Madhya Pradesh State Action Plan on Climate Change

Integrating Concerns - Converging Possibilities

Housing and Environment Department
Government of Madhya Pradesh

2014

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Disclaimer

While compiling the data and information for preparing this document and while analyzing it in order to facilitate its presentation in the framework suggested by MoEF, GoI, the Housing and Environment Department, Government of MP and SKMCCC, EPCO has drawn upon large number of documents from various sources, which are greatly acknowledged. The base year information and data used in this document varies from sector to sector, however it is not beyond 2011-12. While every care has been taken to ensure accuracy in the information published in this document, any error in their accuracy or interpretation is absolutely unintentional.

SAPCC Preparation:

Technical Team:
Manish Singh, Ranjane Raman, Ashung Ngalung
Rajita Kurup, Sonal Khare, Saransh Bajpai, Prateek Barapatre
Manohar Patil,
Lokendra Thakkar

Administrative Support:
Ashok Khurdelia, Rajneesh Sharma, Ayaz Khan, Shafa S. Mawal, Rajendra Singh

Guidance:
Executive Director, EPCO
Director General, EPCO

Prepared by :
State Knowledge Management Centre on Climate Change (SKMCCC), EPCO,
Department of Housing and Environment,
Government of Madhya Pradesh

Developed as part of the GoMP- UNDP project on Strengthening of GoMP Climate Change Cell

Kailash Vijayvargiya
Minister
Urban Administration &
Development Department and
Housing & Environment Department
Government of Madhya Pradesh

B-10, 74 Bungalows
Swami Dayaynand Marg, Bhopal, MP
Ph. 0755-2441061 (Mantralay)
0755-2578540 (O)
0755-2441161(Resi) Fax 0755 -2441161

Preamble

Climate Change is not only a major environmental concern surrounding the human race the world over but also a significant development challenge. Development and climate change are inextricably linked and together call for immediate attention and urgent action. Climate change impacts all regions, more so developing countries. India is no exception. Climate change has posed a great threat to the socioeconomic stability and environmental integrity of countries like India.

As for other regions of the country, the problem is equally serious for the state of Madhya Pradesh, which is highly vulnerable and sensitive to the impacts of climate change. The State Government of Madhya Pradesh is responsive towards this environmentally sensitive and socioeconomically important issue.

Madhya Pradesh is one of the first States in the country to have prepared a State Action Plan on Climate Change (SAPCC). Understanding what climate change means in the development policy context of Madhya Pradesh is the central theme of the SAPCC. It contains a comprehensive and detailed analysis of the impact of climate change on vital sectors such as agriculture, forest cover, water, energy, urban development, etc. The document, through wide range of consultations and research, has also come up with possible strategies to cope with the impact of climate change through appropriate adaptation and mitigation measures.

The Government of Madhya Pradesh in its vision document has resolved to establish a State Knowledge Management Centre on Climate Change (SKMCCC). Accordingly a Climate Change Knowledge Center has been set up in EPCO. The State Government has also declared EPCO as the State Designated Agency for Climate Change related issues. The objective of SKMCCC is to connect science, policy and practitioners and institutionalize climate change concerns across all sectors in order to ensure a sustainable future for the people of the state.

I appreciate the efforts of SKMCCC, EPCO which are highly praiseworthy. Such initiative is not only the need of the hour for addressing the issue of climate change in our state but also for fulfilling the agenda of sustainable development.

I believe that a climate change proof world is well within our reach only if we put our act together to reconcile the objective of inclusive growth and preservation of the world nature's equilibrium.

(Kailash Vijayvargiya)

अॅन्टोनी डिसा
मुख्य सचिव
Anthony de Sa
Chief Secretary

मध्यप्रदेश शासन
वल्लभ भवन, भोपाल 462004
Government of Madhya Pradesh
Vallabh Bhawan, Bhopal - 462004

Preface

Scientific evidence from multiple resources indicate that, without a doubt, climate is changing. It is also possible to suggest with increased confidence that climate is changing because of increased human activities which have serious repercussions on social and economic development.

While the international community is deliberating on evolving mechanisms for reducing or mitigating GHG emissions, we in Madhya Pradesh are committed to focus on mitigating emissions as well as developing strategies to adapt to the changing climatic conditions in order to pursue the state's development goals in a sustainable manner.

Preparation of State Action Plan on Climate Change and establishing the State Knowledge Management Centre on Climate Change are steps towards enhancing informed decision taking capacity of the state with regard to climate change issues.

The SAPCC has been drafted after wide consultations and participation with stakeholders so as to set up a common but shared agenda for climate change mitigation and adaptation. This State Action Plan is a document which aims to connect between evolving climate science, policies and practices. SAPCC is a dynamic document and would be subjected to periodic review so as to revisit the suggested strategies and constantly refine them.

I commend the efforts of EPCO and Housing and Environment Department for taking the lead in preparing the MP State Action Plan on Climate Change.

5th June, 2014

(Anthony de Sa)
Chief Secretary

S N Mishra, IAS
Principal Secretary

Housing & Environment Department
Government of Madhya Pradesh
Mantralaya, Vallabh Bhawan, Bhopal, MP

Foreword

The world today is faced with the challenge of sustaining economic growth while ensuring environmental conservation. Climate Change is a serious environmental threat to humanity and has implications for sustainable development. Our climate is already changing. Rainy season is shifting and incidence of droughts and floods is increasing. Scientific studies suggest that these incidences are likely to get more frequent and severe in future given the warming of the earth because of the anthropogenic emissions of green house gases.

The state of Madhya Pradesh has reason to be concerned about Climate Change, as we have a large population dependent on agriculture and forests for livelihood. The state's economy is also dependent on natural resources and any adverse impact on these and allied sectors will negate our efforts to alleviate poverty and ensure sustainable livelihood for the population. This is an opportune time to integrate the concerns of Climate Change into our policies and ensure ultimate objective of sustainable development with inclusive growth.

While engaging with national policies and programmes it is important for us to develop well-researched and formulated mitigation and adaptation strategies specific to the state to respond effectively to the possible impacts of Climate Change. To address the changing climatic conditions State Action Plan on Climate Change (SAPCC) has been developed by the Climate Change Cell of EPCO. The Government of MP has also declared EPCO as the State Designated Agency for Climate Change related issues for the state.

The State Action Plan on Climate Change has flagged important issues which require attention. The action plan has highlighted key sectoral concerns and strategies for action in order to lead the way.

The issue of Climate Change is multidisciplinary and demands cross sectoral convergence which requires interdepartmental coordination as well as constructive engagement with all the concerned stakeholders. The Housing & Environment Department would continue to strive to mainstream Climate Change concerns across all the sectors for achieving the objective of sustainable development. I appreciate the efforts of EPCO and professionals of Climate Change Cell for their commendable work.

(S.N. Mishra)

Date : 5th June, 2014

Ajatshatru Shrivastava, IAS
Executive Dirctor

ENVIRONMENTAL PLANNING & COORDINATION ORGANISATION

Acknowledgement

Madhya Pradesh State Action Plan on Climate Change (MP SAPCC) has been drafted through a process that relied on dialogues and discussions with various stakeholders. Most of the insights and ideas were originated and further debated, refined, validated in these intellectual discourses. The concerns and issues presented in this action plan are outcomes of this dialogue process.

A wide range of consultations with policy makers, academicians, grass root leaders, civil society organizations and media were undertaken for SAPCC preparations from initial outline to final draft. Many insights were gained from the first launching workshop held in April 2010 wherein not only the process of SAPCC preparation was validated but also broad contours of the SAPCC were identified. This was followed by a series of consultation workshops with departments and different stakeholders both at Bhopal and at regional levels.

I greatly acknowledge proactive engagements of all the departments for facilitating the sectoral workshops and offering comments on the draft chapters. Special thanks go to all the Vice-Chancellors, Divisional Commissioners and District Collectors who provided local leadership and facilitated the regional consultations. Thankfulness is extended to IIFM for providing the initial draft of the SAPCC which was subjected to various rounds of iterations and subsequent vetting by subject experts. Thanks are also due to Centre for Environment Education for partnering with us in organising all the agro-climatic zone level consultation workshops.

My special thanks to GIZ- India for making the early draft of the Vulnerability Assessment Report available to us as part of the MoEF-GIZ project on Climate Change Adaptation in Rural Areas of India and my gratitude's to all the members of the Project Steering Committee for providing leadership, guidance and encouragement.

I thank the officials of the Ministry of Environment and Forests, GoI, Dr. Subodh K. Sharma, Advisor, Climate Change, Dr. S. Satapathy, Director, Climate Change and all the members of the Expert Committee for their valuable comments and suggestions.

Special thanks to the United Nations Development Programme- India for supporting the project on Strengthening of GoMP Climate Change Cell under which the SAPCC has been developed. Last but not least, I wish to commend and acknowledge the efforts of the officers and staff of the climate change division for their commitment and unstinted efforts to accomplish the task in time with finesse.

(Ajatshatru Shrivastava)

Abbreviations and Acronyms

ACS	Additional Chief Secretary
ACZ	Agroclimatic Zone
AI	Artificial Insemination
BDB	Biodiversity Board
BEE	Bureau of Energy Efficiency
BLY	Bachat Lamp Yojana
BPL	Below Poverty Line
BRTS	Bus Rapid Transport System
CAMPA	Compensatory Afforestation Management and Planning Authority
CC	Climate Change
CCA-RAI	Climate Change Adaptation in Rural Areas of India
CDM	Clean Development Mechanism
CDPs	City Development Plans
CERs	Certified Emission Reductions
CHCs	Community Health Centers
CNG	Compressed Natural Gas
CS	Chief Secretary
DECC	Department of Energy and Climate Change
DoA	Department of Farmer Welfare and Agriculture Development
DoAH	Department of Animal Husbandry
DoC&I	Commerce, Industries and Employment Department
DoE	Department of Energy
DoF	Department of Finance
DoH	Horticulture and Food Processing Department
DoH&E	Department of Housing and Environment
DoHFW	Health and Family Welfare Department
DoT	Department of Transport
DSM	Demand Side Management
ECBC	Energy Conservation and Building Codes
EEA	European Environment Agency
EHV	Extra High Voltage
EPCO	Environmental Planning and Coordination Organisation
ERM	Enterprise Resource Management
FD	Forest Department
FRA	Forest Rights Act
GHG	Green House Gas
GIM	Green India Mission
GIS	Geographic Information System
GoI	Government of India
GoMP	Government of Madhya Pradesh
GoMP CC Cell	Government of Madhya Pradesh Climate Change Cell
GSDP	Gross State Domestic Product
GW	Groundwater
HDI	Human Development Indices
HEPs	Hydro Electric Power
ID	Irrigation Department
IDSP	Integrated Diseases Surveillance Programme
IEC	Information, Education and Communication
IGCC	Integrated Gasification Combined Cycle
IISR	Indian Institute of Sugarcane Research
IMR	Infant Mortality Rate
INCCA	Indian Network of Climate Change Assessment
IPCC	Intergovernmental Panel on Climate Change
ITK	Indigenous Traditional Knowledge
ITS	Intelligent Transport System
IUCN	International Union for Conservation of Nature
JFMCs	Joint Forest Management Committees
JNNURM	Jawaharlal Nehru National Urban Renewal Mission
KMC	Knowledge Management Centre
LPG	Liquified Petroleum Gas
M&E A	Monitoring and Evaluation Agency
MACC	Marginal Abatement Cost Curves
MMR	Maternal Mortality Rate
MNREGA	Mahatma Gandhi National Rural Employment Guarantee Act

MoEF	Ministry of Environment and Forests
MoH	Ministry of Health
MoHFW	Ministry of Health and Family Welfare
MoP	Ministry of Power
MoU	Memorandum of Understanding
MoUD	Ministry of Urban Development
MoWR	Ministry of Water Resources
MPCAs	Medicinal Plant Conservation Areas
MPCDMA	Madhya Pradesh Clean Development Mechanism Agency
MPCST	Madhya Pradesh Council of Science and Technology
MPPGCL	Madhya Pradesh Power Generation Company Limited
MPSAPCC	Madhya Pradesh State Action Plan on Climate Change
MPUVN	Madhya Pradesh Urja Vikas Nigam
MRTS	Mass Rapid Transport System
MSW	Municipal Solid Waste
MDSM	Municipal Demand Side Management
NAPCC	National Action Plan on Climate Change
NBC	National Building Codes
NC	National Communication
NGOs	Non-Governmental Organisations
NMEEE	National Mission on Enhanced Energy Efficiency
NMSA	National Mission on Sustainable Agriculture
NNMR	Neonatal Mortality Rate
NRED	New and Renewable Energy Department
NSM	National Solar Mission
NTFP	Non Timber Forest Product
NVBDCP	National Vector Borne Diseases Control Programme
NVDA	Narmada Valley Development Authority
NWM	National Water Mission
PAs	Protected Areas
PAT	Perform, Achieve and Trade
PHCs	Primary Health Centres
PHED	Public Health Engineering Department
PIC	Project Implementation Committee
PIM	Participatory Irrigation Management
PLF	Plan Load Factors
PMU	Project Monitoring Unit
PPAs	Peoples Protected Areas
PPP	Public Private Partnership
PPR	Peste des Petits Ruminants
PRECIS	Providing Regional Climate for Impact Studies
PRIs	Panchayati Raj Institutions
PS	Principal Secretary
PSC	Project Steering Committee
RAY	Rajiv Awas Yojana
RD	Panchayat and Rural Development Department
RE	Renewable Energy
REDD	Reduced Emission from Degradation and Deforestation
RPO	Renewable Purchase Obligation
S & T	Science and Technology
SGDP	State Gross Domestic Product
SHCs	Sub-health Centers
SKMCCC	State Knowledge Management Center on Climate Change
SPD	State Project Director
SWAT	Soil and Water Assessment Tool
T&D	Transmission and Distribution
TERI	The Energy and Resources Institute
THI	Temperature Humidity Index
TOF	Trees Outside Forests
TWs	Transmission Windows
UADD	Urban Administration and Development Department
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
WRD	Water Resources Department
WSRP	Water Sector Restructuring Project

Executive Summary

Background

It has been conclusively ascertained that significant changes are taking place in physical and biological systems across the globe due to warming of climate [IPCC, 2007, AR4-WKG-II]. Sustainable development, food and economic security of nations which depend more on natural resources are at threat especially when there are limited accesses to financial and technological resources that can help abate the adverse impacts of Climate Change.

In Indian context, climate change is inducing an additional stress on the ecological and socio-economic systems as they are already under tremendous pressures for various reasons including increasing population, rapid unplanned urbanization, industrialization and associated activities. The natural resources based economy makes India, as a Nation, all the more vulnerable in this perspective. The Climate Change concerns of India led to the formulation of National Action Plan on Climate Change [NAPCC, 2008], which outlines eight missions that are adaptive as well as mitigative in nature.

It is imperative that India's diverse physiography and climatic parameters need to be considered carefully while adopting the strategies to tackle the Climate Change concerns. Hence, states of the Indian Union have been advised to devise and implement strategies in view of their respective climate related sensitivities and vulnerabilities. Climate Change provides challenges around both fronts, i.e. rural and urban, for development in the state.

The state is marked with a complex social structure, a predominantly agrarian economy, a difficult and inaccessible terrain, and scattered settlements over vast areas that together pose several formidable problems to service delivery systems. Climate Change has the potential to undermine existing efforts to tackle the mountain of poverty removal in the state and the complex social development problems.

Drought, lack of investment to produce year round cropping, degrading forest resource will all be exacerbated by Climate Change and will pose difficulties in offering better and diversified livelihoods to the masses.

The Madhya Pradesh Context

Madhya Pradesh is considered to be vulnerable with respect to Climate Change. It is a centrally located land locked state with undulating topography and diverse physiography. The State is drained by rain-fed rivers and receives 1160 mm average rainfall annually [MP Resource Atlas 2007, MPCST], though keeps varying across the State. It has rich bio-diversity, vast forest cover and plenty of mineral wealth.

As per the census 2011, total population of Madhya Pradesh stands at 72.6 millions, out of which 52.5 millions are in rural parts which rely on primary sectors like agriculture, horticulture, fishery, livestock, poultry and forestry for livelihoods. These natural resources based livelihood sources are expected to be impacted more than the secondary and other sectors.

Changes in climatic conditions can bring irreversible changes to these systems. Some of the projected climate risks for M.P. are increase in maximum and minimum temperatures, changes in spatial and temporal distribution of monsoon, increase in frequency and intensity of rains, loss of rainy days, extended summers etc. Climate Change will not only affect the natural resources but would also impact upon human health and availability of safe habitats in the times to come. These climate risks indeed have the potential to hamper the sustainable development of the state.

Process of MP SAPCC Preparation

MP SAPCC has been prepared by the GoMP Climate Change Cell (GoMP CC Cell) now developed as full fledged State Knowledge Management Center on Climate Change (SKMCCC) at Environmental Planning and Coordination Organisation (EPCO) functioning

under the Department of Housing & Environment, GoMP with financial assistance from UNDP India under the project "Strengthening Madhya Pradesh Climate Change Cell".

The SAPCC formulation followed a bottom-up approach which involved cross sectoral stakeholder consultations convened at two levels viz sectoral consultations with respective line departments and regional consultations at agro-climatic zone level. The sectors that were reviewed for integrating Climate Change concerns in their respective planning included Agriculture, Horticulture, Animal Husbandry, Fisheries, Water, Forest & Biodiversity, Rural Development, Energy, Renewable Energy, Health, Urban Habitat and Transport, Industries and Environment.

In order to ensure gender balance, special care was taken while devising the strategy for SAPCC. During stakeholder participation and rounds of iterations for refinement, special efforts were made to ensure representation and participation of women.

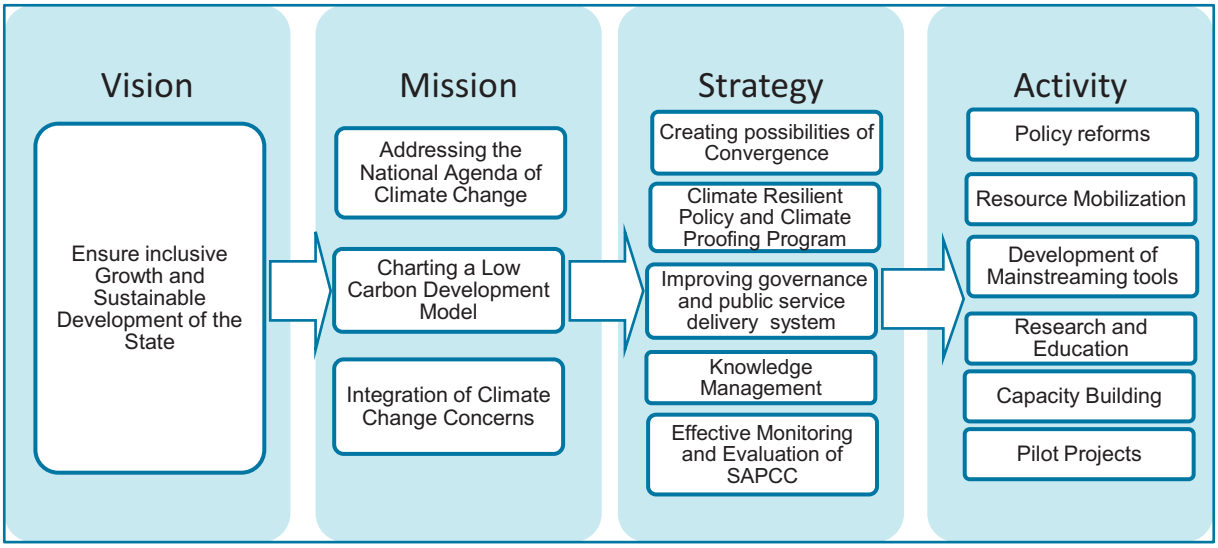
The Guiding Principle of MP SAPCC

The State Action Plan on Climate Change (SAPCC), aims to address the regional concerns and to outline strategies required to develop a climate resilient state. The strategies and recommendations of the SAPCC will, in due course, strengthen the developmental planning process of the state with policy level interventions favouring low carbon growth. Since Vulnerability and Adaptation (V&A) have been underlined as the key concerns for Madhya Pradesh, the focus of SAPCC is on devising appropriate adaptation strategies based on vulnerability assessment and subsequently integrating and mainstreaming into respective policies and programmes. The vision, mission, strategy and activity are summarised in the diagram below.

Key Climate Change Sectoral Strategies

Despite the wealth of its resources and having tremendous potential, Madhya Pradesh faces a number of challenges in reconciling the imperatives of environment and development.

Uncertain climatic conditions, developmental challenges and associated agonies together with reduced adaptive capacities are making Madhya Pradesh highly vulnerable to the impacts of Climate Change. The consultations carried out at various levels provided deep insights into both - the issues and the possible solutions to resolve the issues. Summarised next are the sector-wise identified key concerns and key strategies to address the concerns.



SKMCCC, EPCO

Forests

Madhya Pradesh, with 31% of geographical area as forest land [FSI 2011], is rich in floral and faunal biodiversity. These forests host 9 National Parks, 25 Wildlife Sanctuaries, 2 Biosphere Reserves, 5 Tiger Reserves and also house a large number of villages which are highly dependent on forests for livelihoods of villages.

It is predicted that changing climate may affect the composition and distribution of types of forests of Madhya Pradesh. These changes may also alter the productivity of NTFPs/ fodder/ fuel wood etc which are the basic sources of livelihood for forest dependent communities. Shifts in habitat and search for favourable weather would induce migration of wild animals and may subsequently increase the incidences of man-wild conflicts.

Key Strategies for Forestry Sector

* *Develop Forest Management (Working) Plans based on the different forest types in view of Climate Change*
* *Enhance forest conservation, Afforestation (with special emphasis on Compensatory Afforestation) and Reforestation activities through viable models*
* *Prioritise soil and water conservation measures as part of SFM practices*
* *Reduce over-dependence on forests for energy by alternate energy sources*
* *Strengthen forest fire management mechanism throughout the year*
* *Create corridors for species migration*
* *Support and develop market linkages for forest based livelihood opportunities*
* *Impetus to Climate Change relevant research and development*
* *Study on impacts of Climate Change on MP forests*
* *Types and create awareness*

In terms of phyto bio-diversity, many Alien Invasive Species may expand their spread threatening the existence of indigenous species. Longer dry spells in forested areas may trigger frequent and intense incidences of forest fires.

