. A few key indicators are available on the website of the census. In addition to the printed volumes and soft copies, special tables required by researchers and administrators can be obtained from the census organisation on request.

### 2.2.1 Census Publications

#### Primary Census Abstract (PCA)

Primary Census Abstract (PCA) gives the number of houses and households, total population, population by social groups – Scheduled Castes and Scheduled Tribes, 0–6 years population, number of literate by sex, number of main workers classified into nine industrial categories, marginal workers and non-workers. These details are available at the national, state, district and sub-district levels separately for rural areas and urban areas. The lowest level at which this data is available is villages for rural areas and wards for cities and towns and hence, it is possible to compute the literacy rate, sex ratio, work participation rate etc. for every village/ward in the country from this source.

#### Village Directory

In addition to the primary census abstract, the village directory provides information for each village on the availability of educational and medical facilities, drinking water, post and telegraph facilities, market days, transportation facilities (bus stops, railway stations, waterways), approach to the village, nearest town and its distance, power supply and staple food of the people, and land use pattern (area under forest, irrigated and un-irrigated land, and area not available for cultivation).

#### A-Series: General Population Tables

This series of tables gives data on area, houses and population, decadal variations in the population since 1901 for district/state/country. It also provides data on villages classified by population size.

#### B-Series: General Economic Tables

In the past, the economic questions changed from one census to the next often making it difficult to examine trends. However, since 1981, information on work participation is obtained using the labour force concept and individuals are classified as 'Main Worker', 'Marginal Worker' or 'Non-worker'. Census 2001 defined a 'Main Worker' as one who had participated in any economically productive activity for a period of more than six months, at any time during the reference period of the preceding one year. A person who had worked for less than six months during the reference period was defined as a 'Marginal Worker'. 'Work' included even part-time help or unpaid work on the farm, in a family enterprise or in any other economic activity. A person who did not work at all during

#### Notes

the reference period was treated as a 'Non-Worker'. Data on 'Seeking/Available for Work' from among the 'Non-Workers' and 'Marginal Workers' is also collected to get a broad idea of unemployment and underemployment.

'Economic Tables', provide this information by level of education. Main and Marginal Workers are classified by industrial categories of work, occupation, age and educational level; Non-Workers by main activity, age and educational level, and those seeking work by age, educational level, and whether they have worked earlier. There are state-level and district-level tables. The information has been presented by sex and place of residence, rural or urban.

### **C-Series: Social and Cultural Tables**

This series of tables gives data on age, marital status, educational level, school attendance, mother tongue, bilingualism, and religion. Data on marital status, educational level and school attendance are available, cross-classified by age group, while data on school attendance in the age-group 5–19 years has also been classified by work participation. These are available at the district level, for rural and urban areas, and by sex. In addition to social characteristics such as literacy, school participation and language, the tables enable computation of the singulate mean age at marriage (SMAM), which is an important demographic and social indicator.

### **D-Series: Migration Tables**

Data on migration characteristics like place of birth, place of last residence, reason for migration and duration of residence at the place of enumeration are available in this series. Information on educational level, economic activity and age-distribution of the migrants and reason for migration at the state and district levels is also provided by these tables. It is possible to estimate in-migration, out-migration, net migration, inter-censal and lifetime migration, up to the district level separately for rural and urban areas and by sex. At the state level, migration rates can be obtained by age.

### **F-Series: Fertility Tables**

This series of tables provides data on female age at marriage, number of children ever born and number of children surviving to ever-married women, number of births and order of last years' births. Data on age at marriage has been classified by duration of marriage, while all other data has been classified by the age of the woman. At the state level, disaggregation is available by districts and also by religion, educational level and work status of the woman.

This data is important for ascertaining the age patterns of fertility. The percentage distribution of women classified by parity of children ever born helps in indirectly assessing the level of fertility. Moreover, the tabulation of children ever born and children surviving by age of mother allow the indirect estimation of childhood mortality. Tables are provided at the district level and by sex of children, from which it is possible to estimate early childhood mortality including the under-five mortality rate for each district in the country indirectly by applying certain demographic techniques.

### **H-Series: Tables on Houses and Household Amenities**

These tables give information on housing and household amenities, namely, the type of material used for construction of the house; tenure status, number of rooms and household size; availability of electricity, drinking water supply (by source) and toilet facilities and type of fuel used for cooking. Aggregate indicators of housing conditions at the village level can be computed from these tables.

## **Notes**

### Special Tables on Scheduled Castes and Scheduled Tribes (SC/ST)

Scheduled Caste and Scheduled Tribe (SC/ST) populations are described by various characteristics such as age, sex, education and marital status in these tables. Main and Marginal Workers among SCs and STs are tabulated separately by age, sex, education, industrial category and occupation. Non-workers are classified by age, sex, education separately for SCs and STs. There are three additional tables for the ST population relating to religion, mother tongue and bilingualism at the state/district level.

### Data on Disability

The 1981 and 2001 Census obtained data on specific aspects of disability in the population, which were then tabulated.

### Data on Age-sex Distribution

The age-sex distribution of a population is valuable in most demographic and socio-economic analyses. Fertility and mortality rates in a population vary by age. Apart from demographic concerns, the data on age-structure are required for planning and for a number of administrative, scientific, technical and commercial purposes. Many schemes in the social and economic sectors are designed for children, adolescents, youth, women and the elderly and require age-sex disaggregated data. The projection of the number of households and population, school enrolment, labour force, requirement for schools and teachers, health services, food and housing, problems of economic dependency are some of the key areas in which the age-sex disaggregated data is of prime importance. In the 2001 Census, the age data based on a single year and quinquennial age groups by sex and place of residence were tabulated at the state level and district levels.

#### 2.2.2 Quality of Age Data

Errors inevitably occur in the collection of census data. It is essential, therefore, to detect and quantify the errors by evaluation so that the users may be aware of the quality of the census data. The two major types of errors in census data are coverage errors and content errors. Coverage errors result from omission or duplication of individuals, and hence affect all information collected including the age-sex data. Content errors, on the other hand, occur due to inadequate information supplied or mistakes made in reporting or recording information. A common form of content error is the misreporting of age. Age misreporting affects the quality of age data. Hence, there should be an evaluation of age-sex data before performing any demographic analysis.

#### Visual Inspection of Age Data

Age data at the national and sub-national levels are examined first by visual inspection in the form of single-year graphs and age pyramids; any unusual concentrations at particular ages indicate probable errors in the age data. Inaccuracies thus detected are quantified by calculating the United Nation Age Sex Accuracy Index.

A particular and common form of age misreporting is age heaping, that is, a noticeable concentration of some specific digits; this is also known as 'digit preference', frequently found at the ages ending with digits '0' and '5'. A line graph with age in single years on

### Notes

the X-axis and the number (or percentage) of persons on the Y-axis is quite useful. If the population under study has not experienced any sharp changes in fertility and mortality or sudden changes in migration, then the population age distribution is expected to follow a smooth graph. Sharp changes or a zigzag (or serrated) pattern indicates digit preference. There are simple methods available like age ratio, age-sex ratio, progressive age ratio and the UN Joint Score. Two commonly used measures of the degree of digit preference are 'Whipple's Index of Concentration' and 'Myer's Blended Index'. A value of the Myer's Index over 60 indicates that the data is of very poor quality.

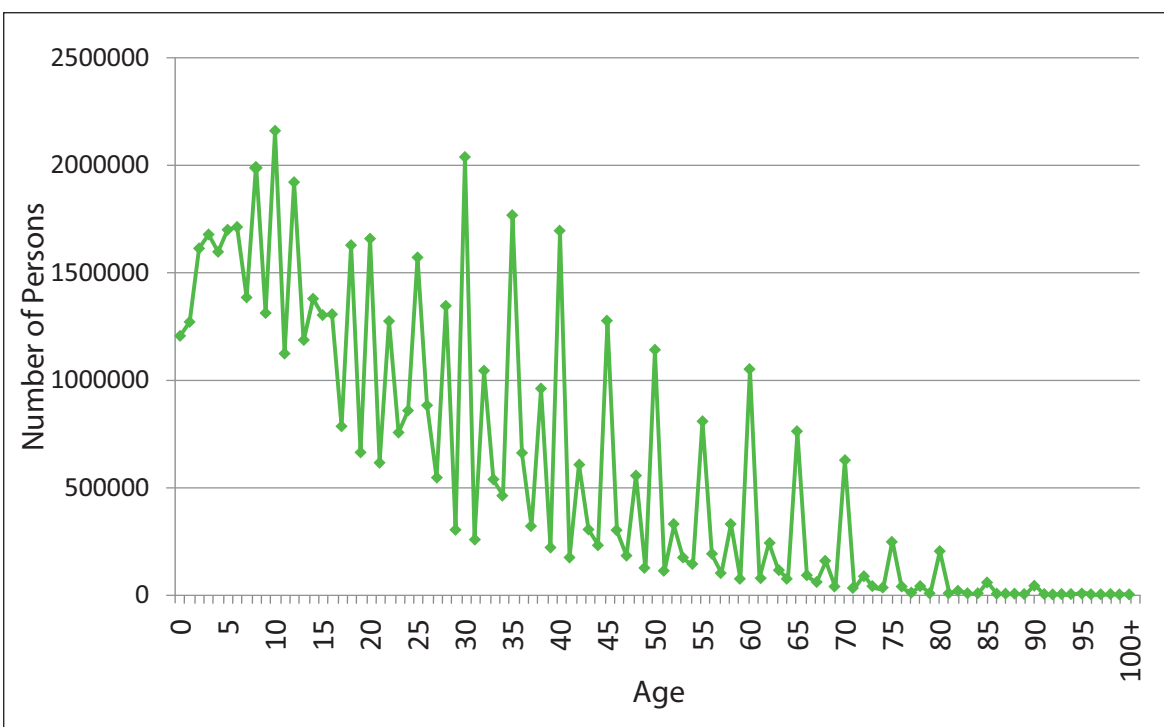
There can be biased misreporting of age, over-reporting of ages in an age-range and under-reporting; these result in a distorted age distribution. Post-enumeration checks are used to estimate errors of coverage or omission and of biases in age reporting<sup>2</sup>.

### Age-sex Distribution

#### Madhya Pradesh 2001 Census

The age distribution has been analysed for a single year for Madhya Pradesh, 2001 as an example. A strong preference for ages ending in digits '0' and '5' can be seen. Figure 2.1 shows irregular fluctuations, especially peaks at ages ending with digits '0', '5' and '2' and troughs at ages ending with digits '1', '9' and '7'; this indicates that the data is distorted by strong preferences or avoidance of certain ages or ages ending with particular digits.

**Figure 2.1: Number of Persons by Age, Madhya Pradesh, 2001**

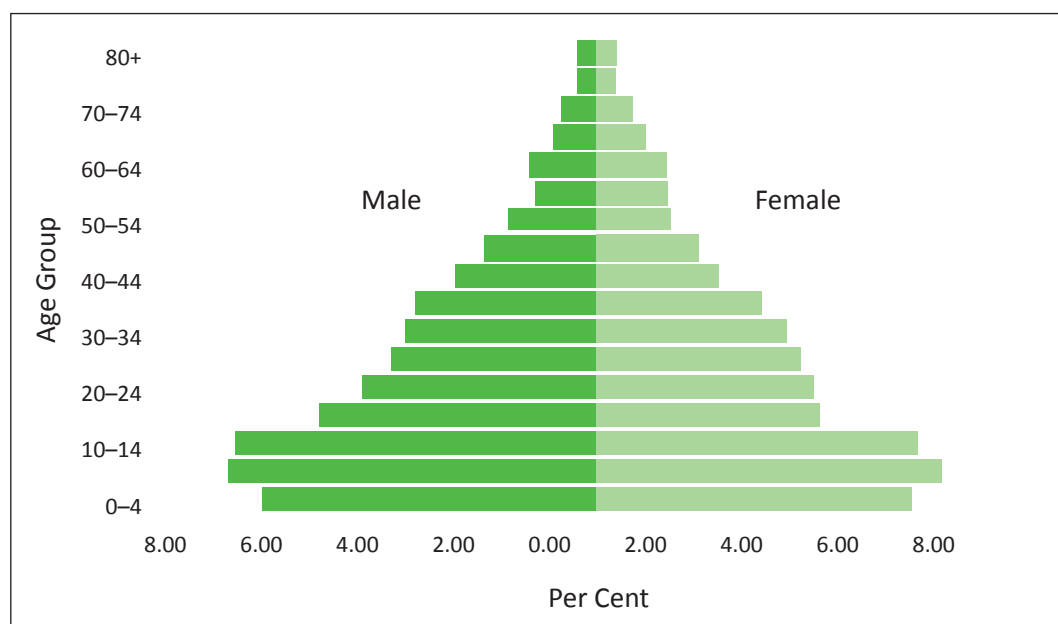


Source: Registrar General, India, 2005, *Social and Cultural Tables, Series C-13 Single Year Age Returns by Sex and Residence, 2001*, Office of Registrar General & Census Commissioner, India, New Delhi.

<sup>2</sup> Bhat, P.N.M., S. Preston and T. Dyson, 1984, *Vital Rates in India, 1961-81*, National Academy Press, Washington, DC.

### Notes

**Figure 2.2: Age-Sex Pyramid, Madhya Pradesh, 2001**



Source: Registrar General, India, 2005, *Report and Tables on Age, Social and Cultural Tables, Series, C-14, C-14 SC & C-14 ST, 2001, Vol.1*, Office of Registrar General & Census Commissioner, India, New Delhi.

## Notes

### Age-sex Pyramid

The 'age-sex pyramid' is a simple, but important tool used to learn about demographic changes in the population in the past. The age-sex pyramid (Figure 2.2) shows surviving people in each age group in the population by sex, with males on the left and females on the right side of the bar diagram. The vertical line of the pyramid represents the age group of the population (Y-axis). The age groups must be of equal width. This is a percentage pyramid, which shows relative differences in population size at each age-sex group. Grouping of ages in the quinquennial interval reduces the errors that have ensued from digit preference.

## 2.3 Vital Registration

Vital registration is concerned with the continuous recording of vital events such as live births, deaths, foetal deaths, marriages and so on, for the study of population change. According to the Registration of Births and Deaths Act 1969, the registration of births and deaths are compulsory. It provides useful statistics for the planning and evaluation of public health programmes and demographic research.

### 2.3.1 Civil Registration System (CRS)

Civil Registration System (CRS) is the recording of vital events, that is, live births, still births, deaths and marriages, under statutory provisions, on a continuous and permanent basis. The registration records are useful primarily as legal documents and secondly as a source of data. For individuals, it is the legal proof of age, identity, nationality, inheritance and civil status. The vital records are also useful in administrative purposes for planning and monitoring various programmes such as those related to health, education, electoral rolls and social security benefits.

The registration of vital events is coordinated by the Registrar General of India (RGI). Each state and union territory has a hierarchy of registrars in geographical units. At the local level, births and deaths are recorded by the Registrar or Sub-Registrar of specific areas and the basic information is based on the reports of heads of households or appointed informants. In the case of household events, the head of the household is responsible for reporting the events, whereas the medical officer in-charge reports events taking place in health institutions. This information is compiled and provided in standard formats to Registrars at higher levels and finally to the Chief Registrar who, in turn, collates the information and transmits it to the RGI. Collectively, these offices constitute the CRS.

**Table 2.1a: Statement 1; Persons Responsible for Reporting of Births and Deaths under Sections 8 & 9 of the RBD Act, 1969**

| Informant                                                                                                                                                                                                     | Place of Occurrence of Events                                                                                                                                           |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                                                                                                                                                                                                             | 2                                                                                                                                                                       |
| (a) Head of the household and in his absence, his nearest relative and in his absence, oldest adult male person                                                                                               | Events occurring in a house                                                                                                                                             |
| (b) Medical officer in-charge or any person authorised by him                                                                                                                                                 | Events occurring in hospital, Health Centre, nursing home or other like institutions                                                                                    |
| (c) Jailor in-charge                                                                                                                                                                                          | Events occurring in jail                                                                                                                                                |
| (d) Person in-charge                                                                                                                                                                                          | Events occurring in <i>choultry</i> , <i>chhatram</i> hostel, <i>dharamshala</i> , boarding house, lodging house, tavern, barrack, toddy shop or place of public resort |
| (e) Headman or other corresponding officer of the village in the case of a village and officer in-charge of a local police station elsewhere                                                                  | Newborn child or dead body found deserted in a public place                                                                                                             |
| (f) Officer, who conducts an inquest                                                                                                                                                                          | Deaths not covered under clauses (1)(e) of Section 8(1) of the Act                                                                                                      |
| (g) Superintendent of the plantation specified by the rules [ <i>The informants mentioned in clauses (a) to (f) above have to furnish the necessary particulars to the superintendent of the plantation</i> ] | Events in plantation                                                                                                                                                    |
| (h) Person in-charge of a moving vehicle                                                                                                                                                                      | Events in moving vehicle on land, air and water                                                                                                                         |

Source: Handbook on RBD Act, 2004; Available at: [http://mospi.nic.in/Mospi\\_New/upload/vital\\_stat\\_2010/topic.pdf](http://mospi.nic.in/Mospi_New/upload/vital_stat_2010/topic.pdf)

## Notes

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**Table 2.1b: Civil Registration Hierarchy in the States of Madhya Pradesh and Orissa**

| S. No. | State Level           |                                                                                                                                                                                                                                                                            | District Level/<br>Below District Level                                                                                                      | Local Area Level<br>(Rural)                                                                                                                                                                               |
|--------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1      | 2                     | 3                                                                                                                                                                                                                                                                          | 4                                                                                                                                            | 5                                                                                                                                                                                                         |
| 1.     | <b>Madhya Pradesh</b> | <b>Chief Registrar:</b><br>Commissioner,<br>Economics &<br>Statistics<br><br><b>Addl. Chief Registrar<br/>District Collectors</b><br><br><b>Dy. Chief Registrar:</b><br>Dy. Director (VS)<br><br><b>Asst. Chief Registrar:</b><br>Assistant Director (VS)                  | <b>District Registrar:</b><br>District Planning<br>Officer<br><br><b>Addl. District Registrar:</b><br>Addl. District<br>Medical Officer      | <b>Registrar:</b><br>Chief Executive Officer,<br>Janpad Panchayat<br><br><b>MO in-charge of</b><br>PHC/CHC/Civil and<br>District Hospitals<br><br><b>Sub-Registrar:</b><br>Panchayati Secretary/<br>Karmi |
| 2.     | <b>Orissa</b>         | <b>Chief Registrar:</b><br>Director of<br>Health Services<br><br><b>Addl. Chief Registrar:</b><br>Joint Director of Health<br>Services (Public Health)<br><br><b>Dy. Chief Registrar:</b><br>Dy. Director (VS)<br><br><b>Asst. Chief Registrar:</b><br>Asst. Director (VS) | <b>District Registrar:</b><br>Chief District<br>Medical Officer<br><br><b>Addl. District Registrar:</b><br>Addl. District<br>Medical Officer | <b>Registrar:</b><br>Medical officer in-charge<br>of PHC                                                                                                                                                  |

Source: Available at: [http://mospi.nic.in/Mospi\\_New/upload/vital\\_stat\\_2010/topic](http://mospi.nic.in/Mospi_New/upload/vital_stat_2010/topic)

The Chief Registrar of States sends the following information to the Registrar General of India – a monthly report, which includes the total number of registration units from where information has been received, number of births, deaths and infant deaths by districts and place of residence, rural/urban. Annual returns in the form of statistical tables, which are standard for all states, are also available.

A standard tabulation plan has been implemented in all the states. On the basis of annual vital statistics provided from the Chief Registrar, the Registrar General of India publishes a comprehensive annual report entitled, '*Vital Statistics of India*'.

### Quality of Civil Registration Data

The CRS provides data not only at the national level, but also at the district and sub-divisional levels. However, like many developing nations, births and deaths are grossly under-registered in India. It is estimated that about 26 million births and nine million deaths occur in India every year, of which only about 53 per cent births and 48 per cent deaths are registered. The coverage of registration level varies from state to state and is classified as 'somewhat reliable' to 'very poor'. Besides, even in states which have a high level of registration, there is considerable delay in compiling and publishing statistics<sup>3</sup>.

<sup>3</sup> Pathak, K.B. and F. Ram, 1994, *Completeness of Civil Registration in India and Some States*, IIPS Research Report No. 2, 1993–94.

Table 2.2 provides a comparative picture of birth and death rates in India and its states computed from the Civil Registration and Sample Registration System data. It has been observed that the birth rates are grossly underestimated. The coverage of births and deaths for India is roughly around 63 per cent and 55 per cent, respectively. Table 2.2 also gives the level of under-registration for all the states. It is seen that Bihar has the lowest level of registration of births (17%) and deaths (22%). On the other hand, a few states have good coverage. Therefore, it is important to assess the coverage levels of CRS data before using it. It is also seen that in some states, the registration of births and deaths is more than 100 per cent, which may be partly because the CRS reporting is from a place that is not their usual place of residence.

In the present scenario, the CRS is the only source of data on vital statistics at the district and below levels. If the data is complete and its coverage is good, it can be a rich source for preparing district-level estimates of fertility and mortality. Since CRS in India suffers from serious errors, it is not being used to estimate vital rates and to carry out meaningful demographic analysis. Thus, the district-level data manager has a pivotal role in filling this critical gap. Systemic issues related to the transmission of information right from the lowest administrative level to district will have to be streamlined and promptness in capturing and transmitting the information will have to be worked out besides better linkages will have to be evolved with the health sector for covering institutional births.

Another limitation of CRS data is that there is a time lag of about four to five years before the reports are published which results in low utility of data, even if it is of good quality. Major improvements in the CRS are now underway, with the launching of the campaign on birth certificates in 2003. One of the goals of the National Population Policy (MoHFW, 2000)<sup>4</sup> is to achieve full coverage of registration of births, deaths, marriages and pregnancies by 2010.

## Notes

**Table 2.2: Crude Birth and Crude Death Rates based on CRS and SRS and Level of Registration of Births and Deaths – States and Union Territories, 2005**

| S. No. | India/State/Union Territory | Crude Birth Rate |             | Level of Registration of Births | Crude Death Rate |            | Level of Registration of Deaths |
|--------|-----------------------------|------------------|-------------|---------------------------------|------------------|------------|---------------------------------|
|        |                             | CRS              | SRS         |                                 | CRS              | SRS        |                                 |
| 1      | 2                           | 3                | 4           | 5                               | 6                | 7          | 8                               |
|        |                             | CRS              | SRS         | CRS/SRS*100                     | CRS              | SRS        | CRS/SRS*100                     |
|        | <b>India</b>                | <b>14.9</b>      | <b>23.8</b> | <b>62.5</b>                     | <b>4.2</b>       | <b>7.6</b> | <b>55.0</b>                     |
| 1.     | Andhra Pradesh              | 11.6             | 19.1        | 61.0                            | 4.4              | 7.3        | 60.5                            |
| 2.     | Arunachal Pradesh           | 17.2             | 23.3        | 73.9                            | 1.2              | 5.0        | 23.5                            |
| 3.     | Assam                       | 17.8             | 25.0        | 71.2                            | 3.1              | 8.7        | 35.1                            |
| 4.     | Bihar                       | 5.1              | 30.4        | 16.9                            | 1.8              | 8.1        | 21.7                            |
| 5.     | Chhattisgarh                | 17.2             | 27.2        | 63.3                            | 6.3              | 8.1        | 77.3                            |
| 6.     | Goa                         | 16.8             | 14.8        | 100.0                           | 7.8              | 7.1        | 100.0                           |
| 7.     | Gujarat                     | 21.2             | 23.7        | 89.5                            | 4.6              | 7.1        | 65.1                            |
| 8.     | Haryana                     | 20.5             | 24.3        | 84.3                            | 4.9              | 6.7        | 72.9                            |
| 9.     | Himachal Pradesh            | 21.0             | 20.0        | 100.0                           | 5.9              | 6.9        | 85.2                            |
| 10.    | Jammu and Kashmir           | 12.2             | 18.9        | 64.8                            | 2.9              | 5.5        | 52.0                            |
| 11.    | Jharkhand                   | 8.8              | 26.8        | 32.9                            | 3.3              | 7.9        | 41.3                            |

Contd. ...

<sup>4</sup> Ministry of Health & Family Welfare, 2000, *National Population Policy, 2000*, Department of Family Welfare, Ministry of Health & Family Welfare, New Delhi.

| S. No.                   | India/State/Union Territory | Crude Birth Rate |      | Level of Registration of Births | Crude Death Rate |     | Level of Registration of Deaths |
|--------------------------|-----------------------------|------------------|------|---------------------------------|------------------|-----|---------------------------------|
| 1                        | 2                           | 3                |      | 4                               | 5                |     | 6                               |
|                          |                             | CRS              | SRS  | CRS/SRS*100                     | CRS              | SRS | CRS/SRS*100                     |
| 12.                      | Karnataka                   | 18.1             | 20.6 | 87.6                            | 6.5              | 7.1 | 91.9                            |
| 13.                      | Kerala                      | 16.8             | 15.0 | 100.0                           | 6.2              | 6.4 | 96.4                            |
| 14.                      | Madhya Pradesh              | 15.7             | 29.4 | 53.3                            | 4.7              | 9.0 | 52.6                            |
| 15.                      | Maharashtra                 | 16.3             | 19.0 | 85.9                            | 5.2              | 6.7 | 78.1                            |
| 16.                      | Manipur                     | 10.6             | 14.7 | 72.0                            | 2.1              | 4.1 | 50.8                            |
| 17.                      | Meghalaya                   | 31.2             | 25.1 | 100.0                           | 4.0              | 7.5 | 53.3                            |
| 18.                      | Mizoram                     | 21.4             | 18.8 | 100.0                           | 5.0              | 5.1 | 97.9                            |
| 19.                      | Nagaland                    | 22.5             | 16.4 | 100.0                           | 3.0              | 3.8 | 79.5                            |
| 20.                      | Orissa                      | 19.0             | 22.3 | 85.3                            | 6.6              | 9.5 | 69.1                            |
| 21.                      | Punjab                      | 18.8             | 18.1 | 100.0                           | 6.1              | 6.7 | 91.4                            |
| 22.                      | Rajasthan                   | 18.7             | 28.6 | 65.3                            | 4.6              | 7.0 | 65.9                            |
| 23.                      | Sikkim                      | 19.1             | 19.9 | 95.8                            | 4.6              | 5.1 | 90.8                            |
| 24.                      | Tamil Nadu                  | 16.5             | 16.5 | 100.0                           | 6.5              | 7.4 | 87.4                            |
| 25.                      | Tripura                     | N.A.             | 16.0 | —                               | N.A.             | 5.7 | —                               |
| 26.                      | Uttar Pradesh               | 10.7             | 30.4 | 35.3                            | 1.8              | 8.7 | 21.2                            |
| 27.                      | Uttarakhand                 | 12.9             | 20.9 | 61.5                            | 3.1              | 7.4 | 41.6                            |
| 28.                      | West Bengal                 | 18.2             | 18.8 | 97.0                            | 3.3              | 6.4 | 51.1                            |
| <b>Union Territories</b> |                             |                  |      |                                 |                  |     |                                 |
| 1.                       | Andaman and Nicobar Islands | 13.6             | 15.7 | 86.9                            | 4.0              | 4.7 | 84.7                            |
| 2.                       | Chandigarh                  | 21.3             | 17.3 | 100.0                           | 10.2             | 4.5 | 100.0                           |
| 3.                       | Dadra and Nagar Haveli      | 23.3             | 29.4 | 79.4                            | 3.9              | 5.1 | 76.4                            |
| 4.                       | Daman and Diu               | 18.8             | 19.1 | 98.3                            | 4.0              | 5.6 | 71.7                            |
| 5.                       | Delhi                       | 20.6             | 18.6 | 100.0                           | 6.0              | 4.6 | 100.0                           |
| 6.                       | Lakshadweep                 | 14.6             | 19.1 | 76.6                            | 4.4              | 6.3 | 70.0                            |
| 7.                       | Puducherry                  | 43.4             | 16.2 | 100.0                           | 10.4             | 7.1 | 100.0                           |

In places where levels of registration of births and deaths are more than 100%, only 100% is considered.

Source: Registrar General, India, 2009, *Vital Statistics of India based on the Civil Registration System, Special Report 2002–05*, Office of Registrar General, India, Ministry of Home Affairs, New Delhi.

### 2.3.2 Sample Registration System (SRS)

With the idea of generating reliable and continuous data on births and deaths, the Office of Registrar General, India, initiated the scheme of sample registration of births and deaths in India popularly known as the Sample Registration System (SRS) in 1964–65 on a pilot basis and on a regular basis from 1969–70. Since then the SRS has been regularly providing data.

The SRS' main objective is to provide reliable estimates of birth rates, death rates and infant mortality rates at the natural division level for rural areas and at the state level for urban areas. Natural divisions are National Sample Survey (NSS) classified group of contiguous

administrative districts with distinct geographical and other natural characteristics. It also provides data for other measures of fertility and mortality including total fertility, infant and child mortality rates at higher geographical levels. In order to facilitate the effective tracking of the MDGs on under-five mortality, the estimates of under-five mortality rate for India and the larger states separately for rural and urban areas and also by sex have been made a regular feature of the SRS—Annual Statistical Report starting from the year 2008<sup>5</sup>. Similarly, the estimates of maternal mortality generated under the domain of SRS starting from 1997 provide important inputs for tracking the MDGs on maternal mortality.

### Data Collection System under SRS

The Vital Statistics Division of the Office of the RGI at the national level coordinates the implementation work, formulates and prescribes necessary standards. It provides necessary instructions and guidance; undertakes tabulation and analysis of data and their dissemination. The SRS has the unique feature of combining the advantages of the survey method and registration procedures as it is based on a dual record system. It consists of a continuous enumeration of births, deaths, and still births as they occur in a set of sampled villages and urban blocks by a part-time local resident enumerator (for example, primary school teacher, mid-wife, social or health worker). Additionally, an independent retrospective survey is carried out every six months by the supervisors appointed by the state headquarters. The data obtained from these two sources are then matched and the unmatched or partially matched events are re-verified in the field to get an unduplicated count of the correct events. Supervision of field work is an important component of SRS to maintain the quality of data. Officers of the Vital Statistics Division in the headquarters visit SRS units and undertake surprise checks.

### Structure of the Sample Registration System

The main components of SRS are:

- Base-line survey of the sample units to obtain demographic details of the usual resident population of the sample areas
- Continuous (longitudinal) enumeration of vital events pertaining to usual resident population by the enumerator
- Independent retrospective half-yearly surveys for recording births and deaths, which occurred during the half-year under reference and up-dating the house-list, household schedule and the list of women in the reproductive age group along with their pregnancy status by the Supervisor
- Matching of events recorded during continuous enumeration and those listed in the course of the half-yearly survey
- Field verification of unmatched and partially matched events
- Filling of Verbal Autopsy Forms for finalised deaths

The forms used and the system of flow of information in SRS are presented in Appendix 2.2.

### The SRS Reports

The SRS reports are annually published by the Office of the Registrar General, India (RGI). They give information on the age-sex structure of the population, age-specific fertility rates and other fertility indicators, age-specific death rates by sex and other mortality indicators. The reports also provide information on the type of medical attention at birth, and type of medical help received before death. Since 1990, data on mean age

### Notes

<sup>5</sup> Registrar General, India, 2011, *Sample Registration System, Statistical Report, 2009*, Office of Registrar General, India, Ministry of Home Affairs, India, New Delhi.

at effective marriage for females, interval between current and previous live births and distribution of live births by birth order have been included in the SRS report. Three year moving average of sex ratio at birth (since 2000) and the child sex ratio in the age group 0–4 years (since 2002), have been included.

Apart from these reports, the *SRS Bulletin* is published at half-yearly intervals giving estimates of birth and death rates, natural growth rate and infant mortality rate (IMR) for states and UTs by sex and urban-rural residence. The SRS constructs life tables based on the average age-specific death rates for five years for India and the major states (with a population exceeding ten million) by sex and rural-urban residence. Life tables for smaller states are not provided. The SRS also provides occupational issues for special surveys conducted from time to time.

### **Compendiums of India's Fertility and Mortality Indicators for 1971–97 and 1971–07 based on SRS**

The compendiums present the estimates of birth rate, death rate, IMR, natural growth rate and total fertility rate (TFR) etc. based on SRS data for India and States/UTs since the inception of the SRS in 1971. They also give sex-wise estimates of death rate, IMR, other infant mortality indicators at three-year intervals and mean age at marriage for females for India and for its States/UTs. Estimates of birth rate, death rate, natural growth rate, mortality rates by sex, and fertility and marital fertility indicators for the smaller states and UTs are also presented for the years for which they are available<sup>6</sup>. The 1971–2007 compendiums also contain data on personal habits at the national level collected during the Baseline Survey 2004<sup>7</sup>.

#### **Quality of SRS Data**

Though SRS estimates of births and deaths at state and national levels are widely accepted as reliable, some deficiencies have been noted. There is some possibility that an event may be missed by both the enumerator and investigator. For instance, children, who show signs of life after birth, but die within a few seconds/minutes or soon after birth, are likely to be reported as still births. The SRS can suffer from such a bias, which may result in the underestimation of mortality. Bhat (2002) has estimated the completeness of death reporting and omission of births in SRS and he found that at the national level there was an omission of 7.4 per cent of births by SRS<sup>8</sup>.

### **2.3.3 Causes of Death**

Under the existing reporting system in India, at the national level, the RGI is responsible for the collection, collation and publication of the causes of death statistics on an annual basis. At the state level, the Vital Statistics Division of the Directorate of Health deals with the causes of death statistics. The SRS provides lay reporting of deaths using verbal autopsy methodology by collecting information about the signs and symptoms of illness prior to death in determining the underlying causes of death of the deceased from the care-giver, especially a family member. This method introduced in India in 1965, was the first verbal autopsy based cause of death reporting system in the world. In 1960, the RGI initiated a 'Model Registration Scheme' (MRS) which was renamed the 'Survey of Causes of Death (Rural) (SCDI)' in 1982. The data under SCD was collected from a sample of villages using a lay diagnosis and reporting system.

<sup>6</sup> Registrar General, India, 1999, *Compendium of India's Fertility and Mortality Indicators, 1971–97* based on the Sample Registration System (SRS), Office of Registrar General, India, New Delhi.

<sup>7</sup> Registrar General, India, 2008, *Compendium of India's Fertility and Mortality Indicators, 1971–07* based on the Sample Registration System (SRS), Office of Registrar General, India, New Delhi.

<sup>8</sup> Bhat, P.N.M., 2008, 'Completeness of India's Sample Registration System: an assessment using the general growth balance method', *Population Studies*, 56(2), pp.118–34.

## **Notes**

Since January 1999, a cause of death component called SRS-COD has been added to the SRS main system, which covers both rural and urban areas. Initially, a verbal autopsy was done on each death reported in the SRS sample units by supervisors. The system has since been modified as 'representative, re-sampled, routine household interview of mortality with medical evaluation' (RHIME) in which the reports on verbal autopsy are evaluated by two independent medical practitioners. The causes are classified in accordance with the International Classification of Diseases, Tenth Revision (ICD-10) of the World Health Organization (WHO) and grouped in broad categories. The distribution of deaths by major causes is published for India, High Focused States and other states by major age groups and gender<sup>9</sup>.

Deaths due to maternal causes constitute a major factor of female mortality in India. The Maternal Mortality Ratio (MMR) is an important indicator to measure the country's progress in maternal health. In the absence of reliable estimates, efforts have been made in the past to make indirect estimates of MMR. However, the SRS now provides more reliable direct estimates from household interviews, of causes of death across the country during the period, 1997–2006. The RHIME approach noted above allows the identification of maternal death and the indicators of maternal mortality are estimated for India and its major states.

#### Quality of Data on Causes of Death

The major problems associated with the cause of death statistics in India are poor coverage, high incidence of unclassifiable cause of death, long delay and irregular publication of statistics and lack of systematic screening. The cause of death columns added to the SRS data collection forms do not provide for the recording of symptoms necessary for the systematic screening and coding of cause of death reports. Moreover, the health workers who are responsible for the collection of information from the household are not completely trained and the medical officer in-charge classifies the death based on the information provided by the health worker and this sometimes results in misclassification. However, the RHIME system reduces such errors considerably.

#### Notes

## 2.4 Surveys

The demographic sample and health surveys are other important sources of data. Instead of covering the entire population as is done in a census, information is collected only from a sample of the population, which is representative of the whole and from which inferences are drawn about the population.

### 2.4.1 National Family Health Surveys (NFHS)

Three rounds of the National Family Health Survey (NFHS) were conducted in 1992–93, 1998–99 and 2005–06, on a nationally representative sample of households spread over all the states in India. This was sponsored by the MoHFW and a number of international developmental partners with technical contribution from Macro International. All the three rounds of NFHS were implemented by the International Institute of Population Sciences (IIPS), Mumbai as the nodal agency. This survey provides valuable information for understanding the socio-demographic profile and reproductive health care of ever-married women in India. Table 2.3 presents some of the selected topics covered in the three rounds of NFHS.

<sup>9</sup> Registrar General, India, 2009, Report on Causes of Death in India, 2001–03, Office of Registrar General, India, Ministry of Home Affairs, New Delhi.

**Table 2.3: Sample Size and Selected Topics Covered in Three Rounds of the NFHS**

| Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | NFHS-1<br>(1992-93)                  | NFHS-2<br>(1998-99)                  | NFHS-3<br>(2005-06)                                                               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|--------------------------------------|-----------------------------------------------------------------------------------|
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 2                                    | 3                                    | 4                                                                                 |
| Number of households surveyed                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 88,562                               | 91,196                               | 109,041                                                                           |
| Ever married women (EMW) interviewed                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 89,777<br>(age-group<br>13-49 years) | 90,000<br>(age-group<br>15-49 years) | 124,385<br>(age-group<br>15-49 years)                                             |
| Number of men interviewed                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | —                                    | —                                    | 74,369                                                                            |
| Number of adult men and women tested for HIV                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | —                                    | —                                    | 102,946                                                                           |
| Estimates of HIV prevalence                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                      |                                      | All-India and six states (UP, AP, Karnataka, Maharashtra, Manipur and Tamil Nadu) |
| Crude birth rate (preceding three years survey)                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 28.7                                 | 24.8                                 | 23.1                                                                              |
| Total fertility rate (preceding three years survey)                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 3.39                                 | 2.85                                 | 2.68                                                                              |
| <b>The following information was collected through NFHS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                      |                                      |                                                                                   |
| <ul style="list-style-type: none"> <li>• Fertility and fertility preferences, family planning</li> <li>• Morbidity and mortality, child immunisation, child morbidity and treatment</li> <li>• Maternal and reproductive health and nutrition of children</li> <li>• Knowledge of HIV/AIDS, source of knowledge about HIV/AIDS and knowledge of ways to avoid AIDS</li> <li>• Status of women, domestic violence and anaemia</li> <li>• Reproductive health problems and quality of family welfare services</li> </ul> |                                      |                                      |                                                                                   |
| <b>In addition, the following information was collected only in NFHS-III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                      |                                      |                                                                                   |
| <ul style="list-style-type: none"> <li>• Perinatal mortality, male involvement in family welfare, adolescent reproductive health</li> <li>• High-risk sexual behaviour, family-life education and health conditions among slum and non-slum dwellers for eight cities (Chennai, Delhi, Hyderabad, Indore, Kolkata, Meerut, Mumbai and Nagpur)</li> </ul>                                                                                                                                                               |                                      |                                      |                                                                                   |

Source: 1. International Institute for Population Sciences and ORC Macro, 1995, *National Family and Health Survey (NFHS-1)*, 1992-93, Mumbai.

2. International Institute for Population Sciences and ORC Macro, 2002, *National Family and Health Survey (NFHS-2)*, 1998-99, Mumbai.

3. International Institute for Population Sciences and ORC Macro, 2007, *National Family and Health Survey (NFHS-3)*, 2005-06, Mumbai.

## Notes

Descriptive national and state reports for all three rounds and a few special reports on selected subjects are available. These reports can be accessed on [www.nfhsindia.org](http://www.nfhsindia.org). Unit-level data are in the public domain (with the identity of the respondent and the village concealed in order to maintain confidentiality) and can be accessed by researchers. The NFHS, however, does not provide any information at the district level.

## 2.4.2 District-Level Household and Facility Surveys (DLHS)

The Reproductive and Child Health (RCH) programme is implemented by the MoHFW to provide quality services at the grassroots level and to facilitate utilisation of RCH services by the community. District-Level Household and Facility Surveys (DLHS) provides estimates of RCH indicators. These surveys are carried out under the auspices of the MoHFW, with financial support from a number of developmental partners, and are implemented by IIPS, Mumbai as the nodal agency. The first round of the Rapid Household Survey (RHS) along with a facility survey was conducted in all the districts of the country, in two phases during 1998–99. This was followed by the second and third rounds conducted during 2002–04 and 2007–08, respectively.

The DLHS provides the following information:

- Coverage of maternal and child care
- Extent of safe delivery
- Contraceptive prevalence
- Unmet need for family planning
- Awareness about reproductive tract infections (RTIs), sexually transmitted infections (STI) and HIV/AIDS
- Utilisation of government health services and user satisfaction
- Facility survey to assess manpower, infrastructure, equipment, drugs, funds utilisation and public health facilities

To get information on the above, the following selected topics are covered and given in Table 2.4.

**Table 2.4: Sample Size and Selected Topics Covered in Three Rounds of DLHS and Facility Surveys**

| Topics                                     | DLHS-1<br>(1998–99)              | DLHS-2<br>(2002–04)     | DLHS-3<br>(2007–08)        |
|--------------------------------------------|----------------------------------|-------------------------|----------------------------|
| <b>Sample Population, India</b>            |                                  |                         |                            |
| Number of households surveyed              | 529,817                          | 620,107                 | 720,320                    |
| Number of eligible women interviewed       | 474,463                          | 507,622                 | 643,944                    |
| Unmarried women (15–24)                    | —                                | —                       | 166,260                    |
| Number of children aged under three        | —                                | —                       | —                          |
| Number of men interviewed                  | 257,245                          | —                       | —                          |
| Husbands of eligible women                 | —                                | 330,820                 | —                          |
| <b>Health Care Establishments in India</b> |                                  |                         |                            |
| Topics                                     | Facility Survey<br>1999, Phase I | Facility Survey<br>2003 | Facility Survey<br>2007–08 |
| No. of surveyed districts                  | 210                              | 370                     | 596                        |
| Districts Hospitals (DH)                   | 210                              | 370                     | 596                        |
| First Referral Unit (FRU)                  | 760                              | 1625                    | —                          |

Contd. ...

## Notes

| Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Facility Survey<br>1999, Phase I | Facility Survey<br>2003 | Facility Survey<br>2007–08 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|-------------------------|----------------------------|
| Community Health Centre (CHC)                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 886                              | 1,625                   | 4,162                      |
| Primary Health Centre (PHC)                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 7,959                            | 9,688                   | 8,619                      |
| Sub-Centre (SC)                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | —                                | 18,385                  | 18,068                     |
| Indian System of Medicine &<br>Homeopathy (ISM&H) Hospitals                                                                                                                                                                                                                                                                                                                                                                                                                       | —                                | 2,151                   | —                          |
| Indian System of Medicine &<br>Homeopathy (ISM&H) Dispensaries                                                                                                                                                                                                                                                                                                                                                                                                                    | —                                | 7,064                   | —                          |
| <b>Information on the following topics were collected in all the three rounds of DLHS</b>                                                                                                                                                                                                                                                                                                                                                                                         |                                  |                         |                            |
| <b>Household Characteristics</b> <ul style="list-style-type: none"> <li>• Background characteristics of households</li> <li>• Characteristics of women, husbands and fertility</li> <li>• Maternal health care</li> <li>• Child health care and immunisation</li> <li>• Family planning</li> <li>• Accessibility and perception about government health facilities</li> <li>• Reproductive health problems and awareness of RTIs/STIs and HIV/AIDS</li> </ul>                     |                                  |                         |                            |
| <b>In DLHS–III, the following additional information was collected</b>                                                                                                                                                                                                                                                                                                                                                                                                            |                                  |                         |                            |
| <b>Characteristics of Unmarried Women</b><br>Family-life education, knowledge about minimum legal age at marriage<br>Menstruation-related problems and practices; and knowledge about contraception<br>Knowledge about RTI/STI and HIV/AIDS<br>Health facilities: availability and quality                                                                                                                                                                                        |                                  |                         |                            |
| <b>The following information was collected in the Facility Survey</b>                                                                                                                                                                                                                                                                                                                                                                                                             |                                  |                         |                            |
| District hospital/sub-divisional hospital/rural hospital (RH)/community health centre (CHC)                                                                                                                                                                                                                                                                                                                                                                                       |                                  |                         |                            |
| Infrastructure, staff position, supply of tubal rings and selected kits, stocks [contraceptives, vitamin-A solution, oral rehydration solution (ORS) packet], equipment (in operation theatre, X-ray and ECG machine, and cold chain equipment)                                                                                                                                                                                                                                   |                                  |                         |                            |
| <b>The following information about Primary Health Centres was collected in the Facility Survey</b>                                                                                                                                                                                                                                                                                                                                                                                |                                  |                         |                            |
| Infrastructure, staff position, training status of PHC staff (medical officer, paramedical staff), stocks (contraceptives, prophylactic drugs, and vaccines), regular supply of kits, contraceptives and vaccines, equipment [infant and adult weighing machine, deep freezer and vaccine carrier, blood pressure measuring (BP) instrument, autoclave and steam steriliser drum, medical termination of pregnancy (MTP) suction aspirator, and labour room, table and equipment] |                                  |                         |                            |
| <b>The following information about sub-centres was collected in the Facility Survey</b>                                                                                                                                                                                                                                                                                                                                                                                           |                                  |                         |                            |
| Coverage (village covered by sub-centre, distance from village and distance from PHCs), infrastructure, staff, ANM residence location (whether sub-centre quarters or own house in village that sub-centre belongs to)                                                                                                                                                                                                                                                            |                                  |                         |                            |

Source: 1. International Institute for Population Sciences and MoHFW, 1999, *India: Rapid Household Survey–RCH Project, 1998, Mumbai*.

2. International Institute for Population Sciences and MoHFW, 2006, *Reproductive and Child Health–District Level Household Survey, 2002–04, Mumbai*.

3. International Institute for Population Sciences and MoHFW, 2010, *District Level Household & Facility Survey, 2007–08, Mumbai*.

The DLHS has published descriptive national and state reports for all the three rounds. The key indicators in the form of fact sheets for states and districts have already been published and can be accessed at [www.rchiips.org](http://www.rchiips.org). Individual-level data for the first two rounds can be obtained from IIPS on request for research purposes. The measure of accuracy of some selected indicators in terms of sampling errors, 95 per cent confidence intervals and design effects are given in the Annexure to these reports.

### 2.4.3 National Sample Surveys (NSS)

The National Sample Survey Organisation (NSSO) was set up in 1950, by the Government of India to fill the data gaps for socio-economic, health and morbidity data on a sample basis. The National Sample Survey (NSS) is a nationwide, large-scale survey, carried out in successive rounds, for a period of six months to one year for each round. It collects detailed information on consumer expenditure and employment in various rounds. The NSSO also collects data on fertility, mortality, morbidity, maternal and child health care, utilisation of health services, expenditure on health, the condition of the elderly, and knowledge of family planning, attitude and practices, internal migration and so on, in the various rounds. It provides estimates of literacy, school enrolment, and utilisation of educational services. A few rounds have also sought information on physical disability and the utilisation of the public distribution system. The data is tabulated and presented in various NSS reports. The NSS estimates are given at the state-level and some estimates are presented for agro-climatic zones within states, which have been tabulated and presented. However, district-level estimates are not available. Topics covered during different rounds of surveys carried out by the NSSO are given below in Table 2.5.

#### Notes

**Table 2.5: Selected Topics Covered in NSS Data Collection**

| S. No. | Round Scheduled No. | Subjects Covered                                                                         |
|--------|---------------------|------------------------------------------------------------------------------------------|
| 1.     | 38(10)              | Employment and Unemployment (1983)                                                       |
| 2.     | 42(25.1)            | Maternity, Child Care, Family Planning and Utilisation of the Public Distribution System |
|        | 42(25.2)            | Participation in Education (1986–87)                                                     |
|        | 42(25.7)            | Utilisation of Medical Services (1986–87)                                                |
|        | 42(27)              | Survey on Persons aged 60 years and above (1986–87)                                      |
| 3.     | 43(10)              | Employment and Unemployment (1986–87)                                                    |
| 4.     | 44(29.1)            | Living Conditions of Tribals (1988–89)                                                   |
|        | 44(29.3)            | Migration and Ownership of Land by Non-Tribal in Tribal Areas (1988–89)                  |
| 5.     | 47(30)              | Literacy and Culture (1991)                                                              |
|        | 47(26.0)            | Disabled Persons (1991)                                                                  |
|        | 47(3.1)             | Village Facilities (1991)                                                                |
| 6.     | 49(0.21)            | Particulars of Slums                                                                     |
|        | 49(1.0)             | Consumer Expenditure                                                                     |
|        | 49(1.2)             | Housing Condition and Migration (1993)                                                   |

Contd. ...

| S. No. | Round Scheduled No. | Subjects Covered                                                                                                                                                                                                                                                                                                                        |
|--------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7.     | 50(10)              | Employment and Unemployment (1993–94)                                                                                                                                                                                                                                                                                                   |
| 8.     | 52(25.0)            | Health Care (1995–96)                                                                                                                                                                                                                                                                                                                   |
| 9.     | 52(25.2)            | Participation in Education (1995–96)                                                                                                                                                                                                                                                                                                    |
| 10.    | 54(3.3)             | Common Property Resources and Village Facilities (1998)                                                                                                                                                                                                                                                                                 |
| 11.    | 55(1.0)             | Consumer Expenditure                                                                                                                                                                                                                                                                                                                    |
| 12.    | 55(10 & 10.1)       | Employment and Unemployment (1999–2000)                                                                                                                                                                                                                                                                                                 |
| 13.    | 56(1.0)             | Consumer Expenditure (2000–01)                                                                                                                                                                                                                                                                                                          |
| 14.    | 57(1.0)             | Consumer Expenditure (2001–02)                                                                                                                                                                                                                                                                                                          |
| 15.    | 58(1.0)             | Consumer Expenditure (2002)                                                                                                                                                                                                                                                                                                             |
|        | 58(1.2)             | Housing Conditions (2002)                                                                                                                                                                                                                                                                                                               |
|        | 58(0.21)            | Particulars of Slum (2002)                                                                                                                                                                                                                                                                                                              |
|        | 58(3.1)             | Village Facilities (2002)                                                                                                                                                                                                                                                                                                               |
|        | 58(26)              | Disabled Persons (2002)                                                                                                                                                                                                                                                                                                                 |
| 16.    | 60(10)              | Employment and Unemployment (2004)                                                                                                                                                                                                                                                                                                      |
|        | 60(25.0)            | Morbidity and Health Care, Immunisation of Children aged 0–4 years, Pregnancy, Childbirth and Maternity Care, Delivery, Condition of Aged, Old-age Dependency, Aged Persons by Sex, Aged by their Living Arrangement, Aged Depending on Others for day-to-day Maintenance, Aged Persons who cannot Move and are Confined to Bed or Home |

## Notes

Source: National Sample Survey Organisation, Department of Statistics, Ministry of Planning and Programme Implementation, Government of India (Different Rounds).

### 2.4.4 Annual Health Survey (AHS)

The National Rural Health Mission (NRHM) was launched by the Government of India in April 2005, with the view of bringing about dramatic improvement in the health system and the health status of the people, especially those who live in rural areas. Recognising the need for an information base, one of the core strategies of NRHM is ‘strengthening capacities for data collection, assessment and review for evidence based planning, monitoring and supervision’. The Government of India taking a step in this direction launched the Annual Health Survey (AHS) in 284 districts in nine states across the country to assess the impact of various schemes under NRHM; this is jointly implemented by the MoHFW, RGI, and Ministry of Home Affairs.

The nine states in which this survey is to be conducted are Bihar, Jharkhand, Madhya Pradesh, Chhattisgarh, Uttarakhand, Uttar Pradesh, Orissa, Rajasthan and Assam. The AHS aims to provide information on the impact of the various NRHM schemes on the TFR, and IMR at the district level, and MMR at the regional level. The AHS bulletin provides the CBR, CDR, IMR, NNM, U5MR, and SRB and is available at [www.censusindia.gov.in](http://www.censusindia.gov.in).

## 2.4.5 Other Surveys

### Multiple Indicator Cluster Surveys

The United Nations Children's Fund (UNICEF) along with the Government of India's Department of Women and Child Development (DWCD) designed multiple indicator surveys (MICS–2000) to assess the situation of women and children. Apart from household characteristics, the survey dealt with school attendance, health status, nutrition, education, family planning, morbidity and registration of births. At the national level, the survey covered 1.19 lakh\* households under a two-stage stratified sample design. The MICS–2000 complements the existing database. The survey's descriptive report gives many indicators at the national and state levels, and is available at: <http://www.childinfo.org/files/india.pdf>.

### Coverage Evaluation Survey

The Coverage Evaluation Survey, 2009 (CES, 2009), a nationwide survey covering all states and UTs of India, was carried out during November 2009 to January 2010. The data was collected from 45,058 households, 22,604 mothers of children of age 12–23 months and 22,984 women who delivered during the last 12 months. The fact sheets are available at [www.unicef.org/India](http://www.unicef.org/India). This survey provides no district-level information.

### All-India Surveys on Family Planning Practices by Operations Research Group (ORG)

The Operations Research Group (ORG), Baroda conducted surveys on the knowledge and practice of family planning methods on a nationwide basis in 1970, 1980 and 1988–89. The main objective of the surveys was to gather information on the awareness of family planning, willingness to practice birth control for limiting family size and spacing of children, knowledge of the various birth control devices, attitude towards various family planning methods, exposure to mass media, and the socio-economic and demographic factors.

### Youth in India: Situation and Needs Study 2006–07 (Youth Study)

The study on the youth in India was conducted by the IIPS and the Population Council, New Delhi. This is the first ever state-level representative study carried out to identify key transitions experienced by married and unmarried youth in India. The survey was conducted in six states (Andhra Pradesh, Bihar, Jharkhand, Maharashtra, Rajasthan and Tamil Nadu) and covered over 180,000 households, and nearly 51,000 young women and men from rural and urban areas in each district in the selected states. The major dimensions of youth life covered were education, work force participation, family life, sexual activity, marriage, health and civic participation. The report provides state-level indicators on the magnitude and patterns of sexual and reproductive practices both within and outside marriage as well as related knowledge, decision-making and attitudes<sup>10</sup>.

### National AIDS Control Organisation (NACO) Surveys

In 1986, following the detection of the first AIDS case in the country, the National AIDS Committee was constituted in the MoHFW. As the epidemic spread, the need was felt for a nationwide programme and an organisation to steer it. In 1992, India's first National AIDS Control Programme, 1992–99 was launched, and National AIDS Control Organisation (NACO) was established to implement the programme through 35 HIV/AIDS Prevention and Control Societies. The reports are available on <http://naco.nic.in/vsnaco/indianscene/bss.htm>. NACO conducts two main surveys as discussed briefly below.

### Sentinel Surveillance Surveys

Surveillance is the collection of data for action. 'Sentinel surveillance' for HIV is done to provide information on trends and levels of the HIV epidemic in specified populations.

\* 1 lakh = 100, 000

<sup>10</sup> International Institute for Population Sciences (IIPS) and Population Council, 2010, *Youth in India: situation and needs study, 2006–07*, Mumbai.

## Notes

This can serve as an early warning of a situation that needs action. Sentinel surveillance for HIV is conducted on specified high-risk groups such as female sex workers (FSWs), men having sex with men (MSM) and injecting drug users (IDUs). It also looks at the low-risk group of pregnant women seeking antenatal care (ANC) which represents the general male and female adult population. Surveillance 'sites' from where blood samples are obtained are chosen for each group. The ANC clinics at government hospitals are tapped for information on pregnant women, and samples are also taken from males and females with STI who visit the hospital. Surveillance for HIV infection comprises four broad areas: HIV Sentinel Surveillance, AIDS Case Surveillance, Behavioural Surveillance and Sexually Transmitted Infections available at: <http://ari.ucsf.edu/ari/policy>.

### **Behaviour Surveillance Survey (BSS)**

AIDS Prevention and Control (APAC) implements prevention and care programmes with NGO partners and also measures the effect of the programme and its intervention. The Behaviour Surveillance Survey (BSS) is conducted every year to study trends in sexual behaviour of a high-risk population along with respective state AIDS Control Societies. The BSS survey provides information for planning, designing, implementation, and monitoring and evaluation of HIV/AIDS control programmes. Its objectives are to measure trends in sexual behaviour of the target population using indicators like knowledge, sexual behaviour, urethritis prevalence and treatment-seeking behaviour for male respondents, STD symptoms and treatment-seeking behaviour for women in prostitution (WIP), perception of risk, voluntary HIV testing, exposure to interventions, injecting behaviour, stigma and discrimination. In the BSS, the following population groups are surveyed: WIP, truckers and helpers, male youth in slums, male and female factory workers and MSM.

### **Notes**

The BSS' findings are used to recognise successful strategies that drive high-risk populations towards safe sexual behaviour, and those that fail to deliver the intended message. They also help identify those segments of population that have not adopted safe behaviour despite the message having reached them and the reason for the same; understand other influences that counter HIV/AIDS messages, such as misconceptions and other impediments; and redesign intervention strategies on the basis of the findings available at: <http://www.onlinenaco.org>.

### **Integrated Disease Surveillance Project (IDSP)**

The Integrated Disease Surveillance Project (IDSP) was launched by MoHFW in November 2004 and is a decentralised, state-based surveillance programme. It is intended to detect early warning signals of impending outbreaks and to help initiate an effective response in a timely manner. The major components of the project are: (i) integrating and decentralisation of surveillance activities; (ii) strengthening of public health laboratories; (iii) human resource development (HRD) training of state surveillance officers, district surveillance officers, rapid response teams (RRTs), other medical and paramedical staff; and, (iv) use of information technology for collection, collation, compilation, analysis and dissemination of data.

Data is collected on a weekly (Monday–Sunday) basis. The information is collected in three specified reporting formats, namely “S” (suspected cases), “P” (presumptive cases) and “L” (laboratory confirmed cases) by health workers, clinicians and clinical laboratory staff. Weekly data provides time trends. Whenever there is a rising trend of illnesses in any area, it is investigated by Medical Officers (MOs)/RRTs, in order to diagnose and control the outbreak. Currently the collection is weekly, and the disease surveillance reports are from about 78 per cent (312/399) districts. In Phase I, 190 out of 210 districts (90%) and in

Phase II, 121 out of 189 districts (64%) sent weekly reports to IDSP's Central Surveillance Unit. Data analysis and action are being undertaken by the respective districts. Emphasis is being laid on reporting of surveillance data from major hospitals both in the public and private sectors and also Infectious Disease Hospitals (IDHs). The compilation of this data and disease outbreak alerts has been started recently. On an average, 10–15 outbreaks are reported every week to the Central Surveillance Unit, IDSP. The report is available at: <http://idsp.nic.in> – the hard copy is not available.

It was felt that the efficiency and generation of early warning signals would substantially improve if infectious/communicable disease hospital (ICDH) data were collected and analysed separately. Thus, a separate ICDH network was planned within IDSP with the following objectives:

- (i) Integrate all ID/CD hospitals in the network
- (ii) Ask the network to report epidemic-prone diseases
- (iii) Use reporting systems covering presumptive and laboratory confirmed cases
- (iv) Develop surveillance information based on out-patient and in-patient records
- (v) Collect data on real time/daily/weekly basis. The details of the same may be accessed from: <http://idsp.nic.in/>

## Notes

## 2.5 Service Statistics

Service statistics refer to the recording of implemented activities during the course of programme implementation at various administrative levels. The service statistics system, in the Indian family planning programme maintains and publishes, *inter alia*, periodic information on the number of acceptors of different methods of family planning and their socio-economic characteristics such as age, education, occupation, number of living children and so on. As the family planning (welfare) programme is integrated with maternal and child health (now RCH), the service statistics of the programme also cover various RCH aspects, which have now been subsumed under the HMIS of NRHM.

### 2.5.1 Health Management Information System (HMIS)

An 'Integrated Management Information and Evaluation System' for the Health and Family Welfare Sector was devised by the Central Bureau of Health Intelligence in 1972. The system consisted of data on specific indicators that would have an impact on the national health programmes. The collected data was aggregated at the district level, from where it was transferred to the higher levels; the state directorate and then to the national level. A strict time schedule was prescribed for the collection, compilation and submission of data at each level. Though the Health Management Information System (HMIS) was launched using a perfectly designed methodology and afforded a comprehensive coverage of many vital aspects of health management, yet there were many limitations.

- Data received from workers was incomplete and inconsistent.
- No proper format was provided to health workers for the collection of data so repeated errors were made.
- It was seen that when quantity was stressed upon, quality suffered. Undue importance given to ranking based on the indicators computed from the data resulted in malpractices and manipulation of data.

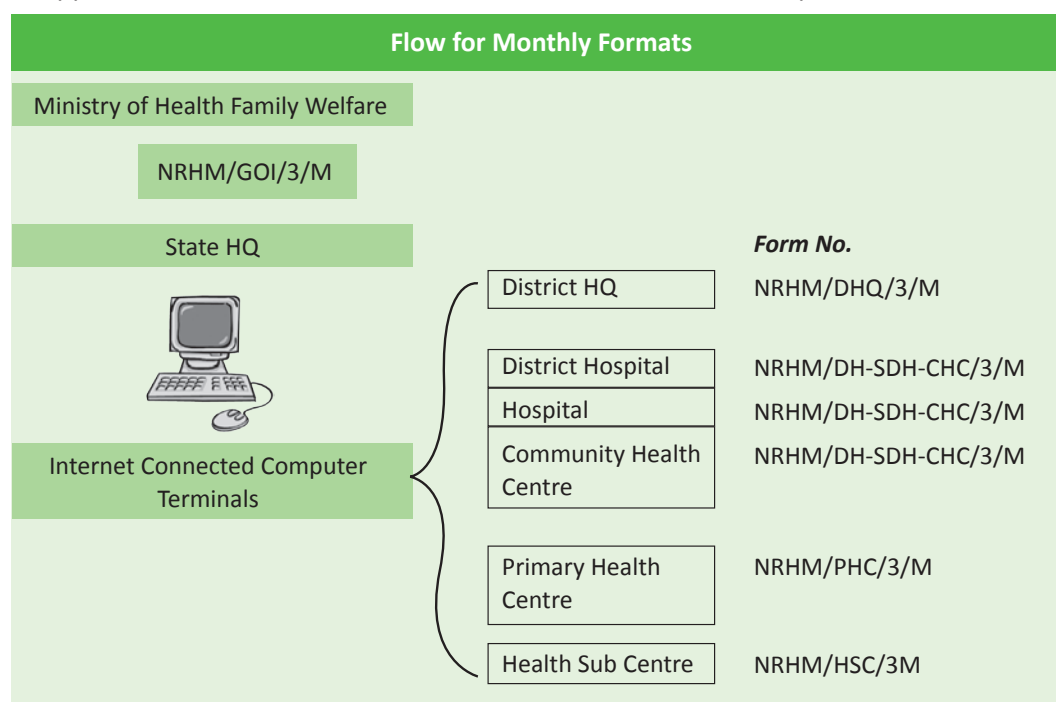
To overcome the above limitations, the HMIS was revised from the sub-centre level to the district level (bottom to up) to generate data not only for the preparation of reports for the next level of authorities that was higher, but also for monitoring the activities at the respective levels. The revised HMIS, designed to help identify only minimum essential indicators, aggregate and analyse the data, and provide the results for various users, was introduced in 1993.

The sub-centre remained the basic reporting unit for the collection of data. All health workers are provided with several registers in which they enter services rendered during field visits on the spot. These daily entries have made it easy for health workers to compile their monthly reports. The feedback system is strictly implemented and monitored. All districts, divisional heads and state-level programme officers have been provided computers to make the flow of information fast, accurate and efficient.

### HMIS: A Digital Initiative

The HMIS web portal was launched by the MoHFW on 21 October 2008, as part of the NRHM initiative to enable the capturing of public health data from both public and private institutions in rural and urban areas across the country. The portal was envisaged as a 'Single Window' for all public health data for the MoHFW<sup>11</sup>. The figure below is indicative of the flow of information from the facilities and is not an exact model of the administrative hierarchies, which may vary across the states. The salient features and its utility are given in Appendix 2.3. The details of the same can be accessed from: <http://nrhm-mis.nic.in>.

## Notes



Source: National Rural Health Mission, 'Instructions at a glance' (draft), October 2008, MoHFW.

### 2.5.2 Medical Certification of Cause of Death (MCCD)

The Medical Certification of Cause of Death (MCCD)<sup>12</sup> is an integral part of the Vital Statistics System of Registration. Its main aim is to provide a reliable database for generating mortality statistics. The necessary data is collected in the prescribed form filled in by designated

<sup>11</sup> Ministry of Health & Family Welfare, 2009, *Health Management Information System (HMIS), Preliminary Observation and Data Issues*, Government of India, New Delhi, available at: <http://nrhm-mis.nic.in>

<sup>12</sup> Registrar General, India, 2009, *Medical Certification of Causes of Death, 2004*, Office of Registrar General, India, Ministry of Home Affairs, New Delhi.

hospitals in the country. A separate form has to be filled for non-institutional deaths by medical practitioners. Both forms are almost identical and cover details such as name of deceased, sex, age, immediate cause of death, antecedent cause and other significant conditions, accident, suicidal, and homicidal deaths and death during pregnancy and delivery. Information on morbidity is not collected under the MCCD scheme. The statistics presented in the report give information on the cause of death, the cause of death cross-classified by sex and broad age-groups in both public and private institutions. The data for 1986 was obtained from a total of 15 states/UTs which increased to 24 in 2001. The report also provides information on the number and percentage of medically certified deaths, percentage distribution of medically certified deaths in 19 broad age groups classified by sex and also for the major cause group. The different volumes of reports provide time series data on MCCD on

- (i) Medically certified deaths by sex according to major cause groups (ICD-10)–India during 1986–2001
- (ii) Percentage of medically certified deaths by sex according to major cause groups (ICD-10)–India during 1986–2001

### 2.5.3 Crime Statistics

Statistics on crime in India are annually published by the National Crime Records Bureau, Ministry of Home Affairs, and the Government of India. For the first time, district-wise information on crimes against children, crimes against SCs/STs and their analysis has been introduced. The report provides data on crimes in 32 large cities that have a population of 10 lakhs and above as per the 2001 Census. It provides a vivid data tabulation on violent crimes, disposal of cases by the police and courts, crimes against women, children and SCs/STs and property stolen, recovered, economic offences, juvenile delinquency, arrests and trials, custodial crime, police firing, persons killed and injured, police casualties, complaints against police personnel, human rights violation by them, police strength, expenditure and infrastructure. The report has detailed information and analysis<sup>13</sup>, but the quality of data is a matter of concern.

#### Notes

## 2.6 Reports and Compiled Data Sets

### 2.6.1 Statistical Abstracts of India

This is a regular publication of the Central Statistical Organisation (CSO), Ministry of Statistics and Programme Implementation, Government of India, New Delhi (*please refer to*: <http://www.mospi.gov.in>) and the 2001 version is available. The Statistical Abstract contains time series data for national and state aggregates from 1990–91 onwards. The different types of statistics included in the abstract are provided in 39 separate sections and include the following: area and population, rainfall, agriculture, livestock and fisheries, forest, sericulture, irrigation, mining, industry, power, banks, cooperative societies, joint stock companies, insurance, trade, balance of payment, Indian Railways, motor vehicles, roads, shipping, civil aviation, tourism, post and telecommunication, labour, trade unions, prices, national products and related aggregates, national finance, income tax, exchange and currency, crime statistics, account statistics, education, news paper and periodicals, public health statistics, housing local bodies, electrical statistics and Five-Year Plans.

<sup>13</sup> Government of India, 2003, *Crime in India, National Crime Records Bureau, 2001*, Ministry of Home Affairs, New Delhi.

### 2.6.2 Selected Socio-economic Statistics, India

The CSO brought out a report, *Selected Socio-Economic Indicators for India*, in December 1983. It has been published regularly since 1993, but with a revised nomenclature, *Selected Socio-economic Statistics, India*. It covers 11 different heads, population, labour and employment, education, health, family welfare and nutrition, public order and safety, mass communication, housing and transport, environment, income, consumption, prices and international comparison of development.

### 2.6.3 Human Development Reports

The UNDP has been publishing the *Human Development Report* annually since 1990. The report ranks countries on the basis of a composite index, called the Human Development Index (HDI). The report also provides other indices such as the Human Poverty Index (HPI), Gender Development Index (GDI), and Technology Advancement Index (TAI) for most countries in the world. In India, the Planning Commission published the *National Human Development Report* for the country. India's Human Development Report (HDR), 2004–05 and 2010 ranks states on the basis of HDI and HPI. The key areas covered in India's HDR are agriculture, industry, poverty, economy, population, education, health, children, regional disparity and women.

#### Notes

Among the various states, Madhya Pradesh was the first to bring out its HDR, followed by Karnataka. Subsequently other states such as Rajasthan (2002), Maharashtra (2000) and Punjab (2004) published their HDRs. Most of these reports have examined inter-district variations within the state with respect to human development. Some states have brought out district-level HDRs available at: <http://undp.org.in>.

### 2.6.4 Projection Reports (UN, RGI, Others)

Most national governments project the population for their own countries. In addition, a few international organisations prepare population projections for the world, regions, and individual countries. The United Nations and the US Census Bureau regularly issue global and national projections. The UN projections are the most widely used. Many national governments, international agencies, the media, researchers, and academic institutions rely on UN projections.

#### United Nations Population Projections

*World Population Prospects*, 2006 Revision, Vol. II, 'Sex and Age-Distribution of the World Population', presented the 20<sup>th</sup> round of the official United Nations Population estimates and projections compiled by the Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat. The 2006 Revision builds on the 2004 Revision and incorporates both the results of the 2000 round of the national population census and of the recent specialised survey conducted worldwide. These sources provide both demographic and other information to assess the progress made in achieving the internationally agreed development goals, including the MDGs.

The 2006 Revision of *World Population Prospects* provides a comprehensive and consistent set of population data for the world's countries. Table 2.6 contains estimates and projections of the national population by five year age-group and sex for 1950–2050, and demographic indicators for the same period. Data for 1950–2005 are estimates and those thereafter are projections.

**Table 2.6: World Population Projection, Medium Variant, 1950–2050****[World Population Prospects: The 2006 Revision Population Database]**

| Year | Population<br>(in thousands) | Year | Population<br>(in thousands) |
|------|------------------------------|------|------------------------------|
| 1950 | 2,535,093                    | 2005 | 6,124,123                    |
| 1955 | 2,770,753                    | 2010 | 6,906,558                    |
| 1960 | 3,031,931                    | 2015 | 7,295,135                    |
| 1965 | 3,342,771                    | 2020 | 7,667,090                    |
| 1970 | 3,698,676                    | 2025 | 8,010,509                    |
| 1975 | 4,076,080                    | 2030 | 8,317,707                    |
| 1980 | 4,451,470                    | 2035 | 8,587,050                    |
| 1985 | 4,855,264                    | 2040 | 8,823,546                    |
| 1990 | 5,294,879                    | 2045 | 9,025,982                    |
| 1995 | 5,719,045                    | 2050 | 9,191,287                    |
| 2000 | 6,124,123                    |      |                              |

Source: United Nations, 2007, *World Population Prospects: The 2006 Revision*, Vol. II, 'Sex and Age Distribution of the World Population', Department of Economic and Social Affairs (Population Division) of the United Nations Secretariat, New York.

## Notes

Recently the 2010 Revision of the World Population Prospects has been released, which is the 22<sup>nd</sup> round of global demographic estimates and projections undertaken by the Population Division of the United Nations Department of Economic and Social Affairs of the United Nations Secretariat. The projections have been made till 2100 under this revision. Details can be accessed at: [http://esa.un.org/unpd/wpp/unpp/panel\\_population.htm](http://esa.un.org/unpd/wpp/unpp/panel_population.htm).

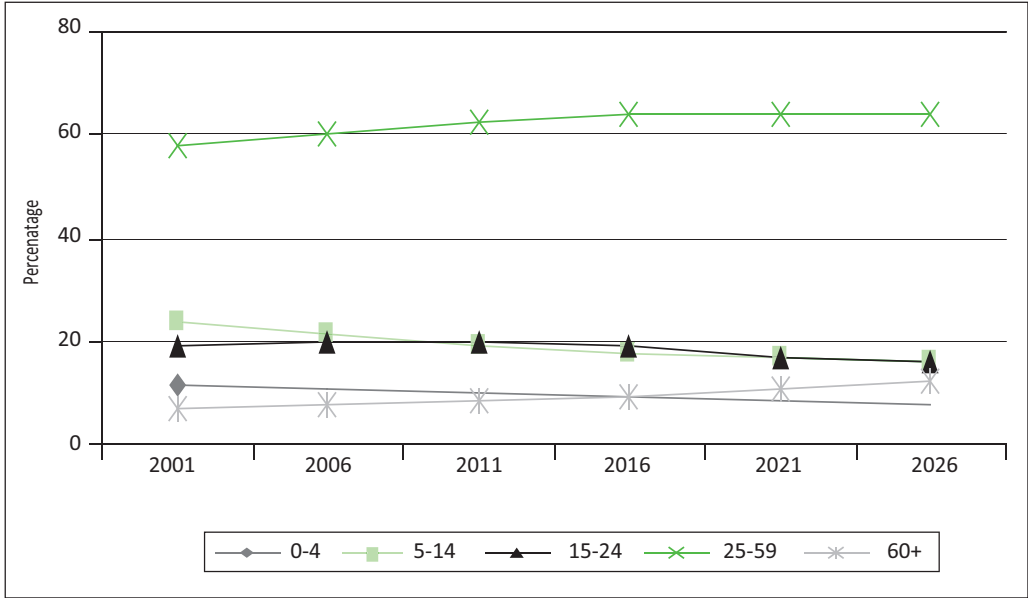
### Report of the Technical Group on Population Projection, RGI, India, 2006

The Expert Committee/Technical Group under the Chairmanship of the RGI has made population projections on the basis of the latest available census data, that is, the age-sex distribution of the population and migration data of the 2001 Census. The latest levels and trends of fertility and mortality data available from the SRS are utilised for population projection. The group has made population projections for the period, 2001–26. The report contains, in addition to the final projected figures of population characteristics, the assumptions and the methodology adopted in projecting different demographic indicators. A 'Summary of Findings' has been provided at the beginning of the report to provide population details in a nutshell along with the behaviour of related demographic indicators at the national and state levels in the years to come. In the Appendix under the section, 'Detailed Tables', the first two Tables 17 and 17A contain projected population figures and related important information at the national and state levels, which are a summary of the projection results. Some charts and graphs have been included in the report to make it user-friendly.

For the projection of population by age and sex up to 2026, 21 states have been considered and the component method of population projection has been applied. The states include Andhra Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttaranchal, Uttar Pradesh and West Bengal. The projection for the seven north-eastern states (excluding Assam) has also been carried out as a whole.

For the State of Goa and six UTs, the mathematical method has been applied. Figure 2.3 presents the line graphs of the population in broad age groups and the total for India during 2001–26 based on the population projection of RGI, 2006.

Figure 2.3: Percentage of Population by Broad Age-Group, India, 2001–26



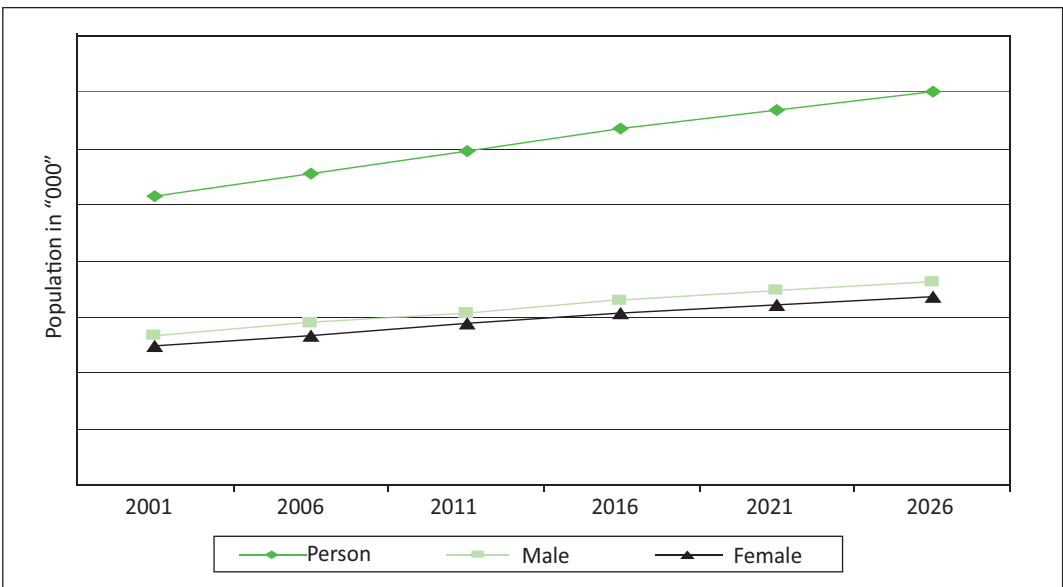
### Notes

Source: Registrar General, India, 2006, *Population Projections for India and States, 2001–26, Report of the Technical Group on Population Projections Constituted by the National Commission on Population*, Office of the Registrar General & Census Commissioner, India, New Delhi.

### Population Projection by the Population Foundation of India (PFI)

The Population Foundation of India (PFI) in collaboration with the Population Reference Bureau has made population projections for India and the major states, that is, states with a population of 10 million, using the component method of projection. In this method, separate assumptions are made regarding fertility, mortality and migration. For India and the major states, the report provides sex age-wise projections of population in the age groups 0–4, 5–14, 15–49, 15–64 and 65 and above till 2011, available at [www.prb.org](http://www.prb.org).

Figure 2.4: Trends in Population by Sex, India, 2001–26



Source: Same as Figure 2.3.

### Age-sex Population Projection by Residence and Social Groups (2002–07)

Chandrasekhar *et al.* (2009) have made an attempt to project age-sex specific population (quinquennial age groups up to 80+) by residence as on 1 April 2002, 2007, 2012, and 2017 for all states and UTs. They have also projected the age sex distribution of SCs/STs by residence as on 1 April 2002, 2007, 2012, and 2017 for all states and Union Territories (UTs). While projecting population by residence, the cohort component method has been used with the assumption that there has been no migration from rural areas. For smaller states and UTs like the Andaman and Nicobar Islands, Chandigarh, Dadra and Nagar Haveli, Daman and Diu, Delhi, Goa, Lakshadweep and Puducherry, the ratio method has been applied to project age and sex populations<sup>14</sup>.

### District-level Population Projections, UNFPA, 2009

The United Nations Population Fund (UNFPA) has carried out population projections at the district level by age and sex for eight selected states: Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, and Uttar Pradesh. District-level population projections have been made for the period, 2006–16 at an interval of five years<sup>15</sup>. The projections made by RGI (2006), for these states have been used as the basis for projections for districts within the respective states.

The ratio method has been used to project population. First, the ratio of the district population to the state population was computed for three years, 1981, 1991 and 2001. Based on the district ratio at these census dates, the annual change in the ratio was computed and projected for 2006, 2011 and 2016. The projected ratios of the district population were then applied to the respective state populations projected by the RGI (2006) to get the projected district populations for 2006, 2011 and 2016. While projecting the district population within the state, the district ratios are assumed to follow recent trends. The population projections are carried out for the conventional five-year age groups. The single year age distribution of the projected population, particularly younger ages, is obtained using Sprague multipliers for each projection year. The publication is available at <http://india.unfpa.org> and the tables in excel files are uploaded on the Ministry of Health and Welfare website (<http://www.mohfw.nic.in/>).

#### Notes

### 2.6.5 Rural Health Statistics in India

The quarterly bulletin, *Rural Health Statistics in India* has been published by the Rural Health Division of the Director General of Health Services, New Delhi since 1993. The bulletin presents information mainly on infrastructure, training and development, health and manpower in rural areas. The infrastructure information includes PHCs in rural areas, population norms, establishment of health sub-centres, PHCs and CHCs or RHs. The section on training and development includes information about training programmes for *dais* (traditional birth attendants or TBAs), village health guides (VHGs), Female Health Workers (FHWs), Male Health Workers (MHWs), male and female multipurpose workers (MPWs), as well as promotion training courses for auxiliary nurse midwives (ANMs). Detailed information at the state level from 1999 onward is provided in six parts. Part I gives an all-India summary on rural health statistics. Part II contains state-wise demographic indicators mainly on population, density, birth rate, death rate and IMR, while Part III contains state-wise information on rural health infrastructure. Part IV relates to health manpower in rural areas. Part V covers training activities and Part VI gives some parameters of achievements of rural health schemes, while Part VII has some important annexures.

<sup>14</sup> Chander Shekhar, *et al.*, 2009, *Age-Sex Population Projection by Residence and Social Group, 2002–17*, International Institute for Population Sciences (IIPS), Mumbai.

<sup>15</sup> UNFPA, 2009, *District Level Population Projections in Eight Selected States of India, 2006–16*.

### 2.6.6 Central Bureau of Health Intelligence (CBHI)

The Central Bureau of Health Intelligence (CBHI), Directorate General of Health Services, MoHFW published its first report, *Health Statistics of India*, 1951–53. This was followed by subsequent issues covering health statistics till 1975. The above said publication was modified and later brought out as the Pocket Book of *Health Statistics of India* till 1980. The annual publication, *Health Statistics of India* was revived from 1981 and continued till 1985. However, from 1986, this annual publication was renamed Health Information of India and published till 2005. It provided information on seventeen different items for the states and India: (i) population; (ii) vital statistics; (iii) socio-economic indicators; (iv) pattern of government investment and expenditure on health, family welfare and Ayurveda, Yoga and Naturopathy Unani, Siddha and Homeopathy (AYUSH); (v) poverty and disability, (vi) medical and paramedical education; (vii) medical health and nursing manpower statistics; (viii) secondary and tertiary medical care services; (ix) primary health-care services (government); (x) public health statistics; (xi) cause of death statistics; (xii) EPI (Expanded Programme of Immunisation); (xiii) health insurance statistics; (xiv) food adulteration, and production of drugs and pharmaceuticals; (xv) ISM & H (Indian System of Medicine and Health); and (xvi) international comparative statistics. The comparative figures for earlier periods are given in tables to enable planners, decision-makers and others in the field of health and socio-economic development to avail time series data<sup>16</sup>. The important publications of the CBHI are listed in Appendix IV.

#### Notes

### 2.6.7 Annual Reports of the Ministry of Health and Family Welfare

The Family Welfare Year Book (FWYB), an annual publication of the MoHFW was launched in 1972–73. The FWYB provides detailed family welfare performance statistics on various facets of the Family Welfare Programme in India. Besides the Family Welfare Service Statistics, the year book also provides a wide range of demographic, socio-economic and related statistics as well as past trends.

The year book is presented in four sections: A, B, C, and D. Section A provides information on population and vital statistics in 40 tables (A.1 to A.40). Section B is on Family Welfare Programme Statistics, and is divided into two parts. Part (i) presents information on immunisation coverage and medical termination of pregnancy (MTP) services through six tables (B.1. to B.6), and Part (ii) is mainly on family planning acceptance, which is shown through 14 tables (B.7 to B.20). Section C presents the impact of the Family Welfare Programme, including couples protected, births averted and couple protection rates in 26 tables (C.1 to C.26). Section D is on outlay and expenditure on family welfare provided through six tables (D.1 to D.6), and lastly, there are Annexures. Thus, the year book gives detailed data on contraceptive methods used, fertility related indices, family planning expenditure, MCH-related data, and so on<sup>17</sup>.

### 2.6.8 Centre for Monitoring the Indian Economy (CMIE)

The Centre for Monitoring the Indian Economy (CMIE) regularly publishes reports based on data gathered from various sources. The report entitled, *Economic Intelligence* published since 1980, provides data on several indicators covering population, agriculture, minerals, energy, transport and communication, industry, banking, health and education for each district of India. Population and broad economic activities are also provided in the report for the major towns of India. The document also presents an index of the relative level of development of infrastructure in a district available at: <http://www.cmie.com>.

<sup>16</sup> Source: <http://www.cbhidghs.nic.in>

<sup>17</sup> Ministry of Health & Family Welfare, 2009, *Family Welfare Programme in India, Year Book, 2008*, Department of Family Welfare, Ministry of Health & Family Welfare, Government of India, New Delhi.

## 2.7 Summary

- Major district-level demographic data is mainly available from various population censuses, registration of vital events (CRS), DLHS, and HMIS.
- At the state and national levels, data is obtained from the Census, SRS, NSS, NFHS, service statistics and other surveys.
- The population census provides information on the demographic, social and economic characteristics of the population at different administrative level from village to national level.
- The CRS in India suffers from gross under-registration and delay in the publication of reports. In the absence of good coverage and the quality of CRS data, users have to depend on surveys conducted by different agencies.
- The SRS reports provide age-sex structure of the population, age-specific fertility and mortality rates by sex. However, there is always a time lag of two-three years to get these estimates.
- The DLHS gives detailed information on marriage and fertility, family planning, maternal health, child immunisation and Vitamin-A supplements, treatment of childhood diseases and knowledge of HIV/AIDS and RTI/STI among ever-married women.
- Performance statistics from the HMIS portal on child health and immunisation, maternal health and family planning for 2008–09 are also available.

### Notes

## EXERCISES

**Exercise 1:** Construct an age-sex pyramid for Madhya Pradesh (Use the data given below).

**Table 2.A: Age and Sex-wise Population of Chhatarpur District, Madhya Pradesh for Census 2001**

| Age Group    | Persons       | Males        | Females      |
|--------------|---------------|--------------|--------------|
| 0–4          | 11471         | 6005         | 5466         |
| 5–9          | 13225         | 7039         | 6186         |
| 10–14        | 14136         | 7703         | 6433         |
| 15–19        | 12268         | 6931         | 5337         |
| 20–24        | 10668         | 5871         | 4797         |
| 25–29        | 9420          | 4905         | 4515         |
| 30–34        | 8095          | 4184         | 3911         |
| 35–39        | 7537          | 3906         | 3631         |
| 40–44        | 5692          | 3207         | 2585         |
| 45–49        | 4392          | 2379         | 2013         |
| 50–54        | 3277          | 1827         | 1450         |
| 55–59        | 2533          | 1284         | 1249         |
| 60–64        | 2365          | 1182         | 1183         |
| 65–69        | 1577          | 803          | 774          |
| 70–74        | 1125          | 594          | 531          |
| 75–79        | 529           | 260          | 269          |
| 80+          | 705           | 305          | 400          |
| <b>Total</b> | <b>109078</b> | <b>58421</b> | <b>50657</b> |

Source: Registrar General, India, 2005, *Social and Cultural Tables, Series C–14 Population in Five-years Age Groups by Sex and Residence, 2001*, Office of Registrar General & Census Commissioner, India, New Delhi.

**Exercise 2:** Draw a line graph and assess the quality of data for digit preference/avoidance for Chhatarpur District, Madhya Pradesh, 2001.

**Exercise 3:** Compute progressive ratio of single year data for Chhatarpur District, Madhya Pradesh, 2001. Assess the quality of data about age heaping and give your comments.

**Table 2.B: Single-year Age Data by Sex, Chhatarpur District, Madhya Pradesh**

| Chhatarpur |         |       |         |        |         |       |         |
|------------|---------|-------|---------|--------|---------|-------|---------|
| Age(x)     | Persons | Males | Females | Age(x) | Persons | Males | Females |
| 0          | 34863   | 18253 | 16610   | 51     | 1803    | 1012  | 791     |
| 1          | 32251   | 16777 | 15474   | 52     | 7584    | 4053  | 3531    |
| 2          | 43653   | 22592 | 21061   | 53     | 4248    | 1290  | 2958    |
| 3          | 44506   | 22834 | 21672   | 54     | 3052    | 1300  | 1752    |
| 4          | 42280   | 22243 | 20037   | 55     | 21741   | 12461 | 9280    |
| 5          | 45984   | 24562 | 21422   | 56     | 4512    | 2211  | 2301    |
| 6          | 45808   | 23708 | 22100   | 57     | 2499    | 1022  | 1477    |
| 7          | 32500   | 16856 | 15644   | 58     | 8998    | 2869  | 6129    |
| 8          | 55748   | 29154 | 26594   | 59     | 1604    | 785   | 819     |
| 9          | 33330   | 17319 | 16011   | 60     | 28349   | 16422 | 11927   |
| 10         | 57617   | 30924 | 26693   | 61     | 1549    | 895   | 654     |
| 11         | 27757   | 15295 | 12462   | 62     | 6248    | 3206  | 3042    |
| 12         | 49516   | 27452 | 22064   | 63     | 2950    | 906   | 2044    |
| 13         | 30820   | 16828 | 13992   | 64     | 1641    | 770   | 871     |
| 14         | 33411   | 18763 | 14648   | 65     | 18998   | 10578 | 8420    |
| 15         | 31999   | 18941 | 13058   | 66     | 1919    | 964   | 955     |
| 16         | 30836   | 17945 | 12891   | 67     | 1385    | 646   | 739     |
| 17         | 17105   | 9840  | 7265    | 68     | 3993    | 1321  | 2672    |
| 18         | 39400   | 22863 | 16537   | 69     | 701     | 329   | 372     |
| 19         | 14001   | 7932  | 6069    | 70     | 16467   | 9425  | 7042    |
| 20         | 42865   | 23663 | 19202   | 71     | 563     | 318   | 245     |
| 21         | 12109   | 6786  | 5323    | 72     | 2236    | 1182  | 1054    |
| 22         | 30858   | 17729 | 13129   | 73     | 854     | 317   | 537     |
| 23         | 17363   | 7449  | 9914    | 74     | 530     | 284   | 246     |
| 24         | 19849   | 9793  | 10056   | 75     | 6229    | 3391  | 2838    |
| 25         | 37890   | 22752 | 15138   | 76     | 692     | 354   | 338     |
| 26         | 20224   | 10389 | 9835    | 77     | 310     | 157   | 153     |
| 27         | 11906   | 6380  | 5526    | 78     | 1111    | 445   | 666     |
| 28         | 32717   | 14580 | 18137   | 79     | 194     | 91    | 103     |
| 29         | 5733    | 2884  | 2849    | 80     | 5318    | 2839  | 2479    |
| 30         | 47550   | 27417 | 20133   | 81     | 185     | 102   | 83      |
| 31         | 4480    | 2272  | 2208    | 82     | 548     | 291   | 257     |
| 32         | 23653   | 12224 | 11429   | 83     | 187     | 81    | 106     |
| 33         | 11945   | 4095  | 7850    | 84     | 123     | 63    | 60      |
| 34         | 9986    | 4012  | 5974    | 85     | 1445    | 795   | 650     |
| 35         | 38636   | 24596 | 14040   | 86     | 173     | 104   | 69      |
| 36         | 14007   | 7511  | 6496    | 87     | 90      | 51    | 39      |
| 37         | 6606    | 3114  | 3492    | 88     | 192     | 76    | 116     |
| 38         | 21397   | 8294  | 13103   | 89     | 58      | 35    | 23      |
| 39         | 3915    | 1910  | 2005    | 90     | 1137    | 586   | 551     |
| 40         | 39402   | 24172 | 15230   | 91     | 63      | 29    | 34      |
| 41         | 2997    | 1687  | 1310    | 92     | 117     | 57    | 60      |
| 42         | 13622   | 7217  | 6405    | 93     | 48      | 19    | 29      |
| 43         | 6810    | 2017  | 4793    | 94     | 52      | 30    | 22      |
| 44         | 4957    | 2133  | 2824    | 95     | 347     | 180   | 167     |
| 45         | 29265   | 18118 | 11147   | 96     | 45      | 25    | 20      |
| 46         | 6215    | 3153  | 3062    | 97     | 31      | 17    | 14      |
| 47         | 3903    | 1725  | 2178    | 98     | 97      | 47    | 50      |
| 48         | 13247   | 4929  | 8318    | 99     | 71      | 39    | 32      |
| 49         | 2065    | 978   | 1087    | 100+   | 150     | 58    | 92      |
| 50         | 30000   | 18421 | 11579   |        |         |       |         |

Source: Registrar General, India, 2005, *Social and Cultural Tables, Series C–13 Single Year Age Returns by Sex and Residence, 2001*, Office of Registrar General & Census Commissioner, India, New Delhi.

**Hint:** Progressive Ratio (PR) =  $(x + n)/x$ .

## APPENDICES

### Appendix 2.1

| S. No. | Series/ Table     | Title                                                                                                                                    | Level of Presentation |
|--------|-------------------|------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
|        | <b>B-Series</b>   | <b>Economic Tables</b>                                                                                                                   |                       |
| 1.     | B-1\$, *          | Main workers, marginal workers, non-workers and those marginal workers, non-workers seeking work classified by age                       | State/District        |
| 2.     | B-2\$, *          | Main workers, marginal workers, non-workers and those marginal workers, non-workers seeking work classified by age, sex and religion     | State/District        |
| 3.     | B-3 *             | Main workers, marginal workers, non-workers and those marginal workers, non-workers seeking work classified by educational level and sex | State/District        |
| 4.     | B-9 *             | Main workers by educational level, age and sex                                                                                           | State/District        |
| 5.     | B-11\$, *         | Marginal workers by main activity, age and sex                                                                                           | State/District        |
| 6.     | B-12*             | Marginal workers by main activity, age, sex and religious community                                                                      | State/District        |
| 7.     | B-13\$, *         | Non-workers by main activity, age and sex                                                                                                | State/District        |
| 8.     | B-14              | Non-workers by main activity, age, sex and religious community                                                                           | State/District        |
| 9.     | B-15 *            | Non-workers by main activity, educational level and sex                                                                                  | State/District        |
| 10.    | B-16              | Marginal workers and non-workers seeking/ available for work classified by educational level, age and sex                                | State/District        |
|        | <b>C-Series</b>   | <b>Socio-Cultural Tables</b>                                                                                                             |                       |
| 1.     | C-2\$, *          | Marital status by age and sex                                                                                                            | State/ District       |
| 2.     | C-3 *             | Marital status by religious community and sex                                                                                            | State/District        |
| 3.     | C-4\$, *          | Ever married and currently married population by age at marriage and duration of marriage                                                | State/ District       |
| 4.     | C-5               | Ever married and currently married population by age at marriage and duration of marriage and religious community                        | State/District        |
| 5.     | C-6               | Ever married and currently married population by age at marriage and duration of marriage and educational level                          | State/District        |
| 6.     | C-8\$, *          | Educational level by sex for population aged 7 and above                                                                                 | State/District        |
| 7.     | \$, *C-8 Appendix | Educational level graduate and above by sex for population aged 15 and above                                                             | State/District        |
| 8.     | C-9               | Educational level by religious community and sex for population aged 7 and above                                                         | State/District        |

Contd. ...

| S. No. | Series/ Table   | Title                                                                                                                                                 | Level of Presentation |
|--------|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| 9.     | C-10\$, *       | Population attending educational institution by age, sex and type of educational institution                                                          | State/District        |
| 10.    | C-11, *         | Population attending educational institution by completed educational institution, age and sex                                                        | State/District        |
| 11.    | C-15 *          | Religious community by age-group and sex                                                                                                              | State/District        |
| 12.    | C-20\$          | Disabled population by type of disability, age and sex                                                                                                | State/District        |
| 13.    | C-21            | Disabled population by type of disability, marital status, age and sex                                                                                | State/District        |
| 14.    | C-23            | Disabled population among main workers, marginal workers, non-workers by type of disability, age and sex                                              | State/District        |
| 15.    | C-24            | Disabled non-workers by type of disability and sex                                                                                                    | State/District        |
|        | <b>D-Series</b> | <b>Migration Tables</b>                                                                                                                               |                       |
| 1.     | D-1             | Population classified by place of birth, age and sex                                                                                                  | State/District        |
| 2.     | D-2\$, *        | Migrants classified by place of last residence, sex and duration of residence in place of enumeration                                                 | State/District        |
| 3.     | D-3\$, *        | Migrants by place of last residence, duration of residence and reason for migration                                                                   | State/District        |
| 4.     | D-4             | Migration by place of last residence, age, sex, educational level and duration of residence                                                           | State/District        |
| 5.     | D-5             | Migration by place of last residence, age, sex, reason for migration and duration of residence                                                        | State/District        |
| 6.     | D-6             | Migration by place of last residence, economic activity, age, sex, and duration of residence                                                          | State/District        |
| 7.     | D-7             | Migration by place of last residence with duration 0-9 years reporting 'Work/Employment', as reason for migration by, age, sex, and educational level | State/District        |
| 8.     | D-10            | Migration by place of last residence, age, sex, marital status and duration of residence 0-9 years                                                    | State/District        |
| 9.     | D-11\$          | Persons born and enumerated in the district of the state                                                                                              | State/District        |
| 10.    | D-12            | Migrants by place of residence with duration of residence as 0-9 years and age                                                                        | State/District        |
|        | <b>F-Series</b> | <b>Fertility Tables</b>                                                                                                                               |                       |
| 1.     | F-1 \$, *       | Number of women and ever married women by present age, parity and total children ever born by sex                                                     | State/District        |

Contd. ...

| S. No. | Series/ Table   | Title                                                                                                                                           | Level of Presentation |
|--------|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| 2.     | F-2             | Number of women and ever married women by present age, parity, religious community and total children ever born by sex                          | State/District        |
| 3.     | F-3             | Number of women and ever married women by present age, parity, educational level and total children by sex                                      | State/District        |
| 4.     | F-5\$, *        | Number of women and ever married women by present age, number of surviving children and total surviving children by sex                         | State/District        |
| 5      | F-6             | Number of women and ever married women by present age, religious community and number of surviving children and total surviving children by sex | State/District        |
| 6.     | F-7             | Number of women and ever married women by present age, educational level, number of surviving children and total surviving children by sex      | State/District        |
| 7.     | F-9\$           | Number of women and currently married women by present age, number of births last year                                                          | State/District        |
| 8.     | F-10            | Number of women and currently married women by present age, religious community                                                                 | State/District        |
| 9.     | F-11            | Number of women and currently married women by present age educational level, number of births last year by sex and birth order                 | State/District        |
| 10.    | F-13            | Ever-married women by number of children ever born, number of male children ever born and number of surviving children by sex                   | State/District        |
| 11.    | F-14            | Currently married women by number of children ever born, number of male children ever born and number of surviving children by sex              | State/District        |
|        | <b>H-series</b> | <b>Household Tables</b>                                                                                                                         |                       |
| 1.     | HH-1\$, *       | Normal households by household size                                                                                                             | State/District        |
| 2.     | HH-2            | Houseless households by household size (Lakshadweep not shown)                                                                                  | State/District        |
| 3.     | HH-3 *          | Institutional households by household size                                                                                                      | State/District        |
| 4.     | HH-5 *          | Households with number of aged persons (60 years) by sex and by household size                                                                  | State/District        |
| 5.     | HH-6            | Households by marital status, sex and age of the head of the household                                                                          | City                  |
| 6.     | HH-7            | Households by religion, sex of the head of the household and household size                                                                     | State/District        |
| 7.     | HH-9\$, *       | Households by the number of literate among the members of the household aged 7 years and above                                                  | State/District        |

Contd. ...

| S. No.                             | Series/ Table           | Title                                                                                                                        | Level of Presentation |
|------------------------------------|-------------------------|------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| 8.                                 | HH-9\$, *<br>Appendix A | Households by the number of literate among the male members of the household aged 7 years and above                          | State/District        |
| 9.                                 | HH-9\$, *<br>Appendix B | Households by the number of females literate among the female members of the household aged 7 years and above State/District | State/District        |
| 10.                                | HH-12                   | Households by the number of literate, religion of the head of household                                                      | State/District        |
| 11.                                | HH-13                   | Households with members aged 15 years and above and with or without an educational level of matriculation and above          | State/District        |
| 12.                                | HH-14\$                 | Households with children in the age group 5–14 years by number of children attending school                                  | State/District        |
| 13.                                | HH-14 A                 | Appendix: Households with female children in the age group 5–14 years by number of female children attending school          | State/District        |
| 14.                                | HH-15                   | Households with the number of workers and number of main workers                                                             | State/District        |
| 15.                                | HH-15<br>Appendix       | Households with the number of workers by household size                                                                      | State/District        |
| 16.                                | HH-16                   | Households by size and number of members seeking/available for work                                                          | State/District        |
| 17.                                | HH-16 A                 | Appendix: Households by the number of female members and number of female members seeking/available for work                 | State/District        |
| 18.                                | HH-17                   | Households by the number of disabled persons and household size                                                              | State/District        |
| 19.                                | HH-17<br>Appendix A     | Households by the number of disabled males and household size                                                                | State/District        |
| 20.                                | HH-17<br>Appendix B     | Households by the number of disabled females and household size                                                              | State/District        |
| \$: Social Group (SC, ST); *: City |                         |                                                                                                                              |                       |

Source: Registrar General, India, 2005, *Census and You: Basic Results from Census, 2001, Catalogue and Services*, Office of Registrar General & Census Commissioner, India.

## Appendix 2.2

### Forms used and system of flow of information in the Sample Registration System (SRS):

Depending on the various operations under the system, the following types of form are used under the main components of SRS.

#### (i) Baseline Survey Forms

Form 1: House List

Form 2: Household Schedule

Form 3: List of Pregnant Women

#### (ii) Continuous Enumeration Forms

Form 4: Births recorded by enumerators (January—June/July—December)

Form 5: Deaths recorded by enumerators (January—June/July—December)

Form 6: Monthly reports of births

Form 7: Monthly reports of deaths

#### (iii) Half-yearly Survey Forms

Form 9: Births recorded by supervisors (January—June/July—December)

Form 10: Deaths recorded by supervisors (January—June/July—December)

Form 15: Distribution of usual resident population by age, sex and marital status  
(as on 1 July/1 January)

Form 16: Distribution of female population by broad age-group and levels of education  
(as on 1 July of the year)

Form 17: Number of females who got married by age at effective marriage  
(January—June/July—December)

#### (iv) Compilation/Tabulation Forms

Form 8: Consolidated monthly report on births and deaths

Form 11: Finalised list of births (January—June/July—December)

Form 12: Finalised list of deaths (January—June/July—December)

Form 13: Results of the HYS for births (January—June/July—December)

Form 14: Results of the HYS for deaths (January—June/July—December)

## Flow Chart of Information under SRS

| BASELINE SURVEY<br>(By Supervisor with the help of Enumerator)                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                   | CONTINUOUS ENUMERATION<br>(By the Enumerator) |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|--|
| 1. House List (FORM 1)<br>2. Household Schedule (FORM 2)<br>3. List of Pregnant Women (FORM 3)<br>4. Baseline population<br>a. By Age, Sex and Marital Status (FORM 15)<br>b. Female population by age and levels of education (FORM 16) | BIRTHS                                                                                                                                                                                                                                                                                            | DEATHS                                        |  |
|                                                                                                                                                                                                                                          | Births recorded by the Enumerator (FORM 4)                                                                                                                                                                                                                                                        | Deaths recorded by the Enumerator (FORM 5)    |  |
|                                                                                                                                                                                                                                          | Monthly Report (FORM 6)                                                                                                                                                                                                                                                                           | Monthly Report (FORM 7)                       |  |
|                                                                                                                                                                                                                                          | ↓                                                                                                                                                                                                                                                                                                 | ↓                                             |  |
|                                                                                                                                                                                                                                          | Consolidated monthly report (FORM 8) by the States and the Union Territories to ORGI                                                                                                                                                                                                              |                                               |  |
| Half-yearly Survey (HYS)                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                   |                                               |  |
| 1. Updating House List (FORM 1) and Household Schedule (FORM 2)<br><br>2. Population for each HYS (FORM 15 and 16)<br><br>3. Number of Ever Married Women (FORM 17)                                                                      | BIRTHS                                                                                                                                                                                                                                                                                            | DEATHS                                        |  |
|                                                                                                                                                                                                                                          | List of births (FORM 9)                                                                                                                                                                                                                                                                           | List of deaths (FORM 10)                      |  |
|                                                                                                                                                                                                                                          | MATCHING<br>Births: (FORM 4 with FORM 9)                                                                                                                                                                                                                                                          | Deaths: (FORM 5 with FORM 10)                 |  |
|                                                                                                                                                                                                                                          | RE-VERIFICATION<br>(By third person or jointly by enumerator and supervisor)<br>Finalisation of FORMS 11 to 14 by implementing agencies<br>Finalised list of BIRTHS (FORM 11)<br>Finalised list of DEATHS (FORM 12)<br>Results of HYS for BIRTHS (FORM 13)<br>Results of HYS for DEATHS (FORM 14) |                                               |  |
| Transmission to State/ORGI                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                   | Transmission of FORMS 11 to 17 to ORGI        |  |

## Appendix 2.3

The salient features of HMIS web portal are as given below:

- Web-based data capturing system
- Easy interface and navigation
- Dispensing with paper forms
- Work-flow similar to physical reporting system
- Entry at district level to begin with
- Include district-level FMRs
- Both online and offline mode of entry
- Facility-based data capturing
- Automatic data aggregation
- Key indicators to be generated for local use
- Intelligent analysis for use at all levels
- Standard and custom reports
- Modular, expandable and scalable
- Ever evolving based on feedback from users

It is hoped that this will encourage debate among the various stakeholders like public health personnel, academicians and the public to promote informed decision-making in fine tuning health-related policy initiatives. The reports emanating from the data committed by the states will be available in the public domain. Authorised users have the facility of logging on to the portal and generating reports based on provisional data as well. The web portal has a 'Notifications' section, which contains important letters and instructions sent to the states regarding monitoring and evaluation activities. The monitoring information system (MIS) for the national health programmes would be amalgamated with the HMIS portal interface. This will facilitate the district users in having a single point of data entry for these programmes and also help in generating reports.

## Appendix 2.4

### Important Publications of CBHI

- *National Road Safety Profile of India, 2008*
- *National Recommendations on Improving and Strengthening of Implementation of International Classification of Diseases (ICD-10), 2006*
- *Managing Human Resources for Health in India: Case-Studies of Madhya Pradesh and Gujarat, 2007 – Major Recommendations*
- *Health Sector Policy Reform Options Database (HS-PROD)*
- *National Health Profile (NHP) of India, 2008*
- *Mortality Statistics in India, 2007*
- *Improving and Strengthening the Use of ICD-10 and Medical Record System in India, 2006*
- *Health Information of India, 2005*
- *ICD-10*

# Measures of Fertility and Mortality and Methods of Estimation

## Learning Objectives

- This chapter is designed to help participants understand the basic measures of fertility and mortality and to comprehend computation and interpretation
- To familiarise participants with indirect methods of estimation of fertility and mortality

## 3.1 Introduction

Fertility (births) and mortality (deaths) are two major components of population growth. Current population size, age structure and composition are the outcomes of past fertility and mortality. Future population size, age structure and composition will be determined by future fertility and mortality. This chapter defines various concepts and commonly used measures of fertility and mortality along with explanations of relevant concepts. It also gives some simple methods of estimating important measures indirectly.

## 3.2 Basic Concepts

### 3.2.1 Rates, Ratios, Proportions and Probability

In the fields of health and demography, a **rate** measures the occurrence of some particular event (births, deaths, etc.) in a population per unit exposure during a given time-period. The rate is expressed per 1000 or sometimes per 100000 units of the denominator to avoid fractions:

$$\text{Rate} = \frac{\text{Number of occurrences}}{\text{Mid-year population}}$$

Sometimes the following formula can also be used in place of the above as per the availability of data:

$$\text{Rate} = \frac{\text{Number of occurrences}}{\text{Person-years of exposure to the risk of occurrence}}$$

A **ratio** expresses a relation in size between two quantities that are possibly related. The numerator is not necessarily a component of the denominator. The numerator and denominator may involve an interval of time, especially the numerator.

## Notes

Broadly, a ratio is the result of dividing one quantity by another. It is expressed in the format:

$$\frac{x}{y}$$

The basic difference between rates and ratios is that the numerator is a component of the denominator in calculating a rate, but this is not necessarily so in a ratio. For example, Maternal Mortality is expressed in terms of both Rate and Ratio, however the interpretation varies accordingly.

An example of Maternal Mortality Rate and Maternal Mortality Ratio is shown below:

$$\text{Maternal Mortality Rate} = \frac{\text{Number of maternal deaths* in age group 15–49 in a given year and area}}{\text{Number of women in age group 15–49 in that year and area}} * 100,000$$

$$\text{Maternal Mortality Ratio} = \frac{\text{Number of maternal deaths* in age group 15–49 in a given year and area}}{\text{Number of live births in a given year and area}} * 100,000$$

\*Maternal death is defined as the death of a woman while pregnant or within 42 days of termination of pregnancy irrespective of the duration and site of the pregnancy, from any causes related to or aggravated by the pregnancy or its management but not from accidental or incidental causes.

One can observe the basic difference in the two measures of Maternal Mortality given above. In the first measure, Maternal Mortality Rate, the numerator is a part of the denominator, whereas in Maternal Mortality Ratio, the numerator is not a part of the denominator.

Some of the commonly used ratios are given below:

**Sex Ratio of Total Population**

Sex ratio of total population is the number of males per 100 females in the total population. However in India, the sex ratio is calculated as the number of females per 1000 males. For example, the population sex ratio increased from 927 females per 1000 males to 933 females per 1000 males from 1991 to 2001. In Census 2011 this has shown a further increase to 940 females per 1000 males (Table 3.1).

**Child Sex Ratio**

Child sex ratio is the ratio of boys per 100 girls in the age group 0–6 years. In India, child sex ratio is also calculated as females per 1000 males in the 0–6 year age group. For example, the child sex ratio for India was 927 in 2001 but has declined to 914 in 2011 (Table 3.1).

Notes

**Table 3.1: Child Sex Ratio and Overall Sex Ratio (females per 1,000 males), 1951–2011**

| Year | Child Sex Ratio | Overall Sex Ratio |
|------|-----------------|-------------------|
| 1951 | 983             | 946               |
| 1961 | 976             | 941               |
| 1971 | 964             | 930               |
| 1981 | 962             | 934               |
| 1991 | 945             | 927               |
| 2001 | 927             | 933               |
| 2011 | 914             | 940               |

Source: Report for different census years.

### Sex Ratio at Birth (SRB)

This is the ratio of boys born per 100 girls born. It generally lies between 103 and 107, subject to local biological variations. High sex ratios (more than 110) at birth in some Asian countries are now attributed to sex-selective abortions due to a strong preference for sons. It is also an indicator of sex-discrimination in some countries. There is another way of calculating the Sex Ratio at Birth (SRB), where the ratio of girls per 1000 boys is taken into consideration (see Table 3.2 for Sex Ratio at Birth for India and Selected states, 2008).

**Table 3.2: Sex Ratio at Birth in India and Selected States, 2006–08**

| India/States   | Sex Ratio at Birth |       |
|----------------|--------------------|-------|
|                | Total              | Urban |
| India          | 904                | 894   |
| Bihar          | 914                | 880   |
| Chhattisgarh   | 975                | 914   |
| Jharkhand      | 922                | 846   |
| Madhya Pradesh | 919                | 921   |
| Orissa         | 937                | 917   |
| Rajasthan      | 870                | 849   |
| Uttar Pradesh  | 877                | 875   |

Source: Registrar General of India, 2009, Sample Registration System Statistical Report, 2008, Office of the Registrar General of India, New Delhi.

Often, a **proportion** is also labeled as a ‘rate’. For example, the proportion of persons who are literate is called Literacy Rate. Similarly, the proportion of persons in a population who have a certain disease at a point in time is the prevalence rate of that disease. Thus, Contraceptive Prevalence Rate is also a proportion. Here, the numerator is a component of the denominator, but unlike the rate defined earlier, there is no occurrence of events over time.

**Probability**<sup>1</sup> refers to the *chance* that an event will occur. It is a concept that is frequently used in formulating several health and demography indicators.

$$\text{Probability} = \frac{\text{Number of Occurrences}}{\text{Number of Preceding Events (Trials)}}$$

### Notes

<sup>1</sup> Preston Samuel H., Patrick Heuveline and Michel Guillot, 2001, *Demography: Measuring and Modeling Population Processes*, Blackwell, UK.

Therefore, probability cannot exceed 1 and also cannot be negative.

**For example,**

$$1. \text{ Probability of dying before 1 year of age } ({}_1q_0) = \frac{\text{Number of infant deaths in a given year}}{\text{Number of live births in that year}}$$

$$2. \text{ Probability of dying in 5–9 age group} = \frac{\text{Number of deaths in 5–9 age group}}{\text{Number of persons who reached exactly age 5}}$$

### 3.2.2 Births and Deaths

#### Live Birth

A live birth is the complete expulsion or extraction of the infant from its mother – a product of conception, which after separation shows any sign of life. The signs are: breathing, beating of heart, pulse, or movement. The period of gestation does not matter as long as some sign of life is seen after separation. Generally, whenever the term 'birth' is used, it refers to a live birth unless otherwise specified.

#### Death

Death is the permanent disappearance of all evidence of life at any time after a birth has taken place.

#### Foetal Wastage (Foetal Death)

Termination of a pregnancy that did not result in a live birth is termed foetal wastage.

#### Still Birth

A pregnancy of more than 28 weeks of gestation that did not result in a live birth is called still birth.

#### Children Surviving (CS)

The total number of children which a woman has borne as live births and are still alive (at the time of enumeration), is called number of children surviving (CS). Children alive but not staying with the woman (mother) must be counted in the number of children surviving to a woman.

#### Children Ever Born (CEB)

This fertility indicator is a cohort measure of fertility. Children Ever Born (CEB) is the total number of children a woman has borne till the date of enumeration. This also includes those children whom a woman has borne as live births but who died before the date of enumeration. Therefore, the following equation can be written as the definition of CEB:

$$\text{Children Ever Born (CEB)} = \text{Children Surviving (CS)} + \text{Children Died (CD)}$$

#### Parity

Parity refers to the number of births a woman has had, that is, if a woman has not given any birth she is referred to as zero-parity woman. Therefore, a woman who has  $n$  number of births is called  $n$ -parity woman. This also enables one to provide the estimates of childlessness by calculating the proportion of zero-parity women in the age group 45–49.

#### Notes

### Birth Order

This refers to the order of a live birth a woman has had, that is, if a woman has two births, the first birth is of order one and the second, of order two. In the case of twins, one should consider the same birth order for both the children.

While parity refers to women, birth order refers to children (or births). Therefore, birth order starts from 1 whereas parity starts from 0. Symbolically, to analyse  $n^{\text{th}}$  order births women with  $(n-1)^{\text{th}}$  parity should be considered. According to the requirement, various fertility measures can be derived from the birth order and parity data.

|             |   |   |   |   |       |
|-------------|---|---|---|---|-------|
| Parity      | : | 0 | 1 | 2 | $n-1$ |
| Birth Order | : | 1 | 2 | 3 | $n$   |

## 3.3 Measures of Fertility and Reproduction

### 3.3.1 Measures of Fertility

#### Crude Birth Rate (CBR)

Crude Birth Rate (CBR) is the simplest and most frequently used measure of period fertility, which requires the minimum amount of information on birth statistics. It is defined as the total number of births during a given year in a given geographical area (B) divided by the average (or mid-year) population in that year and geographical area (P):

$$\text{CBR} = \frac{B}{P} * 1000$$

- The rate is crude as it is influenced by the age-sex distribution of the population in addition to fertility and hence it is not advisable to use the CBR to compare the levels of fertility for any two populations which may differ widely in their age-sex composition (see Table 3.3 for Crude Birth Rate of India and selected States, 2008).
- For mid-year population calculation see Chapter 5.
- The whole population is not responsible for giving birth.

#### General Fertility Rate (GFR)

General Fertility Rate (GFR) is defined as the number of births per year per thousand women in the childbearing age:

$$\text{GFR} = \frac{B}{W_{15-49}} * 1000$$

where,  $W_{15-49}$  is the total number of women in the childbearing age (15–49) at the mid-point of the year in a given geographical area. Sometimes we use the total women in the age group 15–44 in place of 15–49, depending upon the level of fertility in the area of study.

The main advantage of the GFR is that it includes those members of the female population of reproductive age supposed to be exposed to the risk of giving birth. This measure is generally used as a component of the population projection method (Table 3.3).

#### Notes

**Table 3.3: Crude Birth Rate and General Fertility Rate, India and Selected States, 2008**

| India/States   | CBR  | GFR   |
|----------------|------|-------|
| India          | 22.8 | 88.1  |
| Bihar          | 28.9 | 127.3 |
| Chhattisgarh   | 26.1 | 98.7  |
| Jharkhand      | 25.8 | 105.1 |
| Madhya Pradesh | 28.0 | 118.8 |
| Orissa         | 21.4 | 79.3  |
| Rajasthan      | 27.5 | 113.3 |
| Uttar Pradesh  | 29.1 | 122.8 |

Source: Same as Table 3.2.

### Age-Specific Fertility Rate (ASFR)

The age pattern of childbearing in any population is best revealed by computing age-specific fertility rates (ASFR), which is the number of births per woman in a given age group, year and geographical area (Table 3.4):

$$ASFR(f_x) = \frac{{}_5B_x}{{}_5W_x}$$

where,  ${}_5f_x$  is the age-specific fertility rate of women aged 'x' to x+5 years

${}_5W_x$  is the number of women aged 'x' to x+5 years at mid-year in a geographical area

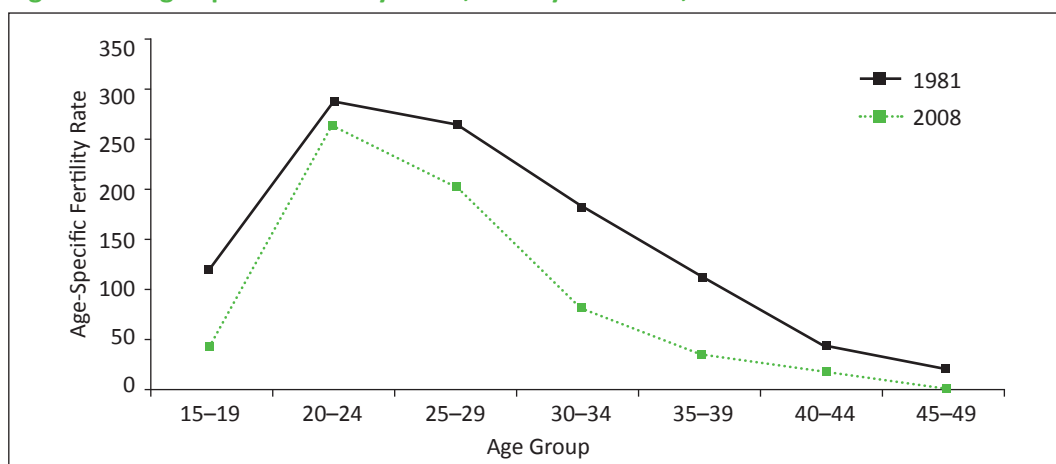
${}_5B_x$  is the number of births in a year to the women of ages 'x' to x+5 years in the geographical area;

'x' = 15, 20, 24, .....45

ASFR is usually expressed in terms of per thousand women.

$$ASFR(20-24) = \frac{\text{No. of births in age group 20-24 in a given year and geographical area}}{\text{No. of women in age group 20-24 in that year and geographical area}} * 1000$$

**Figure 3.1: Age-Specific Fertility Rates, Madhya Pradesh, 1981 and 2008**



Source: Same as Table 3.2.

Fertility rate in the age group 15–19 years is a measure of adolescent fertility. This group has a high fertility rate. It is also known that any birth in this age group carries a high risk of mortality for both mother and child. Therefore, programmes should focus on postponement of childbearing in the 15–19 year age group.

### Total Fertility Rate (TFR)

This is an overall summary measure of fertility and is obtained by summing the age-specific fertility rate for each age of the childbearing span. In other words, Total Fertility Rate (TFR) is the number of children which a woman of a hypothetical cohort is expected to bear during her lifetime, if she were to bear children throughout her life as per the given ASFR schedule, and survive through the entire period of reproduction (see Table 3.4 for Total Fertility Rate of India and Selected States, 2008).

Symbolically, if the age-specific fertility rates are for single year of age, then:

$$TFR = \sum_x n f_x \quad \text{for 'x' = 15, 16, ..... 49}$$

### Notes

and if the age-specific fertility rates are for five-year age groups then:

$$TFR = 5 * \sum_x {}_5f_x \quad \text{for 'x' = 15, 20, ..... 45}$$

If ASFR is expressed in terms of per 1000 women, then:

$$TFR = \frac{5 * \sum ASFR}{1000}$$

**For example,** TFR for India can be calculated as:

$$TFR = 5 * (41.6 + 200.1 + 158.3 + 73.3 + 32.7 + 12.3 + 4.9)/1000$$

$$TFR = 5 * 523/1000$$

$$TFR = 2.6$$

**Table 3.4: Age-Specific Fertility Rates and Total Fertility Rate, India and Selected States, 2008**

| Age-Group  | India      | Bihar      | Chhattisgarh | Jharkhand  | Madhya Pradesh | Orissa     | Rajasthan  | Uttar Pradesh |
|------------|------------|------------|--------------|------------|----------------|------------|------------|---------------|
| 15–19      | 41.6       | 47.3       | 47.9         | 53.3       | 48.1           | 40.6       | 48.4       | 32.6          |
| 20–24      | 200.1      | 231.0      | 242.1        | 212.2      | 261.8          | 164.5      | 260.4      | 233.6         |
| 25–29      | 158.3      | 226.5      | 176.1        | 178.0      | 201.8          | 148.9      | 198.6      | 243.2         |
| 30–34      | 73.3       | 138.9      | 86.5         | 105.0      | 83.6           | 77.9       | 87.6       | 131.7         |
| 35–39      | 32.7       | 77.5       | 26.3         | 57.8       | 38.5           | 26.9       | 45.3       | 75.0          |
| 40–44      | 12.3       | 35.6       | 12.5         | 22.2       | 16.4           | 10.0       | 17.8       | 30.3          |
| 45–49      | 4.9        | 15.0       | 0.3          | 14.8       | 3.7            | 3.6        | 9.1        | 15.3          |
| <b>TFR</b> | <b>2.6</b> | <b>3.9</b> | <b>3.0</b>   | <b>3.2</b> | <b>3.3</b>     | <b>2.4</b> | <b>3.3</b> | <b>4.0</b>    |

Source: Same as Table 3.2.

### 3.3.2 Measures of Reproduction

#### Gross Reproduction Rate (GRR)

Gross Reproduction Rate (GRR) indicates the average number of daughters of a hypothetical cohort of women by the end of their reproductive life, if the women bear children according to a given schedule of age-specific fertility rates (taking only female births) without experiencing any mortality till the end of reproductive life. In other words, this measures the capacity of women to replace themselves, as implied by the set of current fertility rates without taking into consideration the effect of mortality.

$$GRR = 5 \sum_{x=15} \frac{{}_5B_x^f}{{}_5W_x}$$

where,  ${}_5B_x^f$  is number of female births to women aged 'x' to x+5

${}_5W_x$  is number of women aged 'x' to x+5 years at mid-year in a geographical area

x = 15, 20, 25, .....45

In case births are not tabulated by sex of newborn babies, then:

$$GRR = TFR * \text{proportion of female births}$$

$$\text{that is, } GRR = TFR / (1 + SRB)$$

where, SRB is sex ratio at birth and we assume that it does not vary by age of women.

In case of GRR, mortality is not taken into consideration (see Table 3.5 for GRR in India and Selected States).

**Table 3.5: Gross Reproduction Rate of India in Selected States, 2008**

| India/States   | Gross Reproduction Rate |
|----------------|-------------------------|
| India          | 1.2                     |
| Bihar          | 1.8                     |
| Chhattisgarh   | 1.5                     |
| Jharkhand      | 1.5                     |
| Madhya Pradesh | 1.6                     |
| Orissa         | 1.2                     |
| Rajasthan      | 1.6                     |
| Uttar Pradesh  | 1.8                     |

Source: Same as Table 3.2.

#### Net Reproduction Rate (NRR)

It is a measure of the average number of daughters that would be born to a cohort of women during their lifetime if they experienced a fixed ASFR and Age-Specific Mortality Rate (ASMR). Therefore:

$$NRR = \frac{1}{1 + SRB} \left[ \sum_{x=15} {}_5f_x * \frac{{}_5L_x}{l_0} \right]$$

where,  ${}_5L_x$  is number of person-years lived by the women in the age group 'x' to x+5.

In other words, NRR is the number of daughters who would replace their mothers.

*Note:* How to calculate the value of  ${}_5L_x$  will be explained in Chapter 6

#### Notes

## Replacement Level Fertility (RLF)

The level of fertility where a woman is replaced by her daughter on an average is called replacement level fertility (RLF). In other words, this is the level of fertility that gives  $NRR=1$ . In populations with low mortality, a TFR of 2.1 is generally taken as RLF. It (the RLF) is the precondition for population stabilisation (process to achieve zero growth of population in the long run; this is called the 'stationary population' in demographic terminology). However, if a population attains replacement level fertility, it does not mean that the size of population stabilises immediately. Even after fertility reaches replacement level, population growth persists for some time due to a large number of couples already existing in the reproductive age in that population. This phenomenon is called *population momentum*. This can be understood by using the simple example of driving a car. A driver uses the brakes to stop a car, but it does not stop immediately. It takes a few seconds to stop completely because of the momentum and during this period it moves forward before coming to a stop.

*India's National Population Policy (2000) has a medium-term objective to achieve replacement level fertility by the year 2010 for the country as a whole. On the other hand, under the National Rural Health Mission (NRHM) this goal needs to be achieved by 2012. However, at the state level, there are wide variations in the timing of attainment of replacement level fertility. Four of the large northern states – Uttar Pradesh, Bihar, Rajasthan and Madhya Pradesh – may take more time, beyond 2010. On the other hand, Andhra Pradesh, Delhi, Himachal Pradesh, Karnataka, Kerala, Punjab, Maharashtra, Tamil Nadu and West Bengal achieved replacement fertility rate in 2009<sup>2</sup>.*

### Notes

## 3.4 Indirect Estimation of Fertility

Most measures of fertility listed above require data on births and deaths in a population along with the age-sex composition so that age-specific rates can be computed. This is possible when a good vital registration system is in place. However, when the coverage of registration is incomplete, as is the case in most parts of India, such rates cannot be computed. At the same time, since many demographic features are structurally interrelated, some information from the census or surveys can be used to get a good idea of fertility and mortality. Demographic techniques have been developed to make use of incomplete or defective information to estimate certain demographic measures indirectly. A large number of methods of indirect estimation are described in the *UN Manual X*<sup>3</sup>. Some commonly used techniques for estimating measures of fertility and mortality are discussed in this section and the next.

### 3.4.1 Reverse Survival Method for Indirect Estimation of Fertility

This method allows the estimation of fertility measures in the five and 10-year periods prior to the census. Theoretically, children aged 0–4 years and 5–9 years at the time of census (for example 2001 census) are the survivors of the births that have taken place in the population during the two five-year periods preceding the census (during 1996–2001 and 1991–96 respectively). If one is interested in obtaining fertility rates during the five years preceding the census, then the number of children enumerated in the age group 0–4 years is *reverse survived* using the appropriate survival ratio in order to estimate births that have taken place during the five-year period just preceding the census (born during 1996–2001). If one is interested in estimating fertility rates during this period, then the

<sup>2</sup> Registrar General of India, 2011, Sample Registration System Statistical Report No.1, Office of the Registrar General & Census Commissioner of India, Government of India, New Delhi.

<sup>3</sup> United Nations, 1983, *Manual X: Indirect Techniques for Demographic Estimation*, United Nations Publications, Sales No. E83 XIII 7.

children enumerated in the age group 5–9 years are reverse survived using the appropriate survival ratio. It is known that the population in the age group 0–4 is generally under-enumerated and in the age group 5–9 over-reported. Thus, if this is the case with the study population, it is suggested that we use both 0–4 and 5–9 populations for estimating the fertility levels in the population using reverse survival method and take the average of the two estimates or reverse survive the population in the age-group 0–9 years to estimate fertility levels during the 10-year period preceding the census. Populations in other age groups can also be used; most of the recent estimates at the district level for India have used the 0–6 age group (because data on population in the age group 0–6 is available immediately after the enumeration) and estimated fertility during the seven-year period preceding the census. Since data on age are available at the district level, the reverse survival procedure has been found to be very useful to obtain district level estimates of fertility by Bhat<sup>4</sup> and Guilmoto and Rajan<sup>5</sup>.

### Assumptions

1. Reporting of age, especially of children, is accurate.
2. Population is not affected by migration (fertility of migrants and non-migrants do not differ).
3. Level and age-pattern of mortality during early childhood are known, or follow a model life table.

### Notes

### Data Requirements

1. Population in the young age groups, say 0–4, 5–9, or 0–6 years, by sex on the date of enumeration. (Proportion of population in the respective age group can also be used).
2. Total population at two consecutive censuses or exponential growth rate between two consecutive censuses; or
3. Life table survival ratios (or  ${}_nL_x$  values) for early age groups. If a life table for the area under study is not available, the level of early childhood mortality can be estimated from the same census using CEB and CS data (discussed later) and values of  ${}_nL_x$  inferred.

### Description of the Method

The steps given below, for the age group 0–4, yield estimates for the five-year period preceding a census enumeration. Similar estimates can be obtained for the earlier five-year period, or for seven-year and ten-year periods prior to enumeration.

**Step I:** Obtain combined survival ratio ( $S_{B \rightarrow 0-4}$ ) for both sexes from a suitable life table from birth to age group 0–4 as:

$$S_{B \rightarrow 0-4} = \frac{{}_5L_0}{5 * I_0}$$

where,  ${}_5L_0$  is population aged 0–4 years in the life table and  $I_0$  is the initial population (radix) in the life table.

<sup>4</sup> Bhat, P.N. Mari, 1994, 'Levels and Trends in Indian Fertility: a reassessment', *Economic and Political Weekly*, 29 (51–2).

<sup>5</sup> Guilmoto, Christopher Z. and S. Irudaya Rajan, 2002, 'District Level Estimates of Fertility from India's 2001 Census', *Economic and Political Weekly*, 16 February.

**Step II:** Estimate average annual births ( $B_{(t-5, t)}$ ) during the five years preceding the census date as:

$$B_{(t-5, t)} = \frac{1}{5} * \frac{{}_5P_0^t}{S_{B \rightarrow 0-4}}$$

$$= \frac{{}_5P_0^t}{{}_5L_0^t/I_0}$$

where,  ${}_5P_0^t$  is population aged 0–4 years in the most recent census at time 't'.

**Step III:** Obtain birth rate  $BR_{(t-5, t)}$  during the last 5 years preceding census as follows:

$$BR_{(t-5, t)} = \frac{B_{(t-5, t)}}{P_{(t-2.5, t)}} * 1000$$

For this, we need to know the mid-year population, that is, the value of  $P_{t-2.5}$  (population 2.5 years prior to the census) which is obtained as follows:

$$P_{t-2.5} = P_t * e^{-2.5 * r}$$

where,  $P_t$  = Total population in census year 't' and 'r' is the inter-censal exponential annual growth rate.

Thus:

$$BR_{(t-5, t)} = \frac{{}_5P_0^t}{({}_5L_0/I_0) * P_t * e^{-2.5 * r}} * 1000$$

$$BR_{(t-5, t)} = \frac{{}_5P_0^t}{P_t} * \frac{e^{2.5 * r}}{{}_5L_0/I_0} * 1000, \text{ or}$$

$$BR_{(t-5, t)} = \frac{C_{(0-4)}^t * e^{2.5 * r}}{{}_5L_0/I_0} * 1000 \dots\dots\dots (1)$$

where,  $C_{(0-4)}^t$  is the proportion of population in the age group 0–4 at time 't'.

In case we are using population in the age group 0–9 years, equation (1) will become:

$$BR_{(t-10, t)} = \frac{C_{(0-9)}^t * e^{5 * r}}{{}_{10}L_0/I_0} * 1000$$

Survey data such as the district-level household survey (DLHS) or the National Family Health Survey (NFHS) can also be used to estimate birth for the corresponding years. To calculate mid-year population in survey data, one has to use household-level information where information on births comes from women. In MS-Excel exponential ( $e$ ) is written as *EXP* and natural log as *ln*. Once CBR is obtained for a district, one can also estimate TFR using regression TFR on CBR obtained empirically.

## Notes

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The following relationships are obtained using the sample registration system for 1971–2007 at the national level.

|                |                                                      |
|----------------|------------------------------------------------------|
| India          | $\ln (\text{TFR}) = -3.324 + 1.373 \ln (\text{CBR})$ |
| Madhya Pradesh | $\ln (\text{TFR}) = -3.741 + 1.484 \ln (\text{CBR})$ |
| Orissa         | $\ln (\text{TFR}) = -3.504 + 1.418 \ln (\text{CBR})$ |
| Rajasthan      | $\ln (\text{TFR}) = -3.583 + 1.450 \ln (\text{CBR})$ |
| Uttar Pradesh  | $\ln (\text{TFR}) = -2.834 + 1.252 \ln (\text{CBR})$ |
| Bihar*         | $\ln (\text{TFR}) = -2.695 + 1.213 \ln (\text{CBR})$ |

\*Based on 1981–2008 SRS estimates. Regression line for Chhattisgarh and Jharkhand cannot be developed due to unavailability of data. Therefore, to calculate TFR from birth rate for Chhattisgarh and Jharkhand, one can use the regression line given for Madhya Pradesh and Bihar respectively.

**Illustration:** To understand the reverse survival method of estimating birth rate, Madhya Pradesh has been taken as an example and the method is explained in the following steps:

**Step I:** First it is necessary to calculate  $S_{0-4}$ . In the absence of a district life table, one can assume that the district survival ratio  $S_{0-4}$  is similar to the state's survival ratio. Therefore, using SRS life table for 1998–2002, appropriate to birth during the one year preceding the census:

## Notes

$$\begin{aligned}
 L_{0-4} &= L_{0-1} + L_{1-4} \\
 &= 93171 + 342442 \\
 &= 435613 \\
 S_{0-4} &= 435613 / (5 * 100000)
 \end{aligned}$$

*Note:* Ideally one should borrow the value of  $L_{0-1}$ ,  $L_{1-4}$  from the district specific life table.

**Step II:** Estimated average annual births ( $B_{1996-2001}$ ), in the five years preceding the census date is:

$$\begin{aligned}
 B_{1996-2001} &= (1/5) * \{7368736 / [435613 / (5 * 100000)]\} \\
 &= 1691579
 \end{aligned}$$

**Step III:** To obtain birth rate during five years preceding the census ( $BR_{1996-2001}$ ), one can write:

$$BR_{1996-2001} = (B_{1996-2001} / P_{1998.5}) * 1000$$

where,  $P_{1998.5}$  is the population at mid-point of 1996–2001 and therefore can be calculated from prior knowledge of exponential interpolation:

$$P_{1998.5} = P_{2001} * \text{Exp} (-2.5 * r)$$

where, 'r' is the inter-censal annual exponential growth rate between 1991 and 2001 censuses.

For Madhya Pradesh 'r' is calculated as 0.01951 and hence:

$$\begin{aligned}
 P_{1998.5} &= 60348023 * \text{Exp} (-2.5 * 0.01951) \\
 &= 57475179
 \end{aligned}$$

then,

$$BR_{1996-2001} = 1691579 * 1000 / 63364463$$

$$BR_{1996-2001} = 29.43 \text{ per thousand}$$

Similarly, birth rate based on births during the whole inter-censal period (population 0–9 years) can be estimated.

### 3.4.2 Regression Methods for Fertility Estimation based on Birth Order Statistics

Most sources that collect total births also collect information on birth order. In other words, total births are distributed by order of birth. Empirically it has been observed that there is a very high correlation between fertility rates (CBR, TFR) and birth order distribution. Percentage of births of order one and two is negatively related to TFR.

Birth order information is also available in the Civil Registration System (CRS). Under the assumption that registration of births is not related to the order of child, the percentage of first and second order births (PFSB) are useful indicators of fertility. Data on birth order have been made available in the census at the district level since 1981. This information is used by many researchers to estimate fertility measures using simple regression technique. The general form of linear regression technique is as follows:

$$TFR_i = \alpha + \beta_i * PFSB_i + e_i$$

where,  $i = 1, 2, \dots, n$ , ' $\alpha$ ' is constant and  $\beta_i$  is slope

#### Notes

In simple words, slope can be defined as per unit change in dependent variable (TFR) due to unit change in independent variable (PFSB), where,  $PFSB_i$  shows the percentage of first and second order births in  $i^{th}$  district, and  $e_i$  is the residual or deviation between observed and estimated fertility rates for a given district.

In the past, estimating fertility using PFSB was attempted by Brass<sup>6</sup>, Bhat<sup>7</sup> and Ram *et al.*<sup>8</sup>. The most recent method by Ram *et al.*<sup>9</sup>, is presented below. The method used the percentage of the first and second order births as independent variables to estimate the total fertility rate from the 1981 and 1991 censuses and developed a set of regression equations symbolically shown as:

(a) Linear  $TFR = \alpha + \beta * PFSB + e$

(b) Exponential  $TFR = e^{(\alpha + \beta * PFSB + e)}$

where, ' $\alpha$ ' is a constant and ' $\beta$ ' is the regression coefficient, 'PFSB' is the percentage of the first and the second order births to total births, and 'e' is the error term.

A rigorous analysis revealed that the relationship is better modelled by the exponential function rather than by the linear (Ram *et al.*)<sup>10</sup>. Using the percentage of first and second order births as independent variables and  $\ln(TFR)$  as a dependent variable, one can compute the value of constants ' $\alpha$ ' and ' $\beta$ '.

<sup>6</sup> Brass, William, 1971, 'On the Scale of Mortality', in W. Brass (eds.), *Biological Aspect of Demography*, Taylor and Francis, London.

<sup>7</sup> Bhat, P.N. Mari, 2004, *Some Indirect Methods for Estimation of Fertility and Contraceptive Use at District Level*, Population Research Centre, Institute of Economic Growth, New Delhi.

<sup>8</sup> Ram F., Chander Shekhar and S. Mohanty, 2005, *Human Development: strengthening district level vital statistics in India*, International Institute for Population Sciences, Mumbai.

<sup>9</sup> *Ibid*, 8.

<sup>10</sup> *Ibid*, 8.

Using information from three consecutive censuses from 1981 to 2001, an estimate of TFR can be made directly, using the following formula:

$$\text{TFR} = 12.2675 * [\text{EXP} (-0.0221 * \text{PFSB})]$$

where, PFSB is the percentage of total births that are of the first or the second order.

The regression relationships may be obtained on the national basis or for individual states and districts. The coefficients may vary slightly from (state to state) those given above, depending on the data used to estimate the coefficients.

This methodology has been developed keeping in view the following:

- Statistics on birth order even at the district level are readily available in the census or the civil registration system
- The method does not require estimation/use of any mortality component
- The method is free from age-misreporting in younger age-groups
- The method does not require specialised technical skills for estimation, and therefore, it is easy to understand and use by district level managers

## Notes

In case there is under-reporting or under-registration of births, it is believed that the ratio may hardly be affected. Preference is given to the use of exponential relationships to carry out fertility estimation at the district level, as the variability is relatively higher for an exponential than for a linear one. There exists an inverse relationship between the percentage of first and second order births (PFSB) and TFR, that is, as PFSB increases TFR is likely to decrease. Table 3.6 provides the district level TFR estimates based on PFSB using the exponential relationship in the 2002–04 DLHS.

**Table 3.6: Total Fertility Rate based on the Percentage of First and Second Order Births for Madhya Pradesh and its Convergence Districts, 2001**

| District              | PFSB (2001) | TFR (2001) |
|-----------------------|-------------|------------|
| Chhatarpur            | 38.7        | 5.6        |
| Mandla                | 53.8        | 3.8        |
| Rajgarh               | 55.4        | 3.7        |
| Satna                 | 45.3        | 4.7        |
| West Nimar (Khargone) | 47.7        | 4.3        |
| Madhya Pradesh        | 50.6        | 4.0        |

Source: Office of the Registrar General of India and Census Commissioner, Census of India, 2001, Fertility Tables: F-9, Registrar General and Census Commissioner for India, New Delhi.

## 3.5 Mortality and Morbidity: Concepts and Measures

### 3.5.1 Measuring Mortality

#### Crude Death Rate (CDR)

Crude Death Rate (CDR) is the number of deaths (D) in a given year and a given area per thousand mid-year (average) population (P) in the same year and area (Table 3.7):

$$\text{CDR} = \frac{D}{P} * 1000$$

*Note:* It is called CDR because mortality is affected by the age composition of the population. Therefore, CDR should not be used to compare the levels of mortality in two populations if the age-sex composition of the populations differs widely.

**Table 3.7: Crude Death Rate of India and Selected States, 2008**

| India/States   | Crude Death Rate |       |       |
|----------------|------------------|-------|-------|
|                | Total            | Rural | Urban |
| India          | 7.4              | 8.0   | 5.9   |
| Bihar          | 7.3              | 7.4   | 6.0   |
| Chhattisgarh   | 8.1              | 8.5   | 6.4   |
| Jharkhand      | 7.1              | 7.5   | 5.2   |
| Madhya Pradesh | 8.6              | 9.4   | 6.0   |
| Orissa         | 9.0              | 9.4   | 6.9   |
| Rajasthan      | 6.8              | 7.0   | 6.1   |
| Uttar Pradesh  | 8.4              | 8.8   | 6.6   |

Source: Same as Table 3.2.

### Age-Specific Death Rate (ASDR)

Age-Specific Death Rate (ASDR) is the number of deaths per thousand population in a specified age group, in a given year and geographical area:

$$ASDR = \frac{{}_nD_x}{{}_nP_x} * 1000$$

where,  ${}_nD_x$  is the total deaths in a given age group 'x' to x+n

${}_nP_x$  is the total mid-year population in that age group

Generally, in most of the exercises and analyses, ASDR should be calculated separately by sex, as male and female death rates differ widely. In theoretical work, ASDR is presented by  ${}_nM_x$ , which is also called central death rate, where the multiplier 1000 is not used. This is a basic input to construct the life table of any population. In most places which provide mortality estimates by age group, ASDRs are given for 0–1 and 1–4 years age groups, because risk factors in these two age groups are very different and a high proportion of deaths under-five are concentrated in infancy.

$$ASDR (5-9) = \frac{\text{Number of deaths in the age group 5-9 in a year and geographical area}}{\text{Mid-year population (5-9)}} * 1000$$

*Note:* If the line graph drawn between ASDR at y-axis and age at x-axis shows a J-shape pattern for developed countries and a U-shape pattern for developing countries, it is because mortality rates are comparatively higher during early childhood in developing countries. Given the high mortality during infancy and early childhood, a number of rates have been defined for the segments of early life. These are listed below.

### Infant Mortality Rate (IMR)

Infant Mortality Rate (IMR) is defined as the number of infants dying under one year of age in a year in a given geographical area per thousand live births in the same year and geographical area. It is a good indicator of the health status of a given area or population, since it tends to reflect the population's socio-economic condition and status of health services. It can be calculated as follows:

$$IMR = \frac{\text{Number of deaths of infants under age 1 in a given year and area}}{\text{Total live births in same year and area}} * 1000$$

### Notes

### Still Birth Rate (SBR)

Still Birth Rate (SBR) is defined as the number of still births per total births (live births and still births) in one year in a defined geographical population and is given by:

$$\text{SBR} = \frac{\text{Number of still births in a given year and geographical area}}{\text{Number of (live births + still births) in that year and area}} * 1000$$

According to SRS (2008), still birth rate is eight per thousand births in India (Madhya Pradesh: 7; Chhattisgarh: 15; Orissa: 13; Rajasthan: 10; Uttar Pradesh: 9). This indicator can be calculated annually from HMIS data for district estimates of still birth rate.

### Neonatal Mortality Rate (NMR)

Neonatal Mortality Rate (NMR) is defined as the number of infants dying within four weeks or 28 days (in first month) of life in a year and geographical region, per thousand live births in the same year and geographical region and is given by:

$$\text{NMR} = \frac{\text{Number of deaths of infants up to 4 weeks in a given year and area}}{\text{Number of live births in given year and area}} * 1000$$

### Early Neonatal Mortality Rate (ENMR)

Early Neonatal Mortality Rate (ENMR) is defined as the number of infant deaths during the first seven days of life in a year and geographical region per thousand live births in the same year and geographical region and is given by:

$$\text{ENMR} = \frac{\text{Number of deaths of infants in first week of life in a given year and geographical area}}{\text{Total live births in that year and area}} * 1000$$

### Perinatal Mortality Rate (PMR)

Perinatal Mortality Rate (PMR) is defined as the number of still births/late foetal deaths (after 28 weeks of gestation), plus deaths within the first week of life in a year and geographical region per thousand births (live and still) in a year and geographical region and is given by:

$$\text{PMR} = \frac{\text{Number of deaths after 28 weeks of gestation + deaths of newborns within 7 days in a given year and area}}{\text{Number of (live births + still births) in that year and area}} * 1000$$

### Post Neonatal Mortality Rate (PNMR)

Post Neonatal Mortality Rate (PNMR) is defined as the number of infant deaths between 4 weeks and 52 weeks of age per thousand live births in a given year and is given by:

$$\text{PNMR} = \frac{\text{Number of infant deaths between 4 weeks and 52 weeks of age in a given year and area}}{\text{Total number of live births in a given year and area}} * 1000$$

**Remember that IMR = NMR + PNMR (Table 3.8).**

### Child Mortality Rate (CMR)

**The Child Mortality Rate (CMR) is actually ASDR for the age group 1–4 years.** It is defined as the total number of deaths of children in the 1 to 4 year age-group, in a given year and geographical region, per thousand population of that geographical area and in that year:

$$\text{CMR} = \frac{\text{Total number of child deaths between ages 1 to 4 years in a given year and area}}{\text{Total Population between ages 1 to 4 years in that year and area}} * 1000$$

Estimates for IMR and CMR at the state level are provided annually by the Sample Registration System.

### Under-five Mortality Rate (U5MR)

Under-five Mortality Rate (U5MR) is the probability of death before completing five years of age. It is denoted by  $q(5)$  and is obtained from the life table as:

$$U5MR = 1 - (I_5/I_0)$$

Sometimes we estimate probability of death before ages 2, 3, or 5, denoted by  $q(2)$ ,  $q(3)$ , and  $q(5)$ , respectively, indirectly using data on children ever-born and children surviving. Here  $q(5)$  is nothing but the U5MR. In case IMR ( ${}_1q_0$ ) and child mortality ( ${}_4q_1$ ) are given, U5MR can be calculated.

Therefore,

$$\begin{aligned} p_1 &= 1 - {}_1q_0 \\ p_2 &= 1 - {}_4q_1 \\ {}_5p_0 &= p_1 * p_2 \\ {}_5q_0 &= 1 - {}_5p_0 \\ &= 1 - p_1 p_2 \end{aligned}$$

The IMR and U5MR rates are considered the most important indicators of development. The Millennium Development Goals (MDGs), the Eleventh Five-Year Plan and the National Rural Health Mission (NRHM) goals, have all set targets to reduce infant and child mortality. The MDG target is to reduce IMR and U5MR by two-thirds by 2015, as compared to 1990.

**Figure 3.2: Time Reference for Mortality in Childhood and Infancy**

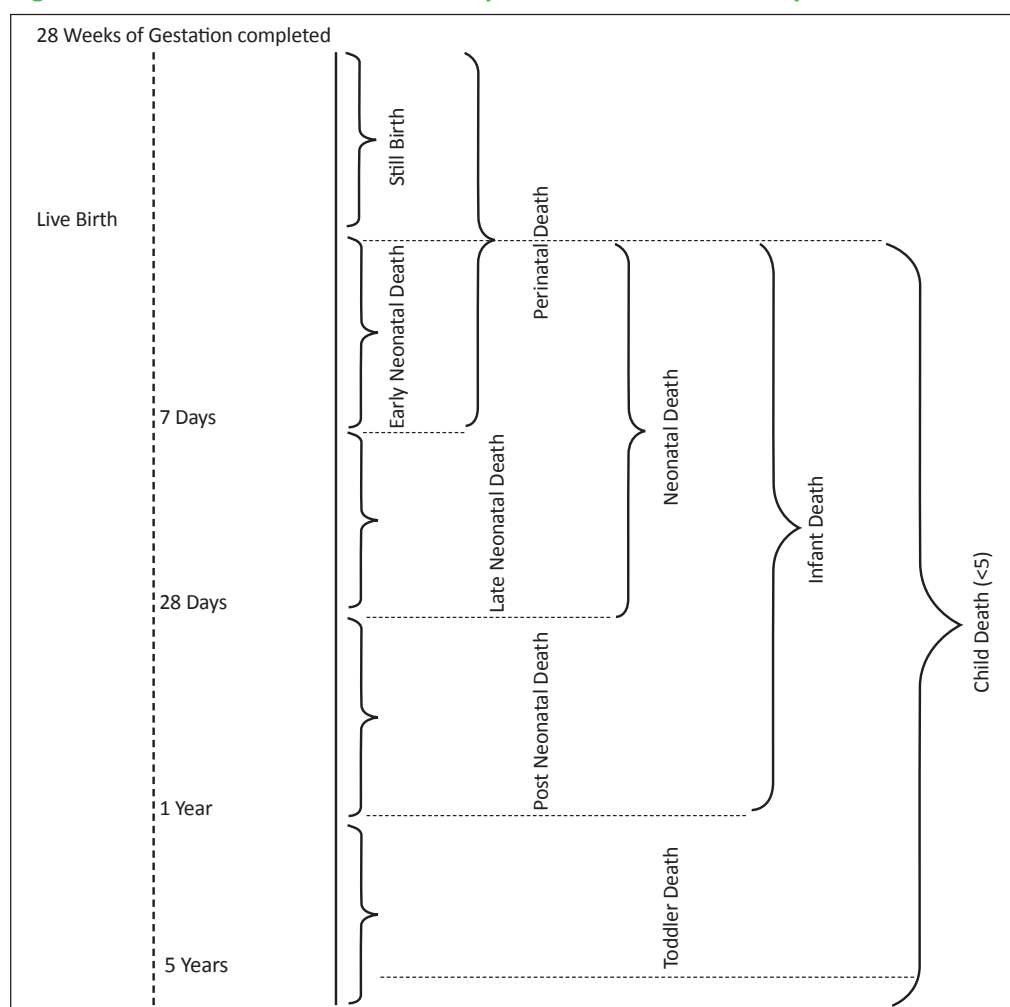


**Table 3.8: Infant Mortality Rate, Child Mortality Rate, Neonatal Mortality, Post-Neonatal Mortality, Perinatal Mortality and Still-birth in India and Selected States, 2008**

| India/States   | IMR | CMR | NMR | PNMR | PMR | SBR |
|----------------|-----|-----|-----|------|-----|-----|
| India          | 53  | 16  | 35  | 18   | 35  | 8   |
| Bihar          | 56  | 19  | 32  | 24   | 27  | 0.5 |
| Chhattisgarh   | 57  | 17  | 39  | 28   | 51  | 15  |
| Jharkhand      | 46  | 14  | 25  | 21   | 26  | 2   |
| Madhya Pradesh | 70  | 24  | 48  | 22   | 45  | 7   |
| Orissa         | 69  | 20  | 47  | 22   | 47  | 13  |
| Rajasthan      | 63  | 19  | 43  | 20   | 43  | 10  |
| Uttar Pradesh  | 67  | 22  | 45  | 22   | 42  | 9   |

Source: Same as Table 3.2.

### Life Expectancy at Birth

Life expectancy or expectation of life at birth is the most commonly used measure of mortality (or survival). This is obtained from the life table which can be constructed from the age-specific death rates in a cohort or period (*for details see Chapter 6*).

## Notes

### 3.5.2 Measuring Morbidity

#### Incidence Rate

It is defined as the number of NEW cases of specified diseases occurring in a defined population during a specified period of time. It is given by the formula:

$$\text{Incidence Rate} = \frac{\text{Number of new cases of specified disease during a given time period}}{\text{Population at risk}} * 1000$$

#### Prevalence Rate

It is defined as the number of all current cases (NEW and OLD) of a disease at one point of time in relation to a defined population. It is given by the formula:

$$\text{Prevalence rate} = \frac{\text{Number of new cases and old cases of specified disease existing at a given point in time}}{\text{Estimated population at the same point in time}} * 1000$$

#### Case Fatality Rate

It is the ratio of number of deaths due to a particular disease to total cases of that particular disease. Case Fatality Rate is typically used in acute infectious diseases (for example, food poisoning, cholera, measles) and is defined as:

$$\text{Case Fatality Rate} = \frac{\text{Total deaths due to a particular disease}}{\text{Total reported cases due to the same disease}} * 100$$

Its usefulness in measuring chronic diseases is limited, because the period from onset to death is long and variable. Case Fatality Rate for the same disease may vary in different epidemics because of changes in the agent, host and environmental factors.

### 3.6 Indirect Estimation of Mortality

A number of techniques have been developed to estimate the level of mortality using censuses and surveys data, such as age distribution and number of children ever-born and surviving. An important and useful technique developed initially by Brass<sup>11</sup>, later modified and refined, allows estimation of childhood mortality from tabulations of children ever-born (CEB) and surviving by age of women. The details are as follows:

#### Brass Method

Brass was the first to develop a procedure for converting proportions of dead CEB reported by women in the age-group 15–19, 20–24, etc. into estimates of the probability of dying before attaining certain exact childhood ages. He developed a set of multipliers for converting the statistics on the proportion of children dead ( $D_i$ ) among the total CEB to women in the reproductive ages ('i' refers to age group of women, where 'i' = 1 for the age group 15–19 years, 'i' = 2 for 20–24 and so on) into estimates of the probability of dying before attaining exact childhood age x,  $q(x)$ , where  $q(x) = 1 - l(x)/l(0)$ , the probability of dying between birth and exact age 'x'.  $l(x)$  is the number of persons surviving to exact age 'x' and  $l(0)$  is the initial size of the cohort. The multipliers were selected according to the value of  $P(1)/P(2)$ , which is a good indicator of the age patterns of fertility at younger ages, where  $P(i)$  is the average parity or average number of children ever-born reported by women in the  $i^{\text{th}}$  age-group.

#### Data Requirements

1. Mean CEB and mean CS by five-year age group (denominator for mean is total women)
2. Mean age at childbearing
3. Month and year of survey (or census)

#### Method

The basic form of the estimation equation is:

$$q(x) = K_i * D_i \dots\dots\dots(1)$$

where, 'i' is the age group of the women, 1 for ages 15–19, 2 for 20–24, ..., 7 for 45–49

'x' is the age of the child which depends on the age group of women, and equals 1, 2, 3, 5, 10, 15 and 20 for age groups 'i' = 1, 2, ...7 respectively

$q(x)$  denotes the probability of dying between birth and exact age 'x'

$D_i$  denotes the proportion of children dead among CEB to women in the  $i^{\text{th}}$  age group

$K_i$  is the constant (meant to adjust for non-mortality factors determining the value of  $D_i$ ).

Brass found that the relation between the proportion of children dead ( $D_i$ ) and a life table mortality measure  $q(x)$  was primarily influenced by the age pattern of fertility, because it is this pattern that determines the distribution of the children of a group of women by length of exposure to the risk of dying. Brass gave values of the  $K_i$  multipliers for different values of  $P(1)/P(2)$  (*UN Manual X*)<sup>12</sup>.

<sup>11</sup> Brass, W. and Others, 1968, *The Demography of Tropical Africa*, Princeton University Press.

<sup>12</sup> *Ibid.*, 3.

#### Notes

### Assumptions

1. The risk of a child's dying is a function of only the age of the child and not of any other factor (women's age or child's birth order, for example).
2. The ASFRs and ASMRs have remained constant for the particular age range and the period.
3. There is no strong relation between the mortality of women and their children. The percentage of omission of surviving children is the same as that for the CEB.

In practice, however, it has been noted that the children of young and old mothers experience relatively higher mortality risks compared to others. For this reason, the IMR estimate derived from the equation (1) given above, based on the proportion of children dead for women aged 15–19 years, often yields higher levels of child mortality than the estimates based on the children of middle-aged women. Therefore, the mortality estimates derived from the children of women aged 15–19 are generally disregarded in part, for this reason as well as for the reason that the number of children born and dead among these women is usually fewer.

### Brass Method Modifications

Sullivan<sup>13</sup> developed Brass-type multipliers by using the empirical fertility schedule and regression technique combined with Coale-Demeny model life tables<sup>14</sup>. He provided two types of multipliers, one relating to age-group (20–24, 25–29 and 30–34) and another by duration of marriage (0–4, 5–9 and 10–14). The multiplier of age model is recommended for use in the Indian context as data on duration of marriage is either not available or not reliable.

Trussell<sup>15</sup> generated a third set of multipliers using three-parameter model fertility schedules given by Coale and Trussell<sup>16</sup> and the Coale-Demeny model life tables<sup>17</sup>. The basic concept and assumptions are the same in all the three methods. In 1985, another set of multipliers have also been generated by Palloni and Heligman<sup>18</sup> by using UN Model life tables for developing countries. The United Nations software package for mortality measurement MORTPAK, provides estimates of  $q(x)$  under various model life tables.

### Limitations

It has been observed that the accuracy of the estimates obtained by using any of the procedures mentioned above depends on the pace of mortality change, onset of childbearing and the age of children. The error is larger when childbearing starts early and the child is older (above age 5, i.e.  $q(10)$ ,  $q(15)$  etc.). Further, it is observed that decline in mortality affects the estimate more than decline in fertility. In addition to the assumptions made, the quality of data also affects the estimates of infant and child mortality.

<sup>13</sup> Sullivan, J. M. 1972., 'Models for the Estimation of the Probability of Dying between Birth and Exact Ages of Early Childhood', *Population Studies*, 26(1), March, pp. 79–97.

<sup>14</sup> Coale, A.J. and P. Demeny, with B. Vaughan, 1983, *Regional Model Life tables and Stable Populations*, Academic Press, New York.

<sup>15</sup> Trussell, J. 1975, 'A Re-examination of the Multiplying Factors for Brass Technique for Determining Childhood Survivorship Rates', *Population Studies*, 29(1), pp. 97–107.

<sup>16</sup> Coale, A.J. and Trussell, J. 1974, 'Model Fertility Schedules, Variation in the Age Structure of Childbearing in Human Population', *Population Index*, 40(2).

<sup>17</sup> *Ibid.*, 14.

<sup>18</sup> Palloni, A. and L. Heligman, 1985, 'Re-estimation of Structural Parameters to Obtain Estimates of Mortality in Developing Countries', *Population Bulletin of the United Nations*, 18, United Nations Publications, Sales No. E.85.XIII.6, pp. 10–33.

### Notes

The estimate based on data from 15–19 age-group,  $q(1)$  seems to be unreliable. Generally,  $q(2)$ ,  $q(3)$  and  $q(5)$ , are taken as reliable estimates of mortality and  $q(1)$  is extrapolated from these values;  $q(2)$  being the probability of dying before the age of two and so on.

The infant and child mortality rates estimated from the reported number of surviving children among CEB are cumulative rates and are free from errors of the reference periods which otherwise affect validity of the estimates of current death rates. Besides, as data on surviving CEB are tabulated by district, by rural and urban areas, and by sex, it is possible to estimate early childhood mortality including the U5MR rate for each district by sex. At the state level, estimates by certain socio-economic characteristics (education of mother, religion, scheduled caste/tribe membership, and work status) are also possible. The Office of the Registrar General of India (RGI) has been providing such estimates after every census since 1981.

**Illustration:** IMR ( ${}_0q_1$ ), child mortality ( ${}_4q_1$ ) and under-5 mortality (U5MR) have been calculated for Chhatarpur district of Madhya Pradesh using the Brass method on 2001 census data. Total children ever born, total children surviving and total number of women by age are F–1 and F–5 fertility series provided in the 2001 Census for Chhatarpur district (Table 3.9). The original column numbers are preserved in Table 3.7 to make the figure traceable in electronic data provided by the RGI's office and by the Census Commissioner. Average CEB and average children surviving are calculated using the figures in Table 3.9.

## Notes

**Table 3.9: Total Children Ever Born and Total Children Surviving, Chhatarpur, Madhya Pradesh, 2001**

| Age Group | Number of Women | No. of Children Ever Born | Average No. of CEB | No. of Children Surviving | Average No. of Children Surviving |
|-----------|-----------------|---------------------------|--------------------|---------------------------|-----------------------------------|
| 15–19     | 55,820          | 10,937                    | 0.196              | 9,248                     | 0.166                             |
| 20–24     | 57,624          | 79,549                    | 1.380              | 69,144                    | 1.200                             |
| 25–29     | 51,485          | 148,641                   | 2.887              | 128,368                   | 2.493                             |
| 30–34     | 47,594          | 191,421                   | 4.022              | 162,474                   | 3.414                             |
| 35–39     | 39,136          | 183,148                   | 4.680              | 152,407                   | 3.894                             |
| 40–44     | 30,562          | 158,445                   | 5.184              | 128,653                   | 4.210                             |
| 45–49     | 25,792          | 141,188                   | 5.474              | 111,884                   | 4.338                             |

Source: Office of the Registrar General of India and Census Commissioner, Census of India, 2001, Fertility Tables: F–1, F–5, Registrar General and Census Commissioner for India, New Delhi.

## Steps for calculating IMR ( ${}_0q_1$ ), child mortality ( ${}_4q_1$ ) and life expectancy ( $e^0$ )

**Step I:** First, we need to calculate mean age at child bearing (MAC), for which the following formula can be used:

$$\text{MAC} = \frac{17.5 * \text{ASFR (15-19)} + 22.5 * \text{ASFR (20-24)} + 27.5 * \text{ASFR (25-29)} + 32.5 * \text{ASFR (30-34)} + 37.5 * \text{ASFR (35-39)} + 42.5 * \text{ASFR (40-44)} + 47.5 * \text{ASFR (45-49)}}{\text{ASFR (15-19)} + \text{ASFR (20-24)} + \text{ASFR (25-29)} + \text{ASFR (30-34)} + \text{ASFR (35-39)} + \text{ASFR (40-44)} + \text{ASFR (45-49)}}$$

Once MAC is calculated, we can provide input in the CEBCS module of MORTPAK (a software developed by the United Nations) or Q5 (developed by the US Census Bureau). In the case of Chhatarpur, we obtained the value of MAC as 23.4 years for the data provided in Table 3.9.

**Step II:** Inputs needed are Year and Months of Census/Survey, value of MAC and data being used (whether births are tabulated by mother's age or duration of marriage). We have to input the value of average children ever born and average children surviving by age of mother/duration of marriage.

**Step III:** Once we click run, the module will provide the results. It is important to know which life table is appropriate for a district. In general, for a high mortality region, we assign South Asian, UN Model life tables. In the case of providing values for  ${}_0q_1$ ,  ${}_4q_1$  and life expectancy, one should take the average of the values for two age groups 20–24 and 25–29. It is recommended that we ignore the estimate of  $q(1)$  obtained from the age group 15–19 since this represents the mortality of the children of very young mothers, which is unusually high. To get the value of mortality rate for the under 1 year age group per thousand, one has to multiply the obtained value by 1000. Thus, UMR, IMR and life expectancy for Chhatarpur district of Madhya Pradesh are 103 per thousand, 62 per thousand and 57.2 years, respectively.

*Note:* The estimates are not very sensitive to MAC. One can also estimate all the three mortality indicators separately for male/female and social groups (SCs/STs/Others) in a similar fashion, as data for these subgroups at the district level are available in the census.