Increasing temperatures and consequent dry spells may increase desertification in western Madhya Pradesh which may, in turn, result in bio-diversity losses and affect economy of the area.

Uncontrolled grazing, illegal felling and unsustainable practices of fuel wood collection were mentioned as some of the human induced prime reasons for forest degradation.

Water

Madhya Pradesh receives an average annual rainfall of 1160 mm [MP Resource Atlas 2007, MPCST] and is drained by ten large and small rainfed rivers which are major sources of water for the state. Groundwater also contributes to the state's water resources to a greater extent. The annual surface water and groundwater availability are 81.5 lakh ha meters and 35.53 BCM respectively.

The rainfed nature of rivers of Madhya Pradesh has made them highly susceptible to the variations in the distribution and patterns of rainfall. Reduction in the stream run off will have adverse impacts on irrigation and hydro power projects besides reducing the availability of water for all

Key Strategies for Water Sector

* *Develop comprehensive water data base in public domain*
* *Accelerate surface water development activities in the state*
* *Promote recharge of groundwater with special focus on over exploited areas*
* *Plan for efficient water supply systems and management*
* *Encourage water management practices like water auditing, regulated exploration of groundwater, water recycling, etc*
* *Enhance basin level integrated watershed management*
* *Review of existing water storing structures in view of excess precipitation*
* *Restoration of traditional water storing structures as groundwater recharging structures*
* *Impetus to climate change relevant research and development*
* *Capacity building- institutional and personnel to integrate climate change concerns in planning*

the other purposes.

The climate projections for MP indicates increase in intensity of the rains, thus a conscious effort needs to be made to review the technical aspects of the water storing and distributing structures. Many of such structures are very old hence special emphasis should be given on the storing capacity of these structures in order to avert any flood like situation.

Groundwater is also in a critical condition across the State, most affected being the western parts. Though State Water Policy 2003 mentions that groundwater should be explored only for drinking purposes, lack of adherence is often observed. Distribution loss that happens during municipal water supply is another issue which needs to be attended to. Water Pollution is another big concern for the state. Depletion of water resources and deterioration of water quality is big concern for the state.

Agriculture & Allied

About 70% of the rural population of Madhya Pradesh is engaged in primary sector covering agriculture, horticulture, animal husbandry, fisheries and dairy development. This sector contributes about 30% to the State Net Domestic Product. Out of the total number of holdings, 65% holdings belong to small and marginal farmers occupying only 26% of cultivable land [Agriculture Census 2000-01]. Horticultural crops occupy nearly 3.25% of the total cropped area of the state [XI Five Year Plan, MP].

Agriculture has a two way relationship with Climate Change. One, where the activities related to agriculture adds Green House Gases (GHG's) in the atmosphere and other where climatic variations impact the agriculture sector tremendously. Burning of agricultural residues in fields and excessive use of energy intensive water pumps leads to emissions while traditional method of paddy cultivation may result in methane emissions adding to Green House Gases (GHGs) in the atmosphere and other where climatic variations impact the agriculture sector tremendously.

Extreme events like frost, excess rain, and high temperatures have resulted in huge losses in productivity. Shifting of rainfall pattern affects cropping patterns. Mono-cropping reduces the crop diversity and adversely affects the soil health.

The horticultural crops are also sensitive towards changing climate. Availability of water is a major constraint for horticultural crops, particularly in drought like situations. Storms and hail storms induce damages in horticultural crops during flowering and fruit bearing stage. Rise in temperature can lead to pest emergence, which may make plants tender towards the insects' attacks. Series of new diseases have also been observed in fruit plants due to change in climatic parameters. Heavy rains also impose physical damage on trees and fruit plants.

Key Strategies for Agriculture Sector

- *Promote Soil and Water Conservation technologies*
- *Promote dry land agriculture and horticulture*
- *Plan for cropping systems suitable for each agro-climatic zone*
- *Introduce policies for managing climate risks for a sustainable productivity*
- *Enhancing dissemination of new and appropriate technologies and strengthening research*
- *Creation of Agriculture Information management including information on climate forecast*
- *Additional impetus to mechanization and accessibility to markets*
- *Creation of rural business hubs for diversification of livelihoods*
- *Capacity building of communities on sustainable harvesting, water management, use of fertilisers, sustainable agri-residue management etc*
- *Promotion to Climate Change relevant research and development*
- *Capacity building to integrate Climate Change concerns*

Animal husbandry is an important sector in context of Climate Change. MP has about 14% of total cattle population of the country. As of cattle census 2007, the total number of livestock in the

State stood at 40.6 million. Population of poultry birds stood at in excess of 7 millions. Fishery is one of the mainstays of livelihood of economically weaker sections in the State. About 3.96 Lakh Hectare water areas have been brought under fish culture.

Animals are equally susceptible to the impacts of Climate Change as human beings. Increased vector borne diseases, reduced productivity, impacts of heat and water stress etc are the threats to health of livestock. Challenge lies in breaking the beliefs and training the communities about the benefits of indigenous species of cattle, their housing requirements based on the changing climatic conditions, and most importantly feed and fodder in order to maintaining their health and productivity.

Fishery, livelihood of economically weaker sections, is also threatened because of Climate Change. Increasing temperatures will not only impact the availability of fish seeds but would also adversely affect the entire fish productivity. It will also affect the suitability of fish species to particular temperatures of water. Growth retardation of inland fish species is predicted. It may also bring in a shift in the breeding period of fishes.

Key Strategies for Livestock & Fisheries Sector

- *Ensure availability of adequate feed, fodder and water for livestock in drought and flood conditions*
- *Enhance capacity for disease surveillance, forecast, monitoring and management*
- *Ensure adequate housing and dedicated water bodies for livestock to overcome heat stress*
- *Promote rearing of indigenous species that can adapt to changing climatic conditions*
- *Promote use of livestock waste for use as organic manure*
- *Create infrastructure f or processing, storage and transport of livestock products*
- *Develop best practices of fish rearing suitable for different agro-climatic zones of MP*
- *Creating fish seed banks for easy availability to fishermen*
- *Impetus to Climate Change relevant research and development*
- *Capacity building-institutional and personnel to integrate Climate Change concerns in planning*

Health

According to the United Nations Industrial Development Organization (UNIDO), Climate Change is likely to have a greater impact on India compared to other countries similarly positioned, on account of the unique combination of its geography, diverse population characteristics and extremely high carbon-based energy dependence. Madhya Pradesh is among the 6 states in India which contributes to 65% of malarial incidences. 30 districts of MP are under top 100 districts which have very high Infant Mortality Ratio [Census 2011].The situation of health of the state's population may be aggravated by the changing climatic conditions.

Key Strategies for Health Sector

- *Develop disease profile of communities*
- *Development of weather based early warning systems*
- *Upscaling of disaster management preparedness to check epidemic outbreaks*
- *Early case detection and quick control with focus on areas where coverage is low or has not reached*
- *Strengthening supportive systems for environment management*
- *Public awareness on Health and Climate Change*
- *Strengthening supply chain management and developing robust infrastructure for drugs storage*
- *Stringent laws to implement bio-medical waste management rules*
- *Impetus to Climate Change relevant research and development*
- *Capacity building of health personnel and institutions to integrate Climate Change concerns in planning and actions*

The Health Department is already undertaking mapping of diseases in the state. Integrated Diseases Surveillance Programme (IDSP) is being

implemented by the department to address health concerns. Under malaria prevention programmes run by the state, monovalent rapid diagnostic kits are promoted in the remote villages which can diagnose only P. falciparum infections. Bivalent kits are also available but their application is limited for lack of trained medical professionals in these villages. Besides the vector borne diseases that could expand its occurrences, other infections that are related to varying temperature and humidity indices are also imminent threats to human health.

Cases of multiple drug resistant diseases are increasing in view of loss of drug potency due to its storage under non-appropriate conditions. On time availability of drugs poses challenge. Increased heat & cold waves affects the already vulnerable section of the society. With increasing pollution increase in respiratory diseases and allergies is also predicted to increase.

Urban Administration & Transport

Madhya Pradesh has a large and growing urban population. Urbanization in Madhya Pradesh is expected to intensify over the coming decades.

Key Strategies for Urban Sector

- *Ensure energy efficiency in residential and commercial sectors*
- *Develop Urban Storm Water Management Mechanism*
- *Efficient solid waste and waste water management*
- *Sustainable urban transport and enhanced rail connectivity*
- *Regulated and planned urban expansion*
- *Efficient urban water supply system*
- *Monitored and regulated groundwater exploration*
- *Promote sustainable in frastructure and wise water practices*
- *Public awareness about Climate Change induced health risks*
- *Need for Climate Change relevant research and development*
- *Capacity building to integrate Climate Change concerns in city planning*

The urban population is expected to have 34% share of the state's population by the year 2026 [Chetan Vaidya Report, DEA, GoI 2009]. In the national scenario, transportation accounts for 8% of the GHG emissions in which road transport accounts for 94.5% [INCCA Report, India].

There is about 74,000 Kms road network across the state in the form of national highways, state highways, district roads and village roads. Number of registered vehicles per thousand population of MP is 80 as compared to the National level of 68 [Transportation Statistics 2008-09], reflecting over dependency on privately owned vehicles in the absence of sufficient and efficient public transportation system.

Urban areas, residential as well as commercial, consume a large share of power being generated in the state. With the growing size of cities, management of waste has become a major challenge. There is tremendous scope of improvement in the present practice of solid waste management. Loss of urban green cover is enhancing the effects of increasing urban temperatures and is leading to the generation of Urban Heat Islands.

Climate Change poses a threat of increased incidences of urban malaria, dengue etc as cities provide ideal breeding sites for these vectors sometimes in terms of unhealthy sanitation in the urban slums, accumulated sewage water, or at times, by providing micro environments through air conditioners and air coolers.

Numbers of registered vehicles per thousand population of MP is more than the national average. Road transport in MP is highly fuel inefficient. Local conveyances for mass transportation are not up to the mark. There is over-dependence on privately owned vehicles.

Energy & Renewable Energy

MP is a fast developing state and thus there is tremendous need for energy. About 58% of the energy generated in the State is from thermal sources and only 42% from renewable sources, mainly hydro electricity though there is huge

potential for other renewable energy generation. Total installed capacity of renewable energy is 2.5% of the total installed capacity. The State's contribution to total power generation, at present, is 4537.92 MW. In the Annual Plan 2012-13, the state is on way to get rid of the power shortage by setting up new power generation projects to meet the ever increasing power demand, expand and strengthen transmission system.

Key Strategies for Energy Sector

- *Enhance efficiency in generation of power*
- *Exploration and feasibility assessment of new technologies using conventional fuel*
- *Structure green tariff for incentivising the production of clean energy*
- *Improve DSM in Street lighting, public buildings and water pumping*
- *Improved mechanism for use of energy efficient pumps for irrigation*
- *Campaign for implementation of ECBC Codes*
- *Explore and tap the potential that exist in CDM domain*

Plant Load Factors (PLF) is serious concerns for the Thermal power plants in M P because they are ageing plants with old technology. Poor quality of coal, lack of sufficient fund to upgrade the plant adds to the problems. Existing T & D losses and demand for more energy in every sector will increase the GHG emissions from energy sector. The focus should be on improving the technologies and to move towards energy efficiency.

Industries

Industries are the major establishments that significantly contribute to GHGs. As per the national greenhouse inventory, direct emissions from industrial sources accounted for nearly 21% of the total CO_2 emissions from the country [INCCA, 2007]. In Madhya Pradesh, most of the industries are mining based especially because of its abundant mineral wealth like limestone, coal, bauxite, iron ore, silica etc. Besides these there are manufacturing facilities of public sector undertakings like BHEL, National Fertilisers Ltd., Ordinance Factory, and Currency Printing Press etc. Till January 2011, the State has 733 large and medium industrial units providing livelihoods to about 1.75 lakh people.

Key Strategies for Industries Sector

- *Review of MP Industrial Policy 2004 to address CC concerns*
- *Implementation of Perform, Achieve and Trade Mechanism*
- *Avail opportunities of carbon market for mitigation*
- *Integrated water management plan for industrial clusters*
- *Effective industrial waste management and pollution control*
- *Build Industry Network on the themes of Reuse and Recycle.*
- *Impetus to Climate Change relevant research and development*
- *Capacity building of personnel and institutions to integrate Climate Change concerns in planning and actions*

Obsolete and inefficient technology still used in many industries lead to high energy consumption. Industrial business model economy is of prime importance while society and environment have a little say in deciding the activity. Effluents of untreated waste in nearby areas and non-compliance of environmental standards by many industries are a major concern. Diversion of fertile land for industrial use, and employment generation through industrialization for weaker section of society will be more vulnerable due to Climate Change.

Panchayat & Rural Development

Madhya Pradesh is predominantly a rural state with 54,903 villages [Census 2011]. Livelihoods of these people are dependent on agriculture and natural resources. The poor are the most vulnerable to Climate Change as they have the least resources to cope with these changes. Rural Development is largely a cross cutting sector. The sector propels the agenda of convergence and integration of Climate Change concerns in rural areas of Madhya Pradesh. There are many State

Key Strategies for Rural Development Sector

* *Evaluation of existing rural development programmes in climate change context to make them climate proof*
* *Training and capacity building of rural communities on aspects of soil & water conservation, sustainable harvesting and animal husbandry practices, need of fodder cultivation etc*
* *Climate Change concerns to be institutionalised in the annual plans of Panchayat*
* *Credit availability for rural infrastructure development and insurance against climate induced vulnerabilities*
* *Exploring possibilities of making the villages carbon neutral*
* *Impetus to climate change relevant research and development*

Government initiated projects and programmes, under implementation, in the state which aims at the welfare of the rural population. It is now time to review them in order to make these schemes climate proof and the rural population resilient.

The prominent concern for the sector is lack of education and information among communities about the risks posed by Climate Change and the ways to address them. Dependence on natural resources is the way of life but unsustainable practices of harvesting, irrigation, elimination of crop residue, forest degradation, deteriorating soil and water quality are augmenting the problems besides other impacts of Climate Change.

The shifting cropping patterns, changed distribution of rains, longer dry spells, changing vegetation types etc are the troubles offered by Climate Change to the rural communities. Adding on to it are the health hazards caused due to Climate Change like tribal malaria, dengue, chikungunya, heat stress, jaundice, cholera etc.

Distress migration, in view of repeated crop failures and lack of local options for alternative income generation activities, is a big concern which impedes the implementation of rural development schemes and activities.

The strategies to deal with these situations are typical and most of them could be addressed through capacity building and education. For a holistic rural development, it is imperative that inter-departmental coordination is ensured in successful implementation of any programme and activities.

Environment

Environment sector is a cross cutting sector. Environment cannot be looked at as a secluded subject any more. Every activity from agriculture to industries, forests to cities, urban life to rural life, animal health to human health has a give and take relation with environment. With Climate Change concerns, it becomes all the more necessary to take environment into consideration in the planning process of any of these activities.

Environment conservation has always been in the agenda of the State Government. It has always been integrated in the planning process of the State. In the context pertaining to Climate Change induced vulnerabilities, it becomes very vital to look at the developmental processes and plans

Key Strategies for Environment Sector

* *Establishing a State Climate Change Knowledge Management Centre (SCCKMC)*
* *Development of state of the art evaluation tools to provide policy makers with choice of strategies to be implemented – e.g. Sectoral GHG inventorisation and generation of Marginal Abatement Cost Curves (MACC)*
* *Assessing Vulnerability of the State in context of Climate Change*
* *Assessing various developmental programmes to understand their climate resilient quotient and suggest measures to make them climate proof*
* *Capacity building of various stakeholders on CC issues*
* *Assisting department in mainstreaming CC concerns in planning process*
* *Commissioning of baseline studies for each sector to evolve appropriate sectoral criteria/indicators for monitoring and evaluation of State Action Plan on Climate Change*

with Climate Change perspective so as to maintain a balance between development and environment.

Monitoring and Evaluation

For measuring the effectiveness of the State Action Plan on Climate Change it is necessary to have a M & E framework in place. This essentially identifies the successes and failures of the overall objective of the action plan, and enables one to make, as appropriate, midterm course changes to the adaptation and mitigation strategies identified, correcting past mistakes and improving practices suggested in the action plan. M & E has to be a participatory process. The GoMP SKMCCC will monitor and evaluate the integration of climate concerns in various developmental policies and capacity development of the various line departments. The departments would assess the climate policy goals in terms of strategies laid out for each sector to climate proof the sector.

Way Forward

Following a proactive approach to address the state's concerns regarding Climate Change, the State Action Plan on Climate Change has been prepared. The state strives for sustainable development without compromising on the development needs of the state. The key strategies outlined in the SAPCC (along with the new strategies as per the need of situation) will guide the way forward for the state departments to integrate and mainstream the Climate Change concerns in the schemes, projects, programmes, missions and policies to make Madhya Pradesh a resilient state which can, to an extent, handle the challenges and risks of Climate Change by making its population adapt to and thus less vulnerable to Climate Change. Detail cost for each of the activity can be ascertained after deciding the scope and scale of activities.

SKMCCC, EPCO

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Section-I

"The section provides an insight into the National initiative on climate change, NAPCC 2008, the State profile and the State initiatives to address its climate change concerns. Detailed analysis of observed climatic trend over Madhya Pradesh and climatic projections (mid century & end-century as per PRECIS A1B scenario) is also presented in this section. A separate Vulnerability Assessment study for the state was carried out under the MoEF - GIZ project on Climate Change Adaptation in Rural Areas of India. Early inferences of this report are also informing this section."

* *Introduction*
* *Madhya Peadesh Profile*
* *State Initiatives on Climate Change*
* *Observed Climate Trends and Climate Change Projections*
* *Vulnerability Assessment*

1 Introduction

Climate Change and National Initiatives

India has a diverse physiography surrounded by oceans along its southern borders, Himalayas at its north, a vast plateau at its centre, desert on its western region and low rising hills on its south eastern and south western borders resulting in a climate that is highly variable across its expanse. Here, still around 2/3rd population is dependent on agriculture, and 40% of agricultural land is rainfed, making agriculture dependent livelihoods highly vulnerable to Climate Change. This vulnerability may, in due course, pose a threat to the food security of the Nation. Other climate sensitive sectors like forestry, water resources, urban and rural development, human and animal health etc are equally vulnerable. In addition, an unequal social and economic development across the country has resulted in differential coping capacities among the population. The changing climatic parameters are likely to exacerbate the vulnerabilities further; unless actions are taken now to adapt to the same .

India's Climate Change concerns have been addressed in its National Action Plan on Climate Change released in June 2008 [NAPCC, 2008]. The eight "National Missions" formulated within the National Action Plan include:

- National Solar Mission - Aims to increase the share of solar energy in the total energy mix and to undertake R & D for better and affordable technologies
- National Mission for Enhanced Energy Efficiency – Aims to save 10,000 MW of energy by the end of XI Five Year Plan in 2012 and to enhance energy efficiency in industries and residential applications.
- National Mission on Sustainable Habitat – Aims to make habitats sustainable through improvements in energy efficiency in building, management of solid waste and model shift to public transport.
- National Water Mission - Aims to improve water use efficiency by 20% with respect to the current scenario and to ensure integrated water resource management helping to conserve water, minimize wastage and ensure more equitable distribution both across and within states.
- National Mission for Sustaining the Himalayan Ecosystem - Aims to evolve management measures for sustaining and safeguarding the Himalayan glacier and mountain eco-system.
- National Mission for a "Green India" – Aims to increase the forest cover from the present 23% to 33% in order to preserve ecological balance and biodiversity.
- National Mission for Sustainable Agriculture – Aims to devise strategies to make Indian agriculture more resilient to Climate Change.
- National Mission on Strategic Knowledge for Climate Change – Aims to devlelop a better understanding of climate science, impacts and challenges.

The impacts and vulnerabilities of various sectors due to climate change in India have been highlighted in various reports, such as the 1st National Communication made to the UNFCCC in 2004 and later in a report brought out by the MoEF for 4 major regions of the country (NATCOM, 2004; INCCA, 2010).

2 Madhya Pradesh Profile

Introduction

Madhya Pradesh is India's second largest state by area and sixth largest state by population. The state has a complex social structure, a predominantly agrarian economy, undulating terrain, scattered settlements over a vast area, and a large population below poverty line. The state has fifty districts grouped into ten administrative divisions.

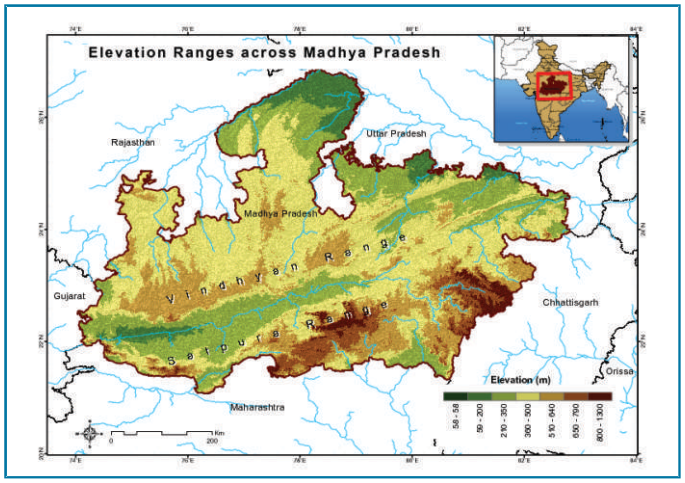


Fig. 2.1 Physiographic Map of MP

Madhya Pradesh has an area of 3,08,252 sq.kms constituting 9.38% of the land area of the country. It lies between lat. 21°04'N and long. 74°02' and 82°49' E. Being centrally located, it is often referred to as the "Heart of India". The state is bordered on the west by Gujarat, northwest by Rajasthan, north - east by Uttar Pradesh, east by Chhattisgarh, and south by Maharashtra. It has diverse physiography with large plateaus, numerous mountain ranges, meandering rivers and miles of forests supporting rich biodiversity.

Physiography

The country has been divided into three major physiographic regions viz., the Mountain Region of the Himalayas, the Great Indo-Gangetic and Brahmaputra Plains and the Traingular Plateau of the Peninsula. Madhya Pradesh falls in the last region i.e. the Traingular Plateau of the Peninsula which is subdivided into following land form units.

- Northern Plains: Parts of central highlands covering Gird region fall in this land form unit
- Central Highlands: Malwa plateau, parts of Bundelkhand upland, Vindhyan scraplands, Madhya Bharat plateau, and parts of Aravalli range are included in this land form unit.
- Eastern Plateau: This unit includes parts of Baghelkhand plateau (MP & Chhattisgarh), parts of Chhota Nagpur Plateau, Mahanadi Basin and Dandakaranya plateau (Chhattisgarh)

Climate

Madhya Pradesh falls under sub-tropical Climatic Region with three distinct seasons viz., winter season (Dec-Feb), summer season (Mar–May) and rainy season (June–Oct).

Minimum temperature may go up to 1°C in winters and maximum can go up to 48°C in summers. Average annual rainfall for the state is 1160 mm with the heaviest rains in the south-eastern parts which decreases towards north-west.

Temperature variability

Season	Mean Min	Mean Max
Summer	22°C	38°C
Winter	10°C	25°C

Table 2.1 Temperature Variability

Balaghat receives the maximum rains with an average of 1600 mm. Most of the rainfall is received from the south-west monsoon during June to September [MP Resource Atlas 2007, MPCST]

Land Use	Area in '000 ha	%
Total geographical area	30,825	
Reporting area for land utilization	30,757	100.00
Forests	8,696	28.27
Not available for land cultivation	3,401	11.06
Permanent pastures and other grazing lans	1,337	4.35
Land under misc. tree crops and groves	19	0.06
Culturable wasteland	1,160	3.77
Fallow lands other than current fallows	621	2.02
Current fallows	582	1.89
Net area sown	14,941	48.58

Table 2.2 Physiographic Map of MP *(Source:Land use Statistics, Ministry of Agriculture, GoI, 2008-09)*

Land use

Major land use in Madhya Pradesh is of Agriculture (48.58%) and Forest (28.27%) [FSI, 2011].

Forest

Madhya Pradesh has a vast expanse under forest cover which is spread across an area of 94.69 lakh Ha (31 % of total geographical area of the State). This is equal to 12.44% of the forest area of India. The state's forest area has been classified into Reserved Forest (RF), Protected Forest (PF) and Unclassified Forest [MP Resource Atlas 2007, MPCST]. These forests are house to a rich floral and faunal biodiversity and host 22,600 forest villages whose livelihoods depend substantially on the forest produce.

Madhya Pradesh has been a pioneer both in in-situ and ex-situ biodiversity conservation. The state holds 9 National Parks and 25 Sanctuaries. These parks and sanctuaries are spread over an area of 10,862 sq.km

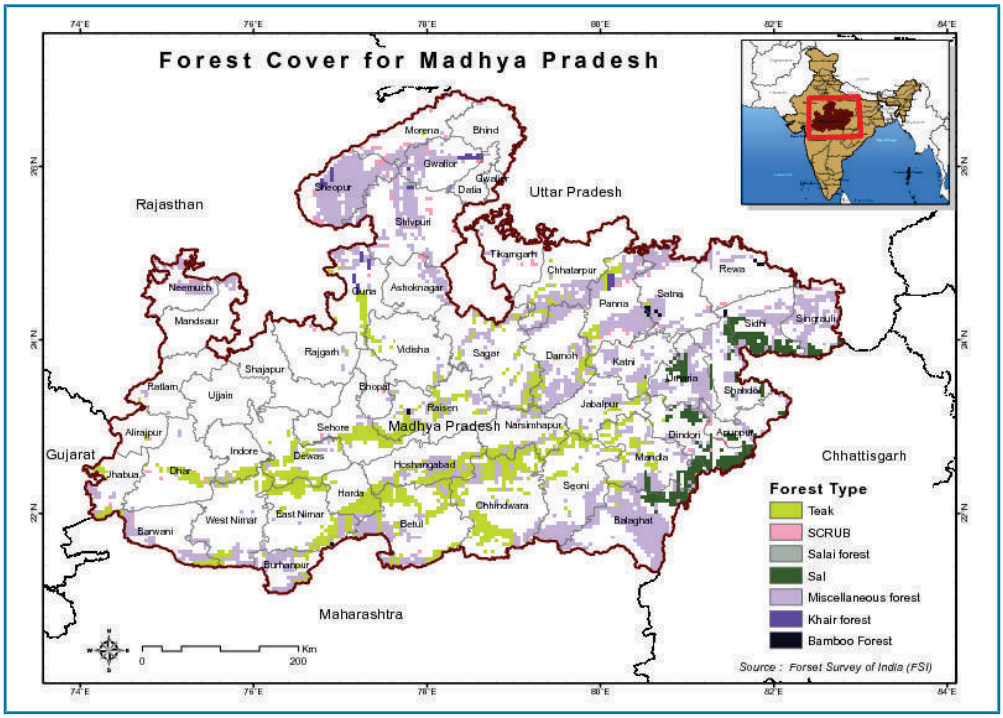


Fig. 2.2 Forest Cover Map of Madhya Pradesh

constituting 11.40% of the total forest area [MP Resource Atlas 2007, MPCST]. Three Biosphere Reserves namely, Pachmarhi, Achanakmar – Amarkantak and Panna are also located in MP.

Biodiversity

Madhya Pradesh has a wide variety of wild animals inhabiting the vast expanse of its forest areas. It has 9 national parks and 25 sanctuaries. It has nearly 20% of the tiger population of the country. Herbivors like the chital, sambar, black buck, chinkara, nilgai, wild boars etc., roam about freely in the forests of the state. Important recognized breeds of cattle considered as native breeds of Madhya Pradesh are 'Malwi' and 'Nimari'. 'Gaolao' breed is found all over 'Vidarbh' region of Maharashtra and adjoining areas of Madhya Pradesh (Chhindwara district) and 'Kankattha' breed of cattle in Panna district. Similarly, 'Bhadawari' breed of Buffalo is found in abundance at Bhind and Gwalior districts. 'Jaloni' breed of sheep is found in Tikamgarh and Shivpuri which forms the border with Jhansi and Jalaun districts of Uttar Pradesh. 'Jamnapari' breed of goat is found in various villages of Bhind district situated near Chambal River. 'Malwi camel' is also found in Mandsaur district of Madhya Pradesh. In the poultry sector 'Kadaknath' is the native breed of Madhya Pradesh found at Jhabua and Dhar districts of Madhya Pradesh.

Agriculture

Agriculture, the prime livelihood source of majority of the State's rural population, is highly influenced by soils and climatic conditions. Net sown area of Madhya Pradesh is 150.78 lakh Ha which is about 49% (above than country's net sown area percentage) of the total geographical area of the State [MP Resource Atlas 2007, MPCST].

In order to delineating potential areas for agriculture, India is divided into fifteen agroclimatic zones and twenty agroecological regions whereas Madhya Pradesh is divided into eleven agroclimatic zones and five agroecological regions [Soil Resources and Agroclimatic Zones of Madhya Pradesh by V.S.Tomar, G.P.Gupta and G.S.Kaushal].

Per capita gross cropped area in the state is 0.33 Ha which is double than all India average of 0.18 Ha and the cropping intensity is 135% which is slightly higher than all India average of 126%. The state ranks 1st in pulse, soybean and gram production and 2nd in oilseed production. For cotton and sugarcane the state is positioned at 7th and 11th rank respectively [MP Resource Atlas 2007, MPCST].

Soils

The state is characterised by a great diversity of parent rocks which have weathered under different climatic conditions, vegetative covers and topographic situations to form soils with different characteristics in different zones. The principal underlying rocks are Deccan Traps, Vindhyan Sandstones, Archaean Gneisses, Gondwanas and Lametas.

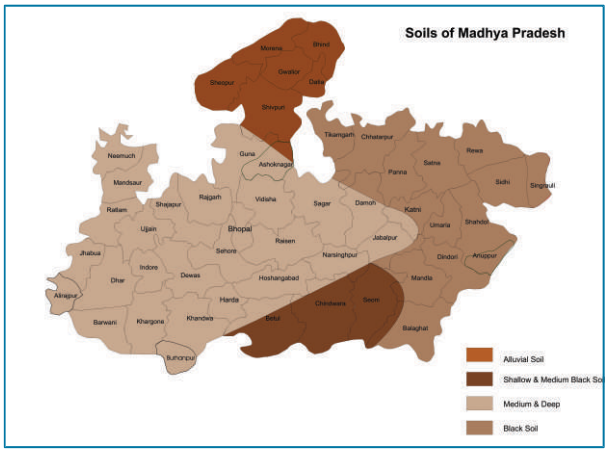


Fig. 2.3 Soil Map of Madhya Pradesh

According to Raychaudhuri et al (1961) and Sinha and Gupta (1985), the state comprises of a variety of soils ranging from rich clayey to gravelly. Major groups of soils are Alluvial, Medium & deep black, Shallow & medium black, Mixed red & black, Red & lateritic and Red & yellow [Soil Resources and Agroclimatic Zones of Madhya Pradesh by V.S.Tomar, G.P. Gupta and G.S.Kaushal].

Water Resources

Narmda River is the life line of Madhya Pradesh. Nearly 60% of the surface water can be retained for different uses. Thus there is a scope for almost more than double the irrigation capacity by building small dams in different streams. It is also seen that, the eastern and south-eastern part of Madhya Pradesh has more runoff because of relatively higher rainfall, high gradient and occurrence of crystalline rocks in the major portion of the area. The central part receives lesser rains and therefore proportionate decrease in runoff water and cropping patterns.

Western part of Madhya Pradesh receives much less rain and hence the relative runoff is less. Most of the streams are almost dry for 4 to 6 months in the year (Jan to June). It is essential that this runoff water should be harnessed by putting a series of small and medium dams on small and big streams. This will not only provide sufficient water on the surface for different uses but also the percolation into the ground. It will increase the level of the ground water to a great extent.

The total quantity of surface and ground water is distributed in different catchment areas of Madhya Pradesh. Madhya Pradesh is endowed with seven river basins draining a watershed area of about 308 lakh Ha [MP Resource Atlas 2007, MPCST].

Major rivers of the state include Narmada, Chambal, Betwa, Son, Ken, Tons, Sind, Wainganga, Mahi and Tapi. Total annual replenishable groundwater resource and the total annual groundwater availability of the state is 37.19 and 35.53 BCM respectively. Annual recharge from monsoon in the state is 30.64 BCM where as recharge from other sources are estimated at 6.55 BCM.

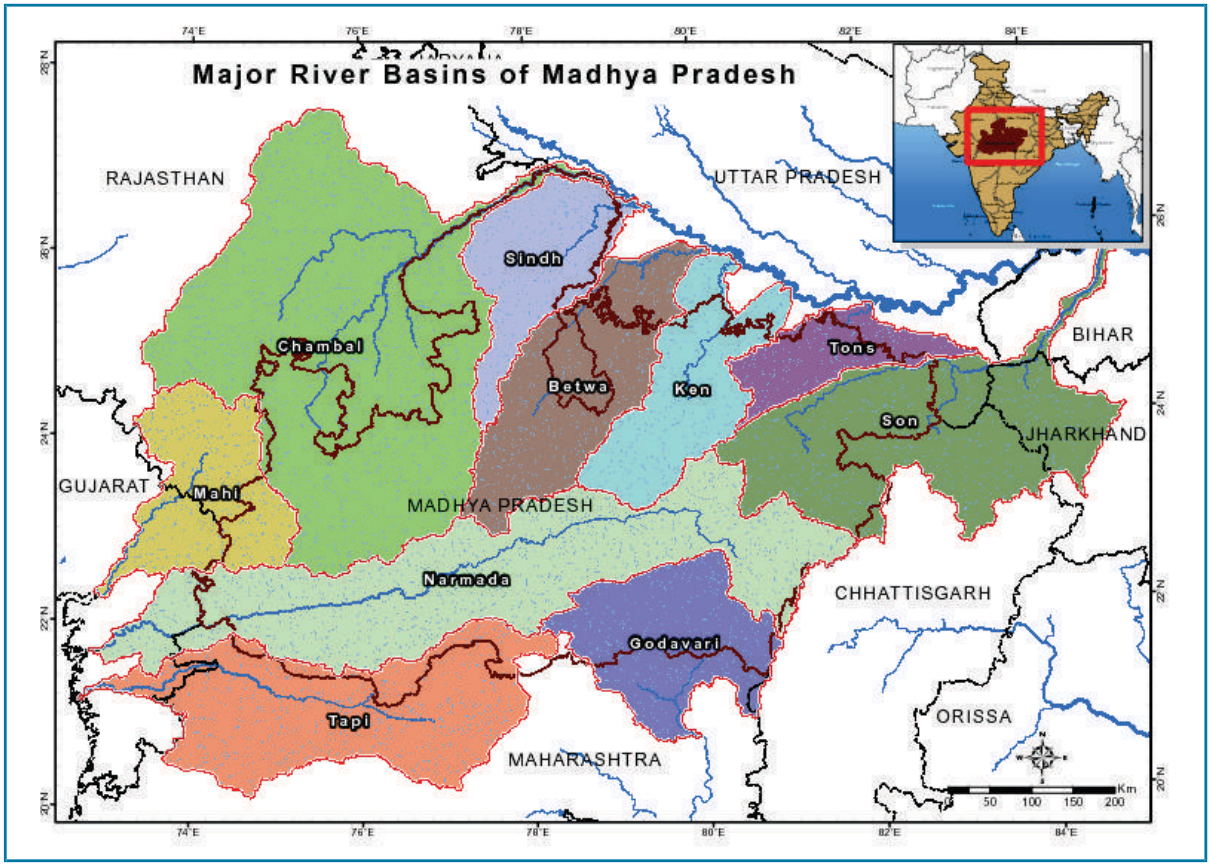


Fig. 2.4 Major Basins of Madhya Pradesh

Mineral Resources

The state ranks first in production of Diamond, Diaspore, Pyrophyllite and Copper. Except Malwa plateau and some of the central districts, entire state is rich in mineral resources. Coal, Bauxite, Limestone, Asbestos, Calcite, Manganese, Dolomite etc are some of the mineral resources of the state.

Socio-Economic Profile

Some of the indicators that determine the adaptive capacity of population include its economic strength, access to infrastructure, access to health facilities, land use pattern, literacy rates, income generating sectors and their strengths, policies and governance structures. A brief description of all these indicators, as they exist now, is summarised below:

Demography: Total population of Madhya Pradesh is 7,25,97,565 [Census 2011]. With respect to 2001 there has been an increase of 24.34% with a population density of 196 people per square kilometer. About 72% of state's population resides in villages whose main occupation is agriculture. Sex ratio of the state stands at 930 whereas the literacy rate is 70.6%.

Madhya Pradesh has a substantial tribal population. The lifestyle, culture and customs of this community are more akin to nature. Gond is the best known tribe and forms the largest group in Madhya Pradesh. Agaria, Pradan, Ojhan, Solahas are the descendent tribal groups originating from Gonds, with two sub castes - Rajgond and Datoliya. Bhil, the second largest tribe is largely concentrated in the area around Jhabua, Dhar and Ratlam.

Economic Profile: The Gross State Domestic Product (GSDP) is only 3.6% of the total Indian Gross Domestic Product. Of this the primary sector comprising of agriculture, forests and fisheries contributes 26% to GSDP, with 43% of the workers being cultivators and 29% agricultural labourers. So the basic livelihoods of three-quarters of the state are derived from the primary sector.

The secondary sector comprising of mining, manufacturing, electricity, water supply and construction contributes 26.93% to GSDP and the tertiary sector constituting railways and other transport, communication, banking and allied services, public services, tourism development across the state contributes 46.1% to GSDP.

It is the secondary and tertiary sectors which have seen substantial growth in the state, while growth in the primary sector being almost static. The inequity in development across the state is reflected in the below poverty line population recently estimated for each district of Madhya Pradesh . As per this study, in 2004-2005, about 38% of the population was below poverty line.

GSDP as of 2005 – 2006 current prices (Rs.in crores)	118586 (Planning Atlas, MP ,2005-06)	4294706 (ESI,2006-07)
Per Capita Income at Current prices 2009 -2010 (Rs.)	24146 (DPR, MP)	46492 (PIB GoI)
Installed Power Capacity (MW)	8539	159398.5
National Highway Length (km)	4,670	70,548
Population (2011 census)	72,597,565	1,210,193,422
Sex Ratio (females/1000 males)	930	940
Literacy rate (2011 census)	70.6%	74.04%
Crude Birth Rate per 1000 births (2006)	29.1	23.5
Life Expectancy at Birth, Male (Years) - 2003	57.8	61.8
Life Expectancy at Birth, Female (Years) - 2003	57.5	53.7
Proportion of Population Below Poverty line (2004-05)	38.3	27.5

Table 2.3 Economic Profile of MP

[2] *Source:* http://www.mp.gov.in/spb/international-aide projects/ pmpsu/outputstobeupload2008.11.10 /DistrictWisePovertyEstimates.pdf

Governance: The state of MP has vibrant three-tier Panchayati Raj system and Urban Local bodies as the institutions of local self-governance. The state has 10 Commissioner Divisions, 51 Districts, 272 Tehsils and 313 Community Development Blocks, including 89 Tribal Development Blocks.

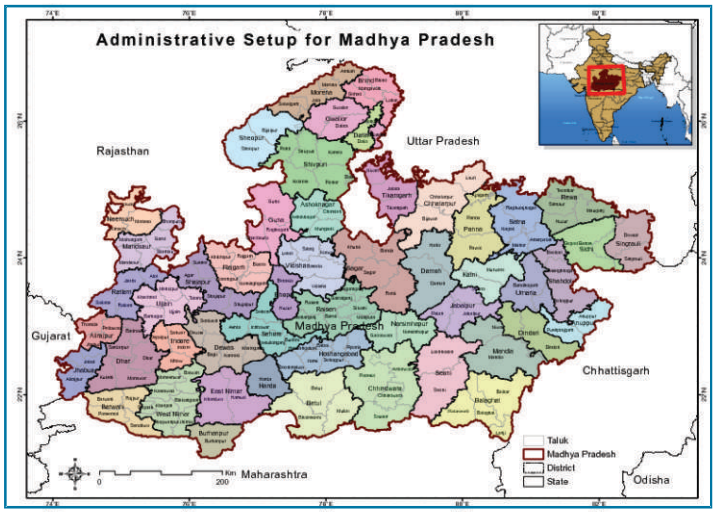


Fig. 2.5 Administrative Map of MP

Under three-tier Panchayati Raj, the state has at present 51 Zila Panchayats, 313 Janpad Panchayats and 23,051 Village Panchayats, 14 Municipal Corporations, 96 Municipalities and 250 Nagar Panchayats. This has effectively improved delivery of key services integrating the administrative, academic units and local bodies. Also a provision has been made to encourage innovations in the state, for creative ideas generated at the field level or by a department so that it could be supported under the plan on a pilot basis.

Infrastructure

Physical infrastructure like road and transport, irrigation, power, telecommunication etc contributes to economic growth through generation of income and employment and social infrastructure consisting of education, health, housing and financial infrastructure like banking and insurance contributes to the process of growth through generation of human capabilities and capacity building.

Physical infrastructure

Transport: Madhya Pradesh has 73,311 km of roads, of which 60,000 km are surfaced. It has 4,286 km of national highways, 8,728 km of state highways, 10,817 km of major district roads (MDRs), and 48,590 km of other district roads (ODRs)/village roads. The road network is 45 km/100 sq km in Madhya Pradesh (National average is 75 km per 100 sq km).

Power: Madhya Pradesh has total installed power generation capacity of 8,539 MW, which comprised 4,582.9 MW under state utilities, 3,525 MW under central utilities and 216.1 MW under the private sector. Coal-based thermal power and hydro power contribute around 51.4% and 38.7% to the total installed capacity, respectively. Balance generation capacity is based on nuclear and renewable energy sources. The present average energy consumption per capita in the State is 580.34 kWh.

Telecommunication: The state has a tele-density of 40.4 (telephone connections per 100 populations). The state has about 2560 telephone exchanges with 28.6 million telephone connections.

Urban infrastructure

Under the Jawaharlal Nehru National Urban Renewal Mission (JNNURM), 22 projects have been sanctioned for urban centres such as Bhopal, Indore, Jabalpur and Ujjain. Projects for water supply, solid-waste management and urban transport have been identified for development under the JNNURM. 50% of the population is connected to sewage network in major cities.

Water supply: The average per capita supply of water in major cities such as Indore is around 80 litres per day. Under the JNNRUM, cities are planned to achieve per capita water supply of 135 litres per day between 2015 and 2021.

Social infrastructure

Education Sector: Madhya Pradesh had a literacy rate of 70.6 %. The state has about 159 engineering colleges, 139 management institutes and five medical colleges

Health Infrastructure: The healthcare services network of Madhya Pradesh comprises 50 district hospitals (13,400 beds), 333 community health centres, 1,155 primary health centres and 8,659 sub-centres. The total number of in-patient beds in Madhya Pradesh (excluding medical colleges) was 26,971.

Climate Change and Development Issues of the State

Background

Madhya Pradesh is endowed with a rich environment and long traditions of symbiotic relationship between people and natural resources which is predominantly rural and has a substantial population living below the poverty line. Despite a growth rate of more than 40% in the urban population in the last decade, the proportion of its population living in rural areas is fairly high at 72%. The consequences of poverty are visible in several other human development parameters.

The state is also rich in terms of natural resources – forests, wildlife, mineral wealth and water bodies. The state has the largest forest cover in the country, with 94.69 lakh Ha of legally designated forests. It has 20% of the country's and 10% of the world's tiger habitats. Madhya Pradesh is among the top eight mineral rich states of the country, producing about 23 major and minor minerals and contributing to 15.39% of total coal production of the country during 2009-10. As far as water resources are concerned, nine major rivers originate within the state; with an estimated annual run-off of about 81719 hectares meters. Madhya Pradesh has a large population of rural and tribal people, with a high dependence on agriculture, forests and fishery for their livelihood. It has the highest concentration of tribal population as compared to other major states of India (20.27% as against 8.20% at all India level, according to the 2001 census) and home to about 46 recognized scheduled tribes. According to the State Annual Plan of 2011-12, there is a scheduled tribe population of about 1 crore residing in about 22,000 villages in the vicinity of forests, who are largely dependent on the forests for their livelihood.

The state is seeking to attract more investments in future, with a fast improving infrastructure, peaceful industrial climate, and progressive industrial policies based on incentives. At the same time, it is also aspiring to revitalize the traditionally rich handloom, khadi and village handicraft and sericulture industries as well as develop agri- food processing and herbal processing industries (considering the state's abundant non timber forest produce). The state's energy requirement is currently dependent on conventional energy sources-thermal and hydel, with a total installed generation capacity of 8539 MW available for the state. The state has accorded priority to the promotion of renewable energy, particularly solar energy to reduce the energy shortage and ensure sustainable development. The state offers viable sites having potential for production of more than 5.5 kWh/sq. m. for installation of solar based power projects.