These rates can be calculated using any recent data such as DLHS (2007–08). However, to estimate rates below district-level requires a sufficiently large sample. The rates obtained from the census are referred to one prior to the enumeration date. It is also difficult to decide the pattern of model life table when the mortality situation differs across districts. Therefore, one has to be extremely careful while using this method to estimate the probability of dying as the mortality pattern cannot be assumed to be the same for a developed district and a backward one.

*Note:* In the absence of the required software, the use of DEMOTECH can provide fairly good estimates of  $q(2)$ ,  $q(3)$  and  $q(5)$ .

### 3.7 Summary

- Distinction between a ratio and a rate has been made clear.
- Basic fertility and mortality measures, which have definite implications for the planning processes are defined and their interpretations are provided along with the computation procedure.
- Indirect methods are to be applied when the indicators cannot be calculated directly from the available sources of data. Both direct and indirect methods are illustrated in this chapter.
- All possible data sources, which provide numerators and denominators for these indicators have been mentioned.

## EXERCISES

**Exercise 1:** From the given census data, 2001 (Fertility Table, Series F9) below, calculate ASFR and TFR (by direct method) for Chhatarpur District, Madhya Pradesh.

**Exercise 2:** Also, calculate TFR (by indirect method using birth order statistics given from census data, 2001 (Fertility Table, Series F9).

**Table 3.A: Number of Births Last Year by Sex and Birth Order for Chhatarpur District, Madhya Pradesh**

| Chhatarpur |             |                            |         |                           |      |      |      |      |      |      |
|------------|-------------|----------------------------|---------|---------------------------|------|------|------|------|------|------|
| Age        | Total Women | Number of Births Last Year |         | Order of Births Last Year |      |      |      |      |      |      |
|            |             | Males                      | Females | 1                         | 2    | 3    | 4    | 5    | 6    | 7+   |
| 15–19      | 55820       | 1690                       | 1534    | 2444                      | 613  | 116  | 51   | 0    | 0    | 0    |
| 20–24      | 57624       | 6851                       | 5995    | 4781                      | 4343 | 2430 | 867  | 265  | 69   | 91   |
| 25–29      | 51485       | 5753                       | 5007    | 1214                      | 2134 | 2808 | 2370 | 1277 | 586  | 371  |
| 30–34      | 47594       | 3692                       | 3331    | 266                       | 573  | 1035 | 1460 | 1396 | 1129 | 1164 |
| 35–39      | 39136       | 1924                       | 1728    | 66                        | 152  | 307  | 483  | 655  | 664  | 1325 |
| 40–44      | 30562       | 907                        | 905     | 39                        | 44   | 116  | 198  | 252  | 276  | 887  |
| 45–49      | 25792       | 471                        | 526     | 23                        | 36   | 85   | 119  | 121  | 166  | 447  |

Source: Registrar General, India, (Census of India, 2001), *Fertility Tables, Series F9, Number of Births Last Year by Sex and Birth Order, 2001*, Office of Registrar General & Census Commissioner, India.

**Exercise 3:** Calculate crude birth rate using Reverse Survival Method based on Census Data, 2001.

**Table 3.B: Total and Child Population of Chhatarpur District, Madhya Pradesh**

| Chhatarpur                               |          |         |        |
|------------------------------------------|----------|---------|--------|
| Reverse Survival Method                  |          |         |        |
| Population                               | Combined | Rural   | Urban  |
| Total Population, 2001                   | 1474723  | 1150428 | 324295 |
| Total Population, 1991                   | 1158076  | 934552  | 223524 |
| Population aged (0–4) years, 2001        | 197553   | 160629  | 36924  |
| Population aged (5–9) years, 2001        | 213370   | 171328  | 42042  |
| * $e_0^0$ (LEB), Madhya Pradesh, 2002–06 | 58.0     | 56.6    | 65.1   |
| * $L_{0-4} = (L_{0-1} + L_{1-4})/100000$ | 4.43     | 4.38    | 4.63   |

Source: Registrar General, India, 2007, *General Population Tables, Series A, Total Population by Sex and Residence, 2001*, Office of Registrar General & Census Commissioner, India.

Note: Combined, rural, urban population is taken from 1991 and 2001 Census. Population aged (0–4) and (5–9) should be taken from 2001 Census.

\* $e_0^0$  (LEB) and  $L_{0-4}$  are taken from SRS Abridged Life Table 2002–06 (State of Madhya Pradesh).

**Exercise 4:** Calculate the probability of death before age 2 and under-five mortality with the help of DEMOTECH Software. [Use F–1 (Children ever born) and F–5 (Children surviving) census data, 2001 given below.]

**Table 3.C: Total Children Ever Born and Total Children Surviving by Sex for Chhatarpur District, Madhya Pradesh**

| District Chhatarpur |             |                                |        |         |                                |        |         |
|---------------------|-------------|--------------------------------|--------|---------|--------------------------------|--------|---------|
| Present Age         | Total Women | Total Children Ever Born (F–1) |        |         | Total Surviving Children (F–5) |        |         |
|                     |             | Persons                        | Males  | Females | Persons                        | Males  | Females |
| 15–19               | 55,820      | 10,937                         | 5,589  | 5,348   | 9,248                          | 4,716  | 4,532   |
| 20–24               | 57,624      | 79,549                         | 41,211 | 38,338  | 69,144                         | 35,959 | 33,185  |
| 25–29               | 51,485      | 148,641                        | 77,173 | 71,468  | 128,368                        | 67,018 | 61,350  |
| 30–34               | 47,594      | 191,421                        | 99,368 | 92,053  | 162,474                        | 85,425 | 77,049  |
| 35–39               | 39,136      | 183,148                        | 95,641 | 87,507  | 152,407                        | 81,097 | 71,310  |
| 40–44               | 30,562      | 158,445                        | 82,874 | 75,571  | 128,653                        | 69,008 | 59,645  |
| 45–49               | 25,792      | 141,188                        | 75,052 | 66,136  | 111,884                        | 61,285 | 50,599  |

Source: Registrar General, India, (Census of India, 2001), *Fertility Tables, Series F1 & F5, Total Children Ever Born and Total Children Surviving by Sex, 2001*, Office of Registrar General & Census Commissioner, India.

**Exercise 5:** Calculate CBR and CDR for each year. Based on the results, give your comments about CRS data.

**Table 3.D: Births and Deaths Statistics for Madhya Pradesh and Convergence Districts**

| Registered Live Births and Deaths for Madhya Pradesh State and its Five Convergence Districts |                                     |        |        |         |                                     |        |        |        |
|-----------------------------------------------------------------------------------------------|-------------------------------------|--------|--------|---------|-------------------------------------|--------|--------|--------|
| State/<br>District                                                                            | Registered Births<br>(As on 1 July) |        |        |         | Registered Deaths<br>(As on 1 July) |        |        |        |
|                                                                                               | 2002                                | 2003   | 2004   | 2005    | 2002                                | 2003   | 2004   | 2005   |
| Madhya Pradesh                                                                                | 732356                              | 789985 | 981723 | 1027916 | 300382                              | 324460 | 308225 | 310299 |
| Chhatarpur                                                                                    | 24512                               | 14368  | 23684  | 17778   | 1831                                | 5335   | 5610   | 4637   |
| Mandla                                                                                        | 17304                               | 16942  | 13981  | 12726   | 2356                                | 6891   | 5321   | 4751   |
| Satna                                                                                         | 17212                               | 16806  | 20356  | 22395   | 4165                                | 9870   | 7127   | 8099   |
| Rajgarh                                                                                       | 14970                               | 14642  | 18584  | 19051   | 2529                                | 6481   | 6127   | 5230   |
| West Nimar                                                                                    | 9263                                | 13626  | 26653  | 24593   | 4682                                | 5989   | 7162   | 6527   |

Source: Registrar General, India 2009, *Vital Statistics of India based on the Civil Registration System, Special Report, 2002–05*, Office of Registrar General & Ministry of Home Affairs, New Delhi.

**Table 3E: Projected Population for Madhya Pradesh and Convergence Districts**

| State/District | Projected Population (As on 1 July) <sup>#</sup> |          |          |          |
|----------------|--------------------------------------------------|----------|----------|----------|
|                | 2002                                             | 2003     | 2004     | 2005     |
| Madhya Pradesh | 61849685                                         | 63003314 | 64178461 | 65375526 |
| Chhatarpur     | 1510146                                          | 1537338  | 1565021  | 1593202  |
| Mandla         | 913946                                           | 929051   | 944406   | 960015   |
| Satna          | 1914240                                          | 1948110  | 1982579  | 2017657  |
| Rajgarh        | 1289539                                          | 1316855  | 1344750  | 1373235  |
| West Nimar     | 1571264                                          | 1603366  | 1636123  | 1669550  |

<sup>#</sup> Projections done using census population of 2001 & 2011.

Source: 1. Registrar General, India, 2007, *General Population Tables, Series A, Total Population by Sex and Residence, 2001*, Office of Registrar General & Census Commissioner, India.

2. Registrar General, India, 2011, *Provisional Population Totals, Paper 1 of 2011, India Series 1, 2011*, Office of Registrar General & Census Commissioner, India.



# Interpolation, Extrapolation and Age Smoothing

## Learning Objectives

In this section participants will learn about interpolation, extrapolation and smoothing the age data

### 4.1 Interpolation and Extrapolation

#### 4.1.1 Point Data Interpolation

The numerator and denominator information used in estimating various demographic indicators such as birth, death and migration rates in India are essentially collected from sources such as vital registration systems, population censuses and nationally representative surveys including the Sample Registration System (SRS), District Level Household and Facility Survey (DLHS) and National Family Health Survey (NFHS). While some sources like the vital registration system provide the numerator information on a continuous basis, sources like the population census and special surveys provide the numerator/denominator information on, for instance, births and population by age and sex and the total population figures periodically, every five or ten years approximately. Sometimes the essential data collected on a particular variable (e.g. total population of a country or the age distribution of population by five-year age groups) may be defective or unavailable for a particular year/period in a time series of information collected. Often there is a need to generate information pertaining to the denominator/numerator of demographic indicators for intermediate time points, or for points beyond the last date for which information is available, say between two census years, or beyond the last census.

#### 4.1.2 Definitions

##### Interpolation and Extrapolation

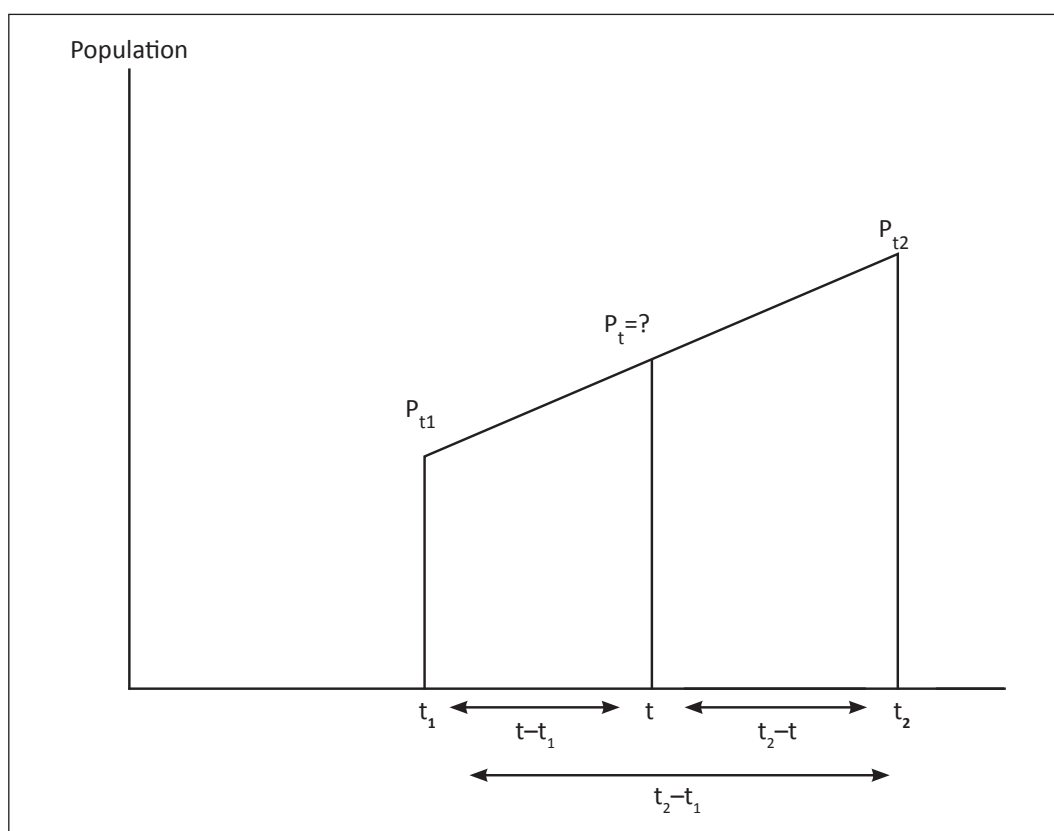
**Interpolation** is a means for generating data for intermediate time points while **extrapolation** is used for generating data beyond the time point for which data is available. Several mathematical and graphic devices are used both for interpolation and extrapolation, and also for subdividing grouped data into component parts. Suppose we have the population of Madhya Pradesh from three consecutive censuses as shown below:

**Table 4.1: Population – Madhya Pradesh, 1981–2001**

| Census Year (y) | 1981     | 1991     | 1997 | 2001     | 2008 |
|-----------------|----------|----------|------|----------|------|
| Population (p)  | 38168507 | 48566242 | ?    | 60348023 | ?    |

Source: 1. Registrar General, India, 1983, 'Social and Cultural Tables, Series II, Part IV-A, 1981', Office of Registrar General & Census Commissioner, India, New Delhi.  
 2. Registrar General, India, 1992, 'Final Population Total, Series-1, 1991', Office of Registrar General & Census Commissioner, India, New Delhi.  
 3. Registrar General, India, 2005, 'Social and Cultural Tables, Series C–13 Single Year Age Returns by Sex and Residence, 2001', Office of Registrar General & Census Commissioner, India, New Delhi.

Suppose we are interested in obtaining the population for the years 1997 and 2008. Obtaining the population for 1997 is referred to as 'interpolation', as it is between the two available values of 1991 and 2001, and obtaining the population for 2008 is referred to as 'extrapolation' as it is beyond the latest available value of 2001. It is possible to plot the known points on a two-dimensional graph; taking time on the X-axis and population on the Y-axis, drawing a smooth curve passing through the points and then reading the values on the curve corresponding to the desired time points from the graph. This method, though quite useful and often employed, is subject to judgmental error in drawing the smooth curve. Mathematical methods are, therefore, preferred and recommended.



## Notes

When populations  $P_{t1}$  and  $P_{t2}$  at two time points  $t_1$  and  $t_2$  respectively are available, we can find the population  $P_t$  at time ' $t$ ' between  $t_1$  and  $t_2$  by interpolation as shown in the above figure. The simplest method is linear interpolation, which is based on the assumption that the change in the value is linear between two points.

The value of  $P_{t1}$  is derived by linear interpolation as:

$$P_t = \theta P_{t1} + (1-\theta)P_{t2}$$

where,  $\theta = (t_2 - t)/(t_2 - t_1)$  and where  $t_1 < t_2$  are the two time points for which values of  $P_{t1}$ , and  $P_{t2}$  respectively are available, and  $t$  is between  $t_1$  and  $t_2$ .

### Example 1: (Interpolation)

Hence, to obtain the population of Madhya Pradesh for 1997 by interpolation between known populations of 1991 and 2001, we have:

$$\begin{aligned}\theta &= (2001-1997)/(2001-1991) \\ &= 4/10 \\ &= 0.4\end{aligned}$$

$$\begin{aligned}\text{then, } P_{1997} &= 0.4 * P_{1991} + (1-0.4) * P_{2001} \\ &= (0.4 * 48566242) + (1-0.4) * 60348023 \\ &= 55635310\end{aligned}$$

*Note:* The interpolated population for the year 1997 is between the population figures for 1991 and 2001.

### Example 2: (Extrapolation)

Linear extrapolation of the population at time 't' from two preceding population figures for  $t_1$  and  $t_2$ ,  $t_1 < t_2 < t$  can be obtained as follows:

$$\begin{aligned}P_t &= \beta P_{t_1} + (1-\beta)P_{t_2} \\ \text{where, } \beta &= (t_2-t)/(t_2-t_1)\end{aligned}$$

#### Notes

Applying this to obtain the population of Madhya Pradesh for 2008 by extrapolation from the available populations of 1991 and 2001 shown in Table 4.1, we have:

$$\begin{aligned}\beta &= (2001-2008)/(2001-1991) \\ &= (-7/10) \\ &= -0.7 \\ \text{then, } P_{2008} &= -0.7 * P_{1991} + (1-(-0.7)) * P_{2001} \\ &= -0.7 * 48566242 + 1.7 * 60348023 \\ &= 136588009\end{aligned}$$

*Note:* The extrapolated figure for the population for 2008 is more than that of the population for 2001.

The mean household size (MHHS) of Madhya Pradesh in 1991 and 2001 was 5.7 and 5.5 respectively. Extrapolate the MHHS of Madhya Pradesh for 2009.

Mean household size of Madhya Pradesh can be obtained using the following formula:

$$\begin{aligned}MHHS_t &= \beta * MHHS_{t_1} + (1-\beta) * MHHS_{t_2} \\ \text{where, } \beta &= (t_2-t)/(t_2-t_1) \\ MHHS &= \text{Mean Household Size}\end{aligned}$$

Applying this formula we can get MHHS for the year 2009 ( $MHHS_t$ )

$$\begin{aligned}\beta &= (2001-2009)/(2001-1991) \\ &= (-8/10) \\ &= -0.8 \\ MHHS_{2009} &= -0.8 * MHHS_{1991} + (1-(-0.8)) * MHHS_{2001} \\ &= -0.8 * 5.7 + 1.8 * 5.5 \\ &= 5.3\end{aligned}$$

So the mean size of the household of Madhya Pradesh in 2009 is 5.33.

**Interpolation** can also be done with second or higher degree polynomials and other functions such as the exponential. The number of known values required depends on the function adopted. The choice depends on which function is felt to give the best fit. The exponential curve gives good results in the case of population. First the growth rate is computed as follows:

$$r = [\ln (P_{t_2} / P_{t_1})] / (t_2 - t_1)$$

and the interpolated values for time  $t$ , between  $t_1$  and  $t_2$  are given by:

$$P_t = P_{t_2} e^{r(t-t_2)}$$

For **extrapolating** Madhya Pradesh's population to 2008 on the basis of 1991 and 2001 populations:

$$\begin{aligned} r &= [\ln(60348023/48566242)]/10 \\ &= 0.02171 \end{aligned}$$

and the extrapolated population in 2008 is:

$$\begin{aligned} P_{2008} &= 60348023 * e^{[0.02171*(2008-2001)]} \\ &= 60348023 * e^{(1.164125)} \\ &= 60348023 * 1.164125 \\ &= 70252661 \end{aligned}$$

## Notes

This is actually a mathematical projection using the exponential curve.

Note that there is some difference between the extrapolations using the linear and the exponential functions. In the case of populations, the exponential curve is preferred as population growth is well modelled by it. For short intervals, the linear interpolation and extrapolations are fairly satisfactory; otherwise a more appropriate growth curve needs to be chosen.

The methods of interpolation and extrapolation given above do not require that the interval be in full years. Often users need populations for intermediate points. The Indian census refers to 1 March of the year (2001, 1991...) and hence the projections shown above refer to 1 March of the respective years. However, if one needs the value for another date, say, 1 July, the same method applies. The time gap needs to be calculated precisely. For example, the gap between 1 July 2008 and 1 March 2001 is seven years and four months, that is, 7.3 years.

### 4.1.3 Grouped Data Interpolation (Division of Population into Sub-groups of Age)

Often we get the age distribution of the population by five or ten-year age groups, but we need data by single years of age. For example, projections are generally available in five-year age groups, but to estimate school enrolments at different stages, there is a need to know the population in specific single ages, say 6, 7, 8....14, 15 and so on. For interpolation into single years, it is usually assumed that 'the observed pattern of the distribution of grouped data is also valid for within age groups', that is, a smooth curve passes through the given age group and neighbouring groups. This problem may be solved by applying the method of pro-rating, the graphic method or some mathematical methods, as in the case of point data interpolation.

The fitting of polynomials to age distribution is good in principle, but very cumbersome in practice. However, some statisticians have provided sets of multipliers that can be applied to the population in the age group under reference and in neighbouring age groups, so as to yield populations in single years of age. Some common methods are those by Karup-King, Sprague and Beers, which used oscillatory interpolation formulae. Thus the procedure is made very simple. In Appendix X of 'The Methods and Materials' of Shyrock and Siegel (2004) several sets of multipliers for point interpolation are presented. This is explained by an example of how to apply the Sprague fifth-difference formula. The Sprague multipliers give panels separately for the first age group (0-4), the second age group (5-9), middle age groups (10-14, 15-19, 20-24...) and again for the last two age groups<sup>1</sup>.

**Example:** The following is the five-year age group data for males in India for the year 2001.

**Table 4.2: Male Indian Population in Five-year Age Groups, 2001**

| Age Group | Population |
|-----------|------------|
| 0-4       | 57,120     |
| 5-9       | 66,735     |
| 10-14     | 65,633     |
| 15-19     | 53,940     |
| 20-24     | 46,321     |
| 25-29     | 41,558     |
| 30-34     | 37,362     |
| 35-39     | 36,039     |

Source: Registrar General, India, 2005, 'Social and Cultural Tables, Series C-13, Single Year Age Returns by Sex and Residence, 2001', Office of Registrar General & Census Commissioner, India, New Delhi.

Using this data and the Sprague multipliers for grouped data for the sub-division of groups into fifths (see Sprague Multipliers, p. 84 ), one can estimate the population corresponding to single ages: 2, 8, 18, 31 and 38 denoted by  $P_2 \dots P_{38}$  as follows:

$$\begin{aligned}
 P_2 &= 57120 * (.184) + 66735 * (.040) + 65633 * (-.032) + 53940 * (.008) \\
 &= 11511 \\
 &\text{(Use third row of first panel as 2 falls in the first age group)}
 \end{aligned}$$

$$\begin{aligned}
 P_8 &= 57120 * (-.016) + 66735 * (.184) + 65633 * (.040) + 53940 * (-.008) \\
 &= 13559 \\
 &\text{(Use fourth row of second panel as 8 falls in the second age group)}
 \end{aligned}$$

$$\begin{aligned}
 P_{18} &= 66735 * (.0064) + 65633 * (-.0416) + 53940 * (.2224) + 46321 * (.0144) + 41558 * (-.0016) \\
 &= 10294 \\
 &\text{(Use fourth row of middle panel (2<sup>nd</sup> set) as 18 falls in a middle-age group)}
 \end{aligned}$$

The study population has age group 30-34 as the next-to-last age group, and the age group 35-39 as the last age group. Therefore, one should use the last two panels (given on page 85) respectively to calculate the number of persons at 31 and 38 years.

$$\begin{aligned}
 P_{31} &= 46321 * (-.008) + 41558 * (.040) + 37362 * (.184) + 36039 * (-.016) \\
 &= 7590 \\
 &\text{(Use second row of next-to-last panel since 31 is in the second to last group here)}
 \end{aligned}$$

<sup>1</sup> Siegel, J.S. and D.A. Swanson (eds.), 2004, *The Methods and Materials of Demography*, Second Edition, New York: Elsevier Academic Press, Ch. 20, p.700.

## Notes

## Notes

$$\begin{aligned} P_{38} &= 46321*(-.008) + 41558*(.040) + 37362*(-.096) + 36039*(.264) \\ &= 7219 \end{aligned}$$

(Use fourth row of the last panel as 38 falls in the last age group here)

## 4.2 Smoothing of Population by Age and Sex

Once it is known that the age structure of the given population is not accurate (it is well known that age misreporting distorts age distribution in India), one may try to adjust age data by applying one of the several smoothing techniques available. The smoothing procedure involves the application of a formula to the original data. There are two types of smoothing techniques. While one type modifies the totals, the other does not. The procedures that modify the totals may further be divided into light and strong. Of the several procedures, the strong method is commonly used in India. The strong smoothing procedure may be explained in three simple steps: (i) the given age data is grouped in ten-year age groups and then this distribution is smoothed. (ii) The results are adjusted to the census population in smoothed ages. (iii) Finally, the smoothed ten-year age groups are separated into five-year age groups<sup>2</sup>.

Note that the smoothing technique applied always depends on the knowledge of the errors occurring in the age and sex data distribution under consideration. Appraising the accuracy of the given age and sex data depends on studying the raw data through the several procedures explained earlier. The comparison of census results over time, and an understanding of the fertility, mortality and migration situation in the study population are essential in order to comprehend the process of appraising the accuracy of the given data.

Before smoothing the age data, one should take care of the 'not stated' group. The total figure of 'age not stated' is to be prorated into the given age before the age smoothing process.

### Data Requirements

Raw data on the age and sex distribution of the population under consideration over a time period (both for interpolation/extrapolation and for smoothing of the population)

### Data Sources

Censuses and surveys

### Disaggregation

For males, females, both sexes combined

### Availability

State-level and district-level and also by rural and urban areas

### Software/Worksheets to be used

For smoothing the age data, worksheet AGESMTH can be used which is available in DEMOTECH Software.

<sup>2</sup> Arriaga, E.E., 1994, *Population Analysis with Microcomputers*, Vols.I & II, New York: Bureau of the Census, USAID, and UNFPA.

### Caution

Smoothening is done on the assumption that the observed irregularities in age distribution are on account of errors. However, on occasion, say wars or major famines, mortality rises and fertility falls drastically for short periods, causing true disturbances in the age distributions. If such events have occurred in the recent past, smoothening would actually eliminate the information that the age distribution could have given about demographic processes in the past. Therefore, smoothening should be avoided if there is evidence of such major disturbances.

### Notes

## 4.3 Summary

- Interpolation, 'the art of inferring intermediate values within a given series of data by use of a mathematical formula or a graphical procedure'.
- Extrapolation, 'the art of inferring values that go beyond the given series of data', is a set of mathematical tools frequently used by demographers to derive certain data that does not exist and is of particular importance for the purpose of the study.
- There are data smoothening techniques that should be applied before using age data for further analysis.

## EXERCISES

**Exercise 1:** Interpolate the population of Madhya Pradesh and its districts for the year 2007. Also extrapolate for the year 2014.

**Table 4.A: Population of 2001 and 2011 for Madhya Pradesh and its Districts**

| State and District | Census Population |          | District    | Census Population |         |
|--------------------|-------------------|----------|-------------|-------------------|---------|
|                    | 2001              | 2011     |             | 2001              | 2011    |
| Madhya Pradesh     | 60348023          | 72597565 | Indore      | 2465827           | 3272335 |
| Morena             | 1592714           | 1965137  | West Nimar  | 1529562           | 1872413 |
| Bhind              | 1428559           | 1703562  | East Nimar* | 1713134           | 2066436 |
| Gwalior            | 1632109           | 2030543  | Rajgarh     | 1254085           | 1546541 |
| Datia              | 628240            | 786375   | Vidisha     | 1214857           | 1458212 |
| Shivpuri           | 1441950           | 1725818  | Bhopal      | 1843510           | 2368145 |
| Guna*              | 1666767           | 2085917  | Sehore      | 1078912           | 1311008 |
| Tikamgarh          | 1202998           | 1444920  | Raisen      | 1125154           | 1331699 |
| Chhatarpur         | 1474723           | 1762857  | Betul       | 1395175           | 1575247 |
| Panna              | 856558            | 1016028  | Hoshangabad | 1084265           | 1240975 |
| Sagar              | 2021987           | 2378295  | Jabalpur    | 2151203           | 2460714 |
| Damoh              | 1083949           | 1263703  | Narsimhapur | 957646            | 1092141 |
| Satna              | 1870104           | 2228619  | Mandla      | 894236            | 1053522 |
| Rewa               | 1973306           | 2363744  | Chhindwara  | 1849283           | 2090306 |
| Shahdol*           | 1575303           | 1814510  | Seoni       | 1166608           | 1378876 |
| Sidhi*             | 1831152           | 2304647  | Balaghat    | 1497968           | 1701156 |
| Mandsaur           | 1183724           | 1339832  | Sheopur     | 559495            | 687952  |
| Ratlam             | 1215393           | 1454483  | Umaria      | 515963            | 643579  |
| Ujjain             | 1710982           | 1986597  | Neemach     | 726070            | 825958  |
| Shajapur           | 1290685           | 1512353  | Barwani     | 1081441           | 1385659 |
| Dewas              | 1308223           | 1563107  | Harda       | 474416            | 570302  |
| Jhabua*            | 1394561           | 1752768  | Katni       | 1064167           | 1291684 |
| Dhar               | 1740329           | 2184672  | Dindori     | 580730            | 704218  |

Source: 1. Registrar General, India, 2007, 'General Population Tables, Series A, Total Population by Sex and Residence, 2001', Office of Registrar General & Census Commissioner, India, New Delhi.

2. Registrar General, India, 2011, 'Provisional Population Totals, Paper 1 of 2011, India Series 1, 2011', Office of Registrar General & Census Commissioner, India, New Delhi.

**Hint** for Interpolation and Extrapolation

Let,

$$t_1 = 2001, t_2 = 2011, t_3 = 2007 \text{ and } t_4 = 2014$$

$$P_{t_1} = \text{Population of 2001}$$

$$P_{t_2} = \text{Population of 2011}$$

$$P_{t_3} = \text{Population of 2007} = ?$$

$$P_{t_4} = \text{Population of 2014} = ?$$

**1. Formula for Interpolation**

$$P_{2007} = \theta * P_{2001} + (1-\theta) * P_{2011}$$

$$\text{where } \theta = (2011-2007)/(2011-2001)$$

**2. Formula for Extrapolation**

$$P_{2014} = \beta * P_{2001} + (1-\beta) * P_{2011}$$

$$\text{where } \beta = (2011-2014)/(2011-2001)$$

**Exercise 2:** Split the five years population of Chhatarpur District of Madhya Pradesh, 2001 into single years.

**Table 4.B: Population of Chhatarpur District by Age Group 2001**

| Age Group | Persons |
|-----------|---------|
| 0–4       | 11471   |
| 5–9       | 13225   |
| 10–14     | 14136   |
| 15–19     | 12268   |
| 20–24     | 10668   |
| 25–29     | 9420    |
| 30–34     | 8095    |
| 35–39     | 7537    |
| 40–44     | 5692    |
| 45–49     | 4392    |
| 50–54     | 3277    |
| 55–59     | 2533    |
| 60–64     | 2365    |
| 65–69     | 1577    |
| 70–74     | 1125    |

Source: Registrar General, India, 2005, 'Social and Cultural Tables, Series C–14 Population in Five Year Age Groups by Sex and Residence, 2001', Office of Registrar General & Census Commissioner, India, New Delhi.

**Hint:** Use Sprague Multipliers for splitting population in five year age groups into single years. See next page for Sprague Multipliers.

| Sprague Multipliers                 |           |           |           |           |           |
|-------------------------------------|-----------|-----------|-----------|-----------|-----------|
| First panel                         |           |           |           |           |           |
| Ages                                | Age 0–4   | Age 5–9   | Age 10–14 | Age 15–19 |           |
| Age 0                               | 0.3616    | –0.2768   | 0.1488    | –0.0336   |           |
| Age 1                               | 0.2640    | –0.0960   | 0.0400    | –0.0080   |           |
| Age 2                               | 0.1840    | 0.0400    | –0.0320   | 0.0080    |           |
| Age 3                               | 0.1200    | 0.1360    | –0.0720   | 0.0160    |           |
| Age 4                               | 0.0704    | 0.1968    | –0.0848   | 0.0176    |           |
| Second panel                        |           |           |           |           |           |
| Ages                                | Age 0–4   | Age 5–9   | Age 10–14 | Age 15–19 |           |
| Age 5                               | 0.0336    | 0.2272    | –0.0752   | 0.0144    |           |
| Age 6                               | 0.0080    | 0.2320    | –0.0480   | 0.0080    |           |
| Age 7                               | –0.0080   | 0.2160    | –0.0080   | 0.0000    |           |
| Age 8                               | –0.0160   | 0.1840    | 0.0400    | –0.0080   |           |
| Age 9                               | –0.0176   | 0.1408    | 0.0912    | –0.0144   |           |
| Middle panel ( 1 <sup>st</sup> Set) |           |           |           |           |           |
| Ages                                | Age 0–4   | Age 5–9   | Age 10–14 | Age 15–19 | Age 20–24 |
| Age 10                              | –0.0128   | 0.0848    | 0.1504    | –0.0240   | 0.0016    |
| Age 11                              | –0.0016   | 0.0144    | 0.2224    | –0.0416   | 0.0064    |
| Age 12                              | 0.0064    | –0.0336   | 0.2544    | –0.0336   | 0.0064    |
| Age 13                              | 0.0064    | –0.0416   | 0.2224    | 0.0144    | –0.0016   |
| Age 14                              | 0.0016    | –0.0240   | 0.1504    | 0.0848    | –0.0128   |
| Middle panel ( 2 <sup>nd</sup> Set) |           |           |           |           |           |
| Ages                                | Age 5–9   | Age 10–14 | Age 15–19 | Age 20–24 | Age 25–29 |
| Age 15                              | –0.0128   | 0.0848    | 0.1504    | –0.0240   | 0.0016    |
| Age 16                              | –0.0016   | 0.0144    | 0.2224    | –0.0416   | 0.0064    |
| Age 17                              | 0.0064    | –0.0336   | 0.2544    | –0.0336   | 0.0064    |
| Age 18                              | 0.0064    | –0.0416   | 0.2224    | 0.0144    | –0.0016   |
| Age 19                              | 0.0016    | –0.0240   | 0.1504    | 0.0848    | –0.0128   |
| Middle panel ( 3 <sup>rd</sup> Set) |           |           |           |           |           |
| Ages                                | Age 10–14 | Age 15–19 | Age 20–24 | Age 25–29 | Age 30–34 |
| Age 20                              | –0.0128   | 0.0848    | 0.1504    | –0.0240   | 0.0016    |
| Age 21                              | –0.0016   | 0.0144    | 0.2224    | –0.0416   | 0.0064    |
| Age 22                              | 0.0064    | –0.0336   | 0.2544    | –0.0336   | 0.0064    |
| Age 23                              | 0.0064    | –0.0416   | 0.2224    | 0.0144    | –0.0016   |
| Age 24                              | 0.0016    | –0.0240   | 0.1504    | 0.0848    | –0.0128   |
| and so on, until age group 60–64    |           |           |           |           |           |

Contd. ...

| Sprague Multipliers |           |           |           |           |
|---------------------|-----------|-----------|-----------|-----------|
| Next-to-last-panel  |           |           |           |           |
| Ages                | Age 55–59 | Age 60–64 | Age 65–69 | Age 70–74 |
| Age 65              | –0.0144   | 0.0912    | 0.1408    | –0.0176   |
| Age 66              | –0.0080   | 0.0400    | 0.1840    | –0.0160   |
| Age 67              | 0.0000    | –0.0080   | 0.2160    | –0.0080   |
| Age 68              | 0.0080    | –0.0480   | 0.2320    | 0.0080    |
| Age 69              | 0.0144    | –0.0752   | 0.2272    | 0.0336    |
| Last panel          |           |           |           |           |
| Ages                | Age 55–59 | Age 60–64 | Age 65–69 | Age 70–74 |
| Age 70              | 0.0176    | –0.0848   | 0.1968    | 0.0704    |
| Age 71              | 0.0160    | –0.0720   | 0.1360    | 0.1200    |
| Age 72              | 0.0080    | –0.0320   | 0.0400    | 0.1840    |
| Age 73              | –0.0080   | 0.0400    | –0.0960   | 0.2640    |
| Age 74              | –0.0336   | 0.1488    | –0.2768   | 0.3616    |

Source: Siegel, J.S. and D.A. Swanson (eds.), 2004, *The Methods and Materials of Demography*, Second Edition, Elsevier Academic Press, New York, Ch. 20, p. 700.

**Exercise 3:** Smoothen the Single Year Age Population of Chhatarpur District of Madhya Pradesh, 2001.

**Table 4.C: Single Year Population by Sex, Chhatarpur District, Madhya Pradesh**

| Age (x) | Persons | Males | Females | Age (x) | Persons | Males | Females |
|---------|---------|-------|---------|---------|---------|-------|---------|
| 0       | 34863   | 18253 | 16610   | 51      | 1803    | 1012  | 791     |
| 1       | 32251   | 16777 | 15474   | 52      | 7584    | 4053  | 3531    |
| 2       | 43653   | 22592 | 21061   | 53      | 4248    | 1290  | 2958    |
| 3       | 44506   | 22834 | 21672   | 54      | 3052    | 1300  | 1752    |
| 4       | 42280   | 22243 | 20037   | 55      | 21741   | 12461 | 9280    |
| 5       | 45984   | 24562 | 21422   | 56      | 4512    | 2211  | 2301    |
| 6       | 45808   | 23708 | 22100   | 57      | 2499    | 1022  | 1477    |
| 7       | 32500   | 16856 | 15644   | 58      | 8998    | 2869  | 6129    |
| 8       | 55748   | 29154 | 26594   | 59      | 1604    | 785   | 819     |
| 9       | 33330   | 17319 | 16011   | 60      | 28349   | 16422 | 11927   |
| 10      | 57617   | 30924 | 26693   | 61      | 1549    | 895   | 654     |
| 11      | 27757   | 15295 | 12462   | 62      | 6248    | 3206  | 3042    |
| 12      | 49516   | 27452 | 22064   | 63      | 2950    | 906   | 2044    |
| 13      | 30820   | 16828 | 13992   | 64      | 1641    | 770   | 871     |
| 14      | 33411   | 18763 | 14648   | 65      | 18998   | 10578 | 8420    |
| 15      | 31999   | 18941 | 13058   | 66      | 1919    | 964   | 955     |
| 16      | 30836   | 17945 | 12891   | 67      | 1385    | 646   | 739     |
| 17      | 17105   | 9840  | 7265    | 68      | 3993    | 1321  | 2672    |
| 18      | 39400   | 22863 | 16537   | 69      | 701     | 329   | 372     |
| 19      | 14001   | 7932  | 6069    | 70      | 16467   | 9425  | 7042    |
| 20      | 42865   | 23663 | 19202   | 71      | 563     | 318   | 245     |
| 21      | 12109   | 6786  | 5323    | 72      | 2236    | 1182  | 1054    |
| 22      | 30858   | 17729 | 13129   | 73      | 854     | 317   | 537     |
| 23      | 17363   | 7449  | 9914    | 74      | 530     | 284   | 246     |
| 24      | 19849   | 9793  | 10056   | 75      | 6229    | 3391  | 2838    |
| 25      | 37890   | 22752 | 15138   | 76      | 692     | 354   | 338     |
| 26      | 20224   | 10389 | 9835    | 77      | 310     | 157   | 153     |
| 27      | 11906   | 6380  | 5526    | 78      | 1111    | 445   | 666     |
| 28      | 32717   | 14580 | 18137   | 79      | 194     | 91    | 103     |
| 29      | 5733    | 2884  | 2849    | 80      | 5318    | 2839  | 2479    |
| 30      | 47550   | 27417 | 20133   | 81      | 185     | 102   | 83      |
| 31      | 4480    | 2272  | 2208    | 82      | 548     | 291   | 257     |
| 32      | 23653   | 12224 | 11429   | 83      | 187     | 81    | 106     |
| 33      | 11945   | 4095  | 7850    | 84      | 123     | 63    | 60      |
| 34      | 9986    | 4012  | 5974    | 85      | 1445    | 795   | 650     |
| 35      | 38636   | 24596 | 14040   | 86      | 173     | 104   | 69      |
| 36      | 14007   | 7511  | 6496    | 87      | 90      | 51    | 39      |
| 37      | 6606    | 3114  | 3492    | 88      | 192     | 76    | 116     |
| 38      | 21397   | 8294  | 13103   | 89      | 58      | 35    | 23      |
| 39      | 3915    | 1910  | 2005    | 90      | 1137    | 586   | 551     |
| 40      | 39402   | 24172 | 15230   | 91      | 63      | 29    | 34      |
| 41      | 2997    | 1687  | 1310    | 92      | 117     | 57    | 60      |
| 42      | 13622   | 7217  | 6405    | 93      | 48      | 19    | 29      |
| 43      | 6810    | 2017  | 4793    | 94      | 52      | 30    | 22      |
| 44      | 4957    | 2133  | 2824    | 95      | 347     | 180   | 167     |
| 45      | 29265   | 18118 | 11147   | 96      | 45      | 25    | 20      |
| 46      | 6215    | 3153  | 3062    | 97      | 31      | 17    | 14      |
| 47      | 3903    | 1725  | 2178    | 98      | 97      | 47    | 50      |
| 48      | 13247   | 4929  | 8318    | 99      | 71      | 39    | 32      |
| 49      | 2065    | 978   | 1087    | 100+    | 150     | 58    | 92      |
| 50      | 30000   | 18421 | 11579   |         |         |       |         |

Source: Registrar General, India, 2005, *Social and Cultural Tables, Series C-13 Single Year Age Returns by Sex and Residence, 2001*, Office of Registrar General & Census Commissioner, India, New Delhi.

**Hint:** Use Strong Method of Smoothening.

# Population Projections

## Learning Objectives

To understand:

- The use of exponential method at the national and state level
- Application of the ratio method of population projection at the district and below the district level
- Method of projecting the number of households
- The projection of the future labour force participation rate and size of labour force

## 5.1 Introduction

For effective policy formulation, planning and programme implementation, every country requires data on various aspects of the socio-economic conditions at different levels of disaggregation. These aspects of governance are closely related to the size and structure of the population. It is, therefore, of paramount importance to know the various aspects of the size of the population and its structure at different points of time and to project the population with the help of available trends and the size of the population. Projections are conditional statements about the future, for example, if death/birth rates decline to an assumed level, what will be the size of the population in the future. Population projection means estimating the population of a country or an area for a given point in time in the future. Thus, population projection is the estimation of the future population's size and structure. Many a time, terms such as 'population projection', 'prospect', 'forecast' or 'prediction' are used interchangeably to denote estimates of future populations. Yet, each of these terms carries a distinctly different meaning. The word 'projection' means something thrown forward. It gives a view of future events based on factual information and assumptions. A 'prospect' gives the view of future events without judgment on the probability of its actual occurrence. A 'forecast' means that the event will probably occur and a 'prediction' implies a strong likelihood of the occurrence in the future. Thus, population projection indicates what future population trends will be if the assumed levels of fertility, mortality and migration are realised.

The projection of the total population of a nation, state or sub-region serves as a means to assess the magnitude of the requirement of goods and services in the future. For programme planning, the projection of different segments of the population, such as age and sex composition, rural-urban population, school-going population, labour force, housing etc. are required. They are of great help with regard to the planning for various activities, such as, schooling, social infrastructure facilities, medical centres, hospitals, transport etc. that will be required over time in the future. Population projection provides a scenario for the future, thereby providing insights for preparing appropriate policy in

### Notes

order to achieve developmental goals. In 1958, the Planning Commission established an Expert Committee on Population Projection. The population projections prepared by the Expert Committee are constantly reviewed, extended and if necessary, revised, as and when fresh data on population composition and characteristics become available. The first such projection was prepared in 1958, which was based on the 1951 Census results. Subsequently, after every census, expert committees prepared the population projections for India, all states and union territories and for corresponding rural and urban areas. After the 2001 Census, the Technical Group on Population Projection was constituted under the chairmanship of the Registrar General and Census Commissioner of India, 2006. The population projections were carried out till 2026.

## 5.2 Methods of Population Projection

### 5.2.1 Balancing Equation

The most basic method of population projection in demography is based on the balancing equation that decomposes population change over time into the components of population change. The first component is called natural change and the second component is net migration. The method can be depicted as:

#### Notes

$$P_t - P_0 = (\text{Births} - \text{Deaths}) + (\text{In-migration} - \text{Out-migration})$$

$$\Rightarrow P_t = P_0 + (\text{Births} - \text{Deaths}) + (\text{In-migration} - \text{Out-migration})$$

where,  $P_t$  = population at time  $t$ , the end of the period  
 $P_0$  = population at time 0, the beginning of the period

Hence, we can represent population projection by balancing the equation as:

$$P_t = \text{Base Population} + \text{Natural Increase} + \text{Net Migration}$$

Predicting the size of the population at future time points using a balancing equation is possible once the expected number of births, deaths, in-migrants and out-migrants are available from reliable sources during the period of projection. We can also adopt different procedures to carry out projections of all the components at the right hand side of the balancing equation.

### 5.2.2 Mathematical Methods of Projection

A common way of projecting population is to fit an appropriate mathematical curve to recent population trends and extrapolate the trend. It is also possible to change the parameters in the function to allow for deviation from past trends. A number of mathematical functions such as linear, geometric, exponential, logistic, Gompertz, etc. are used for this purpose. The Exponential Growth Function is the most commonly used for short-term projections, since population growth follows this function closely.

The exponential growth model is just a refined version of the geometric growth model. In the geometric growth model, the implicit assumption made for projecting the total population is that it is compounding every year. This means that population is assumed to grow only after a fixed interval. Yet, in reality population grows at each small time interval (second, minute, hours and days). Therefore, a more realistic growth model is the exponential growth model. The exponential growth function is used for quick estimation

of the future population and it assumes that the population growth at any given time is proportional to the population size at that moment.

### Data Requirements

- Population at initial time  $t_0$  (i.e.  $P_{t_0}$ ) and population at a later date  $t_1$  (i.e.  $P_{t_1}$ ) or
- Growth rate ('r') over the period ( $t_1-t_0$ )

Formula for computation of annual exponential growth rate is:

$$r = \frac{1}{(t_1 - t_0)} * \ln \left( \frac{P_{t_1}}{P_{t_0}} \right)$$

where,  $P_{t_1}$  and  $P_{t_0}$  are populations at time points  $t_1$  and  $t_0$  respectively  
'ln' is the natural logarithm.

Formula for projecting population to time  $t_2$  using the exponential growth rate model is:

$$P_{t_2} = P_{t_1} * e^{r*t}$$

where,  $P_{t_1}$  = Population at an initial base time '0'

$P_{t_2}$  = Population at a later time Point 't'

$r$  = Average annual exponential rate of population growth expressed as per person per year otherwise known as annual exponential growth rate

$t$  =  $t_2-t_1$  (Time in years elapsed from ' $t_1$ ' to ' $t_2$ ')

$e$  = Exponential which is written as  $\exp(r*t)$  in Excel sheet

### Notes

**Note:** Calculated values of 'r' are generally multiplied by 100 to express the growth rate in terms of percentage. However, in the exponential growth function for population projection, actual value is used.

When population figures in two consecutive censuses are available, the growth rate for the period between two censuses can be computed from the formula given above.

### Example of Mathematical Projection

If we wanted to project the population for Madhya Pradesh for 2001 before the census was conducted, it could have been done as follows.

**Step I:** Using the population of Madhya Pradesh in the previous two Censuses, 1981 and 1991, the annual exponential growth rate can be calculated as follows:

$$\begin{aligned} r &= \frac{1}{10} * \ln \frac{P_{91}}{P_{81}} \\ &= \frac{1}{10} * \ln \frac{48566242}{38168507} \\ &= \frac{1}{10} * 0.240918 \\ &= 0.0240918 \end{aligned}$$

**Step II:** Project the population of Madhya Pradesh in 2001 using the exponential growth model as:

$$P_{2001} = P_{1991} * e^{r*t}$$

Since the growth rate, 'r' is 0.0240918 and the gap between 2001 and 1991 is 10 years:

$$\begin{aligned} P_{2001} &= 48566242 * e^{0.0240918*10} \\ &= 48566242 * 1.272417 \\ &= 61796493 \end{aligned}$$

*Note:* The actual population of Madhya Pradesh according to the 2001 Census was 60348023. This is lower than the above-projected value. This is because fertility in the state during 1991–2011 declined and as a consequence, the natural growth rate also declined. However, the population projection using exponential growth rate assumed continuation of 1981–91 growth rates. In the case of Rajasthan, it was found that the population projection was very close to the actual census counts in 2001. This clearly shows that the accuracy of projection depends on the extent to which assumptions are realistic.

## Notes

**Table 5.1: Population Projection by Exponential Growth Rate Method**

| States         | Census Population 1981 | Census Population 1991 | Exponential Growth Rate | Projected Population 2001 |
|----------------|------------------------|------------------------|-------------------------|---------------------------|
| 1              | 2                      | 3                      | 4                       | 5                         |
| India          | 665287849              | 838583988              | 0.0231                  | 1057020816                |
| Orissa         | 26370271               | 31659736               | 0.0183                  | 38010185                  |
| Rajasthan      | 34261862               | 44005990               | 0.0250                  | 56521363                  |
| Madhya Pradesh | 38168507               | 48566242               | 0.2409                  | 61796493                  |
| Chhattisgarh   | 14010337               | 17614928               | 0.0229                  | 22146882                  |

Source: 1. Registrar General, India, 1983, *Social and Cultural Tables, Series II, Part IV-A, 1981*, Office of Registrar General & Census Commissioner, India, New Delhi.

2. Registrar General, India, 1992, *Final Population Total, Series-1, 1991*, Office of Registrar General & Census Commissioner, India, New Delhi.

3. Registrar General, India, 2005, *Social and Cultural Tables, Series C–13 Single Years Age Returns by Sex and Residence, 2001*, Office of Registrar General & Census Commissioner, India, New Delhi.

## 5.2.3 Ratio Method

Population projections at the sub-national level or at the lower level of administrative units are gaining importance due to their utility in local level planning and implementation of development programmes. However, both the mathematical and component projection methods have some limitations. One of the difficulties of mathematical methods is that they cannot be used for making sub-national population projections. This is because if the same growth function, such as the exponential, is applied to the country and its different sub-divisions (states), the total of the projected populations of all the sub-divisions may not match with the population obtained independently for the country. Though sophisticated methods of population projection are available, such as Cohort-Component Method of Population Projection, which requires detailed trends of each component of population change (fertility, mortality and migration), often the data on population components for sub-divisions are scanty. Therefore, the ratio method is an appropriate choice for projecting the population at the sub-regional level and below.

This method can be used for population projections at the district, *tehsil*, town or any similar area. The method is based on the ratio of the smaller area to that of the larger area. The only prerequisite for this method is that the population projection for the larger area should be available. District-level projections are carried out with prior knowledge of the state's projected population. For India and the states, the Registrar General of India (RGI) as well as some other organisations and demographers have provided detailed population projections using the component projection method and the projected population for the larger area can be used for making population projections at the district level and *tehsil* level.

### Assumption

This method is based on the assumption that the observed trends in the ratios of a sub-region's (say a district) population to that of the region's total population (state) will continue in the future.

### Methodology

In this method, given the population size at two or more time points in the past, the trend in the ratio of population of a sub-region to the total population of the region (say the ratio of the district population to that of the state population) is calculated. Then this trend is used to predict the ratio in the future. To get the projected population of the sub-region, the predicted ratio is multiplied by the projected population of the region (say, the state). The ratios are then expressed as a continuous function of time. The general form is expressed as follows:

$$R_i^t = f_i(t)$$

where,  $R_i^t$  is the ratio of population of  $i^{\text{th}}$  sub-region to the population of the region at time 't'  
 $f_i(t)$  is a function of time, linear or non-linear.

From the above function, the ratio at future dates is projected. Then the estimate of the future population of sub-region 'i' at any time 't' ( $P_i^t$ ) is estimated by multiplying the projected future ratio ( $R_i^t$ ) by the projected population of the region at time 't' ( $P^t$ ).

$$P_i^t = R_i^t * P^t$$

Since each of the ratios is estimated independently, it may be possible that ratios of all the sub-regions may not necessarily add up to unity. In that case, a pro-rata adjustment should be made in the ratios to reach unity. This can be done by multiplying all the projected ratios by a factor  $1/\sum R_i^t$  as shown below:

$$R_i'^t = R_i^t * 1/\sum R_i^t$$

### Boundary Adjustments of Sub-national Region

It has often been seen that new districts are carved out from time to time, which requires adjustment of the population figures for both the districts (the new one as well as the parent district from which the new district has been created). It is desirable to get the adjusted population figures of the districts, which are affected by boundary changes, for both the census periods. Thus, if a district has been divided between the latest two censuses, the populations of the new districts should be obtained at both the census dates. If this is not possible, the undivided district's population should be used in both the censuses, and consequently, the projections would also relate to the undivided district.

### Data Requirements

- The population of the region and sub-regions (state and districts) at a minimum of two consecutive censuses.

### Notes

- The figures for the state's projected population may be obtained by using the exponential method of population projections or from already available sources. These may have been prepared by an organisation using the component method. For example, *Population Projections for India and States 2001–2026, Report of the Technical Group on Population Projections Constituted by the National Commission on Population* provides projections up to 2026.

### Calculation Procedure

The procedure described below for district projections is useful for further sub-divisions (*tehsils* etc.) within a large geographic unit for which projections are available.

**Step I:** Compute the ratio of the population of the district in the state that is, the ratio of the district population to the state population. In case of any boundary changes, the population figures need to be adjusted before computing the ratio as discussed earlier.

**Step II:** Compute the annual difference between the population ratios at the two censuses. Let the ratios of the population of district 'i' at the two census dates,  $t_1$  and  $t_2$ , be  $R_i^{t_1}$  and  $R_i^{t_2}$ . Then the annual difference is given by  $(R_i^{t_2} - R_i^{t_1}) / (t_2 - t_1)$ . As the Indian censuses are separated by a 10-year period, the gap  $(t_2 - t_1)$  is 10 years.

**Step III:** Project the population ratios for the time for which the projected population is desired. To do so, we need to multiply the annual difference calculated in Step II, by the time duration from base to the point for which population projections are required. It is possible that in some districts ratios may raise or fall, thus the difference could be positive or negative.

Mathematically it may be shown as:

$$R_i^t = R_i^{t_2} + (t - t_2) * (R_i^{t_2} - R_i^{t_1}) / (t_2 - t_1)$$

This now becomes the projected ratio of district 'i' at time 't'.

**For example,** projecting the population of the district by the ratio method for a year in the future (say 2015), based on ratios of the districts in the 2001 and 2011 Censuses, we may write the above formula in the following manner.

$$R_i^{2015} = R_i^{2011} + (t^{2015} - t^{2011}) * (R_i^{2011} - R_i^{2001}) / 10$$

*Note that the sum of all the projected population ratios of the district must be equal to one.*

*Note:* There are alternate ways of projecting the proportions. This can be done by using the exponential method of projection.

**Step IV:** Multiply the state-level population with the projected population ratio of the district.

$$P_i^t = R_i^t * P_t$$

In the following section, the district-level population projection as on 2011 using the ratio method is carried out for Madhya Pradesh as an illustration.

**Column (1), Name of the District:** Many times, in between two census time points, new districts emerge due to the reclassification of boundaries, for which the population data has to be adjusted accordingly. As discussed above, either the bifurcated district for the recent census has to be clubbed together or the original district has to be bifurcated at the previous census. In this example, the former approach has been adopted.

### Notes

**Columns (2) and (3):** Obtain from the Census of India, 2001 and 2011 respectively.

**Columns (4) and (5):** Ratio of population of the district to that of the state for 2001 and 2011 respectively.

**Column (6):** The annual difference between the two census population ratios.

[Col. (6) = {Col. (5) – Col. (4)}/10]

**Column (7):** Projected population ratios [Col. (7)=Col. (5) + {t\*Col. (6)}], here t=10. If it is for five years then 't' will be 5.

**Column (8):** District Projected Population, 2016. This can be done by multiplying the state-level projected population with the projected population ratio of the district, Col. (7).

**Table 5.2: Projected Populations of Districts of Madhya Pradesh by Ratio Method, 2011**

| State and District    | Population      |                 | Population Proportion |        | Annual Difference | Projected Population Proportion 2016 | Projected Population 2016 |
|-----------------------|-----------------|-----------------|-----------------------|--------|-------------------|--------------------------------------|---------------------------|
|                       | 2001            | 2011            | 2001                  | 2011   |                   |                                      |                           |
| 1                     | 2               | 3               | 4                     | 5      | 6                 | 7                                    | 8                         |
| <b>Madhya Pradesh</b> | <b>60348023</b> | <b>72597565</b> |                       |        |                   |                                      | <b>77875000</b>           |
| Morena                | 1592714         | 1965137         | 0.0264                | 0.0271 | 0.00007           | 0.02741                              | 2134343                   |
| Bhind                 | 1428559         | 1703562         | 0.0237                | 0.0235 | –0.00002          | 0.02336                              | 1819373                   |
| Gwalior               | 1632109         | 2030543         | 0.0270                | 0.0280 | 0.00009           | 0.02843                              | 2214166                   |
| Datia                 | 628240          | 786375          | 0.0104                | 0.0108 | 0.00004           | 0.01104                              | 859960                    |
| Shivpuri              | 1441950         | 1725818         | 0.0239                | 0.0238 | –0.00001          | 0.02371                              | 1846544                   |
| Guna*                 | 1666767         | 2085917         | 0.0276                | 0.0287 | 0.00011           | 0.02929                              | 2280903                   |
| Tikamgarh             | 1202998         | 1444920         | 0.0199                | 0.0199 | 0.00000           | 0.01989                              | 1548743                   |
| Chhatarpur            | 1474723         | 1762857         | 0.0244                | 0.0243 | –0.00002          | 0.02421                              | 1884996                   |
| Panna                 | 856558          | 1016028         | 0.0142                | 0.0140 | –0.00002          | 0.01390                              | 1082167                   |
| Sagar                 | 2021987         | 2378295         | 0.0335                | 0.0328 | –0.00007          | 0.03239                              | 2522157                   |
| Damoh                 | 1083949         | 1263703         | 0.0180                | 0.0174 | –0.00006          | 0.01713                              | 1333970                   |
| Satna                 | 1870104         | 2228619         | 0.0310                | 0.0307 | –0.00003          | 0.03055                              | 2379320                   |
| Rewa                  | 1973306         | 2363744         | 0.0327                | 0.0326 | –0.00001          | 0.03249                              | 2530154                   |
| Shahdol*              | 1575303         | 1814510         | 0.0261                | 0.0250 | –0.00011          | 0.02444                              | 1903212                   |
| Sidhi*                | 1831152         | 2304647         | 0.0303                | 0.0317 | 0.00014           | 0.03245                              | 2526785                   |
| Mandsaur              | 1183724         | 1339832         | 0.0196                | 0.0185 | –0.00012          | 0.01788                              | 1392088                   |
| Ratlam                | 1215393         | 1454483         | 0.0201                | 0.0200 | –0.00001          | 0.01998                              | 1556133                   |
| Ujjain                | 1710982         | 1986597         | 0.0284                | 0.0274 | –0.00010          | 0.02687                              | 2092564                   |
| Shajapur              | 1290685         | 1512353         | 0.0214                | 0.0208 | –0.00006          | 0.02055                              | 1600668                   |
| Dewas                 | 1308223         | 1563107         | 0.0217                | 0.0215 | –0.00001          | 0.02146                              | 1671018                   |
| Jhabua*               | 1394561         | 1752768         | 0.0231                | 0.0241 | 0.00010           | 0.02466                              | 1920484                   |
| Dhar                  | 1740329         | 2184672         | 0.0288                | 0.0301 | 0.00013           | 0.03072                              | 2392340                   |
| Indore                | 2465827         | 3272335         | 0.0409                | 0.0451 | 0.00042           | 0.04718                              | 3674332                   |

Contd. ...

| State and District | Population |         | Population Proportion |        | Annual Difference | Projected Population Proportion 2016 | Projected Population 2016 |
|--------------------|------------|---------|-----------------------|--------|-------------------|--------------------------------------|---------------------------|
|                    | 2001       | 2011    | 2001                  | 2011   |                   |                                      |                           |
| 1                  | 2          | 3       | 4                     | 5      | 6                 | 7                                    | 8                         |
| West Nimar         | 1529562    | 1872413 | 0.0253                | 0.0258 | 0.00004           | 0.02601                              | 2025893                   |
| East Nimar*        | 1713134    | 2066436 | 0.0284                | 0.0285 | 0.00001           | 0.02850                              | 2219640                   |
| Rajgarh            | 1254085    | 1546541 | 0.0208                | 0.0213 | 0.00005           | 0.02156                              | 1679293                   |
| Vidisha            | 1214857    | 1458212 | 0.0201                | 0.0201 | 0.00000           | 0.02006                              | 1562479                   |
| Bhopal             | 1843510    | 2368145 | 0.0305                | 0.0326 | 0.00021           | 0.03366                              | 2620982                   |
| Sehore             | 1078912    | 1311008 | 0.0179                | 0.0181 | 0.00002           | 0.01815                              | 1413335                   |
| Raisen             | 1125154    | 1331699 | 0.0186                | 0.0183 | -0.00003          | 0.01819                              | 1416792                   |
| Betul              | 1395175    | 1575247 | 0.0231                | 0.0217 | -0.00014          | 0.02099                              | 1634449                   |
| Hoshangabad        | 1084265    | 1240975 | 0.0180                | 0.0171 | -0.00009          | 0.01666                              | 1297195                   |
| Jabalpur           | 2151203    | 2460714 | 0.0356                | 0.0339 | -0.00018          | 0.03302                              | 2571401                   |
| Narsimhapur        | 957646     | 1092141 | 0.0159                | 0.0150 | -0.00008          | 0.01463                              | 1139412                   |
| Mandla             | 894236     | 1053522 | 0.0148                | 0.0145 | -0.00003          | 0.01436                              | 1118185                   |
| Chhindwara         | 1849283    | 2090306 | 0.0306                | 0.0288 | -0.00019          | 0.02787                              | 2170203                   |
| Seoni              | 1166608    | 1378876 | 0.0193                | 0.0190 | -0.00003          | 0.01882                              | 1465955                   |
| Balaghat           | 1497968    | 1701156 | 0.0248                | 0.0234 | -0.00014          | 0.02274                              | 1770718                   |
| Sheopur            | 559495     | 687952  | 0.0093                | 0.0095 | 0.00002           | 0.00958                              | 745948                    |
| Umaria             | 515963     | 643579  | 0.0085                | 0.0089 | 0.00003           | 0.00902                              | 702638                    |
| Neemuch            | 726070     | 825958  | 0.0120                | 0.0114 | -0.00007          | 0.01105                              | 860529                    |
| Barwani            | 1081441    | 1385659 | 0.0179                | 0.0191 | 0.00012           | 0.01967                              | 1531820                   |
| Harda              | 474416     | 570302  | 0.0079                | 0.0079 | 0.00000           | 0.00785                              | 611539                    |
| Katni              | 1064167    | 1291684 | 0.0176                | 0.0178 | 0.00002           | 0.01787                              | 1391756                   |
| Dindori            | 580730     | 704218  | 0.0096                | 0.0097 | 0.00001           | 0.00974                              | 758420                    |

Source: 1. Registrar General, India, 2007, *General Population Tables, Series A, Total Population by Sex and Residence, 2001*, Office of Registrar General & Census Commissioner, India.

2. Registrar General, India, 2011, *Provisional Population Totals, Paper 1 of 2011, India, Series 1, 2011*, Office of Registrar General & Census Commissioner, India.

#### **Note: Procedure for projecting newly formed districts in 2011**

In Madhya Pradesh State, 2001, five districts namely Guna, Shahdol, Sidhi, Jhabua and East Nimar were changed to Guna and Ashoknagar; Shahdol and Anuppur; Sidhi and Singrauli; Jhabua and Alirajpur; and East Nimar and Burhanpur in 2011 respectively. Therefore, before projecting the population beyond 2011, the populations of the newly formed districts are combined with the population of the district from which they have been carved.

Thus, the total population of the combined districts are used for computing the population ratio and then the population ratios are estimated for the projection years. Finally, the projected populations of those combined districts are split into the population of the new districts as well as the old districts in 2011, according to their ratios of population to the combined districts of the year 2011. The results of all five districts are presented in tabulated form and the calculation is given for one district for a better understanding of the procedure used.

| Name of Districts in 2001 | Districts in 2011                             |                    |                                                 |                    | Combined Population* in 2011 |
|---------------------------|-----------------------------------------------|--------------------|-------------------------------------------------|--------------------|------------------------------|
|                           | Districts from which New Districts are Formed | Population in 2011 | Name of New Districts which were Formed in 2011 | Population in 2011 |                              |
| 1                         | 2                                             | 3                  | 4                                               | 5                  | 6<br>(Col.3+Col. 5)          |
| Guna                      | Guna                                          | 1240938            | Ashoknagar                                      | 844979             | 2085917                      |
| Shahdol                   | Shahdol                                       | 1064989            | Anuppur                                         | 749521             | 1814510                      |
| Sidhi                     | Sidhi                                         | 1126515            | Singrauli                                       | 1178132            | 2304647                      |
| Jhabua                    | Jhabua                                        | 1024091            | Alirajpur                                       | 728677             | 1752768                      |
| East Nimar                | East Nimar                                    | 1309443            | Burhanpur                                       | 756993             | 2066436                      |

\*Combined population of districts.

Contd. below...

Source: Same as Table 5.2.

| Districts in 2011 | Proportion of Population in 2016 | Projected Population in 2016 | Districts in 2011 | Proportion of Population in 2016 | Projected Population in 2016 |
|-------------------|----------------------------------|------------------------------|-------------------|----------------------------------|------------------------------|
| 7                 | 8<br>(Col. 3÷Col.6)              | 9                            | 10                | 11                               | 12<br>(Col. 5÷Col.6)         |
| Guna              | 0.594912                         | 1356938                      | Ashoknagar        | 0.405088                         | 923965                       |
| Shahdol           | 0.586929                         | 1117051                      | Anuppur           | 0.413071                         | 786161                       |
| Sidhi             | 0.488802                         | 1235096                      | Singrauli         | 0.511198                         | 1291689                      |
| Jhabua            | 0.584271                         | 1122083                      | Alirajpur         | 0.415729                         | 798401                       |
| East Nimar        | 0.633672                         | 1406524                      | Burhanpur         | 0.366328                         | 813116                       |

#### *Illustration of Guna District*

**Step I:** In 2011 the population of Ashoknagar and Guna is combined

Combined (Guna + Ashoknagar) population

$$= 1240938 + 844979$$

$$= 2085917$$

**Step II:** A. Proportion of population of Ashoknagar in 2011

$$= [\text{Population of Ashoknagar in 2011} / \text{Population of (Ashoknagar + Guna) in 2011}]$$

$$= (844979 / 2085917)$$

$$= 0.405088$$

B. Proportion of population of Guna in 2011

$$= [\text{Population of Guna in 2011} / \text{Population of (Ashoknagar + Guna) in 2011}]$$

$$= (1240938 / 2085917)$$

$$= 0.594912$$

**Step III: A. Projected population of Ashoknagar in 2016**

$$\begin{aligned} &= \text{Proportion of population of Ashoknagar in 2011} \times \text{projected population of Guna}^* \text{ in 2016 (combined)} \\ &= (0.405088 \times 2280903) \\ &= 923965 \end{aligned}$$

**B. Projected population of Guna in 2016**

$$\begin{aligned} &= \text{Proportion of population of Guna in 2011} \times \text{projected population of Guna}^* \text{ in 2016 (combined)} \\ &= (0.594912 \times 2280903) \\ &= 1356938 \end{aligned}$$

**Advantages**

The ratio method of projecting the sub-national population has the advantage of simplicity of computation and is applicable in situations where:

1. Adequate data on vital statistics is lacking for a given area; and/or
2. The relatively small population of the area or the data available for a limited time period makes it impractical to use the component population projection method.

**Notes**

..... This method can be used for projecting the age-sex distribution of a geographic sub-  
..... division. It is also useful for projecting the population separately for rural and urban areas.  
..... This method can also be applied for the projection of a city's population.

**Limitations**

..... Though the main factor affecting the redistribution of the population at the sub-national  
..... level is internal migration, which is likely to be influenced by the socio-economic  
..... development of the area, the method does not directly take into account future socio-  
..... economic development. It assumes that districts growing more rapidly than the state in  
..... recent years will continue to do so even in the future, but certain socio-economic-political  
..... developments may change the pattern and this cannot be predicted.

**5.2.4 Projection of the Number of Households**

Certain amenities are required for each household. If the number of future households is known, basic amenities such as electrification, water and sanitation, and access to transportation can be planned accordingly.

People may use the concept of 'household' and 'family' interchangeably, but conceptually they are different. A *household* is defined as person(s) voluntarily living alone or together in a housing unit making common arrangements for basic living needs such as food and other essentials of living, whereas a *family* is defined as a collection of persons who are related through kinship, marriage or adoption and who may or may not stay together. Persons in a household may not necessarily be related, though they usually are.

In a census, a house is defined as a building or part of a building with a separate main entrance from the road or main courtyard or staircase, used or recognised as a separate unit.

However, the concept of '*head of the household*' is not easy to operationalise. In a report by the United Nations Department of International Economic and Social Affairs (UNDIESA), the head of the household is defined as a member of the household in whose name the

housing unit occupied by the household is owned, rented or maintained. If there is no such person, the household head may be any other adult member of the household<sup>1</sup>.

As each household has only one head, the number of heads of households is equivalent to the number of households. The headship rate approach is the most widely used method for projecting households. A headship rate is defined as the number of heads of the households per 100 persons. If an assumption can be formulated about future levels of headship rates, then by applying the assumed levels of headship rates to the projected population in the future, future number of households can be estimated.

### Data Requirements

- Number of household heads in the base year
- Total population in the base year
- Projected population
- Projected headship rate

### Calculation Procedure

$$\text{Household headship rate in year 't' (HHR}^t\text{)} = \frac{\text{No. of household heads in year t (HH}^t\text{)}}{\text{Population in year t (P}^t\text{)}}$$

### Notes

If 't' is the base year, then the number of households in the future is projected as:

$$\text{HH}^t = \text{P}^t * \text{HHR}^t$$

For example, for years t+5, t+10, t+15 the number of households is projected as:

$$\begin{aligned}\text{HH}^{t+5} &= \text{P}^{t+5} * \text{HHR}^{t+5} \\ \text{HH}^{t+10} &= \text{P}^{t+10} * \text{HHR}^{t+10} \\ \text{HH}^{t+15} &= \text{P}^{t+15} * \text{HHR}^{t+15}\end{aligned}$$

It is always appropriate to project households in rural and urban areas separately and add these up to estimate the total number of households in a region, as the pattern of household formation differs between rural and urban areas.

### Sources and Quality of Headship Data

The total number of households at the national and sub-national levels at a particular time can be obtained from the last census. As the entire population is enumerated in a census, this data is reliable.

<sup>1</sup> UNDIESA, 1990, *Projection Methods for Integrating Population Variable into Development Planning, Vol.1, Methods for Comprehensive Planning, Module 2, Methods for Preparing School Enrolment, Labour Force and Employment Projections*, UN Population Division, New York.

Table 5.3: Projection of the Number of Households for Madhya Pradesh and its Selected Districts for 2011

| State/<br>District | Population |          | No. of<br>Households |               | Headship Rates            |                           | Difference<br>between<br>1991<br>and 2001<br>Rates | Annual<br>Difference       | Projected<br>HHR*<br>(2011)    | Projected<br>Population<br>2011 | Projected<br>Households<br>2011   |
|--------------------|------------|----------|----------------------|---------------|---------------------------|---------------------------|----------------------------------------------------|----------------------------|--------------------------------|---------------------------------|-----------------------------------|
|                    | 1991       | 2001     | 1991                 | 2001          | 1991                      | 2001                      |                                                    |                            |                                |                                 |                                   |
|                    | 1          | 2        | 3                    | 4             | 5<br>(Col. 3 ÷<br>Col. 1) | 6<br>(Col. 4 ÷<br>Col. 2) | 7<br>(Col. 6 –<br>Col. 5)                          | 8<br>(Col. 7 ÷<br>Col. 10) | 9<br>(Col. 6 + Col. 8)<br>x 10 | 10                              | 11<br>(Col. 9 x Col. 10)<br>÷ 100 |
| Madhya<br>Pradesh  | 48566242   | 60348023 | 10395620             | 10919653      | 21.4                      | 18.1                      | –3.3                                               | –0.33                      | <b>14.78</b>                   | 72200000                        | 10673976                          |
| Chhatarpur         | 1158076    | 1474723  | 166000               | 263817        | 14.3                      | 17.9                      | 3.6                                                | 0.36                       | <b>21.44</b>                   | 1807069                         | 387515                            |
| Satna              | 1465384    | 1870104  | 210500               | 353077        | 14.4                      | 18.9                      | 4.5                                                | 0.45                       | <b>23.40</b>                   | 2296279                         | 537222                            |
| Rajgarh            | 992764     | 1254085  | 140900               | <b>218297</b> | 14.2                      | 17.4                      | 3.2                                                | 0.32                       | <b>20.62</b>                   | 1524887                         | 314448                            |

Source: 1. Registrar General, India, 2007, *General Population Tables, Series A, Total Population by Sex and Residence, 2001*, Office of Registrar General & Census Commissioner, India.

2. Registrar General, India, 2004, *Household Tables, Series H1, 2001*, Office of Registrar General & Census Commissioner, India.

3. Registrar General, India, 2011, *Provisional Population Totals, Paper 1 of 2011, India Series 1, 2011*, Office of Registrar General & Census Commissioner, India.

\*HHR' = Household Headship Rate in year 't'.

## Advantages

The household headship method is very easy to use and it requires minimum information.

## Limitations

- It is very difficult to accurately estimate the future level of headship rates.
- The method is unable to integrate ongoing household formation and dissolution processes over time in society, as social changes affect household formation.

## 5.2.5 Labour Force Projection

The size of the labour force, its structure, composition and distribution play an important role in determining the development of the country. Recent discussions about unemployment and the demand for employment, place the task of projecting the future size of the labour force upon statisticians and economists. It is very difficult to have a unanimous definition of labour force. As per the United Nations (UN), the labour force contains all economically active persons, including those currently employed, and those not currently employed, but seeking employment. The UN definition excludes those not seeking employment, housewives, students, very young children, and elderly people who are retired and no longer economically active<sup>2</sup>.

The projection of the labour force is based on the projected population (preferably by age and sex) and the projected labour force participation rate (also preferably by age and sex). For any year 't', the age-sex-specific labour force participation rate is defined as the number of persons in the labour force in a specific age-sex group in the year 't' divided by the total population of that age-sex group in year 't'. If we can project the future labour force participation rate and population by each sex and age group for a given point of time in the future, we can get the projected labour force at that time.

## Data Requirements

- Projected populations by age and sex
- Projected labour force participation rate by age and sex

## Calculation Procedure

If 't' is the base year, then the present labour force is the sum over age groups  $i = 1, 2, 3 \dots$

Total labour force at time 't' ( $LF^t$ ) =  $\{\sum (\text{male labour force participation rate})_{i,M}^t * \text{total male population in age group 'i' at time 't'}\} + \{\sum (\text{female labour force participation rate})_{i,F}^t * \text{total female population in age group 'i' at time 't'}\}$ .

Then for future time point 's', the labour force is projected as:

$$LF^s = \{\sum (LFPR)_{i,M}^s * P_{i,M}^s\} + \{\sum (LFPR)_{i,F}^s * P_{i,F}^s\}$$

where,

$LF^s$  = total labour force at time 's'

$(LFPR)_{i,M}^s$  = male labour force participation rate in age group 'i' at time 's'

$(LFPR)_{i,F}^s$  = female labour force participation rate in age group 'i' at time 's'

$P_{i,M}^s$  = total male population in age group 'i' at time 's'

$P_{i,F}^s$  = total female population in age group 'i' at time 's'

## Notes

<sup>2</sup> Ibid., 1.

For future years t+5, t+10, the size of labour force is projected as:

$$LF^{t+5} = \{ \sum (LFPR)_{i,M}^{t+5} * P_{i,M}^{t+5} \} + \{ \sum (LFPR)_{i,F}^{t+5} * P_{i,F}^{t+5} \}$$

$$LF^{t+10} = \{ \sum (LFPR)_{i,M}^{t+10} * P_{i,M}^{t+10} \} + \{ \sum (LFPR)_{i,F}^{t+10} * P_{i,F}^{t+10} \}$$

## Notes

It is always appropriate to project the labour force in rural and urban areas separately, as the pattern of age-sex specific labour force participation rate differs significantly between the two.

### Sources and Quality of Data

The census gives us data regarding the total population of a particular age group and total working population of that age group at the national and sub-national levels at a particular time. Census questionnaires probe respondents for their age, place of residence, occupation and type of economic activity which they are engaged in, whether they are working part-time or full-time, whether they are self-employed, whether they receive remuneration in kind or in goods [cash or kind; goods are considered a form of payment in kind], and what their vocational skills are.

### Limitations

Labour force projection will certainly tell us the future size of the force that will be available for labour/work but the quality, expertise or the efficiency of the labour force is very hard to project. Besides, the projection of the labour force participation rate is also difficult. Therefore, it is customary to assume constant participation rates or extrapolate these based on recent trends. Changes in the economy can change participation rates as well.

## 5.3 Sources of Error in Projections

Population projections suffer from some weaknesses. Groenewold and Navaneetham<sup>3</sup> (1998) have noted various sources of error in projections.

First, the input data can be wrong, due to errors in registration, rounding-off (measurement) and calculation. For example, base-year population structures may be based on incorrect census coverage or age/sex selective undercounting or age-misreporting.

Further, problems may arise due to incorrect specification of projection parameters. For example, life expectancy is projected to rise at the rate observed in the last 20 years, but it may increase at a different rate.

Unexpected events, such as outbreak of war, impact of epidemics, impact of AIDS, economic boom, etc. cannot be anticipated and hence even a good projection veers off the mark. The forecast also fails when a forecaster makes projections in the year preceding a sustained downward trend in fertility rates. In other words, the precision of the forecast depends on the timing when the forecast is made.

Stochastic fluctuations in the estimated numbers of births, deaths and migrants are not taken into account by our projection methods, which are essentially deterministic. Fortunately, research shows that such errors are generally small. However, some researchers have applied a stochastic approach to projections. Errors may also arise due to inaccurate projection model specification. For instance, if the international migration component is

<sup>3</sup> Groenewold, G. and K. Navaneetham, 1998, *The Projection of Populations: data appraisal, basic methods and applications*, Centre of Development Studies, Thiruvananthapuram.

left out in the projection model, errors will emerge. (It is common to assume international migration to be negligible while making national projections of many countries, but in reality, this component is significant.)

Overall, the most important sources of error are erroneous assumptions regarding trends in the components of change (fertility, mortality and migration) and, especially in the case of developing countries, inaccurate and unreliable input data.

## Notes

### 5.4 Summary

- There are various methods of population projection and the use of these methods depends upon the availability of input data. The most commonly used mathematical method is the exponential method of population projection.
- The ratio method of population projection is useful, particularly for sub-national population projection, and it uses the ratio of the population of a smaller area to that of a larger area.
- The household projection and the labour force projection give an idea about the future number of households and the size of the labour force, which in turn help the government to plan and utilise the resources accordingly.

## EXERCISES

**Exercise 1:** Project population of Madhya Pradesh for the year 2016 by the Exponential Method.

**Table 5.A: Total Population of Madhya Pradesh for Census Years 2001 and 2011**

| Population of Madhya Pradesh |            |
|------------------------------|------------|
| Year of Census               | Population |
| 2001                         | 60348023   |
| 2011                         | 72597565   |

Source: 1. Registrar General, India, 2007, *General Population Tables, Series A, Total Population by Sex and Residence, 2001*, Office of Registrar General & Census Commissioner, India.

2. Registrar General, India, 2011, *Provisional population totals, Paper 1 of 2011, India, Series 1, 2011*, Office of Registrar General & Census Commissioner, India.

**Hint:**

Formula for projecting population to time  $t_2$  using the exponential growth rate model

**Step I:** Calculate Exponential growth rate during 2001 to 2011 as:

$$r = \frac{1}{(2011-2001)} * \ln \left( \frac{P_{2011}}{P_{2001}} \right)$$

**Step II:** Calculate projected population of Madhya Pradesh for the year 2016 using exponential method as:

$$P_{2016} = P_{2011} * e^{r*(2016-2011)}$$

**Exercise 2:** Project population of the districts for the Year 2016 by the Ratio Method.

**Table 5.B: Input data 1, Population of 2001 and 2011 for Madhya Pradesh and its Districts**

| State and District | Population |          |
|--------------------|------------|----------|
|                    | 2001       | 2011     |
| Madhya Pradesh     | 60348023   | 72597565 |
| Morena             | 1592714    | 1965137  |
| Bhind              | 1428559    | 1703562  |
| Gwalior            | 1632109    | 2030543  |
| Datia              | 628240     | 786375   |
| Shivpuri           | 1441950    | 1725818  |
| Guna*              | 1666767    | 2085917  |
| Tikamgarh          | 1202998    | 1444920  |
| Chhatarpur         | 1474723    | 1762857  |
| Panna              | 856558     | 1016028  |
| Sagar              | 2021987    | 2378295  |
| Damoh              | 1083949    | 1263703  |
| Satna              | 1870104    | 2228619  |
| Rewa               | 1973306    | 2363744  |
| Shahdol*           | 1575303    | 1814510  |

Contd. ...

| State and District | Population |         |
|--------------------|------------|---------|
|                    | 2001       | 2011    |
| Sidhi*             | 1831152    | 2304647 |
| Mandsaur           | 1183724    | 1339832 |
| Ratlam             | 1215393    | 1454483 |
| Ujjain             | 1710982    | 1986597 |
| Shajapur           | 1290685    | 1512353 |
| Dewas              | 1308223    | 1563107 |
| Jhabua*            | 1394561    | 1752768 |
| Dhar               | 1740329    | 2184672 |
| Indore             | 2465827    | 3272335 |
| West Nimar         | 1529562    | 1872413 |
| East Nimar*        | 1713134    | 2066436 |
| Rajgarh            | 1254085    | 1546541 |
| Vidisha            | 1214857    | 1458212 |
| Bhopal             | 1843510    | 2368145 |
| Sehore             | 1078912    | 1311008 |
| Raisen             | 1125154    | 1331699 |
| Betul              | 1395175    | 1575247 |
| Hoshangabad        | 1084265    | 1240975 |
| Jabalpur           | 2151203    | 2460714 |
| Narsimhapur        | 957646     | 1092141 |
| Mandla             | 894236     | 1053522 |
| Chhindwara         | 1849283    | 2090306 |
| Seoni              | 1166608    | 1378876 |
| Balaghat           | 1497968    | 1701156 |
| Sheopur            | 559495     | 687952  |
| Umaria             | 515963     | 643579  |
| Neemuch            | 726070     | 825958  |
| Barwani            | 1081441    | 1385659 |
| Harda              | 474416     | 570302  |
| Katni              | 1064167    | 1291684 |
| Dindori            | 580730     | 704218  |

Source: 1. Registrar General, India, 2007, *General Population Tables, Series A, Total Population by Sex and Residence, 2001*, Office of Registrar General & Census Commissioner, India.

2. Registrar General, India, 2011, *Provisional Population Totals, Paper 1 of 2011, India, Series 1, 2011*, Office of Registrar General & Census Commissioner, India.

**Input data 2**, Projected population of Madhya Pradesh for 2016 is 77875000.

**Exercise 3:** Project households for given districts for the year 2016.

**Table 5.C: Population and Number of Households for Selected Districts of Madhya Pradesh**

| Districts  | Population<br>1991 | Population<br>2001 | Population<br>2011 | No. of<br>Households<br>in 1991 | No. of<br>Households<br>in 2001 |
|------------|--------------------|--------------------|--------------------|---------------------------------|---------------------------------|
| 1          | 2                  | 3                  | 4                  | 5                               | 6                               |
| Chhatarpur | 1158076            | 1474723            | 1762857            | 203885                          | 263,817                         |
| Mandla     | 1291263            | 894236             | 1053522            | 249300                          | 191,633                         |
| Rajgarh    | 992764             | 1254085            | 1546541            | 169645                          | 218,297                         |
| Satna      | 1465384            | 1870104            | 2228619            | 263975                          | 353,077                         |
| Damoh      | 898125             | 1083949            | 1263703            | 171890                          | 222,743                         |

Source: 1. Registrar General, India, 2007, *General Population Tables, Series A, Total Population by Sex and Residence, 2001*, Office of Registrar General & Census Commissioner, India.  
 2. Registrar General, India, 2004, *Household Tables, Series H1, 2001*, Office of Registrar General & Census Commissioner, India.  
 3. Registrar General, India, 2011, *Provisional Population Totals, Paper 1 of 2011, India, Series 1, 2011*, Office of Registrar General & Census Commissioner, India.

**Exercise 4:** Project school enrolment of primary and middle level for the years of 2011 and 2016 for given districts of Madhya Pradesh.

**Table 5.D: Student Enrolment in Primary and Middle Level and Child Population for Convergence Districts of Madhya Pradesh**

| Districts  | Primary Level        |                      |                      |                      | Middle Level         |                       |                      |                       |
|------------|----------------------|----------------------|----------------------|----------------------|----------------------|-----------------------|----------------------|-----------------------|
|            | 2004–05              |                      | 2008–09              |                      | 2004–05              |                       | 2008–09              |                       |
|            | Enrolment<br>(Total) | Population<br>(6–11) | Enrolment<br>(Total) | Population<br>(6–11) | Enrolment<br>(Total) | Population<br>(12–14) | Enrolment<br>(Total) | Population<br>(12–14) |
| Chhatarpur | 256369               | 253352               | 299420               | 252798               | 77947                | 117598                | 101522               | 123084                |
| Mandla     | 165024               | 131475               | 143404               | 124232               | 56123                | 64195                 | 60779                | 65823                 |
| Rajgarh    | 194250               | 202792               | 256293               | 200977               | 57321                | 89749                 | 80600                | 93814                 |
| Satna      | 316367               | 301647               | 377066               | 304356               | 137696               | 148942                | 152423               | 155541                |
| West Nimar | 234905               | 255656               | 308193               | 251882               | 66202                | 116508                | 90082                | 122165                |

Source: 1. National University of Educational Planning and Administration (NUEPA), 2008, *District Report Card, 2007–08, In Elementary Education in India: where do we stand?*, National University of Educational Planning and Administration (NUEPA), New Delhi.  
 2. Registrar General, India, 2005, *Social and Cultural Tables, Series C–13, Single Year Age Returns by Sex and Residence, 2001*, Office of Registrar General & Census Commissioner, India, New Delhi.  
 3. UNFPA, 2009, *District Level Population Projections in Eight Selected States of India, 2006–16*, India.

**Table 5.E: Child Population for the Years 2011 and 2016 for Convergence Districts of Madhya Pradesh**

| Districts  | Population 6–11 |        | Districts  | Population 12–14 |        |
|------------|-----------------|--------|------------|------------------|--------|
|            | 2011            | 2016   |            | 2011             | 2016   |
| Chhatarpur | 254451          | 257757 | Chhatarpur | 124749           | 128080 |
| Mandla     | 120571          | 113249 | Mandla     | 63360            | 58435  |
| Rajgarh    | 201472          | 202463 | Rajgarh    | 94714            | 96514  |
| Satna      | 306089          | 309556 | Satna      | 156378           | 158052 |
| West Nimar | 253751          | 257490 | West Nimar | 123943           | 127499 |

Source: UNFPA, 2009, *District Level Population Projections in Eight Selected States of India, 2006–2016*, India.



# Life Tables

## Learning Objectives

To understand:

- Definition and types of life tables
- Uses of life tables
- Construction of a life table
- Software for constructing a life table
- Millenium Development Goals (MDGs) and other indicators that can be derived from a life table

## 6.1 Introduction

Mortality is one of the vital components of population change. The district-level/local-level planning needs to take into consideration scientifically accounted age-sex composition of the district/local population net of mortality. For instance, for providing routine immunisation at periodic intervals to children less than five years, the district/local health officials must have an idea of the number of children born in the district/locality in the preceding five years and the number of children who survived the first five years of life. Similarly, for extending the old age pension scheme to elders above 60 years of age, the district/local authority has to account for the number of persons reaching 60 years and those who have survived beyond. In both the premises, accounting of mortality is important and as such there is an inevitable need to have scientific methods for accounting anticipated number of deaths in a population. One such scientific tool, developed centuries ago, is the life table. Life tables are prepared separately for males and females to assess the gender differentials in mortality. This enables district/local planners to prepare strategies aiming at abolishing the gender differentials in mortality.

### 6.1.1 What is a Life Table?

The life table is “a tabular display of life expectancy and the probability of dying at each age (or age- group) for a given population, according to the age-specific death rates prevailing at that time. The life table gives an organised, complete picture of a population’s mortality”<sup>1</sup>. A life table is also described as a “table that displays various pieces of information about the dying out of a birth cohort”<sup>2</sup>. It summarises a cohort’s mortality experience in a tabular form. We may also summarise a cohort’s mortality experience by means of graphs and mathematical formulae. Kintner<sup>3</sup> states that the life table “conceptually traces a cohort of

### Notes

<sup>1</sup> Haupt Arthur and Thomas. T. Kane, 2004, *PRB’s Population Hand Book*, 5<sup>th</sup> Edition, Population Reference Bureau, Washington, DC, p. 59.

<sup>2</sup> Preston, Samuel H., Patrick Heuveline and Michel Guillot, 2001, *Demography: measuring and modeling population processes*, Blackwell, London, Ch. 3, pp. 38–70.

<sup>3</sup> Siegel, J.S. and D.A. Swanson (eds.), 2004, *The Methods and Materials of Demography*, 2<sup>nd</sup> Edition, Elsevier Academic Press, New York, Ch. 3, pp. 301–40.

newborn babies through their entire life under the assumption that they are subject to the current observed schedule of age-specific mortality rates”.

Males and females exhibit distinctive age patterns of mortality as they have different life courses and are exposed to different age-specific risk patterns. Life tables for males and females capture the distinctive age patterns of mortalities by sex. The most important summary measure of mortality, life expectancy at birth (the average years expected to live from birth by individuals of a population), and survival ratio (the chances of survival from one age to a higher age), are the two most important by-products of a life table which have found wide application in planning at the district/local levels.

This Chapter is intended to introduce the concept of life table, highlight its uses, comprehend the definition and interpretation of a life table as well as input data for construction of a life table and source of availability. An attempt is made to provide a computer module on the life table to learn the method of constructing an abridged life table.

## 6.2 Life Tables – Types, Availability and Uses

### 6.2.1 Types of Life Tables

#### Notes

Life tables are of several types. According to the reference year of the table, they are distinguished into two types: the generation or cohort life table and the current or period life table.

#### Cohort (or Generation) Life Tables

These tables are constructed based upon the mortality experiences of a real birth cohort (for instance, all persons born in the year 2000). Here the mortality experience of that particular birth cohort is observed from its beginning till the death of all the cohort members. The cohort life tables are conceptually simple. However, their construction requires collection of data over a long period and thus they are not practical. They may be of some historical interest, but are not useful in answering current life-expectancy questions.

#### Period (or Current) Life Tables

These are derived from the age-specific death rates for one year, or an average of three or five years. During this period, the mortality of the population may not change substantially. The period life table thus represents the experience of a **synthetic or hypothetical cohort** located in a single year. A synthetic cohort's mortality rates are a combination of rates from many different real birth cohorts during the year. They do not represent the mortality experience of an actual cohort. The period life table is a more useful tool for mortality analysis than the cohort life table, as it provides a cross-sectional view of the mortality of a population in a given year.

#### Complete and Abridged Life Tables

A life table can be for a single year age or for broad age groups, usually five or ten years. Based on the width of the age interval in which the data are presented, life tables are also classified into two types: complete and abridged. A life table is said to be a **complete life table** when it is constructed by using single years of age. A life table is said to be an **abridged life table** when it is constructed by using broader age groups. Demographers generally construct abridged life tables rather than complete life tables<sup>4</sup>.

<sup>4</sup> Siegel, J.S., et al., in f.n. 3.

### 6.2.2 Availability of Life Tables

Life table construction has a long history. In the seventeenth century, the first ever attempt to construct a life table was made by John Graunt (1620–74). Several others tried to improve on it. Edmund Halley (1656–1742) followed a more rigorous mathematical approach<sup>5</sup>. Since then, many countries in the world have constructed a number of national and sub-national life tables.

Construction of life tables in India dates back to the late nineteenth century. In India, life tables were initially constructed using age composition of the population from two successive censuses. After the introduction of the Sample Registration System (SRS), the Office of the Registrar General of India (RGI) started providing life tables for India as a whole and its major states, using the age-specific death rates averaged for five years as input starting from the reference year, 1970–75. The latest life tables published by the RGI refer to the period 2002–06.

### 6.2.3 Uses of Life Tables

Life tables are designed basically to study mortality; however, they are used in a variety of ways in various fields by specialists<sup>6</sup>.

Some of the specialists who employ life tables in their studies frequently are public health workers, demographers, actuaries and economists.

Life tables are especially employed in:

- Making population projections
- Studying widowhood, orphan-hood, length of married life, length of working life and length of disability-free life
- Fixing the eligibility age for old-age pension schemes, retirement age, and premium for health and life insurance
- MDG Indicators (infant and under-five child mortality rates)
- Obtaining indirect estimation of fertility, mortality and migration rates

#### Notes

### 6.3 Period Abridged Life Table Construction

As stated earlier, period abridged life tables can be prepared with less difficulty and often are more convenient to use. The assumptions underlying and the steps involved in constructing the period abridged tables are given below. The same procedure is used to construct the complete period life tables.

The following few assumptions will be made before constructing any life table: (1) No changes in membership of the cohort except due to death; (2) People die at each age according to a mortality schedule that is fixed in advance and does not change over time; (3) At each age (excepting the first few years of life, i.e., 0, 1, 2, 3, and 4), deaths are more or less evenly distributed across age groups; (4) Cohort normally consists of persons of the same sex.

The first column of a life table is invariably 'age'. The six basic life table functions (columns) usually calculated and published for every life table are  ${}_nq_x$ ,  ${}_x l_x$ ,  ${}_n d_x$ ,  ${}_n L_x$ ,  $T_x$  and  $e^0_x$ . Some refer to exact age 'x' and some to the age interval (x, x+n). These columns are defined

<sup>5</sup> Rowland, D.T., 2006, *Demographic Methods and Concepts*, Oxford University Press, New York, Ch.8, pp. 266–99.

<sup>6</sup> Siegel, J.S., *et al.*, f.n. 3.

in Table 6.3.1. All these life table functions are interrelated and as such one may directly calculate some of the functions from the others. Of the above six, the initial function  ${}_nq_x$  is the pivotal function in the life table from which all other life table functions are generally derived.

An abridged life table normally has rows for ages 0, 1, 5, and for every fifth year of age. Age 1 is invariably included to take account of concentration of mortality in infancy. Since certain functions in a life table refer to exact ages (exact age means as on a birthday), the rows of an abridged life table are usually labelled as single years, 0, 1, 5, 10, 15, etc., indicating the age groups 0–1, 1–4, 5–9, 10–14, etc. When using a spreadsheet, an additional column next to the age column showing the number of years in each age group is a useful addition to the life table.

Table 6.3.2 shows an example of a period abridged life table construction using age specific death rates (ASDR, also written symbolically as ' ${}_nm_x$ ') from Madhya Pradesh for females, for the reference period 2002–06. The Appendix Table A also presents the period abridged life table constructed using ASDR data from Kerala for females for the same reference period. Graphic presentation of the life table columns is discussed in Section 6.6. Appendix Box A presents certain points relevant to life table construction. The interpretation of the various life-table columns and the formulae used in computing various columns with an example (using the data from Table 6.3.2) are explained in this chapter in a few steps.

## Notes

### Interpretation of the Life Table and its Columns

As stated earlier, a life table is interpreted/defined here as a device that “depicts the lifetime mortality experience of a single cohort of newborn babies, who are subject to the age-specific mortality rates on which the table is based.” (Siegel and Swanson, 2004:306) The cohort of newborn babies, called the ‘radix of the life table’, is usually assumed to be 100,000.

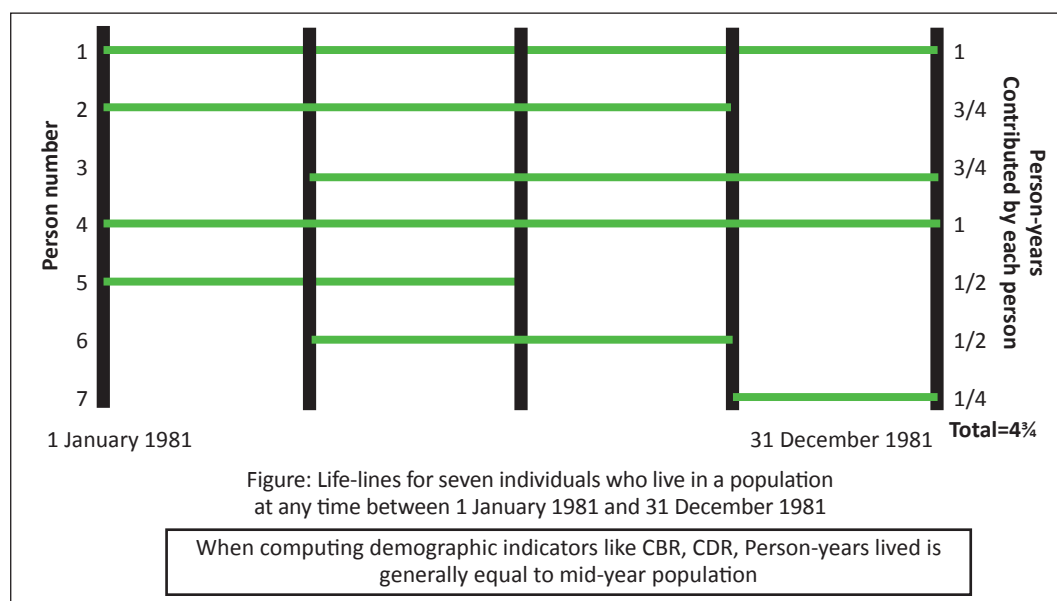
The six basic life table functions (columns) mentioned earlier may be defined *verbally* as shown below:

**Table 6.3.1: Interpreting the Basic Life Table Columns**

| Column | Notation  | Interpretation                                                                             |
|--------|-----------|--------------------------------------------------------------------------------------------|
| 1.     | $x$       | Exact age $x$ ; where $x = 0, 1, 5, 10, 15, \dots, 85$ years                               |
| 2.     | ${}_nm_x$ | Age-specific death rate between ages ' $x$ ' and $x+n$                                     |
| 3.     | ${}_nq_x$ | Probability of dying between ages ' $x$ ' and $x+n$                                        |
| 4.     | $l_x$     | Number left alive (or surviving) age ' $x$ ', among a hypothetical birth cohort of 100,000 |
| 5.     | ${}_nd_x$ | Number dying between ages ' $x$ ' and $x+n$                                                |
| 6.     | ${}_nL_x$ | Person-years lived between ages ' $x$ ' and $x+n$                                          |
| 7.     | $T_x$     | Person-years lived above age ' $x$ '                                                       |
| 8.     | $e_x^0$   | Expectation of life at age ' $x$ '                                                         |

Note: Exact age: Age on birthday;  ${}_nm_x \approx {}_nM_x$  = the observed ASDR;  $n$  = width of the age interval in years; Person-years: The sum of all years members of a population have lived during a fixed interval or over their whole lives.

**Figure 6.3.1: Concept of Person-years Lived**



Source: Preston, Samuel H., Patrick Heuveline and Michel Guillot, 2001, *Demography: measuring and modeling population processes*, Blackwell, London, Ch. 3, p. 5.

**Table 6.3.2: Example of Period Abridged Life Table: SRS Based Abridged Life Tables, Madhya Pradesh, Females, 2002–06**

| Exact Age $x$ | ASDR between Ages $x$ and $x+n$ (INPUT) | Probability of Dying between Ages $x$ and $x+n$ | Number Surviving at Age $x$ | Number Dying between Ages $x$ and $x+n$ | Person-Years Lived between Ages $x$ and $x+n$ | Person-Years Lived above Age $x$ | Expectation of Life at Age $x$ |
|---------------|-----------------------------------------|-------------------------------------------------|-----------------------------|-----------------------------------------|-----------------------------------------------|----------------------------------|--------------------------------|
| $x$           | ${}_n m_x$                              | ${}_n q_x$                                      | $l_x$                       | ${}_n d_x$                              | ${}_n L_x$                                    | $T_x$                            | $e^0_x$                        |
| 0             | 0.09529                                 | 0.08933                                         | 100000                      | 8933                                    | 93747                                         | 5791150                          | 57.9                           |
| 1             | 0.02099                                 | 0.07977                                         | 91067                       | 7265                                    | 346106                                        | 5697403                          | 62.6                           |
| 5             | 0.00215                                 | 0.01069                                         | 83802                       | 896                                     | 416770                                        | 5351298                          | 63.9                           |
| 10            | 0.00153                                 | 0.00762                                         | 82906                       | 632                                     | 412951                                        | 4934527                          | 59.5                           |
| 15            | 0.00242                                 | 0.01203                                         | 82274                       | 990                                     | 408897                                        | 4521577                          | 55.0                           |
| 20            | 0.00256                                 | 0.01272                                         | 81285                       | 1034                                    | 403839                                        | 4112679                          | 50.6                           |
| 25            | 0.00266                                 | 0.01321                                         | 80251                       | 1060                                    | 398604                                        | 3708840                          | 46.2                           |
| 30            | 0.00287                                 | 0.01425                                         | 79191                       | 1128                                    | 393132                                        | 3310236                          | 41.8                           |
| 35            | 0.00341                                 | 0.01691                                         | 78062                       | 1320                                    | 387012                                        | 2917104                          | 37.4                           |
| 40            | 0.00399                                 | 0.01975                                         | 76743                       | 1516                                    | 379923                                        | 2530092                          | 33.0                           |
| 45            | 0.00560                                 | 0.02761                                         | 75227                       | 2077                                    | 370940                                        | 2150169                          | 28.6                           |
| 50            | 0.00739                                 | 0.03628                                         | 73149                       | 2654                                    | 359113                                        | 1779228                          | 24.3                           |
| 55            | 0.01202                                 | 0.05835                                         | 70496                       | 4113                                    | 342195                                        | 1420116                          | 20.1                           |
| 60            | 0.02195                                 | 0.10404                                         | 66382                       | 6906                                    | 314646                                        | 1077921                          | 16.2                           |
| 65            | 0.03538                                 | 0.16252                                         | 59476                       | 9666                                    | 273214                                        | 763275                           | 12.8                           |
| 70            | 0.10164                                 | 1.00000                                         | 49810                       | 49810                                   | 490061                                        | 490061                           | 9.8                            |

Source for  ${}_n m_x$ : Registrar General, India, 2008, *SRS Based Abridged Life Tables, 2002–06*, Office of the Registrar General of India, Ministry of Home Affairs, New Delhi.

Note: Values given in the shaded cells are observed to be derived using formulae different from those in the remainder of that particular column.

### Steps in construction of period abridged life table

As stated earlier, abridged life tables usually begin with the ages 0–1, 1–4, followed by five-year age groups: 5–9, 10–14, ..., 85+.

Steps involved in the calculation of various columns in an abridged life table are as follows:

#### Step I: Calculation of ${}_n m_x$

Obtain the age-specific death rates using the formula  ${}_n m_x = D_x / P_x$

where,  $D_x$  = number of deaths of persons in (x, x+n) age-group occurring in the reference period (usually one year or average of three or five years)

$P_x$  = population of persons in (x, x+n) age group at the mid-point of the reference period.

See also Figure 6.6.1. for the graphic presentation of the column  ${}_n m_x$ .

#### Step II: Calculation of ${}_n q_x$

The fundamental step in calculating a life table is to convert the set of ASDRs ( ${}_n m_x$ ) into a set of probabilities of dying at each age group ( ${}_n q_x$ ). For this, various formulae were suggested by several researchers like Greville, Chiang, Reed-Merrell, Keyfitz, etc.

#### Notes

We compute  ${}_n q_x$  using the following formula<sup>7</sup>:

$${}_n q_x = n * {}_n m_x / (1 + (n - a_x) * {}_n m_x)$$

where  $a_x$  = the average person-years lived between ages 'x' and x+n for those persons dying in the age-interval (x, x+n) where x = 0, 1, 5, 10, 15, etc.

In the case of high mortality countries, it is common to use  ${}_1 a_0 = 0.3$ ,  ${}_4 a_1 = 1.5$  and  ${}_5 a_x = 2.5$ .

In the case of low mortality countries it is common to use  ${}_1 a_0 = 0.1$ ,  ${}_4 a_1 = 1.5$  and  ${}_5 a_x = 2.5$ .

Thus, the final formulae we may use in obtaining  ${}_n q_x$  are:

When  $n = 1, x = 0$   ${}_1 q_0 = {}_1 m_0 / (1 + 0.7 * {}_1 m_0)$  Take  ${}_1 a_0 = 0.3$

When  $n = 4, x = 1$   ${}_4 q_1 = 4 * {}_4 m_1 / (1 + 2.5 * {}_4 m_1)$  Take  ${}_4 a_1 = 1.5$

When  $n = 5, x = 5, 10, 15, \dots$   ${}_5 q_x = 5 * {}_5 m_x / (1 + 2.5 * {}_5 m_x)$  Take  ${}_5 a_x = 2.5$

${}_{\infty} q_{70} = 1.00000$ ; the symbol ' $\infty$ ' indicates 'infinity'

For the last (open-ended) age interval  $q_{x+}$  (or  $q_A$ ) is always equal to 1.0, as all those alive at the beginning of the last age interval will die eventually.

**For example**, in Table 6.3.2:

$${}_1 q_0 = {}_1 m_0 / (1 + 0.7 * {}_1 m_0) = 0.09529 / (1 + 0.7 * 0.09529) = 0.08933$$

$${}_4 q_1 = 4 * {}_4 m_1 / (1 + 2.5 * {}_4 m_1) = 4 * 0.02099 / (1 + 2.5 * 0.02099) = 0.07977$$

$${}_5 q_5 = 5 * {}_5 m_5 / (1 + 2.5 * {}_5 m_5) = 5 * 0.00215 / (1 + 2.5 * 0.00215) = 0.01069$$

$${}_5 q_{20} = 5 * {}_5 m_{20} / (1 + 2.5 * {}_5 m_{20}) = 5 * 0.00256 / (1 + 2.5 * 0.00256) = 0.01272$$

<sup>7</sup> Preston, *et al.*, f.n. 2, p. 49.

### Step III: Calculation of $l_x$

Let,  $l_0 = 100000$ , then

$$l_{x+n} = l_x * (1 - q_x)$$

$l_x$  is one of the most useful columns in a life table and it refers to an exact age rather than an age interval. Its first value,  $l_0$ , is the **radix** and is always taken to be a round number either 1 or 100,000. Each  $l_x$  shows the population that survived from the immediately preceding  $l_x$ . Notice that  $l_x$  is a decreasing function of  $x$ , and as age increases,  $l_x$  must decrease.

**For example**, in Table 6.3.2:

$$l_1 = l_0 * (1 - q_0) = 100000 * (1 - 0.08933) = 91067$$

$$l_5 = l_1 * (1 - q_1) = 91067 * (1 - 0.07977) = 83802$$

$$l_{20} = l_{15} * (1 - q_{15}) = 82274 * (1 - 0.01203) = 81285$$

See also Figure 6.6.2. for the graphic presentation of the column  $l_x$ .

### Step IV: Calculation of ${}_n d_x$

$${}_n d_x = l_x - l_{x+n}$$

Also note that  ${}_n d_x = l_x - l_{x+n}$

This column in the life table shows the number who would die within each age interval. Notice that for the last (open-ended) interval, the number of persons dying in the age interval is the same as the number alive, at its start.

That is,  ${}_{\infty} d_{70} = l_{70}$

**For example**, in Table 6.3.2:

$$\begin{aligned} {}_5 d_{20} &= l_{20} - l_{25} \\ &= 81285 - 80151 \\ &= 1134 \end{aligned}$$

### Step V: Calculation of ${}_n L_x$

$$\begin{aligned} {}_n L_x &= a_x * l_x + (n - a_x) * l_{x+n} \\ &\text{(or)} \\ &= n (l_{x+n} + a_x * d_x) \end{aligned}$$

This formula indicates that it is the total number of person-years lived (contributed by those alive and those who died) between exact ages 'x' and x+n.

By substituting the values of  ${}_1 a_0 = 0.3$ ,  ${}_4 a_1 = 1.5$  and  ${}_5 a_x = 2.5$ , for  ${}_n a_x$  in the above general formula we may obtain the following equations which are used in our study:

$$\text{When } n=1, x=0 \quad {}_1 L_0 = 0.3 * l_0 + 0.7 * l_1$$

$$\text{When } n=4, x=1 \quad {}_4 L_1 = 1.5 * l_1 + 2.5 * l_5$$

$$\text{When } n=5, x=5, 10, 15, \dots \quad {}_5 L_x = 2.5 * (l_x + l_{x+5})$$

$${}_{\infty} L_{70} = l_{70} / {}_{\infty} M_{70} \text{ is also written as } L_{70+}$$

### Notes

As the open-ended interval has no defined length, there is a need to make an assumption about the number of years (on average) persons alive at the start of the interval will live. The formula given above (i.e.,  ${}_5L_{70}$ ) provides a good approximation.

**For example**, in Table 6.3.2:

$${}_1L_0 = 0.3 * I_0 + 0.7 * I_1 = 0.3 * (100000) + 0.7 * (91067) = 93747$$

$${}_4L_1 = 1.5 * I_1 + 2.5 * I_5 = 1.5 * (91067) + 2.5 * (83802) = 346106$$

$${}_5L_{20} = 2.5 * (I_{20} + I_{25}) = 2.5 * (81285) + 2.5 * (80251) = 403839$$

#### Step VI: Calculation of $T_x$

$$\text{For any age 'x', } T_x = T_{x+n} + {}_nL_x$$

**For example**,

$$\text{For } x = 60, T_{60} = T_{65} + {}_5L_{60}$$

The above formula indicates that  $T_x$ , the total number of person-years lived above age 'x', is obtained by cumulating the  ${}_nL_x$  values from bottom to top. With an increase in age, the population shrinks. As a result,  $T_x$  also necessarily shrinks.

For terminal age, say  $x = 70$ , the formula will be:  $T_{70} = {}_\infty L_{70}$  i.e. ( $T_{70+} = L_{70+}$ )

Notice that  $T_x$  like  $I_x$  refers to exact age 'x', not an age interval

**For example**, in Table 6.3.2:

$$T_{20} = T_{25} + {}_5L_{20} = 3708838 + 403839 = 4112677$$

$$T_{70+} = {}_\infty L_{70}$$

$$\text{Here, } T_{70+} = 490059$$

$$\text{Then, } T_{65} = T_{70} + {}_5L_{65} = 490059 + 273214 = 763273$$

#### Step VII: Calculation of $e_x^0$

$$e_x^0 = T_x / I_x$$

This formula may be understood as follows:

For the  $I_x$  people alive at age 'x', the total number of years left for them to live is given by  $T_x$ . Thus, on average, these  $I_x$  individuals will live for further  $T_x / I_x$  years.

The average number of years available to a newborn to live is generally referred to as the **expectation of life at birth** and is obtained as  $e_0^0 = T_0 / I_0$

**For example**, in Table 6.3.2:

$$e_0^0 = T_0 / I_0 = 5791148 / 100000 = 57.91 \text{ years}$$

$$e_{20}^0 = T_{20} / I_{20} = 4112677 / 81285 = 50.60 \text{ years}$$

**For life table, birth rate = death rate =  $1/e_0^0$**

See also Figure 6.6.3 for the graphic presentation of the column  $e_x^0$ .

#### Notes

## 6.4 Data Requirements, Data Sources, Disaggregation, and Software Availability

### Data Requirements

A **reliable** set of age-specific death rates (ASDRs).

### Data Sources

Vital registration system; nationally representative sample surveys like the SRS, the National Family Health Survey (NFHS), and the District Level Health and Facility Survey (DLHS) in the case of India.

### Disaggregation

By sex (males, females, both sexes combined) and by residence (rural, urban and total).

### Software Availability

Several software programmes are available for constructing a period abridged life table. For instance:

- The United Nations software package MORTPAK for Windows application 'LIFTB'
- Excel worksheet developed and provided by IIPS

Official life tables in India are prepared from time to time using the UN-MORTPAK-LITE application LIFTB.

### Notes

## 6.5 MDG and Other Indicators Derived from the Life Tables

### 6.5.1 Life Expectancy at Birth ( $e_0^0$ )

Life expectancy at age '0' or the life expectancy at birth,  $e_0^0$  is calculated as  $e_0^0 = T_0/I_0$ . This is the most commonly used summary measure of health (or mortality) and reflects the overall mortality level of a population. Life expectancy at birth (LEB) is essentially a hypothetical measure as it is based on current death rates. It is an important input (health indicator) in the construction of the Human Development Index (HDI).

It may be noted that in the absence of reliable information on ASDRs, the life expectancy at birth is calculated indirectly, using procedures like the regression approach. It may also be obtained from the model life tables<sup>8</sup> or Coale and Demeny system of model life tables<sup>9</sup> using the information on some indicators of mortality.

About a century ago, life expectancy at birth in India was just over 20 years as mortality was quite high, but with the decline in mortality, it has now increased to over 60 years. In many developed countries, mortality is very low and as a result, life expectancy is close to 80 years.

<sup>8</sup> United Nations, 1982, *Model Life Tables for Developing Countries*, United Nations, Population Studies No.77, New York.

<sup>9</sup> Coale, A.J. and P. Demeny, with B. Vaughan, 1983, *Regional Model Life Tables and Stable Populations*, Academic Press, New York.

### Range of Variation in Life Expectancy at Birth ( $e_0^o$ )

Table 6.5.1 shows the values of  $e_0^o$  for select states in India. The  $e_0^o$  is seen to vary from males to females and over the study states due to varying socio-economic and health conditions.

**Table 6.5.1: Life Expectancy at Birth, India and 16 Major States, 2002–06**

| India/States          | Males       | Females     | Total       |
|-----------------------|-------------|-------------|-------------|
| <b>INDIA</b>          | <b>62.6</b> | <b>64.2</b> | <b>63.5</b> |
| Andhra Pradesh        | 62.9        | 65.5        | 64.4        |
| Assam                 | 58.6        | 59.3        | 58.9        |
| Bihar                 | 62.2        | 60.4        | 61.6        |
| Gujarat               | 62.9        | 65.2        | 64.1        |
| Haryana               | 65.9        | 66.3        | 66.2        |
| Himachal Pradesh      | 66.5        | 67.3        | 67.0        |
| Karnataka             | 63.6        | 67.1        | 65.3        |
| <b>Kerala</b>         | <b>71.4</b> | <b>76.3</b> | <b>74.0</b> |
| <b>Madhya Pradesh</b> | <b>58.1</b> | <b>57.9</b> | <b>58.0</b> |
| Maharashtra           | 66.0        | 68.4        | 67.2        |
| Orissa                | 59.5        | 59.6        | 59.6        |
| Punjab                | 68.4        | 70.4        | 69.4        |
| Rajasthan             | 61.5        | 62.3        | 62.0        |
| Tamil Nadu            | 65.0        | 67.4        | 66.2        |
| Uttar Pradesh         | 60.3        | 59.5        | 60.0        |
| West Bengal           | 64.1        | 65.8        | 64.9        |

Source: Same as Table 6.3.2.

### Notes

### 6.5.2 Life Table Survival Ratios

Life table survival ratios are calculated from a life table and they in turn are used in making population projections. The five-year survival ratio, denoted by  ${}_5S_x$ , is given as:

$${}_5S_x = {}_5L_{x+5} / {}_5L_x$$

*Note:* Since the  ${}_5L_x$  function is the number of persons alive between ages 'x' and 'x+5', the ratio of two consecutive  ${}_5L_x$  values represents the survival over a period of five years, from the age group 'x' to 'x+5' to the next older age group, 'x+5' to 'x+10'.

While defining  ${}_5S_x$ , the youngest and oldest age groups require special attention.

The first, second and last survival ratios respectively are obtained using the following specific formulae:

${}_5S_B = ({}_1L_0 + {}_4L_1) / (5 * I_0)$  which is the survival from birth in a five-year period to the age group 0–4

${}_5S_0 = {}_5L_5 / ({}_1L_0 + {}_4L_1)$  which is the survival from 0–4 to 5–9

$S_{A-5} = T_A / T_{A-5}$  where A is the oldest age group which is open-ended; for instance, 70+ in Table 6.3.2.

### Calculation of ${}_nS_x$

$${}_5S_x = {}_5L_{x+5} / {}_5L_x$$

For example, in Table 6.3.2:

$${}_5S_8 = ({}_1L_0 + {}_4L_1) / (5 \cdot {}_1L_0) = (93747 + 346106) / (5 \cdot 100000) = 0.87970$$

$${}_5S_0 = {}_5L_5 / ({}_1L_0 + {}_4L_1) = 416770 / (93747 + 346106) = 0.94752$$

$${}_5S_{20} = {}_5L_{25} / {}_5L_{20} = 398604 / 403839 = 0.98704$$

$${}_5S_{60} = T_{70} / T_{65} = 490059 / 763273 = 0.64204$$

### 6.5.3 Infant ( ${}_1q_0$ ), Child ( ${}_4q_1$ ) and Under-five ( ${}_5q_0$ ) Mortality Indicators

${}_1q_0$  is generally referred to as 'the probability of dying between birth and age 1'. It is also referred to as the measure of 'Infant Mortality Rate' or IMR.  ${}_1q_0$  may be computed using  $l_x$  column values as:

$${}_1q_0 = (l_0 - l_1) / l_0$$

${}_4q_1$  is generally referred to as 'the probability of dying between age 1 and age 4'. It is also referred to as the measure 'Child Mortality Rate' or CMR. It may be computed as:

$${}_4q_1 = ({}_5q_0 - {}_1q_0) / (1 - {}_1q_0)$$

${}_5q_0$  is generally referred to as 'the probability of dying between birth and age 5' and is the 'Under-five Mortality Rate'. It may be computed using  $l_x$  column values as:

$${}_5q_0 = (l_0 - l_5) / l_0$$

The two measures,  ${}_1q_0$  and  ${}_5q_0$ , are used in MDGs as they are considered to be very important mortality or health indicators.

#### Indirect calculation of ${}_1q_0$ , ${}_5q_0$ and ${}_4q_1$ using a life table

For example, in Table 6.3.2:

$$\begin{aligned} {}_1q_0 &= (l_0 - l_1) / l_0 \\ &= (100,000 - 91067) / 100000 \\ &= 0.08933, \text{ that is, IMR of 89 per 1000 live births} \end{aligned}$$

$$\begin{aligned} {}_5q_0 &= (l_0 - l_5) / l_0 \\ &= (100000 - 83802) / 100000 \\ &= 0.16198, \text{ that is, Under-five Mortality Rate of 162 per 1000 live births} \end{aligned}$$

$$\begin{aligned} {}_4q_1 &= ({}_5q_0 - {}_1q_0) / (1 - {}_1q_0) \\ &= (0.16198 - 0.08933) / (1 - 0.08933) \\ &= 0.079776, \text{ that is Child Mortality Rate of 80 per 1000 live births} \end{aligned}$$

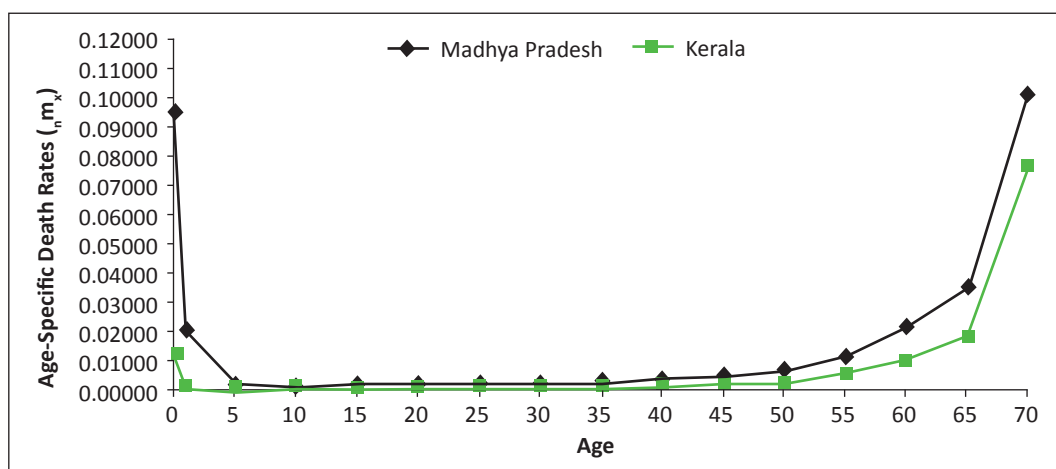
## 6.6 Graphic Presentation of Selected Period Life Table Columns

The graphs of  $l_x$ ,  $nq_x$  or  $nM_x$ , and  $e_x^0$  for human populations follow a fairly standard pattern or shape, irrespective of sex or of the country to which they refer.

### Notes

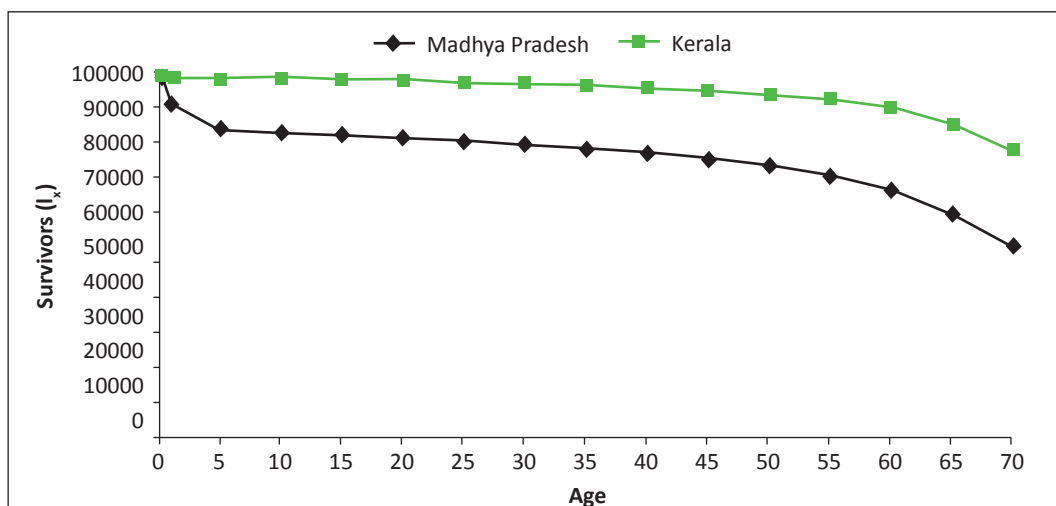
As seen from the graphs given in Figures 6.6.1, 6.6.2 and 6.6.3, while  $l_x$  and  $e_x^0$  display a decrease in their values with an increase in age,  ${}_n m_x$  (or even  ${}_n q_x$ , not given here) display a J or U-shaped pattern over age. In case of  $e_x^0$ , you may notice for Madhya Pradesh that for the age '1' the value of life expectancy is more than that of the age '0', which indicates that mortality is generally very high in the first year of age '0' when compared to age '1' and above. Note that  $e_0^0$  is the average for the whole population and includes low age at death for those dying during infancy, whereas  $e_1^0$  is the average of those who have survived infancy and thus does not include very low survival for most. The  ${}_n m_x$  and  ${}_n q_x$  graphs are seen to show higher values at ages below five, and at old ages of the curve due to high mortality during infancy and early childhood and old age.

**Figure 6.6.1: Graphic Presentation of  ${}_n m_x$  Column for Females of Madhya Pradesh and Kerala, 2002–06**



Source: Same as Table 6.3.2 and Appendix Table A.

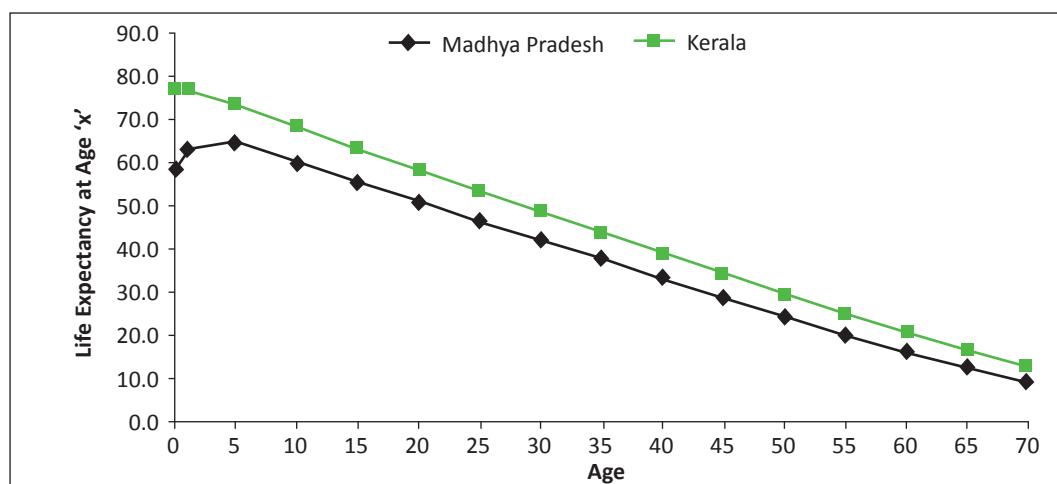
**Figure 6.6.2: Graphic Presentation of  $l_x$  Column for Females of Madhya Pradesh and Kerala, 2002–06**



Source: Table 6.3.2 and Appendix Table A.

## Notes

**Figure 6.6.3: Graphic Presentation of  $e_0^0$  Column for Females of Madhya Pradesh and Kerala, 2002–06**



Source: Same as Table 6.3.2 and Appendix Table A.

## 6.7 Life Table Construction at the Sub-national Level

As stated, life tables play an important role in understanding the mortality situation of any given population for any particular time period. However, the construction of a life table requires a reliable set of ASDRs. Unfortunately, for districts in India, we find it impossible to get a set of reliable ASDRs from any source. The only way we can then study the mortality situation of any district in India is by means of using some indirect approach, such as adopting the mortality situation of an appropriate “model life table”, such as the UN South Asian Model, with the help of any given mortality indicator, for instance IMR, of the population under study. However, recently some attempts are being made to construct life tables even for districts in India.

### Notes

## 6.8 Summary

- A life table is defined as a table that displays various pieces of information about the dying out of a birth cohort.
- It describes the extent to which a generation of people (the life table cohort) dies with age.
- It comprises a set of columns, most of which can be calculated from any of the others.
- The only input required to construct a life table is a reliable set of ASDRs.
- Life tables are used in different fields of research and in different subject areas.
- They give a set of summary indices which are useful in several ways.
- The summary measure ‘life expectancy at birth’ is used as a key indicator in the construction of the Human Development Index. It is also used for the assessment of the level of mortality, for the assessment of social, economic and technological development of a nation and also for the comparison of mortality levels of different regions within a country.
- In addition to a life table format, other ways of summarising a cohort’s mortality experience are in graphical form or in the form of a mathematical function.

## EXERCISES

**Exercise 1.** Construct an Abridged Life Table for Madhya Pradesh State, Males, 2002–06 using the following Age Specific Death Rates.

| x  | ${}_n m_x$ | ${}_n q_x$ | $l_x$ | ${}_n d_x$ | ${}_n L_x$ | $T_x$ | $e^0_x$ |
|----|------------|------------|-------|------------|------------|-------|---------|
| 0  | 0.09155    |            |       |            |            |       |         |
| 1  | 0.01467    |            |       |            |            |       |         |
| 5  | 0.00237    |            |       |            |            |       |         |
| 10 | 0.00127    |            |       |            |            |       |         |
| 15 | 0.00178    |            |       |            |            |       |         |
| 20 | 0.00198    |            |       |            |            |       |         |
| 25 | 0.00258    |            |       |            |            |       |         |
| 30 | 0.00297    |            |       |            |            |       |         |
| 35 | 0.00448    |            |       |            |            |       |         |
| 40 | 0.00560    |            |       |            |            |       |         |
| 45 | 0.00755    |            |       |            |            |       |         |
| 50 | 0.01403    |            |       |            |            |       |         |
| 55 | 0.01921    |            |       |            |            |       |         |
| 60 | 0.02904    |            |       |            |            |       |         |
| 65 | 0.04321    |            |       |            |            |       |         |
| 70 | 0.09613    |            |       |            |            |       |         |

Source for  ${}_n m_x$ : Registrar General, India, 2008, *SRS Based Abridged Life Tables, 2002–06*, Office of the Registrar General of India, Ministry of Home Affairs, New Delhi.

**Hint:** Steps in calculating an Abridged Life Table:

Given the  ${}_n m_x$  as the input, different life table columns can be calculated using the following formulae, in a few steps:

**Given Input:** Age Specific Death Rates (ASDRs or  ${}_n m_x$ )

**Step I. Calculate  ${}_n q_x$**

( ${}_n q_x$ : Probability of dying between ages 'x' and x+n)

$${}_1 q_0 = {}_1 m_0 / (1 + 0.7 * {}_1 m_0)$$

$${}_4 q_1 = 4 * {}_4 m_1 / (1 + 2.5 * {}_4 m_1)$$

$${}_5 q_x = 5 * {}_5 m_x / (1 + 2.5 * {}_5 m_x), \dots\dots\dots (1)$$

for ages 'x' = 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65

Apply formulae (1) for ages given above to complete the  ${}_n q_x$  column of the table. For the last age 70, use

$${}_{\infty} q_{70} = 1.00000$$

**Step II. Calculate  $l_x$** 

( $l_x$ : Number of people left alive at age 'x')

$$l_0 = 100000 \text{ (= Radix of the life table)}$$

$$l_{x+n} = l_x * (1 - {}_nq_x)$$

Apply formulae to complete the  $l_x$  column of the table.

**Step III. Calculate  ${}_nd_x$** 

( ${}_nd_x$ : Number of people dying between ages 'x' and x+n)

$${}_nd_x = l_x * {}_nq_x$$

Apply formulae to complete the  ${}_nd_x$  column of the table.

**Step IV. Calculate  ${}_nL_x$** 

( ${}_nL_x$ : Person-years lived between ages 'x' and x+n)

$${}_1L_0 = 0.3 * l_0 + 0.7 * l_1$$

$${}_4L_1 = 1.5 * l_1 + 2.5 * l_5$$

For ages x = 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, use

$${}_5L_x = 2.5 * (l_x + l_{x+5}),$$

$${}_{\infty}L_{70} = l_{70} / m_{70}$$

Enter formulae to complete the  ${}_nL_x$  column of the table.

**Step V. Calculate  $T_x$** 

( $T_x$ : Person-years lived above age 'x')

$$T_x = T_{x+n} + {}_nL_x, \text{ (i.e., cumulate } {}_nL_x \text{ from bottom to top)}$$

$$T_{70+} = {}_{\infty}L_{70}$$

Enter formulae to complete the  $T_x$  column of the table.

**Step VI. Calculate  $e_x$** 

( $e_x^0$ : Expectation of life at age 'x')

$$e_x^0 = T_x / l_x$$

Enter formulae to complete the  $e_x$  column of the table.

*Note:* In the above formulae, \* stands for multiplication.

**Exercise 2:** Selected questions related to the interpretation of the values in the life table along with the appropriate answers provided below for your convenience. Try to answer the questions without seeing the answers.

**Questions related to the interpretation of the values in the life table  
(Provide your answers with reference to Table 6.3.2 for Madhya Pradesh)**

1. What is the probability for an individual under one year of age to die in MP?
2. How many years can an individual born in MP expect to live?
3. What is the probability of an individual's dying between the ages of 5 and 10?
4. What is the mortality rate between 5 and 10 years of age?
5. What is the probability that an individual reaching 5 years of age reaches 10?

(For the appropriate answers see below)

**Answers**

1. *The probability of dying between 0 and 1 in MP ( ${}_1q_0$ ) is 0.08933.*
2. *The number of years that a child born may expect to live, i.e., the life expectancy at birth in MP ( $e^0_0$ ) is 57.9 years.*
3. *The probability of an individual dying between ages 5 and 9 (i.e.,  ${}_5q_5$ ) is 0.01069.*
4. *The central mortality rate between ages 5 and 9 (i.e.,  ${}_5M_5$ ) is 0.00215.*
5. *Probability of surviving from age 5 to age 10 =  $l_{10}/l_5$   
 $= 82906/83802$   
 $= 0.989308$*

## APPENDICES

**Table A: SRS Based Abridged Life Table, Kerala, Females, 2002–06**

| Exact Age x | ASDR between Ages x and x+n (INPUT) | Probability of Dying between Ages x and x+n | Number Surviving at Age x | Number Dying between Ages x and x+n | Person-Years Lived between Ages x and x+n | Person-Years Lived above Age x | Expectation of Life at Age x |
|-------------|-------------------------------------|---------------------------------------------|---------------------------|-------------------------------------|-------------------------------------------|--------------------------------|------------------------------|
| x           | ${}_n m_x$                          | ${}_n q_x$                                  | $l_x$                     | ${}_n d_x$                          | ${}_n L_x$                                | $T_x$                          | $e^0_x$                      |
| 0           | 0.01247                             | 0.01236                                     | 100000                    | 1236                                | 99135                                     | 7622155                        | 76.2                         |
| 1           | 0.00079                             | 0.00315                                     | 98764                     | 311                                 | 394276                                    | 7523021                        | 76.2                         |
| 5           | 0.00031                             | 0.00155                                     | 98452                     | 152                                 | 491880                                    | 7128744                        | 72.4                         |
| 10          | 0.00029                             | 0.00145                                     | 98300                     | 142                                 | 491143                                    | 6636864                        | 67.5                         |
| 15          | 0.00052                             | 0.00260                                     | 98157                     | 255                                 | 490150                                    | 6145721                        | 62.6                         |
| 20          | 0.00091                             | 0.00454                                     | 97903                     | 444                                 | 488401                                    | 5655571                        | 57.8                         |
| 25          | 0.00095                             | 0.00474                                     | 97458                     | 462                                 | 486136                                    | 5167169                        | 53.0                         |
| 30          | 0.00105                             | 0.00524                                     | 96996                     | 508                                 | 483711                                    | 4681034                        | 48.3                         |
| 35          | 0.00131                             | 0.00653                                     | 96488                     | 630                                 | 480867                                    | 4197322                        | 43.5                         |
| 40          | 0.00177                             | 0.00881                                     | 95858                     | 845                                 | 477181                                    | 3716455                        | 38.8                         |
| 45          | 0.00231                             | 0.01148                                     | 95014                     | 1091                                | 472341                                    | 3239275                        | 34.1                         |
| 50          | 0.00287                             | 0.01425                                     | 93923                     | 1338                                | 466268                                    | 2766933                        | 29.5                         |
| 55          | 0.00602                             | 0.02965                                     | 92585                     | 2745                                | 456059                                    | 2300665                        | 24.8                         |
| 60          | 0.01072                             | 0.05220                                     | 89839                     | 4690                                | 437471                                    | 1844606                        | 20.5                         |
| 65          | 0.01864                             | 0.08905                                     | 85149                     | 7583                                | 406790                                    | 1407136                        | 16.5                         |
| 70          | 0.07754                             | 1.00000                                     | 77567                     | 77567                               | 1000345                                   | 1000345                        | 12.9                         |

Source: For  ${}_n m_x$  data: Same as Table 6.3.2.

### Box A: General Note

#### *Irrespective of the type of life table*

- Subscript before the symbol indicates the width of the age interval.
- Subscript after the symbol indicates the starting age of the age interval.
- Some functions in the life table namely,  $l_x$ ,  $T_x$ , and  $e_x$  always refer to a single (exact) age (Exact age = age on a birthday).
- Some functions in the life table namely,  ${}_n M_x$ ,  ${}_n q_x$ ,  ${}_n p_x = (1 - {}_n q_x)$ ,  ${}_n d_x$ ,  ${}_n L_x$ ,  ${}_n S_x$ , always refer to age intervals that begin with exact age 'x' and extend for exactly 'n' years.
- The 'cohort of newborn babies' in a life table is called the 'radix of the table' and is usually assumed to be 100,000.
- The final age group in the life table is always open-ended, like 70 +, 85 +.
- The following relationships always hold for the open-ended age interval:

$$- {}_{\infty} d_{70} = l_{70}$$

$$- {}_{\infty} q_{70} = 1$$

$$- {}_{\infty} L_{70} = T_{70}$$

$$- {}_{\infty} m_{70} = l_{70} / T_{70} = 1 / e^0_{70} \text{ [or } e^0_{70} = 1 / {}_{\infty} m_{70}]$$



# Reproductive and Child Health (RCH)

## Learning Objectives

- To acquaint/familiarise participants with the importance of reproductive and child health (RCH) as a component of health of the population
- To familiarise participants with goals, plans and policies regarding RCH in India
- To provide concepts, definitions and interpretation of RCH indicators and its implications in planning and monitoring programme

## 7.1 Introduction

The International Conference on Population and Development (ICPD) Programme of Action, Paragraph 7.2, defines reproductive health as: “A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity, in all matters relating to the reproductive system and its functions and processes. Reproductive health therefore implies that people are able to have a satisfying and safe sex life and that they have the capability to reproduce and the freedom to decide if, when and how often to do so.”

Implicit components of health in this definition are:

- The right of men and women to be informed and to have access to safe, effective, affordable and acceptable methods of family planning of their choice, as well as other methods of their choice for regulation of fertility.
- The right of access to health-care services that will enable women to go safely through pregnancy and childbirth and provide couples with the best chance of having a healthy infant.

The reproductive and child health approach therefore ensures that:

- People have the ability to reproduce and regulate their fertility, and that couples have access to services for treatment of infertility.
- Women are able to go through pregnancy and childbirth safely. This means that women have access to antenatal, natal and postnatal care, safe-delivery services, and access to information on health problems and complications and their management during pregnancy, delivery and post-delivery period.
- The outcome of pregnancy is successful in terms of maternal and infant survival and well-being. This includes availability of services for neo-natal care and infant health care, for reducing risk of maternal mortality and to treat morbidity during the post-delivery period.

### Notes

- Couples are able to have sexual relations free of fear of pregnancy and of contracting diseases. This includes access to contraceptive services, information about contraception in general and about contraceptive methods, treatment for reproductive tract and sexually transmitted infections (RTI/STI) and safe abortion services.

The concept is in keeping with the evolution of an integrated approach to the programme aimed at improving the health status of women and young children, which was part of the family welfare programme, universal immunisation programme, oral rehydration therapy promotion, child survival and safe motherhood programme, acute respiratory infection control and so on. The RCH-I programme incorporated components relating to child survival and safe motherhood and included two additional components relating to STIs and RTIs. The programme also integrated all components related to fertility.

The ICPD held in Cairo in 1994 endorsed a rights-based approach to reproductive and sexual health. This includes support for reproductive health services that protect a woman's general health and well-being, that allow for well-informed decisions, and respect for individual choices. Attaining the goals of sustainable and equitable development requires that individuals are able to exercise control over their reproductive behaviour.

Reproductive rights embrace certain human rights that are already recognised in national laws, international human rights documents and other relevant UN consensus documents. These rights rest on the recognition of the basic right of all couples and individuals to decide freely and responsibly the number, spacing and timing of their children and to have the information and means to do so, and the right to attain the highest standard of sexual and reproductive health. They also include the right of all to make decisions concerning reproduction free of discrimination, coercion and violence (*ICPD 1994: Summary of the Programme of Action*).

Details of sexual and reproductive rights can be found in the International Planned Parenthood Federation (IPPF) publication titled *Charter on Sexual and Reproductive Rights* (IPPF, 1996).

## 7.2 National Rural Health Mission (NRHM)

Recognising the importance of health in the process of economic and social development and to improve the quality of life of its citizens, the Government of India launched the NRHM on 5 April 2005 for a period of seven years. The focus of the programme is to reduce maternal and child morbidity and mortality and the total fertility rate (TFR). The present NRHM subsumes the RCH programme. The mission seeks to improve rural health care delivery. It is operational in the whole country with a special focus on 18 states — Bihar, Jharkhand, Madhya Pradesh, Chhattisgarh, Uttar Pradesh, Uttarakhand, Orissa, Rajasthan, Jammu and Kashmir, Himachal Pradesh; and eight states in the north-east, including Assam.

The main aim of NRHM is to provide accessible, affordable, accountable, effective and reliable primary health care, especially to the poor and vulnerable sections of the population, women, children and the rural population. The mission aims at IMR and MMR reduction, providing universal access to public health services such as women's health, child health, water, sanitation and hygiene, immunisation and nutrition, prevention and control of communicable and non-communicable diseases including locally endemic diseases, access to integrated comprehensive primary health care, population stabilisation, gender and demographic balance, revitalising local health traditions and mainstreaming AYUSH and promotion of a healthy lifestyle.

### Notes

### 7.2.1 Objectives of the NRHM

The State Programme Implementation Plan under NRHM shall pursue the following objectives by 2012:

- Reduce IMR to 60 per 1000 live births
- Reduce MMR to less than 220 per 100,000 live births
- Reduce TFR to 2.1
- Increase proportion of institutional deliveries to 50 per cent by 2007, to 65 per cent by 2008 and to 75 per cent by 2009
- Improve health services through Mobile Medical Units to reach difficult areas and among disadvantaged population groups

### 7.2.2 Key Strategies Adopted in NRHM to Meet Goals

In order to provide accessible, affordable and equitable health services to the rural population with special focus on the underprivileged, the following key strategies are recommended:

- One of the most important flagship programmes under the NRHM is inclusion of *Janani Suraksha Yojana* (JSY) for families below the poverty line (BPL). This is effectively implemented to improve institutional deliveries through provision of referral transport, escort pregnant women to institutions and improved hospital care in High Focus states. The scheme has been extended to all pregnant women without conditions.
- Providing affordable, quality health care to the poorest households in the remotest regions.
- Increasing participation and ownership of the community by mobilising village health and sanitation committees (VHSC) and *Rogi Kalyan Samitis* (RKS).
- Improved management capacity: professionalising management and enhancing public health skills.
- Flexible financing: provision of untied funds at the institutional level.
- Innovations in human resource development for the health sector.
- Setting of standards norms with an inbuilt monitoring and evaluation framework.

The details of the core and supplementary strategies to be adopted in order to meet the Mission goals are available in the NRHM (2005–12) Mission Document of the Government of India at the web link: [www.mohfw.nic.in](http://www.mohfw.nic.in)

## 7.3 RCH Monitoring Indicators

### 7.3.1. Maternal Health-care Indicators

Promotion of maternal health during pregnancy, at the time of delivery and during the post-natal period, is the most important component of the RCH programme.

*Early registration of pregnancy* is an indicator which speaks about coverage, reach and surveillance of health workers and also awareness of the community to avail of antenatal services as early as possible. Early registration of pregnancy is important as it would bring women under the supervision of a service provider in the early stage of pregnancy. Early registration would also help to identify unwanted and unplanned pregnancies and

#### Notes

provide appropriate health-care services. It is expected that more than 60 per cent of the pregnancies should be registered in the first trimester. This also helps to identify expected complicated cases and referring them to the appropriate health facility.

In the following section, indicators of maternal care have been described.

### Antenatal Care (ANC)

Antenatal care (ANC) is an important component of the maternal health-care programme and includes the following:

- Early registration of pregnancy
- Provision of a minimum of three antenatal check-ups (includes history taking, physical examination, examination of abdomen to know growth, presentation and position of foetus, height and weight recording, urine/haemoglobin examination, blood pressure examination, tetanus toxoid immunisation, IFA tablets for prophylaxis/treatment of anaemia, etc.)
- Advice on food, nutrition and rest
- Advice on safe abortion services for those who require it
- Suspecting/identifying complications during pregnancy and prompt referral
- Motivating for institutional delivery or delivery at the hands of a skilled birth attendant
- Advice for breastfeeding and postnatal care, including newborn care
- Advice for birth spacing

### Notes

**Indicators of ANC Registration:** Percentage of pregnant women registered in a given area and year out of the total number of estimated pregnant women in the same area and same year. Percentage of pregnant women registered for ANC can be calculated as follows:

$$\frac{\text{Total no. of pregnant women registered for ANC in a given area and year}}{\text{Total no. of estimated pregnant women in a given area and year}} * 100$$

Total number of estimated pregnant women in a given area in a given year is usually taken as 10 per cent more than the total estimated births. This is done to accommodate for pregnancy wastage due to abortions and still births. Thus, the denominator can be obtained as follows:

**Step I:** No. of estimated births in an area in a given year will be:

$$\frac{\text{Crude birth rate}}{1000} * \text{Mid year population in the given area}$$

**Step II:** No. of estimated pregnant women in the given area in the given year will be:

$$\text{No. of estimated births} * 1.10$$

### For example:

The population of Mandla District is 970000 and the crude birth rate (CBR) is 30 births per 1000 population. A total of 28,500 pregnant women in the district were registered for ANC services in 'x' year, out of them 13,500 were registered during the first trimester (that is up to completion of 12 weeks).

In this population, total number of estimated pregnancies would be calculated as follows:

**Step I:**

$$\text{No. of estimated births} = \frac{30}{1000} * 970000$$

$$= 29100$$

**Step II:**

$$\text{No. of estimated pregnancies} = 29100 * 1.10$$

$$= 32010$$

Percentage of pregnant women registered for ANC services in Mandla is:

$$\frac{28500}{32010} * 100 = 89.0\%$$

*Importance of the indicator:* About 89 per cent of the pregnant women in Mandla registered for ANC during their pregnancy and the remaining 11 per cent did not do so. This indicator gives the programme manager an idea about the coverage of antenatal registration in that area. The manager can calculate ANC registration coverage for each block or PHC under him/her and identify the areas where the coverage is low and the reasons for poor performance. This would help him/her to take appropriate actions to improve the performance.

This indicator can be calculated annually from the Health Management Information System (HMIS) reports available with the district and also from institutional HMIS reports. This data can also be made available from surveys (for instance, DLHS, AHS survey).

#### Notes

#### **Percentage of Pregnant Women Registered for ANC in the First Trimester**

- a. In the case of *large surveys*, percentage of pregnant women registered for ANC in the first trimester is as given below:

$$\frac{\text{Total no. of pregnant women registered for ANC in the first trimester in a given area and year}}{\text{Total no. of pregnant women in a given area and year}} * 100$$

$$= \frac{13500}{32010} * 100$$

$$= 42.2\%$$

This means that just a little over two-fifths of the women in Mandla District were registered for ANC services during the first trimester of pregnancy.

- b. In the case of *data from HMIS*, percentage of pregnant women registered for ANC in the first trimester is calculated as shown below:

$$\frac{\text{Total no. of pregnant women registered for ANC in the first trimester in a given area and year}}{\text{Total no. of pregnant women registered for ANC in a given area and year}} * 100$$

$$= \frac{13500}{28500} * 100$$

$$= 47.4\%$$

This means that just a little over 47 per cent of the women in Mandla District were registered for ANC services during the first trimester of pregnancy, which is higher than that estimated from the survey data (42.2 per cent). Low ANC registration in the first trimester could be because of lack of awareness of the community and lack of outreach of the service providers. It is to be noted that the data on ANC from the public sector does not include women who receive ANC care from private sector health facilities (from where a large number of women access ANC services).

### Iron and Folic Acid Tablets Distribution

Anaemia is a condition characterised by reduction in the concentration of haemoglobin (Hb) in the blood. Anaemia during pregnancy is considered important as it contributes to maternal morbidity/mortality as well as adversely influences foetal outcome. Obstetric complications such as ante-partum and post-partum haemorrhages are relatively far more common among anaemic women. Under the RCH programme, haemoglobin estimation is done for all pregnant women who come for an ANC check-up. Further, for preventing anaemia, pregnant women with an Hb level of more than 11 grams are given 100 iron-folic acid (IFA) tablets to be consumed over hundred days (one tablet a day). For anaemic women with a Hb count of less than 11 grams, 200 tablets of IFA are given (two tablets a day for 100 days). Severely anaemic pregnant women (those with a haemoglobin level less than 7 grams) are referred to first referral units (FRUs) for further management, including blood transfusion.

### Notes

Distribution and consumption of IFA tablets are therefore two of the most important components of all antenatal services. It has been observed that although IFA tablets are distributed to women, there is no follow-up and monitoring. Hence, the consumption of IFA tablets too is a critical indicator for assessing the quality of antenatal services in a population.

Auxiliary nurse midwives (ANMs) during their home visits or during Village Health and Nutrition Days (VHNDs) and accredited social health activists (ASHAs) must regularly contact pregnant women and motivate them to consume IFA tablets. In addition, they must also keep a record of the pregnant women who have consumed IFA tablets. This information can be obtained from the regular HMIS report of ANMs.

**Percentage of Pregnant Women given IFA Tablets:** In Mandla District, an estimated 32,010 women were pregnant. Of them 28,500 were registered for ANC services and 28,000 were given 100 IFA tablets.

- a. In the case of *large surveys*, the percentage of pregnant women who received 100 IFA tablets can be computed as described below:

$$\frac{\text{Total no. of pregnant women who received 100 IFA tablets in a given area and year}}{\text{Total no. of estimated pregnant women in a given area and year}} * 100$$

**For example,** the coverage of IFA tablets among pregnant women in Mandla is:

$$\frac{28000}{32010} * 100 = 87.5\%$$

Thus, nearly 88 per cent of the pregnant women in Mandla were given 100 IFA tablets during pregnancy, and the remaining 13 per cent (approximately), did not receive any IFA tablets.

- b. In the case of *data from HMIS*, the percentage of pregnant women who received 100 IFA tablets can be calculated as shown below:

$$\frac{\text{Total no. of pregnant women who received 100 IFA tablets in a given area and year}}{\text{Total no. of pregnant women registered for ANC services in a given area and year}} * 100$$

**For example,** the coverage of IFA tablets among pregnant women in Mandla is:

$$\frac{28000}{28500} * 100 = 98.2\%$$

Thus, over 98 per cent of the pregnant women in Mandla were given 100 IFA tablets during pregnancy.

Using the above formula, the percentage of women who received two doses (or a booster dose) of tetanus toxoid and those who received at least three ANC check-ups during pregnancy can also be calculated. For this, the numerator will be the number of women who received specific services (say two doses of TT injection or three or more ANC check-ups) and the denominator will either be the total number of estimated pregnant women whose pregnancy resulted in a live or a still birth (in case of large-scale surveys) or the total number of pregnant women registered for ANC services (in case of HMIS) in a given area and year.

In case of HMIS, tracking can be done on a periodic basis (monthly, quarterly etc.).

### Full ANC Coverage

A woman is considered to have received full ANC if she completes at least three ANC visits, receives two doses or a booster dose of tetanus toxoid during pregnancy and IFA tablets for at least 100 days. Full ANC is found to have a complementary effect on the reduction of maternal mortality levels in a population. The data needed to compute this indicator can easily be obtained from the DLHS or AHS.

- a. In the case of *large surveys*, the percentage of pregnant women who received full ANC can be calculated as below:

$$\frac{\text{Total no. of pregnant women who received at least 3 ANC check-ups, 2 doses of TT injection and 100 IFA tablets in a given area and year}}{\text{Total no. of estimated pregnant women in a given area and year}} * 100$$

### Notes

- b. In the case of *data from HMIS*, the percentage of pregnant women who received full ANC can be calculated as below:

$$\frac{\text{Total no. of pregnant women who received at least 3 ANC check-ups, 2 doses of TT injection and 100 IFA tablets in a given area and year}}{\text{Total no. of pregnant women registered for ANC in a given area and year}} * 100$$

*Note:* Sometimes for calculating full ANC coverage, women who consumed 100 IFA tablets are taken into consideration instead of those who have received 100 IFA tablets.

### **Institutional Delivery (ID)**

Institutional delivery (ID) is a good indicator of the availability, accessibility and reach of MCH services. Existing literature has demonstrated that deliveries which take place in health facilities or at home, assisted by a skilled birth attendant (SBA) reduce maternal mortality significantly. Institutional deliveries are defined as deliveries conducted in a health facility such as a district hospital, Community Health Centre (CHC), Primary Health Centre (PHC), accredited Health Sub-centre or in a private hospital. An SBA is a gynaecologist, medical officer or an auxiliary nurse midwife (ANM)/lady health visitor (LHV) who has received special training for the management of normal delivery, identification and management of complications and prompt referral. A *Dai* or a traditional birth attendant (TBA), even if trained, is not considered a SBA.

Data on type of deliveries (institutional, home deliveries by SBAs) can be obtained from the annual HMIS data of the district. HMIS also provides this information for each block. This can be used to calculate the percentage of institutional deliveries. This information can also be obtained from survey data, such as the DLHS or AHS.

Percentage of institutional deliveries is given by:

$$\frac{\text{Total no. of institutional deliveries in a given area and year}}{\text{Total no. of estimated deliveries in a given area and year}} * 100$$

### **Postnatal Care (PNC)**

Postnatal care (PNC) begins immediately after the birth of a baby and continues up to 42 days (six weeks). This is a critical period for the mother as the majority of direct obstetric deaths are due to post-partum haemorrhage and sepsis. This period also has a significant bearing on the health of the newborn baby as the status of the mother's health (among other factors) influences the early initiation of breastfeeding and continuation of exclusive breastfeeding. It also helps in the care of the newborn, especially thermal regulation and prevention of infections.

Health workers are expected to make a minimum of three visits to the women during the post-natal period for various services. Of these, the first visit by the health worker is expected to take place within 48 hours, second visit during the first week and the third visit after 15 days, but within 42 days of the delivery. Since more and more deliveries are now institutional deliveries and women are discharged after 48 hours, it is expected that in such cases the ANM would include a minimum of two visits for clients. Keeping women in the hospital for a few days can be a good strategy to reduce maternal morbidity and mortality considerably, as many complications occur in the first two days of the delivery. Table 7.1 gives the estimated time from the onset of complications to death for a few selected obstetric complications.

### **Notes**

**Table 7.1: Estimated Average Time from Onset of Complication to Death**

| Complication       | Average Time from Onset of Complication to Death |
|--------------------|--------------------------------------------------|
| Haemorrhage        | One hour                                         |
| <i>Post-partum</i> | Two hours                                        |
| <i>Ante-partum</i> | Twelve hours                                     |
| Eclampsia          | Two days                                         |
| Obstructed labour  | Three days                                       |
| Infection          | Six days                                         |

**Percentage of women who received all three PNC visits**

Percentage of women who received all three postnatal visits is a good indicator of provision of comprehensive PNC services and can be calculated as given below:

$$\frac{\text{No. of women who received all 3 PNC visits after delivery but before 42 days in a given area and year}}{\text{No. of estimated deliveries in a given area and year}} \times 100$$

**Notes**

**Percentage of women who received PNC within the first 48 hours**

$$\frac{\text{No. of women who received PNC within 48 hours after delivery in a given area and year}}{\text{No. of estimated deliveries in a given area and year}} \times 100$$

**Percentage of women discharged within 48 hours of delivery from the health institution**

The percentage of women who are discharged early (within 48 hours of delivery) is a good indicator to assess the quality of available postnatal care in the population and can be calculated as below:

$$\frac{\text{No. of women who delivered at health facilities and were discharged within 48 hours from the health facility in a given area and year}}{\text{Total no. of women who delivered at health facilities in a given area and year}} \times 100$$

**Maternal Mortality Ratio (MMR)**

The World Health Organization (WHO) has defined maternal death as “The death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any causes related to or aggravated by the pregnancy or its management but not from accidental or incidental causes.”

The Maternal Mortality Ratio (MMR) is defined as the number of maternal deaths per 100,000 live births in a given area in a given year. This is the most commonly used impact indicator, as it expresses risk of deaths among women once they become pregnant. The MMR can be calculated from the registration records or the household survey. For calculating MMR, one needs:

- Total number of maternal deaths
- Number of births (direct information or CBR and the size of the population)

At present, MMR is estimated from the SRS data and at the state-level for large states for a three-year period (*Compendium of India's Fertility and Mortality Indicators 1971–2007*, Office of the Registrar General of India, 2009, New Delhi).

The MMR can be computed as below:

$$\frac{\text{Total no. of maternal deaths in a given area and year}}{\text{Total no. of live births in the given area and year}} * 100,000$$

#### **Limitations for the calculation of MMR from service records**

- Estimation of MMR from service statistics is hampered because many deaths are simply not recorded or reported and the cause of death is often misclassified.
- Considering the relatively low occurrence of maternal death, MMR cannot be validated for a small population (e.g. a block or a small district).
- Even though it is possible to estimate a fairly accurate MMR, this ratio tells us very little on what is useful for effective planning and monitoring.

**Important:** If one wants to calculate a fairly accurate MMR even with a 20 per cent margin of error, one has to study a sample size of 50,000 births (around 16.5 lakh population). This is very costly and time-consuming.

## Notes

**Table 7.2: Estimated MMR from SRS for India and its States, 1997–98 to 2007–09**

| India and Bigger States        | Period     |            |            |            |            |
|--------------------------------|------------|------------|------------|------------|------------|
|                                | 1997–98    | 1999–2001  | 2001–03    | 2004–06    | 2007–09    |
| <b>India</b>                   | <b>398</b> | <b>327</b> | <b>301</b> | <b>254</b> | <b>212</b> |
| Assam                          | 568        | 398        | 490        | 480        | 390        |
| Bihar/Jharkhand                | 531        | 400        | 371        | 312        | 261        |
| Madhya Pradesh/Chhattisgarh    | 441        | 407        | 379        | 335        | 269        |
| Orissa                         | 346        | 424        | 358        | 303        | 258        |
| Rajasthan                      | 508        | 501        | 445        | 388        | 318        |
| Uttar Pradesh/Uttaranchal      | 606        | 539        | 517        | 440        | 359        |
| <b>EAG and Assam Sub-total</b> | <b>520</b> | <b>461</b> | <b>438</b> | <b>375</b> | <b>308</b> |
| Andhra Pradesh                 | 197        | 220        | 195        | 154        | 134        |
| Karnataka                      | 245        | 266        | 228        | 213        | 178        |
| Kerala                         | 150        | 149        | 110        | 95         | 81         |
| Tamil Nadu                     | 131        | 167        | 134        | 111        | 97         |
| <b>South Sub-total</b>         | <b>187</b> | <b>206</b> | <b>173</b> | <b>149</b> | <b>127</b> |
| Gujarat                        | 46         | 202        | 172        | 160        | 148        |
| Haryana                        | 136        | 176        | 162        | 186        | 153        |
| Maharashtra                    | 166        | 169        | 149        | 130        | 104        |
| Punjab                         | 280        | 177        | 178        | 192        | 172        |
| West Bengal                    | 303        | 218        | 194        | 141        | 145        |
| Other                          | —          | 276        | 235        | 206        | 160        |
| <b>Other Sub-total</b>         | <b>184</b> | <b>229</b> | <b>199</b> | <b>174</b> | <b>250</b> |

Source: 1. Registrar General, India, 2009, *Compendium of India's Fertility and Mortality Indicators, 1971–2007*, Office of the Registrar General of India, New Delhi, p. 15.

2. Registrar General, India, 2011, *Sample Registration System, Special Bulletin on Maternal Mortality in India, 2007–08*, New Delhi, Office of Registrar General & Census Commissioner, India.

## Obstetric Service Indicators

In addition to the indicators mentioned above, there are a few more indicators that can be estimated for the area easily. Important among them are (i) the proportion of births taking place in facilities having basic and comprehensive emergency obstetric care (EmOC); and (ii) the percentage of caesarean section deliveries among all births.

**Table 7.3: Components of Basic EmOC and Comprehensive EmOC**

|                             |                                                                                                                                                                                                                                                                                                                                                             |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Basic EmOC Services         | <ul style="list-style-type: none"> <li>• Administer parental antibiotics</li> <li>• Administer parental oxytocic drugs</li> <li>• Administer parental anticonvulsants for pre-eclampsia and eclampsia</li> <li>• Perform manual removal of placenta</li> <li>• Perform removal of retained products</li> <li>• Perform assisted vaginal delivery</li> </ul> |
| Comprehensive EmOC Services | <ul style="list-style-type: none"> <li>• All Basic EmOC services</li> </ul> <p><b>Plus</b></p> <ul style="list-style-type: none"> <li>• Perform surgery (caesarean section)</li> <li>• Perform blood transfusion</li> </ul>                                                                                                                                 |

## Notes

### ***Proportion of all births in basic and comprehensive EmOC facilities***

In about 15 per cent of all deliveries, women are expected to experience obstetric complications and would require these services. However, this indicator only communicates information about the proportion of all births and not the proportion of obstetric complications managed by these institutions.

### ***Percentage of caesarean section out of all births***

About 5 per cent of all pregnant women are expected to require caesarean section service. This means that one-third of the women who develop serious complications will need treatment in a comprehensive EmOC facility ( $5/15 = 0.33\%$ ). However, some doctors, especially in private facilities, perform caesarean sections whether these are necessary or not. In some cases, women prefer a caesarean section to a normal delivery. Such factors can result in high caesarean section rates.

Like any major surgery, a caesarean section carries the risk of injury or death for the women who undergo it. However, in case of complications such as obstructed labour, the benefits to the women outweigh the risks. In such cases, if a caesarean section is not performed, a woman can die or develop serious complications. However, considering all pros and cons, the World Health Organization (WHO) adopted 5 per cent of all births, the minimum acceptable level and 15 per cent of all births, as the maximum acceptable level. A low figure for caesarean sections in an area would indicate that women with obstetric complications are dying due to either lack of availability of services or not reaching the facility in time. A detailed description can be seen in Table 7.4.

**Table 7.4: Indicators for Increasing the Pace of MMR Reduction**

| S.No.  | Indicator                                            | Description                                                                                                                  | Numerator                                                                                                                                         | Denominator                                                                               | Acceptable Level                                  |
|--------|------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|---------------------------------------------------|
| 1.&2.* | Availability of EmOC (national or sub-national)      | Ratio of EmOC facilities to population and geographical distribution of facilities                                           | No. of facilities in area providing basic or comprehensive EmOC                                                                                   | Population of area divided by 500,000                                                     | ≥ 5 EmOC facilities per 500,000 population        |
|        |                                                      |                                                                                                                              | No. of facilities in area providing comprehensive EmOC                                                                                            | Population of area divided by 500,000                                                     | ≥ 1 comprehensive facility per 500,000 population |
| 3.     | Proportion of all births in EmOC facilities          | Proportion of all births in population in EmOC facilities                                                                    | No. of women giving birth in EmOC facilities in specified period                                                                                  | Expected no. of births in area in same period                                             | Recommended level to be set locally               |
| 4.     | Met need for EmOC                                    | Proportion of women with major direct obstetric complications treated at EmOC facilities                                     | No. of women with major direct obstetric complications treated in EmOC facilities in specified period                                             | Expected no. of women with severe direct obstetric complications in area in same period** | 100%                                              |
| 5.     | Caesarean section as a proportion of all births      | Proportion of all births in population by caesarean section in EmOC facilities                                               | No. of caesarean sections in EmOC facilities in specified period                                                                                  | Expected no. of births in area in same period                                             | 5-15%                                             |
| 6.     | Direct obstetric case fatality rate                  | Proportion of women with major direct obstetric complications who die in EmOC facilities                                     | No. of maternal deaths due to direct obstetric causes in EmOC facilities in specified period                                                      | No. of women treated for direct obstetric complications in EmOC facilities in same period | <1%                                               |
| 7.     | Intrapartum and very early neonatal death rate       | Proportion of births that result in an intrapartum or a very early neonatal death within the first 24 hrs in EmOC facilities | No. of intrapartum deaths (fresh stillbirths; ≥ 2.5 kg) and very early neonatal deaths (≥ 24 hr; ≥ 2.5 kg) in EmOC facilities in specified period | No. of women giving birth in EmOC facilities in same period                               | To be decided                                     |
| 8.     | Proportion of maternal deaths due to indirect causes | Percentage of all maternal deaths in EmOC facilities due to indirect causes                                                  | No. of maternal deaths due to indirect causes in EmOC facilities in specified period                                                              | All maternal deaths (from direct and indirect causes) in EmOC facilities in same period   | None set                                          |

\* Indicators 1 and 2 involve the same calculations, with data on the corresponding regional population and facility instead of aggregated national data.