Challenges

Despite the wealth of its resources and tremendous potential, Madhya Pradesh faces a number of challenges, in terms of environment and development. Some districts in MP are among the highest in India in terms of social vulnerability to the twin challenges of Climate Change and economic globalization [TERI, 2000]. The incidence of poverty in the state is among the highest in the country. Maintaining and enhancing productivity in agriculture is one major challenge, arising out of a number of reasons such as loss of soil fertility, increasing cost of production and owing to the largely rain-fed nature of agriculture in the state. Erratic and uneven distribution of rainfall poses a major constraint for achieving targeted levels of production.

With Climate Change, this could be expected to increase in future. Growing population and developmental needs have increased the pressure on forests, which in turn has led to reduced livelihood opportunities for the rural and tribal people. Over exploitation of ground water has led to a significant decline in ground water levels in many blocks of the state, which may aggravate with the stress imposed by Climate Change. Madhya Pradesh is urbanizing at fifth highest rate in the country [State Annual Plan,

2011-12] and hence there is need and opportunity to develop the urban areas in an environmentally sustainable manner. The state is also gearing to face the challenge due to energy shortage, favouring development of agricultural and industrial sector and providing electricity to all.

Policy Framework for Climate Change

The State of MP has reasons to be concerned about adverse impact of Climate Change. It is facing twin challenge of maintaining and enhancing economic growth at the same time prevent deterioration and degradation of its natural resources on which large section of the population depends for their livelihoods.The foregoing chapters clearly underline the fact that Vulnerability and Adaptaion (V&A) are the key concerns for the State of Madhya Pradesh. With this background the SAPCC envisages to ensure economic growth which is inclusive and also environmentally sustainable. In accordance of the vision, the SAPCC proposes to address the National agenda of Climate Change by taking appropriate adaptaion measures and suggests developing low carbon development model in line with the Planning Commission of India with a rider that it should not impede the socio-economic development process of the state.

The SAPCC proposes to proactively integrate the concerns of Climate Change into development planning process and capitalize the opportunity of convergence wherever possible. It also prepares the state to have climate compitable and resilient developmental policies and programmes. The SAPCC categorically recommends setting up of a mechanism for effective monitoring and evaluation of the provisions of SAPCC and impacts of Climate Change on various sectors for managing knowledge, research and education and capacity building.

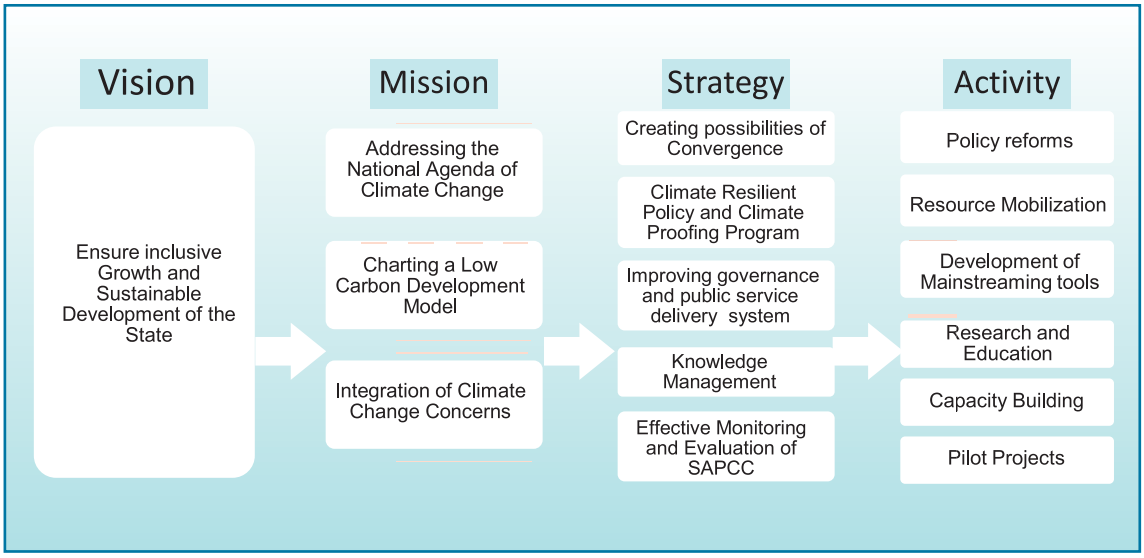


Fig. 2.6 Policy Framework for SAPCC

3 State Initiatives in Climate Change

The Government of Madhya Pradesh has declared EPCO as the State Designated Agency for addressing Climate Change issues and had established a Climate Change Cell (GoMP CC Cell) in EPCO in 2009. The Cell worked to manage the strategic knowledge related to Climate Change. It undertook activities that help to mainstream Climate Change concerns in the planning and developmental policies of the state and develop a mechanism to effectively monitor & evaluate the provision of SAPCC. Now the CC cell has been converted into a State Knowledge Management Centre on Climate Change (SKMCCC).

The State Government has also constituted Madhya Pradesh Clean Development Mechanism Agency (MP CDMA) in October 2010 to address the mitigation issues of the state. GoMP SKMCCC and MP CDMA, functions under the overall administrative control of Department of Housing and Environment, Government of Madhya Pradesh.

Climate Change Initiatives

MoEF-GIZ Project on Climate Change Adaptation in Rural Areas of India

Objectives

- Vulnerability & Risk Assessment
- Development of Technical Adaptation Option
- Climate Proofing of Development Programme
- Information and Knowledge Management in Climate Change & Human Capacity Development

Indo-UK Project on Vulnerability & Adaptation

Objectives

- To gain in depth understanding of Climate Change induced vulnerability
- How relevant resilience building and adaptation measures can be effectively incorporated

GoMP-UNDP Project on Strengthening MP Climate Change Cell

Objectives

- Strengthen MP Climate Change Cell and develop it into a StateKnowledge Management Centre on Climate Change
- Prepare a State Action Plan on Climate Change
- Assist in mainstreaming Climate Change concerns into sectoral policies and programmes

Madhya Pradesh State Action Plan on Climate Change (MP SAPCC)

The Process

The State Action Plan on Climate Change (SAPCC) has been formulated under the GoMP-UNDP Project 'Strengthening MP Climate Change Cell'. Specific to the GoMP-UNDP project, an institutional set up was constituted which comprises of a Project Steering Committee (PSC), a Project Implementation Committee (PIC) and a Project Management Unit (PMU). The PSC functions under the chairmanship of the Chief Secretary, GoMP which provides overall policy guidance and ensure ownership amongst the concerned departments and stakeholders. The PIC has been formed under the Principal Secretary, Housing and Environment Department, GoMP and is responsible for making administrative and financial decisions and to undertake periodic reviews.

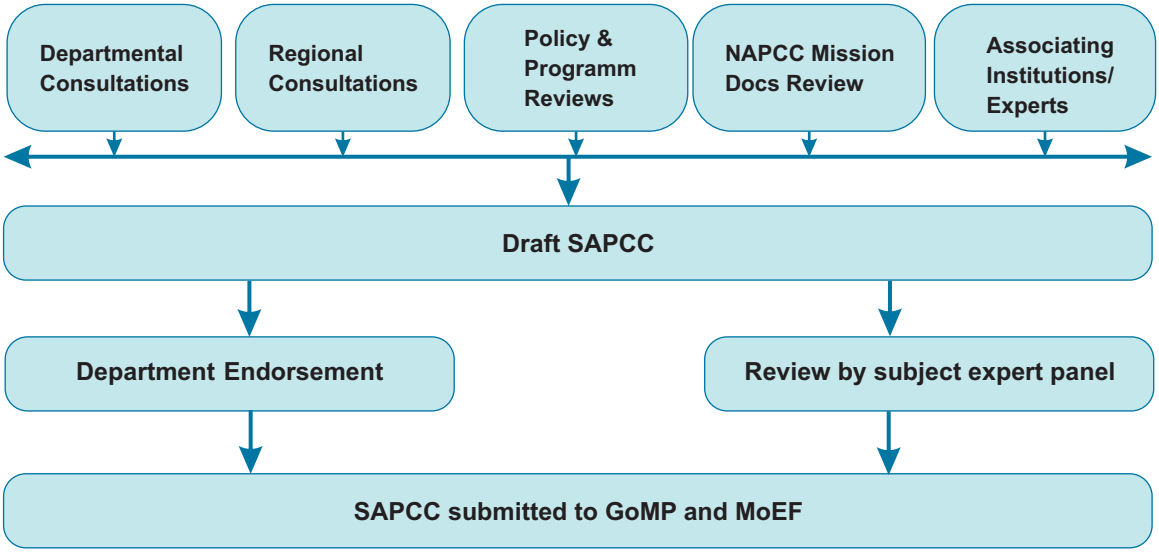


Fig. 3.1 Process of SAPCC preparation

Stakeholder Consultations

The GoMP CC Cell adopted a bottom-up approach to develop the SAPCC whereby series of consultation workshops were organised with identified climate sensitive line departments (sectoral) and across the state in all the 11 agroclimatic zones (ACZ). A thorough review of sectoral programmes/policies and NAPCC Missions was done, in order to keep SAPCC in line with the national objectives as well as state objectives.

These workshops helped in realising and recording the sectoral and regional implications of Climate Change, nature of Climate Change perceived in general and the probable strategies that may be included in the SAPCC to combat the likely impacts.

In all, 27 such consultations were conducted. Officials and scientists from government departments, academia from research and educational institutes, civil society representatives including those from NGOs and general public participated in these workshops and shared their concerns. It is expected to evoke a wider ownership of the process and product which can go a long way in ensuring successful implementation of the recommendations of SAPCC.

Project Launch workshop

The project was launched in a two-day state level workshop on 26th – 27th April, 2010 at the State Academy of Administration, Bhopal. The workshop was attended by departmental officers, sector experts, academicians, scientists and researchers from various institutions. Participants were divided into four group i.e 1) Forestry, Wildlife and Biodiversity 2) Agriculture, Horticulture, Animal Husbandry & Fisheries 3) Health and Water and 4) Energy and Industries to facilitate targeted discussions pertaining to the sectors. Launch workshop offered an opportunity to introduce the project to all the government departments as well as to other stakeholders.

Networking Workshop

This workshop was organised to identify institutions/organisations working on Climate Change related aspects and to get useful insights into their competencies, projects in process and areas of convergences with the Cell's activities. This workshop was convened on 7th July, 2010 at Bhopal with an objective to network with major national and state level research and educational institutions. 31 institutions participated in this event.

Sectoral Consultations

Objectives of sectoral consultation workshops were to understand the sectoral policies and programme in effect, future developmental plans, preparedness and strategies with respect to Climate Change and perceived threats to the sector from changing climatic conditions (Participant mix: Fig. 3.2).

Agro Climatic Zone Consultations

Thirteen workshops were organised in eleven agroclimatic zones of the state with an objective to map regional issues with people's participation. More than 1700 people including representatives from regional offices of departments, civil society organisations, researchers, media and farmers participated in these workshops (Participant mix: Fig. 3.3).

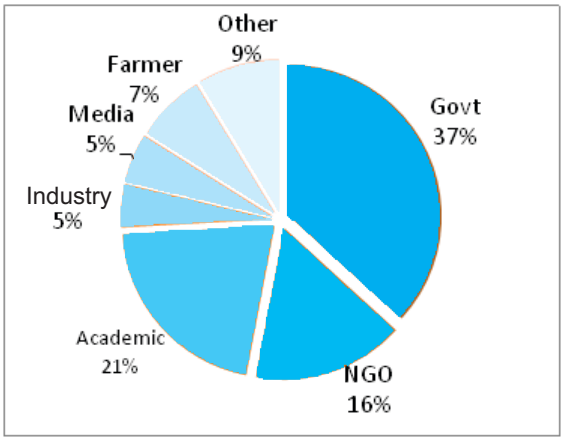


Fig. 3.2 ACZ Stakeholders' Participation

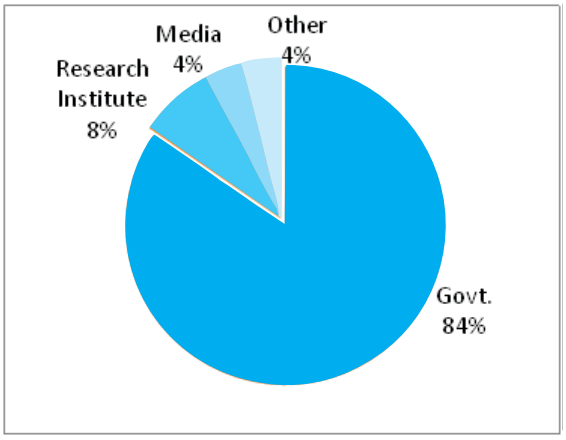


Fig. 3.3 Departmental Stakeholders' Participation

4 Observed Climate Trends and Projected Change

Observed Climate Trends

Madhya Pradesh has a subtropical climate with three distinct seasons viz. Winter from December to February followed by summer season from March to May and rainy season extending from June to October.

Data used for analysis of observed climate

A very high resolution (0.50° x0.50° degree) daily rainfall and temperature data set for the period 1971-2005 prepared by IMD for the Indian region has been used for this assessment. The data set was developed using quality controlled data from more than 6000 rain-gauge stations over India. A well tested interpolation method (Shepard's method) was used to interpolate the station data into regular grids of 0.5° X 0.5° Lat x Long.

Rajeevan and Bhate, 2009

During winters the mean temperature remains around 10°C and mean maximum temperature remains 25°C and the minimum temperature goes down to 1°C in some regions. During summers, the mean minimum temperature is 22°C and mean maximum is 38°C. The maximum temperature during summer can go up to 48°C, especially in May and June which are the hottest months. The average temperature statistics for Madhya Pradesh is presented below in Fig. 4.1.

The average annual rainfall for the state is 1160 mm. Rainfall is heaviest in the south-eastern parts of the state and it decreases as one move towards the north-west. Balaghat in the south receives the maximum rains; where average rainfall is above 1600 mm.

The other southern districts of Mandla, Dindori and Anuppur receive between 1200-1400 mm of rain. The rainfall drops to the 1000-1200 mm as one move further north and west. Western districts in MP including most of those in the Malwa plateau and Sheopur and Shivpuri in the north receives 800-1000 mm of rain. Average annual rainfall is below 800 mm in the south-western tip of the state, including southern half of Jhabua and western half of Barwani district. The rainfall is below 800 mm in the districts lying to the northern most part of the state including Morena, Datia, Gwalior and Bhind. Most of the rainfall in the state is received from the south-west monsoon during June to September. Season wise distribution of average rainfall is presented in Fig. 4.2.

ACZ	Rainfall (mm)	Min. Temp. (°C)
Vindhya Plateau	1200-1400	0-2.5
Jhabua Hills	800-1000	0
Nimar Plains	800-1000	2.5-5.0
Bundelkhand	800-1400	-
Malwa Plateau	1000-1200	0
Gird Zone	800-1000	Below 0
NHR Chhattisgarh	1200-1600	0-2.5
Chhattisgarh plains	1200-1600	2.5-5.0
Satpura Plateau	1000-1200	0-2.5
Central Narmada Valley	1200-1600	2.5-5
Kymore Hills	1100-1400	0-2.5

Table 4.1 ACZ Climate Characteristics of MP

Since monsoon receives the maximum volume of rain (more than 90% of the total annual rain fall in Madhya Pradesh), further analysis of the trends of monsoon rainfall is necessary as it forms the main source for agriculture and biodiversity in the state. An account of average rainfall and minimum temperature for all the eleven agroclimatic zones is presented in Table 4.1

Trends of average annual monsoon rainfall is also analysed for each ACZ for the period 1961 – 2002 and depicted in Fig. 4.3. Though there is an inter-annual variability of average monsoon rainfall in the 41 year period in all the ACZs, the rainfall trend is also decreasing in each of them as deciphered by the negative slope of the equation representing the linear trends.

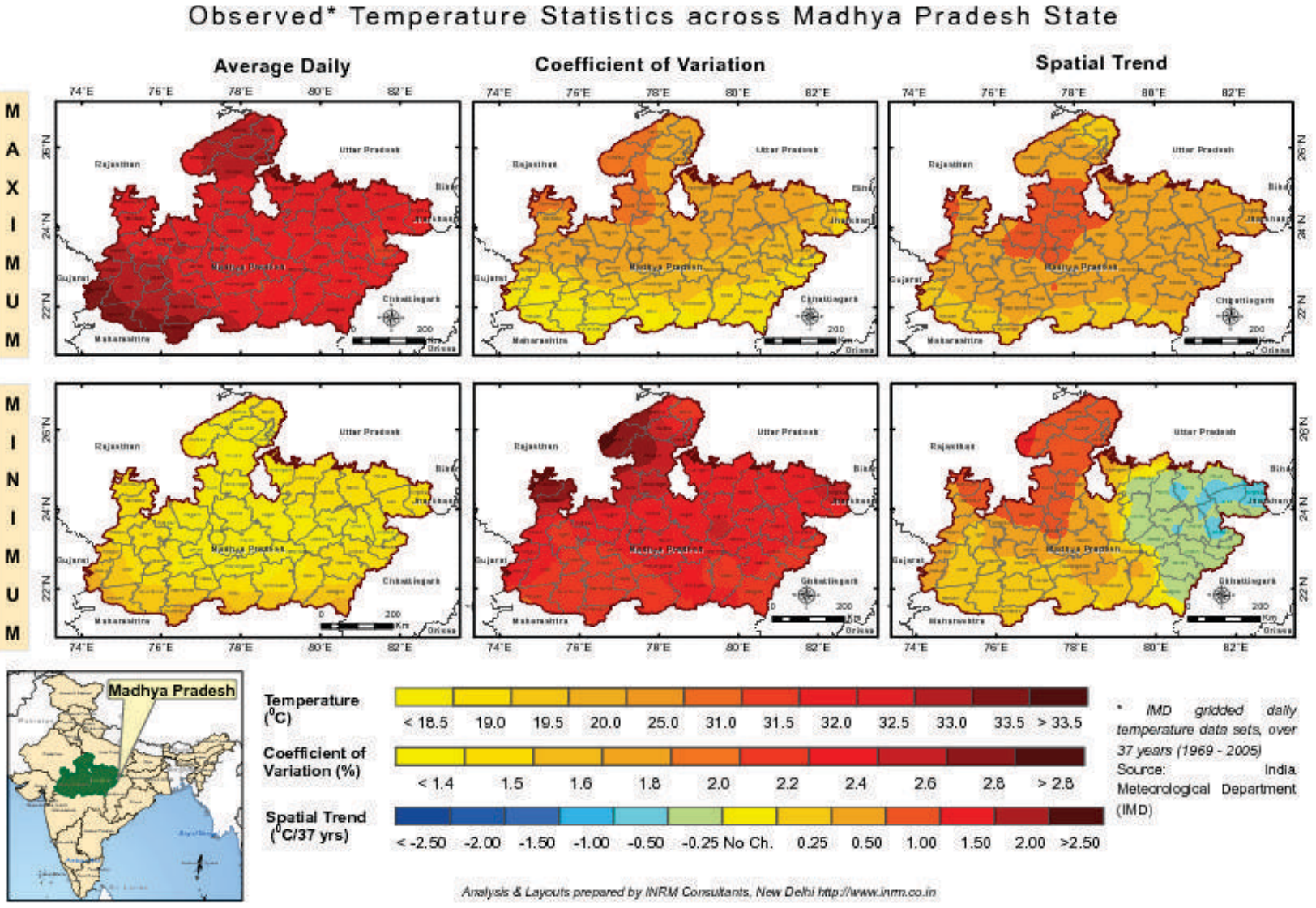


Fig. 4.1 Average Temperature across of MP

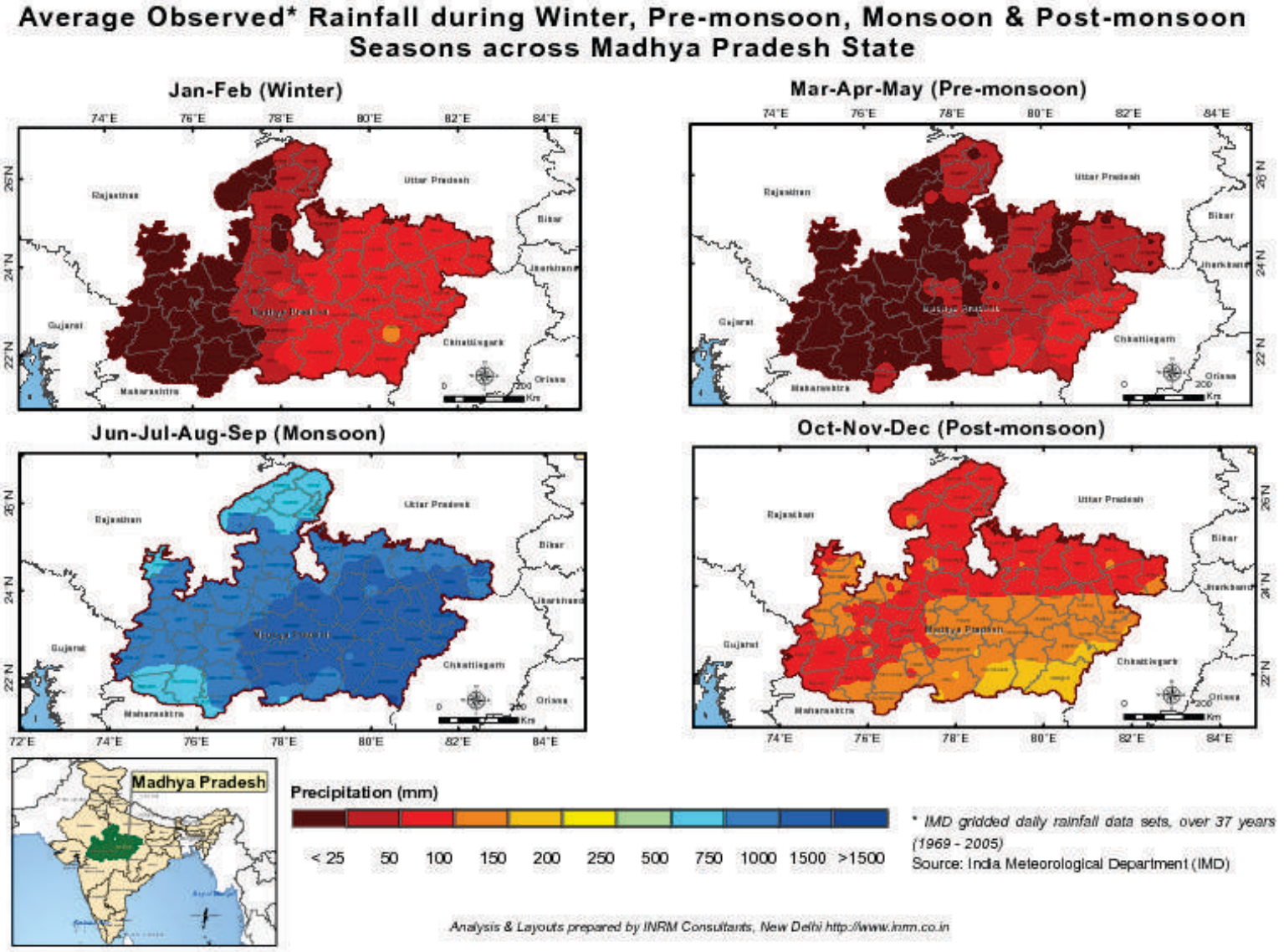


Fig. 4.2 Average Rainfall across MP

Further a study carried out by Goswami et al (2006) , for observations spanning 50 years in the Central Indian region including Madhya Pradesh, indicates that the extreme precipitation events which are above 100mm are increasing in terms of their intensity and frequency, with low and moderate events becoming more and more infrequent (Depiction in Fig. 4.3)