\*\* Equal to 15% of expected births in the same area and period.

### 7.3.2 Child Health Indicators

Infant and child mortality levels in a population reflect the level of socio-economic development and quality of life of the population. The Child Mortality Rate (CMR) and Infant Mortality Rate (IMR) are often used for monitoring and evaluating population and health programmes and policies being pursued by the state. Efforts made by the Department of Health Family Welfare have brought IMR down to 59/1000 live births (SRS 2007; *Compendium of India's Fertility and Mortality Indicators 1971–2007*, Office of the Registrar General of India, 2009, New Delhi). However, the SRS estimates for 2007 show that the rural mortality rates are considerably higher than the urban mortality rates (61 versus 37 per 1000 live births). The post-neonatal mortality rate (PNMR) is almost twice as high in rural areas as in urban areas (40.4 versus 21.8), and CMR is almost thrice as high in rural areas as in urban areas. The under-five mortality rate (U5MR) is twice as high in rural areas as in urban areas. Reduction in IMR and CMR ( ${}_4q_1$ ) levels in a population calls for a multipronged approach for providing effective preventive, promotive and curative services. Increased awareness and utilisation of services related to child care (including immunisation) help bring down IMR and CMR levels in the population. Primary immunisation of children before one year of age with BCG, polio, DPT and the measles vaccine are important interventions to improve child survival and reduce infant mortality and morbidity.

Treatment practices for children suffering from acute respiratory infections (ARIs) and diarrhoea help in assessing the success of national health programmes in achieving their goals of reducing the mortality impact of these illnesses. Information can be obtained from large-scale surveys regarding the treatment of children suffering from these two diseases.

#### Percentage of Children Fully Immunised

Children in the age group 12–23 months are generally considered for calculating immunisation coverage. A fully immunised child is one whose parents/caregivers have followed the national immunisation schedule strictly, making sure s/he has received the BCG vaccine, three doses of DPT, along with polio and measles immunisation before attaining 1 year of age.

Percentage of children fully immunised is given by:

$$\frac{\text{Total no. of children aged 12–23 months who have received BCG, all 3 doses of DPT and polio and measles immunisation in a given area and year}}{\text{Total no. of children aged 12–23 months in a given area and year}} * 100$$

This information can be obtained from large-scale surveys such as DLHS and AHS. Complete immunisation of children reflects the coverage, regularity and reach of services especially through the organisation of VHNDs.

Using the same formula, one can compute immunisation coverage of individual vaccines. For this, in the numerator, consider only the number of children who have received a specific vaccine and the denominator remains the same as the above formula.

#### Notes

**For example,** to calculate the percentage of children who have received the BCG vaccine we use the following:

$$\frac{\text{Total no. of children aged 12–23 months who have received BCG in a given area and year}}{\text{Total no. of children aged 12–23 months in a given area and year}} * 100$$

One can calculate for the remaining vaccines as above, replacing the figures for BCG (used above) with those of the vaccine/immunisation being calculated for.

### **Treatment Seeking for Acute Respiratory Infections and Diarrhoea**

#### ***Percentage of Children who Received Treatment for ARI***

$$\frac{\text{Total no. of children under age 'X' years who had symptoms of ARI and who received treatment in a given area and year}}{\text{Total no. of children under age 'X' years with symptoms of ARI in a given area and year}} * 100$$

#### ***Percentage of Children who Received Treatment for Diarrhoea***

$$\frac{\text{Total no. of children under age 'X' years suffering from diarrhoea and who received treatment in a given area and year}}{\text{Total no. of children under age 'X' years suffering from diarrhoea in a given area and year}} * 100$$

'X': Could be 3 years or 5 years and reference period for disease is generally two weeks.

### **Malnutrition among Children**

India is home to approximately 158 million children under six years of age, and accounts for nearly one-fifth of the world's young children. Malnutrition is the most widespread condition affecting the health of children. Malnutrition in infancy and childhood leads to stunted growth. It makes the child susceptible to infection, recovery is slower and mortality is higher. Undernourished children do not grow to their full potential. Growth monitoring of children below the age of six years through *Anganwadi* workers (AWW) is an important component of the Integrated Child Development Services (ICDS). The World Health Organization has introduced new growth standards and growth charts, which have been approved by the Government of India and are now being used all over the country.

### **Birth Weight**

Percentage of newborns with birth weight recorded can be calculated as follows:

$$\frac{\text{Total no. of newborns whose birth weight was recorded in a given area and year}}{\text{Total no. of live births in a given area and year}} * 100$$

This can also include newborns who were weighed on the day of birth.

### **Notes**

## New WHO Growth Standards and Growth Charts

In the new growth charts, grades of malnourishment have been merged and colour-coded. Grade I and Grade II malnutrition have been merged, and children suffering from this level of malnutrition will henceforth be known as 'moderately malnourished'. This new grade is shown in yellow in the chart. Grade III and Grade IV have been merged and shown as 'severely malnourished' in orange. Children coded green and above are normal children. From the total growth charts available with *Anganwadis*, one can calculate the percentage of children as normal, moderately malnourished and severely malnourished. According to the recently conducted NFHS during 2005–06, 43 per cent of the children below five years of age in India are underweight, this includes 16 per cent of children who are severely underweight. Further, about 48 per cent Indian children under five years of age are stunted and 8 per cent wasted (Z-score = –2 SD), which includes 24 per cent severely stunted and a little over 6 per cent severely wasted (Z-score = –3 SD).

The nutritional status of children is assessed by the following standard indices of physical growth expressed in standard deviation units (Z-scores) from the median of the reference population:

**Height-for-age (stunting):** The height-for-age is an indicator of linear growth retardation and cumulative growth deficits. Children whose height-for-age Z-score is below minus 2 standard deviations (–2 SD) from the median of the reference population are considered short for their age (stunted) and are chronically malnourished. Children below minus 3 standard deviations (–3 SD) from the median of the reference population are considered to be severely stunted. Stunting reflects failure to receive adequate nutrition over a long period of time and is also affected by recurrent chronic illnesses. It thus, represents the long-term effect of malnutrition in a population and does not vary according to recent dietary intake.

**Weight-for-height (wasting):** This measures body mass in relation to body length and describes current nutritional status. Children whose Z-score is below minus 2 standard deviations (–2 SD) from the median of the reference population are considered thin (wasted) for their height and are malnourished. Children below minus 3 standard deviations (–3 SD) from the median of the reference population are considered to be severely wasted. Wasting represents failure to receive adequate nutrition in the period immediately preceding the survey and may be the result of inadequate food intake or a recent episode of illness causing weight loss and the onset of malnutrition.

**Weight-for-age (underweight):** This is a composite index of the height-for-age and weight-for-height. It takes into account both acute and chronic malnutrition. Children whose Z-score is below minus 2 standard deviations (–2 SD) from the median of the reference population are considered underweight. Children below minus 3 standard deviations (–3 SD) from the median of the reference population are considered to be severely underweight.

## Percentage of Underweight Children

The percentage of underweight children can be calculated as shown below:

a. Moderately underweight

$$\frac{\text{Total no. of children under 5 years whose Z score for weight-for-age is below } -2 \text{ SD in a given population}}{\text{Total no. of children under 5 years in a given population}} * 100$$

## Notes

b. Severely underweight

$$\frac{\text{Total no. of children under 5 years whose Z score for weight-for-age is below } -3\text{SD in a given population}}{\text{Total no. of children under 5 years in a given population}} * 100$$

*Note:* Similarly one can also calculate percentages of children moderately/severely stunted/wasted in a population.

## 7.4 Family Planning

India, currently the second most populous country in the world, sustains about 17 per cent of the world's population in less than three per cent of the earth's land area. Realising the need to check its growing population, India became the first country in the world to launch a family planning programme in 1951. The successive Five-Year Plans have provided the policy framework and funding for the development of nationwide health care infrastructure and manpower. After being re-christened the Family Welfare Programme in 1978, MCH services began to receive greater attention. The centrally-funded programme has been providing states with additional infrastructure, manpower and consumables needed for the delivery of services.

### Notes

The family planning programme is now an integral component of the RCH programme. The ICPD's recommendations have been followed and there has been a paradigm shift in programme planning and management. The target-oriented approach has been replaced with a client-centred approach to arrive at expected level of achievement (ELA) in spacing and permanent methods, through decentralised planning, rights and cafeteria approach. A **National Population Policy (NPP)** was announced in 2000 that articulated the new broad-based approach towards population stabilisation, and set long-term policy goals with a focus on the underserved people.

#### Family Planning Indicators

**Contraceptive Prevalence Rate (CPR):** This can only be calculated based on data from a large-scale household survey and is given by:

CPR (any method)

$$\frac{\text{No. of users of any method of family planning by currently married women in a given area and year}}{\text{Currently married women aged 15–49 years in a given area and year}} * 100$$

The CPR for any individual method (e.g. sterilisation, IUD, oral pills, condoms, traditional method etc.) can also be calculated by using the above formula. However, in such instances, only the numerator will change and it will be the number of users of a specific method for which method-specific contraceptive prevalence rate needs to be calculated.

The data from HMIS gives method-wise information on acceptors and using this data, a few indicators as described below can be calculated:

**For example:**

***Percentage of sterilisation acceptors***

$$\frac{\text{Total no. of sterilisation acceptors in a given area and year}}{\text{Currently married women aged 15–49 years in a given area and year}} * 100$$

***Percentage of IUD acceptors***

$$\frac{\text{Total no. of IUD acceptors in a given area and year}}{\text{Currently married women aged 15–49 years in a given area and year}} * 100$$

*Note:* Currently married women are the same as eligible women given in official records.

**Unmet Need for Family Planning:** Unmet need for family planning is an important indicator for assessing the potential demand for family planning services. The unmet need for family planning is of two types – for limiting and for spacing. Married women who are not using any contraceptive method but who do not want any more children are defined as having ‘unmet need for limiting’. Married women who are not using any contraceptive method but want to wait for two or more years before having another child are defined as having ‘unmet need for spacing’.

The sum of the unmet need for limiting and the unmet need for spacing is the ‘unmet need for family planning’. Current contraceptive users are considered to have a ‘met need for contraception’. The total demand for family planning is the sum of unmet need and met need.

**Notes**

**Unmet need for spacing methods**

**Numerator:**

- Married women whose pregnancy was mistimed.
- Women in amenorrhea who are not using any method of family planning and whose last childbirth was mistimed or whose last childbirth was unwanted but now they say that they want more children.
- Fecund women who are neither pregnant nor in amenorrhea, who are not using any method of family planning and who want to wait for two or more years for the next birth. This also includes fecund women who are not using any method of family planning and are unsure whether they want another child or who want another child but are unsure when to have it.

**Denominator:** All currently married women in the reproductive age group 15–49 years.

## Notes

### Unmet need for limiting methods

#### Numerator:

- a. Married women whose pregnancy was unwanted.
- b. Women in amenorrhea who are not using any method of family planning, whose last child was unwanted and who do not want any more children.
- c. Fecund women who are neither pregnant nor in amenorrhea who are not using any method of family planning and who do not want any more children. Women who are pregnant and women in amenorrhea who became pregnant while using some method are excluded from the unmet need category.

**Denominator:** All currently married women in the reproductive age-group 15–49.

Information of unmet need can be calculated from special surveys (for example, NFHS provides information on the unmet need for the state; DLHS provides information on the unmet need for the state as well as for the district).

Unmet need specifies the percentage of couples who have understood the importance of family planning and who want to limit their family either by spacing or by limiting methods and who need services to be provided to them.

## 7.5 Summary

- This module provides detailed information on various reproductive and child health indicators with suitable examples.
- The indicators discussed in the modules can be obtained for the districts using data from HMIS as well as large-scale surveys such as DLHS and AHS.
- The programme managers can assess the status and quality of RCH services in their area (district or block) and take necessary steps for improvement.

## APPENDIX

### Selected Reproductive and Child Health Indicators, Madhya Pradesh and Selected Districts, 2007-08

| Indicators                                                                                  | Madhya Pradesh | Chhatarpur | West Nimar | Mandla | Rajgarh | Satna |
|---------------------------------------------------------------------------------------------|----------------|------------|------------|--------|---------|-------|
| <b>Maternal Health</b>                                                                      |                |            |            |        |         |       |
| Percentage of women registered in the 1 <sup>st</sup> trimester during their last pregnancy | —              | 35.6       | 41.4       | 27.9   | 42.0    | 24.6  |
| Percentage of women who had at least 3 ANC visits during the last pregnancy                 | 34.2           | 28.6       | 40.7       | 28.0   | 41.1    | 27.7  |
| Percentage of women who got at least one TT injection during their last pregnancy           | 60.4           | 64.9       | 66.3       | 58.2   | 68.6    | 53.7  |
| Percentage of institutional deliveries                                                      | 47.1           | 50.7       | 42.3       | 28.5   | 50.0    | 42.4  |
| Percentage of home deliveries assisted by a doctor/nurse/LHV/ANM                            | 5.7            | 5.0        | 5.2        | 1.6    | 8.6     | 6.5   |
| Percentage of women who received PNC within 48 hours of delivery                            | —              | 24.2       | 30.7       | 31.6   | 40.3    | 37.6  |
| <b>Current Use of Family Planning</b>                                                       |                |            |            |        |         |       |
| <b>Percentage of currently married women aged 15–49</b>                                     |                |            |            |        |         |       |
| Any method                                                                                  | 56.2           | 49.1       | 65.7       | 58.7   | 46.4    | 48.8  |
| Any modern method                                                                           | 53.1           | 42.3       | 64.5       | 56.9   | 41.9    | 45.9  |
| Female sterilisation                                                                        | 45.1           | 37.7       | 57.4       | 50.4   | 36.3    | 39.2  |
| Male sterilisation                                                                          | 0.8            | —          | 0.6        | 3.4    | 0.4     | 2.2   |
| IUD                                                                                         | 0.5            | 0.1        | 0.4        | 0.4    | 0.2     | 0.4   |
| Pill                                                                                        | 1.9            | 0.5        | 2.4        | 1.4    | 0.9     | 1.3   |
| Condom                                                                                      | 4.6            | 3.8        | 3.7        | 1.2    | 4.0     | 2.6   |
| <b>Unmet Need for Family Planning</b>                                                       |                |            |            |        |         |       |
| Percentage of unmet need for spacing                                                        | 8.6            | 12.2       | 6.5        | 5.7    | 12.1    | 15.6  |
| Percentage of unmet need for limiting                                                       | 10.7           | 16.6       | 7.4        | 9.2    | 12.0    | 14.9  |
| Total unmet need for FP                                                                     | 19.3           | 28.8       | 13.9       | 14.9   | 24.1    | 30.5  |
| <b>Child Immunisation</b>                                                                   |                |            |            |        |         |       |
| <b>Percentage of children aged 12–23 months who received</b>                                |                |            |            |        |         |       |
| Full immunisation (BCG, 3 doses each of DPT, polio and measles)                             | 36.2           | 30.1       | 50.5       | 30.5   | 26.4    | 25.6  |
| BCG                                                                                         | 84.2           | 80.1       | 79.2       | 85.2   | 81.7    | 84.6  |
| Three doses of polio vaccine                                                                | 55.1           | 52.1       | 62.8       | 54.3   | 43.7    | 54.8  |
| Three doses of DPT vaccine                                                                  | 47.4           | 31.8       | 62.5       | 47.2   | 49.0    | 45.8  |
| Measles vaccine                                                                             | 57.7           | 53.6       | 64.9       | 69.4   | 52.1    | 58.4  |

Contd. ...

| Indicators                                                                                                   | Madhya Pradesh | Chhatarpur | West Nimar | Mandla | Rajgarh | Satna |
|--------------------------------------------------------------------------------------------------------------|----------------|------------|------------|--------|---------|-------|
| <b>Vitamin A Supplements</b>                                                                                 |                |            |            |        |         |       |
| Percentage of children aged 9–35 months who received at least one dose of Vitamin A                          | 39.5           | 27.8       | 56.0       | 55.9   | 22.0    | 49.9  |
| Percentage of children aged 21 months or more who received three doses of Vitamin A                          | —              | 0.0        | 12.8       | 11.5   | 1.2     | 10.0  |
| <b>Treatment of Childhood Diseases<br/>(Children under 3 years based on the last two surviving children)</b> |                |            |            |        |         |       |
| Percentage of children with diarrhoea in the last two weeks who received ORS                                 | 29.9           | 12.1       | 47.5       | 33.0   | 23.6    | 43.3  |
| Percentage of children with diarrhoea in the last two weeks who were given treatment                         | 63.9           | 69.0       | 80.5       | 54.8   | 70.3    | 57.2  |
| Percentage of children with acute respiratory infection/fever in the last two weeks who were given treatment | 62.6           | 56.6       | 80.4       | 46.3   | 78.3    | 61.2  |
| Percentage of children who had a check-up within 24 hours after birth (based on last live birth)             | —              | 25.2       | 29.3       | 31.4   | 40.6    | 39.6  |
| Percentage of children who had a check-up within 10 days after delivery (based on last live birth)           | —              | 23.0       | 30.3       | 36.8   | 41.0    | 38.6  |

Source: International Institute for Population Sciences, 2008, *District-level Household Survey, 2007–08*, Fact Sheet India, IIPS, Mumbai.

# Levels of Living

## Learning Objectives

- To understand the concepts of poverty, poverty line, incidence of poverty, and the difference between estimating the poor and identifying the poor
- To find data sources at sub-national levels to estimate poverty
- To understand the procedure adopted for the identification and enumeration of the poor

## 8.1 Introduction

A 'decent life for all' has been the prime objective of every development practitioner in society, be it individual welfare or the State. Increasing social science research in this area clearly indicates that there is a need to ensure a 'decent living standard' for all. The crude meaning of 'decent life' is confined to accessing the 'basic necessities' for survival<sup>1</sup>. Literature on the 'capability approach', 'human development' and 'development as freedom' is an extension of this.

The Gross Domestic Product (GDP) has been accepted as an important yardstick of development. However, scholars hold the view that an indices-based measure (PQLI, HDI<sup>2</sup> etc.) is the refined way of measuring development. The acceptability of indices brought the shift from 'single variable' base indicator to 'index base' indicator for measuring development. Over time, it has been recognised that income is not the proper index of development. One also needs to incorporate the different views on the concept of 'freedom' and 'social justice' to measure development. The new Multi-dimensional Poverty Index (MPI) initiated by the Oxford Poverty and Human Development Initiative (OPHI) and used in human development reports, is an improvement over the Human Development Index (HDI) and the Human Poverty Index (HPI). The MPI is an index of acute multidimensional poverty. It reflects deprivations in different fields, from education to health outcomes to assets and services. The MPI assesses the nature and intensity of poverty at the individual level. Poor people are those who have multiple deprivations and the extent of their poverty is measured by the extent of their deprivations. The MPI can be used as an analytical tool to identify the most vulnerable people, show aspects in which they are deprived and help to reveal the interconnections among deprivations. This enables policy-makers to target resources and design policies more effectively.

<sup>1</sup> Scholars have different opinions about the concept, 'decent standard of living'. There is a plethora of literature on this issue, but here we are confined to the crude concept of 'decent standard of living' which is economic well-being.

<sup>2</sup> Human Development Index measures the achievement of a group/region in terms of a composite variable. The UNDP has been preparing the HDI, Human Poverty Index, Gender Development Index and Gender Empowerment Measure, every year at the national, sub-national and state levels. Initiatives have been taken to prepare similar types of reports at the district-level for all states. For details, kindly visit the UNDP website or refer to Thorat, Mahamallik and Venkatesan, 2007, *Human Poverty and Socially Disadvantaged Groups in India: Discussion Paper Series- 18*, Human Development Resource Centre, UNDP, India, New Delhi. A chart and methodology of construction of Human Development and Human Poverty Index is given in detail in Appendices 5 and 6 of the above-mentioned text.

## Notes

The responsibility of ensuring a 'decent life' has also gone beyond the respective states and government. Developed nations, developing nations and civil society organisations (CSOs) play a critical role in ensuring a 'decent life' for all. The recent campaign on MDGs is a unique example of civil society's initiative for ensuring a 'decent life'.

However, income remains a major concern in all developing and underdeveloped countries despite all debates on PQLI and HDI to measure development. Therefore, the issue of poverty is as important an aspect as it was, a few years ago, in the context of measuring development. In addition to other indicators, income—or its proxy, expenditure—still remains the core parameter to assess the achievement level. Expenditure data has been used to estimate poverty in India. Therefore, it is necessary to understand the concept and measurements of poverty as an important parameter of the level of living.

There are two ways of estimating poverty in India (i) estimation of poverty based on poverty line and consumption expenditure, and (ii) identification and enumeration of the poor. The 'poverty line' is given by the Planning Commission and the level of consumption expenditure is collected by the National Sample Survey Organisation (NSSO) through a periodic sample survey. This enables us to estimate the number of poor persons or households. However, based on certain criteria of exclusion (13 criteria)<sup>3</sup>, the Ministry of Rural Development (MoRD) tries to identify the poor through the census method. There is a difference between estimating the poor and identifying the poor. Before discussing methods for estimating and identifying the poor, it is important to understand the nuances of poverty.

## Notes

### 8.2 Concept of Poverty

Poverty is the condition of lacking basic human needs such as minimum food or nutrition, health, education, safe drinking water, clothing and shelter because of the inability to afford them. This is also referred to as absolute poverty or destitution. Relative poverty is the condition of having fewer resources or less income than others. While absolute poverty relates to the proportion of people below the level of minimum need, relative poverty is concerned about the level of inequality.

One approach is to think of one's well-being as the command over commodities in general, so people are better off if they have a greater command over resources. The focus is on whether households or individuals have enough resources to meet their basic needs. In this approach, money, either as income or as expenditure, is central to the poverty issue. This conventional way of looking at or measuring poverty in terms of money is the starting point for the analysis of poverty.

The second approach emphasises the 'ability to obtain' minimum needs for survival, that is, enough food or shelter or health care or education. In this view, the analyst needs to go beyond the traditional monetary measures of poverty. Prof. Amartya Sen (1987) has tried to articulate well-being (and poverty) in a broader framework; he argues that well-being comes from a "capability" to function in society. Capability gives ownership over resources and income. Thus, poverty arises when people lack key capabilities. Viewed in this way, poverty is a multidimensional phenomenon and less amenable to simple solutions.

<sup>3</sup> The 13 indicators are: Size of landholding, type of house, availability of clothing per person, food security, sanitation, literacy, possession of consumer durables, means of livelihood, status of household labour, status of children between 6-14 years, type of indebtedness, reasons for migration and preference for assistance.

## 8.3. Estimation of Poverty

The first step in estimating poverty is defining an indicator of well-being such as income or consumption per capita. In the absence of reliable income data at the individual level in India, the government as well as social scientists use 'expenditure data' as a close proxy of 'income' for poverty estimation. Further, one of the important reasons to prefer expenditure over income for poverty estimation is its stability. In other words, the fluctuation in consumption data is less as compared to income.

For estimation of poverty, let us assume that a measure of household well-being is chosen, say consumption expenditure. The next step is to choose a poverty line. Households whose consumption expenditure falls below that line will be considered poor. The most acceptable way of counting the poor in India is by segregating the people who do not have the capacity to spend the prescribed amount on food in a month. So, two variables are required for the estimation of the poor, (i) poverty line, and (ii) monthly per capita consumption expenditure.

### 8.3.1 Poverty Line

A 'poverty line' divides the poor from the non-poor. The poverty line used in India has been partly normative and partly behavioural. It has been estimated by converting the minimum required consumption level of food, clothing, shelter, fuel, and health and education expenditure to a cut-off point of income, and those earning below this cut-off are called poor. The concept of poverty line was attempted for the first time in India in 1962, based on the concept of 'balanced diet'. The 'national minimum' for each household was fixed at Rs. 100 and Rs. 125 for rural and urban households respectively. This national minimum excludes expenditure on health and education, which are two important components of a decent standard of living. According to our Constitution and the commitments of a welfare State, these facilities are expected to be provided by the State.

Dandekar and Rath used the calorie measure to redefine the poverty line in 1971. However, they took the help of the national minimum criteria and adjusted their calorie-based poverty line for rural and urban areas. Therefore, the poverty line remains the same as it was before. This is just a new method or argument to define the poverty line. Incidentally, the proposed national minimum criteria by the Working Group in 1962 was based on a broad judgment of basic needs and was in no way scientifically related to nutritional requirements, although it covers the calories.

The Task Force defined the poverty line as the per capita expenditure level at which the average per capita, per day calorie intake was 2,435 calories in rural areas and 2,095 calories in urban areas. The Task Force used the age and sex, activity-specific calorie allowance recommended by the Nutrition Expert Group (1968) to estimate the average daily per capita requirements for rural and urban areas (Planning Commission, 1993)<sup>4</sup>. Considerable literature has been published during this period due to the availability of data and scientific methodology. However, this calorie requirement was rounded off to 2,400 calories and 2,100 calories for rural and urban areas respectively for purposes of convenience. The 28<sup>th</sup> Round (1973–74) of NSSO data relating to household consumption expenditure, was used to estimate the equivalent value of expenditure incurred by a household/person. It was estimated that one has to spend Rs. 49.09 to get 2,400 calories and Rs. 56.64 to get 2,100 calories in rural and urban areas respectively.

<sup>4</sup> Planning Commission, 1993, *Report of the Expert Group on Estimation of Proportion and Number of Poor*, Perspective Planning Division, Government of India, New Delhi.

#### Notes

The present poverty line concentrates mainly on the purchasing power required to meet the prescribed calories. However, it neglects one main issue—that of nutritional status. There is no link established between calories required, expenditure required and nutrition level. Against this backdrop, the Expert Group decided to adopt the Mixed Reference Period (MRP) based estimates of consumption expenditure as the basis for defining poverty lines in the future. The Expert Group estimated a new poverty line, which takes into account the consumption expenditure and the expenditure on health and education (see Government of India, 2009)<sup>5</sup>.

### Consumption Expenditure

The NSSO collects two different sets of consumption expenditure data, namely consumption data collected using 30 days recall period and data collected using 365 days recall period. The 365 days recall period is for five less frequently used items such as clothing, footwear, durable goods, education and institutional medical expenses and the 30 day recall period is for the remaining items. The former consumption distribution is termed Uniform Reference Period (URP) and the latter is termed Mixed Reference Period (MRP). The URP is mainly used to estimate poverty in India [For details see Sen (2000) and Sen and Himanshu (2004)]<sup>6</sup>.

### 8.3.2 Sources of Data

As discussed above, two sets of information are required for the estimation of poverty:

#### Notes

(i) Poverty line

(ii) Monthly per capita consumption expenditure

While information relating to the poverty line is provided at regular intervals by the Planning Commission, Government of India, the data relating to the monthly per capita consumption expenditure (MPCE) can be estimated from the 'level and pattern of consumption expenditure' series collected by NSSO at regular intervals.

### 8.3.3 Headcount Ratio of Poverty (HRP)

The most widely-used measure for the estimation of poverty is the *headcount ratio*, which measures the proportion of the population that is counted as poor, often denoted by  $P_0$ .

Formally,

$$P_0 = \frac{n}{N}$$

where  $n$  is the number of poor (people below the poverty line) and  $N$  is the total population (or sample). This is commonly expressed in terms of a percentage.

**Table 8.1: Hypothetical Data for Calculating the Headcount Ratio**

| Individuals             | Expenditure of Each Individual |     |     |     |     | Headcount Ratio of Poverty (in Percentage) |
|-------------------------|--------------------------------|-----|-----|-----|-----|--------------------------------------------|
|                         | 1                              | 2   | 3   | 4   | 5   |                                            |
| Expenditure in Region A | 100                            | 80  | 150 | 190 | 220 | 40                                         |
| Expenditure in Region B | 120                            | 115 | 150 | 190 | 250 | 40                                         |

Poverty Line = 125

Headcount ratio of poverty for **Region A**

$$= (2/5) = 0.4 \text{ per cent}$$

Headcount ratio of poverty for **Region B**

$$= (2/5) = 0.4 \text{ per cent}$$

<sup>5</sup> Government of India, 2009, *Report of the Expert Group to Review the Methodology for Estimation of Poverty*, Planning Commission.

<sup>6</sup> Sen, A. and Himanshu, 2004, *Poverty and Inequality in India*, *Economic and Political Weekly*, September 18.

Table 8.1 provides a hypothetical situation where two different geographic regions with a dissimilar distribution of consumption expenditure yield similar estimates of poverty. There are five individuals each in Region A and Region B and the distribution of consumption expenditure is different in these regions. By applying the Rs. 125 as the cut-off point of the poverty line, it is estimated that 40 per cent of the population are living below the poverty line in both the regions.

Using unit data from the National Sample Survey, the estimates of percentage of population living below poverty line for rural and urban areas in the State of Madhya Pradesh have been provided. A separate poverty cut-off point is used for rural and urban areas. The numerator indicates the number of people who are living below the threshold poverty line, whereas the denominator indicates the total population in 2004–05. Based on this, it was found that 37 per cent of the rural population in Madhya Pradesh is living below poverty line compared to 43 per cent in urban Madhya Pradesh.

Headcount ratio of poverty for **Rural Madhya Pradesh** =  $(16931740/46018374) \times 100$   
= 36.8%

Headcount ratio of poverty for **Urban Madhya Pradesh** =  $(6010730/14069192) \times 100$   
= 42.7%

Based on the data available from the Planning Commission and NSSO, the headcount ratio of poverty for rural and urban areas separately at three points of time has been estimated and plotted on a graph. It is clear from both graphs that the headcount ratio of poverty in both rural as well as urban areas has been declining. However, the rates of decrease vary across social groups (see Figures 8.1 and 8.2 ).

**Figure 8.1: Trend of Poverty in Rural India, 1983 to 2004–05**

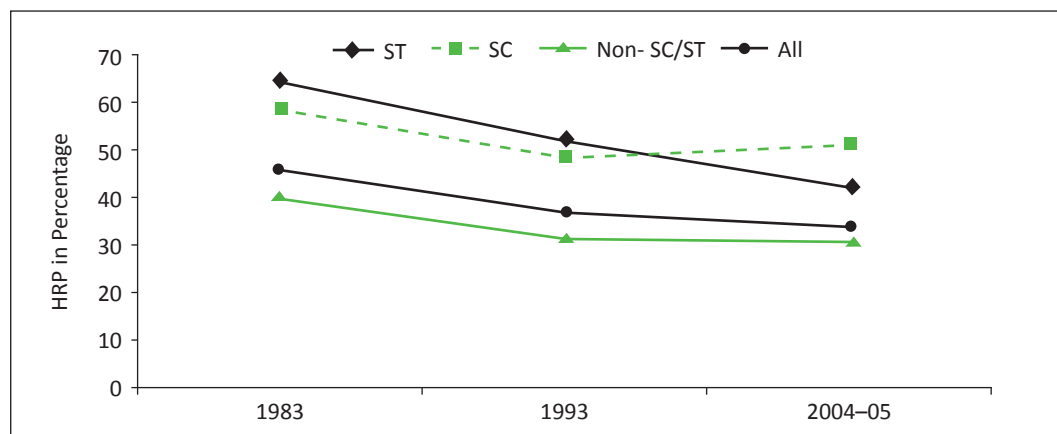
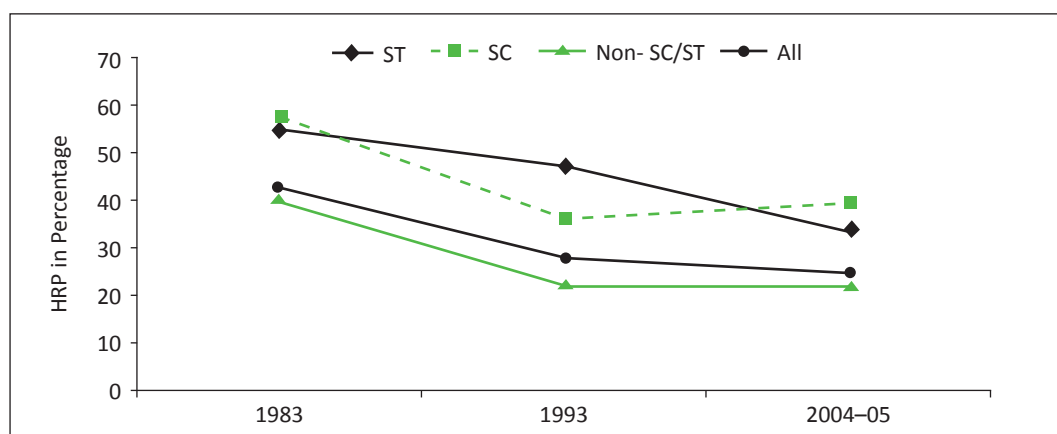


**Figure 8.2: Trend of Poverty in Urban India, 1983 to 2004–05**



## Notes

It is estimated that around 27.6 per cent of the population is poor at the all India level. The level of poverty is 28.3 per cent in rural areas, whereas it is 25.6 per cent in urban areas. Among the 17 major states, the level of poverty is highest in Orissa (46.6) and lowest in Punjab (8.1). The interesting part is that a number of states show a high level of urban poverty and Madhya Pradesh is one of them. It is possible to estimate poverty at the district level from the 61<sup>st</sup> Round of NSSO. However, the small sample size of the estimated figures is sometimes found unacceptable. In future, with the increase in the sample size, district level poverty figures will be very helpful for planning purposes.

**Table 8.2: Estimated Poor (Headcount Ratio) across State and Sector (%)**

| State            | Rural       | Urban       | Total       |
|------------------|-------------|-------------|-------------|
| Andhra Pradesh   | 10.5        | 27.4        | 14.8        |
| Assam            | 22.1        | 3.6         | 20.4        |
| Bihar            | 42.6        | 36.1        | 42.0        |
| Chhattisgarh     | 40.8        | 42.2        | 41.0        |
| Gujarat          | 18.9        | 13.3        | 17.0        |
| Haryana          | 13.2        | 14.5        | 13.6        |
| Jharkhand        | 46.2        | 20.3        | 42.0        |
| Karnataka        | 20.7        | 32.6        | 24.3        |
| Kerala           | 13.2        | 20.0        | 14.8        |
| Madhya Pradesh   | 36.8        | 42.7        | 38.2        |
| Maharashtra      | 29.6        | 32.1        | 30.6        |
| Orissa           | 46.9        | 44.7        | 46.6        |
| Punjab           | 9.0         | 6.3         | 8.1         |
| Rajasthan        | 18.3        | 32.3        | 21.4        |
| Tamil Nadu       | 23.0        | 22.5        | 22.8        |
| Uttar Pradesh    | 33.3        | 30.1        | 32.7        |
| West Bengal      | 28.4        | 13.5        | 24.7        |
| <b>All India</b> | <b>28.3</b> | <b>25.6</b> | <b>27.6</b> |

Source: Estimated from unit level record of 'Level and Pattern of Consumption Expenditure, 2004–05', NSSO.

## Notes

### 8.3.4 Poverty Gap Index

A moderately popular measure of poverty is the **poverty gap index**, which adds up the extent to which individuals, on an average, fall below the poverty line, and expresses it as a percentage of the poverty line. More specifically, it defines the poverty gap ( $G_i$ ) as the poverty line ( $z$ ) less actual income (expenditure) ( $y_i$ ) for poor individuals; the gap is considered to be zero for everyone else. Using the index function, we have :

$$\text{Poverty Gap Index } P_1 = \frac{1}{N} \sum_{i=1}^n \frac{G_i}{z}$$

This measure is the mean proportionate poverty gap in the population (where the non-poor have zero poverty gaps). Some people find it helpful to think of this measure as the cost of eliminating poverty (relative to the poverty line) because it shows how much will have to be transferred to the poor to bring their income or expenditure up to the poverty line (as a proportion of the poverty line). The minimum cost of eliminating poverty using

targeted transfers is the sum of all the poverty gaps in a population; every gap is filled up to the poverty line. However, this interpretation is only reasonable if the transfers could be carried out efficiently, for instance with lump sum transfers, which are implausible. Clearly, this assumes that the policy-maker has a lot of information; one should not be surprised to find that a “pro-poor” government would need to spend far more than this for the reduction of poverty. At the other extreme, one can consider the maximum cost of eliminating poverty, assuming that the policy-maker knows nothing about who is poor and who is not. From the form of the index, it can be seen that the ratio of the minimum cost of eliminating poverty with perfect targeting ( $G_p$ ) to the maximum cost with no targeting ( $z$ , which would involve providing everyone with enough to ensure that they are not below the poverty line) is the poverty gap index. Thus, this measure is an indicator of the potential saving to the poverty alleviation budget.

Using hypothetical data in Table 8.1 Poverty Gap Index can be calculated as follows:

$$\begin{aligned}\text{Poverty Gap Index for Region A} &= \frac{1}{5} \sum \{[(125-100)/125] + [(125-80)/125]\} \\ &= 1/5 (70/125) \\ &= 0.112\end{aligned}$$

$$\begin{aligned}\text{Poverty Gap Index for Region B} &= \frac{1}{5} \sum \{[(125-115)/125] + [(125-120)/125]\} \\ &= 1/5 (15/125) \\ &= 0.024\end{aligned}$$

The limitation of the headcount ratio is that it only provides the estimation of population living below poverty line. It does not indicate how far the poor people are lying below the poverty line (the depth of poverty). This is usually assessed by the poverty gap ratio.

In the given example in Table 8.1, it has been observed that the expenditure of two individuals in Regions A and B are different. The expenditure of those individuals living below poverty line is close to the poverty line in Region B compared to Region A. Hence the depth of poverty is higher in Region A as compared to Region B. To provide a numerical estimate of the poverty gap ratio (PGR), the poverty ratio for Region A and Region B has been computed. It was found that the PGR was higher in Region A than in Region B (0.112 in Region A vs. 0.024 in Region B) indicating that the depth of poverty is higher in Region A as compared to Region B.

## Notes

## 8.4 Measures of Inequality

### Gini Coefficient

Inequality is a broader concept than poverty and is defined over the **entire** population. It does not only focus on the poor. The most widely used single measure of inequality is the Gini coefficient, **which ranges from 0 (perfect equality) to 1 (perfect inequality)**. The Gini coefficient is derived from the Lorenz curve, which sorts the population from the poorest to richest, and shows the cumulative proportion of the population on the horizontal axis and the cumulative proportion of area owned (or income) on the vertical axis.

Figure 8.3 shows the concentration of the ownership of land; it is formed by plotting the cumulative distribution of the area of land owned against the cumulative frequency distribution of the households possessing that area, with the help of the Lorenz curve. If the distribution of the dependent variable is equal, the plot will show as a straight, 45° line.

## Notes

Unequal distributions will yield a curve. The gap between this curve and the 45° line is the inequality gap. Such a gap exists everywhere, although the degree of inequality varies. This is a graphical representation of the Gini coefficient. The Gini coefficient estimated here for land distribution data of Madhya Pradesh for 1992 is 0.649.

The Gini coefficient measures the area between the Lorenz curve and the line of equality. This can be computed using the formula:

$$\text{Gini Coefficient} = \frac{1}{100 \times 100} * \{\sum [X_i * (Y_{i+1})] - \sum [Y_i * (X_{i+1})]\}$$

where, X is the number of households  
Y is the acres of land owned

For example, 237 households in the sample have landholding of more than 20 hectares and possess 6683 hectares of land. On the other hand, 9884 households do not own any land (see Table 8.3). The Gini coefficient value of 0.649 indicates that the inequality in the distribution of land holdings is high in the state.

**Table 8.3: Data of Land Distribution in Madhya Pradesh**

| Area in Hectares | Number of Households | Area          | Percentage Distribution of Households | Cumulative Percentage Distribution of Households | Percentage Distribution of Area Owned | Cumulative Percentage Distribution of Area | $X_i * (Y_{i+1})$ | $Y_i * (X_{i+1})$ |
|------------------|----------------------|---------------|---------------------------------------|--------------------------------------------------|---------------------------------------|--------------------------------------------|-------------------|-------------------|
|                  | x                    | Y             | X                                     | $X_i$                                            | Y                                     | $Y_i$                                      |                   |                   |
| (1)              | (2)                  | (3)           | (4)                                   | (5)                                              | (6)                                   | (7)                                        | (8)               | (9)               |
| Nil              | 9884                 | 0             | 10.50                                 | 10.50                                            | 0.00                                  | 0.00                                       | 0                 | 0.00              |
| <0.002           | 4410                 | 4             | 4.69                                  | 15.19                                            | 0.00                                  | 0.00                                       | 4.09              | 0.00              |
| 0.002–0.20       | 14693                | 441           | 15.61                                 | 30.80                                            | 0.27                                  | 0.27                                       | 26.03             | 9.30              |
| 0.21–0.40        | 3485                 | 941           | 3.70                                  | 34.50                                            | 0.58                                  | 0.85                                       | 63.17             | 32.60             |
| 0.41–0.50        | 3837                 | 1612          | 4.08                                  | 38.58                                            | 0.99                                  | 1.83                                       | 294.29            | 95.89             |
| 0.51–1.00        | 12984                | 9478          | 13.80                                 | 52.38                                            | 5.80                                  | 7.63                                       | 1209.64           | 545.93            |
| 1.01–2.00        | 18063                | 25288         | 19.19                                 | 71.57                                            | 15.47                                 | 23.10                                      | 2768.93           | 1918.01           |
| 2.01–3.00        | 10803                | 25495         | 11.48                                 | 83.05                                            | 15.59                                 | 38.69                                      | 3989.72           | 3395.76           |
| 3.01–4.00        | 4445                 | 15291         | 4.72                                  | 87.77                                            | 9.35                                  | 48.04                                      | 5061.23           | 4399.98           |
| 4.01–5.00        | 3592                 | 15733         | 3.82                                  | 91.59                                            | 9.62                                  | 57.66                                      | 5967.16           | 5417.21           |
| 5.01–6.00        | 2218                 | 12243         | 2.36                                  | 93.94                                            | 7.49                                  | 65.15                                      | 7055.48           | 6287.07           |
| 6.01–8.00        | 2403                 | 16268         | 2.55                                  | 96.50                                            | 9.95                                  | 75.10                                      | 8051.43           | 7368.46           |
| 8.01–10.00       | 1519                 | 13625         | 1.61                                  | 98.11                                            | 8.33                                  | 83.44                                      | 8558.02           | 8237.17           |
| 10.01–12.00      | 576                  | 6198          | 0.61                                  | 98.72                                            | 3.79                                  | 87.23                                      | 9468.82           | 8700.75           |
| 12.01–20.00      | 964                  | 14200         | 1.02                                  | 99.75                                            | 8.69                                  | 95.91                                      | 9974.818          | 9591.22           |
| 20.01 and above  | 237                  | 6683          | 0.25                                  | 100.00                                           | 4.09                                  | 100.00                                     |                   |                   |
| <b>Total</b>     | <b>94113</b>         | <b>163501</b> | <b>100.00</b>                         |                                                  | <b>100.00</b>                         |                                            | <b>62499.90</b>   | <b>56005.80</b>   |

Source: Land and Livestock Holding, NSSO 1992.

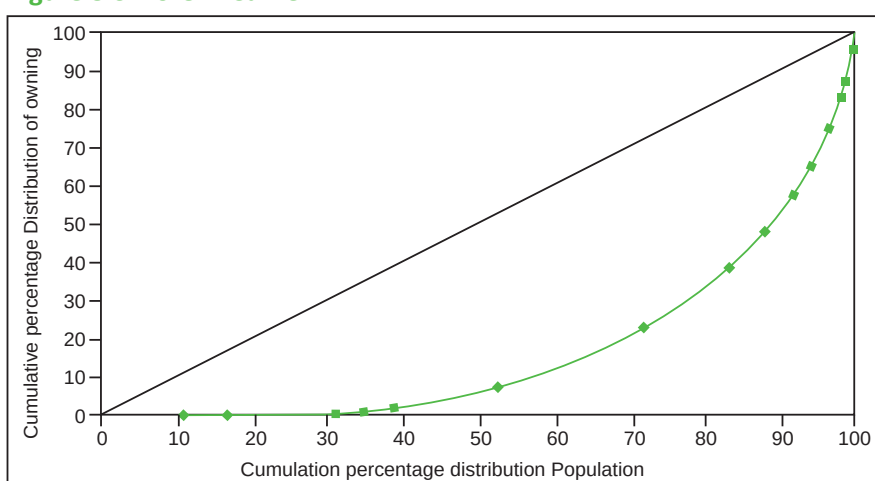
$$\sum [X_i * (Y_{i+1})] = 62499.9$$

$$\sum [Y_i * (X_{i+1})] = 56005.8$$

$$\text{Gini Coefficient} = \frac{1}{100 * 100} [(62499.9) - (56005.8)] = 0.649$$

A Lorenz graph has also been plotted using the same set of data to have a visual understanding of the extent of inequality. In the Lorenz curve, the 45° line is known as the line of absolute equality where, as we move along the x-axis, each 10 per cent increment of households would own an additional 10 per cent of wealth. Any deviation of the curve from this line indicates inequality. The greater the deviation, the more the inequality.

**Figure 8.3: Lorenz Curve**



## Notes

## 8.5 Identifying the Poor

The Integrated Rural Development Programme (IRDP) was launched in October 1980, in all the blocks of the country, as an instrument of poverty alleviation in rural areas and to identify families below the poverty line (BPL). The Ministry of Rural Development, Government of India took the initiative to identify BPL families in rural India for the effective implementation of its poverty alleviation programmes. The idea was to provide assistance to poor families under different government initiated schemes (**IRDP, TRYSEM, DWCRA, EAS, JRY**, and so on). However, the identification results drew the attention of policy-makers and academicians because of the high level of **non-poor being included** (hereafter, Type I errors) and **poor being excluded** (hereafter, Type II errors) in the initial level of identification. As the method was unscientific during the first selection, it generated a significant proportion of Type I and Type II errors. To overcome these errors, in 1992 a detailed procedure was prescribed to identify BPL families in rural India. It was the first systematic census to identify BPL families using the income criterion. This criterion was dropped during the next Census (1997) with the observation that there is a tendency among the households to under-report their actual income in a bid to gain benefits.

The 1997 criteria use two Schedules to identify BPL families. **Schedule A** has five identifiable indicators, and households that do not satisfy these are accepted as BPL households (Exclusion Criteria). In **Schedule B**, a screening through consumption expenditure was exercised among the excluded households to ensure the inclusion of the poor. In addition, there is a series of questions posed to the identified poor households to know their household characteristics, in order to provide suitable benefits under different schemes.

The high level of Type I and Type II errors forced the Ministry to further modify the method of selecting BPL families. In 2002, the Ministry adopted a point method, based on 13 criteria.

## Notes

The 2002 BPL Census shifted from the exclusion criteria to the 13-criteria method, based on socio-economic indicators, reflecting the quality of life in rural areas (see footnote 3 on page 148). Each household would be given a score of 0–4 (based on their access or ownership in ascending order) for each of the 13 quantifiable indicators, depending on their response to the question. The scores of the  $i^{\text{th}}$  household on all these parameters are then summed up to create an aggregate score  $S_i$ . Hence, the aggregate score of a household would range from a minimum of zero to a maximum of 52 (symbolically,  $0 \leq S_i \leq 52$ ). Finally, a household would be categorised as poor or non-poor based on the ‘cut-off’ score decided by the region and the states. These ‘cut-off’ scores could vary across states since the concerned state governments were asked to restrict the number of poor households, equivalent to the estimated percentage of the poor for the year 1999–2000 with a  $\pm 10$  per cent margin.

**Table 8.4: Indicators Used for Identification of BPL Households in Census 2002**

| S. No. | Indicators                                                                                             | Levels                                               |                                                  |                                                                       |                                                                          |                                                            |
|--------|--------------------------------------------------------------------------------------------------------|------------------------------------------------------|--------------------------------------------------|-----------------------------------------------------------------------|--------------------------------------------------------------------------|------------------------------------------------------------|
|        |                                                                                                        | (1)                                                  | (2)                                              | (3)                                                                   | (4)                                                                      | (5)                                                        |
| 1.     | <b>Landholdings</b>                                                                                    | Nil holdings                                         | Less than 1 Ha. unirrigated or 0.5 Ha. irrigated | More than 1 and less than 2 Ha. unirrigated or 0.5 to 1 Ha. irrigated | More than 2 Ha. and less than 5 Ha. unirrigated or 1.0-2.5 Ha. irrigated | More than 5 Ha. unirrigated or more than 2.5 Ha. irrigated |
| 2.     | <b>Type of house</b>                                                                                   | Houseless                                            | <i>Kutcha</i>                                    | <i>Semi-pucca</i>                                                     | <i>Pucca</i>                                                             | Urban type                                                 |
| 3.     | <b>Availability of clothing per person</b>                                                             | Less than two sets                                   | More than two sets but less than four            | More than four sets but less than six                                 | More than six sets but less than ten                                     | More than ten sets                                         |
| 4.     | <b>Food security</b>                                                                                   | Less than one meal per day in major part of the year | Normally one meal per day but sometimes less     | Normally one meal per day throughout the year                         | Two meals per day and occasional shortage                                | Enough food                                                |
| 5.     | <b>Sanitation</b>                                                                                      | Open defecation                                      | Group latrines with irregular water supply       | Group latrines with regular water supply                              | Group latrines with irregular water supply and sweeper                   | Private latrine                                            |
| 6.     | <b>Ownership of consumer durables, vis., TV, electric fan, kitchen appliances, cooker, radio, etc.</b> | Nil                                                  | Any one item                                     | Two items only                                                        | Any three                                                                | All items                                                  |
| 7.     | <b>Literacy status of highest literate</b>                                                             | Illiterate                                           | Up to primary                                    | Completed secondary/ passed 10 <sup>th</sup>                          | Graduate/ professional                                                   | Postgraduate/ professional                                 |
| 8.     | <b>Status of household labour</b>                                                                      | Bonded labour                                        | Women and child labour                           | Only adult female and no child labour                                 | Adult males only                                                         | Others                                                     |
| 9.     | <b>Means of livelihood</b>                                                                             | Casual labour                                        | Subsistence cultivation                          | Artisan                                                               | Salary                                                                   | Others                                                     |

Contd. ...

| S. No. | Indicators                                   | Levels                                         |                                             |                                        |                                       |                                                              |
|--------|----------------------------------------------|------------------------------------------------|---------------------------------------------|----------------------------------------|---------------------------------------|--------------------------------------------------------------|
|        |                                              | (1)                                            | (2)                                         | (3)                                    | (4)                                   | (5)                                                          |
| 10.    | <b>Status of children between 6-14 years</b> | Not going to school and working                | Going to school and working                 | -                                      | -                                     | Going to school and not working                              |
| 11.    | <b>Type of indebtedness</b>                  | Daily consumption purposes from normal sources | For production purposes from normal sources | For other purposes from normal sources | Borrowing from institutional agencies | No indebtedness and possess assets                           |
| 12.    | <b>Reasons for migration</b>                 | Casual work                                    | Seasonal employment                         | Other forms of livelihood              | Non-migrant                           | Other purpose                                                |
| 13.    | <b>Preference for assistance</b>             | Wage employment                                | Self-employment                             | Training and skill upgradation         | Housing                               | Loan/subsidy more than Rs one lakh or no assistance required |

Source: Report of the Expert Group to advise the Ministry of Rural Development on the methodology for conducting the Below Poverty Line (BPL) Census for 11<sup>th</sup> Five-Year Plan, 2009, Ministry of Rural Development, Government of India.

Note: This methodology is under revision.

## 8.6 Human Development Indices

### 8.6.1 Human Development Index

The Human Development Index (HDI) is a summary composite index that measures average achievements in three basic aspects of human development, (i) longevity (ii) knowledge and (iii) a decent standard of living. It was found that the process of estimation remaining the same, the 'variables' and their maximum and minimum values differ across regions and reports based on the availability of data. The standard model is:

- Longevity, measured by "life expectancy at birth"
- Knowledge, measured by "a combination of the adult literacy rate and the combined primary, secondary, and tertiary gross enrolment ratio"
- A decent standard of living, measured by "GDP per capita" in US\$ PPP

#### Notes

**Table 8.5: Fixing Minimum and Maximum Value for Human Development Index**

| Dimension                                                | Health Indicators        | Knowledge                                                                            | A Decent Standard of Living                                                                                                                                                                                                                                       |
|----------------------------------------------------------|--------------------------|--------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Indicator                                                | Life Expectancy at Birth | (1) Adult Literacy<br>(2) Enrolment Ratio (combined primary, secondary and tertiary) | GDP per capita in US\$ PPP                                                                                                                                                                                                                                        |
| Established minimum and maximum value for each indicator | 25–85 Years              | 0–100 per cent (Adult Literacy)                                                      | US\$ 100–40000<br>The GDP index is calculated using adjusted GDP per capita. Income is adjusted because achieving a respectable level of human development does not require unlimited income for details (see different <i>Human Development Reports</i> , UNDP). |

Note: For a lucid description on minimum and maximum values, kindly refer to *Human Development Report 1994*, United Nations Development Programme, Oxford University Press, 1994, New Delhi, Chap. 5, pp. 90-101.

### Estimation of HDI

To calculate HDI, a separate index has to be calculated for each dimension. For these dimension indices, minimum and maximum values are chosen for each indicator separately. The formula used for the calculation of these indices is:

$$\text{Dimension Index} = \frac{(\text{Actual Value} - \text{Minimum Value})}{(\text{Maximum Value} - \text{Minimum Value})}$$

Here the performance is expressed as a value between 0 and 1 by applying the above formula. The HDI is then calculated as a simple average of the dimension indices.

### Example (State: Madhya Pradesh)

- (1) **Health Index:** Health index is calculated here with one variable, 'Life expectancy at birth' and by using simple dimension index formula. The minimum and maximum values are set for the health variable (where the maximum is 85 and minimum is 25).

#### Step I. Calculating the Health Index

**Data requirements:** Life expectancy at birth (Madhya Pradesh)

For Madhya Pradesh, the life expectancy at birth is 57.7 (SRS, 2001–05).

**Health Index** (Use dimension index method to arrive at a value)

$$\begin{aligned}\text{Health Index} &= \frac{\text{Life Exp} - 25}{85 - 25} \\ &= \frac{57.7 - 25}{85 - 25} \\ &= 0.5441\end{aligned}$$

- (2) **Education Index:** This is calculated with the help of two variables – Adult Literacy Rate (ALR) and Gross Enrolment Rate (GER) with two-third and one-third weight respectively. The literacy index measures relative achievement in both literacy levels as well as gross enrolment in school. Let us estimate the two indices (i) literacy index (where, maximum is 100 and minimum is 0); and (ii) gross enrolment index (where, maximum is 100 and minimum is 0) through a dimension index formula.

(i) Literacy index (Use dimension index method to arrive at a value)

(ii) Gross enrolment index (Use dimension index method to arrive at a value)

Education index = (weight \* literacy index) + (weight \* gross enrolment index)

⇒ Education index = [(2/3) \* literacy index] + [(1/3) \* gross enrolment index]

#### Step II: Calculating the Education Index

To calculate the education index, both the ALR and combined GER are considered. First an index for adult literacy and one for gross enrolment are calculated. These two indices are then combined to create the education indices, where two-third weight is given to adult literacy and one-third weight to combined gross enrolment. The ALR and GER up to upper primary for Madhya Pradesh are 63.7 per cent and 98 per cent respectively (State Elementary Education Report Card, DISE Report) and education index can be computed as follows:

$$\begin{aligned}\text{(i) Adult literacy index} &= \frac{\text{Adult Literacy Rate} - 0}{100 - 0} \\ &= \frac{63.7 - 0}{100 - 0} \\ &= 0.637\end{aligned}$$

### Notes

$$\begin{aligned}\text{(ii) Gross enrolment index} &= \frac{\text{Gross Enrolment Rate} - 0}{100 - 0} \\ &= \frac{98 - 0}{100 - 0} \\ &= 0.98\end{aligned}$$

$$\begin{aligned}\text{(iii) Education index} &= 2/3 * (\text{adult literacy index}) + 1/3 * (\text{gross enrolment index}) \\ &= (2/3 * 0.637) + (1/3 * 0.98) \\ &= 0.7513\end{aligned}$$

**(3) Decent Standard of Living Index:** This index is calculated by using an adjusted GDP/ NSDP per capita (PPP US \$). Income is adjusted because achieving a respectable level of human development does not require unlimited income. Accordingly, the logarithm of income is used. The minimum and maximum values are set for the income variable (where, the maximum is US\$ 40,000 and the minimum is US\$ 100).

**Decent standard of living index** (Use dimension index method to arrive at a value)

### Step III. Calculating Decent Standard of Living Index

$$\text{Decent standard of living index} = \frac{\text{Log (GDP Per Capita Income in \$ Purchasing Power Parity)} - \text{Log (100)}}{\text{Log (40000)} - \text{Log (100)}}$$

Per capita NSDP for Madhya Pradesh in 2001 at constant prices = Rs. 7,708 (figure obtained from: *Domestic Product of States of India, 1960–61 to 2006–07* by EPW Research Foundation. The data is at 1993–94 series).

Per capita GDP for India in 2001–02 at constant prices = Rs. 10,754

Per capita GDP for India in 2001 (US\$ PPP) = \$ 2,840 (figure obtained from *Kerala Human Development Report, 2005*)

Per capita NSDP for MP in 2001 (\$PPP) = 7708 \* (2840/10754) = \$ 2,036 (for details please see *Kerala Human Development Report, 2005, p. 169*)

$$\begin{aligned}\text{Decent standard of living index} &= \frac{\text{Log (2036)} - \text{Log (100)}}{\text{Log (40000)} - \text{Log (100)}} \\ &= 0.503\end{aligned}$$

**(4) Calculating the HDI:** The above three dimension indices have been used to compute the HDI. It is a simple average of the three dimension indices.

$$\text{HDI} = 1/3 * (\text{health index} + \text{education index} + \text{decent standard of living index})$$

### Step IV. Calculation of HDI

After calculating all the indices, HDI can be computed using the following formula:

$$\begin{aligned}\text{HDI} &= 1/3 (\text{life-expectancy index}) + 1/3 (\text{education index}) + 1/3 (\text{GDP index}) \\ &= (1/3 * 0.544) + (1/3 * 0.751) + (1/3 * 0.503) \\ &= 0.599\end{aligned}$$

So, HDI value for MP is = 0.599

### Notes

In October 2010, UNDP<sup>7</sup> disseminated the revised methodology and variables for computing the Human Development Index. The change in methodology has broadly shifted from using arithmetic mean to geometric mean; the variables were changed with respect to the education and standard of living domain. With respect to education, the ALR and GER were replaced by the mean years of schooling. The expected years of schooling is defined as “the number of years of schooling that a child of school entrance age can expect to receive if prevailing patterns of age-specific enrolment rate were to stay the same throughout the child’s life”. With respect to income domain the GDP per capita was replaced by the GNI per capita (UNDP 2010). However, in this report the HDI has been computed using the old methodology.

## 8.6.2 Human Poverty Index

While the HDI measures average achievement, it also measures deprivations in the three basic dimensions of human development captured in the HDI. The Human Development Resource Centre (HDRC) of UNDP has been estimating two types of Human Poverty Index (HPI): (i) HPI-1 for developing countries and (ii) HPI-2 for OECD countries. HPI-2 measures deprivations in the same dimensions as the HPI-1 and also captures social exclusion. Thus, it reflects deprivations in four dimensions. Calculating the HPI is more straightforward than calculating the HDI. The indicators used to measure deprivation are already normalised between 0 and 100 (because they are expressed as percentages), therefore there is no need to create dimension indices as for the HDI. Here the HPI-1 has been estimated.

### Notes

**Table 8.6: Details of Indicators for the Construction of HPI-1**

| Dimension | A Long and Healthy Life                         | Knowledge            | A Decent Standard of Living                                                   |                                            |
|-----------|-------------------------------------------------|----------------------|-------------------------------------------------------------------------------|--------------------------------------------|
| Indicator | Probability at birth of not surviving to age 40 | Adult literacy (15+) | Percentage of population without sustainable access to improved water sources | Percentage of children underweight for age |

### Calculating the HPI-1

The HPI-1 value can be obtained by a simple average of the above individual dimension indices. The formula for calculating the HPI-1 is as follows:

$$\text{HPI-1} = [1/3(P_1^\alpha + P_2^\alpha + P_3^\alpha)]^{1/\alpha}$$

where,

$P_1$  = Probability at birth of not surviving to age 40 (times 100)

$P_2$  = Adult illiteracy rate (15 and above)

$P_3$  = Unweighted average of population without sustainable access to improved water sources and children underweight for age

$\alpha = 3$

The value  $\alpha = 3$  is used to give additional but not overwhelming weights to areas of more acute deprivation (for details see *Human Development Report, 2004*.)

<sup>7</sup> UNDP, 2010, *Human Development Report, 2010*, Palgrave Macmillan, New York.

The value of  $\alpha$  has an important impact on the value of the HPI. If  $\alpha=1$ , the HPI is the average of its dimensions. As  $\alpha$  increases, greater weight is given to the dimension in which there is the most deprivation. Thus as  $\alpha$  increases towards infinity, the HPI will tend towards the value of the dimension in which deprivation is greatest.

For example if  $P_1 = 2$ ,  $P_2 = 3$  and  $P_3 = 10$  then assigning a weight of 3 gives

$$P_1^3 + P_2^3 + P_3^3 = 8 + 27 + 1000.$$

that is, in the composite variable  $P_3$  will get higher weight.

### Calculation of HPI-1

HPI-1 measures deprivations in the three basic dimensions of human development. These are: (i) A long and healthy life, measured by the probability at birth of not surviving to age 40 years (times 100); (ii) Knowledge, measured by ALR; (iii) A decent standard of living, measured by unweighted average of two indicators: percentage of population without sustainable access to an improved water source and the percentage of children underweight for age.

### Data requirements

- Probability of dying before age 40 for total population of Madhya Pradesh
- Adult illiteracy rate of Madhya Pradesh
- Percentage of population without sustainable access to improved water source for Madhya Pradesh
- Percentage of children underweight for age in Madhya Pradesh

### Notes

### Calculation procedure for HPI-1

#### Step I. Computing probability of dying before age 40

This can be computed using the SRS-based abridged life table for Madhya Pradesh. The following formula can be used:

$$P_1 = [\text{No. of deaths during 0 to 40 years} / \text{Total population at age 0}] * 100$$

$$= [(I_0 - I_{40}) / I_0] * 100$$

$$= [(100000 - 77937) / 100000] * 100$$

$$= [0.2206] * 100$$

$$= 22.06\%$$

#### Step II. Computing Adult illiteracy rate (AIR)

$$P_2 = \text{Number of illiterate adult persons (age 15 and above)} / \text{Total adult population}$$

$$= 36.3\% \text{ (DISE Report)}$$

#### Step III. Computing Deprivation in a Decent Standard of Living

An unweighted average of two indicators is used to measure deprivation in a decent standard of living

- Population without sustainable access to an improved water source for Madhya Pradesh is 25 per cent (data obtained from the *Census Household and Amenities Tables*. To understand the “sustainable access of drinking water”, tap water, hand pump, tube well, well water of within premises and near premises have been considered).
- Children underweight for age in Madhya Pradesh is 60 per cent (Data obtained from NFHS-3 and weigh-for-age below  $-2$  SD).

Unweighted average  $P_3$  is calculated as

$$\begin{aligned} P_3 &= \frac{1}{2} (\text{Population without sustainable access to improved water source}) + \frac{1}{2} (\text{children underweight for age}) \\ &= (\frac{1}{2} * 25) + (\frac{1}{2} * 60) \\ &= 42.5 \% \end{aligned}$$

#### Step IV. Calculation of HPI-1

$$\text{HPI-1} = [1/3(P_1^\alpha + P_2^\alpha + P_3^\alpha)]^{1/\alpha}$$

where,

$$\begin{aligned} P_1 &= (\text{Probability of dying before age 40}) * 100 \\ &= 22.06\% \end{aligned}$$

$$\begin{aligned} P_2 &= \text{AIR} \\ &= 36.3\% (\text{DISE report}) \end{aligned}$$

$$\begin{aligned} P_3 &= \text{Unweighted average of population without sustainable access to improved water sources and children underweight for age} \\ &= 42.5\% \end{aligned}$$

#### Notes

$\alpha = 3$  is assigned to give a moderate penalty.

$$\begin{aligned} \text{Now, HPI-1} &= [1/3 \{(22.06)^3 + (36.3)^3 + (42.5)^3\}]^{1/3} \\ &= 35.59 \end{aligned}$$

So, HPI-1 value for Madhya Pradesh is 35.59.

### 8.7 Summary

- Estimation of poverty and other measures.
- The Human Development Index, the Gender Development Index, the Human Poverty Index, the Gender Empowerment Index, the Infrastructure Index, the Vulnerability Index and the Multidimensional Poverty Index are important indices used frequently by development practitioners to assess the achievement and deprivation levels.
- Of the above, HDI and HPI are the two most popular indices.
- In India, poverty has been used as an important variable to measure the level of development. The estimation of poverty for smaller units such as districts was not possible before the 2004–05 NSSO survey. The 2004–05 survey allows one to estimate poverty at the district level. However, the estimate for some districts could be distorted because of the small sample size and hence one has to be careful while carrying out this exercise at the district level.

## EXERCISE

**Exercise 1:** Calculate the Gini Coefficient, draw the Lorenz Curve and interpret your result for the given hypothetical data.

| LH Category | No. of HH | OA (Ha.) | % of HH | % of OA | Cum. % of HH(X) | Cum. % of OA(Y) | $X_i * Y_{i+n}$ | $Y_i * X_{i+n}$ |
|-------------|-----------|----------|---------|---------|-----------------|-----------------|-----------------|-----------------|
| Nil         | 20        | 0        |         |         |                 |                 |                 |                 |
| Up to 1.00  | 50        | 20       |         |         |                 |                 |                 |                 |
| 1.01–2.00   | 40        | 60       |         |         |                 |                 |                 |                 |
| 2.01–3.00   | 20        | 52       |         |         |                 |                 |                 |                 |
| 3.01–4.00   | 20        | 72       |         |         |                 |                 |                 |                 |
| 4.01–6.00   | 16        | 84       |         |         |                 |                 |                 |                 |
| 6.01–8.00   | 14        | 103      |         |         |                 |                 |                 |                 |
| 8.01–10.00  | 10        | 95       |         |         |                 |                 |                 |                 |
| >10.00      | 10        | 214      |         |         |                 |                 |                 |                 |
| Total       | 200       | 700      |         |         |                 |                 |                 |                 |

Note: LH—Landholding; HH—Household; OA—Operated Area

**Hint:** Gini Coefficient =  $\frac{[X_i * (Y_{i+1})] - [Y_i * (X_{i+1})]}{100 * 100}$

## APPENDICES

### Appendix 8.1

| Variables                                                 | Sources                                                            |
|-----------------------------------------------------------|--------------------------------------------------------------------|
| Population/age/sex/social groups                          | District Statistical Handbook/<br>Statistical Abstract             |
| Occupations: SEA/AL/SENA/OL                               | District Statistical Handbook/<br>Statistical Abstract             |
| Education: Literacy/Level of education                    | Education Data/District Statistical Handbook                       |
| Land distribution (Ownership)                             | District Statistical Handbook/<br>Statistical Abstract             |
| Irrigation coverage and status                            | District Statistical Agriculture situation                         |
| Telephone connections and number of<br>mobile phones sold | District Statistical Handbook/<br>Statistical Abstract             |
| Vehicles registered in that area                          | District Statistical Handbook/<br>Statistical Abstract             |
| Defaulters of Cooperative and Commercial<br>Banks         | District Statistical Handbook/<br>Statistical Abstract             |
| Employment in Public Services                             | District Statistical Handbook/<br>Statistical Abstract             |
| Number of employment days generated<br>through NREGA      | District Statistical Handbook/<br>Statistical Abstract             |
| Housing status                                            | District Statistical Handbook/<br>Statistical Abstract             |
| Landlessness                                              | Record Room/District Statistical Handbook/<br>Statistical Abstract |

### Appendix 8.2

A list of consumption expenditure series, year of survey, round, time covered, sample size is shown here for reference

| Year of Survey | Round | Time Covered        | Sample Size                                                                          |
|----------------|-------|---------------------|--------------------------------------------------------------------------------------|
| 1972-73        | 27    | Oct 1972–Sept 1973  | Rural Households–72270<br>Urban Households–52820                                     |
| 1978-79        | 32    | July 1977–June 1978 | Rural Households–99766<br>Urban Households–58162<br>Village–8216<br>Urban Block–4871 |
| 1983           | 38    | Jan 1983–Dec 1983   | Rural Households–75913<br>Urban Households–41983<br>Village–7799<br>Urban Block–4327 |
| 1987-88        | 43    | July 1987–June 1988 | Rural Households–82661<br>Urban Households–45358<br>Village–8321<br>Urban Block–4583 |

Contd. ...

| Year of Survey | Round | Time Covered        | Sample Size                                                                          |
|----------------|-------|---------------------|--------------------------------------------------------------------------------------|
| 1993-94        | 50    | July 1993–June 1994 | Rural Households–69206<br>Urban Households–46148<br>Village–6951<br>Urban Block–4650 |
| 1999-2000      | 55    | July 1999–June 2000 | Rural Households–71385<br>Urban Households–48924<br>Village–6046<br>Urban Block–4116 |
| 2004-05        | 61    | July 2004–June 2005 | Rural Households–79298<br>Urban Households–45346<br>Village–7999<br>Urban Block–4602 |

Note: In other rounds of NSSO, too, a consumer expenditure inquiry on a reduced scale is being carried out from the 42<sup>nd</sup> Round (1986-87) onwards. From the 45<sup>th</sup> Round onwards the subject coverage of this schedule has been expanded to include some important questions on employment so that an annual series of consumer expenditure and employment data is now available.

## Appendix 8.3

### List of Issues on which NSSO brought out Reports/Data during Different Periods

#### Land and Livestock Holdings and Debt and Investment, NSSO 48<sup>th</sup> Round (January–December 1992)

1. Operational Land holdings in India, 1991-92: salient features, p. 407.
2. Livestock and Agricultural Implements in Household Operational Holdings, 1991–92, p. 408
3. Seasonal Variations in the Operation of Landholdings in India: 1991–92, p. 414
4. Household Assets and Liabilities as on 30 June 1991, p. 419
5. Indebtedness of Rural Households as on 30 June 1991, pp. 420–21
6. Indebtedness of Urban Households as on 30 June 1991, p. 421
7. (Part I)—Household Borrowings and Repayments during 1 July 1991 to 30 June 1992, p. 431
8. (Part II)—Household Borrowings and Repayments during 1 July 1991 to 30 June 1992, p. 431
9. (Part I)—Household Assets and Indebtedness of Social Groups as on 30 June 1991, p. 432
10. (Part II)—Household Assets and Indebtedness of Social Groups as on 30 June 1991, p. 432
11. Household Capital Expenditure during 1 July 1991 to 30 June 1992, p. 437

#### Housing Conditions and Migration with Special Emphasis on Slum Dwellers, NSSO 49<sup>th</sup> Round (January–June 1993)

12. Slums in India
13. Housing Conditions in India

14. Migration in India
15. Key Results on Employment and Unemployment
16. Employment and Unemployment in India, 1993–94
17. Employment and Unemployment Situation in Cities and Towns in India, 1993–94
18. Economic Activities and School Attendance by Children in India, 1993–94
19. Participation of Indian Women in Households Work and other Specified Activities, 1993–94
20. Unemployed in India, 1993-94: salient features
21. Employment and Unemployment Situation among Social Groups in India, 1993–94
22. Employment and Unemployment Situation among Social Groups in India, 1993–94

#### **Consumer Expenditure, NSSO 50<sup>th</sup> Round (July 1993–June 1994)**

23. Key Results on Household Consumer Expenditure, 1993–94
24. Level and Pattern of Consumer Expenditure
25. Consumption of some Important Commodities in India
26. Nutritional Intake in India
27. Dwellings in India
28. Energy used by Indian Households
29. Sources of Household Income in India, 1993–94
30. Reported Adequacy of Food Intake in India, 1993–94
31. Differences in Level of Consumption among Socio-economic Groups
32. IRDP Assistance and Participation in Public Works, 1993–94
33. Use of Durable Goods by Indian Households, 1993–94
34. Ownership of Livestock, Cultivation of Selected Crops and Consumption Levels, 1993–94
35. Consumption of Tobacco in India, 1993–94
36. Wages in Kind, Exchange of Gifts and Expenditure on Ceremonies and Insurance in India, 1993–94

#### **Consumer Expenditure and Unorganised Manufacturing Sector, NSSO 51<sup>st</sup> Round (July 1994–June 1995)**

37. Unorganised Manufacturing Sector in India: its size, employment and some key estimates
38. Unorganised Manufacturing Enterprises in India: salient features
39. Assets and Borrowings of the Enterprise Manufacturing Enterprise in India
40. Household Consumer Expenditure and Employment Situation in India, 1994–95

**Consumer Expenditure, Education, Health and Aged in India, NSSO 52<sup>nd</sup> Round (July 1995–June 1996)**

41. Household Consumer Expenditure and Employment Situation in India, 1994–95
42. Attending an Educational Institution in India: its level, nature and cost
43. Morbidity and Treatment of Ailments
44. Maternity and Child Health Care in India
45. The Aged in India: A Socio-Economic Profile, 1995–96

**Consumer Expenditure and Unorganised Trade, NSSO 53<sup>rd</sup> Round (January–December 1997)**

46. Household Consumer Expenditure and Employment Situation in India, 1997
47. Small Trading Units in India and their Basic Characteristics, 1997 (Vol. I)
48. Small Trading Units in India and their Basic Characteristics, 1997 (Vol. II)

**Consumer Expenditure, Employment-Unemployment and Common Property Resources, NSSO 54<sup>th</sup> Round (January–June 1998)**

49. Household Consumer Expenditure and Employment Situation in India
50. Drinking Water, Sanitation and Hygiene in India
51. Travel and Use of Mass Media and Financial Services by Indian Households
52. Cultivation Practices in India
53. Common Property Resources
54. Choice of Reference Period for Consumption Data

**Consumer Expenditure, Employment and Unemployment and Non-agricultural Enterprises in the Informal Sector in India, NSSO 55<sup>th</sup> Round (July 1999–June 2000)**

55. Household Consumer Expenditure in India (July–December 1999): key results
56. Household Consumer Expenditure in India 1999–2000: key results
57. Employment and Unemployment in India, 1999–2000: key results
58. Non-agricultural Enterprises in the Informal Sector in India, 1999–2000: key results
59. Level and Pattern of Consumer Expenditure in India, 1999–2000
60. Employment and Unemployment Situation in India, 1999–2000 (Part I)
61. Employment and Unemployment Situation in India, 1999–2000 (Part II)
62. Informal Sector in India, 1999–2000: salient features
63. Non agricultural Workers in Informal Sector based on Employment Unemployment Survey, 1999–2000
64. Consumption of Some Important Commodities in India, 1999–2000
65. Employment and Unemployment Situation in Cities and Towns of India, 1999–2000

66. Sources of Household Income in India, 1999–2000
67. Energy Used by Indian Households, 1999–2000
68. Participation of Indian Women in Household Work and Other Specified Activities, 1999–2000
69. Reported Adequacy of Food Intake in India, 1999–2000
70. IRDP Assistance and Participation in Public Works, 1999–2000
71. Employment and Unemployment among Religious Groups in India, 1999–2000
72. Employment and Unemployment among Social Groups in India, 1999–2000
73. Migration in India, 1999–2000
74. Nutritional Intake in India, 1999–2000
75. Differences in Level of Consumption among Socio-economic Groups, 1999–2000
76. Literacy and Levels of Education in India, 1999–2000
77. Sources of Household Consumption in India, 1999–2000

**Pilot Survey on Suitability of Reference Period for Measuring Household Consumption**

78. Results of a Pilot Survey on Suitability of Different Reference Periods for Measuring Household Consumption

**Consumer Expenditure, Employment-Unemployment and Unorganised Manufacturing, NSSO 56<sup>th</sup> Round (July 2000–June 2001)**

79. Household Consumer Expenditure and Employment-Unemployment Situation in India, 2000–01
80. Unorganised Manufacturing Sector in India, 2000–01: key results
81. Unorganised Manufacturing Sector in India, 2000–01: characteristics of enterprises
82. Unorganised Manufacturing Sector in India, 2000–01: employment, assets and borrowings
83. Unorganised Manufacturing Sector in India, 2000–01: input, output and value added

**Unorganised Service Sector and Consumer Expenditure, NSSO 57<sup>th</sup> Round (July 2001–June 2002)**

84. Household Consumer Expenditure and Employment Situation in India, 2001–02
85. Unorganised Service Sector in India, 2001–02: salient feature
86. Unorganised Service Sector in India, 2001–02: characteristics of enterprises

**Consumer Expenditure, Employment-Unemployment, Disabled Persons and Village Facilities, NSSO 58<sup>th</sup> Round (July 2002–December 2002)**

87. Household Consumer Expenditure and Employment: unemployment situation in India
88. Disabled Persons in India, July–December 2002

89. Condition of Urban Slums, 2002: salient feature
90. Report on Village Facilities, July–December 2002
91. Housing Condition in India, 2002: housing stock and constructions
92. Housing Condition in India Household Amenities and Other Characteristics

**Consumer Expenditure, Employment-Unemployment, Situation Assessment Survey of Farmers, NSSO 59<sup>th</sup> Round (January–December, 2003)**

93. Household Consumer Expenditure and Employment: unemployment situation in India
94. Household Ownership Holdings in India, 2003
95. Some Aspects of Operational Landholdings in India, 2002–03
96. Livestock Ownership across Operational Landholding Classes in India, 2002–03
97. Seasonal Variation in the Operational Landholdings in India, 2002–03
98. Consumption Expenditure of Farmer Households
99. Some Aspects of Farming, 2003
100. Income, Expenditure and Productive Assets of Farmer Households, 2003
101. Indebtedness of Farmer Households
102. Access to Modern Technology for Farming, 2003
103. Household Assets and Liabilities in India as on 30 June 2002
104. Household Indebtedness in India as on 30 June 2002
105. Household Borrowings and Repayments in India during 1 July 2002 to 30 June 2003
106. Household Assets Holding, Indebtedness, Current Borrowings and Repayments of Social Groups in India (as on 30 June 2002)
107. Household Capital Expenditure in India during 1 July 2002 to 30 June 2003

**Consumer Expenditure, Employment-Unemployment, Morbidity, Health Care and Condition of the Aged, NSSO 60<sup>th</sup> Round (January–June 2004)**

108. Household Consumer Expenditure in India, January–June 2004
109. Employment and Unemployment Situation in India, January–June 2004
110. Morbidity, Health Care and the Condition of the Aged

**Consumer Expenditure, NSSO 61<sup>st</sup> Round (July 2004–June 2005)**

111. Level and Pattern of Consumer Expenditure, 2004–05
112. Household Consumption of Various Goods and Services in India, 2004–05, Vol.I, Major States and All-India
113. Household Consumption of Various Goods and Services in India, 2004–05, Vol.II, Minor States and Union Territories (Detailed Tables 1–4 only)

- 114. Public Distribution System and Other Source of Household Consumption, 2004–05
- 115. Public Distribution System and Other Source of Household Consumption, 2004–05
- 116. Energy Sources of Indian Households for Cooking and Lighting, 2004–05
- 117. Perceived Adequacy of Food Consumption in Indian Households, 2004–05
- 118. Nutritional Intake in India
- 119. Household Consumer Expenditure among Socio-Economic Groups: 2004–05

**Employment-Unemployment, NSSO 61<sup>st</sup> Round (July 2004–June 2005)**

- 120. Employment and Unemployment Situation in India, Part I
- 121. Employment and Unemployment Situation in India, Part II
- 122. Employment and Unemployment Situation among Social Groups in India, 2004–05
- 123. Status of Education and Vocational Training in India, 2004–05
- 124. Participation of Women in Specified Activities along with Domestic Duties, 2004–05
- 125. Informal Sector and Conditions of Employment in India (Part I)
- 126. Informal Sector and Conditions of Employment in India (Part II)
- 127. Employment and Unemployment Situation in Cities and Towns in India, 2004–05
- 128. Employment and Unemployment Situation among Major Religious Groups in India, 2004–05

**Household Consumer Expenditure, Employment and Unemployment, Unorganised Manufacturing Enterprises, NSSO 62<sup>nd</sup> Round (July 2005–June 2006)**

- 129. Employment and Unemployment Situation in India
- 130. Household Consumer Expenditure in India, 2005–06
- 131. Operational Characteristics of Unorganised Manufacturing Enterprises in India
- 132. Unorganised Manufacturing Sector in India: employment, assets and borrowings
- 133. Unorganised Manufacturing Sector in India: input, output and value-added

**Service Sector Enterprises (Excluding Trade) and Household Consumer Expenditure, NSSO 63<sup>rd</sup> Round (July 2006–June 2007)**

- 134. Household Consumer Expenditure in India, 2006–07
- 135. Service Sector in India, 2006–07: operational characteristics of enterprises

## Learning Objectives

- To have an overview and understanding of existing policies and programmes on education
- To get acquainted with the existing sources of data on education
- To develop skills in the estimation of the MDGs related to education and other indicators

## 9.1 Introduction

According to the Constitution of India, education is a fundamental right of the citizen and aims at the overall development of the individual. Education enables individuals to become more responsible and informed, and provides them with a voice in politics and society that is essential for sustaining democracy. Education also helps to accelerate the pace of development, as it equips people to be more productive.

## 9.2 Policy, National Goals and Objectives

In accordance with the Constitutional commitment to ensure free and compulsory education for all children up to the age of 14 years, the provision of Universal Elementary Education (UEE) has been a salient feature of national policy since Independence. This has been spelt out emphatically in the National Policy on Education (NPE), and the Programme of Action (POA), 1992. A number of schemes and programmes were launched in pursuance of the emphasis embodied in the NPE and the POA. Since Independence, the Central and State Governments have been expanding the provision of primary formal and non-formal education to realise the UEE goal. The challenge now is to sustain and deepen current reforms in education and encourage local planning and management of strategies for expanding and improving primary education. Time and again, the Central and State Governments have initiated various programmes which are discussed below.