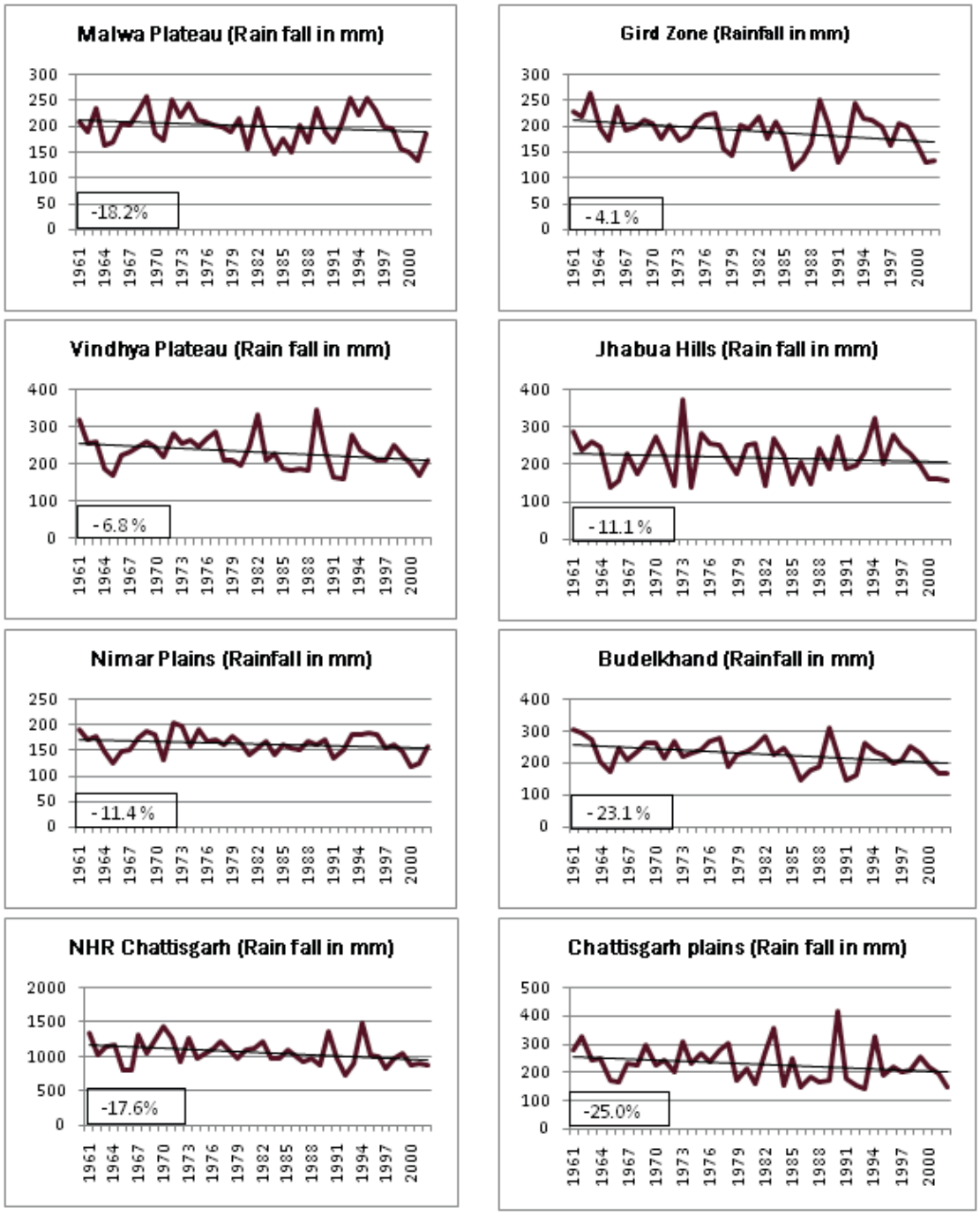
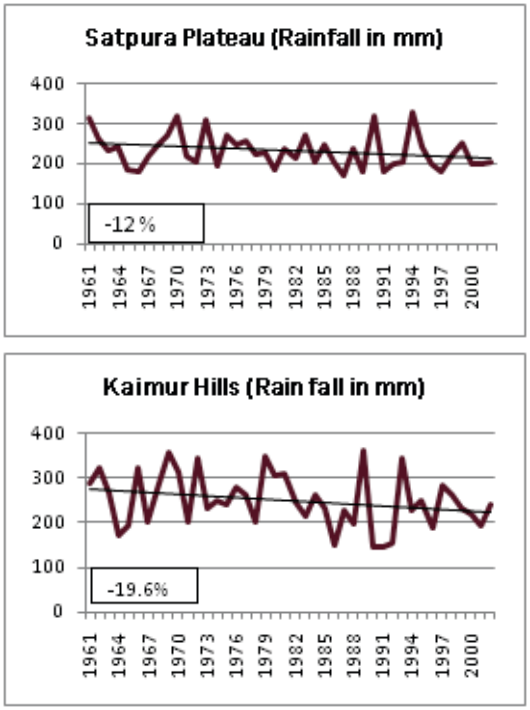


Fig. 4.3 Average Monsoon Rainfall (June, July, August and September) trends in various agroclimatic zones of MP between 1961-2002. Figures within boxes indicate the decreased trend in rainfall in this period (*Source: India water portal* http://indiawaterportal/metdata *accessed on June 2011)*.

[3]B. N. Goswami, V. Venugopal, D. Sengupta, M. S. Madhusoodanan,2 Prince K. Xavier; Increasing Trend of Extreme Rain Events Over India in a Warming Environment, *Science* 1 December 2006: Vol. 314. no. 5804, pp. 1442 - 1445



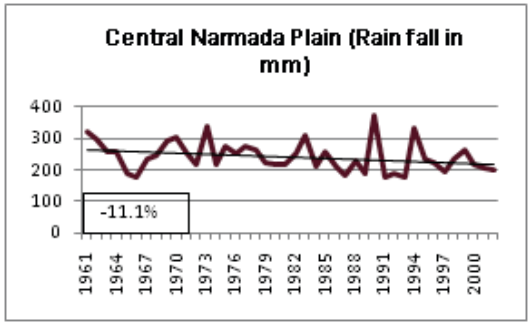


Fig. 4.3 Average Monsoon Rainfall (June, July, August and September) trends in various agroclimatic zones of MP between 1961-2002. Figures within boxes indicate the decreased trend in rainfall in this period (*Source: India water portal* http://indiawaterportal/metdata *accessed on June 2011).*

Climate Projections

Climate projections for 2030s (2021-2050) and 2080s (2071-2098) have been derived from PRECIS (Providing Regional Climate for Impact Studies), which is a desktop version of the HadRM3 model with a grid resolution of 0.44° x 0.44°. PRECIS simulation dataset is provided by the Indian Institute of Tropical Meteorology, Pune. The Climate Change scenarios are driven by the GHG emission scenarios - A1B which assumes a future world of very rapid economic growth, a global population that peaks in mid-century and declines thereafter, and assumes rapid introduction of new and more efficient technologies. Change in precipitation and temperature in 2030s and end of the century 2080s have been derived with respect to 1970s (1961-1990).

Temperature: The average surface daily maximum temperatures, in the period 2030s is projected to rise by 1.8-2.0°C throughout Madhya Pradesh and the daily minimum temperature is projected to rise between 2.0°C to 2.4°C during the same period; the eastern half of the state experiencing more warming than the western half. By 2080s, the maximum temperature is projected to rise between 3.4°C to 4.4°C with northern region experiencing warmer temperatures. The minimum temperatures are likely to rise by more than 4.4°C all over Madhya Pradesh (Fig. 4.4)

Rainfall: Projections of rain fall in Madhya Pradesh for the period 2021 to 2050 (Fig. 4.5) indicates that there is likely to be decrease in winter rainfall as one movse from eastern part of MP to western part of MP. In pre-monsoon period, the rainfall is increasing only in the Southern part of MP, with decreasein rain fall in all other parts. In the Monsoon period, there is a slight increase in rainfall all over MP (the increase being 1.25 times the rainfall observed in the current climate), and with no change in the Morena, Shivpuri, Bhind, Gwalior area.

During post monsoon period, slowly again the western end of MP is likely to face decrease in rain fall, with no change or little increase in rainfall in most other parts of the state. In 2100 there is an overall increase in rain fall with southern states likely to receive more rain fall in the northern states. The increase in rain fall during the post monsoon and pre monsoon periods are projected to be more than the increase in rain falls

projected for the monsoon period.

The Table 4.2 summarises projected changes in climate parameters as derived from PRECIS -

Projected Changes in Climate	2021 -2050	2071-2100
Daily Maximum Temperatures	1.8-2°C increase	3.4-4.4°C increase
Daily Minimum Temperatures	2.0-2.4°C increase	>4.4°C increase
Monsoon Precipitation	Increase in precipitation by 1.25 times the current observed rainfall in most parts of Madhya Pradesh; No change in Morena, Shivpuri, Gwalior and Bhind; Increase in precipitation in eastern parts of Hoshangabad, northern part of Betul, north eastern parts of Betul and Southern part of Sehore	More than 1.35 times increase in precipitation with respect to observed climate in most parts of Madhya Pradesh. With major parts of Hoshangabad and Damoh, Mandla and northern parts of Balaghat will experience rain in excess of 1.45 times the observed climate now. The extreme northern and western part of the state will also experience excess rainfall but less than most of the other areas.
Winter Precipitation	Decrease in precipitation	Substantial increase in precipitation in Central and South western part of Madhya Pradesh increasing from between 1.45 to 1.85 times.

Table 4.2 Projected Changes in Climate Parameters of MP

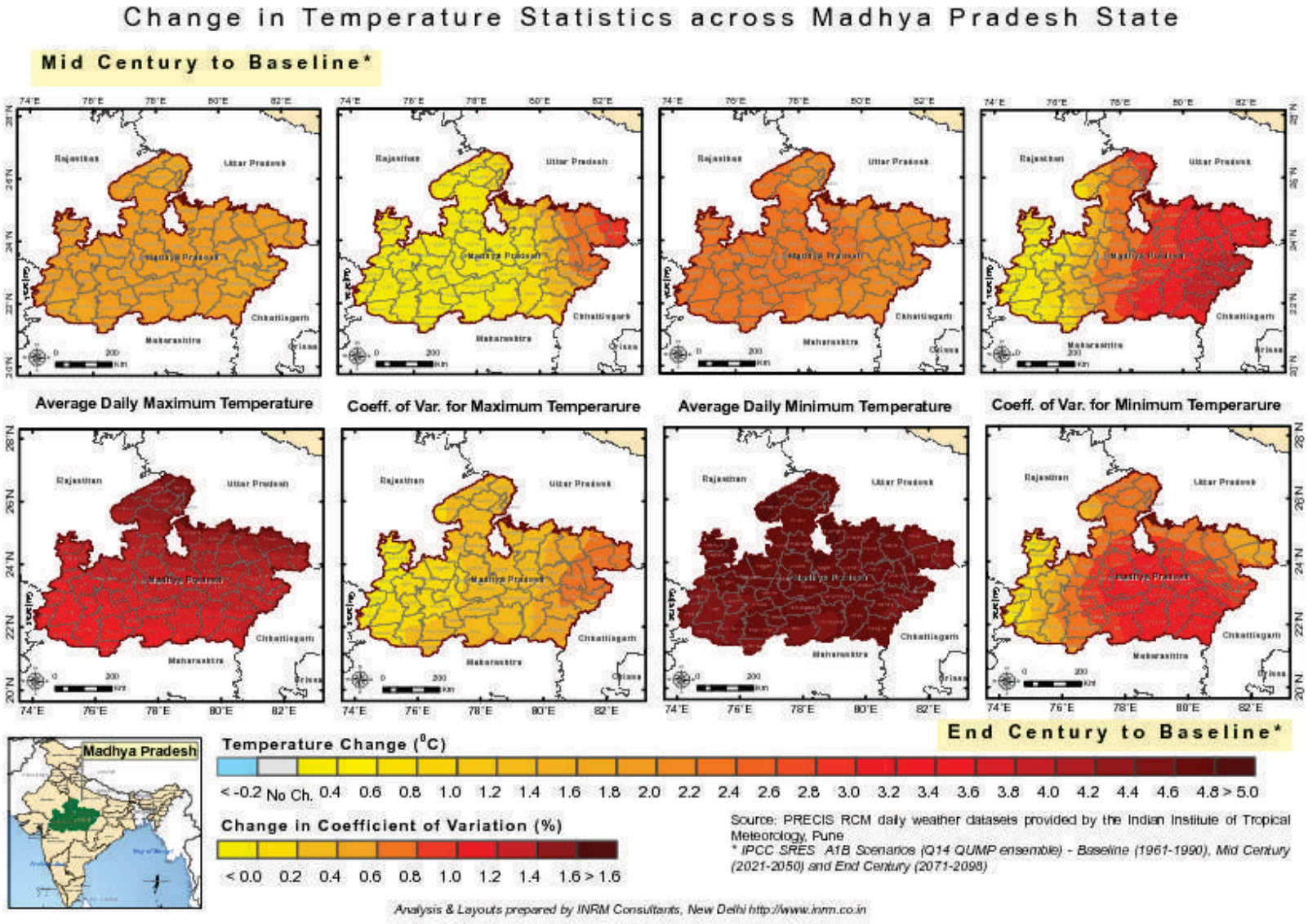


Fig. 4.4 Change in daily average maximum and minimum temperatures in between 2021-2050 and between 2071-2100 with respect to base line (1961-1990)

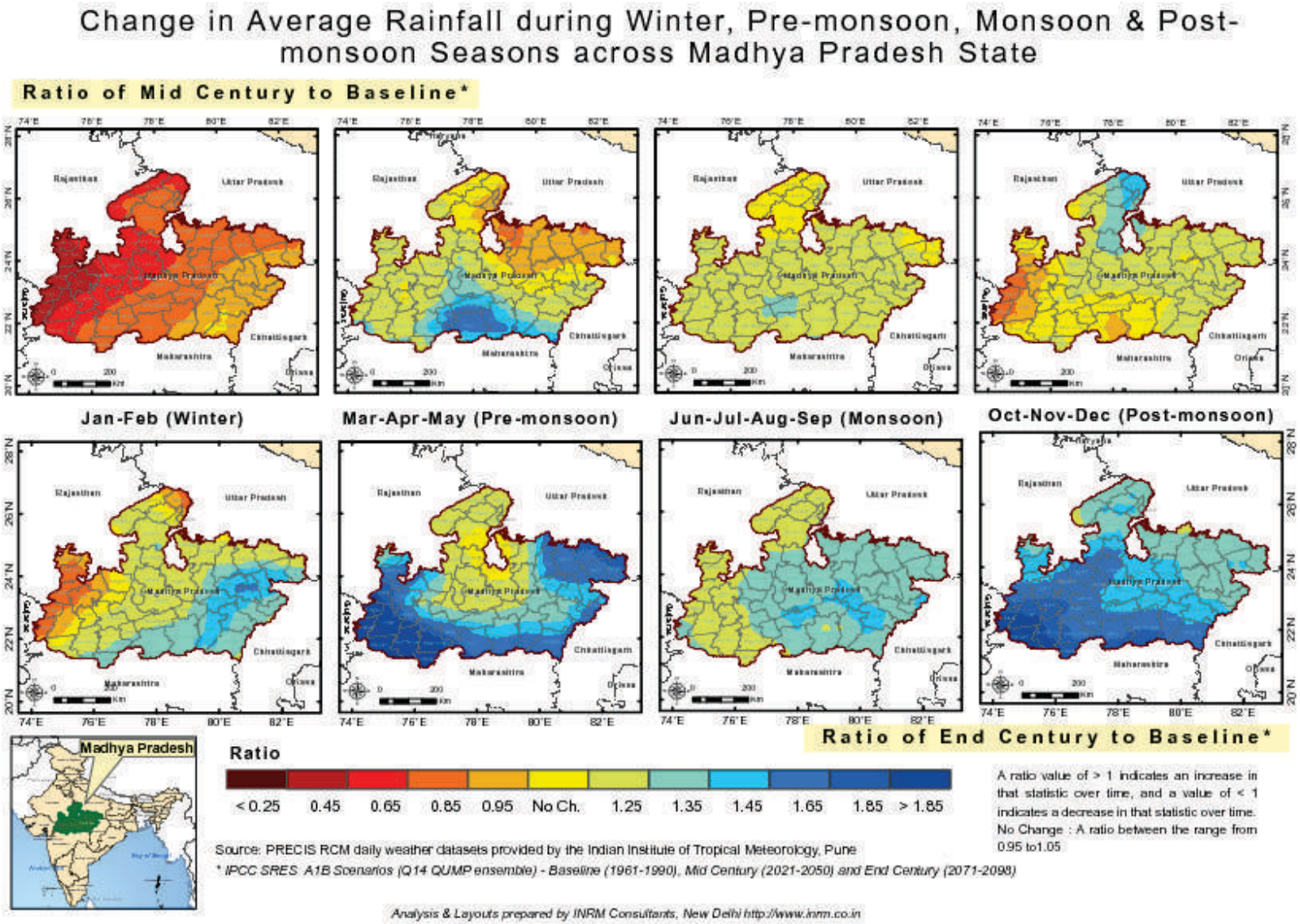


Fig. 4.5 Change in average seasonal precipitation in 2021-2050 and 2071-2100 with respect to baseline (1961-1990)

5 Vulnerability Assessment

Background

According to IPCC, Vulnerability is a function of the character, magnitude and rate of climate variation to which a system is exposed; its sensitivity; and adaptive capacity [IPCC, 2001] and Vulnerability of a system refers to its physical, social and economic aspects and it varies across regions, sectors and social groups. Understanding the regional and local dimensions of vulnerability is therefore essential to develop appropriate and targeted adaptation efforts. At the same time, such efforts must recognize that Climate Change impacts will not be felt in isolation, but as a combination of multiple stresses. Assessment of vulnerability to climate variability and change broadly helps in:

- Understanding current vulnerability.
- Identify the factors that render some districts more vulnerable than others.
- Inform and facilitate the decision-making process.
- Selection of adaptation strategies and practices.

Climate Change Vulnerability in context of MP

With an agrarian economy and natural resources dependent livelihoods of majority of its population, Madhya Pradesh tend to be vulnerable to the vagaries of Climate Change. Districts of Madhya Pradesh were identified as highly vulnerable, socially, in a study which examined exposure to the effects of Climate Change and economic globalisation [TERI, 2000].

Natural calamities like drought, floods and hailstorms are common features for the state. Almost every year one or the other part of the state is affected by drought like conditions enhancing distress migration despite the implementation of various developmental initiatives.

The forest and environmental resources in the state are also under pressure. Pollution of rivers/wetlands, degradation of forests and biodiversity loss is being observed. Poverty and environment linkages are impacting on the Human Development Index and also on disease burden in the state. Inadequate sanitation and safe drinking water still pose a challenge for the state.

In order to have a broad understanding of the Climate Change induced vulnerabilities of the state a detailed assessment was carried out taking into account socioeconomic and environmental indicators.

Methodology of Vulnerability Assessment

To assess the vulnerability of the districts in Madhya Pradesh a composite index is developed by multivariate analysis of individual indicators (social, economic, agriculture, water resource, forest, climate and health) which are vulnerable to Climate Change. In the development of aggregated indicators problems arise when the weights of each index have to be selected. Principal Components Analysis (PCA) is used as an approach to set the weights as a function of the explained variance [Jollands et al., 2004]. The steps involved are:

- To convert raw data into a normalized form. This is done to make the raw data unit free, to avoid one variable having an undue influence on the analysis, to get the relative position of each district in respect of the indicators. Normalized values always lie between 0 and 1.
- To construct the Socioeconomic Index (SEI) by taking all indicators used to construct the Social Index (SI) and Economic Index (ECI) respectively.
- To construct the Environmental Index (ENI) by taking all indicators used to construct the Agriculture Index (AGI), Water Resource Index (WRI), Forest Index (FOI), Climate Index (CLI) and Health Index (HLI).

- To construct the overall Composite Vulnerability Index (CVI) combining all indicators used to construct the SI, ECI, AGI, WRI, FOI, CLI and HLI.
- Identify the districts which are most vulnerable to Climate Change by ranking the districts based on Composite Vulnerability Index.

The indicators and index are subjected to be refined after testing since the model is in a continual process of improvement. The indicators are classified into three classes, which consist of adaptive capacity, sensitivity, and exposure. The indicators are assigned different weights determined by Principal Component Analysis (PCA) to avoid the uncertainty of equal weighting given the diversity of indicators used [Deressa, Hassan and Ringler, 2008].