### 9.2.1 National Literacy Mission (NLM)

The National Literacy Mission (NLM) was launched on 5 May 1988 and its aim was to attain a literacy rate of 75 per cent by 2007. This mission's dominant strategy is imparting functional literacy through literacy campaigns. The NLM's General Council is headed by the Minister of Human Resource Development and the Executive Council is headed by the Secretary (Elementary Education and Literacy). The Directorate of Adult Education provides necessary technical and resource support to NLM. The NLM was revitalised on 30 September 1999 with the goal of total literacy. Now an integrated approach under

### Notes

the 'Total Literacy Campaign' is being implemented under a project called 'Literacy Campaign: an Operational Restoration' which encompasses the programmes of Total Literacy Campaign (TLC) and Post Literacy Programme (PLP).

Ever since its inception, the NLM has strengthened its partnership with NGOs and developed both institutional and informal mechanisms to provide an active promotional role in the literacy movement for more effective implementation and outcomes.

### 9.2.2 National Programme of Nutritional Support to Primary Education (School Mid-day Meal Programme)

This scheme was launched on 15 August 1995 to boost the UEE in terms of increasing enrolment, retention and attendance in primary classes by supplementing the nutritional requirements of children attending primary schools. It is an ambitious scheme that has been operationalised throughout the country in a very short period. The programme envisages the provision of a nutritious and wholesome cooked meal of 100 grams of food grains per school day, free of cost, to all children in Standards 1–4 by 1997–98. During 1995–96, 378 districts, 225,000 schools and 33.5 million children were covered with an expenditure of Rs. 4,412 million. In 1996–97, the scheme was extended to cover 55.4 million children with an expenditure of Rs. 8,110 million. The scheme became fully operational in 1997–98 covering nearly 110 million children in primary classes. As a result of this, a positive impact on school enrolment and retention has been reported.

#### Notes

### 9.2.3 Total Literacy Campaign (TLC)

The NLM's goal is to attain full literacy, that is, a sustainable threshold level of 75 per cent by 2005. The NLM seeks to achieve its goal by imparting functional literacy to non-literates in the age group 15–35 years, which has been the focus of attention because these persons are in the productive and reproductive period of life. The Total Literacy Campaign (TLC) offers them a second chance, in case they missed the opportunity or were denied access to mainstream formal education. The thrust is on the attainment of functional literacy through prescribed norms of literacy and numeracy. A detailed survey is conducted in the district to enumerate and identify non-literate people. The process of the survey also provides opportunities for contact and interaction. During the survey, volunteer teachers and master trainers are also identified.

Out of over 600 districts in the country, 597 districts have already been covered under the TLC. The number of continuing education districts is 328. As per periodic monitoring system of the officials of the National Literacy Mission, the success of the TLC has been slower in the states of Bihar, Haryana, Punjab, Jharkhand and Uttar Pradesh.

### 9.2.4 Sarva Shiksha Abhiyan (SSA)

The Sarva Shiksha Abhiyan (SSA) is a historic stride towards achieving the long-cherished goal of UEE through a time-bound integrated approach, in partnership with the states. The SSA aims to provide useful and quality elementary education to all children in the age group 6–14 years by 2010. The SSA is an effort to recognise the need for improving the performance of the school system and to provide community-owned quality elementary education in mission mode. It also envisages bridging the gender and social gaps. The objectives of the programme when it was launched are given below:

- All children in school by 2003, Education Guarantee Centre, Alternate School, 'Back to School' camp by 2003
- All children complete five years of primary schooling by 2007

- All children complete eight years of schooling by 2010
- Focus on elementary education of satisfactory quality with emphasis on education for life
- Bridge all gender and social category gaps at the primary stage by 2007 and at the elementary education level by 2010
- Universal retention by 2010

Since the inception of the SSA, access to schools has improved to 98 per cent of habitations at the primary level and 86 per cent at the upper primary level. The SSA has improved enrolment by 25 million between 2001 and 2005, thereby reducing the out-of-school children to 3 to 4 per cent, the hardest to reach in the 6–14 year age-group. The dropout rates at the primary level are declining and that of girls is declining more sharply. The gender parity has improved from 0.81 (2001–02) to 0.93 at the elementary stage of education. The transition rate from primary to upper primary (Classes V to VI) has improved to 83.72 per cent. During the X<sup>th</sup> Plan the basic infrastructure has improved through the opening of 1.87 lakh schools, the appointment of 8.12 lakh teachers, the construction of 1.70 lakh buildings and 7.13 lakh additional classrooms. Also, 1.72 lakh drinking water facilities and 2.18 lakh toilets have been created due to the efforts made under the SSA. More emphasis is being given to quality under the SSA, as specific provisions are being made for learning enhancement programmes, remedial teaching and emphasis on teacher training.

### 9.2.5 The Right to Education (RTE) Act

The Right of Children to Free and Compulsory Education (RTE) Act was passed by the Parliament of India on 4 August 2009 and the Act came into force on 1 April 2010. The SSA is the main vehicle for the implementation of the RTE Act. The Act describes the modalities for the provision of free and compulsory education for children between the ages of 6 and 14 years under Article 21A of the Indian Constitution, the same as the right to life.

The salient features of the RTE Act are:

- Every child in the age group of 6–14 years will be provided eight years of elementary education in an age appropriate classroom in the vicinity of his/her neighbourhood.
- Any cost that prevents a child from accessing school will be borne by the State, which shall have the responsibility of enrolling the child, as well as ensuring attendance and the completion of eight years of schooling.
- No child shall be denied admission for want of documents; no child shall be turned away if the admission cycle in the school is over and no child shall be asked to take an admission test. Children with disabilities will also be educated in mainstream schools.
- All private schools shall be required to enrol children from weaker sections and disadvantaged communities to the extent of 25 per cent of their enrolment, by simple random selection. No seats in this quota can be left vacant. These children will be treated on par with all the other children in the school and subsidised by the State at the rate of average per-learner costs in government schools (unless the per-learner costs in private schools are lower).

## 9.3 Importance of Sub-national Level Indicators in Education

Education is one of the largest social sector development programmes in the country and employs the largest number of educated human resources across the country. The characteristics of the education sector make it necessary to have strong inter-linkages among the data elements, flow of information and their sharing across various users.

### Notes

## 9.4 Data Sources

Like other sectors of the economy, modern well-equipped and skilled human resources for data-collection, compilation, analysis, communication, sharing and dissemination for the education sector as a whole and for its various sub-sectors is a prerequisite for the planning to be effective and responsive to the needs of the stakeholders.

Different types of data sources for education are discussed below:

### Census

- Census of India
- School Census

### Surveys

- National Council for Educational Research and Training (NCERT)—All India Educational Survey
- National Sample Survey (NSS)
- National Family Health Survey (NFHS)
- District Level Household Survey (DLHS-RCH)

### Notes

### Service and Other Statistics

- National Data System at the Ministry of Human Resource Development (MoHRD)
- Planning Commission
- District Information System for Education (DISE)
- Annual Status of Education Report (ASER)
- Total Literacy Campaign (TLC)
- State-level Educational Statistics
- District Education Office

### 9.4.1 Census

#### Census of India

The population census is the most comprehensive source of data on the educational attainment of the entire population and the workforce. The unit of observation is the individual along with the household and not the educational institution. The significance of the population data lies in the complete enumeration of the household members cross-classified with a large variety of data on social and economic variables. The data is available for various levels of aggregation/disaggregation, that is, up to the village/block level. The census data reflects the stock of educated manpower and cumulative outcome of past educational efforts. The data on literacy is available up to the block level, classified by gender and caste. The data related to education collected during Census 2001 pertains to literacy, completed level of educational status of person of seven years and above, and whether he/she is studying or has left their studies<sup>1</sup>.

The census also provides data up to the village-level on infrastructure facilities such as availability of primary schools, non-formal education centres and other amenities. Census tables are available in soft copy and also in published book form for each state. The census data can also be used to assess the social demand for elementary education. The population structure and its distribution in school-going age groups are most commonly used for estimating the demand for education.

<sup>1</sup> Registrar General, India, 2005, *Social and Cultural Tables, C-Series, 2001*, Office of Registrar General & Census Commissioner, India, New Delhi.

## School Census

Detailed data on the school-going age group population is collected annually through a School Census in each village by school teachers. The data is collected from every household in the village and all the children in the school-going age group are enumerated. The reasons for non-enrolment and discontinuation are also recorded. This data is supposed to be used for enrolling children and also for keeping track of out-of-school children. The schools also maintain a record of the average attendance of students. Some summary tables based on average attendance are sent to the district administration for monitoring school attendance. However, no system has been developed to analyse and store the attendance data to improve the educational system at the district-level and below.

### 9.4.2 Surveys

In addition to the population and School Censuses, various survey data and results (that collect data related to educational aspects as a by-product) can be used to derive educational indices. A few of the process indicators on educational services and educational status of the population can be accessed from these surveys. A description of select surveys is given below.

#### All-India Educational Survey (AIES)

The National Council of Educational Research and Training (NCERT) is an apex resource organisation set up by the Ministry of Human Resource Development (MoHRD), Government of India, with its headquarters in New Delhi. The main purpose of the All-India Educational Surveys (AIES) conducted periodically by the NCERT is to collect, compile and disseminate information of the country's overall progress in the area of school education. The seventh survey has been named the All-India School Education Survey (AISES). The survey is comprehensive as it covers all aspects of school education in all states/UTs. It covers the availability of schooling facilities in rural habitations, physical and educational facilities in schools, incentive schemes and beneficiaries, medium of instruction and languages taught, enrolment particularly of Scheduled Tribes and Scheduled Castes (SCs/STs), girls and educationally backward minority communities, teachers and their academic and professional qualifications, library and laboratory facilities, ancillary staff and subject-wise enrolment at the +2 stage of education. In addition, the enrolment and teachers in unrecognised schools, Alternative Schools and AIE Centres, Oriental Schools covering *Sanskrit Pathshalas*, *Madrasas and Maktabas*, Special Schools for children with disabilities, and Pre-primary Institutions are covered. The report is available on the NCERT website and can be downloaded from their website ([www.ncert.nic.in](http://www.ncert.nic.in)).

#### National Sample Survey Organisation (NSSO)

The National Sample Survey Organisation (NSSO) conducts nation-wide surveys on select thematic areas in its various rounds. Some rounds of the NSSO have been devoted to collecting information about education in select households. The subject of education was covered in the 35<sup>th</sup>, 42<sup>nd</sup>, 50<sup>th</sup>, 52<sup>nd</sup>, and 55<sup>th</sup> Rounds of NSSO's sample surveys. The aspects covered include literacy, present levels of education, educational status of individuals, reasons for dropouts and work participation of children. In the case of NSSO, data is also available on private expenditure on education and the number of beneficiaries under different incentive schemes provided to the children.

It has been observed that there are large differences in the estimates of NSSO and MoHRD data. One does not know how much of it can be attributed to sampling errors and how much of it to definitional issues. One reason for the differences could be the different response patterns of the households and schools to education related questions.

#### Notes

### **National Family Health Survey (NFHS)<sup>2</sup> and District Level Household and Facility Survey (DLHS)<sup>3</sup>**

Three rounds of NFHS as well as an equal number of rounds of DLHS data are available. In both NFHS and DLHS, questions regarding the education of all the members are posed to the head of the household or to an adult member of the household. The aspects covered by NFHS and DLHS are literacy, present levels of education, educational status of individual, reasons for dropout, ever attended school, highest standard completed (if five years or older) and if any member is in the age group 5–18 years, name of the school and college attended, tuition and reasons for not attending school. The NFHS data can be used for the state level, while DLHS data can be used up to the district level. The NFHS and DLHS-RCH have their raw data and published books are available for public use. The raw data can also be requested from the International Institute for Population Sciences (IIPS).

#### **9.4.3 Service and Other Statistics**

Service statistics only include data from public schools and government recognised schools, and do not include any private unaided schools.

#### **National Data System at Ministry of Human Resource Development (MoHRD)**

Since educational planning and administration for elementary education is a state subject, the primary responsibility for the collection, compilation, tabulation, analysis and transmission of educational data lies with the education departments of the states/UTs. The state/UT level data is aggregated and reported at the national level in prescribed formats. The collection, compilation, analysis and publication of national data are coordinated by the Department of Education, Ministry of Human Resource Development (MoHRD). Every year, the MoHRD publishes two series of data tables. These are Selected Educational Statistics (SES), which contain state and educational level-wise enrolment and the number of teachers. Some budgetary data on plan and non-plan expenditure of the states is also given. Estimates of children in the age groups, 6–11 years and 11–14 years are also provided in SES, and the Gross Enrolment Ratio (GER) at the primary and middle stages is also calculated.

Data on educational institutions, enrolment, teachers and expenditure is provided by the national system and collected annually with 30 September as the record date. The MoHRD also compiles data on the education budgets of the states/UTs. The data is essentially taken from the budget documents of the states/central government. Financial data pertains to 31 March of every year. The utility of the data is significantly diminished due to the considerable time lags. Further disaggregation of data (district-wise and below) is not available from these documents. The raw data is available only at the district/block level.

#### **Planning Commission (PC)**

The Planning Commission (PC) monitors the progress of the implementation of the Minimum Needs Programme (MNP). Since the UEE is one of the action points under MNP, both physical and financial targets are constantly monitored by the Planning Commission. The enrolment of general, SC and ST students by gender and rural/urban origin are major contents of the data generated by the Planning Commission. In addition, data on the release of grants and their utilisation is also available with the Planning Commission. Although the Planning Commission has the most recent data, it differs widely from the data provided by the states to the MoHRD. The Planning Commission does not publish educational data,

<sup>2</sup> International Institute for Population Sciences (IIPS) and Macro International, 2007, *National Family Health Survey (NFHS-3), 2005–06, India, Vol I*.

<sup>3</sup> International Institute for Population Sciences, 2008, *District Level Household Survey, 2007–08*, IIPS, Mumbai.

#### **Notes**

but permits users to access it for official purposes only. The differences between the data obtained from the MoHRD and the Planning Commission are difficult to explain.

#### **District Information System for Education (DISE)<sup>4</sup>**

The National University of Educational Planning and Administration (NUEPA) has created a comprehensive database on elementary education in India under one of its most prestigious projects, District Information System for Education (DISE). The project covers both primary and upper primary schools in all the districts of the country. What is remarkable about DISE is that it has reduced the time-lag in the availability of educational statistics drastically, from seven to eight years, to less than a year at the national level and to a few months at the district and state levels. The DISE is supported by the MoHRD and UNICEF. NUEPA has successfully developed school report cards of more than 1.25 million primary and upper primary schools. In addition to quantitative information, the report cards also provide qualitative information and a descriptive report about individual schools. The district report cards incorporate information on the following important areas of elementary education:

- Basic data on population, literacy, sex ratio, number of blocks, villages, clusters and schools from which data is reported (presented for all districts except for those created after the 2001 Census). In bifurcated districts, it is not possible to project child population, therefore, a few key indicators are not presented.
- Key data on elementary education in terms of number of schools, enrolment, and teachers, classified by school category and school management (government and private). Details of schools and enrolment in rural areas are also made available category-wise and management-wise.
- Grade-wise and level-wise enrolment along with the percentage of over-age and under-age children at the primary and upper primary levels of education in each district.

#### **Notes**

#### **Annual Status of Education Report (ASER)**

The Annual Status of Education Report (ASER) started in 2005, provides the outcome-level indicators of attending school among children by testing the level of comprehension using simple tools appropriate to an age group. In ASER 2008, households were asked about children's attendance in school in the seven days preceding the interview. Different types of tests were also given to them. Raw data is available on the ASER website.

#### **Total Literacy Campaigns (TLCs)**

In recent years, considerable data on the literacy status of the adult population was collected in districts covered under Total Literacy Campaigns (TLCs). The data not only provides insights into the magnitude and structure of the illiterate, but also throws considerable light on the voluntary agencies, social activists, etc. Some evaluation studies were conducted to establish the effectiveness of the TLC approach. Most of the data generated by TLC is not computerised.

#### **State-level Educational Statistics**

While at the national level there is considerable uniformity in the data reporting system, the scope and the format of data compilation and publication differs widely from state to state. State data is more detailed as compared to the national data and provides temporal and spatial data on institutions, enrolment, teachers and expenditure (Plan and non-Plan). While some states provide data on class-level enrolment separately for SCs, STs, OBCs and other students, others do not attach much importance to the publication of educational statistics.

<sup>4</sup> <http://www.dise.in>.

The states are also free to collect any additional data through surveys on matters associated with policy, planning and implementation of various state-level programmes. For example, states running mid-day meal schemes might be interested in studying the impact of such schemes on enrolment and retention.

The state legislature has the authority to ask departments for any data/information needed that is required by public representatives. Such information is generally compiled from secondary sources of data, but sometimes specific information is also collected from relevant sources.

### **District Education Office (DEO)**

The principal source of data at the district level continues to be the district education office (DEO). All the institutional-level data collected from primary and upper primary schools is stored in raw form in the office of the DEO. While some data is aggregated by blocks, the disaggregated data can be retrieved at the district level. There are no national-level guidelines and technical support for the computerisation of educational statistics. During the Seventh and Eighth Five-Year Plan periods, the Central Government initiated a centrally-sponsored scheme for strengthening educational statistics. The scheme failed miserably due to its unrealistic objectives and was rejected by the states.

### **Notes**

#### **Other Sources**

As mentioned earlier, there are many other sources that provide educational data. The university departments of education, SCERTs, DIETs and other teacher training colleges have compiled area-specific data.

For the projection of school enrolment, the projected school-going population in different age groups is required. The projected population by age (in single year 6,7, 8,...18) and sex as on 1 March from 2001–26 for each state is available in *Population Projections for India and States, 2001–26* at the Office of the Registrar General & Census Commissioner, India. District-level projections for eight states have been published by UNFPA and the report is available at <http://india.unfpa.org>.

## **9.5 Educational Indicators**

The educational planners, researchers and administrators may frequently need to evaluate the different indicators of education using the data on school education. Hence, it is necessary to know the indicators and calculation methods. The calculation methods and formulae of important indicators are categorised on the basis of access, participation, equity, infrastructure, quality, finance and efficiency and are discussed under the following categories:

- Population-based indicators
- Student-based indicators
- Teacher-based indicators
- Institution-based indicators
- Expenditure-and cost-based indicators

### **9.5.1 Population-based Indicators**

#### **Literacy Rate**

Literacy rate is an outcome indicator, which numerically qualifies the accumulated achievement of primary education and literacy programmes in imparting basic literacy

skills to the population. Literacy represents the potential for further intellectual growth and contribution to the economic and socio-cultural development of society. It is a common practice to present and analyse literacy rates together with the absolute number of adult illiterates as improvements in literacy rates may sometimes be accompanied by increases in the illiterate population due to the changing demographic structure. The working definition of literacy in the Indian Census since 1991 is the percentage of the population of an area at a particular time, aged seven years or above, who can read and write with understanding. Here the denominator is the population aged seven years or more.

$$\text{Literacy Rate} = \frac{\text{Population aged above seven years who can read and write with understanding at a particular time and area}}{\text{Population aged seven years or more at a particular time and area}} * 100$$

**Example I:** In Madhya Pradesh, 2001, the population above seven years who could read and write with understanding was 31,906,109 and the total population of seven years and more of the same state for the same year was 49,766,795. The literacy rate is calculated as follows:

$$\begin{aligned}\text{Literacy rate} &= (31906109 / 49766795) * 100 \\ &= 64.1\%\end{aligned}$$

#### Notes

**Table 9.1: Literacy Rate in Madhya Pradesh and Some Selected Districts, 2001**

| District              | Literacy Rate |             |             |
|-----------------------|---------------|-------------|-------------|
|                       | Persons       | Males       | Females     |
| <b>Madhya Pradesh</b> | <b>64.1</b>   | <b>76.8</b> | <b>50.3</b> |
| Chhatarpur            | 53.4          | 65.5        | 39.4        |
| Mandla                | 60.8          | 76.7        | 45.4        |
| Rajgarh               | 54.0          | 69.5        | 37.4        |
| Satna                 | 65.1          | 77.8        | 51.4        |
| West Nimar            | 64.0          | 74.0        | 53.7        |

Source: Registrar General, India, 2005, *Social and Cultural Tables, C-Series, 2001*, Office of Registrar General & Census Commissioner, India, New Delhi.

### 9.5.2 Student-based Indicators

#### Gross Enrolment Ratio (GER)

**Definition:** Gross Enrolment Ratio (GER) is the total enrolment in a specific-level of education, regardless of age, expressed as a percentage of the eligible official school-age population corresponding to the same level of education in a given school year.

**Calculation method:** Divide the number of pupils (or students) enrolled in a given level of education, regardless of age, by the population of the designated age group which corresponds to the specified level of education, and multiply by 100.

$$\text{Primary Level GER} = \frac{\text{Total enrolment in Class I – V}}{\text{Population of age 6 – 11 years}} * 100$$

**Example II: Enrolment in School by Age for a Particular District**

| Age          | Grades I–V    | Grades VI–VIII |
|--------------|---------------|----------------|
| <6           | 770           | —              |
| 6–11         | 267100        | 13385          |
| 11–14        | 10244         | 195386         |
| 14+          | 75            | 8784           |
| <b>Total</b> | <b>278189</b> | <b>217555</b>  |

Suppose the total population in the age group 6–11 years (which corresponds to the primary level) is 35,1272, the GER for the primary level in that particular year is calculated as follows:

$$\begin{aligned}\text{GER} &= \frac{278189}{351272} * 100 \\ &= 79.2\%\end{aligned}$$

The GER for all the other levels are calculated along similar lines.

In NCERT’s *All India School Education Survey* (the latest being the seventh in the AIES series) GER is available by sex and place of residence. It is useful at the state level and district level as it provides detailed data and is easily accessible. However, the data is published every five years ([www.7thsurvey.ncert.nic.in](http://www.7thsurvey.ncert.nic.in)). The Ministry of Human Resource Development, Government of India provides state-level, but not district-level, GER data. Secondly, it is only available in printed form. The DISE provides GER up to the district-level.

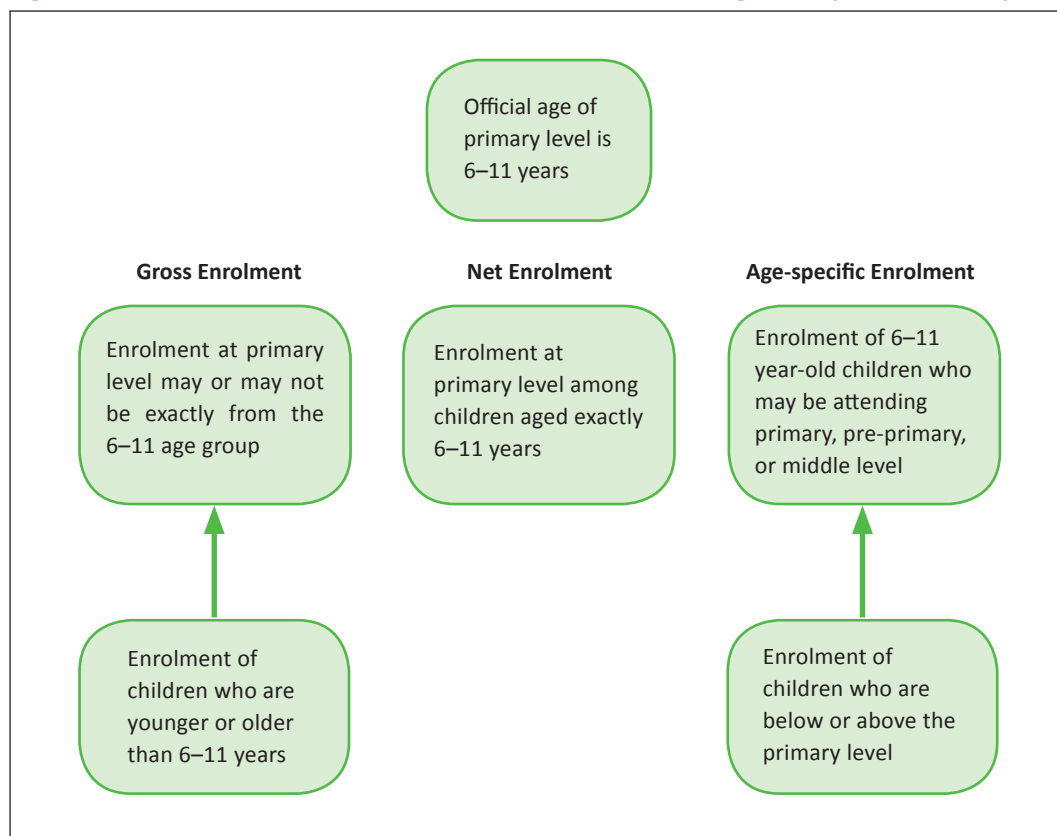
A high GER generally indicates a high degree of participation, irrespective of whether the pupils belong to the official designated age group or not. A GER value approaching or exceeding 100 per cent indicates that a country is, in principle, able to accommodate all of its school-age population, but it does not indicate the proportion already enrolled. The achievement of a GER of 100 per cent is therefore a necessary, but not sufficient condition, for enrolling all eligible children in school. When the GER exceeds 90 per cent for a particular level of education, the aggregate number of places for pupils is approaching the number required for universal access of the official age group. However, this is a meaningful interpretation only if one can expect the under-aged and over-aged enrolments to decline in the future to free places for pupils from the expected age group.

Official age of primary level is 6–11 years.

**Notes**

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**Figure 9.1: Schematic Presentation of Enrolment Indicators (using Primary-level as example)**



## Notes

**Table 9.2: Primary-level GER of Selected Districts of Madhya Pradesh**

| District   | Gross Enrolment Ratio |         |         |
|------------|-----------------------|---------|---------|
|            | 2005–06               | 2006–07 | 2007–08 |
| Chhatarpur | 140.7                 | 149.0   | 154.3   |
| Mandla     | 144.9                 | 150.4   | 130.0   |
| Rajgarh    | 127.6                 | 148.7   | 155.6   |
| Satna      | 135.5                 | 151.6   | 153.5   |
| West Nimar | —                     | 136.4   | 137.6   |

Source: National University of Educational Planning and Administration (NUEPA), 2008, 'District Report Cards 2007–08', in *Elementary Education in India: where do we stand?* National University of Educational Planning and Administration (NUEPA), New Delhi.

## Net Enrolment Ratio (NER)

**Definition:** Net Enrolment Ratio (NER) is enrolment of the official designated age group at a given level of education expressed as a percentage of the corresponding population.

**Calculation method:** Divide the number of pupils enrolled who are in the official age group at a given level of education by the population for the same age group, and multiply the result by 100.

$$\text{Primary Level NER} = \frac{\text{Enrolment in Classes I – V, aged 6 – 11 years}}{\text{Population of age 6 – 11 years}} * 100$$

**Example III:** Suppose for a particular district in a particular year, the total number of children in the age group 6–11 years enrolled in primary schools is 267,100 (see the example of GER) and the total population in the age group 6–11 years (which corresponds to the primary level is 351,272), the NER for primary level in that particular year is calculated as follows:

$$\text{NER} = \frac{267100}{351272} * 100$$

$$= 76\%$$

**Table 9.3: Primary-level NER in Select Districts of Madhya Pradesh**

| District   | Net Enrolment Ratio |         |         |
|------------|---------------------|---------|---------|
|            | 2005–06             | 2006–07 | 2007–08 |
| Chhatarpur | 100                 | 100     | 100     |
| Mandla     | 100                 | 100     | 99.9    |
| Rajgarh    | 95.5                | 100     | 100     |
| Satna      | 100                 | 100     | 100     |
| West Nimar | –                   | 98      | 100     |

Source: National University of Educational Planning and Administration (NUEPA), 2008, 'District Report Cards 2007–08', in *Elementary Education in India: where do we stand?* National University of Educational Planning and Administration (NUEPA), New Delhi.

## Notes

A high NER denotes a high degree of coverage for the official school-age population. The theoretical maximum value is 100 per cent. Increasing trends can be considered as reflecting improving coverage at the specified level of education. When the NER is compared with the GER, the difference between the two highlights the incidence of under-aged and over-aged enrolment. If the NER for primary level is 80 per cent for instance, then the complement (100 per cent minus 80 per cent) i.e., 20 per cent is the proportion of children not enrolled at the primary level. However, since some of these children/youth could be enrolled at other levels of education (pre-primary, middle, or higher secondary levels), this difference should in no way be considered as indicating the percentage of students not enrolled. Therefore, to measure universal primary education or UPE, for example, the adjusted primary NER is calculated on the basis of the percentage of children in the official primary school age-range who are enrolled in either primary or secondary education. A more precise complementary indicator is the ASER which shows the participation of the population of each particular age, regardless of the level of education.

### Data Limitations in Enrolment Statistics

The GER and NER for every district in India are also available in the DISE publication and on their website. However, a few schools did not report the age and grade matrix (which are crucial to know the status of elementary education) and a few districts did not report the number of children enrolled in Grade VIII. Therefore, enrolment in upper primary classes does not present the complete picture in Grades VI–VIII; thus GER and NER may not correctly portray universalisation in such districts.

Again, the percentage of children of a specific age group, enrolled in schools that reported data under DISE may simply imply that the remaining children may either be out of school or enrolled in unrecognised schools, Education Guarantee Schools (EGS), non-formal education centres and other learning centres not covered under DISE.

Irrespective of the school structure, enrolment ratio at the primary level is based on Grades I–V and for the upper primary level, on Grades VI–VIII.

In census and surveys one question asked is whether children above five are currently attending school. Using this, the current attendance of children in this age group is documented.

$$\begin{aligned} & \text{Percentage of children of specified age currently attending school} \\ &= \frac{\text{Population of age 'a' in school in year 't'}}{\text{Population of age 'a' in year 't'}} * 100 \end{aligned}$$

**Example IV:** Suppose the population aged 6–14 years currently attending school is 45,000 and the total population of the same age group is 75,000. What will the percentage of children currently attending school be?

$$\begin{aligned} \text{Percentage of children currently attending school} &= \frac{45000}{75000} * 100 \\ &= 60\% \end{aligned}$$

### Retention Rate (RR) at the Primary Level

**Definition:** The percentage of a cohort of pupils (or students) enrolled in the first class of a given level (i.e., Class I for primary) in a given school year, which are expected to continue on to subsequent classes. The retention rate (RR) measures the capacity and internal efficiency of an education system. It illustrates the situation regarding retention of pupils (or students) from class to class, and conversely the magnitude of class-wise dropouts.

**Calculation method:** Divide the total number of pupils belonging to a school cohort who reached each successive class of the specified level of education (e.g., primary level, secondary level etc.), by the number of pupils in the school cohort, i.e. those originally enrolled in class I of primary education, and multiply the result by 100. The retention rate is calculated on the basis of the reconstructed cohort method, which uses data on enrolment and repeaters for two consecutive years.

$$RR = \frac{\text{Enrolment in Class IV/V in year 't' – Repeaters in Class IV/V in year 't'}}{\text{Enrolment in Class I in year 't-3' / 't-4'}} * 100$$

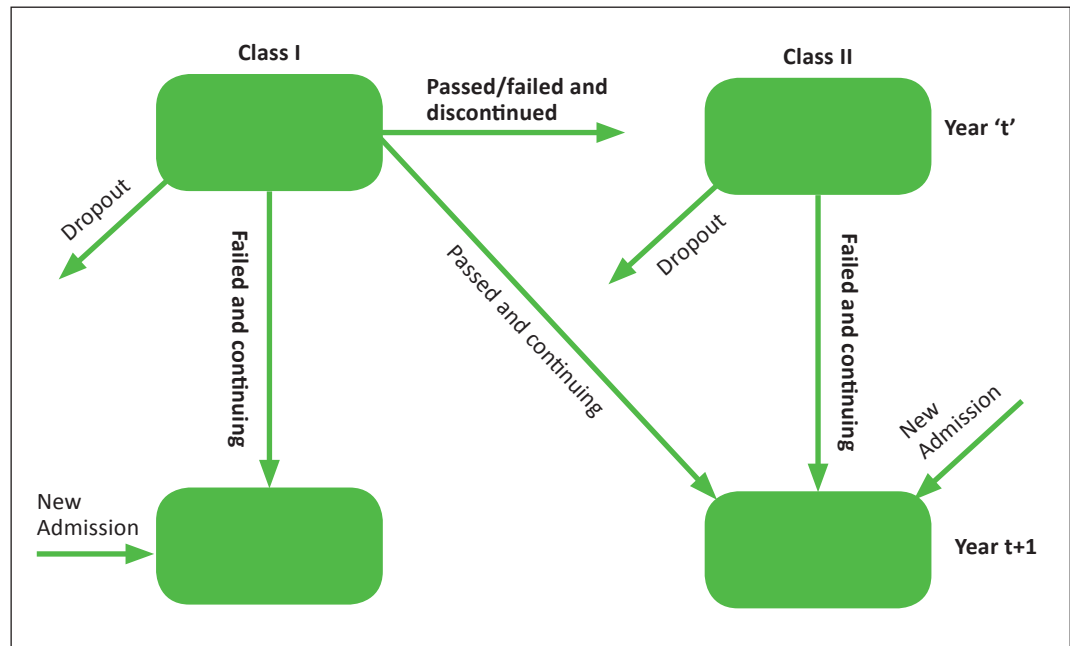
### Notes

**Table 9.4: Retention Rate at the Primary Level in Selected Districts of Madhya Pradesh**

| District       | Retention Rate at the Primary Level |
|----------------|-------------------------------------|
| Madhya Pradesh | 94.3                                |
| Chattarpur     | 85.0                                |
| Mandla         | 67.1                                |
| Rajgarh        | 88.7                                |
| Satna          | 100                                 |
| West Nimar     | 100                                 |

Source: National University of Educational Planning and Administration (NUEPA), 2008, 'District Report Cards 2007–08', in *Elementary Education in India: where do we stand?* National University of Educational Planning and Administration (NUEPA), New Delhi.

Figure 9.2: Progression of Students from Lower to Higher Class



## Notes

Retention rate to the last grade of primary education is of particular interest for monitoring UPE, a central objective for Education For All (EFA) and the MDGs.

### Dropout Rate (DR)

**Definition:** The proportion of pupils from a cohort enrolled in a given class during a given school year that is no longer enrolled in the following school year. The dropout rate (DR) measures the phenomenon of pupils from a cohort leaving school without completion, and its effect on the internal efficiency of the educational system. In addition, it is one of the key indicators for analysing and projecting pupil flows from class to class within the educational cycle.

**Calculation method:** The dropout rate by class is calculated by subtracting the sum of the promotion rate and repetition rate from 100 in the given school year. A cumulative dropout rate in primary education is calculated by subtracting the retention rate from 100 at a given class (see retention rate).

$$DR = \frac{\text{No. of students dropping out from class 'g' in year 't'}}{\text{Total no. of students in class 'g' in year 't'}} * 100$$

**Example V:** Suppose the total students dropping out from Class I–V during the year 2008–09 is 4500 and the total number of students in Class I–V during the same year is 38,000, then the dropout rate is:

$$DR = \frac{4500}{38000} * 100 \\ = 11.8\%$$

**Table 9.5: Primary-level Dropout Rate in Selected Districts of Madhya Pradesh**

| District       | Dropout Rate |
|----------------|--------------|
| Madhya Pradesh | 8.6          |
| Chattarpur     | 7.0          |
| Mandla         | 18.9         |
| Rajgarh        | 5.2          |
| Satna          | 5.0          |
| West Nimar     | 11.4         |

Source: National University of Educational Planning and Administration (NUEPA), 2008, 'District Report Cards 2007–08', in *Elementary Education in India: where do we stand?* National University of Educational Planning and Administration (NUEPA), New Delhi.

Ideally, the rate should approach 0 per cent; a high dropout rate reveals problems in the internal efficiency of the educational system. By comparing rates across classes, it is possible to identify those which require greater emphasis on policy.

### Transition Rate

**Definition:** The number of pupils (or students) admitted to the first class of a higher level of education in a given year, expressed as a percentage of the number of pupils (or students) enrolled in the final class of the lower level of education in the previous year.

**Purpose:** To convey information on the degree of access or transition from one cycle or level of education to a higher one. Viewed from the lower cycle or level of education, it is considered an output indicator, viewed from the higher educational level, it constitutes an indicator of access. It can also help in assessing the relative selectivity of an education system, which can be due to financial requirements.

**Calculation method:** Divide the number of new entrants in the first class of the specified higher level of education by the number of pupils who were enrolled in the final class of the preceding level of education in previous school year, and multiply by 100.

$$\text{Transition Rate} = \frac{\text{New entrants into Class V/VI in year 't+1'}}{\text{Enrolment in class IV/V in year 't'}} * 100$$

### Notes

**Table 9.6: Transition Rate (Primary to Upper Primary) in Selected Districts of Madhya Pradesh**

| District       | Transition Rate |
|----------------|-----------------|
| Madhya Pradesh | 68.0            |
| Chhatarpur     | 49.2            |
| Mandla         | 63.6            |
| Rajgarh        | 64.5            |
| Satna          | 57.0            |
| West Nimar     | 65.5            |

Source: National University of Educational Planning and Administration (NUEPA), 2008, 'District Report Cards, 2007–08', in *Elementary Education in India: where do we stand?* National University of Educational Planning and Administration (NUEPA), New Delhi.

### Gender Parity Index (GPI)

The most widely used indicator of differential in school enrolment by sex is the 'gender parity index' (GPI) through which the empowerment of women in society can be gauged. This index can be developed for most of the indicators (enrolment ratio, literacy rate, repetition rate, coefficient of efficiency etc.) to know the participation of women in educational activity.

$$\text{Gender Parity Index (GPI)} = \frac{\text{Enrolment ratio of girls in primary classes in year 't'}}{\text{Enrolment ratio of boys in primary classes in year 't'}}$$

For example, to calculate the literacy GPI, the female literacy rate is divided by the male literacy rate. A parity index equal to 1 indicates that the female literacy rates and male literacy rates are equal. An index below 1 indicates that the literacy rate of females is lower than that of their counterparts. On the other hand, a value exceeding 1 indicates that the female literacy rates are higher than the male literacy rates. Because of mortality, it is better to compute the index by age groups. The GPI can also be computed between rural and urban areas.

**Example VI:** In the Year 2007–08, in Chhatarpur District of Madhya Pradesh, the total number of girls enrolled in the primary level was 143,269 and the total number of boys enrolled in the primary level was 152,605. What will the GPI be?

### Notes

Total Enrolment in Primary Level = 143269 + 152605

$$= 295874$$

$$\text{GPI} = \{(143269/295874)/(152605/295874)\}$$

$$\text{GPI} = (0.484/0.516)$$

$$= 0.94$$

We can get the GPI from DISE for the national level and from DLHS/DISE for the national, state and district levels.

**Table 9.7: Primary-level GPI in Selected Districts in Madhya Pradesh**

| District       | Gender Parity Index |
|----------------|---------------------|
| Madhya Pradesh | 0.96                |
| Chhatarpur     | 0.94                |
| Mandla         | 1.02                |
| Rajgarh        | 1.02                |
| Satna          | 0.98                |
| West Nimar     | 0.99                |

Source: National University of Educational Planning and Administration (NUEPA), 2008, 'District Report Cards, 2007–08', in *Elementary Education in India: where do we stand?* National University of Educational Planning and Administration (NUEPA), New Delhi.

### 9.5.3 Teacher and School-based Indicators

#### Pupil-Teacher Ratio (PTR)

**Definition:** Pupil-Teacher Ratio (PTR) is the average number of pupils (students) per teacher at a specific level of education in a given school year.

**Calculation method:** Divide the total number of pupils enrolled at the specific level of education by the number of teachers teaching predominantly at that level.

$$\text{PTR} = \frac{\text{Total enrolment in schools of primary category}}{\text{Total number of teachers in schools of primary category}}$$

**Remark:** A teacher is to be classified according to the stage at which she/he is predominantly teaching, that is, the stage of education at which maximum time is devoted. If a teacher is teaching at more than one stage of education and devoting equal time to all the stages, then she/he is to be classified at the highest stage at which she/he is teaching.

In the RTE Act, it is recommended that the PTR should not be more than 40.

**Table 9.8: Primary-level Pupil-Teacher Ratio in Selected Districts of Madhya Pradesh**

| District   | Pupil-Teacher Ratio |
|------------|---------------------|
| Chhatarpur | 50.0                |
| Mandla     | 29.0                |
| Rajgarh    | 38.0                |
| Satna      | 36.0                |
| West Nimar | 46.0                |

Source: National University of Educational Planning and Administration (NUEPA), 2008, 'District Report Cards 2007-08', in *Elementary Education in India: where do we stand?* National University of Educational Planning and Administration (NUEPA), New Delhi.

#### Notes

The PTR at the national, state and district levels can be obtained from DISE. It is very useful at the state and district levels as it provides details and exhaustive coverage. The problem is that it covers only the recognised schools. There are also problems of inconsistency and validity of data.

The MoHRD/Government of India and State Government Education Department Reports also provide data on the PTR.

#### Student Classroom Ratio (SCR)

The Student Classroom Ratio (SCR) presents the average number of pupils sitting in one classroom. The SCR can be calculated using the following formula:

$$\text{SCR} = \frac{\text{Total enrolment in primary schools}}{\text{Total number of classrooms in primary schools}} * 100$$

### 9.5.4 Institutional-based Indicators

#### Percentage of Schools with Common Toilet Facilities

**Definition:** The number of schools of a given category with common toilets is expressed as a percentage of the total number of schools of that category.

**Calculation method:** Divide the number of schools of a given category with common toilets by the total number of schools of that category, and multiply by 100.

$$\text{Schools with common toilet} = \frac{\text{Primary schools having common toilet}}{\text{Total primary schools}} * 100$$

**Example VII:** Suppose in a district during a particular year, the total number of primary schools is 150 and the number of primary schools with common toilet facilities is 85, calculate the percentage of schools with common toilet facilities:

$$\begin{aligned}\text{Schools with common toilet facilities} &= \frac{85}{150} * 100 \\ &= 56\%\end{aligned}$$

The ASER provides data for the number and percentage of schools with toilet facilities by level of school for each state. The DISE also provides the percentage of schools with common toilets at state and district levels and also at the national level.

### Percentage of Schools with Toilets for Girls

**Definition:** The number of schools of a given category equipped with toilets for girls expressed as a percentage of the total number of schools of that category.

**Calculation method:** Divide the number of schools of a given category equipped with toilets for girls by the total number of schools of that category, and multiply by 100.

$$\text{Schools with toilets for girls} = \frac{\text{Primary schools with toilets for girls}}{\text{Total primary schools}} * 100$$

### Notes

**Example VIII:** Suppose in a district during a particular year, the total number of primary schools is 150 and 60 schools have toilet facilities for girls, calculate the percentage of schools with toilet facilities for girls.

$$\begin{aligned}\text{Percentage of schools with toilet for girls} &= \frac{60}{150} * 100 \\ &= 40\%\end{aligned}$$

The ASER provides data for the number and percentage of schools with toilet facilities for girls by level of school for each state. The DISE also provides the percentage of schools with toilet facilities for girls at the national, state and district levels.

### Distance to School

*The percentage of rural population with the facility of a school (of any level: pre-primary, primary, secondary etc.) within 'x' kms.*

**Definition:** The population of rural habitations with a facility of a school within a distance prescribed for that school level (e.g. pre-primary, primary, secondary etc.), expressed as a percentage of the total rural population.

**Calculation method:** Divide the population of rural habitations with a facility of a given school level (e.g. pre-primary, primary, secondary etc., within the distance prescribed), by total rural population, and multiply by 100.

$$\% RA_x^h = \frac{\text{Rural population with facility of school of level 'h' within a distance of 'x' km}}{\text{Total rural population}} * 100$$

where,  $\% RA_x^h$  = Percentage of rural population with a facility of a given school level 'h' (primary, upper primary, secondary and higher secondary level) within a distance of 'x' kilometres.

(Kindly refer to the Remark below for distance criterion)

*Remark:* The NCERT documents on educational surveys reveal that the primary, upper primary, secondary and higher secondary level schooling facilities in India should be made available within a distance of 1, 3, 5 and 8 kilometres respectively. The data for this is available from the NCERT and DLHS village level data.

### 9.5.5 Expenditure/Cost-based Indicators

#### Budget Expenditure

The Union Government's education sector budget allocation has seen a steady increase in the last decade. The 2009–10 budgetary outlay was Rs. 44,528 crore. Elementary education gets top priority. Allocation for the SSA in the 2009–10 budget was Rs. 13,100 crore.

#### As a percentage of GNP/GDP

Expenditure on elementary education as a percentage of the Gross Domestic Product (GDP) is the current expenditure on elementary education in a given year by the GDP for the same year multiplied by 100.

#### Per Student Expenditure

**Per pupil cost at the elementary level:** The total cost (recurring costs plus fixed costs) of elementary education in a year is divided by the total enrolment in elementary classes (I–VIII) in the same year.

**Per capita expenditure on education:** The total cost on education in a year is divided by the total population in the same year.

Annual and periodical reports (selected Education Statistics) are published by MoHRD and provide the total budgetary expenditure incurred for education, as a share of GDP, per student expenditure every year. This only covers limited aspects and government sectors. State ministry reports are also available for these indicators, but are not available in printed form.

#### Notes

## 9.6 Projection of School Enrolment

The enrolment ratio method is the simplest technique for educational projection. The enrolment ratio for a specific level is defined as the ratio of students enrolled in that level divided by the number of children in the age group prescribed for that level. So, for any year in the future, if we can estimate enrolment ratio and projected population for that age group, we can easily estimate the total students enrolled any time in the future by multiplying the projected population for the age group with the enrolment ratio. Generally these ratios are computed separately for boys and girls.

### 9.6.1 Data Requirements

- Total students enrolled in a particular level
- Total children in that age group
- Projected students enrolled
- Projected enrolment ratio

$$\text{Primary-level enrolment ratio} = \frac{\text{Student enrolled in primary school in year 't'}}{\text{Child population in age group 6–11 in year 't'}}$$

or

$$ER_p^t = \frac{E_p^t}{P_{(6-11)}^t}$$

$$\text{hence, } E_p^t = P_{(6-11)}^t * ER_p^t$$

where,  $ER_p^t$  = Enrolment ratio for primary level in year 't'

$E_p^t$  = Number of students enrolled in primary school in year 't'

$P_{(6-11)}^t$  = Child population in age group 6 to 11 in year 't'

If 't' is the base year, then for future years t+5, t+10, t+15 the number of students is projected as:

$$E_p^{t+5} = P_{(6-11)}^{t+5} * ER_p^{t+5}$$

$$E_p^{t+10} = P_{(6-11)}^{t+10} * ER_p^{t+10}$$

$$E_p^{t+15} = P_{(6-11)}^{t+15} * ER_p^{t+15}$$

where,  $E_p^{t+5}$ ,  $E_p^{t+10}$ ,  $E_p^{t+15}$  are the projected number of students enrolled in primary school in the years t+5, t+10, t+15

## Notes

Thus,  $P_{(6-11)}^{t+5}$ ,  $P_{(6-11)}^{t+10}$ ,  $P_{(6-11)}^{t+15}$  are the projected child populations in the years t+5, t+10, t+15 and age group 6 to 11 years. This can be obtained from *Population Projections for India and States 2001–26*, where age-wise projected populations are available for each state and India.  $ER_p^{t+5}$ ,  $ER_p^{t+10}$ ,  $ER_p^{t+15}$  are the projected enrolment ratios for primary level in the years t+5, t+10, t+15. The enrolment ratios for future points of time can be obtained by the extrapolation method discussed in Chapter 4 of this manual.

## 9.6.2 Advantages and Limitations

- The enrolment ratio method is very easy to use and it requires little data.
- It is very difficult to accurately estimate future levels of the enrolment ratio.
- The method cannot capture the problem of late entry to school and repetitions because of students failing.

## 9.7 Summary

- Information about data sources on educational statistics and some basic educational indicators based on population, students, teachers, institutions and expenditure have been discussed. All these are defined, described and illustrated.
- School enrolment projection is discussed.
- Monitoring progress of district-level education can be carried out by using the following indicators:
  - Class-wise enrolment of children for a given year
  - Dropout and transition rate
  - Gender parity and social group's inequality in enrolment
  - Student classroom ratio

## EXERCISES

**Exercise 1:** Calculate Gross Enrolment Ratio (GER), 2008–09 for the districts of Madhya Pradesh.

**Table 9.A: School Enrolment in Primary School and Population of Age Group 6–11 years for Convergence Districts of Madhya Pradesh**

| District   | Total Number of Students Enrolled in Primary School | Population in Age Group (6–11) years | GER |
|------------|-----------------------------------------------------|--------------------------------------|-----|
| Chhatarpur | 299420                                              | 252798                               |     |
| Mandla     | 143404                                              | 113249                               |     |
| Rajgarh    | 256293                                              | 202463                               |     |
| Satna      | 377066                                              | 309556                               |     |
| West Nimar | 308193                                              | 251592                               |     |

Source: 1. National University of Educational Planning and Administration (NUEPA), 2008, 'District Report Cards 2007–08', in *Elementary Education in India: where do we stand?* National University of Educational Planning and Administration (NUEPA), New Delhi.  
 2. UNFPA, 2009, *District Level Population Projections in Eight Selected States of India, 2006–16*, India.

$$\text{GER} = \{(\text{Total students enrolled in grade I–V}) / \text{Children aged 6–11 years}\} * 100$$

**Exercise 2:** Calculate Pupil-Teacher Ratio (PTR), 2008–09 for the districts of Madhya Pradesh.

**Table 9.B: School Enrolment in Primary School and Number of Teachers in Primary School for Convergence Districts of Madhya Pradesh**

| District   | Total Number of Students Enrolled in Primary School | Total Teachers in Primary School | PTR |
|------------|-----------------------------------------------------|----------------------------------|-----|
| Chhatarpur | 299420                                              | 5108                             |     |
| Mandla     | 143404                                              | 5374                             |     |
| Rajgarh    | 256293                                              | 5836                             |     |
| Satna      | 377066                                              | 7544                             |     |
| West Nimar | 308193                                              | 6294                             |     |

Source: National University of Educational Planning and Administration (NUEPA), 2008, 'District Report Cards 2007–08', in *Elementary Education in India: where do we stand?* National University of Educational Planning and Administration (NUEPA), New Delhi.

$$\text{PTR} = (\text{Total students enrolled in primary school} / \text{Total teachers in primary school})$$

**Exercise 3:** Calculate Gender Parity Index (GPI), 2008–09 for the following districts of Madhya Pradesh.

**Table 9.C: Enrolment of Students in Primary School and Population Aged 6–11 by Sex for Convergence Districts of Madhya Pradesh**

| District   | Enrolment at Primary Level, 2008–09 |        | Population Aged 6–11, 2008–09 |        |
|------------|-------------------------------------|--------|-------------------------------|--------|
|            | Girls                               | Boys   | Girls                         | Boys   |
| Chhatarpur | 143269                              | 113556 | 118631                        | 133723 |
| Mandla     | 76274                               | 74880  | 61505                         | 63079  |
| Rajgarh    | 127797                              | 96077  | 95927                         | 104670 |
| Satna      | 184535                              | 93624  | 146238                        | 157791 |
| West Nimar | 155335                              | 152858 | 122119                        | 129473 |

Source: 1. National University of Educational Planning and Administration (NUEPA), 2008, '*District Report Cards 2007–08*', in *Elementary Education in India: where do we stand?* National University of Educational Planning and Administration (NUEPA), New Delhi.  
 2. UNFPA, 2009, *District Level Population Projections in Eight Selected States of India, 2006–16*, India.

**GPI = (Enrolment ratio of girls in primary level in year 't' / Enrolment ratio of boys in primary level in year 't')**

# Drinking Water, Sanitation and Cooking Fuel

## Learning Objectives

To discuss the policies and programmes related to drinking water, sanitation and cooking fuel and its relevance on health outcomes

### 10.1 Introduction

Drinking water and sanitation facilities are crucial for achieving the goal of 'Health for All'. Safe drinking water supply and basic sanitation are so intrinsically linked to human and ecosystem health that they, along with proper hygiene, form the most essential components of a safe and healthy life. Approximately 80 to 90 per cent of untreated sewage is discharged directly into rivers and streams, the main source of water supply in cities (Tibbetts 2000).

***Human faeces remains one of the world's most dangerous pollutants, spreading microbes that cause typhoid, cholera, diarrhoeal illness, amoebic dysentery, and other virulent diseases (WHO 1999).***

Rural India has more than 700 million people residing in about 1.42 million habitations spread over 15 diverse ecological regions. Meeting the drinking water needs of such a large population can be a daunting task. Non-uniformity in the levels of awareness, socio-economic development, education, poverty, practices and rituals and water availability add to the complexity of the task. Despite an estimated total of Rs. 1,105 billion spent on providing safe drinking water since the First Five-Year Plan was launched in 1951, lack of safe drinking water continues to be a major hurdle and a national economic burden. Around 37.7 million Indians are affected by waterborne diseases annually; 1.5 million children are estimated to die of diarrhoea alone; and 73 million working days are lost due to waterborne diseases each year. The resulting economic burden is estimated at \$600 million a year. While 'traditional diseases' such as diarrhoea continue to take a heavy toll, 66 million Indians are at risk due to excess fluoride and 10 million due to excess arsenic in groundwater. In all, 195,813 habitations in the country are affected by poor water quality.

#### Water Resources and Utilisation

- India has 16 per cent of the world's population and 4 per cent of the global fresh water resources.
- Estimates indicate that surface and ground water availability is around 1,869 billion cubic metres (BCM). Of this, 40 per cent is not available for use due to geological and topographical reasons.
- Around 4,000 BCM of fresh water is available due to precipitation in the form of rain and snow, most of which returns to the seas via rivers.

#### Notes

- Ninety-two per cent groundwater extracted is used in the agricultural sector, 5 and 3 per cent respectively for the industrial and domestic sectors.
- Eight to 9 per cent of surface water use is for the agricultural sector and 2 per cent and 9 per cent respectively are used by the industrial and domestic sectors.

Provision of clean drinking water, sanitation and a clean environment are vital to improve the health of people and to reduce the incidence of diseases and death, particularly among children. Women and girls spend hours fetching water and this drudgery must be removed, as it is not only undesirable, but it also takes away other opportunities for self-development. Drinking water is less than one per cent of the total water demand and should have the first priority among all uses of water (*Eleventh Five-Year Plan 2007–2012 Volume II*). Proper handling of water and prevention of contamination are also equally important (*Millennium Health Development Goals in India, 2007*). Contamination of water includes indiscriminate use of chemical fertilisers and chemicals, poor hygienic environment of water sources, open defecation, improper disposal of sewage and solid waste, and pollution from untreated industrial effluents. India has one of the largest rural drinking water supply networks in the world, and a large number of households have access to safe drinking water. Despite this, sanitation coverage is still inadequate, particularly in rural areas and the rural and urban poor continue to bear a disproportionate burden of the non-availability of water (*Millennium Health Development Goals in India, 2007*)<sup>1</sup>.

## Notes

Lack of access to modern cooking fuels represents a bottleneck, holding back progress to achieving the goals worldwide. More than three billion people depend on solid fuels, including biomass (wood, animal dung and agricultural residues) and coal. The inefficient burning of solid fuels on an open fire or traditional stove indoors is the main source of not only hundreds of pollutants, primary carbon monoxide and small particles, but also nitrogen oxide, benzene, butadiene, formaldehyde, polyaromatic hydrocarbons and many other chemicals injurious to health. Burning solid fuel produces extremely high levels of indoor air pollution that women and children breathe in for many hours every day. The more time people spend in such a highly polluted environment, the more dramatic the consequences for the health of women and children (*Fuel for Life: Household Energy and Health*, WHO, p. 8)<sup>2</sup>.

Since the mid-1980s, epidemiological studies have been investigating the impact of exposure to indoor air pollution on health. The results of these studies have recently been reviewed by the World Health Organization (WHO). Inhaling indoor smoke doubles the risk of pneumonia and other acute infections of the lower respiratory tract among children under five years of age. Women exposed to indoor smoke are three times more likely to fall prey to chronic obstructive pulmonary disease (COPD) than women who cook with electricity, gas or other cleaner fuels. Use of coal doubles the risk of lung cancer, particularly among women.

## 10.2 National Policy

Government policies and programmes have also undergone a series of transitions since independence. To begin with, the emphasis was on setting up physical infrastructure in the form of hand pumps. Thereafter, one has seen a transition from technological measures

<sup>1</sup> Centre for Management and Social Research, 2007, *Millennium Health Development Goals in India, 2007: a review*, CMSR.

<sup>2</sup> World Health Organization, 2006, *Fuel for Life, Household Energy and Health*, World Health Organization.

to a socio-technological approach seeking the participation of people. A National Water Policy was drafted in 1987, which was revised in 2002. For ensuring sustainability of systems, steps were initiated in 1999 to institutionalise community participation in the implementation of rural drinking water supply schemes through the *Sector Reforms* project. *Sector Reforms* ushers in a paradigm shift from a “Government oriented supply-driven approach” to a “People oriented demand-responsive approach”. Water quality monitoring is now being considered an important part of the government’s programme. Since 2000, water quality monitoring has been accorded a high priority and institutional mechanisms have been developed at the national, state, district, block and *Panchayat* levels. The government has also outlined requisite mechanisms to monitor the quality of drinking water and devise effective Information, Education and Communication (IEC) interventions to disseminate information and educate people on health and hygiene.

The Government of India launched the National Rural Drinking Water Quality Monitoring and Surveillance Programme in February 2006. This envisages institutionalisation of community participation for monitoring and surveillance of drinking water sources at the grassroots level by *Gram Panchayats* and Village Water and Sanitation Committees, followed by checking the positively tested samples at the district-level and state-level laboratories. The major problem that arises when it comes to addressing problems related to water is that provisions for water supply are distributed across various ministries and institutions and intersectional coordination becomes critical for the success of any programme.

The goals of environmental sustainability include targets on improving people’s access to clean drinking water and basic sanitation. MDG (7.C) stipulates that the proportion of people without sustainable access to safe drinking water and basic sanitation should be reduced to half by 2015. The responsibility for water supply and sanitation at the central and state level is shared by various ministries. The Ministry of Rural Development is responsible for rural water supply through its Department of Drinking Water Supply (DDWS). The Ministry of Housing and Urban Poverty Alleviation is indirectly responsible for water supply and sanitation in the national capital territory of Delhi and other Union Territories.

The Eleventh Five-Year Plan (2007–12)<sup>3</sup> sets high targets and aims to achieve the MDG targets of sanitation in the rural sector by 2012. It also aims to bring down morbidity, mortality and financial losses by controlling waterborne diseases through the creation of basic infrastructure such as water supply and sanitation (*MDG 2000, pp. 96–100*).

Reducing the number of people without effective access to modern cooking fuels by 50 per cent and making improved cooking stoves widely available by 2015 (*Fuel for Life, p. 16*)<sup>4</sup> represents a stepping stone towards achieving the Millennium Development Goals (MDGs).

### 10.2.1 Urban Water Supply and Sanitation

The following are the major schemes in the urban sector initiated since the Tenth Plan.

#### Jawaharlal Nehru National Urban Renewal Mission (JNNURM)

The scheme, introduced in 2005, covers 63 cities with more than 1 million population including 35 metro cities and other state capitals and culturally important towns. It is oriented towards:

- Improving and augmenting the economic and social infrastructure of cities

<sup>3</sup> Planning Commission, 2008, *Eleventh Five-Year Plan, 2007–12*, Vol. II, Government of India, New Delhi.

<sup>4</sup> *Ibid.*, 2.

#### Notes

- Initiating wide-ranging urban sector reforms with the primary aim of elimination of legal, institutional and financial constraints that impeded investment in urban infrastructure and sanitation
- Extending basic services to the poor including security of tenure at affordable prices
- Strengthening municipal governments and their functioning in accordance with the provisions of the Constitution

### Scope of the Mission

The Mission shall comprise of two sub-missions:

- **Sub-Mission for Urban Infrastructure and Governance:** This will be administered by the Ministry of Urban Development through the Sub-Mission Directorate for Urban Infrastructure and Governance. The main thrust of the sub-mission will be on infrastructure projects relating to water supply and sanitation, sewerage, solid waste management, road network, urban transport and re-development of old city areas with a view to upgrading infrastructure therein, shifting industrial and commercial establishments to conforming areas, and so on.
- **Sub-Mission for Basic Services to the Urban Poor:** This will be administered by the Ministry of Urban Employment and Poverty Alleviation through the Sub-Mission Directorate for Basic Services to the Urban Poor. The main thrust of the Sub-Mission will be on integrated development of slums through projects providing utilities such as shelter, basic services and other related civic amenities to the urban poor.

### Notes

### National Water and Sanitation Programme

The Union Government of India appointed the Environmental Hygiene Committee (1948–49), which recommended a comprehensive plan for providing safe water supply and sanitation to the population. Thereafter the **National Water Supply and Sanitation Programme** was launched in 1954. The United Nations declared 1981–90 as the ‘**International Drinking Water Supply and Sanitation Decade**’. The following targets were fixed by the Indian Government for the decade:

- 100% urban and rural water supply
- 50% urban sanitation
- 25% rural sanitation

The Guinea Worm Eradication Programme was linked with this. In 1986, the **National Drinking Water Mission (NDWM)**—also known as the **Rajiv Gandhi Drinking Water Mission (RGDWM)**—was launched in order to provide scientific and cost-effective content to the centrally-sponsored Accelerated Rural Water Supply Programme (ARWSP).

In 1990, the United Nations General Assembly accepted the following guidelines given in the New Delhi Declaration for Water Supply and Sanitation:

- Protection of environment and safeguarding of health through the integrated management of water resources and solid waste
- Organisational reforms, changing attitudes, behaviour, and full participation of women
- Community management of services and strengthening local institutions
- Sound financial practices and application of appropriate technology

As part of the rural sanitation coverage envisaged under this programme, the following activities were considered:

- A demand-driven low-cost sanitation approach
- Involvement of private bodies and NGOs to provide sanitation facilities
- Entrusting *Panchayati Raj* institutions and local administration with the responsibility of operation and maintenance of water supply and sanitation
- Achieving zero incidence of Guinea worm disease by 1993 and total eradication by 1995 by improving water quality
- Improving sanitation in rural areas through IEC programmes, and introducing the concept of total environmental sanitation
- Converting all existing dry latrines to low-cost sanitary latrines

As part of the urban sanitation coverage envisaged under this programme, the following activities were considered:

- Providing reasonable sanitation facilities to a large population
- Total elimination of dry latrines and manual scavenging
- Low-cost on-site sanitation in those parts of cities, small and medium towns that do not have sewers
- Technological innovations to improve the re-usability of recycled waste
- “Polluter paying” principle should be applied to finance waste-disposal programmes
- Involvement of NGOs, the private sector and the community
- Converting all existing dry latrines to low-cost sanitary latrines

## Notes

### Accelerated Urban Water Supply Programme (AUWSP)

This programme was initiated in 1993–94 to provide safe and adequate water supply facilities to the entire population of towns with a population less than 20,000 as per the 1991 Census. Allocation for each qualifying state was to be decided on the basis of the following weightage:

- 50% on the population of such towns
- 35% on the incidence of poverty in a state
- 5% on the number of such towns in states
- 10% in terms of population of such towns covered under programmes such as the [DPAP, DDP, HADP] and Special Category Hilly States

To evaluate the performance of water supply schemes being implemented under the centrally-sponsored AUWSP, in coordination with the state implementing agencies as well as urban local bodies (ULBs) in charge of the day-to-day operation and maintenance of the scheme, an effort has been made under AUWSP to provide safe drinking water at the rate of 70 litres per capita per day (lpcd) and appropriate cost-effective technologies adopted to supply drinking water to small towns.

The main objectives are:

- To provide safe and adequate water supply to the entire population of the town having population less than 20,000 within a fixed time-frame
- To improve the environment and quality of life
- Better socio-economic conditions and more productivity to sustain the economy of the country

### Mega Cities Scheme

Introduced with the objective of undertaking infrastructure development projects of city-wise/regional significance, covering a wide range of components like water supply and sewerage, roads and bridges, city transport, and solid waste management, the scheme has been merged with JNNURM.

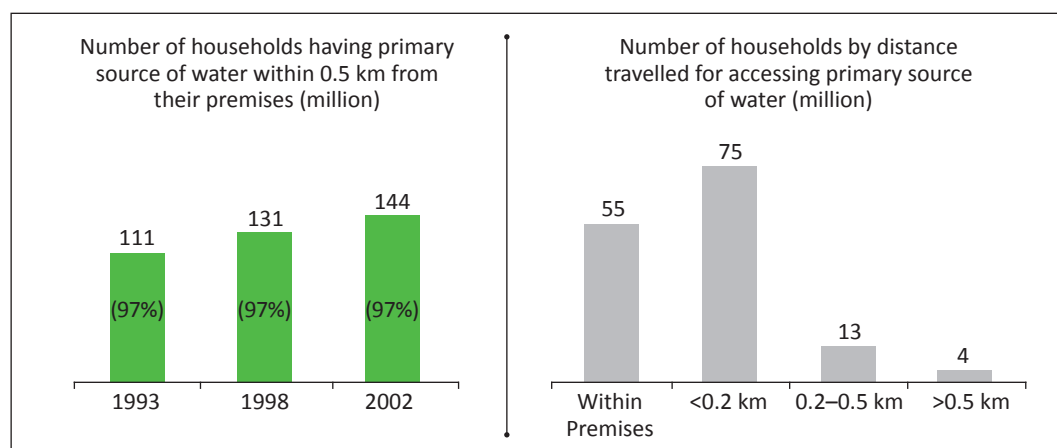
### Integrated Development of Small and Medium Towns Scheme (IDSMT)

The total population of the country increased from 361 million in 1951 to 1027 million in 2001, while the urban population increased from 62 million to 285 million during the same period. The number of metropolitan cities increased from 23 in 1991 to 35 in 2001. Thus, it is evident that there was a clear shift towards large towns, perhaps due to lack of employment opportunities and the poor urban infrastructural base of the small and medium towns. The centrally-sponsored scheme of Integrated Development of Small Medium Towns (IDSMT) was initiated in the year 1979–80 and was continued with timely amendments and modifications till 2004–05. In December 2005, it was subsumed under the Urban Infrastructure Development for Small and Medium Towns (UIDSSMT) Scheme. Investment in the development of small urban centres would help in reducing migration to large cities and support the growth of surrounding rural areas.

### Notes

The scheme covers 5098 towns with a population of less than 1 million according to the 2001 Census. Both these schemes, JNNURM and UIDSSMT, are prestigious Government of India programmes for implementation over a seven-year period. Water supply and sanitation, including drainage and solid waste management, have been accorded high priority with a view to provide these basic amenities to all, including the urban poor.

**Figure 10.1: Water Supply Status in Rural India**



Source: NSSO 49<sup>th</sup>, 54<sup>th</sup>, 58<sup>th</sup> rounds; NSSO 58<sup>th</sup>, 2002.

### Objectives of IDSMT

The main objectives of the IDSMT scheme are:

- Improving infrastructural facilities and helping in the creation of durable public assets in small and medium towns
- Decentralising economic growth and employment opportunities and promoting dispersed urbanisation
- Increasing the availability of serviced sites for housing, commercial and industrial uses
- Integrating spatial and socio-economic planning as envisaged in the Constitution (74<sup>th</sup> Amendment) Act, 1992

- Promoting resource-generating schemes for the urban local bodies to improve their overall financial position

### Low-cost Sanitation Scheme

The centrally-sponsored scheme of Low-cost Sanitation for Liberation of Scavengers was started in 1980–81 initially through the Ministry of Home Affairs, and later through the Ministry of Welfare. From 1989–90, it was operated through the Ministry of Urban Development and later on through the Ministry of Urban Employment and Poverty Alleviation, now renamed Ministry of Housing and Urban Poverty Alleviation. The main objectives of the scheme are to convert the existing dry latrines into low-cost pour flush latrines, to construct new ones where none exist and to achieve the elimination of manual scavenging components.

The scheme:

- Envisaged conversion of dry latrines into low-cost twin pit sanitary latrines and construction of new individual toilets where none exist
- Was applied on a 'whole town basis' and operated through the Housing and Urban Development Corporation with a mix of subsidy
- Was demand-driven in nature with no state fixed allocation/targets
- Has so far helped liberate 52,829 scavengers

### Notes

### 10.2.2 Rural Water Supply and Sanitation

The following are the major schemes in the rural sector:

#### Rural Water Supply Programme

Clean drinking water is a basic necessity of life. Supply of clean drinking water in the rural areas has always been one of the highest priorities of the government. A Technology Mission on drinking water named 'National Drinking Water Mission' (NDWM) was launched in 1986 and subsequently rechristened as 'Rajiv Gandhi National Drinking Water Mission' (RGNDWM) with three key objectives:

- Providing safe drinking water to all villages
- Assisting local communities to maintain sources of safe drinking water in good condition
- Giving special attention to water supply to Scheduled Castes and Scheduled Tribes (SC/ST)

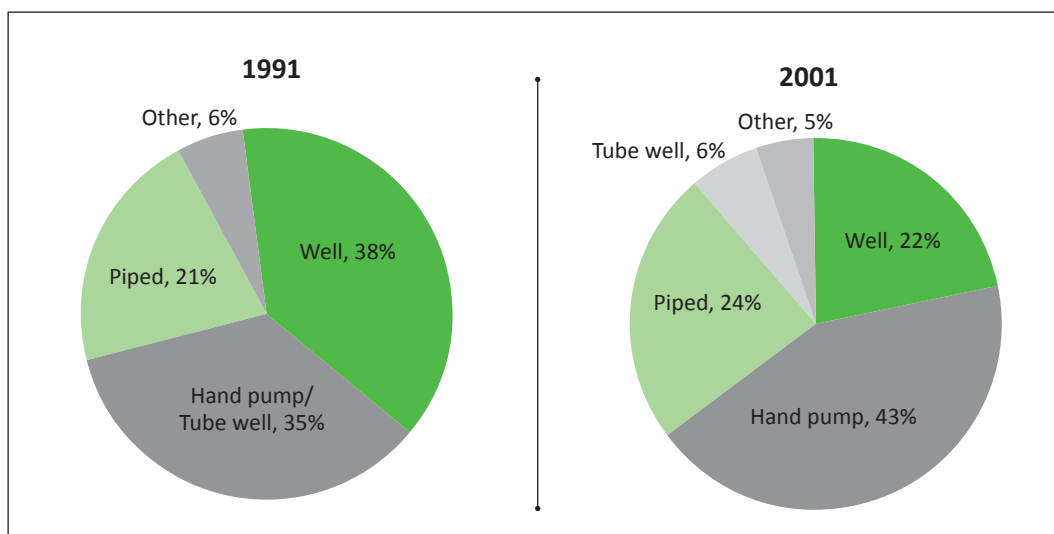
#### Accelerated Rural Water Supply Programme (ARWSP)

The Accelerated Rural Water Supply Programme (ARWSP) is implemented by the Government of India to provide safe drinking water in rural areas. Under this programme, the following norms are to be followed: 40 lpcd of drinking water for human beings, 30 lpcd of additional water for cattle in areas under the Desert Development Programme, one hand-pump or stand post for every 250 persons and availability of water source in the habitation or within 1.6 km in the plains and 100 m. elevation in hilly areas.

The strategies of the programme evolved around the basic premise that the government is responsible for the provision of safe drinking water. The prime objective of the programme was:

- To ensure coverage of all rural habitations and especially to reach the population with no/less access to safe drinking water
- To ensure sustainability of systems and sources
- To preserve quality of water by institutionalising water quality monitoring and surveillance through a 'catchment area' approach

**Figure 10.2: Rural Water Supply – Types of Sources**



Source: 1991 and 2001 Census.

### **Swajaldhara**

*Swajaldhara* has certain fundamental reform principles, which need to be adhered to by State Governments and implementing agencies such as the adoption of a demand-responsive, adaptable approach along with community participation, based on empowerment of villagers to ensure their full participation at different project stages. These principles are mentioned below:

- People's participation in the choice of drinking water scheme, planning
- Ownership of drinking water assets to be with the village community
- Village communities have the power to plan, implement, operate, maintain and manage all water supply and sanitation schemes
- Partial capital cost-sharing either in cash or kind, including labour or both, is 100 per cent responsibility of operation and maintenance by users
- The village community should ensure sustained drinking water supply by taking up conservation measures through rain water harvesting and ground water recharge systems
- The selected village community should bear 10 per cent of the estimated cost of the project and the Government of India, 90 per cent of the capital cost
- Other contributions from two government programmes, MPLADS/MLACDS are prohibited

### **Total Sanitation Campaign (TSC)**

The Government of India restructured the Comprehensive Rural Sanitation Programme with effect from 1 April 1999 and launched the Total Sanitation Campaign (TSC) to eliminate the practice of open defecation in rural areas and to ensure safe disposal of night soil, domestic liquid and soil waste. Thus, the overall aim of TSC is to bring an improvement in the general quality of life in the rural areas by accelerating sanitation coverage that would help reduce water- and sanitation-related diseases. Individual household latrines, school toilets, *Anganwadi* toilets, sanitary complexes and rural sanitary marts are built under the scheme. The launch of a state-level multimedia campaign has been proposed in 2011 in order to change the mindset of the rural public regarding sanitation practices and generate demand for individual household toilets.

### **Notes**

**Table 10.1: Trends in Financial and Physical Allocation under Total Sanitation Campaign (TSC)**

| S. No. | Year    | Financial Allocation<br>(Rs. in crore*) | Physical Allocation<br>(Individual Toilets) |
|--------|---------|-----------------------------------------|---------------------------------------------|
| 1.     | 2000–01 | 11.88                                   | 16086                                       |
| 2.     | 2001–02 | 21.40                                   | 139751                                      |
| 3.     | 2002–03 | 27.79                                   | 276894                                      |
| 4.     | 2003–04 | 45.15                                   | 451701                                      |
| 5.     | 2004–05 | 42.59                                   | 488205                                      |
| 6.     | 2005–06 | 116.99                                  | 613826                                      |
| 7.     | 2006–07 | 84.14                                   | 215286                                      |
| 8.     | 2007–08 | 42.13                                   | 574109                                      |
| 9.     | 2008–09 | 33.06                                   | 339066                                      |
| 10.    | 2009–10 | 244.66                                  | 978651                                      |
| 11.    | 2010–11 | 216.49                                  | 955122                                      |

\* 1 crore= 10 million

### **National Rural Health Mission (NRHM, 2005–12)**

The NRHM aims at effective integration of health centres with determinants of health like sanitation and hygiene, nutrition and safe-drinking water through a district plan for health. It employs the following strategies to do so:

- Train and enhance the capacity of *Panchayati Raj* Institutions (PRI) to own, control and manage public health services
- Implement an oral District Health Plan prepared by the District Health Mission, including drinking water, sanitation and hygiene and nutrition

### **Sanitation and Hygiene under NRHM**

- The TSC is presently implemented in 350 districts.
- Components of TSC include activities that inform, educate and effectively communicate (IEC) on rural sanitation, individual household toilets, women's sanitary complex, and the school sanitation programme.
- Similar to DHM, TSC is also implemented through *Panchayati Raj* Institutions (PRIs).
- The District Health Mission would therefore guide the activities of sanitation at the district level, and promote joint IEC for public health, sanitation and hygiene, through the village health and sanitation committee (VHSC), and promote household toilets and the school sanitation programme. ASHA workers would be given incentives by the Mission for promoting household toilets.

### **10.2.3 National Environment Policy for Fuel**

This policy adopts an integrated approach to energy conservation and promotes the adoption of renewable energy technologies, including hydropower, by appropriately linking efforts to improve conversion, transmission, distribution, and end-use efficiency, and R&D in the dissemination of renewable energy technology. It seeks to remove policy, legal, and regulatory barriers to setting up decentralised generation and distribution systems for power and other secondary energy forms, based on local primary energy resources.

### **Notes**

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It also accelerates national programmes of dissemination of improved fuel-wood stoves and solar cookers suited to local cooking practices and biomass resources and strengthens the monitoring and enforcement of emission standards for both point and non-point sources. The policy aims to implement action plans for major cities to address air pollution for both point and non-point sources, relying on a judicious combination of fiats and incentive-based instruments. It also aims to reduce vehicular pollution by formulating a national strategy for urban transport to ensure adequate investment, public and private, in low pollution mass transport systems.

It promotes reclamation of wastelands by energy plantations for rural energy through multi-stakeholder partnerships involving the land owning agencies, local communities, and investors. The policy strengthens efforts for partial substitution of fossil fuels by bio-fuels, through promotion of bio-fuels plantations, promoting relevant research and development, and streamlining regulatory certification of the new technology (*National Environmental Policy, 2006*).

### 10.3 Importance of Sub-national Indicators

#### Notes

Urban local bodies (ULBs) are in charge of operation and maintenance in urban municipalities. Some of the largest cities have created municipal water and sanitation utilities. However, these utilities remain weak in terms of financial capacity.

There are about 100,000 rural water-supply systems in India. At least in some states, the responsibility for service provision is in the process of being partially transferred from State Water Boards and district governments to PRIs at the block or village level. (According to the sub-divisions of India in 2002 there were about 604 districts and 256,000 villages in India. Blocks are an intermediate level between districts and villages). Where this transfer has been initiated, it seems to be more advanced for single-village water schemes than for more complex multi-village water schemes.

These initiatives are the result of decentralisation following an amendment to the Constitution in 1992. In order to increase the accessibility of drinking water and sanitation at village and ULB levels through constant assessment, it is important to have indicators of accessibility at the sub-national level.

### 10.4 Data Sources

#### 10.4.1 Census

##### Census of India

The census provides data on availability of basic amenities at various levels: by rural and urban areas at the state level; at the town and city level; and finally, at the household level. Data is available for towns and cities administered by municipal corporations, as well as for non-municipal towns. Several basic amenities such as availability of improved drinking water, electricity, toilet facility, use of LPG, and drainage for the outlet of household waste water are critical for good living, health and well-being of a household. Census 2001 classified households by availability and non-availability of electricity in a separate table. This emphasis on availability of electricity was laid because many households in urban areas still rely upon streetlights for light at night. Census 2001 information has been taken as a measure of the access to electricity in this study. The sources of drinking water were provided based on tap, hand pump, tube well, well, ponds, spring and rivers etc. The

sources based on tap and hand pump may be considered as improved sources of drinking water. Similarly, toilet facilities include households with pit latrine, water closet and other latrines, and wastewater outlets at the household level, with drainage which includes both closed and open drains. LPG is considered a clean fuel and information on it was provided by Census 2001 as one of the fuel sources used for cooking.

### 10.4.2 Surveys

#### National Family Health Survey (NFHS) and District-Level Household and Facility Survey (DLHS)

The NFHS is a series of nationwide surveys conducted with a representative sample of households throughout the country. The Ministry of Health and Family Welfare (MoHFW), Government of India (GoI), initiated NFHS surveys to provide high-quality data on population and health indicators. The three rounds of NFHS surveys conducted to date are major landmarks in the development of a demographic and health database for India.

The NFHS collects information on the main source of drinking water, type of toilet facility, source of lighting, type of cooking fuel, religion and caste/tribe of the household head, ownership of a house, ownership of agricultural land, ownership of livestock, ownership of other selected items, and whether the household has a card attesting they are below the poverty line (BPL). Information is also collected on health issues such as the prevalence of tuberculosis (TB), use of private or public health facilities, and ownership of mosquito nets. In addition, a test is conducted to assess whether the household uses cooking salt fortified with iodine or not.

Similar information is also available at the district level from the District-Level Household and Facility Survey (DLHS). It provides information about the source of drinking water for each household. The main source of drinking water has been classified into a number of categories, which are again divided into two main groups – ‘Improved Source of Drinking Water’ and ‘Other Source of Drinking Water’. The former includes piped water, tap water, hand pump, tube well and protected well water, and the latter includes unprotected well, tankers, lakes, ponds, streams and bottled water etc. It also provides information about toilet facilities classified under four main categories: (i) water closest latrines, fitted with a flushing system that may be connected to septic tanks; (ii) pit latrines, attached to a pit dug into the ground; (iii) any other type of latrine, (DLHS-3 collected information about other latrines); and (iv) houses with no latrine, where members defecate outside in the open. The NFHS and DLHS have their raw data, and published reports available for public use and can also be requested from the International Institute for Population Sciences (IIPS) in Mumbai.

#### Notes

## 10.5 Measures of Drinking Water, Sanitation and Fuel

### 10.5.1 Percentage of Households with Access to Improved Sources of Drinking Water

#### Definition

The percentage of households that has access to improved sources of drinking water in a specified territory (village, block, town, district, state etc.) in a reference year is given by:

$$\text{Improved source of drinking water} = \frac{\text{No. of households with access to improved drinking water sources at a particular time and area}}{\text{Total number of households at a particular time and area}} * 100$$

## Notes

The data for the percentage of households with access to improved source of drinking water can be obtained from the Population Census, NFHS and DLHS.

### Improved Sources of Drinking Water

The census and surveys collect data on the following nine types of drinking water sources:

1. Tap (inside residence)
2. Tap (shared/public)
3. Hand pump/bore well
4. Well (covered)
5. Well (uncovered)
6. River/canal
7. Pond/tank/lake
8. Spring
9. Any other source

Among these, tap water, hand pump/bore well, and a covered well are considered improved sources of drinking water.

**Example 1.** Percentage of Households with Access to Safe Drinking Water in Selected Districts of Madhya Pradesh.

| State and District | Total Households | Household Access to Tap Water | Household Access to Improved Source of Water | Percentage of Household Access to Tap Water | Percentage of Household Access to Improved Source of Water |
|--------------------|------------------|-------------------------------|----------------------------------------------|---------------------------------------------|------------------------------------------------------------|
| Madhya Pradesh     | 1837945          | 390950                        | 1803981                                      | 21.3                                        | 98.2                                                       |
| Chhatarpur         | 69905            | 3613                          | 69509                                        | 5.2                                         | 99.4                                                       |
| Mandla             | 12008            | 2931                          | 11243                                        | 24.4                                        | 93.6                                                       |
| Rajgarh            | 44454            | 4676                          | 43916                                        | 10.5                                        | 98.8                                                       |
| Satna              | 63302            | 5524                          | 62212                                        | 8.7                                         | 98.3                                                       |
| West Nimar         | 36413            | 16760                         | 35227                                        | 46.0                                        | 96.7                                                       |

Source: Registrar General, India, 2004, 'Household Tables, Series H-8, Distribution of Household by Source of Drinking Water and its Location, 2001', Office of Registrar General & Census Commissioner, India, New Delhi.

### Formulae used

1. *Percentage of households with access to tap water = (Households with access to tap water/Total households) \* 100*
2. *Percentage of households with access to improved source of water = (Households with access to improved source of water/Total households) \* 100*

**Table 10.2: Percentage of Households with Access to a Tap by Different Classes of Cities in Major States**

| State             | Class 1 | Class 2 | Class 3 | Class 4 | Class 5 | Class 6 |
|-------------------|---------|---------|---------|---------|---------|---------|
| Andhra Pradesh    | 75      | 68      | 60      | 60      | 58      | 62      |
| Assam             | 35      | 31      | 29      | 26      | 34      | 9       |
| Bihar             | 38      | 15      | 12      | 7       | 20      | —       |
| Chhattisgarh      | 65      | 59      | 52      | 55      | 44      | —       |
| Gujarat           | 84      | 85      | 76      | 72      | 83      | 90      |
| Haryana           | 72      | 79      | 68      | 71      | 64      | 24      |
| Himachal Pradesh  | 95      | —       | 95      | 93      | 93      | 93      |
| Jammu and Kashmir | 95      | 82      | 76      | 82      | 65      | 71      |
| Jharkhand         | 50      | 43      | 50      | 44      | 52      | 45      |
| Karnataka         | 81      | 77      | 74      | 71      | 70      | 80      |
| Madhya Pradesh    | 73      | 66      | 67      | 59      | 50      | 43      |
| Maharashtra       | 92      | 85      | 77      | 79      | 74      | 89      |
| Orissa            | 59      | 37      | 34      | 37      | 41      | 51      |
| Punjab            | 71      | 66      | 65      | 52      | 39      | 58      |
| Rajasthan         | 84      | 79      | 75      | 72      | 60      | 55      |
| Tamil Nadu        | 63      | 74      | 65      | 63      | 68      | 70      |
| Uttar Pradesh     | 61      | 51      | 44      | 40      | 37      | 51      |
| Uttaranchal       | 96      | 64      | 81      | 77      | 70      | 85      |
| West Bengal       | 65      | 44      | 34      | 24      | 26      | 30      |

Source: Registrar General, India, 2004, 'Household Tables, H-Series, 2001', Office of Registrar General & Census Commissioner, India, New Delhi.

*Note:* Classification of Cities and its Population Range According to Census, 2001: Class 1 Cities (Population 1 lakh and above); Class 2 Cities (Population 50,000–99,999); Class 3 Cities (Population 20,000–49,999); Class 4 Cities (Population 10,000–19,999); Class 5 Cities (Population 5,000–9,999); Class 6 Cities (Population less than 5,000).

#### Notes

### 10.5.2 Percentage of Households with Access to Protected Toilets

#### Definition

A protected toilet is a toilet which satisfies the following criteria of the Ministry of Health:

- Human excreta waste does not pollute the surface of land and surrounding water
- No flies
- No bad smell
- Toilet is safely constructed
- Animals cannot come into contact with excreta

The percentage of households that has access to protected toilets in a specified territory in a reference year is given by:

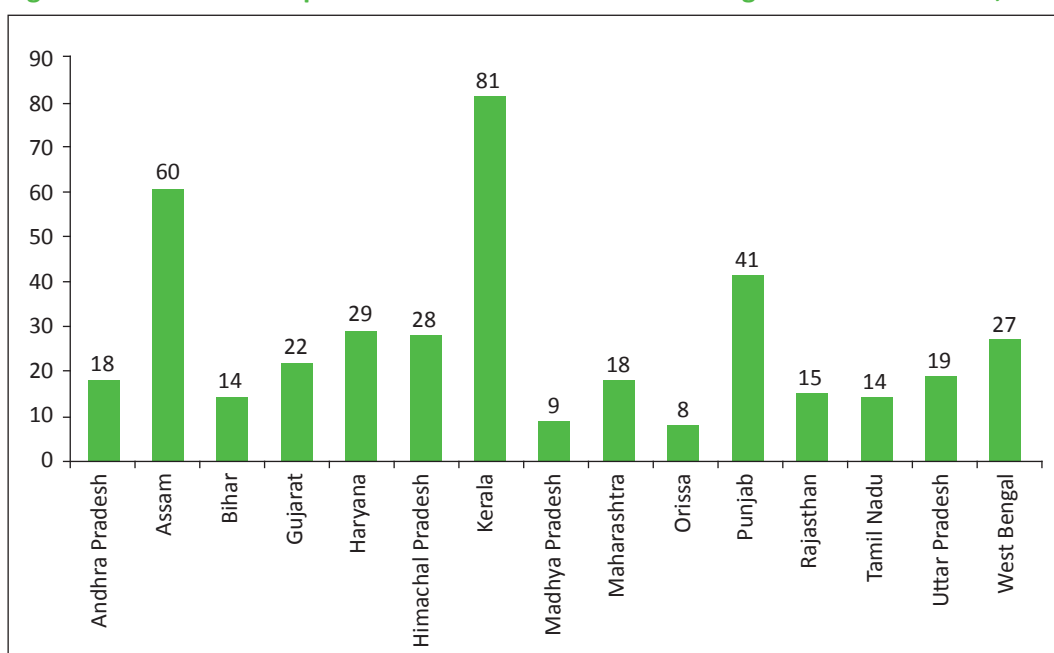
$$\text{Protected toilets} = \frac{\text{Households with access to protected toilets at a particular time and area}}{\text{Total no. of households at a particular time and area}} * 100$$

**Table 10.3: All India Distribution of Households by Availability of Type of Latrine**

| S. No.       | Type of Latrine | Total                |              | Urban                |              | Rural                |              |
|--------------|-----------------|----------------------|--------------|----------------------|--------------|----------------------|--------------|
|              |                 | Number of Households | %            | Number of Households | %            | Number of Households | %            |
| 1.           | No latrine      | 122078136            | 63.6         | 14110936             | 26.3         | 107967200            | 78.1         |
| 2.           | Water closet    | 34598446             | 18.0         | 24761392             | 46.1         | 9837054              | 7.1          |
| 3.           | Pit latrine     | 22076486             | 11.5         | 7840189              | 14.6         | 14236297             | 10.3         |
| 4.           | Other           | 13210867             | 6.9          | 6979859              | 13.0         | 6231008              | 4.5          |
| <b>Total</b> |                 | <b>191963935</b>     | <b>100.0</b> | <b>53692376</b>      | <b>100.0</b> | <b>138271559</b>     | <b>100.0</b> |

Source: Registrar General, India, 2004, 'Household Tables, Series H-10 Distribution of Households by Availability of Bathroom and Type of Latrine within the House and Type of Drainage Connectivity for Waste Water Outlet, 2001', Office of Registrar General & Census Commissioner, India, New Delhi.

**Figure 10.3: Inter-state Disparities in Per Cent of Households Using Toilets in Rural Areas, 2001**



Source: 'Country Paper' presented at Water, Sanitation and Hygiene Education for Schools, Round Table Meeting, Oxford, 24-26 January 2005.

### Percentage of Households with No Open Toilet

Human defecation on open grounds/fields (referred to here as using an 'open toilet') is one of the main reasons for many types of diseases. So it is important to know how many households have or do not have open toilets.

#### Definition

The percentage of households with no open toilets in a specified territory in a reference year is given by:

$$\text{No open toilet} = \frac{\text{No. of households with no open toilets at a particular time and area}}{\text{Total no. of households at a particular time and area}} * 100$$

**Table 10.4: Number of Households (Total) having No Latrines within the Premises, 2001**

| S. No.       | State/UT       | Total No. of Households | Number of Household having No Latrines |             |
|--------------|----------------|-------------------------|----------------------------------------|-------------|
|              |                |                         | Number                                 | %           |
| 1.           | Uttar Pradesh  | 25760601                | 17665175                               | 68.6        |
| 2.           | Rajasthan      | 9342294                 | 6633405                                | 71.0        |
| 3.           | Madhya Pradesh | 10919653                | 8300207                                | 76.0        |
| 4.           | Jharkhand      | 4862590                 | 3905908                                | 80.3        |
| 5.           | Bihar          | 13982590                | 11299239                               | 80.8        |
| 6.           | Orissa         | 7870127                 | 6697920                                | 85.1        |
| 7.           | Chhattisgarh   | 4148518                 | 3559319                                | 85.8        |
| <b>India</b> |                | <b>191963935</b>        | <b>122078136</b>                       | <b>63.6</b> |

Source: Registrar General, India, 2004, 'Household Tables, Series H-10 Distribution of Households by Availability of Bathroom and Type of Latrine within the House and Type of Drainage Connectivity for Waste Water Outlet, 2001', Office of Registrar General & Census Commissioner, India, New Delhi.

**Table 10.5: Number of Urban Households with No Latrines within the Premises, 2001**

| S. No.       | State/UT       | Total No. of Urban Households | Number of Urban Households with No Latrines |             |
|--------------|----------------|-------------------------------|---------------------------------------------|-------------|
|              |                |                               | Number                                      | %           |
| 1.           | Uttar Pradesh  | 5170527                       | 1033671                                     | 20.0        |
| 2.           | Rajasthan      | 2185591                       | 522087                                      | 23.9        |
| 3.           | Bihar          | 1322583                       | 400823                                      | 30.3        |
| 4.           | Madhya Pradesh | 2794858                       | 901630                                      | 32.3        |
| 5.           | Jharkhand      | 1060178                       | 353288                                      | 33.3        |
| 6.           | Orissa         | 1087248                       | 438313                                      | 40.3        |
| 7.           | Chhattisgarh   | 789440                        | 374235                                      | 47.4        |
| <b>India</b> |                | <b>53692376</b>               | <b>14110936</b>                             | <b>26.3</b> |

Source: Registrar General, India, 2004, 'Household Tables, Series H-10 Distribution of Households by Availability of Bathroom and Type of Latrine within the House and Type of Drainage Connectivity for Waste Water Outlet, 2001', Office of Registrar General & Census Commissioner, India, New Delhi.

**Table 10.6: Number of Rural Households with No Latrines within the Premises, 2001**

| S. No.       | State/UT       | Total No. of Rural Households | Number of Rural Households having No Latrines |             |
|--------------|----------------|-------------------------------|-----------------------------------------------|-------------|
|              |                |                               | Number                                        | %           |
| 1.           | Uttar Pradesh  | 20590074                      | 16631504                                      | 80.8        |
| 2.           | Rajasthan      | 7156703                       | 6111318                                       | 85.4        |
| 3.           | Bihar          | 12660007                      | 10898416                                      | 86.1        |
| 4.           | Madhya Pradesh | 8124795                       | 7398577                                       | 91.1        |
| 5.           | Orissa         | 6782879                       | 6259607                                       | 92.3        |
| 6.           | Jharkhand      | 3802412                       | 3552620                                       | 93.4        |
| 7.           | Chhattisgarh   | 3359078                       | 3185084                                       | 94.8        |
| <b>India</b> |                | <b>138271559</b>              | <b>107967200</b>                              | <b>78.1</b> |

Source: Registrar General, India, 2004, 'Household Tables, Series H-10 Distribution of Households by Availability of Bathroom and Type of Latrine within the House and Type of Drainage Connectivity for Waste Water Outlet, 2001', Office of Registrar General & Census Commissioner, India, New Delhi.

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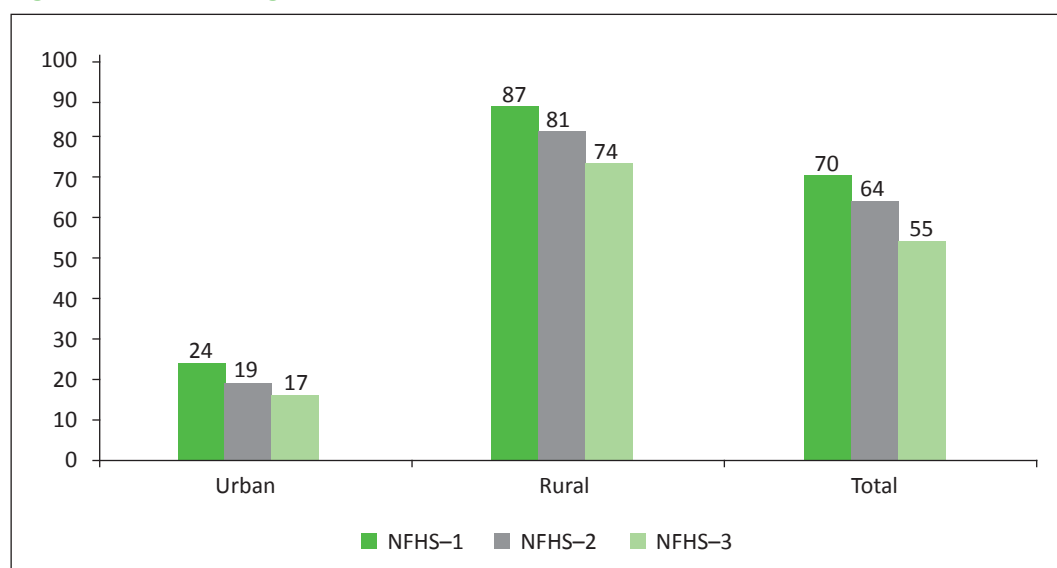
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**Figure 10.4: Percentage of Households with No Toilet Facilities**



Source: International Institute for Population Sciences (IIPS) and Macro International, 2007, *National Family Health Survey (NFHS-3), 2005-06, India: Key Findings*, Mumbai, IIPS.

## Notes

The data for both percentage of households with access to protected toilets and percentage of villages with no open toilet can be obtained from the Population Census, NFHS and DLHS. From the Household Amenities table of the census, we can get data regarding the type of toilet facilities used in particular villages. In the NFHS and DLHS also, data are collected about the kind of toilet facility members of the household usually use in each state and district.

### 10.5.3 Percentage of Households Using Clean Fuel for Cooking

The type of fuel used in the household is one of the important indicators of the household environment. Many types of respiratory diseases may ensue due to inhalation of the smoke of the cooking fuel.

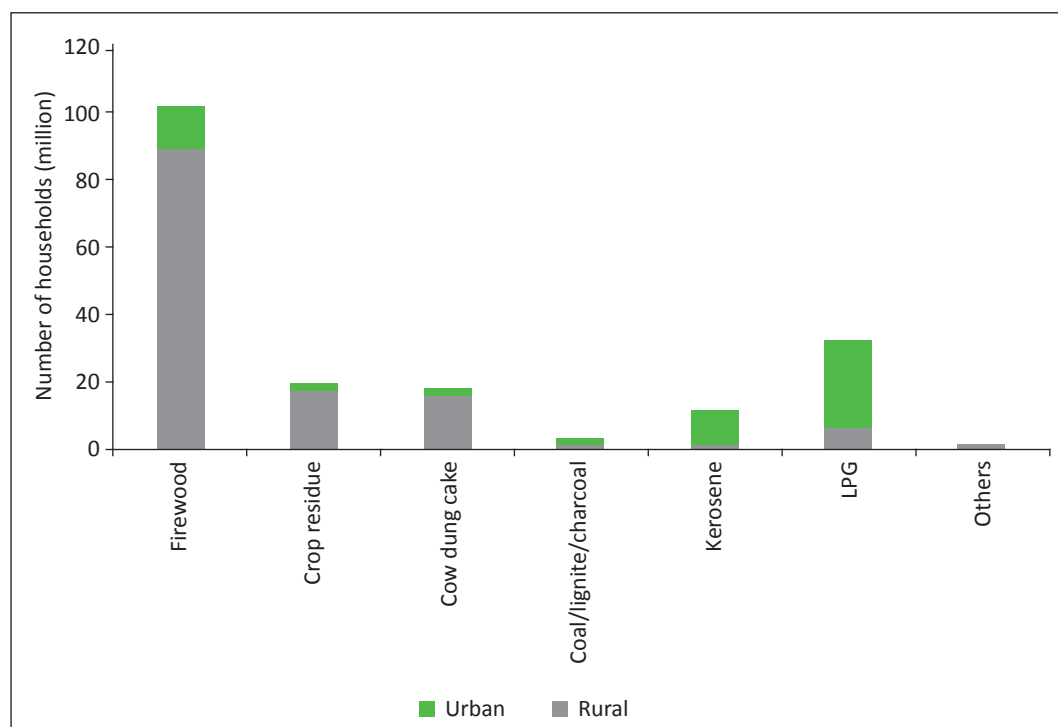
#### Definition

The percentage of households using clean fuel for cooking in a specified territory in a reference year is given by:

$$\text{Clean Cooking Fuel} = \frac{\text{No. of households using clean fuel at a particular time and area}}{\text{Total no. of households at a particular time and area}} * 100$$

If the household is using more than one fuel for cooking, the predominant fuel used for cooking is recorded, in case no cooking is done in the household, the answer is recorded accordingly.

**Figure 10.5: Types of Cooking Fuels Used by Households in India in 2001**



Source: Registrar General, India, 2004, 'Household Tables, Series H-11 Distribution of Households by Availability of Separate Kitchen and Type of Fuel Used for Cooking, 2001', Office of Registrar General & Census Commissioner, India, New Delhi.

#### Notes

**Table 10.7: Scenario for Household Use of LPG, 2005–06 to 2015–16**

| Year                                                                                                            | Number of Households using LPG (million) |       |        | Proportion of Total Households using LPG (%) |       |       | Consumption of LPG (Mt) |       |       |
|-----------------------------------------------------------------------------------------------------------------|------------------------------------------|-------|--------|----------------------------------------------|-------|-------|-------------------------|-------|-------|
|                                                                                                                 | Rural                                    | Urban | Total  | Rural                                        | Urban | Total | Rural                   | Urban | Total |
| <b>Scenario 1: Business as usual with current growth rate</b>                                                   |                                          |       |        |                                              |       |       |                         |       |       |
| 2005–06                                                                                                         | 10.91                                    | 44.87 | 55.78  | 7.27                                         | 72.97 | 26.36 | 1.11                    | 5.35  | 6.46  |
| 2010–11                                                                                                         | 15.17                                    | 63.38 | 78.56  | 9.30                                         | 90.00 | 33.64 | 1.54                    | 7.56  | 9.10  |
| 2015–16                                                                                                         | 21.01                                    | 75.59 | 93.69  | 11.91                                        | 90.00 | 36.35 | 2.14                    | 8.66  | 10.80 |
| <b>Scenario 2: Increased rural growth, with double the growth of rural users, but current use per household</b> |                                          |       |        |                                              |       |       |                         |       |       |
| 2010–11                                                                                                         | 20.67                                    | 63.38 | 84.06  | 12.86                                        | 90.00 | 36.00 | 2.10                    | 7.56  | 9.66  |
| 2015–16                                                                                                         | 39.17                                    | 72.59 | 111.76 | 22.12                                        | 90.00 | 43.36 | 3.97                    | 8.66  | 12.36 |

Source: Ministry of Petroleum and Natural Gas (MoP&NG, 2003b, c).

**Table 10.8: State-wise Use of LPG as Fuel for Cooking in 2000–01**

| S. No.       | State/UT       | Total No. of Urban Households | Households using LPG | Percentage of Households using LPG |
|--------------|----------------|-------------------------------|----------------------|------------------------------------|
| 1.           | Uttar Pradesh  | 25760601                      | 2913579              | 11.3                               |
| 2.           | Rajasthan      | 9342294                       | 1437023              | 15.4                               |
| 3.           | Bihar          | 13982590                      | 529069               | 3.8                                |
| 4.           | Madhya Pradesh | 10919653                      | 1483947              | 13.6                               |
| 5.           | Jharkhand      | 4862590                       | 327624               | 6.7                                |
| 6.           | Orissa         | 7870127                       | 410823               | 5.2                                |
| 7.           | Chhattisgarh   | 4148518                       | 309801               | 7.5                                |
| <b>India</b> |                | <b>191963935</b>              | <b>33596798</b>      | <b>17.5</b>                        |

Source: Registrar General, India, 2004, 'Household Tables, Series H-11 Distribution of Households by Availability of Separate Kitchen and Type of Fuel used for Cooking, 2001', Office of Registrar General & Census Commissioner, India, New Delhi.

## Notes

**Table 10.9: Trend in India's Total LPG Consumption, Number of Consumers and Distributors**

| Years     | Total (All Sectors Consumption ('000 tonnes) | Number of Connections (Million) | Number of Distributors (Actual) |
|-----------|----------------------------------------------|---------------------------------|---------------------------------|
| 1980–81   | 405                                          | 3.3                             | 1105                            |
| 1985–86   | 1241                                         | 10.7                            | 2472                            |
| 1990–91   | 2415                                         | 17.0                            | 3930                            |
| 1995–96   | 3849                                         | 25.7                            | 5165                            |
| 1996–97   | 4183                                         | 29.3                            | 5426                            |
| 1997–98   | 4581                                         | 33.7                            | 5538                            |
| 1998–99   | 5041                                         | 38.1                            | 5648                            |
| 1999–2000 | 6029                                         | 47.3                            | 6161                            |
| 2000–01   | 6613                                         | 57.9                            | 6477                            |
| 2001–02   | 7310                                         | 63.5                            | 7486                            |
| 2002–03   | 8157                                         | 69.8                            | 7910                            |

Source: CMIE, 2003; MoP&NG, 2003c.

Data for percentage of population using different types of fuel used for cooking can be obtained from the Population Census, NFHS and DLHS. From the Household Amenities table of the census, we can gather data regarding the type of fuel used for cooking in the households of each village. The NFHS and DLHS also collect data about the kind of fuel usually used in the household for cooking in each state and district respectively.

## 10.6 National and Sub-national Scenario

- The Census of India 2001 reports that 86.8 per cent of the rural population has access to safe drinking water and 38 per cent have access to sanitation.
- The NFHS-3 (2005–06) reports that 84.5 per cent of the population has access to water and 25.9 per cent has access to sanitation.
- Water is supplied only for a few hours every day, and this leads to a lot of waste as taps are kept open and water is stored, not all of which is used.

- Among the most important elements of the rural sanitation package are safe handling of drinking water, disposal of waste water, and safe disposal of human excreta that contributes to more than 50 per cent of the communicable diseases.
- As per Census 2001, 38 per cent of the total population has access to sanitation (*Working Group Paper, Rural Water Supply and Sanitation*, Gol, 2006), while by the end of 2007 it was estimated that 44 per cent would have access to sanitation (Ministry of Rural Development, Gol, 2007).
- As per the Census 2001, only 36.4 per cent of the total population has toilets within or attached to their houses.
- Sixty-three per cent of the urban population had access to sewerage and sanitation facilities (47% had a sewage facility and 53% had low-cost sanitation facilities) as on 31 March 2004 (*Eleventh Five-Year Plan, 2007–2012 Volume II*, pp. 162–3).

Globally, it is estimated that 1.6 billion people require access to improved sanitation over the period 2005–15 to meet the MDG target and at the current rate of progress, it is likely that we will miss the target by almost 600 million by 2015 (United Nations Development Programme, 2007).

## Notes

### 10.7 Summary

- Concepts of improved drinking water and protected toilets have been introduced and the importance to health outcomes has been emphasised.
- Access to the stated amenities for prevention of waterborne diseases, especially those that affect children, have been emphasised.
- Simple percentage-based indicators, data sources and available figures from national and sub-national surveys are presented.

## APPENDICES

### Appendix 10.1

#### Percentage of Households by Selected Characteristics, Madhya Pradesh 2007–08

| Housing Characteristics                | Total  | Rural  | Urban  |
|----------------------------------------|--------|--------|--------|
| <b>Source of drinking water</b>        |        |        |        |
| Improved source                        | 80.8   | 76.8   | 94.3   |
| Piped water into dwelling/yard/plot    | 9.7    | 2.4    | 34.5   |
| Public tap/standpipe                   | 8.5    | 3.7    | 24.8   |
| Tube well or borehole                  | 7.3    | 6.6    | 9.9    |
| Other improved                         | 55.3   | 64.2   | 25.1   |
| Non-improved source                    | 19.2   | 23.2   | 5.7    |
| <b>Sanitation facility</b>             |        |        |        |
| Improved sanitation                    | 22.1   | 9.5    | 64.7   |
| Flush to sewer/septic/pit              | 21.1   | 9.0    | 62     |
| Pit with slab                          | 0.8    | 0.4    | 1.9    |
| Pit ventilated improved                | 0.1    | 0      | 0.1    |
| Other                                  | 0.2    | 0      | 0.7    |
| Not improved                           | 77.9   | 90.5   | 35.3   |
| Flush not to sewer/septic/pit/twin pit | 0.3    | 0.1    | 0.9    |
| Pit without slab                       | 0.3    | 0.3    | 0.3    |
| Dry toilet                             | 0.2    | 0.2    | 0.3    |
| No toilet/open space                   | 77.1   | 89.9   | 33.8   |
| <b>Fuel used for cooking</b>           |        |        |        |
| Liquefied Petroleum Gas (LPG)          | 12.1   | 2.0    | 46.6   |
| Electricity                            | 0.2    | 0.1    | 0.6    |
| Kerosene                               | 0.6    | 0.1    | 2.1    |
| Wood                                   | 71.8   | 80.5   | 42.3   |
| Others                                 | 15.2   | 17.2   | 8.4    |
| Number of households                   | 51,419 | 39,720 | 11,699 |

Source: International Institute for Population Sciences, 2008, *District Level Household Survey, 2007–08, Fact Sheet India*, IIPS, Mumbai.

## Appendix 10.2

### Percentage of Households with Selected Characteristics by District, Madhya Pradesh, 2007–08

| District          | With Improved Drinking Water | With Improved Sanitation Facility | Using Liquefied Petroleum Gas |
|-------------------|------------------------------|-----------------------------------|-------------------------------|
| Sheopur           | 93.8                         | 9.30                              | 5.10                          |
| Morena            | 86.7                         | 24.5                              | 13.2                          |
| Bhind             | 88.7                         | 23.7                              | 6.80                          |
| Gwalior           | 90.2                         | 43.3                              | 27.2                          |
| Datia             | 86.9                         | 21.4                              | 7.80                          |
| Shivpuri          | 79.3                         | 16.0                              | 8.20                          |
| Guna              | 83.1                         | 15.9                              | 7.80                          |
| Tikamgarh         | 66.8                         | 13.6                              | 5.60                          |
| <b>Chhatarpur</b> | <b>55.0</b>                  | <b>13.8</b>                       | <b>5.00</b>                   |
| Panna             | 68.8                         | 10.6                              | 4.80                          |
| Sagar             | 82.3                         | 24.0                              | 12.4                          |
| Damoh             | 72.5                         | 18.4                              | 7.60                          |
| <b>Satna</b>      | <b>80.9</b>                  | <b>15.2</b>                       | <b>9.10</b>                   |
| Rewa              | 79.4                         | 23.7                              | 5.10                          |
| Umaria            | 62.6                         | 8.40                              | 5.80                          |
| Shahdol           | 60.0                         | 16.2                              | 10.1                          |
| Sidhi             | 55.0                         | 3.10                              | 2.90                          |
| Neemuch           | 77.0                         | 19.6                              | 12.1                          |
| Mandsaur          | 72.2                         | 18.0                              | 11.3                          |
| Ratlam            | 89.2                         | 29.3                              | 17.7                          |
| Ujjain            | 91.2                         | 42.8                              | 28.4                          |
| Shajapur          | 69.1                         | 23.4                              | 10.8                          |
| Dewas             | 90.3                         | 37.7                              | 17.0                          |
| Jhabua            | 82.8                         | 10.5                              | 5.10                          |
| Dhar              | 83.3                         | 21.3                              | 13.0                          |
| Indore            | 99.3                         | 67.0                              | 49.2                          |
| West Nimar        | 89.8                         | 18.6                              | 11.8                          |
| Barwani           | 88.0                         | 13.5                              | 10.5                          |
| East Nimar        | 85.7                         | 23.2                              | 17.6                          |
| <b>Rajgarh</b>    | <b>77.6</b>                  | <b>18.4</b>                       | <b>7.50</b>                   |
| Vidisha           | 86.4                         | 23.2                              | 12.5                          |
| Bhopal            | 97.8                         | 69.5                              | 49.6                          |
| Sehore            | 80.2                         | 23.4                              | 9.10                          |
| Raisen            | 89.9                         | 22.8                              | 6.50                          |
| Betul             | 84.2                         | 19.1                              | 10.4                          |
| Harda             | 84.6                         | 42.9                              | 19.3                          |
| Hoshangabad       | 90.2                         | 42.0                              | 20.7                          |
| Katni             | 91.0                         | 19.1                              | 11.9                          |

Contd. ...

| District              | With Improved Drinking Water | With Improved Sanitation Facility | Using Liquefied Petroleum Gas |
|-----------------------|------------------------------|-----------------------------------|-------------------------------|
| Jabalpur              | 97.2                         | 53.7                              | 34.1                          |
| Narsimhapur           | 99.1                         | 37.5                              | 9.20                          |
| Dindori               | 69.3                         | 5.80                              | 2.40                          |
| <b>Mandla</b>         | <b>79.7</b>                  | <b>15.5</b>                       | <b>7.70</b>                   |
| Chhindwara            | 73.8                         | 21.0                              | 14.9                          |
| Seoni                 | 76.7                         | 14.0                              | 3.70                          |
| Balaghat              | 75.2                         | 13.5                              | 6.30                          |
| <b>Madhya Pradesh</b> | <b>80.8</b>                  | <b>22.1</b>                       | <b>12.1</b>                   |

Source: International Institute for Population Sciences, 2008, *District Level Household Survey, 2007–08, Fact Sheet India*, IIPS, Mumbai.

## Appendix 10.3

Progress on Sanitation and Drinking Water: Estimated for 1990, 2000 and 2008

| Year | Population | Percentage of Urban Population | Use of Sanitation Facilities (Percentage of Population) |                       |                 |          |                       |                 |            |                       |                 |          |                       |                 | Number of People who Gained Access to Improved Sanitation 1990–2008 (thousand) |
|------|------------|--------------------------------|---------------------------------------------------------|-----------------------|-----------------|----------|-----------------------|-----------------|------------|-----------------------|-----------------|----------|-----------------------|-----------------|--------------------------------------------------------------------------------|
|      |            |                                | Urban                                                   |                       |                 | Rural    |                       |                 | Total      |                       |                 |          |                       |                 |                                                                                |
|      |            |                                | Unimproved                                              |                       |                 | Improved |                       |                 | Unimproved |                       |                 | Improved |                       |                 |                                                                                |
|      |            |                                | Shared                                                  | Unimproved Facilities | Open Defecation | Shared   | Unimproved Facilities | Open Defecation | Shared     | Unimproved Facilities | Open Defecation | Shared   | Unimproved Facilities | Open Defecation |                                                                                |
| 1990 | 862162     | 26                             | 49                                                      | 19                    | 4               | 28       | 7                     | 1               | 2          | 90                    | 18              | 6        | 2                     | 74              | 211049                                                                         |
| 2000 | 1042590    | 28                             | 52                                                      | 20                    | 6               | 22       | 14                    | 3               | 4          | 79                    | 25              | 8        | 4                     | 63              |                                                                                |
| 2008 | 1181412    | 29                             | 54                                                      | 21                    | 7               | 18       | 21                    | 4               | 6          | 69                    | 31              | 9        | 6                     | 54              |                                                                                |

| Year | Population | Percentage of Urban Population | Use of Drinking Water Source (Percentage of Population) |                |                |                   |                |                   |                |                |    |    |                | Number of People who Gained Access to Improved Sanitation 1990–2008 (thousand) |        |
|------|------------|--------------------------------|---------------------------------------------------------|----------------|----------------|-------------------|----------------|-------------------|----------------|----------------|----|----|----------------|--------------------------------------------------------------------------------|--------|
|      |            |                                | Urban                                                   |                |                | Rural             |                |                   |                | Total          |    |    |                |                                                                                |        |
|      |            |                                | Improved                                                |                | Total Improved | Improved          |                |                   | Total Improved | Improved       |    |    | Total Improved |                                                                                |        |
|      |            |                                | Piped on Premises                                       | Other Improved |                | Piped on Premises | Other Improved | Piped on Premises |                | Other Improved |    |    |                |                                                                                |        |
| 1990 | 862162     | 26                             | 90                                                      | 52             | 38             | 10                | 66             | 8                 | 58             | 34             | 72 | 19 | 53             | 28                                                                             | 418886 |
| 2000 | 1042590    | 28                             | 93                                                      | 40             | 43             | 70                | 76             | 9                 | 67             | 24             | 81 | 20 | 61             | 19                                                                             |        |
| 2008 | 1181412    | 29                             | 96                                                      | 48             | 48             | 4                 | 84             | 11                | 73             | 16             | 88 | 22 | 66             | 12                                                                             |        |

Source: *Progress on Sanitation and Drinking Water, 2010*, WHO and UNI.



# Monitoring and Evaluation of Development Programmes

## Learning Objectives

- Understanding the concepts, principles and processes of monitoring, evaluation, logical framework and result-based management
- Building capacity in formulation of indicators and monitoring framework
- Building skills and knowledge to monitor development programmes
- Developing competency in the analysis of monitoring information to assess progress and provide feedback to improve programme performance

## 11.1 Introduction

The monitoring and evaluation (M&E) system is an integral part of the programme development and implementation process. It assumes multiple functions and includes the measurement of performance on a regular basis at stipulated time intervals, identification of mid-course corrective actions needed to achieve programme objectives, assistance in judicious allocation of resources, and supporting advocacy for the benefit of other partners and organisations working in the area. In other words M&E helps in:

- Strategic planning
- Making informed decisions regarding operations, management and service delivery
- Judicious allocation of resources, ensuring their effective and efficient use
- Evaluating the extent to which the programme/project is having or has had the desired impact
- Using the findings for advocacy at a broader level

The M&E system therefore, should be designed at the programme/project development stage and not during the project implementation phase. This enables those implementing the project to develop appropriate work-plans with a time-line and responsibilities; identify key indicators that have to be monitored; decide on the frequency of monitoring and undertake evaluation studies at pre-determined intervals. Synergy between programme management and M&E activities of a programme/project right from the formulation stage will result in better planning, implementation and tracking of results.

Development policies and programmes as such are meant to bring about positive changes in the lives of people and, in principle, are guided by the 'Theory of Change'. Keeping the goals and objectives of the programme/project in mind, various interventions are designed and implemented over a period of time and are essential for measuring the changes brought about by the programme interventions. In this context, the concept of M&E becomes the cornerstone of any development programme. It helps in measuring the results of the programme and provides a list of the overall achievements of the programme. The theory

### Notes

of change is a description of how an intervention is supposed to deliver the desired results by describing the causal logical pathways through which intended outcomes are realised. In the process of undertaking the exercise, the three concepts of efficiency, effectiveness and impact that cut across the programme and M&E domains become important.

**Efficiency** measures the outputs in relation to the inputs. It is an economic term, which signifies whether the programme or project has used the least costly resources possible to achieve the desired results. This generally requires comparing alternative approaches for achieving the same outputs, to see whether the most efficient process has been adopted.

**Effectiveness** is the measure the specific objectives that have been achieved by programmes or projects. In evaluating the effectiveness of a programme or project, it is useful to consider the following questions: To what extent were the objectives achieved/ are the objectives likely to be achieved? What were the major factors influencing the achievement or non-achievement of the objectives?

**Impact** refers to the positive and negative changes produced by a development intervention, directly or indirectly, intended or unintended. This includes the main impact and effects resulting from the activity on the local social, economic, environmental and other development indicators. The examination should be concerned with both intended and unintended results and must also include the positive and negative impact of external factors. When evaluating the impact of a programme or a project, it is useful to consider the following questions: What has happened as a result of the programme or project? What real difference has the activity made to the beneficiaries? How many people have been benefited?

An overview of the basic concepts and definition of M&E, the various components of the M&E system, including indicators, its hierarchy, conceptualisation, logical framework analysis, result-based management and modes of data collection have been discussed in this chapter. After introducing the concepts, the chapter focuses on the monitoring of various flagship programmes of the Government of India currently underway and also the achievement of the Millennium Development Goals (MDGs). It draws examples of computing monitoring indicators from the data available through the Management Information Systems (MIS) of various flagship programmes.

## Notes

## 11.2 Basic Concepts and Definitions

### 11.2.1 Monitoring

**Monitoring is concerned with progress.** It aims to ensure that the programme is functioning as planned and will achieve its objectives. Monitoring is, therefore, the **routine** tracking of the key elements of programme/project performance, and usually assesses the inputs and outputs of project activities. This is achieved through a variety of information collection systems including record-keeping, regular reporting, surveillance systems, facility observation, client surveys, etc. The MIS is part of the monitoring system and is an internal activity of the project/programme. Therefore, it should be conducted by those responsible for project implementation at each level of the management hierarchy. It should be carried out regularly or at pre-specified intervals with the primary purpose of achieving the best possible programme performance on a regular basis and provide feedback to programme management at all levels. This enables the management to improve operational plans and take corrective action in the case of shortfalls and constraints during the implementation phase.

The following are examples of monitoring indicators to track performance various levels:

- **Inputs:** Refers to the resources invested in a programme and includes financial, technological and human resources.
- **Process:** Refers to activities carried out to achieve the programme objectives, shows what is done and how well it is done.
- **Output:** Refers to the results of activities achieved at the programme level, and is also referred to as the deliverables of the programme.

These changes are analysed against a framework, work-plans, time-schedules and budgets to assess the progress of the project/programme activities at regular intervals.

Normally, monitoring and supervision are used synonymously. In practice, supervisory and monitoring activities do overlap, but there is a thin line distinguishing the two. For instance, the direct supervisor carries out daily supervision of **inputs** and **operational processes** and reports to the manager. Monitoring, on the other hand, aims to assess the **overall implementation at different levels and focuses not only on the inputs and processes, but also on the project outputs**. The principle of monitoring project activities includes defining key indicators, minimum data collection load, simple and usable reporting formats and timely feedback. Thus, monitoring is a systematic process of tracking the progress of project activities on a regular basis while supervision becomes one of the tools and components of monitoring activities.

## Notes

### Monitoring involves

- Establishing key indicators to judge the progress of project activities
- Setting up systems to collect information relating to these key indicators
- Collecting and recording information as and when the project activities take place
- Analysing information to derive key indicators and track the progress
- Using information to inform day-to-day management decisions
- Providing feedback about bottlenecks and providing direction to improve project implementation

### 11.2.2 Evaluation

**Evaluation aims to assess programme performance.** It allows us to look at the results of the efforts being made in ongoing or completed work, and make sure that they are effective and correspond to the targets and goals. Thus, evaluation is the **episodic** assessment of the changes in targeted results that can be attributed to the programme/project/intervention. Evaluation attempts to **link** a particular output or outcome directly to an intervention after a period of time.

Evaluation is the application of research procedures to assess (inputs, processes, outputs, and outcome/impact) and provide learning to improve ways in which policies and programmes are conducted, from the earliest stages of defining and designing programmes through their development and implementation (Rossi *et al.*, 1993)<sup>1</sup>. Thus, evaluation adopts appropriate research methodology to find out changes in the outcome and impact-level indicators which the programme had aimed to achieve in terms of pre-determined targets or goals.

<sup>1</sup> Rossi, P.H., *et al.*, 1993, *Evaluation: a systematic approach*, Sage Publications, London.

### Evaluation involves

- Looking at what the project/programme intended to achieve – What difference did it make? What impact did it have? What was its progress towards what it wanted to achieve?
- Looking at the strategy of the project/programme – Did it have a strategy? Was it effective in following its strategy? Did the strategy work? If not, why?
- Looking at how the project functioned – Was there an efficient use of resources? What were the opportunity costs? How sustainable is the way in which the project/programme works? What are the implications for the various stakeholders?

Evaluation is defined as a collection of activities designed to determine the value or worth of a specific programme and linking a particular output or outcome directly to a particular intervention. The three sequential levels or phases of evaluation are process, output and impact evaluations as described below.

**Process evaluation:** Aims to assess the various processes adopted during the project and examines the extent to which these processes are implemented. Further, the process evaluation provides insights into whether the intervention has reached the target audience. This gives an idea of whether it is worth undertaking the next level of effect evaluation. Some of the examples of process evaluation include documenting the process of implementation against the work-plan, extent of adherence to the work-plan, timely execution of inputs, training of human resources as planned, and whether all the inputs related to the achievement of the outcome indicators have been put in place.

### Notes

**Output evaluation:** Once findings from the process evaluation are deemed adequate, then the programme's short-term effects or outputs can be evaluated. With reproductive health interventions, immediate effects often relate to behaviour changes and underlying changes in knowledge, attitude and beliefs as well as coverage results. For example, increased knowledge, higher contraceptive prevalence, higher antenatal care (ANC) coverage, increased number of deliveries in institutions, deliveries by trained skilled birth attendants (SBAs) etc., may be examined under the output evaluation process.

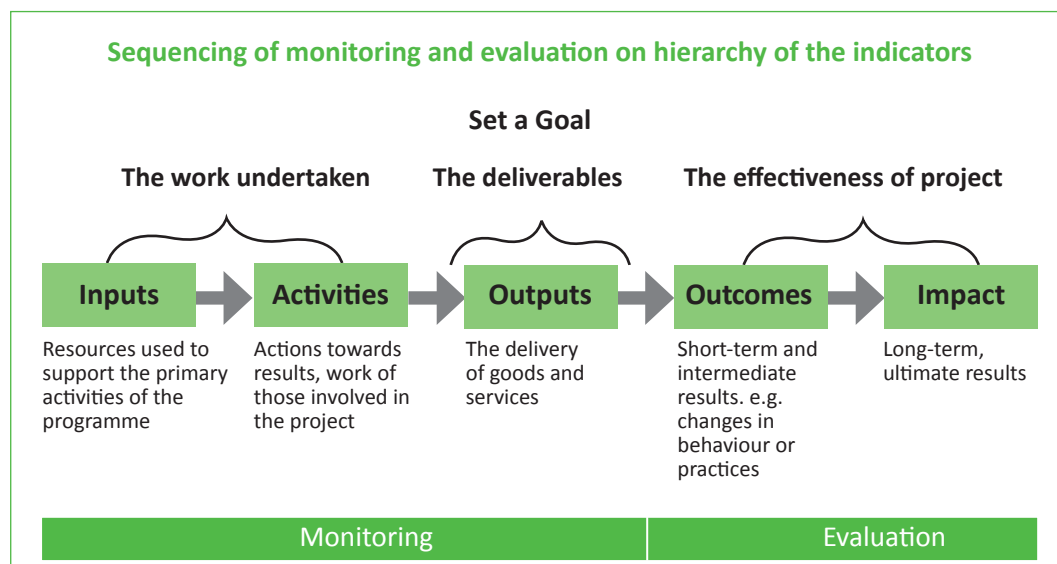
**Outcome evaluation:** Aims to assess the long-term effects of a programme against its ultimate purpose. Once adequate evidence is available that the programme is on track and related activities have been implemented, then impact evaluation is undertaken. This is a higher level of indicator in the hierarchy. Impact evaluation *per se* is rarely done, mainly because it takes a longer time to judge the effect of any programme on the impact-level indicators, and it is an expensive and complex process. Impact evaluation cannot always be easily distinguished from effect (outcome) evaluation, but the following examples should help clarify the distinction.

**Examples:** In many family planning assessments, contraceptive use is often taken as a measure of outcome, but a reduction in unwanted or unintended pregnancies might be taken as an appropriate measure of outcome (proxy); in safe motherhood projects, the percentage of births attended by SBAs is a key measure of output, but the outcome should be defined in terms of a reduction in the proportion of complicated pregnancies and the impact will be a reduction in maternal mortality.

As described earlier, the evaluation exercise applies sophisticated research methodology to estimate and then relate the outcome and impact with project interventions. It tries to single out whether the change that has occurred was actually the result of interventions, or whether it was due to chance or due to the influence of any other factors beyond the project interventions. For this purpose, various evaluation designs are usually employed under the

guidance of evaluation specialists. Since evaluation designs are complex in nature, and an evaluation involves many steps, such as selecting an unbiased sample and randomisation of the cases, it is advised that evaluation specialists or a specialised agency be hired to guide the entire process of selecting the best suited design and executing it.

An illustration of the sequencing of monitoring and evaluation on the hierarchy of the indicators is shown below.



It needs to be stated here that the terms ‘monitoring’ and ‘evaluation’ are often used interchangeably though they are conducted for different purposes. They are two distinct sets of activities, related to each other but, as depicted above, they are not identical.

### 11.2.3 Indicators

Indicators are measurable or tangible signs that something has been done or that something has been achieved. They are the ‘markers of performance’ and can be used to track progress. It is usually helpful to classify indicators into broad categories and then select one or two from each category, so that the key elements of the project activities can be monitored or evaluated and overlap can be avoided. The broad categories include inputs (resources needed to carry out the programme); outputs (the goods produced by the programme); outcome (the knowledge, attitude, and behavioural changes that result, including coverage) and impacts (changes in health, fertility or mortality status due to the project outcomes).

The example of an indicator of community empowerment might be “increased frequency of community members speaking at community meetings”. If one were interested in the gender impact of drilling a well in a village, then one could use “increased time for involvement in development projects available to women” as an indicator. Common indicators for overall health in a community are the infant mortality rate (IMR), child mortality rate (CMR), maternal mortality ratio (MMR), birth rate, and nutritional status.

Indicators are an essential part of an M&E system because they are what we measure and/or monitor. Through the indicators we can ask and answer questions such as:

- Who?
- How many?
- How often?
- How much?

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Indicators used in monitoring and evaluation can be classified as:

- Quantitative
- Qualitative

**Quantitative** indicators are numeric. These tell us “how much or how many”. For example, how many people attended a workshop, how many people passed their final examination, how much a publication cost, how many people were infected with HIV, how far people have to walk to get water and firewood and so on. Quantitative measurement can be expressed in absolute numbers (three out of 241 women in the sample are infected) or as a percentage (50% of households in the area have television sets) or as an average (mean number of ANC visits, mean waiting time for a patient, or median expenditure on treatment). It can also be expressed as a ratio (one doctor for every 30,000 population). One way or another, we get quantitative (number) information by counting or measuring.

A robust quantitative indicator must be SMART as described below:

|   |            |                                                                                           |
|---|------------|-------------------------------------------------------------------------------------------|
| S | Specific   | Must represent the specific desired measurement                                           |
| M | Measurable | The phenomenon could be measured                                                          |
| A | Achievable | Measure what is achievable given the conditions, resources, time period and staff ability |
| R | Relevant   | It should be relevant to the intervention output/outcome/impact                           |
| T | Time-bound | Must represent the achievement of results within a certain period of time                 |

Notes

**Qualitative** indicators are non-numeric. These tell us how people feel about a situation or about how things are done or how people behave. For example, one may discover that 50 per cent of the teachers in a school are unhappy about the assessment criteria used. This is still qualitative information, not quantitative information. We get qualitative information by asking, observing and interpreting.

Some experts find quantitative information valid – it seems solid, reliable and “objective”. They find qualitative information unconvincing and “subjective”. However, it is not true to say that “only quantitative information speaks for itself”. Quantitative information requires just as much interpretation as qualitative information in order to make it meaningful. It may be a “fact” that the enrolment of girls in schools in some areas is declining – counting the number of females enrolled can indicate that – but it does not give the reasons why this decline is taking place. In order to explore the reasons for such drop-outs, one needs qualitative information. Thus, these two types of indicators often supplement and complement each other. The M&E process requires a combination of quantitative and qualitative information in order to be comprehensive. For example, we need to know what the school enrolment figures for girls are, as well as why some parents send their daughters to school while others do not.

11.2.4 Logical Framework Approach

The Logical Framework Approach (LFA) is a management tool mainly used in the design and M&E of development projects. The LFA is an analytical process involving a structured sequence of steps using a set of simple tools and principles. It is designed to guide effective, efficient and consistent planning and the implementation of development activities. The LFA is designed to strengthen participatory processes and ensure that decision-makers have all the information that they need for appraisal.

The LFA can help planners and managers to:

- Analyse activity preparation
- Establish a logical hierarchy of means by which objectives can be achieved
- Identify the potential risks to achieving the objectives and sustainable outcomes
- Establish how outputs and outcomes might best be monitored and evaluated

### The Logical Framework Matrix (LFM)

One standard analytical product of the LFA is the Logical Framework Matrix (LFM). It consists of a matrix with four columns and a number of rows, which summarises selected aspects of an activity design, namely:

- What the activity will do, and what it will produce (activity description)
- The activity's hierarchy of objectives and planned results (also activity description)
- The key assumptions that are being made (assumptions)
- How the activity's achievements will be measured, monitored and evaluated (indicators and means of verification)

The general structure of an LFM and its key terms are described below.

| Activity Description                                                                                                                                                                                                         | Indicators                                                                                        | Means of Verification                                                                                                          | Assumptions                                                                                     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| <b>Goal or impact:</b> The long-term development impact (policy goal) that the activity contributes to at a national or sub-national level                                                                                   | How the achievement will be measured – including appropriate targets (quantity, quality and time) | Sources of information on the goal, purpose, objectives and outputs indicator(s) – including who will collect it and how often | Assumptions concerning the purpose to goal linkage, similarly objective to output linkages etc. |
| <b>Purpose or outcome:</b> The medium-term result(s) that the activity aims to achieve – in terms of benefits to target groups                                                                                               |                                                                                                   |                                                                                                                                |                                                                                                 |
| <b>Component objectives or intermediate results:</b> This level in the objectives or results hierarchy can be used to provide a clear link between outputs and outcomes (particularly for larger multi-component activities) |                                                                                                   |                                                                                                                                |                                                                                                 |
| <b>Outputs:</b> The tangible products or services that the activity will deliver                                                                                                                                             |                                                                                                   |                                                                                                                                |                                                                                                 |

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**Goal/impact** refers to the national or regional objectives which the activity is designed to contribute to, for example, increased income, and improved nutritional status. The goal helps set the macro-level context within which the activity fits, and describes the long-term impact that the activity is expected to contribute to.

**Purpose/outcome** refers to what the activity itself is expected to achieve in terms of sustainable development results, if the relevant assumptions of the activity design are correct. It is the positive developmental change which the activity would produce if it were successful (and the assumptions were accurate).

**Component objectives/intermediate results.** If an activity is relatively large and has a number of components (output/work programme areas), it would be useful to give each component an objective statement. These statements should help provide a logical link between the outputs of that component and the overall purpose/outcome.

**Outputs** refer to the tangible products (goods and services) produced by undertaking a series of tasks as part of the planned activity. For example, irrigation systems or water supplies constructed, children immunised and staff effectively trained. The delivery of outputs should be largely under the activity management's control.

**Work programme** refers to the specific tasks to be undertaken as part of the planned delivery of the activity so that the required output is achieved. Examples for a new community water supply might include: establishing a water users' committee and maintenance procedures, site preparation, collection of local material, tank construction and pipe laying, digging soak pits, and commissioning. However, the LFM should not include too many details about the work programme, or it will become very lengthy and potentially prescriptive. If detailed specification is required, this should be presented separately in a work schedule and not in the matrix itself.

**Inputs** refer to the resources required to undertake the work programme and produce the outputs, for example, personnel, equipment and materials. However, inputs should not be included in the matrix format.

**Assumptions** refer to assumptions made about conditions, which could affect the progress or success of the activity, but over which activity managers may have no direct control, for instance, price changes, rainfall, land reform policies, non-enforcement of supporting legislation, and natural calamities. An assumption is a positive statement of a condition that must be met in order to achieve the objectives. A risk is a negative statement of what might prevent objectives from being achieved.

**Indicators** measure the progress or lack of progress towards meeting the stated objectives. An indicator should provide, where possible, a clearly defined unit of measurement and a target detailing the quantity, quality and timing of expected results. In other words it should be SMART, as explained above.

**Means of verification** should clearly specify the expected source of the information/indicator that needs to be collected. How the information will be collected (method), who will be responsible, and the frequency of collection need to be considered.

## Notes

### Developing Hierarchy of Events—An Illustration of Indicators

|                   |                                                                                                                                                                                                                                                                                                                                         |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Goal</b>       | : Decline in Infant and Child Mortality                                                                                                                                                                                                                                                                                                 |
| <b>Outcome</b>    | : Reduced infant and child deaths due to diarrhoea                                                                                                                                                                                                                                                                                      |
| <b>Indicator</b>  | : <i>Per cent of infants and children died due to diarrhoea</i>                                                                                                                                                                                                                                                                         |
| <b>Output</b>     | : Reduced incidence of diarrhoea<br>Increased use of ORS in the community by training Community Health Workers<br>Increased knowledge and awareness of community members                                                                                                                                                                |
| <b>Indicator</b>  | : <i>Per cent of infants and children given ORS during diarrhoea</i>                                                                                                                                                                                                                                                                    |
| <b>Process</b>    | : Enhanced knowledge of service providers and community and improved service provisions on diarrhoea management                                                                                                                                                                                                                         |
| <b>Indicator</b>  | : <i>Number of health functionaries trained on use of ORS</i><br><i>Number of health functionaries trained on treatment of diarrhoea among children</i><br><i>Number of ORS depots established</i><br><i>Number of ORS depots sold at least specified number of packets of ORS</i><br><i>Number of IEC campaigns on use of ORS held</i> |
| <b>Input</b>      | : Resources developed and supply chain streamlined                                                                                                                                                                                                                                                                                      |
| <b>Indicators</b> | : <i>Training and communication materials developed</i><br><i>Procurement of ORS done and logistics system streamlined</i>                                                                                                                                                                                                              |

### Notes

### 11.2.5 Result-based Management

Result-based management or RBM is a strategy or approach by which an organisation ensures that its processes, products and services contribute towards the achievement of clearly stated results. RBM provides a coherent framework for strategic planning and management by improving learning and accountability. It is also a broad management strategy aimed at achieving important changes in the way institutions operate, with improving performance and achieving results as the central orientation, by defining realistic expected results, monitoring and evaluating progress towards the achievement of expected results, integrating lessons learnt into management decisions and reporting on performance. RBM suggests the following:

- Analysing problems and determining their causes and effects
- Identifying measurable or describable changes (results) to be achieved, based on appropriate problem analyses
- Designing strategies and activities that will lead to these changes (results)
- Balancing expected results with the resources available
- Monitoring progress regularly and adjusting the activities as needed to ensure that the desired results are achieved

- Evaluating, documenting and incorporating lessons learned into decision making for the next phase of planning
- Reporting the results achieved and their contribution towards reaching organisational goals

### What is a Result?

A result is a describable or measurable change in a state that is derived from a cause and effect relationship. This means that a result is a change that can be observed, described and measured in some way, and for which the cause can be identified.

#### Two important things to remember

(i) **RESULT = CHANGE**

(ii) **CAUSE → EFFECT**

Results should be defined on the basis of problem analysis. Problem analysis is the cornerstone for good planning and forms the basis for designing interventions that lead to results. Problem analysis establishes the cause and effect relation between negative aspects of an existing situation. This cause-effect relation when analysed is usually presented in a logical and hierarchical manner (that is, showing the effects of the central problem(s) on top and the causes below) and is commonly known as a problem tree. It is critical that the changes that are to be brought about in the results are clearly linked to the problems that are to be addressed.

### Notes

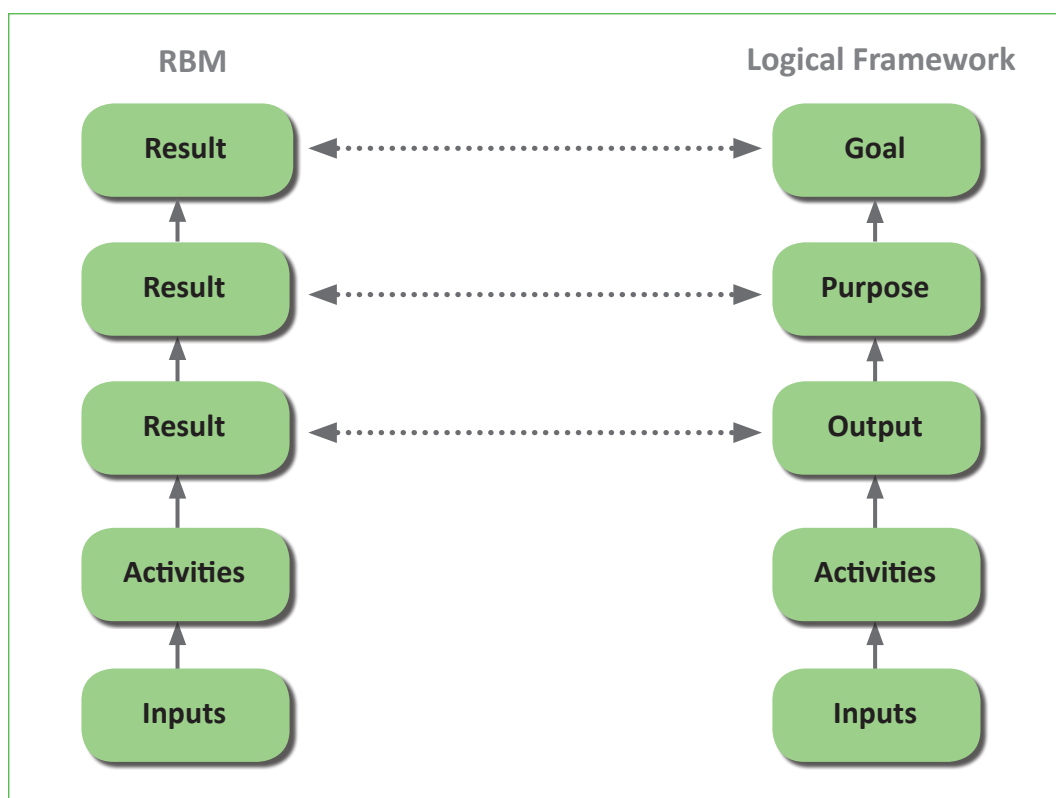
Results may

- Appear within a short time or take years to be fully realised
- Be planned or unforeseen
- Be either positive or negative
- Be reflected at the level of individuals, groups, institutions or society

A statement of results should illustrate the type of change that may be expected because of a specific intervention. It should be:

- As specific as possible
- Realistic in relation to the time and resources available
- Describable or measurable in some way

**Levels of Results:** Goals, purposes and outputs (as defined in the LFM) are the different levels of results under the RBM approach.



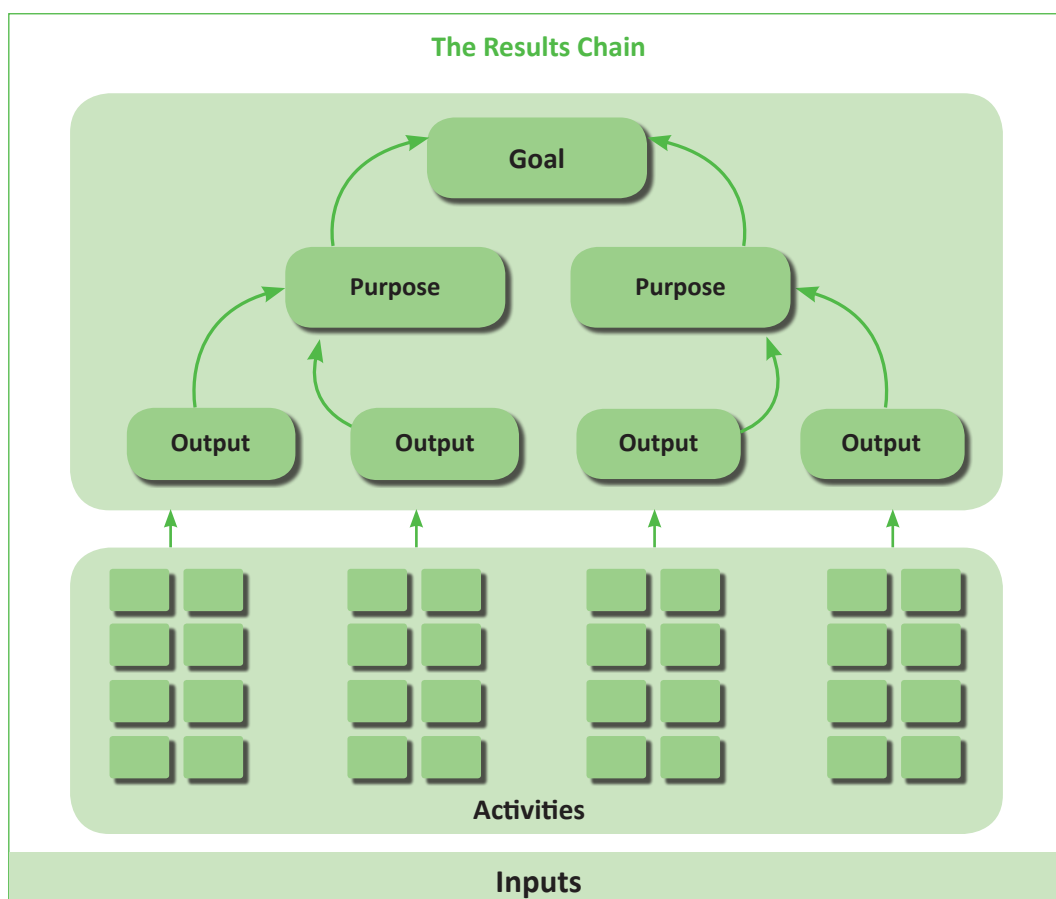
## Notes

### Results Chain

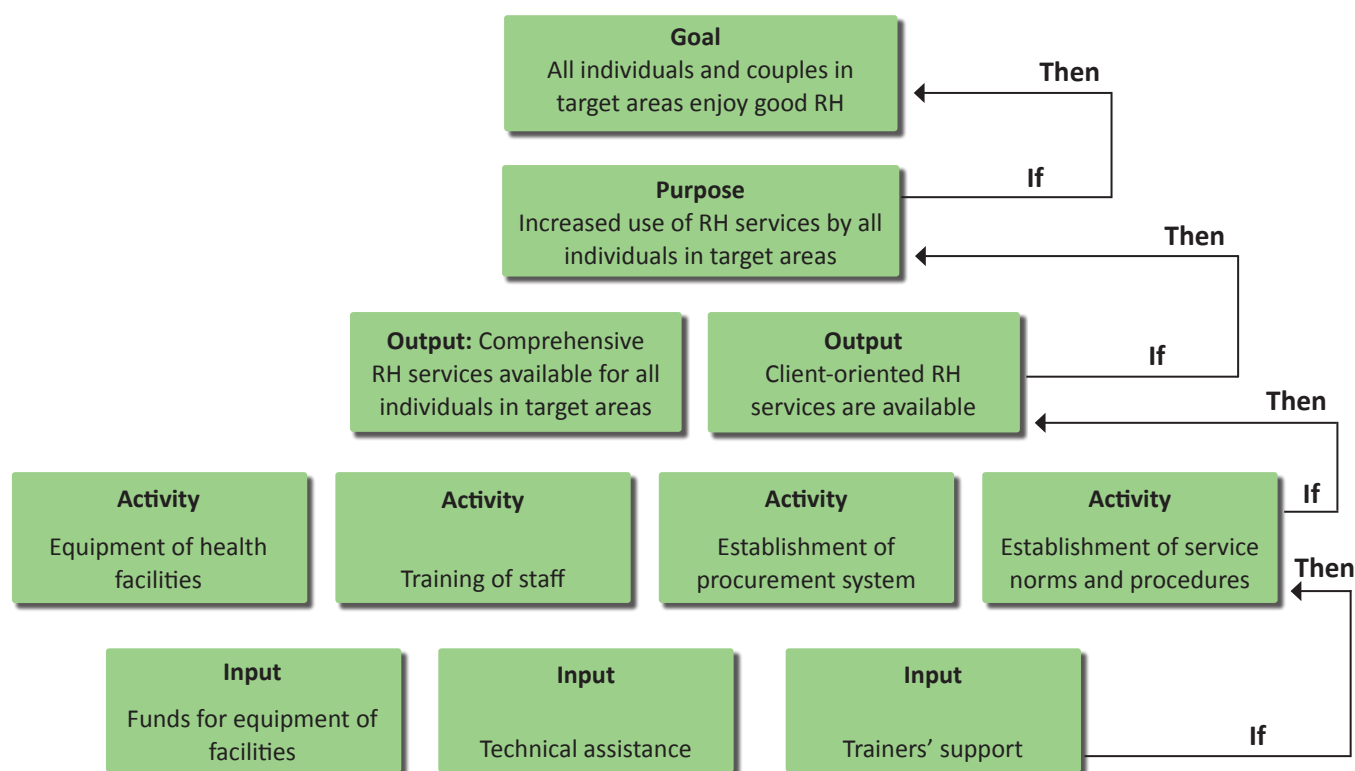
The results chain shows the logical links between activities and the results that may be expected to occur over a period of time, based on a theory of change that assumptions are valid and risks do not materialise. This cause and effect relationship is a central element of RBM.

The results chain is linked with the hierarchy of problems (that is, a problem tree) and is developed from there. The illustration below demonstrates the cause and effect relationship between activities and results. As can be seen in the illustration, the results chain is similar to the vertical logic of the LFM.

Based on the logical framework and RBM concepts, various departments of the Government of India have developed a **Results Framework Document (RFD)**, which captures the objectives of the programmes, activities or actions to be undertaken as well as the success indicators for each of the activities. In addition, the RFD also earmarks financial resources and becomes a useful document to track the progress of both physical and financial performance.



### Example of Results Chain for Reproductive Health (RH)\*



\* This results chain is meant to be illustrative and shows only part of a larger picture of interventions and results in the RH area of a programme.

### 11.2.6 Methods of Collecting Data

The data for monitoring and evaluation can be collected in many ways. These methods could be broadly grouped into two categories.

#### Primary Sources of Data Collection

Data or information collected directly by project personnel or any external agency is termed primary data. In this category, the users of the data are the same as those who have collected first-hand information from the field. Primary sources of data are collected through the following means:

- Surveys – interviewing the respondents using questionnaire mode
- Focus group discussions (FGDs)
- Case studies
- In-depth interviews (IDIs)
- Observations

#### Secondary Sources of Data Collection

Secondary sources of data are those generated by one person and used by many others. In other words, data and reports published by researchers, if analysed by those who have not directly collected the information, are termed secondary data. Examples are the use of research findings or indicators already published by the organisation that conducted the survey. Secondary data are collected through the following means:

- Government records
- Service statistics of programmes
- Census
- Published reports

#### Notes

### 11.3 Monitoring of Development Programmes at Sub-national Level – An Illustration

The Government of India is implementing various national flagship programmes to improve the overall health and educational status of the population and reduce levels of poverty, especially among the vulnerable population. The philosophy of these programmes has been inclusion and social justice. The aim is to ensure that the benefits reach the most vulnerable segments of the population and those who are marginalised and belong to the lower strata of society. Therefore, it is of utmost importance to track the progress of the national flagship programmes and state-sponsored schemes and assess whether the benefits are reaching those for whom they are intended.

Each of the Government of India's flagship programmes has its own Management Information System (MIS). For example, the National Rural Health Mission (NRHM) has a Health Management Information System (HMIS), the *Sarva Shiksha Abhiyan* (SSA) monitors its programme through the District Information System for Education (DISE), and the Rajiv Gandhi Drinking Water Mission (RGDWM) has its Integrated Management Information System (IMIS). In all these cases, the latest information technology has been applied for the compilation of information and its dissemination.

However, the MIS restricts itself to collecting data mainly from those who have received the benefits (numerator) from a given area or from a population group. Generally, it is

seen that the MIS programme provides data on the number of beneficiaries in a given time period, but does not provide information on the actual or potential number of beneficiaries (denominators) who should be provided the services from a given area or a population group. The purpose of any programme's MIS is not to derive higher level indicators, but in many cases, it is to generate relevant indicators to understand the reach and direction of the programme. To derive such indicators, there is a need to get an idea of the proper denominators for the local level. Though the MIS systems of most of the programmes are able to track numerators properly and efficiently, it is important to relate these numerators with the robust estimate of the denominators to judge the exact direction and reach of the programme benefits. Thus, it is important to adopt a holistic approach of tracking programme performance in terms of the inputs provided and output produced by the programme, along with the coverage of the population under each of the programmes.

To estimate and track the reach of the programmes, it is essential to get an idea about the total number of beneficiaries, and the population or segment of the population that needs to benefit from the programme. Since the populations of sub-national geographic areas are available from the census, which is conducted only once in ten years, the office of the Registrar General of India has provided population projections. Again, these projected population figures are available at the state level and not at the district level.

## Notes

UNFPA has published district-level population projections for 2006, 2011 and 2016 for eight states and the figures are available by age and sex. For the population below 14 years of age, single year population projections are also available, particularly for educational planning. Such sources of information can be used to estimate appropriate denominators for monitoring various sectoral programmes. The following section illustrates examples of monitoring health, education, poverty alleviation and water and sanitation programmes and focuses on tracking progress at the district level.

### 11.3.1 Health Sector

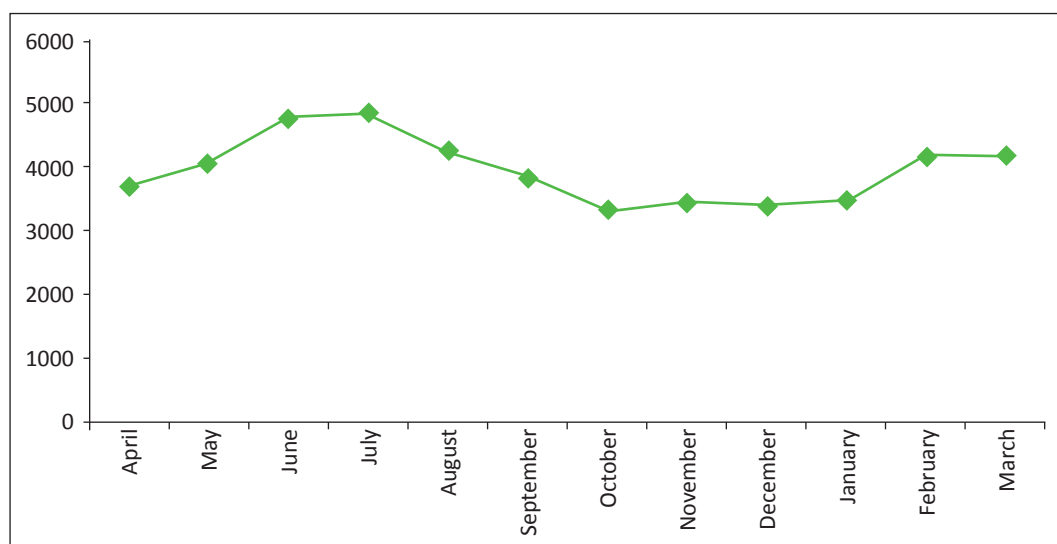
The RCH II programme and the later umbrella programme of the Health Department, namely the NRHM, has rolled out its monitoring system, HMIS, which captures data on various relevant aspects with the aim of tracking the progress of the programme over a period of time and providing timely feedback to ensure corrective measures for improvement. The information is collected and compiled by service providers at different levels, and covers various aspects including service delivery, quality of these services, availability of staff and human resource development (HRD), logistics and infrastructure status. As such, by design, the HMIS provides information mainly in absolute numbers. In order to convert these numbers into meaningful indicators reflecting the performance status of the programme and tracking progress over a period of time, an analytical framework of critical indicators from HMIS has been developed, which is attached as Appendix A. Programme managers may use this framework and compute indicators from the HMIS at the local level.

As an illustration, some crucial indicators in the areas of maternal health, child health and family planning are given on the following pages, based on the information available from HMIS.

### Number of Pregnant Women Registered for ANC by Month

The trend analysis of the number of new pregnancies registered for ANC by the auxiliary nurse midwife (ANM) in a district could be depicted to identify any major month-wise variations in the programme and if so, the reasons could be probed. Further, the data can be compared and analysed for previous years as well. Figure 11.1 below shows the number of pregnant women registered for ANC in Chhatarpur District of Madhya Pradesh.

**Figure 11.1: Number of Pregnant Women Registered for ANC by Month, Chhatarpur, Madhya Pradesh, 2009–10**



#### Notes

### Percentage of ANC Cases Registered in the First Trimester

The HMIS provides information on the total number of ANC cases registered, along with those ANC cases which were registered in their first trimester. Using this information, the percentage of ANC registered in the first trimester can be computed. There are two ways of analysing the information to track progress: by quarter and for the entire year. Fig. 11.2 presents the percentage of ANC cases registered in the first trimester of pregnancy for Chhatarpur District for each quarter, while Fig. 11.3 shows the same information for the entire year for selected districts of Madhya Pradesh for 2009–10.

### Percentage of Pregnant Women who Received Three ANC Check-ups

Another dimension for tracking performance of the programme relates to the percentage of pregnant women who received at least three ANC check-ups out of the total number of registered cases in a year. Figure 11.4 indicates that only around three quarters of the registered pregnant women received three ANC check-ups in Chhatarpur and West Nimar Districts of Madhya Pradesh, which points to better tracking of the provisioning of ANC services in these districts.

**Figure 11.2: Percentage of ANC Cases Registered in the First Trimester by Quarter, Chhatarpur, Madhya Pradesh, 2009–10**

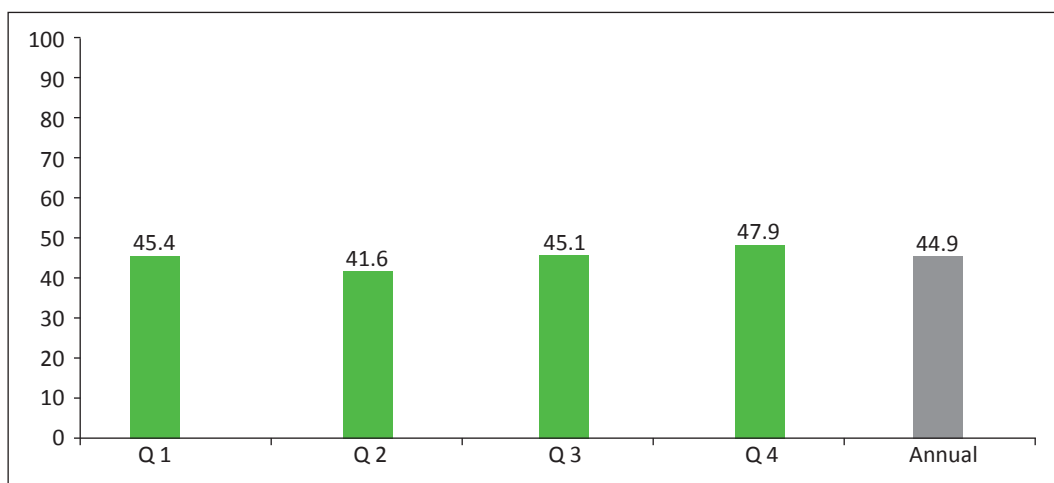


**Figure 11.3: Percentage of ANC Cases Registered in the First Trimester in Selected Districts of Madhya Pradesh, April 2009–March 2010**

#### Notes

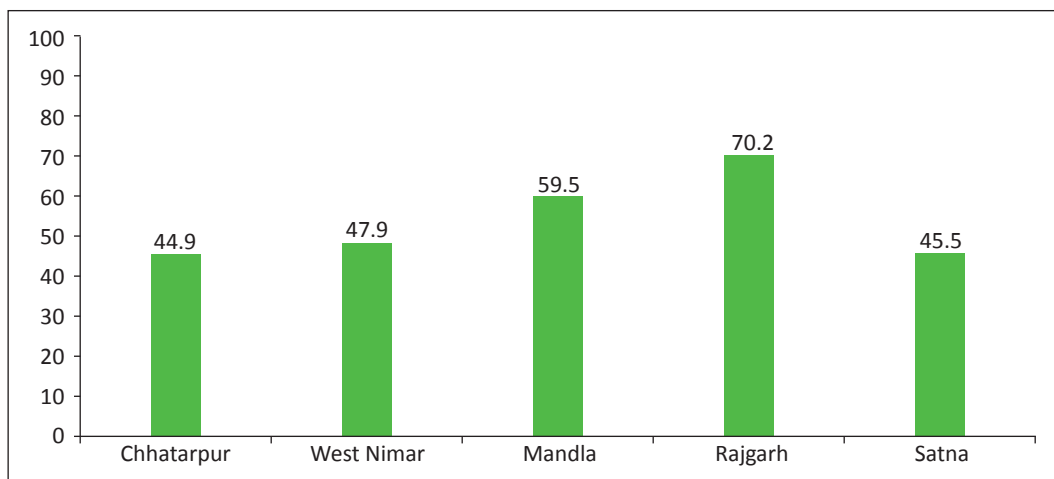
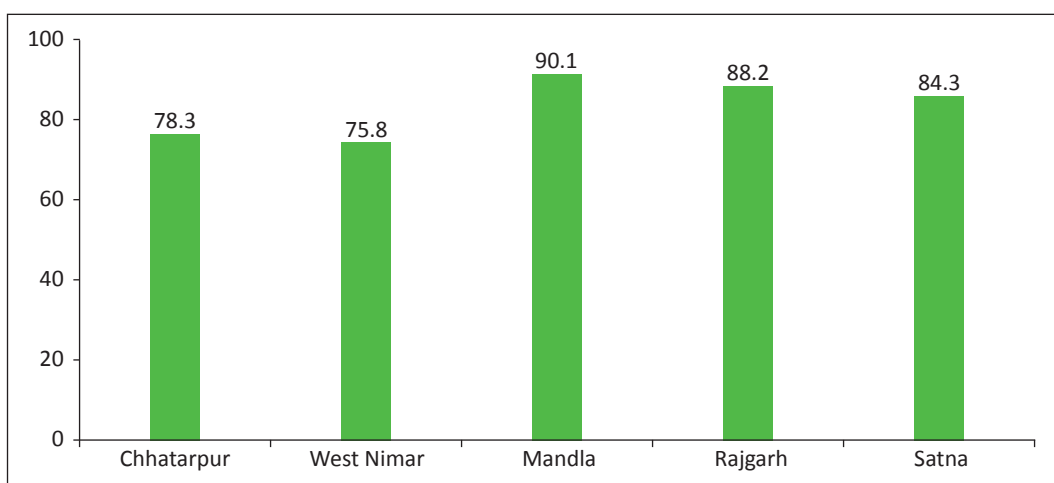


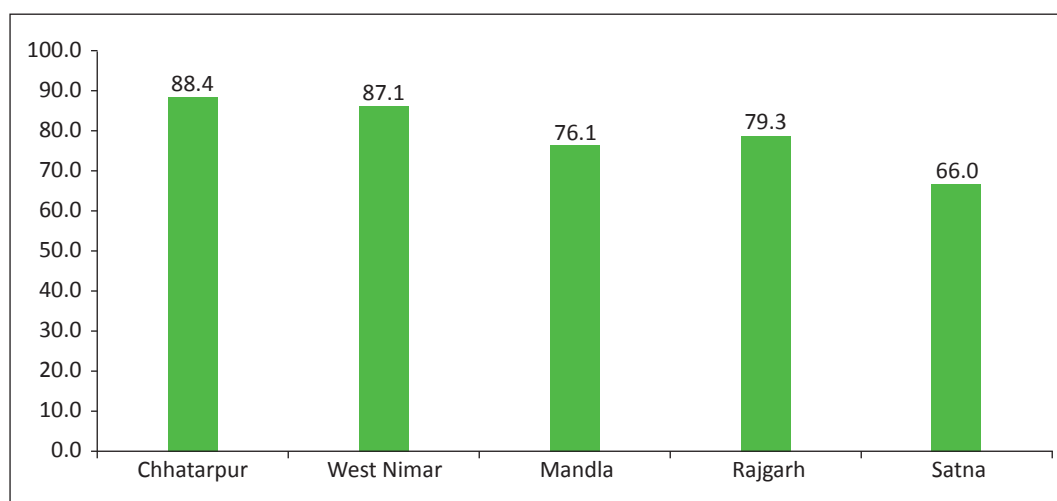
**Figure 11.4: Percentage of Pregnant Women who Received Three ANC Check-ups Out of Total Registered Cases, in Selected Districts of Madhya Pradesh, April 2009–March 2010**



### Percentage of Deliveries Reported by HMIS against Expected Births

One can compare the number of deliveries reported in HMIS against the expected number of births in a given district derived from the available information on birth rate and total population. This gives an idea about the extent to which HMIS has been able to capture the number of deliveries in the given district. For obtaining the expected number of births in selected districts of Madhya Pradesh, the district population from Censuses 2001 and 2011 have been used to estimate mid-year population for 2009–10 by the exponential growth rate method. The district-level crude birth rates from the recently conducted Annual Health Survey have been used to derive estimates of the number of births from the mid-year population. The estimated number of births in the district serves as the denominator. The total number of deliveries reported in HMIS is then computed as a percentage of the expected deliveries to get an idea of the extent of coverage of reported deliveries. Figure 11.5 shows the percentage of deliveries reported in HMIS against the expected number of births in selected districts of Madhya Pradesh. It can be seen that in districts such as Chhatarpur and West Nimar, HMIS captured around 88 per cent of the expected deliveries in 2009–10, while the coverage was only 66 per cent in Satna District.