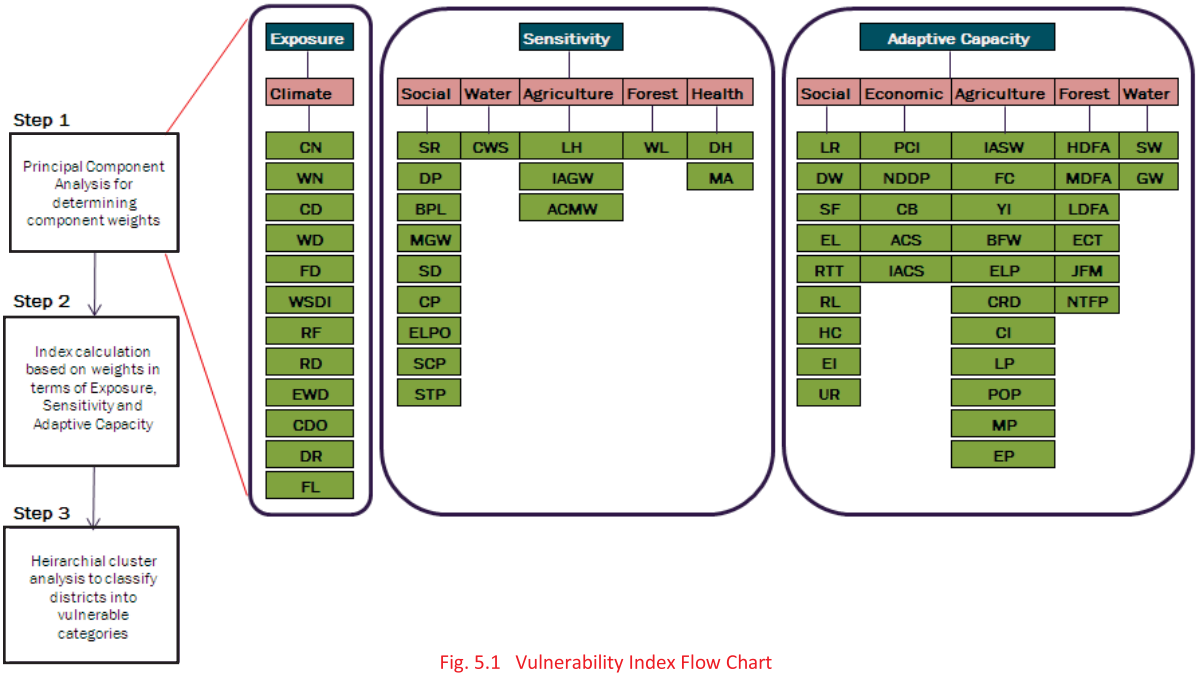


Fig. 5.1 Vulnerability Index Flow Chart

Data projections for mid century and end century

- District wise population of Madhya Pradesh for mid century (2050) and end century (2100) is projected using the Ratio Method.
- Per Capita Income, Net district Domestic Product for mid century (2050) and end century (2100) is projected using the polynomial trend using the 10 years data from 2000-2010.
- Climate, PRECIS simulated climate for IPCC SRES A1B scenario, Impact model outputs for Water Resource and Forest indicators using the PRECIS simulated climate have been used.
- Due to the limitations of the data availability the data for the agriculture and some of the socioeconomic indicators have been assumed to be the same as the base period.

Limitations

As of 2011, Madhya Pradesh has 50 districts, however data for few indicators were available for 45 districts or 48 districts since Burhanpur, Anuppur and Ashoknagar have been added in 2003 while Singrauli and Alirajpur have been added in 2008 in Madhya Pradesh. Therefore for these districts same data is used as the parent district from which they are carved, i.e. East Nimar, Shahdol, Guna, Sidhi and Jhabua respectively.

Vulnerability to Climate Change is a comprehensive multidimensional concept affected by large number of related indicators. These could be related to market, population and other socio-economic factors that act simultaneously together with Climate Change. Vulnerability due to Climate Change impacts can be of various types.

The factors responsible for such changes are grouped into seven components viz., Social, Economic, Agriculture, Forest, Water Resource, Climate and Health. Based on a number of studies that have been reviewed, data availability and time constraint a set of 61 indicators are identified for analysis. The exposure sub-index is comprised of the twelve indicators measuring exposure to variability and extreme values of temperature and precipitation as well as to natural disasters from drought and flood. The sensitivity sub-index is comprised of sixteen indicators and the adaptive capacity sub-index is comprised of thirty three indicators measuring social, economic, water resources, agriculture and forest related indicators.The indicators under each sector and their classification as adaptive capacity, sensitivity or exposure can be referred to in Annexure 5.

Analysis and results

The socio-economic and environmental indicators vary widely within the districts of Madhya Pradesh. The highest range among the social indicators is being recorded for decadal growth rate of population, percentage of people below poverty line, percentage of households with access to sanitation facilities and number of slum dwellers per slum. The variations in the economic indicators are also observed, for example an analysis of the per capita income and net district domestic product at current prices shows that Indore has the highest value while the lowest value is observed in Dindori. Population served per health centre which includes community, primary and sub health centres shows good range of variation among the districts with the highest range being observed for Bhopal and least for Mandla. Among the environmental indicators fertilizer consumption, yield of all crops average, livestock population, flood discharge and annual average rainfall shows the highest range in variation.

BASELINE: It shows cluster 4 (very high vulnerability) comprising of 12 districts to be the most vulnerable. The districts in this cluster are characterized by very low values of Composite Vulnerability Index (CVI) and hence are considered to be vulnerable to Climate Change. The districts in this cluster are in the East and North of Madhya Pradesh except Alirajpur which is located in the South West. The third cluster comprising 22 districts are also vulnerable but are relatively less than the districts in the fourth cluster. The first and the second clusters are made up of 12 and 4 districts respectively have moderate to low vulnerability. The districts in these clusters are located in the Southern region of Madhya Pradesh excepting Gwalior which is located in the North. The districts in these clusters by their high positive indices are less vulnerable to Climate Change because the households have high literacy rate, high per capita income and have more access to infrastructure. They are also characterized by lower values of extreme events due to Climate Change.

It is inferred that districts namely, Dindori, Anuppur, Shahdol, Ashoknagar, Tikamgarh, Umaria, Singrauli, Sidhi, Morena, Alirajpur, Panna, Bhind are the most vulnerable to Climate Change since they have comparatively low adaptive capacity and are highly exposed to Climate Change with respect to other districts while Bhopal, Indore, Hoshangabad and Gwalior are low vulnerable districts as they have higher adaptive capacity and show lower sensitivity and exposure to Climate Change. The lesser vulnerability of districts is associated with its relatively higher economic capacity, its highest irrigation potential, high literacy rate, less exposure to extreme climatic events, larger forest area and better access to infrastructure. The district ranking within each cluster can be seen from Fig. 5.3.

The districts in very high vulnerable category also have very high social, economic, agriculture, forest, water resource, health and climate indices (Fig. 5.4). Dindori, Anuppur, Shahdol, Ashoknagar and

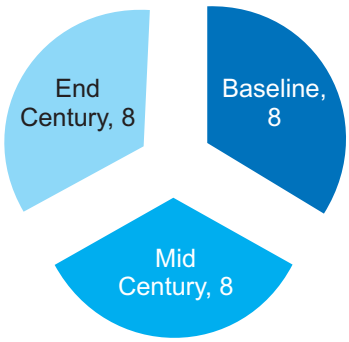
Tikamgarh show higher indices for most of the sub sectors, and thus these districts also show higher vulnerability in the composite VI, except that Tikamgarh has slightly high index with respect to health and water resource, Ashoknagar with respect to water resource and Shahdol with respect to health index. Indore and Bhopal have higher values with regards to all sub indices and thus they are in the best positions in CVI, except that Indore has low index with respect to water resources and Bhopal with respect to health and forest indices.

MID CENTURY: Fig. 5.2 shows the district vulnerability towards mid century. It can be seen that 2 districts namely, Sidhi and Panna have moved to high vulnerable category from the very high vulnerable category in the baseline while Bhind has come to the high vulnerable category from very high in the baseline. The number of districts in moderate category reduces from 12 in the baseline to 7 in the midcentury as 5 districts namely, Burhanpur, Chhindwara, Seoni, Narsimhapur and Ujjain moves to the high vulnerability from moderate vulnerability shown in baseline. Thus the overall vulnerability of districts increases in mid century as compared to the base scenario.

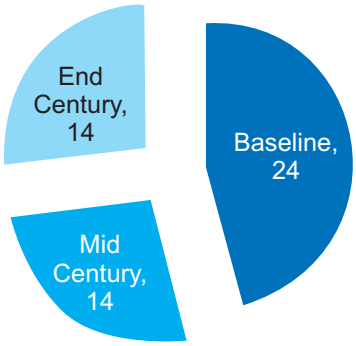
The district ranking within each cluster can be seen from Fig. 5.3. It can be seen from the map that even within the high vulnerability category of 11 districts, Dindori stands out because of high exposure and sensitivity and low adaptive capacity. Additional five districts which have moved from moderate to high vulnerability in the mid century are because of increased sensitivity and exposure indicators as shown in. Bhopal, Indore, Gwalior, and Hoshangabad remain low vulnerable districts.

END CENTURY: Fig. 5.2 shows the district vulnerability towards end century. It can be seen that additional three districts namely, Sidhi, Panna and Bhind moves to very high vulnerable category from the high vulnerability in the mid century. The overall vulnerability of districts increase in the end century compared to the base scenario. Bhopal, Indore, Jabalpur and Hoshangabad remain low vulnerable districts.

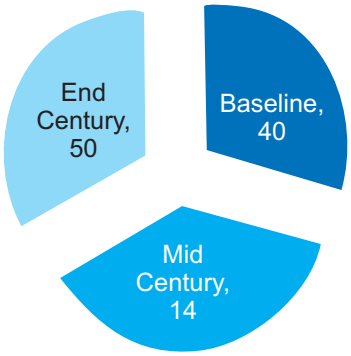
Number of Districts in Low Vulnerability



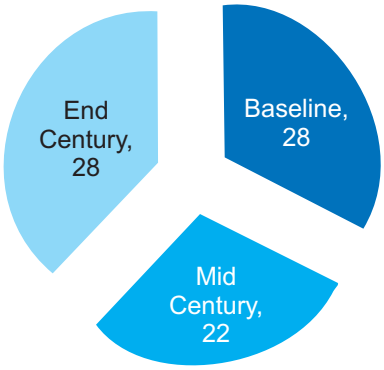
Number of Districts in Moderate Vulnerability



Number of Districts in High Vulnerability



Number of Districts in Very High Vulnerability



The pie charts above give the percentage of districts falling in low, moderate, high and very high vulnerability category under baseline, mid and end century scenario. It can be inferred from the figure, that the districts which are currently moderate to high vulnerability are projected to experience higher vulnerability towards mid and end century.

Table 5.1gives the relative ranking of the districts for the baseline, mid century and end century scenarios. A rank value 1 indicates that the district is least vulnerable to Climate Change with respect to other districts and rank value 50 indicates that it is the most vulnerable among all the districts. Spatial representation of district ranking is depicted in Fig. 5.3.

CVI [(Rank (Cluster, Index)]			
Districts	**Baseline**	**Mid Century**	**End Century**
Bhopal Division			
Bhopal	2 (1, 0.099)	2 (1, 0.089)	2 (1, 0.1)
Raisen	9 (2, 0.018)	11 (2, 0.013)	10 (2, 0.009)
Vidisha	18 (3, -0.001)	17 (3, -0.004)	17 (3, -0.01)
Sehore	22 (3, -0.011)	27 (3, -0.021)	26 (3, -0.024)
Rajgarh	34 (3, -0.036)	43 (4, -0.049)	41 (4, -0.051)
Chambal Division			
Sheopur	32 (3, -0.035)	34 (3, -0.032)	33 (3, -0.038)
Bhind	39 (4, -0.043)	37 (3, -0.038)	38 (4, -0.047)
Morena	42 (4, -0.055)	41 (4, -0.047)	42 (4, -0.053)
Gwalior Division			
Gwalior	3 (1, 0.077)	3 (1, 0.08)	4 (1, 0.071)
Shivpuri	30 (3, -0.028)	29 (3, -0.026)	28 (3, -0.03)
Guna	34 (3, -0.036)	36 (3, -0.036)	35 (3, -0.04)
Datia	37 (3, -0.037)	31 (3, -0.029)	30 (3, -0.036)
Ashoknagar	47 (4, -0.069)	47 (4, -0.067)	45 (4, -0.069)
Indore Division			
Indore	1 (1, 0.133)	1 (1, 0.124)	1 (1, 0.127)
West Nimar	8 (2, 0.022)	7 (2, 0.02)	7 (2, 0.014)
East Nimar	10 (2, 0.016)	10 (2, 0.014)	10 (2, 0.009)
Burhanpur	14 (2, 0.006)	12 (3, 0)	15 (3, -0.004)
Barwani	17 (3, 0.003)	19 (3, -0.005)	21 (3, -0.016)
Dhar	19 (3, -0.002)	14 (3, -0.001)	13 (3, -0.001)
Jhabua	30 (3, -0.028)	33 (3, -0.031)	34 (3, -0.039)
Alirajpur	41 (4, -0.047)	41 (4, -0.047)	39 (4, -0.05)

CVI [(Rank (Cluster, Index)]			
Districts	**Baseline**	**Mid Century**	**End Century**
Jabalpur Division			
Jabalpur	5 (2, 0.048)	5 (2, 0.045)	5 (2, 0.046)
Narsimhapur	12 (2, 0.007)	12 (3, 0)	12 (3, 0.002)
Seoni	12 (2, 0.007)	14 (3, -0.001)	20 (3, -0.015)
Chhindwara	16 (2, 0.005)	20 (3, -0.006)	18 (3, -0.011)
Balaghat	24 (3, -0.013)	24 (3, -0.017)	27 (3, -0.026)
Katni	28 (3, -0.026)	23 (3, -0.013)	23 (3, -0.019)
Mandla	38 (3, -0.039)	40 (4, -0.043)	39 (4, -0.05)
Narmadapuram Division			
Hoshangabad	4 (1, 0.067)	4 (1, 0.063)	3 (1, 0.079)
Harda	6 (2, 0.031)	6 (2, 0.029)	6 (2, 0.031)
Betul	23 (3, -0.012)	28 (3, -0.023)	29 (3, -0.033)
Rewa Division			
Satna	26 (3, -0.016)	22 (3, -0.01)	22 (3, -0.018)
Rewa	34 (3, -0.036)	29 (3, -0.026)	31 (3, -0.037)
Sidhi	43 (4, -0.058)	39 (3, -0.04)	44 (4, -0.063)
Singrauli	44 (4, -0.066)	44 (4, -0.051)	47 (4, -0.073)
Sagar Division			
Sagar	21 (3, -0.007)	21 (3, -0.008)	19 (3, -0.013)
Damoh	26 (3, -0.016)	25 (3, -0.018)	23 (3, -0.019)
Chhatarpur	32 (3, -0.035)	32 (3, -0.03)	35 (3, -0.04)
Panna	39 (4, -0.043)	37 (3, -0.038)	37 (4, -0.046)
Tikamgarh	45 (4, -0.068)	46 (4, -0.062)	46 (4, -0.072)
Shahdol Division			
Umaria	45 (4, -0.068)	45 (4, -0.055)	43 (4, -0.061)
Shahdol	48 (4, -0.089)	48 (4, -0.075)	48 (4, -0.085)
Anuppur	49 (4, -0.093)	49 (4, -0.077)	49 (4, -0.098)
Dindori	50 (4, -0.108)	50 (4, -0.1)	50 (4, -0.118)
Ujjain Division			
Dewas	7 (2, 0.023)	8 (2, 0.018)	7 (2, 0.014)
Neemuch	11 (2, 0.015)	9 (2, 0.015)	9 (2, 0.012)
Ujjain	14 (2, 0.006)	14 (3, -0.001)	13 (3, -0.001)
Ratlam	20 (3, -0.004)	17 (3, -0.004)	15 (3, -0.004)
Mandsaur	25 (3, -0.015)	26 (3, -0.019)	25 (3, -0.023)
Shajapur	28 (3, -0.026)	35 (3, -0.035)	31 (3, -0.037)

Table 5.1 CVI district Ranks (Cluster) for the baseline, mid century, and end century scenarios

Significant Indicators

Principal Component Analysis performed also indicates the indicators which play significant role in explaining vulnerability among the districts. Amongst all the indicators considered in particular sector indicators with weights greater than the average weight of all indicators are considered as important in explaining vulnerability. Table 5.2 gives the list of significant indicators in order of their importance for each sector. These indicators can play important role in decision making in a goal to reduce vulnerability.

Indicators	Conceptual Basis
Social	
Population Served per Health Centre (Community, Primary and Sub Health Centres)	Adaptive Capacity
Percentage of Households With Access To Sanitation Facilities	Adaptive Capacity
Level of urbanization	Adaptive Capacity
Percentage of Households With Access To Safe Drinking Water	Adaptive Capacity
Density of Population	Sensitivity
Number of Slum Dwellers Per Slum	Sensitivity
Percentage of Households owning Radio ,Transistor, Television And Telephones	Adaptive Capacity
Proportion of elderly population aged 65 and above	Sensitivity
Proportion of Child Population In The Age Group 0-6	Sensitivity
Literacy Rate	Adaptive Capacity
Economic	
Agricultural credit societies per lakhs of population	Adaptive Capacity
Loan disbursed by agricultural credit societies per cultivator	Adaptive Capacity
Scheduled commercial banks per lakhs of population	Adaptive Capacity
Agriculture	
Percentage of Land Holdings below 1 Hectare	Sensitivity
Fertilizer Consumption	Adaptive Capacity
Percentage of Net Irrigated Area To Geographical Area By Surface Water	Adaptive Capacity
Percentage of Bio-Farming villages in total villages	Adaptive Capacity
Percentage Share of Agricultural And Cultivators Main Workers	Sensitivity
Yield of All Crops	Adaptive Capacity
Water	
Crop Water Stress(Evapo-transpiration/Potential Evapo-transpiration)	Sensitivity
Surface Water Availability Adaptive Capacity	
Climate	
Warm nights- days when minimum temperature > 90th Percentile	Exposure
Warm Days - Cool nights- days when maximum temperature > 90th Percentile	Exposure
Warm Spell Duration Indicator (Annual count of days with at least 6 consecutive days when maximum temperature>90th percentile)	Exposure
Cool Days - Cool nights- days when maximum temperature < 10th Percentile	Exposure
Cool nights- days when minimum temperature < 10th Percentile	Exposure

Indicators	Conceptual Basis
Flood discharge	Exposure
Extremely Wet Days-Annual total rainfall when rainfall>99th percentile	Exposure
Health	
Percentage of People Having Diarrhoea	Sensitivity
Index of Malaria	Sensitivity
Forest	
Percentage of High Density Forest area to geographical area	Adaptive Capacity
NTFP Diversity(no of varieties)	Adaptive Capacity
Number of JFM Communities	Adaptive Capacity

Table 5.2 List of significant indicators in order of their importance for each sector

The analysis of the pattern of vulnerability of districts in Madhya Pradesh to Climate Change has shown that generally the north, east, south east and south western districts are more vulnerable to Climate Change. This is explained by the greater exposure to drought and climate extremes as well as relatively low levels of technology and socio-economic and infrastructure development.This exercise is a modest attempt to assess the vulnerability issues of the state.

Though the outcome of this VA study largely conforms with the general understanding that MP is exposed to Climate Change vagaries, There is need for developing adaptataion, plan of action for the state with focus on forestry, water, agriculture and health sectors, because on the new knowledge in the field of climate science.

The MP Vulnerability Assessment study was taken up as part of the ongoing MoEF/GIZ combined CCA-RAI project. This is an attempt to understand the vulnerability issues in the state. However, given the geographical size, methodological constraint, sectors involved and paucity of time and data requirement, the study has its own limitations. This is being fine tuned with additional inputs. The study is in the draft stage and efforts are being made to refine the outcomes so that it is more accurate. Readers are advised to refer to the draft report on Vulnerability Assessment available at SKMCCC, EPCO.

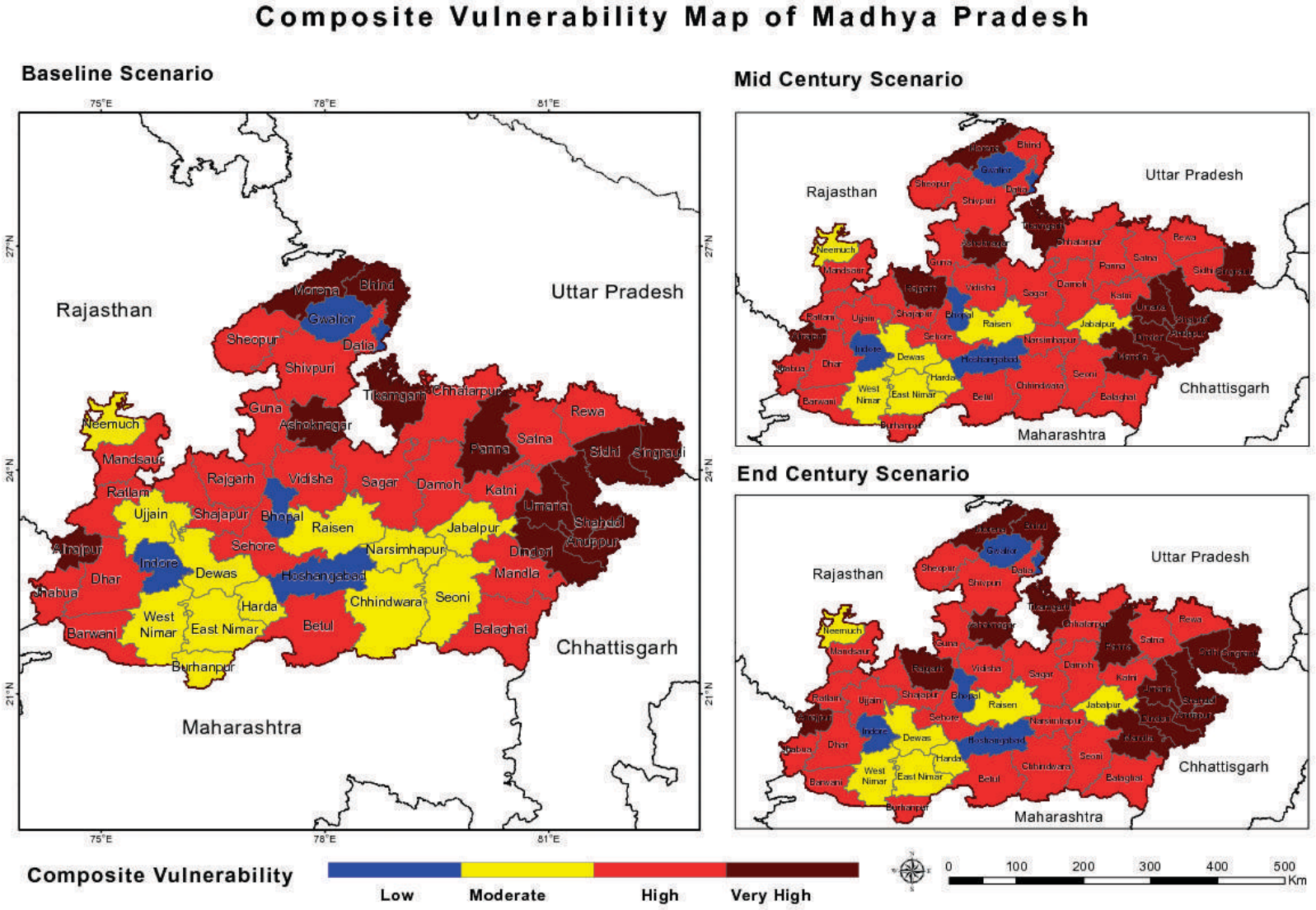


Fig. 5.2 Composite Vulnerability map showing low, moderate, high and very high cluster of districts in M P

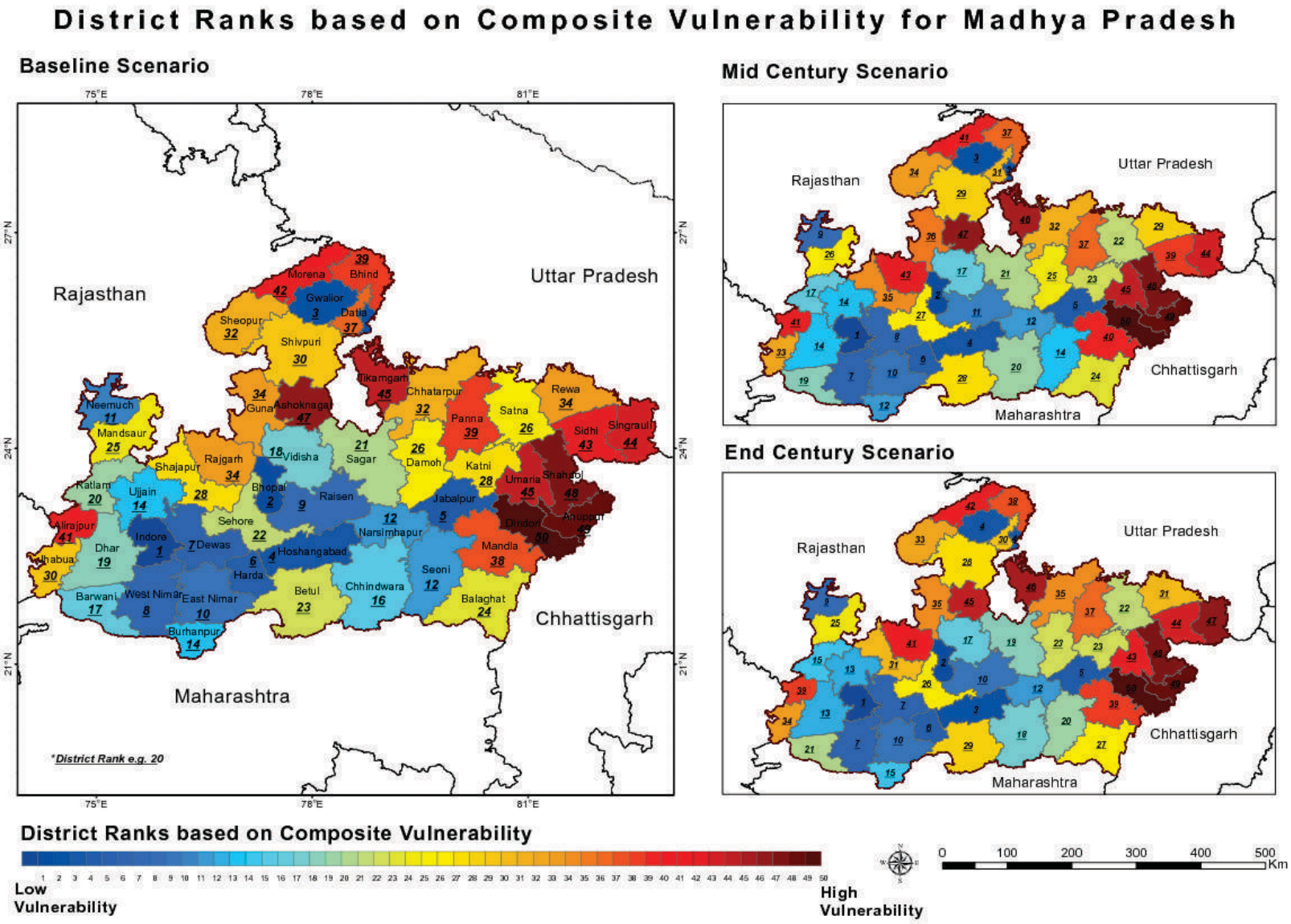


Fig. 5.3 Map showing composite vulnerability ranking of individual districts in M P used for clustering as shown in fig 5.2

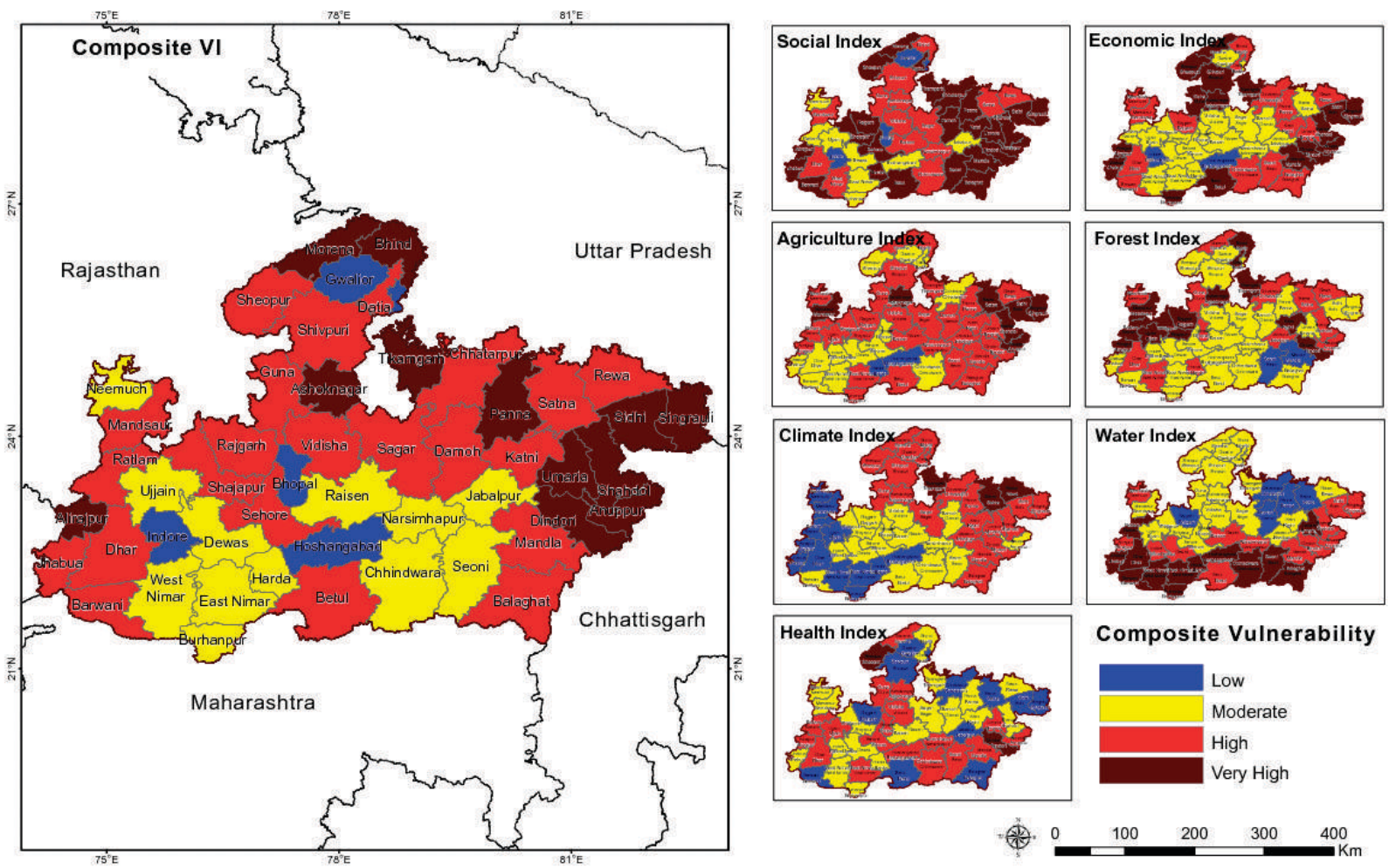


Fig. 5.4 Composite Vulnerability map showing low, moderate, high and very high cluster of districts in MP along with sub-indicescluster map

Section-II

"Considering the Climate Change induced vulnerabilities and challenges that could be concerns for the state, ten sectors were considered sensitive in the context. Through the wide-scale consultation process followed to draft the State Action Plan on Climate Change, all the State Government departments dealing with these identified sectors were consulted. This section provides an overview of identified issues and possible solutions to address these issues."

* *Forestry & Biodiversity*
* *Water Resources*
* *Agriculture, Horticulture, Animal Husbandry & Fisheries*
* *Human Health*
* *Urban Administration & Transport*
* *Energy*
* *New & Renewable Energy*
* *Industries*
* *Rural Development*
* *Environment*

6 Forests and Biodiversity

Background

Madhya Pradesh is endowed with rich forest resource and biodiversity. The role of forest in the ecosysytem is now very much evident and thus conservation and preservation of these forests is crucial and forms utmost priority of the state. They have an important function in maintaining the river flow, which is a major source of irrigation. Apart from providing regulatory services forest are also important from the socio economic perspective. MP has a large tribal population which is socially, culturally and economically dependent on forests for their sustenance. Timber from these forests is important source of revenue for the Forest Department. Non Timber Forest Produce has an important role in providing the livelihood to the forest dwellers. The minor produce from the forests include tendu leaves, harra and sal seeds, several roots, fruits, nuts, seeds, resins and gums etc. Besides agriculture and livestock, rural economy of MP is mainly dependent on forests and forest products.

The management of the forests is done by the State Forest Department. The state manages its forest resource through scientifically prepared documents called 'Working Plans'. "Management Plans" are also prepared for Protected Areas (PAs) to provide guidelines and action plan for scientific management of wildlife resources.

The state forest department is equipped with one of the best Information Technology facility in the country, which is capable of using remote sensing inputs for combating forest fires, monitoring encroachments & monitoring the forest cover status in general. The state ranks 10th in terms of total growing stock.

Forest Statistics of the State

Total Forest Area	30.71% of geographical area of state
	12.44 % of the total forest area of the country
Density wise classification of forest	Dense cover - 8.55% of total state forest cover
	Medium Cover - 45.05% of total state forest cover
	Open Cover - 46.39% of total state forest cover
Forest Types as per Champion & Seth Classification	79.71%- tropical dry deciduous
	17.90% - tropical moist deciduous and
	0.27% - tropical thorn forests
Various Notified Areas	9 National Parks, 25 Wild Life Sanctuaries 5 Tiger Reserves
Important Biodiversity of State	Tree Species - Sal, Teak, Saja, Tendu, Mahua, Harra, Baheda, Aonla, Bija, tinsa, khair, salai, haldu and lendia
	Wildlife – Tiger, Barasingha, Cheetal, Sambhar, Nilgai, Wild boar, Gaur and various upland birds,
Tribal population	20% of state's tribal population
Total forest growing stock in the state	336.15 million cubic meter out of which 249.66 million cubic meter from forest area and 86.49 million cubic meter from Trees outside forest resources
Main forest types based on composition	Teak Forest, Sal Forest and Mixed Forest

Source : Forest Survey of India, State of the Forest Report (2009)

Policies and Programmes

Vaniki Act & Land Revenue Code – The subject of trees on private land is dealt by M. P. Land Revenue Code, 1959. The state enacted Lok Vaniki Act in 2001 to facilitate the owners of woodlots (forest tree crops on private lands) to grow forestry crops & maintain forests on private lands. This Act has also passed the scrutiny of the Apex Court of the country and is a very effective tool in encouraging the farmers to grow more trees (Agro-forestry, farm-forestry, silvi-pasture etc) & increase TOF resource.

Joint Forest Management – A total of 15,228 Forest Protection Committees /Village Forest Committees

are managing about 66,873.85 sq kilometres forest area under Joint Forest Management Programme. As an adaptive social process, JFM is striving to create sufficient future forest production opportunity to satisfy potentially competitive/conflicting interests that would diminish the forest if left unresolved, benefitting lakhs of population in the process. Some of the initiatives taken under the programme for the benefit of JFMCs are –

- Issuance of Central Kisan Credit Cards
- Plantation through private funds
- Strengthening rural electrification through renewable sources
- Introducing alternatives for fuel wood
- Other livelihood options like sericulture, poultry, dairy, lac production etc.

Project Tiger Scheme and Development of National Parks and Sanctuaries Scheme – It involves eco development scheme which is a site specific village (around PAs) level planning by the villagers for sustainable development of village resources which can provide job opportunities ensuring active participation of villagers in protection of PAs and Tribal beneficiaries relocated from PAs. However, future projects of forest management would stress more on development of ecosystem services rather than regional or site specific ones in order to ensuring a wholesome approach towards safeguarding an ecosystem and making it sustainable.

Concerns of Forestry Sector

Forest cover is changing and degrading due to various anthropogenic pressures despite the fact that modern technology particularly fire surveillance and other protection measures have been intensified in the state. Increased dependence on forests for fuelwood and timber, diversion of forest lands for non-forestry purpose; encroachments are some of the main concerns of the sector.

The state has been liberal in providing access to forest and granting entitlement on the small forest products. A section of the forestry experts feel that the entitlement, empowerment and access have not been accompanied by commensurate emphasis on "responsible management and use practices".

All these have resulted into unsustainable extraction and use of NTFP resources of the state. The result has been that a large number of important NTFP yielding species have gone into RET (Rare, Endangered and Threatened) category of IUCN. Studies have shown that many of these species and their collection have reduced from 60-90% in the last 5 years or so. They are most important elements of biodiversity. Continued degradation of forest and consequent depletion of these elements of biodiversity is an indicator of imminent threats from impending impacts of Climate Change.

Records suggest that there are as many as 50,000 people occupying 1,43,000 hectares of forestland. A livestock population of about two crores is also dependent on these forests for grazing. In addition 20,00,000 cattle and other animals visit the state from neighbouring states every year. Extraction of fuel wood mostly for self consumption and also for cash income continues to be a major pressure on

Concerns

* Pressure on forests for fuel wood
* Illegal felling
* Unchecked and unregulated conversion of forest land to farm land
* Overall deteriorating forest health and productivity
* Consumption of forest land for development activities neglecting compensatory afforestation
* Changing type of biodiversity and phenology of plants
* Predicted increase in forest fragmentation
* Increased incidences of man-animal conflicts
* Forest fires
* Unsustainable harvesting practices of forest produce
* Increased pest attacks
* Adverse impacts of extreme weather events (like frost) on forest vegetation

forests. Uncontrolled grazing and unsustainable use of forest resources for income generation will continue to cause forest degradation.

Forest ecosystem conservation assumes special significance vis a vis enhancing forest produce as well as acting as agents of carbon sequestration, however it is essential that the forest dwellers should also receive a part of the compensation for regenerating/ conserving the forests.

Forest degradation and consequent depletion of growing stock is resulting into reduced carbon sequestration potential of forests. Shift of the approach from economic rotation of forest to carbon rotation is needed. The local population living inside forests has limited livelihood opportunities and therefore are driven by market forces to resort to unsustainable extraction of forest resources particularly the NTFPs including medicinal plants. Thus in such areas there may be problems of degradation and reduced carbon sequestration.

The agro-climatic zone wise vulnerability of the forests, based on topography of the zone, forest cover, population dependent on forest produce, revenue earned from forest produce and the status of forest cover and biodiversity of forests, indicates that the forests of Jhabua hills, Nimar plains, Bundelkhand, Gird and Satpura plateau are highly vulnerable. Vulnerability mapping of Indian Forests [Ravindranath et.al.] shows that Central Indian States of M.P. & Chattisgarh are most vulnerable to the effects of the Climate Change.

As temperature increases and rainfall pattern changes, forest growth, and regeneration of forests in all parts of Madhya Pradesh is likely to be affected. It is likely that higher rates of degradation of forests and soils would occur there by affecting biodiversity and hence reduce forest produce, which in turn will affect the livelihood opportunities.

It would be highly important to assess the carbon sequestration potential of the state's forests, especially in view of rapid destruction of these carbon sinks. It is also expected that capacity of forest areas to act as catchment areas for different rivers emanating from the forest regions might lessen due to forest degradation. Increasing forest fires, biodiversity loss & spread of pests and invasion of alien species including weeds leads to increased human and wild life conflicts, as pressures on forest land increase.

Strategies for Forestry sector

1. Development of Sustainable Forest Management Plans for different forest types in view of Climate Change: Detailed studies are recommended to understand impacts of Climate Change on forest productivity in different forest types using different climate and biodiversity models. This would help in developing climate resilient forest management plans. Revival of preservation plots, sample plots & yield plots is also recommended.To move from business as usual scenario adaptation plans for each forest type of MP according to their biophysical vulnerabilities to Climate Change should be developed and implemented.
2. Enhancing the levels of forest conservation, afforestation, reforestation activities through viable models: Most forest areas of the State are well demarcated on the ground and on map. However in view of implementation of FRA, 2006 there may be some honey-combing and fragmentation. Proper demarcation of forest boundaries in view of the vulnerability of remaining forest areas from further encroachments is needed. Similarly for sustainable PA management the forest/ wildlife corridors need to be identified for connecting different National Parks and Sanctuaries of the State. This will allow conservation and migration of gene pool from high concentration areas to lower concentration. State Forest Department with the technical assistance of GIZ is in the process of developing A/R CDM project. More of such initiatives may be undertaken to harness the market based opportunities like REDD+, CDM etc for forest conservation. Regular plantation activities as a measure for restoration of degraded ecosystems should be continued in a well planned manner. To

avoid the conflicts on the issue of biodiversity conservation and livelihood effective implementation of "care and share" mechanism (eg. establishment of PPAs, MPCAs, and CCAs) should be adopted.

3. Prioritise soil and water conservation in forest management: The role of forests in conserving the biodiversity and the hydrological function performed by forests needs to be re-emphasized to prepare for meeting the challenges posed by Climate Change. The catchment area treatments need to be taken on high priority basis with scientific approach. An integrated approach is required to treat the landscape irrespective of its current uses (Forest, grassland, agriculture etc). Integrated watershed management with the help of silvi-pasture development shall be promoted in the forest fringe areas. Identification of critical areas within forests for soil and water conservation should be undertaken. Similarly, water harvesting and storage structures in the form of water bodies, wetlands etc should be created in the forest areas. This would help in soil moisture conservation and would also provide drinking water to wildlife.

4. Research on the impact of CC on the forest types and forest based ecosystem services: Developing 'centres of excellence' to undertake regional analysis for the entire spread of forest types and Climate Change related threats analysis using climate models. Researches to forecast the likely impact of Climate Change phenomenon in forest areas, to assess the vulnerability, carbon sequestration potential and adaptability of indigeneous tree species should be undertaken on high priority. The state has developed well organised fire detection and control mechanism using IT application. These efforts have been helpful in reducing the risk of extensive forest fire. Documentation of the initiatives like PPAs, MPCAs, Community Conserved Areas and exploring the possibility of more such initiatives to involve and develop sense of ownership among the communities for conservation of forests.

5. Capacity building: Orientation of the forest managers, officers and workers to the implications of Climate Change on forest ecosystem as a whole with emphasis on impact on forest growth, carbon sequestration, water balance and overall effect on the productivity of different ecosystems. Imparting training to communities on various schemes /programmes /associated benifits of social forestry, PPA, water conservation, market instruments etc so that they could participate in such initiatives and build their adaptive capacities. Programmes such as "Nav Bihan" launched for the JFMC members of Madhya Pradesh by the M P Forest Department should be replicated for other targeted stakeholders.

6. Promote use of alternate source of energy in forest villages and adjoining revenue villages: So far the forest dwellers have been mostly dependent on forest biomass for lighting, cooking and heating. They need to be encouraged for the use of non conventional source of energy (eg solar) for these purposes. Interventions like green livelihoods (eg: Lighting a Billion Lives programme) to promote alternate fuel use and mechanism to support these interventions need to be done.

7. Livelihood security of Forest Dependent Communities: There is need to strengthen NTFP focused forest management to help forest dependent communities adapt to Climate Change. Traditional sources of livelihood dependent on like Lac & Kosa shall also be enhanced and related skill building programmes should be undertaken. Ecology linked programmes like ecotourism have emerged as potential for enhanced employment and income to local people, these should be built in proper way so that real aim of these programmes could be acheived. Involving the communities in the conservation of the forest and providing opportunity for forest based livelihoods like silviculture, lac culture honey collection etc need to be taken up on high priority basis. The government of Madhya Pradesh has been very liberal, perhaps the only state to recognize the community efforts in conservation of forests and therefore has agreed to distribute substantial part of forest revenue for the welfare of indigenous people.

8. Biodiversity Conservation: Biodiversity is the basis of life and changing climate poses great threat to it. There is a need to strengthen biodiversity institutional mechanism and integrate Climate Change concerns in the Biodiversity Action Plan. There is urgent need to identify ecologically fragile areas, Rare Endangered Threatened (RET) species, Alien Invasive Species (AIS) to supplement working plans for biodiversity conservation.

9. Enhance green cover outside forests: To create good forest cover it is necessary to bring the non forest areas also under green cover. This could be achieved by giving impetus to social forestry, agro forestry and under trees outside forests (TOFs) mainly along roads, canals, railways etc. The Madhya Pradesh Forest Department has planted with the help of local communities, 1.5 crores saplings of Bamboo in Bamboo Year 2010 and 20 lakh plus saplings of Mohua & Khamer on non forest lands. Such initiatives need to be intensified with convergence of other departments.