**Figure 11.5: Percentage of Deliveries Reported by HMIS against Expected Births in Selected Districts of Madhya Pradesh, 2009–10**

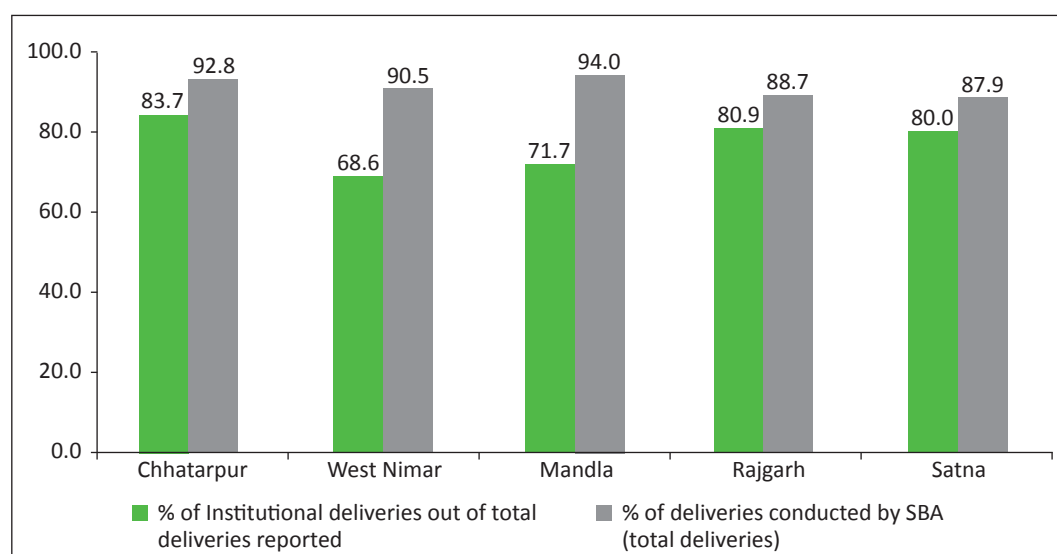


#### Notes

### Percentage of Institutional Deliveries

From the HMIS data, it is possible to track the percentage of deliveries conducted in an institution out of the total number of reported deliveries. As can be seen from Figure 11.6, in three districts of Madhya Pradesh (Chhatarpur, Rajgarh and Satna) more than 80 per cent of the reported deliveries were institutional while in the other two districts, the coverage was 69–72 per cent.

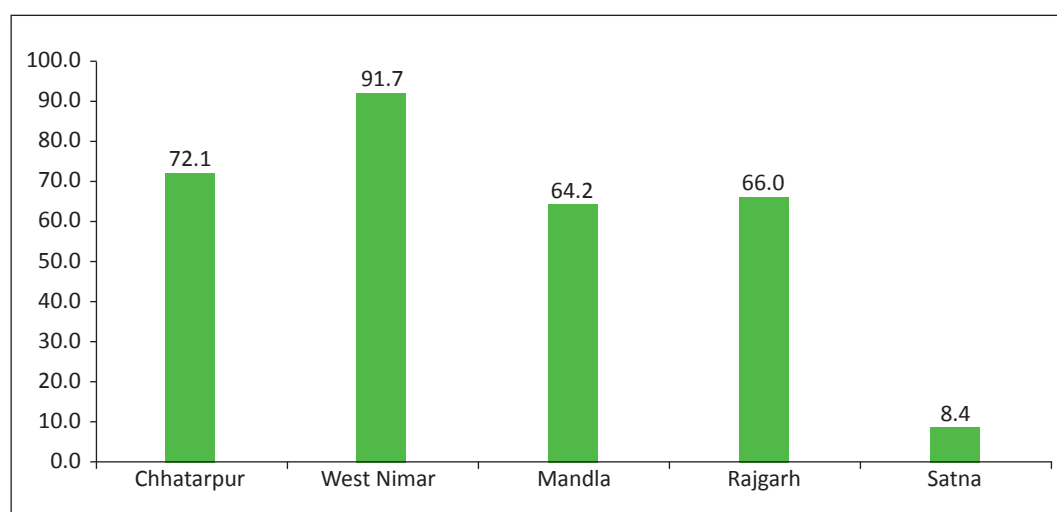
**Figure 11.6: Percentage of Institutional Deliveries out of Total Reported Deliveries and Assistance during Delivery in Selected Districts of Madhya Pradesh, April 2009–March 2010**



#### Percentage of Mothers Discharged within 48 hours after Delivery at the Institution

One of the quality indicators related to institutional delivery is to track how many mothers stay at the institution after delivery. As per the recommended norms, mothers are required to stay for at least for 48 hours after delivery. The indicator in Figure 11.7 suggests that in four of the five selected districts in the state, a very high proportion of mothers do not stay up to 48 hours at the institution, the exception being mothers from Satna District.

**Figure 11.7: Percentage of Institutional Deliveries Discharged under 48 hours in Selected Districts of Madhya Pradesh, April 2009–March 2010**



#### Percentage of Complicated Deliveries Attended to in an Institution

One of the process indicators of reducing maternal mortality is to track the percentage of complicated deliveries attended to in an institution. Experience suggests that around 15 per cent of deliveries face one or more complication that need to be treated at the institution. The analysis of HMIS information related to the number of deliveries attended to at private and public institutions as a percentage of the total number of live births is depicted in Figure 11.8. In most districts, the percentage of deliveries with complications

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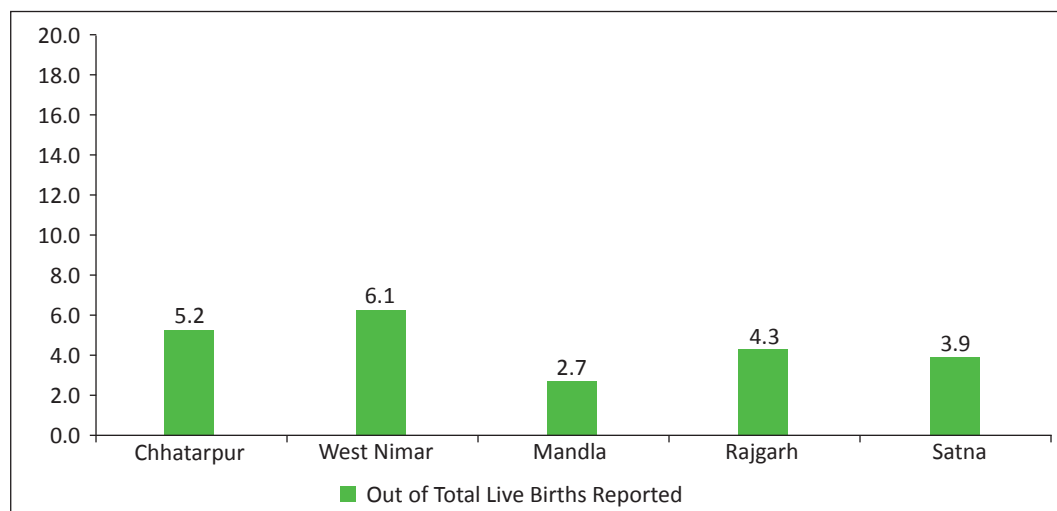
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that are attended to is less than the expected level which reflects that the level of obstetric care provided in the districts is far below the expected norm.

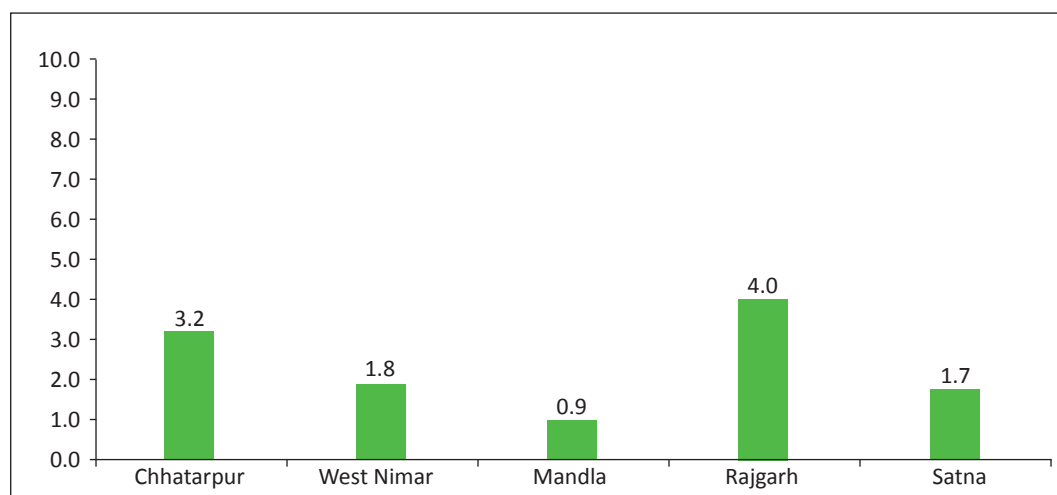
**Figure 11.8: Percentage of Complicated Deliveries Attended to at Public and Private Institutions in Selected Districts of Madhya Pradesh, April 2009–March 2010**



#### Percentage of Total Eligible Couples who Opted for IUD Insertions

The level of efforts made towards the provisioning of the spacing method of contraception could be judged by the percentage of eligible couples in a district who opted for intra-uterine device (IUD) insertions in a given year. The estimate of the number of eligible couples is derived from UNFPA District Level Population Projections and the numbers of IUD insertions are taken from HMIS. Figure 11.9 presents this indicator, which seems to suggest that only a meagre proportion of eligible couples are provided with IUD services in the selected districts of Madhya Pradesh.

**Figure 11.9: IUD Insertion as Percentage of Total Eligible Couples in Selected Districts of Madhya Pradesh, April 2009–March 2010**



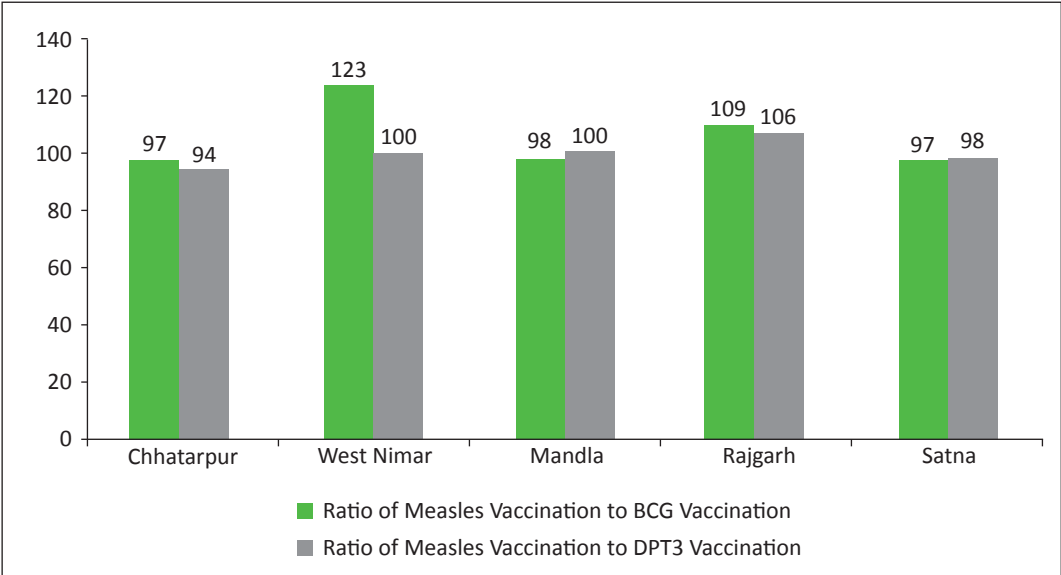
#### Ratio of Children given Measles, BCG and DPT3 Vaccination

In the area of child health, one can analyse the ratio of children who were given the measles vaccine and similarly, the ratio of children given DPT3 and BCG vaccination. In case of discrepancies in the ratio, the children who were not given these vaccinations could be traced.

#### Notes

Figure 11.10 presents the findings for selected districts in Madhya Pradesh for 2009–10. The findings suggest that in the districts of West Nimar and Rajgarh, a greater number of children were given measles vaccine than BCG, which indicates the possibility that a number of children were left out of BCG vaccine coverage during the entire year.

**Figure 11.10: Ratio of Children given Measles to BCG and DPT3 Vaccination in Selected Districts of Madhya Pradesh, April 2009–March 2010**



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The information for monitoring infrastructure can also be taken from the HMIS system as listed below.

**Process Indicators**

- (i) Total number of Primary Health Centres (PHCs) functioning on 24x7 basis
- (ii) Number of District Hospitals working as first referral units (FRUs)
- (iii) Number of Sub Divisional Hospitals working as FRUs
- (iv) Number of Community Health Centres (CHCs) and others working as FRUs

The above information can be converted into indicators: the percentage of PHCs functioning on a 24x7 basis (where the numerator comes from the HMIS and denominator comes from the government records of the total number of PHCs in a district or state).

The indicators can also be computed in another way, which is to measure the number of institutions against the population norms prescribed by the Government of India. For example, the percentage of population covered by CHCs functioning as FRUs in the state/district can be computed (where the numerator comes from the HMIS for a district and the denominator is the total rural population of the district multiplied by 100).

**11.3.2 Education Sector**

The SSA envisaged achieving the goal of universal elementary education (UEE) by 2010. All the states and union territories (UTs) of the country are covered under SSA. In order to monitor the progress of elementary education in India, decentralised levels of data on educational indicators are required. The DISE was established to monitor progress at the district level by the National University of Educational Planning and Administration (NUEPA).

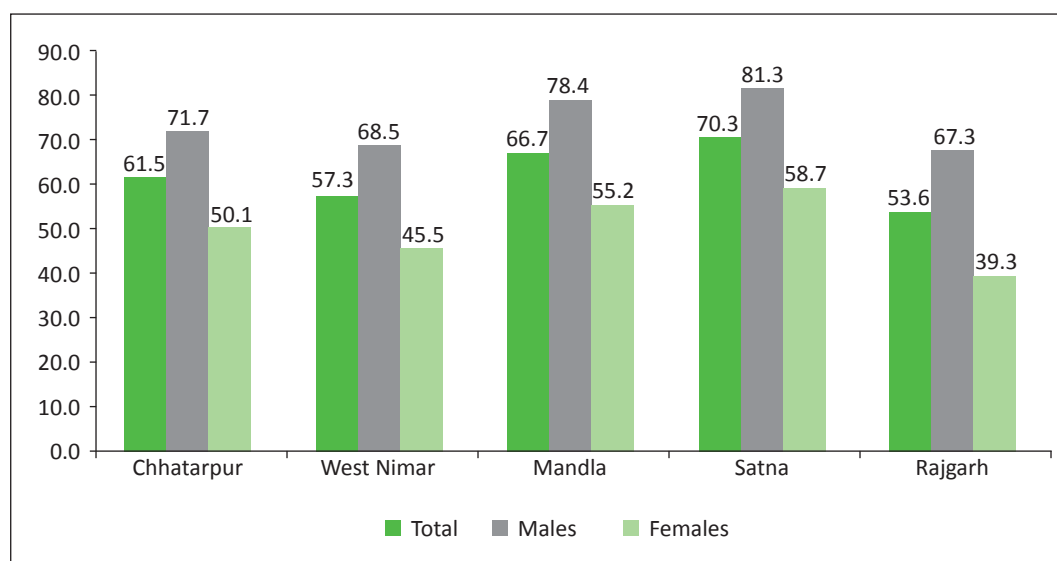
Since 1999, efforts are being made to share district-level data with educational planners, administrators and data users in the form of District Report Cards. Since 2001–02, the scope of DISE has been extended to cover new data elements as well as to expand the scope to the entire elementary education sector. The Report Cards are based on school-level data provided by the State Project/Mission Directors to the Department of School Education and Literacy of the MHRD. Recent information pertains to 2007–08.

DLHS-III provides information on district literacy rates among the population aged seven years and above, which can be compared with the 2001 Census figures to trace the progress of literacy in a district. Figure 11.11 depicts the literacy rate by sex in selected districts of Madhya Pradesh. One may need to be cautious while interpreting the results, as survey estimates are subject to standard errors (and hence confidence interval may be used).

To monitor programme performance, one can examine the primary and upper primary enrolment trends over the years in each district. Similarly, one can track the important indicators such as gross and net enrolment rates (GER and NER), retention rate, gender parity index (GPI), pupil-teacher ratio and then take appropriate decisions to influence programme implementation. Based on the information available from DISE, the following indicators could be computed and used for monitoring primary education programmes at the local level.

## Notes

**Figure 11.11: Literacy Rates in Selected Districts, Madhya Pradesh, DLHS–III, 2007–08**



## Percentage of Scheduled Caste and Scheduled Tribe Enrolment

The percentage of Scheduled Caste (SC) and Scheduled Tribe (ST) children enrolled, juxtaposed against the overall percentage of SCs and STs based on census data, provides useful insights into inclusion of children from vulnerable communities in the educational system. Figure 11.12a indicates the percentage enrolment of SC and ST children compared to the percentage of SC and ST population in the district based on the 2001 Census (which is shown in Figure 11.12b). Enrolment by social groups appears to be equal.

**Figure 11.12a: Percentage of SC and ST Students Enrolled in Primary Schools in Selected Districts of Madhya Pradesh, DISE 2007–08**

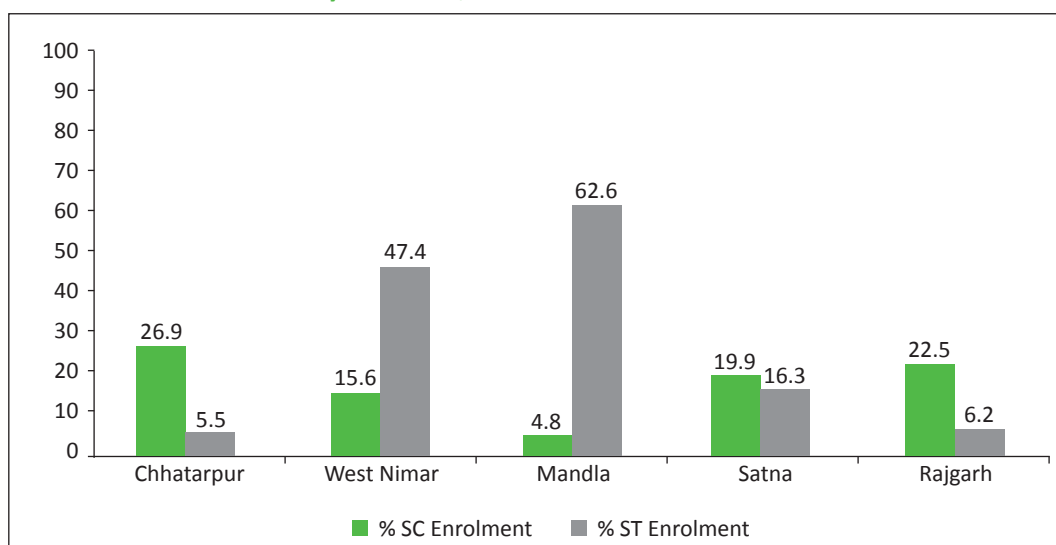
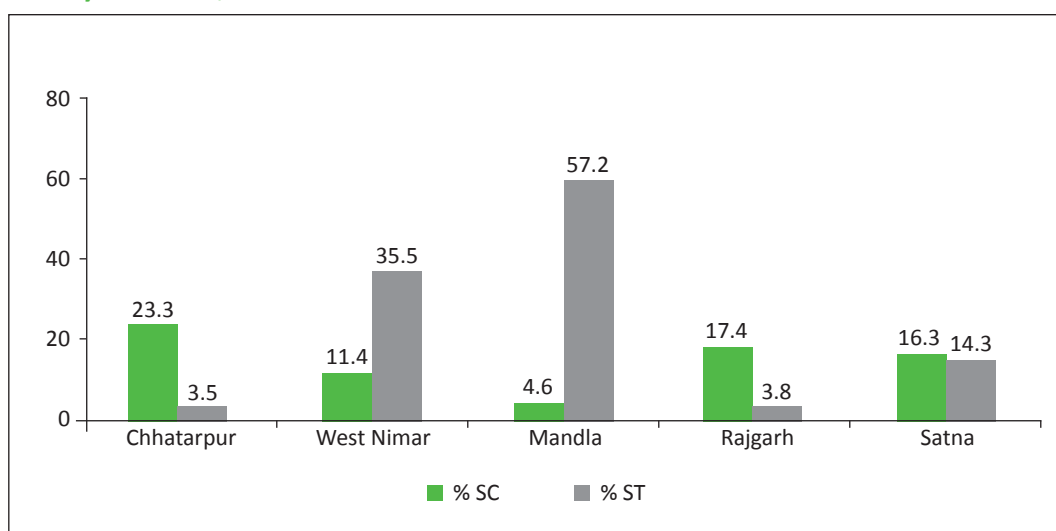


**Figure 11.12b: Percentage of SC and ST Population in Selected Districts, Madhya Pradesh, 2001 Census**



### Gross and Net Enrolment Rates

The DISE information provides GER and NER for the primary section. Figures 11.13 and 11.14 show these rates for the primary and upper primary levels respectively. Both the GER and NER are considerably lower for the upper primary level as compared to the primary level in most selected districts.

**Figure 11.13 Primary-level GER and NER in Selected Districts in Madhya Pradesh, DISE 2007–08**

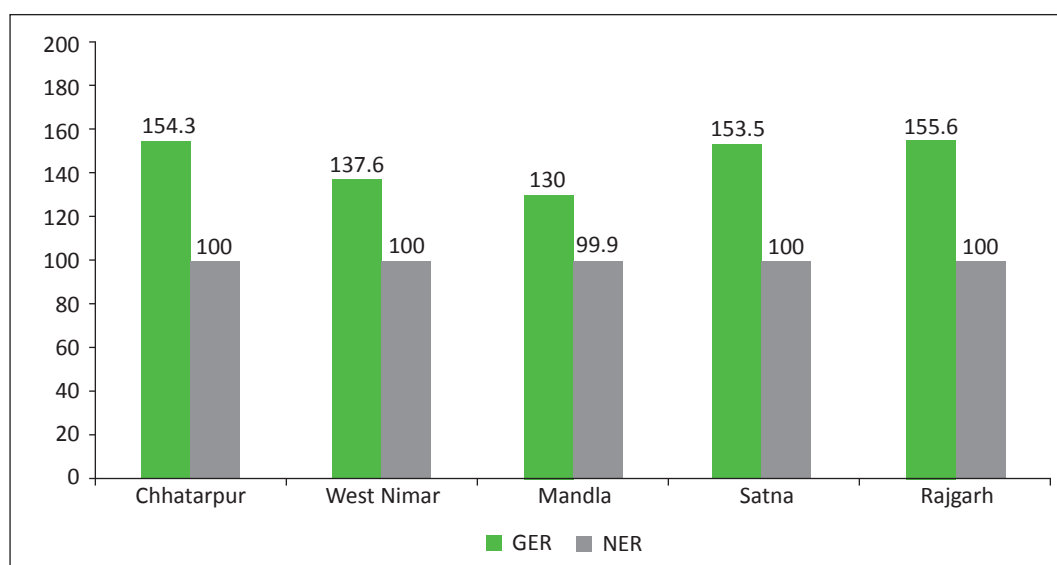
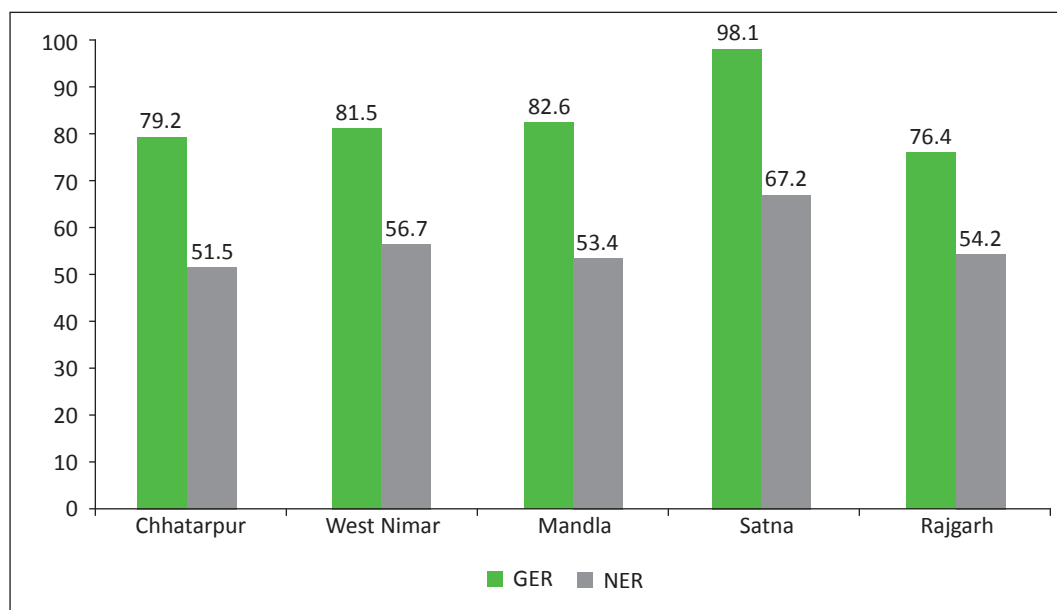


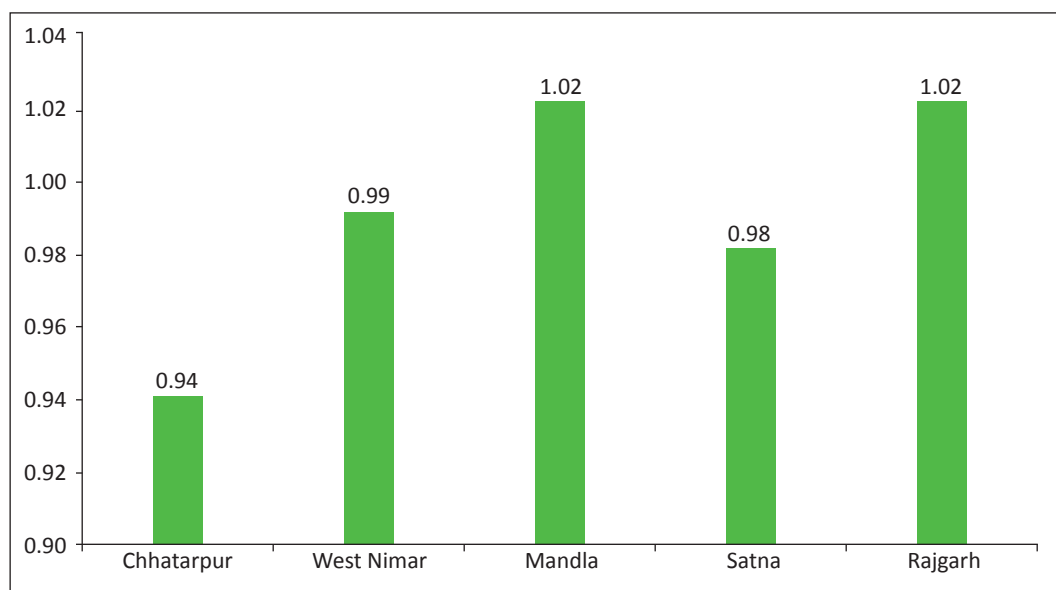
**Figure 11.14: Upper Primary-level NER in Selected Districts in Madhya Pradesh, DISE 2007–08**



### Gender Parity Index (GPI)

The GPI provides the ratio of enrolment of girl students to boys. As indicated in Figure 11.15, far fewer girl students enrolled (94 girls per 100 boys) in the primary level in Chhatarpur District in 2007–08. This has not been the case for other districts.

**Figure 11.15: Gender Parity Index at Primary-level Enrolment in Selected Districts of Madhya Pradesh, 2007-08**

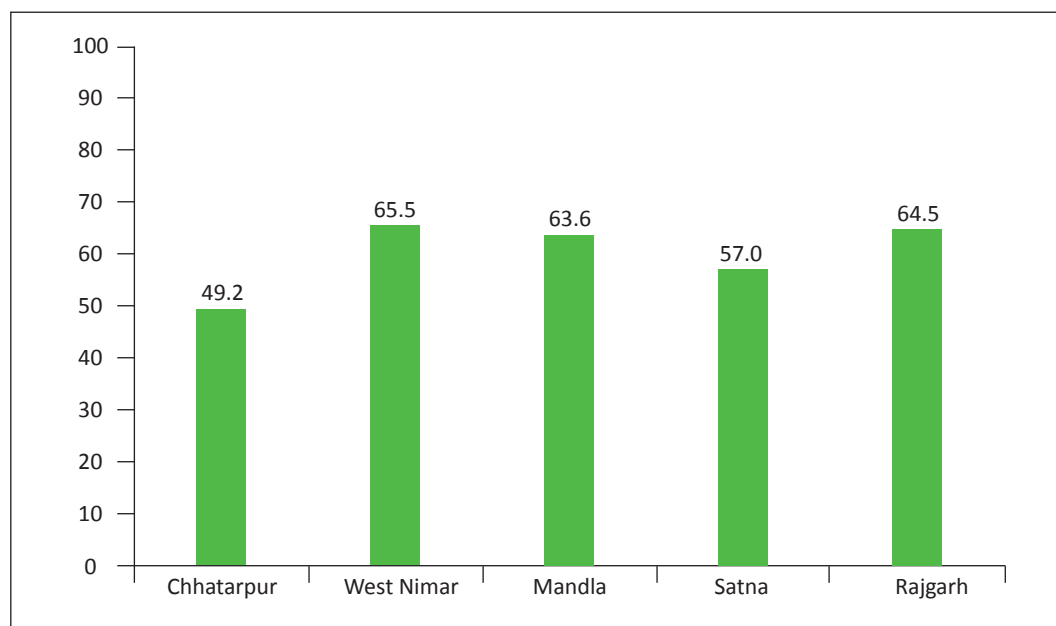


## Notes

### Transition Rate from Primary to Upper Primary Level

The transition from primary to upper primary level has been an issue particularly in rural areas for various reasons. Data available from DISE as depicted in Figure 11.16 can be used to understand the extent to which students drop out between the primary and upper primary levels. Only half of the students in Chhatarpur District were found pursuing upper primary education in 2007–08. In other districts too, nearly one-third of the students did not continue their education at upper primary level.

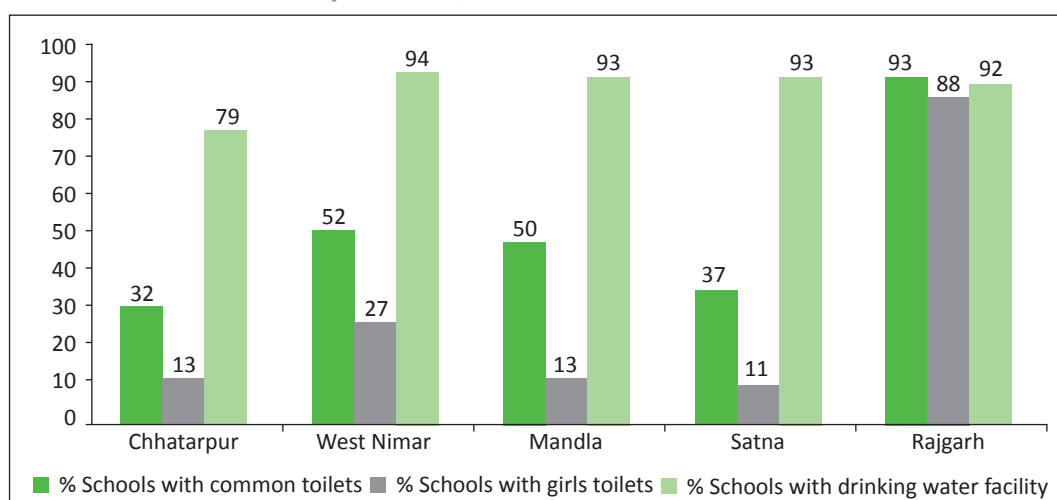
**Figure 11.16: Transition Rate from Primary to Upper Primary in Selected Districts of Madhya Pradesh, DISE 2007–08**



### Availability of Toilets and Drinking Water Facilities in Primary Schools

The percentage of primary schools in a district with toilet facilities, and especially separate toilets for girls, can be tracked with the help of DISE data. Similarly, the provision of drinking water in primary schools can also be analysed so as to initiate appropriate interventions to address the gaps. As can be seen from Figure 11.17, only around one-third of primary schools in Chhatarpur and Satna Districts have toilet facilities as compared to Rajgarh District, where around 93 per cent of the primary schools have this facility. Provision of separate toilets for girls ranges from 11 to 27 per cent in four districts, but touches a high of 88 per cent in Rajgarh. The provision of drinking water facilities is found to be high in primary schools at 92 to 94 per cent in four districts, though lower in Chhatarpur at 79 per cent.

**Figure 11.17: Percentage of Primary Schools with Toilet and Drinking Water Facilities in Selected Districts of Madhya Pradesh, DISE 2007–08**



#### Notes

### 11.3.3 Indicators from MGNREGA

The Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) is a flagship programme of the Government of India. It came into force on September 7, 2005 as National Rural Employment Guarantee Act (NREGA) and its implementation was notified in a phased manner. In Phase I, it was introduced in 200 most backward districts of the country on February 2, 2006. In Phase II, 130 more districts were included with effect from April 1, 2007. The scheme was extended to the remaining 274 districts of India from April 1, 2008. In December 2009, the name was modified and it is now known as the Mahatma Gandhi National Rural Employment Guarantee Act.

The objective of the Act is to enhance livelihood security in rural areas by providing at least 100 days of guaranteed wage employment in a financial year to every household whose adult members volunteer to do unskilled manual work.

While the primary objective of the Act is to augment wage employment, its auxiliary objective is to strengthen natural resource management through works that address causes of chronic poverty, like drought, and thus encourage sustainable development.

The programme has its own in-built monitoring system conducted by senior officials and the norms have been provided for monitoring visits. MGNREGA has a dedicated website which

not only provides general information, but also has detailed data for the state, district and lower levels. The information includes the following:

- Number of households and individuals registered under the programme
- Number of job cards issued
- Number of households and individuals who demanded jobs and were offered jobs
- Person-days of employment provided
- Number of families that have completed 100 days of employment

The above information could be used to track trends and derive meaningful information about the progress of the implementation of MGNREGA.

### Percentage of SC/ST Households Provided Job Cards

The MIS information available on the web about issuance of job cards by social groups can be juxtaposed with the overall social profile of the districts. Figure 11.18a brings out the percentage of SC/STs among those who were issued job cards and also the percentage of SC/ST population obtained from Census 2001. In Mandla District, among those who were provided job cards, only 31 per cent households were STs against the total ST population of 57 per cent, which reflects exclusion of this group of households under the scheme.

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Figure 11.18a: Percentage of SC/ST Households Provided Job Cards in Selected Districts of Madhya Pradesh, 2008–10

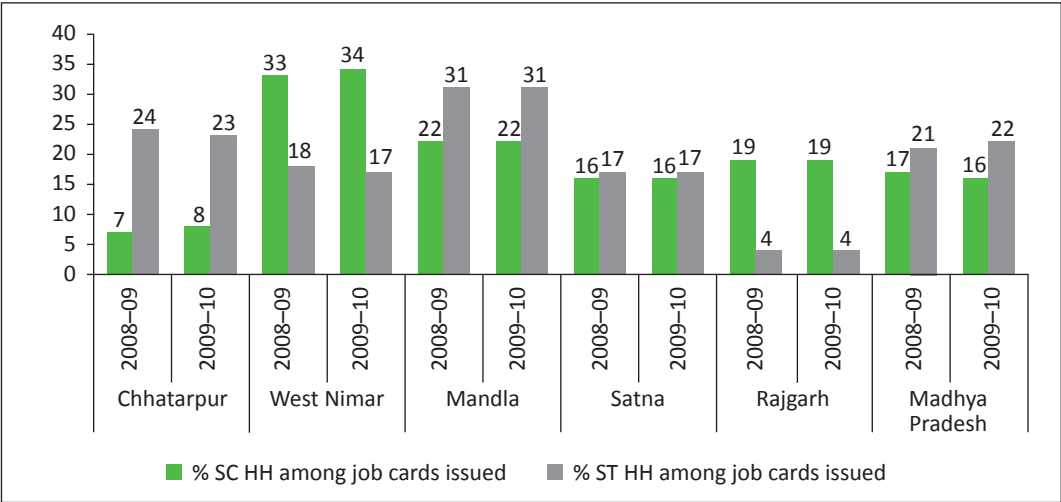
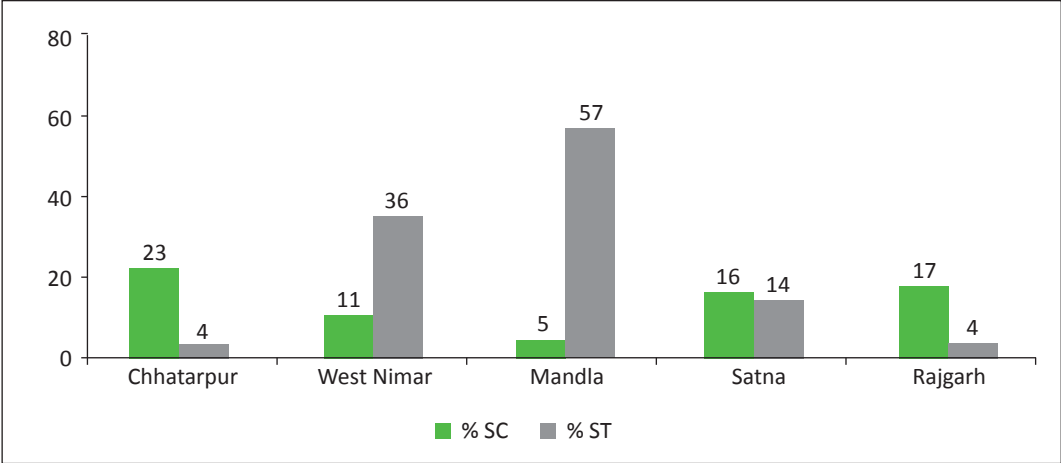


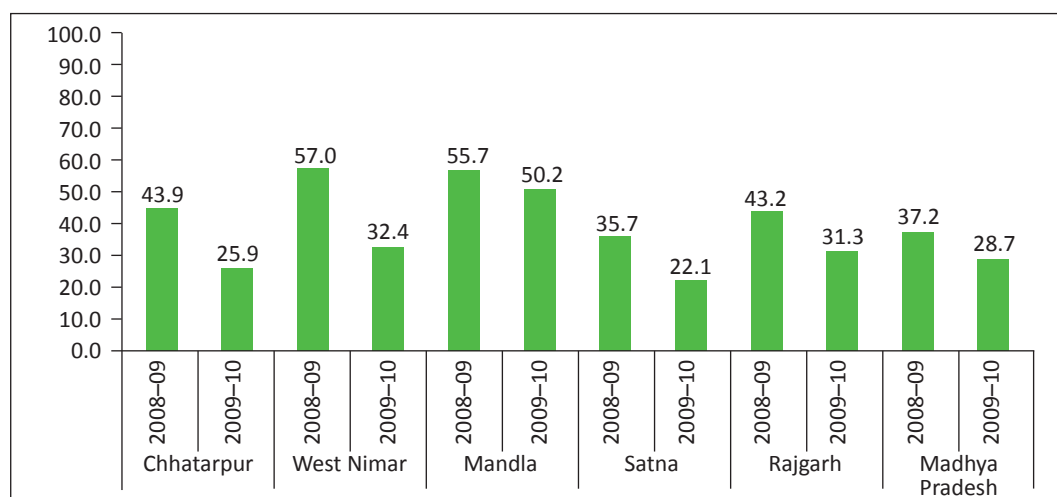
Figure 11.18b: Percentage of SC/ST Population in Selected Districts of Madhya Pradesh, 2001 Census



### Percentage of Households demanding Jobs against Job Cards Issued

The web-based information system can be used to track the percentage of households which demanded jobs against the number of job cards issued. Figure 11.19 brings out this aspect for selected districts of Madhya Pradesh. As can be seen from the figure, around one-third to half the households demanded employment against job cards issued in selected districts of Madhya Pradesh in the financial year, 2008–09 and 2009–10.

**Figure 11.19: Percentage of Households that Demanded Employment against Job Cards Issued in Selected Districts of Madhya Pradesh, 2008–10**

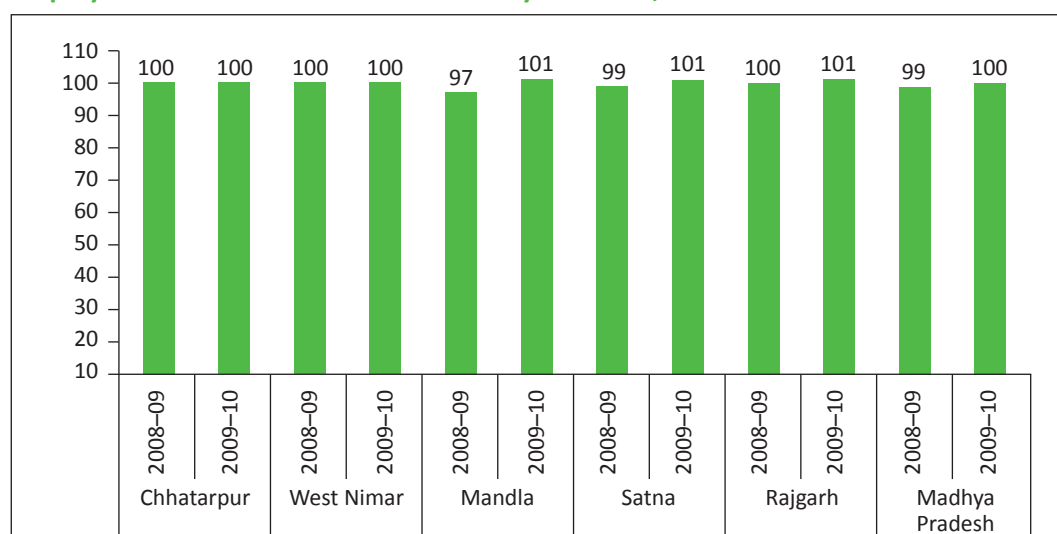


### Notes

### Households that Demanded and were Provided Employment under MGNREGA

The information can be used to track the percentage of households which were provided employment against those that demanded employment. Figure 11.20 depicts the findings for selected districts of Madhya Pradesh in this regard. It is seen that almost all households registered were provided employment; however it does not indicate the number of days of employment provided per household.

**Figure 11.20: Percentage of Households that Demanded and were Provided Employment in Selected Districts of Madhya Pradesh, 2008–10**

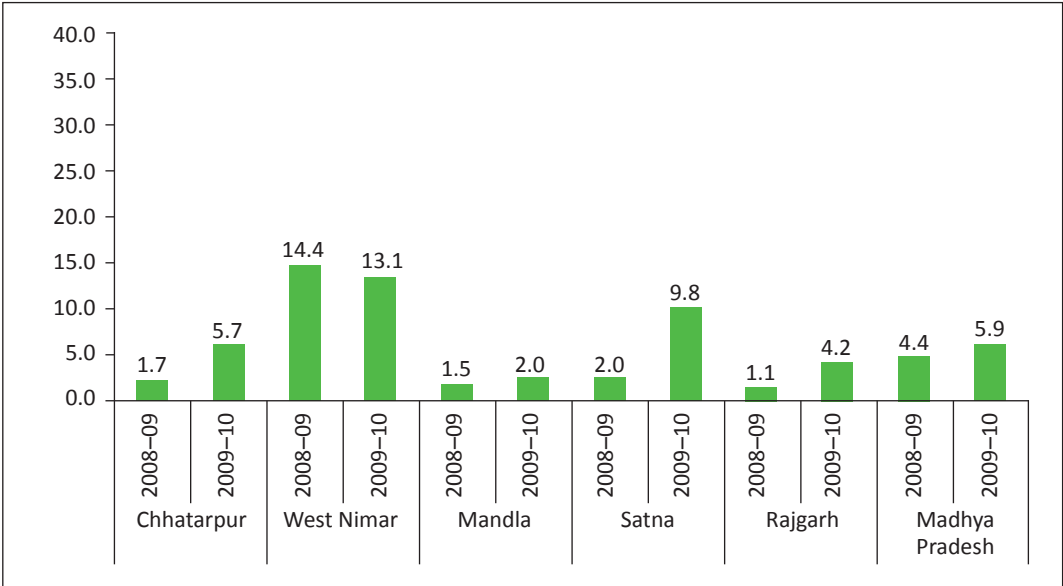


### Percentage of Households that Completed 100 Days of Employment

The main aim of the scheme is to provide 100 days of employment to those who demand it. The information system indicates that only around 14 per cent of households in West Nimar

District of Madhya Pradesh had completed 100 days of employment under the scheme, while in other districts, this percentage is even lower, as can be seen from Figure 11.21.

**Figure 11.21: Percentage of Households that Completed 100 days of Employment in Selected Districts of Madhya Pradesh, 2008–10**

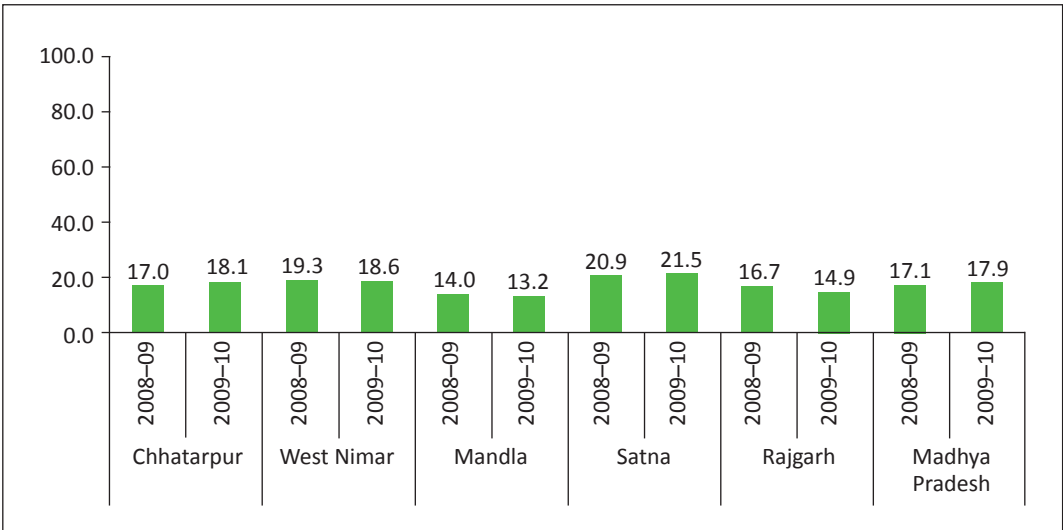


**Notes**

**Number of Days of Employment Generated**

Information on the number of days of employment generated could be used to compute the average number of days of employment generated per person. Figure 11.22 shows findings for selected districts of Madhya Pradesh, for the financial years 2008–09 and 2009–10. The average number of days of employment per person generated in these districts is around 17–18 days a year.

**Figure 11.22: Number of Days of Employment Generated Per Person (Person-days/ Persons provided employment) Madhya Pradesh, MGNREGA, 2008–10**

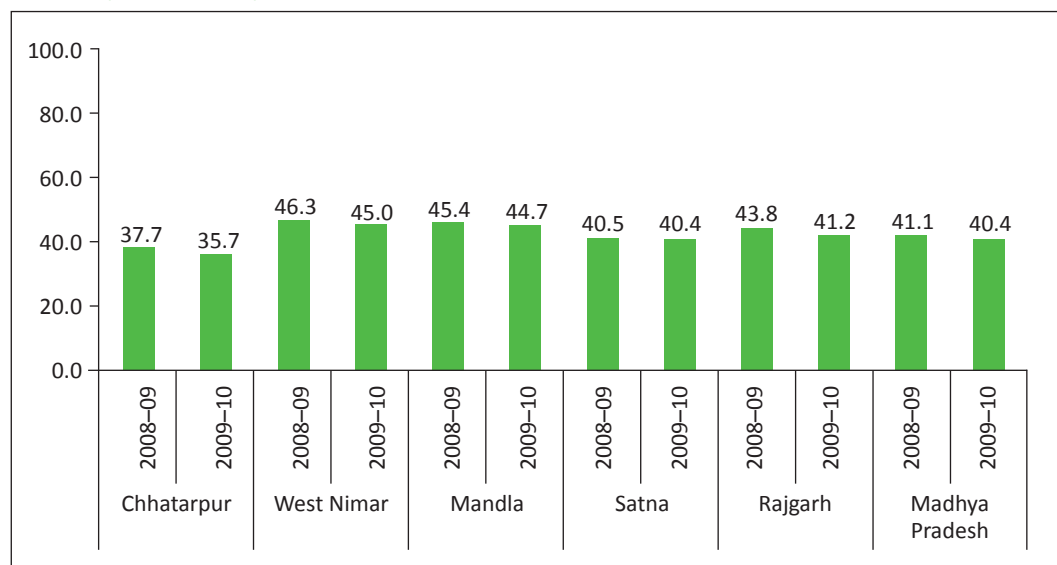


**Percentage Share of Women and SC/ST among Number of Days of Employment Generated**

The share of women in person-days of employment generated by the scheme in selected districts of Madhya Pradesh is presented in Figure 11.23. In a majority of the districts covered

over these two financial years, less than half of the person-days of employment generated were for women (around 40–45%), with approximately one-third in Chhatarpur District.

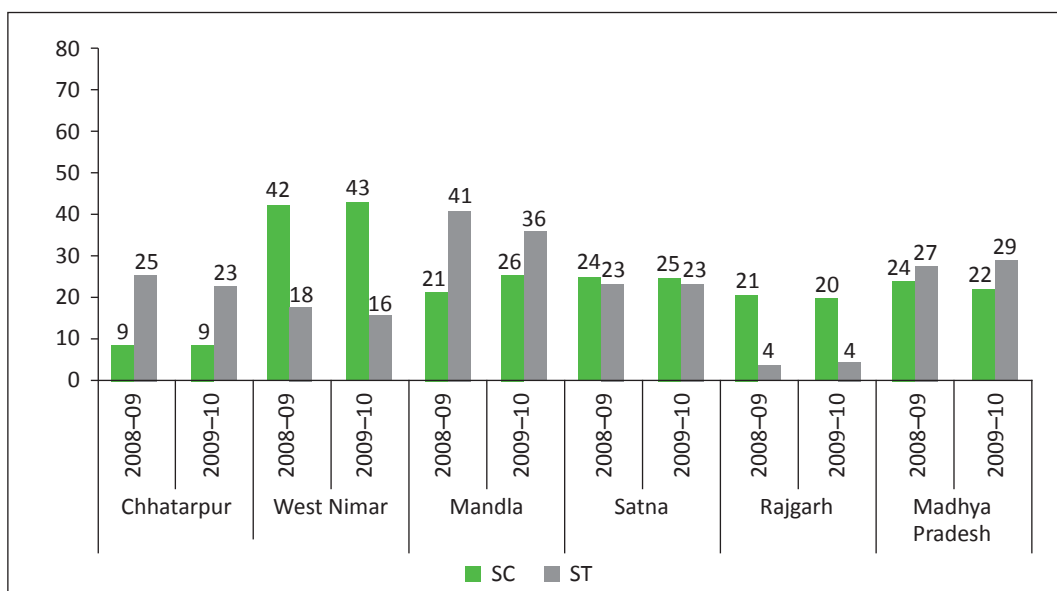
**Figure 11.23: Percentage Share of Women in Days of Employment Generated, Madhya Pradesh, MGNREGA, 2008–10**



#### Notes

As in the case of women, Figure 11.24 provides the share of SCs and STs in person-days of employment generated under the scheme. In most of the selected districts, the share of STs was higher than that of SCs in the number of employment days generated in the two financial years.

**Figure 11.24: Percentage Share of SC/ST in Days of Employment Generated, Madhya Pradesh, MGNREGA**



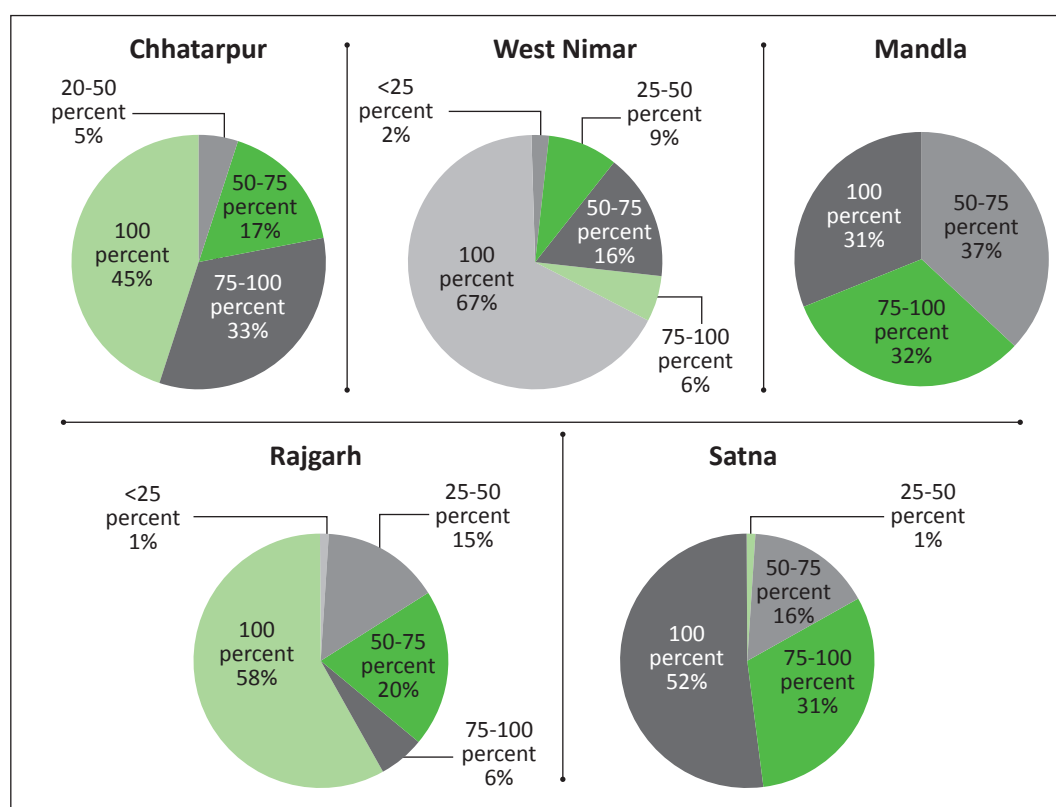
### 11.3.4 Water and Sanitation

The information on water and sanitation related to the Rajiv Gandhi Drinking Water Mission is available from the website (<http://indiawater.gov.in/imisweb/>).

The IMIS of the Department of Drinking Water and Sanitation (DDWS) provides useful information regarding its coverage of the population. Information is provided for each district describing the number of target habitations and the number of habitations with population coverage by drinking water supply. The information is converted to generate the percentage of habitations having coverage with drinking water supply for varying levels of population within each of the habitations.

Figure 11.25 provides the analysis of the data with the percentage of habitations (villages) with varying levels of population covered by drinking water supply in selected districts of Madhya Pradesh as on April 1, 2010.

**Figure 11.25: Percentage of Habitations with Population Coverage of Drinking Water Supply, as on April 1, 2010**



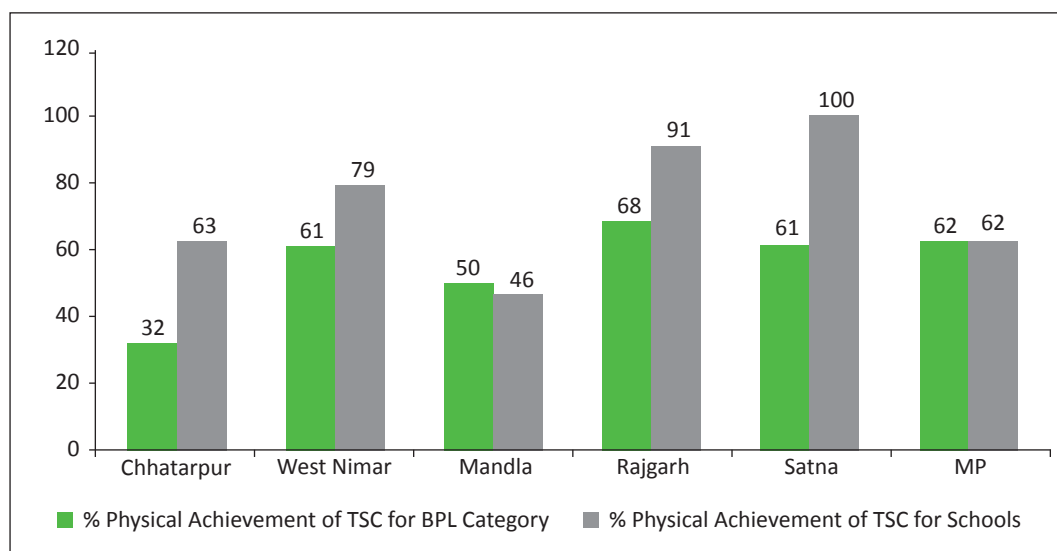
Source: <http://indiawater.gov.in/imisweb/>

Only 31 per cent of the habitations in Mandla District had complete coverage with drinking water supply, while in other districts it ranged from 45 to 67 per cent. On the other hand, 37 per cent of the habitations in Mandla District had provision of drinking water supply for about 50 to 75 per cent of their populations living in these habitations. The analysis indicates that majority of the habitations in the selected districts of Madhya Pradesh had provisions of water supply for large population segments residing within the habitation. The performance of the total sanitation campaign (TSC) can also be judged from the information available from the DDWS' IMIS. Figure 11.26 presents the physical achievement of the TSC components in percentage terms both for the below poverty line (BPL) category as well as

#### Notes

for schools. The percentage of physical achievement under the TSC for the BPL category was only 32 per cent in Chhatarpur, while in other selected districts; it ranged between 50 and 68 per cent. The percentage of physical achievement of the TSC component for schools was the lowest in Mandla District at 46 per cent, while some districts such as Satna (100%) and Rajgarh (91%) showed better performance. The rest of the districts ranged between 62 and 79 per cent in terms of the physical achievement of the school component of TSC.

**Figure 11.26: Performance of TSC Component (%) as on July 30, 2010 in Selected Districts of Madhya Pradesh**



Source: IMIS, Dept. of Drinking Water and Sanitation, Gol.

#### Notes

## 11.4 Summary

The terms 'monitoring' and 'evaluation' are two distinct concepts. The purpose of these activities is also different. However, they help us learn about project implementation and also help in answering questions on efficiency, effectiveness and the impact of project activities. An M&E system is an essential and integral part of the programme development and implementation process. It has multiple functions that include the measurement of performance on a regular basis at stipulated time intervals, identification of mid-course corrective actions needed to achieve programme objectives, plays an advocacy role for the benefit of others working in the area, and helps the judicious allocation of resources. It is important to design the M&E system along with the programme/project development process. This enables the development of an appropriate work-plan with time-lines and responsibilities, indicators that have to be monitored and evaluated, and the frequency of conducting M&E. Synergy between programme management and the M&E unit right from the formulation stage will result in obtaining a better perspective of the programme.

Monitoring is concerned with regular tracking of the activities to see whether they are functioning as per plan or not, while evaluation aims to assess programme performance and is usually conducted either mid-course or at the end of the project.

Measurable indicators form the basis of M&E. These could be quantitative or qualitative. Quantitative indicators should be specific, measurable, achievable, relevant and time-bound. These are known as SMART indicators. There is a hierarchy of indicators. The

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lower level indicators are called input or process indicators, the next level are the output indicators followed by outcome and impact indicators. This hierarchy is determined by the logical sequencing of indicators. There are two approaches describing the hierarchy of the indicators, LFA and RBM, as mentioned earlier in the discussion. In the second approach, all higher level indicators, viz. output, outcome and impact indicators are termed as 'results'.

There are different evaluation designs that could be employed for the evaluation of any project/programme; however, the choice of design depends upon the purpose. Monitoring is based on the data generated by the programme activities on a day-to-day basis. Most programmes have a well-defined MIS and the information could be used to derive meaningful indicators to judge the progress of the Programme.

## APPENDIX

### Critical Indicators from HMIS under NRHM

| S. No.                                   | Key Indicator                                                         | Numerator<br>(with HMIS format reference)                                                           | Denominator<br>(with HMIS format reference)                                             | Computation of the Indicator                                                                                              | Sources of Information                     | Frequency |
|------------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|-----------|
| <b>1. MATERNAL HEALTH</b>                |                                                                       |                                                                                                     |                                                                                         |                                                                                                                           |                                            |           |
| <b>Indicators on Service Coverage</b>    |                                                                       |                                                                                                     |                                                                                         |                                                                                                                           |                                            |           |
| 1.1                                      | Percentage of expected pregnancies registered as ANC cases            | Number of new registered cases of ANC<br>[NRHM/GOI/3/M: M1 1.1]                                     | Estimated number of pregnant women (based on projected population and crude birth rate) | Number of new cases registered for ANC<br>----- X 100<br>Expected number of pregnant women                                | HMIS, population projection report and SRS | Quarterly |
| 1.2                                      | Percentage of expected deliveries conducted in an institution         | Number of deliveries conducted in an institution (public + private)<br>[NRHM/GOI/3/M: M2 2.1 & 2.2] | Total number of expected live births                                                    | Number of institutional (public + private) deliveries<br>----- X 100<br>Expected number of live births                    | HMIS, population projection report and SRS | Quarterly |
| <b>Indicators on Quality of Services</b> |                                                                       |                                                                                                     |                                                                                         |                                                                                                                           |                                            |           |
| 1.3                                      | Percentage of ANC registered in the first trimester                   | Number of new cases of ANC which are registered in first trimester<br>[NRHM/GOI/3/M: M1 1.1.1]      | Total number of new cases registered for ANC<br>[NRHM/GOI/3/M: M1 1.1]                  | Number of new cases of ANC registered in 1 <sup>st</sup> trimester<br>----- X 100<br>Total number of ANC cases registered | HMIS                                       | Monthly   |
| 1.4                                      | Percentage of deliveries conducted by skilled birth attendants (SBAs) | Number of deliveries (at institution or home) conducted by SBAs<br>[NRHM/GOI/3/M: M2 2.1.1 & 2.2]   | Total number of deliveries reported<br>[NRHM/GOI/3/M: M2 2.1 & 2.2]                     | Number of deliveries (at inst. or home) conducted by SBAs<br>----- X 100<br>Total number of reported deliveries           | HMIS                                       | Monthly   |

| S. No.                                             | Key Indicator                                                                                                                                                                                                       | Numerator<br>(with HMIS format reference)                                                                                     | Denominator<br>(with HMIS format reference)                                | Computation of the Indicator                                                                                                                                     | Sources of Information                     | Frequency |
|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|-----------|
| 1.5                                                | Deliveries with obstetric complications attended at institution as percentage of expected births<br><i>(UN Process Indicator is: proportion of expected births in EmOC facility—the minimum expected level-15%)</i> | Number of complicated delivery cases attended at institution (public + private facilities)<br>[NRHM/GOI/3/M: M5 5.1 & 5.2]    | Total number of expected live births                                       | Number of cases of pregnant women with obstetric complications attended at institution (public + private)<br>----- X 100<br>Total number of expected live births | HMIS, population projection report and SRS | Yearly    |
| 1.6                                                | Percentage of institutional delivery in public sector discharged under 48 hours of birth                                                                                                                            | Number of institutional deliveries in public institution discharged under 48 hours after delivery<br>[NRHM/GOI/3/M: M2 2.2.1] | Total number of deliveries in public institution<br>[NRHM/GOI/3/M: M2 2.2] | Number of deliveries in public institution discharged under 48 hours of birth<br>----- X 100<br>Total number of institutional deliveries in public sector        | HMIS                                       | Monthly   |
| <b>Indicators on Infrastructure and Facilities</b> |                                                                                                                                                                                                                     |                                                                                                                               |                                                                            |                                                                                                                                                                  |                                            |           |
| 1.7                                                | Percentage of 24x7 PHCs conducting at least 10 deliveries                                                                                                                                                           | Number of 24x7 PHCs reporting at least 10 deliveries conducted during reporting month<br>[NRHM/PHC/3/M: M2-8 & M14-54]        | Total number of 24x7 PHCs<br>[NRHM/GOI/3/M: M14-14.02]                     | Number of 24x7 PHCs reporting at least 10 deliveries in the reporting month<br>----- X 100<br>Total number of 24x7 PHCs                                          | HMIS                                       | Monthly   |

| S. No.                                          | Key Indicator                                                                                    | Numerator<br>(with HMIS format reference)                                                                                | Denominator<br>(with HMIS format reference)                                               | Computation of the Indicator                                                                                                                           | Sources of Information | Frequency |
|-------------------------------------------------|--------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-----------|
| 1.8                                             | Percentage of FRUs conducting at least 10 C-section deliveries in a quarter                      | Number of FRUs reporting at least 10 C-section deliveries during the reporting quarter<br>[NRHM/DH-SDH-CHC/3/M: M3-9]    | Total Number of FRUs<br>[NRHM/DH-SDH-CHC/3/M: M14-52]                                     | Number of FRUs conducting at least 10 C-section deliveries in the reporting quarter<br>----- X 100<br>Total number of FRUs                             | HMIS                   | Quarterly |
| 1.9                                             | Percentage of DH/SDH/CHC (FRU) having either blood bank or blood storage facility                | Total number of blood banks/blood storage centres in the public sector<br>[NRHM/SG/1/A: A15-15.1 & A16-16.1]             | Total number of DH/SDH/CHC (FRU)<br>[NRHM/SG/1/A: A8, A9 & A10]                           | Total number of blood banks/storage centres<br>----- X 100<br>Total number DH/SDH/CHC (FRU)                                                            | HMIS & PIP             | Yearly    |
| <b>Indicators on Human Resource Development</b> |                                                                                                  |                                                                                                                          |                                                                                           |                                                                                                                                                        |                        |           |
| 1.10                                            | Cumulative percentage of GNM/ANM/LHV trained as SBA                                              | Total number of GNM/ANM/LHV trained as SBA till end of quarter<br>[NRHM/DHQ/2Q: Q4 4.1]                                  | Total number of GNM/ANM/LHV in position<br>[NRHM/DHQ/1A: A16-16.12, A18-18.1b & 18.1c]    | Number of GNM/ANM/LHV trained as SBA till date<br>----- X 100<br>Total number of GNM/ANM/LHV in position                                               | HMIS                   | Quarterly |
| 1.11                                            | Cumulative percentage of doctors trained in use of life-saving anaesthesia for EmOC against plan | Total number of doctors trained in life-saving use of anaesthesia for EmOC till end of quarter<br>[NRHM/GOI/2Q: Q3-3.01] | Total number of doctors planned to be trained in EmOC<br>[NRHM/GOI/1/A: A27 & A28-28.1.1] | Number of doctors trained in use of life-saving anaesthesia for EmOC till date<br>----- X 100<br>Total number of doctors planned to be trained in EmOC | HMIS & PIP             | Quarterly |

| S. No. | Key Indicator                                                                               | Numerator<br>(with HMIS format reference)                                                                                            | Denominator<br>(with HMIS format reference)                                                                                              | Computation of the Indicator                                                                                                                                                                                  | Sources of Information | Frequency |
|--------|---------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-----------|
| 1.12   | Cumulative percentage of doctors trained in obstetric care & management including C-section | Total number of doctors trained in obstetric care & management including C-section till end of quarter<br><br>[NRHM/GOI/2Q: Q3 3.02] | Total number of doctors planned to be trained in obstetric care & management including C-section<br><br>[NRHM/GOI/1/A: A27 & A28-28.1.1] | Number of doctors trained in obstetric care & management including C-section till date<br>----- X 100<br><br>Total number of doctors planned to be trained in obstetric care & management including C-section | HMIS & PIP             | Quarterly |
| 1.13   | Percentage of gynaecologists in position against vacancies                                  | Total number of gynaecologists in position<br><br>[NRHM/DHQ/1/A: A16-16.03 – in position]                                            | Total number of sanctioned positions for gynaecologists<br>[NRHM/DHQ/1/A: A16-16.03 – sanctioned]                                        | Number of gynaecologists in position<br>----- X 100<br><br>Total number of sanctioned positions for gynaecologists                                                                                            | HMIS                   | Yearly    |

| S. No                                 | Key Indicator                                     | Numerator<br>(with HMIS format reference)                                           | Denominator<br>(with HMIS format reference)                                          | Computation of the Indicator                                                                                             | Sources of Information              | Frequency |
|---------------------------------------|---------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-----------|
| <b>2. CHILD HEALTH</b>                |                                                   |                                                                                     |                                                                                      |                                                                                                                          |                                     |           |
| <b>Indicators on Service Coverage</b> |                                                   |                                                                                     |                                                                                      |                                                                                                                          |                                     |           |
| 2.1                                   | Percentage of 12–23 month infants fully immunised | Total number of 12–23 month infants fully immunised<br><br>[NRHM/GOI/3/M: M10-10.3] | Estimated number of 12–23 month infants (based on projected population by age group) | Number of 12–23 month infants fully immunised<br>----- X 100<br><br>Estimated number of infants in 12–23 month age-group | HMIS & population projection report | Yearly    |

| S. No                                    | Key Indicator                                                                           | Numerator<br>(with HMIS format reference)                                                               | Denominator<br>(with HMIS format reference)                                                  | Computation of the Indicator                                                                                                               | Sources of Information | Frequency |
|------------------------------------------|-----------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-----------|
| 2.2                                      | Ratio of BCG vaccination to measles vaccination                                         | Number of 0–11 month infants who received BCG vaccination<br>[NRHM/GOI/3/M: M10-10.1.12]                | Number of 0–11 month infants who received measles vaccination<br>[NRHM/GOI/3/M: M10-10.1.01] | Number of 0–11 month infants who received BCG vaccination<br>----- X 100<br>Number of 0–11 month infants who received measles vaccination  | HMIS                   | Monthly   |
| 2.3                                      | Ratio of DPT3 vaccination to measles vaccination                                        | Number of 0–11 month infants who received DPT3 vaccination<br>[NRHM/GOI/3/M: M10-10.1.12]               | Number of 0–11 month infants who received measles vaccination<br>[NRHM/GOI/3/M: M10-10.1.04] | Number of 0–11 month infants who received DPT3 vaccination<br>----- X 100<br>Number of 0–11 month infants who received measles vaccination | HMIS                   | Monthly   |
| 2.4                                      | Percentage of <i>Anganwadi</i> Centres (AWCs) reported to have conducted VHNDs          | Number of AWCs reported to have conducted VHNDs<br>[NRHM/GOI/3/M: M14-14.03]                            | Total Number of AWCs<br>[NRHM/GOI/2/Q: Q2-2.1]                                               | Number of AWCs reported to have conducted VHNDs<br>----- X 100<br>Total number of AWCs                                                     | HMIS                   | Monthly   |
| <b>Indicators on Quality of Services</b> |                                                                                         |                                                                                                         |                                                                                              |                                                                                                                                            |                        |           |
| 2.5                                      | Percentage of immunised infants who had any adverse event following immunisation (AEFI) | Number of infants who had an adverse event following immunisation<br>[NRHM/GOI/3/M: M10-10.3.5a, b & c] | Total number of infants given any vaccine<br>[NRHM/GOI/3/M: M10-10.1]                        | Number of infants who had an adverse event following immunisation<br>----- X 100<br>Number of infants who received any vaccination         | HMIS                   | Monthly   |

| S. No                                           | Key Indicator                                                                                                | Numerator<br>(with HMIS format reference)                                                 | Denominator<br>(with HMIS format reference)                                                                                                                                      | Computation of the Indicator                                                                                                                                                                         | Sources of Information | Frequency |
|-------------------------------------------------|--------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-----------|
| <b>Indicators on Human Resource Development</b> |                                                                                                              |                                                                                           |                                                                                                                                                                                  |                                                                                                                                                                                                      |                        |           |
| 2.6                                             | Cumulative percentage of doctors trained in integrated management of newborn and childhood illnesses (IMNCI) | Number of doctors trained in IMNCI till the end of the quarter<br>[NRHM/DHQ/2/Q: Q3-3.10] | Total number of medical doctors at CHC (paediatricians, general physicians & general duty medical officers) and PHC level<br>[NRHM/DHQ/1/A: A16-16.04, 16.05 & 16.08, A17-17.1a] | Number of doctors trained in IMNCI till quarter end<br>----- X 100<br>Total number of doctors functioning at CHCs (paediatricians, general physicians and general duty medical officers) and at PHCs | HMIS                   | Quarterly |
| 2.7                                             | Cumulative percentage of doctors trained in sick newborn care unit (SNCU)                                    | Number of doctors trained in SNCU till the end of the quarter<br>[NRHM/DHQ/2/Q: Q3-3.11]  | Total number of doctors at CHC (paediatricians, general physicians & general duty medical officers)<br>[NRHM/DHQ/1/A: A16-16.04, 16.05 & 16.08]                                  | Number of doctors trained in SNCU till quarter end<br>----- X 100<br>Total number of doctors functioning at CHCs (paediatricians, general physicians and general duty medical officers)              | HMIS                   | Quarterly |

| S. No                          | Key Indicator                                                                                           | Numerator<br>(with HMIS format reference)                                                                                        | Denominator<br>(with HMIS format reference)                                                              | Computation of the Indicator                                                                                                                                  | Sources of Information | Frequency |
|--------------------------------|---------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-----------|
| 2.8                            | Cumulative percentage of GNM/ANM/LHV trained in IMNCI                                                   | Number of GNM/ANM/LHV trained in IMNCI till the end of the quarter<br>[NRHM/DHQ/2/Q: Q4-4.04]                                    | Total number of GNM/ANM/LHV at CHC and PHC level<br>[NRHM/DHQ/1/A: A17-17.2 a, 17.3 & A18-18.1a & 18.1b] | Number of GNM/ANM/LHV trained in IMNCI till quarter end<br>----- X 100<br>Total number of GNM/ANM/LHV functioning at CHCs and PHCs                            | HMIS                   | Quarterly |
| 2.9                            | Cumulative percentage of GNM/ANM/LHV trained in home-based newborn care and facility-based newborn care | Number of GNM/ANM/LHV trained in home/ facility-based newborn care till the end of the quarter<br>[NRHM/DHQ/2/Q: Q4-4.05 & 4.06] | Total number of GNM/ANM/LHV at CHC and PHC level<br>[NRHM/DHQ/1/A: A17-17.2 a, 17.3 & A18-18.1a & 18.1b] | Number of GNM/ANM/LHV trained in home/facility-based newborn care till quarter end<br>----- X 100<br>Total number of GNM/ANM/LHV functioning at CHCs and PHCs | HMIS                   | Quarterly |
| <b>Indicators on Logistics</b> |                                                                                                         |                                                                                                                                  |                                                                                                          |                                                                                                                                                               |                        |           |
| 2.10                           | Percentage of districts that have reported no stock-out situation for measles vaccines                  | Number of districts reported no stock-out situation for measles vaccine<br>[NRHM/DHQ/3/M: M1-1.6]                                | Total number of districts<br>[NRHM administrative records]                                               | Number of districts reported no stock-out for measles vaccine<br>----- X 100<br>Total number of districts                                                     | HMIS, NRHM records     | Monthly   |

| S. No                                    | Key Indicator                                                | Numerator<br>(with HMIS format reference)                                                                                                 | Denominator<br>(with HMIS format reference)                                                        | Computation of the Indicator                                                                                                           | Sources of Information             | Frequency |
|------------------------------------------|--------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|-----------|
| <b>3. FAMILY PLANNING</b>                |                                                              |                                                                                                                                           |                                                                                                    |                                                                                                                                        |                                    |           |
| <b>Indicators on Service Coverage</b>    |                                                              |                                                                                                                                           |                                                                                                    |                                                                                                                                        |                                    |           |
| 3.1                                      | NSV/conventional vasectomy as percentage of eligible couples | Number of NSV/conventional vasectomy conducted (at public & private facilities)<br><br>[NRHM/GOI/3M: M9-9.1.1 & 9.1.2]                    | Estimated number of eligible couples                                                               | Number of NSV/conventional vasectomy conducted (at public & private facilities)<br>----- X 100<br>Estimated number of eligible couples | HMIS, population projection report | Yearly    |
| 3.2                                      | Female sterilisation as percentage of eligible couples       | Number of female sterilisations conducted (at public & private facilities)<br>[NRHM/GOI/3M: M9-9.2.1, 9.2.2; 9.3.1, 9.3.2; 9.4.1 & 9.4.2] | Estimated number of eligible couples                                                               | Number of female sterilisations conducted (at public & private facilities)<br>----- X 100<br>Estimated number of eligible couples      | HMIS, population projection report | Yearly    |
| 3.3                                      | IUD insertions as percentage of eligible couples             | Number of IUD insertions (at public and private facilities)<br>[NRHM/GOI/3/ M: M9-9.5.1 & 9.5.2]                                          | Estimated number of eligible couples                                                               | Number of IUD insertions (at public & private facilities)<br>----- X 100<br>Estimated number of eligible couples                       | HMIS, population projection report | Yearly    |
| <b>Indicators on Quality of Services</b> |                                                              |                                                                                                                                           |                                                                                                    |                                                                                                                                        |                                    |           |
| 3.4                                      | IUD removals as percentage of number of IUD insertions       | Number of IUD removals<br><br>[NRHM/GOI/3/ M: M9-9.06]                                                                                    | Number of IUD insertions at public and private facilities<br><br>[NRHM/GOI/3/ M: M9-9.5.1 & 9.5.2] | Number of IUD removals<br>----- X 100<br>Number of IUD insertions (at public & private facilities)                                     | HMIS                               | Monthly   |

| S. No                                              | Key Indicator                                                                                            | Numerator<br>(with HMIS format reference)                                                                                                                | Denominator<br>(with HMIS format reference)                                                                                              | Computation of the Indicator                                                                                                              | Sources of Information | Frequency |
|----------------------------------------------------|----------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-----------|
| 3.5                                                | Percentage of cases that developed complications following sterilisations performed in public facilities | Number of cases of sterilisation-related complications<br>[NRHM/GOI/3/M:<br>M9-9.11.1a & b]                                                              | Total number of sterilisations performed during the quarter in public facilities<br>[NRHM/GOI/3/M:<br>M9-9.1.1.1, 9.2.1.1, 9.3.1, 9.4.1] | Number of cases of sterilisation-related complications<br>----- X 100<br>Sterilisations performed during the quarter in public facilities | HMIS, NRHM records     | Quarterly |
| <b>Indicators on Infrastructure and Facilities</b> |                                                                                                          |                                                                                                                                                          |                                                                                                                                          |                                                                                                                                           |                        |           |
| 3.6                                                | Percentage of DH/SDH/CHC/PHCs providing sterilisation services                                           | Number of public health facilities (DH/SDH/CHC/PHCs) conducting sterilisations<br>[NRHM/PHC/3/<br>M: M9-2.4 – 2.7]<br>[NRHM/DH-SDH-CHC/3/<br>M: M9-2–24] | Total number of DH/SDH/CHC/PHCs<br>[NRHM/SG/1/A:<br>A8, A9, A10 & A11]                                                                   | Total number of public health facilities (DH/SDH/CHC/PHC) conducting sterilisations<br>----- X 100<br>Total number DH/SDH/CHC/PHCs        | HMIS                   | Yearly    |
| 3.7                                                | Percentage of public health facilities (CHCs and PHCs) having doctor trained in NSV                      | Number of CHCs and PHCs having doctor trained in NSV<br>[NRHM/DH-SDH-CHC/3/<br>M: M9-32] +<br>[NRHM/PHC/3/M:<br>M9-34.4]                                 | Total number of Sub-district hospitals, CHCs and PHCs<br>[NRHM/SG/1/A:<br>A9, A10 & A11]                                                 | Total number of CHCs and PHCs having doctor trained in NSV<br>----- X 100<br>Total number of Sub-district hospitals, CHCs and PHCs        | HMIS                   | Quarterly |

| S. No                                           | Key Indicator                                                                          | Numerator<br>(with HMIS format reference)                                                                                                   | Denominator<br>(with HMIS format reference)                                                                                                | Computation of the Indicator                                                                                                                                                                 | Sources of Information | Frequency |
|-------------------------------------------------|----------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-----------|
| <b>Indicators on Human Resource Development</b> |                                                                                        |                                                                                                                                             |                                                                                                                                            |                                                                                                                                                                                              |                        |           |
| 3.8                                             | Cumulative percentage of doctors trained in NSV, mini-lap, laparoscopic sterilisations | Total number of doctors trained in NSV, mini-lap, laparoscopic sterilisations till the end of quarter<br>[NRHM/GOI/2Q: Q3 3.04, 3.05, 3.06] | Total number of doctors functioning at district level and in CHCs and PHCs<br>[NRHM/GOI/1/A: A26-26.1; A27-27.01, 27.03, 27.0; A28-28.1.1] | Number of doctors trained in NSV, mini-lap, laparoscopic sterilisations till the end of quarter<br>----- X 100<br>Total number of doctors functioning at district level and in CHCs and PHCs | HMIS                   | Quarterly |
| 3.9                                             | Cumulative percentage of GNM/ANM/LHV trained in intra-uterine devices (IUD)            | Total number of GNM/ANM/LHV trained in intra-uterine devices till the end of quarter<br>[NRHM/GOI/2Q: Q4 4.2]                               | Total number of GNM/ANM/LHV at CHC and PHC level<br>[NRHM/DHQ/1/A: A17-17.2 a, 17.3 & A18-18.1a & 18.1b]                                   | Number of GNM/ANM/LHV trained in intra-uterine devices till the end of quarter<br>----- X 100<br>Total number of GNM/ANM/LHVs functioning at CHCs and PHCs                                   | HMIS                   | Quarterly |
| <b>Indicators on Logistics</b>                  |                                                                                        |                                                                                                                                             |                                                                                                                                            |                                                                                                                                                                                              |                        |           |
| 3.10                                            | Percentage of districts that have reported no stock-out situation for IUD 380A         | Number of districts reported no stock-out situation of IUD 380A<br>[NRHM/DHQ/3/M: M2-2.1]                                                   | Total number of districts<br>[NRHM administrative records]                                                                                 | Number of districts reported no stock-out of IUD 380A<br>----- X 100<br>Total number of districts                                                                                            | HMIS, NRHM records     | Monthly   |

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