10. Vulnerability mapping of Forests of M.P.: Vulnerability mapping of the forest ecosystem and livelihood of forest dependent communities with reference to Climate Change with the help of indicators like: Forest Cover Map, Wastelend Atlas, Vulnerability Maps, Watershed Atlas, Socio-economic Atlas, Ethnicity, Poverty Index etc should be taken up and accordingly the adaptation plans should be made and implemented in the state.

11. Participation of People: The state has already been engaged in promoting people's participation in sustainable forest management. Over 15000 JFMCs (FPCs, VFCs and EDCs) have already been formed in the state. These need to be strengthened and actively involved in sustainable forest development activities. Community participation in conservation and monitoring actities should be encouraged in order to resolve the conflict between forest and people. This would inculcate sense of owenership among the communities. The communities performing well should be suitably rewarded.

Impact of climate change on forests of Madhya Pradesh

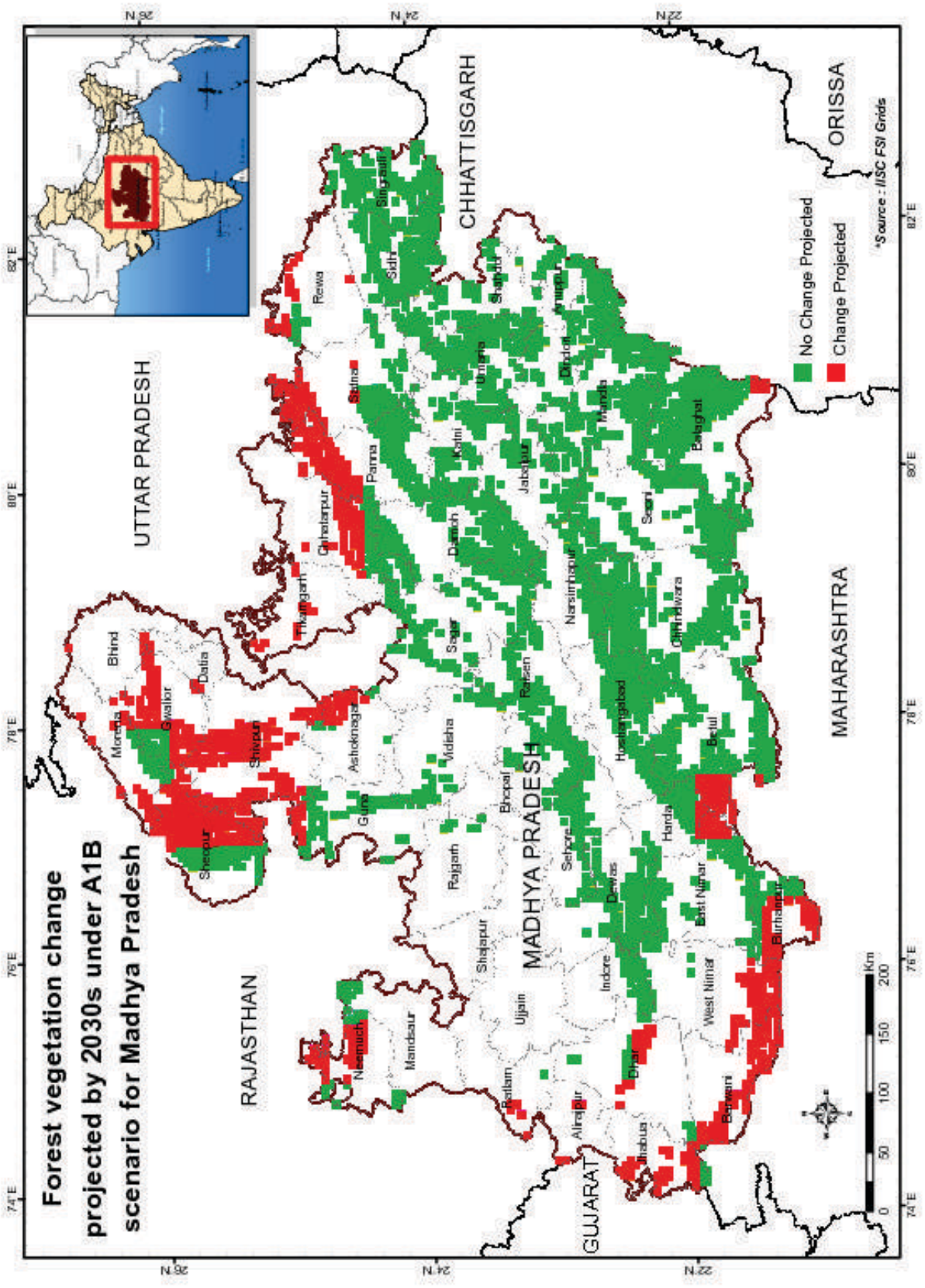
An assessment of the impact of projected climate change on forest ecosystems in Madhya Pradesh has been made using the global dynamic vegetation model IBIS and A1B Climate change scenario for the assessment period 2021-2050 for short term and 2071 – 2100 for long term.

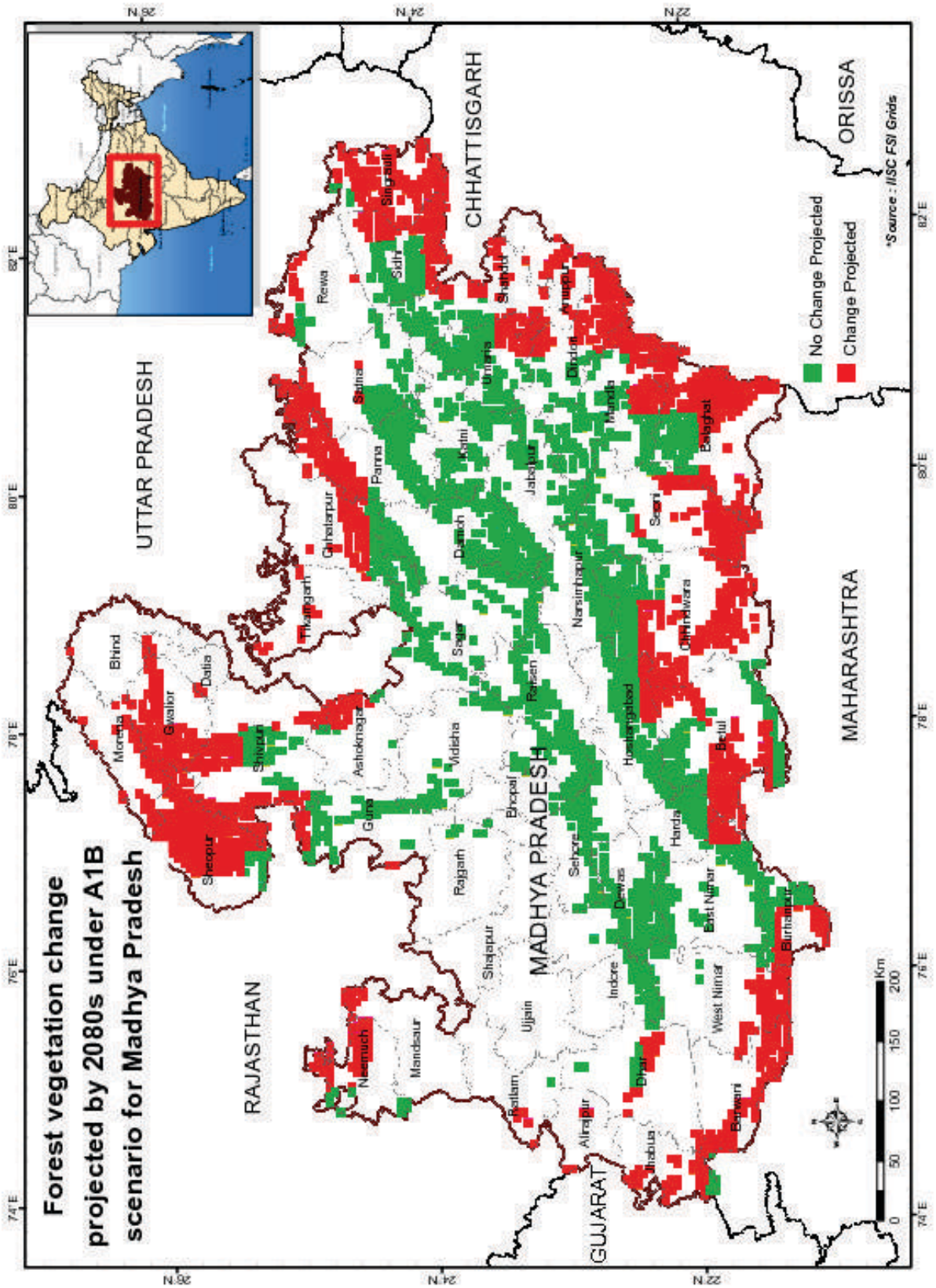
The impacts of projected climate change are assessed at regional climate grid scales (about 50 X 50 km).The dynamic global vegetation model (IBIS) has been validated by Indian Institute of Science, Bangalore for its suitability to Indian conditions. The IBIS model was run at the national level and the outputs are extracted for Madhya Pradesh.

The dynamic vegetation model outputs show that during the short-term period of 2030s, out of the 4426 forested grids in Madhya Pradesh, 1000 (23%) will be impacted by climate change. Percentage of the forested grids projected to be impacted by 2080s is higher to the tune of 48% (2131 grids). The distribution of forested grids projected to be impacted by climate change is presented in Figures below for 2030s and 2080s.

Forested grids mainly in the northern and south western part of Madhya Pradesh are projected to be impacted by climate change during the short-term period (2030s) under A1B scenario (Fig. 6.1). In the long-term period (2080s), in addition to the northern and south western parts, southern and eastern districts of Madhya Pradesh are also projected to be impacted (Fig. 6.2). The forests in the central districts of the state are not likely to be impacted by the projected climate change even by 2080s.

In the districts projected to be impacted by climate change, the future climate is not suitable for the existing forest types and the species present. The forests in the grids projected to be impacted could experience tip drying, changes in physiological and phenological characters and in extreme cases die back, leading to mortaility of the tree species.


Forest vegetation change projected by 2030s under A1B scenario for Madhya Pradesh
No Change Projected
Change Projected
*Source : IISC FSI Grids
UTTAR PRADESH
CHHATTISGARH
ORISSA
MAHARASHTRA
RAJASTHAN
GUJARAT
MADHYA PRADESH
Km
0 50 100 150 200


Forest vegetation change projected by 2080s under A1B scenario for Madhya Pradesh
No Change Projected
Change Projected
*Source : NSC FSI Grids
UTTAR PRADESH
CHHATTISGARH
ORISSA
MAHARASHTRA
RAJASTHAN
GUJARAT
MADHYA PRADESH
Rewa
Sidhi
Singrauli
Shahdol
Anuppur
Umaria
Katni
Jabalpur
Dindori
Mandla
Balaghat
Seoni
Narsimhapur
Chhindwara
Betul
Harda
Hoshangabad
Sehore
Bhopal
Raisen
Vidisha
Sagar
Ashoknagar
Guna
Shivpuri
Gwalior
Bhind
Morena
Datia
Shivpur
Tikamgarh
Ghatarpur
Panna
Satna
Rajgarh
Shajapur
Ujjain
Indore
Dewas
East Nimar
West Nimar
Khargone
Barwani
Burhanpur
Ratlam
Alirajpur
Jhabua
Dhar
Mandsaur
Neemuch
0 50 100 150 200 Km
82°E
80°E
78°E
76°E
74°E
26°N
24°N
22°N

7 Water Resources

Background

The state has a semi arid upstream topography with seven major river basins which form the life line of the state. Rainfall is the major source of water in Madhya Pradesh. Maximum rainfall occurs in the monsoon period from June to September which keeps varying across the state. Though the state receives medium to high levels of rains, the ground storage capacity is low due to physiograhic reasons like poor quality soils of low depth and high slopes, black soils of medium to deep soil depth with flat slopes and the underlying impervious hard rock layer.

The sources of irrigation are classified in the category of major, medium and minor depending on the extent of the area likely to be irrigated from the storage capacity created or from the run off of available rivers. However, high annual evapo-transpiration rate (Green Water Flow) in the region which is on an average 2100 mm and is in most cases double the total annual precipitation results in a substantial proportion of the harvested water being lost to evaporation.

The actual irrigation is far less than the designed irrigation potential of the state; this low utilization is primarily due to the terrain situation because of which it cannot make use of its share of water resources through canal irrigation from rivers without large investments.

Water Statistics of the State

River Basins of MP	River basins: Chambal, Yamuna,Lowerganga, Narmada, Godavari, Tapti, Mahi
Average Annual Rainfall	1160 mm
Total Annual Replenishable Ground wate	India - 433.02 BCM
	State - 37.19 BCM
Net Annual Ground Water Availability	India - 399.25 BCM
	State - 35.53 BCM
Annual Water Recharge Sources	Rainfall -30.06 BCM
	Others 6.55 BCM
Ground water Draft	17.13 BCM
	Domestic & industrial – 6% Irrigation – 94%
Ground water Development	Development stage - 48 %
	Overexploited – 24 Blocks Critical – 5 Blocks Semi critical – 17 Blocks
Annual Surface Water Avialability	81.5 lakh hectare metres
Developed Irrigation Potential	20.59 lakh hectares
Number of Irrigation projects	Major -7
	Medium -102
	Minor - 3237
Share (area) of various irrigation sources	Ground Water – 4106000 h
	Canals – 1041000 ha
	Tanks – 127000 ha
	Others – 919000 ha

Sources : MP Resource Atlas 2007, MPCST, Water Resource Depertment, MP, Central Ground Water Board, India

Groundwater constitutes a major and widely used resource in MP. However, it is not uniformly distributed due to the varied hydrogeology of the state. Western region of the State is largely occupied by the Deccan Trap lava flows of 10-20 m thickness, separable into vesicular and massive units. The vesicular units, at various depths below ground, are moderately productive with wells capable of yielding 250 – 750 cu.m/ day for drawdown of 3-6 metres. The northern and eastern parts are covered by Archean crystalline rocks, Pre-cambrian sedimentary rocks and Gondawna groups of rocks. In these areas groundwater occurs in upper weathered mantle and fractured zones underlying them. Gondawana formations are granular where tubewells are capable of yielding 100-500 cu.m/day for drawdown of 6 to 10 m. Thick alluvial deposits along the Chambal in the northern and Narmada in the southern parts form excellent aquifers but constitutes only 9% of the area.

About half of the available ground water is used for irrigation mainly from privately owned dug wells or shallow tube wells. District-wise groundwater balance data indicate high levels of ground water abstraction in the western and north-western districts compared to the eastern and south-eastern districts

where groundwater potential developed is only a tenth of the utilisable reserves.

The map (Fig. 7.1) shows ten different watershed areas of the prominent rivers in the state. The largest water shed is of Narmada stretching across the state from east to west followed by Chambal in the western region.

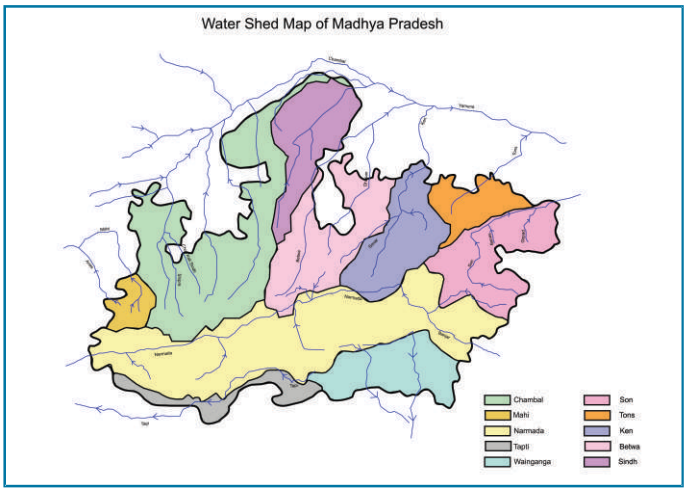


Fig. 7.1 Watershed/river basin map of Madhya Pradesh

Water supply in the state could be differentiated as urban and rural water supply. In the last 25 to 30 years the villages have shifted to ground water extraction through wells and hand pumps for their domestic purposes. Compared to the 30% urban water supply met out with groundwater, a massive 70% of the rural water supply is dependent on the same source.

Table 7.1 shows the trends in irrigation between1977-78 to 2004-2005. As can be seen major irrigation has happened through ground water resources, followed by canals linked to major reservoirs. It is clear that the irrigation through ground water resources has increased 5 times with almost decreasing trends of irrigation through canals and tanks.

Year	Groundwater	Canals	Tanks	Others
1977-78	878	1025	147	187
1989-90	1718	1400	147	405
1998-99	3650	1054	142	821
2004-05	4106	1041	127	919

Table 7.1 Trends of irrigation in MP in '000 ha (Source: Department of Agriculture, GOMP)

Policies and Programmes

Narmada, the lifeline of Madhya Pradesh is the fifth largest river in India. Its potential for irrigation and hydro-electricity has been captured through a series of dams which have been either constructed or are under construction. The Government's Plan is to build 30 large, 135 medium and 3000 small dams to harness the waters of the Narmada and its tributaries.

The MP Water Sector Restructuring Project (WSRP) funded by the World Bank aims to improve the productivity of water and integrate 654 schemes (completed prior to 1986) spread over 30 districts of 5 river basin (Betwa, Chambal, Sindh, Ken and Tons). There are proposals for Interstate River linking projects (Ken-Betwa) and the Parvati Kalsindh-Chambal links which are under consideration with other states. The MP WSRP is improving the overall management of water resources as well as irrigation service delivery, modernising about 650 minor, medium and major irrigations schemes covering an area of about 620,000 ha in the five focus basins.

Concerns of Water Sector

Currently, about 94% of the available water (81.5 lakh ha m), is used for irrigation and the rest is for industrial and domestic use. Of the total irrigation water available to the state, 66.5% of it is groundwater.

Similarly 95% of the water used for drinking and domestic purposes is also obtained from groundwater. In fact, the entire demand for rural drinking water is met through ground water extraction and due to more and more demand of water for agriculture purposes the ground water identified for drinking purposes are also drying up threatening the groundwater dependent rural water supply. The State Water Policy 2007 also mentions that priority should be given to exploration of ground water resources for drinking water purposes.

Between 1998 and 2004, there has been 15.3% rise of water draft from ground water sources in MP. Increasing water demand for human consumption, agriculture and industry, coupled with erratic rainfall has led to supply problems.The indiscriminate exploitation of groundwater not only results in decline of groundwater levels but in some districts like Mandsaur, Neemuch and Ujjain, there is a threat to shallow fresh water aquifers due to inland salinity. The heavy pumpage from shallow tubewells results in upward movement of saline water present in the deep aquifers, causing salinization of fresh water aquifers.

The other serious issues of groundwater quality are high concentration of fluorides (mainly in granitic terrain), agricultural, municipal and industrial pollutions. Water logging in canal command areas leads to soil salinity and needs immediate attention towards conjunctive use of surface and ground water. Post-monsoon flow in most rivers is used for irrigation which further reduces their flows in lean season and the rivers get converted into a series of just small pools.

Concerns

* Unplanned infrastructure development impeding the natural flow of streams
* Deteriorating water quality and reduced safe water availability
* Over dependence on groundwater for various activities
* Unregulated exploration of groundwater
* Inefficient water management practices and plans
* Ignored traditional water storing structures
* Shift in spatial and temporal distribution of rainfall
* Noted increase in intensity of rainfall and also increase in frequency of such events
* Decrease in number of rainy days
* Incidences of extreme weather events such as drought like conditions and flash floods
* Endangered aquatic ecosystem due to disturbed river flow

Water use efficiency in irrigation is generally very low and this is an area of major concern in view of resource depletion. The challenge is to increase efficiency in irrigation and enhancing agricultural productivity through other improved technologies.

In many regions/districts groundwater is being depleted at an alarming rate- one commonly cited reason is highly subsidised electricity for pumping. This needs to be checked either by law or by tariff.The total storage of rainfall through major and minor irrigation dams is quite small. High evapo-transpiration rates of surface water which, at times is double than the precipitation received, leads to loss of soil moisture and surface water as well. High rates of runoff due to topography result in loss of rainwater. Low capacity of natural water recharge in the subsoil in most of the areas of Madhya Pradesh is also a major concern.

The development of surface water resources is less than optimum in the state.Water management status is also far from satisfactory and efficiency of irrigation use is generally very low and service rendered needs improvements. Serious efforts are required to bridge the gap between irrigation potential graded and actual area of irrigation utilization in terms of additional agricultural production.

Analysis of observed rainfall data for the period 1961-2003 indicates an already decreasing annual trend. Also, latest research shows [Goswami et al, 2006] that trends of heavy precipitation (>100mm) events in the last 50 years is increasing as compared to precipitation events less than 100mm. Which means that not only the lower rain fall receipt is decreasing the ground water recharge over the years, but the increase in heavy precipitation events leading to higher run off are also not facilitating adequate ground water recharge.

Strategies to address concerns of Climate Change in Water Sector

1. **Development of a comprehensive water data base in public domain and assessment of the impact of Climate Change on water resources of the State:** A data base needs to be developed to assist in forecasting and research for developing adaptation strategies, better management of action plans, and assessment of water availability and demand by various sectors in the future.
2. **Promote accelerated pace of surface water development in the state:** The programme of command area development must be taken up on a priority basis under which completion and renovation of canal systems, field channels and land levelling should be undertaken in an accelerated mode to fully realise the surface water irrigation potential already created. Also measures like rejuvenation of lakes, village ponds, collection of rainwater for domestic water use in rural areas needs to be promoted.
3. **Water conservation, augmentation and preservation with special focus on areas with over exploited conditions of ground water:** Establishing state water authority to monitor regulation, management and allocation of water for different purposes. Particular attention should be given to artificial recharging of groundwater in over exploited regions. In areas where quality problem exists in deeper aquifers, like inland salinity and high concentration of fluorides, the recharge of shallow aquifers should be given the highest priority. The dried up dugwells in these areas can be fully utilised as recharge structures after providing necessary filters. It should be ensured that the abandoned dugwells (mostly used to dump garbage) are first thoroughly cleaned and disinfected before their use as recharge structure. These wells should be used only as recharge wells and not utilised for any other purpose even when water level rises due to recharge.

   To minimise wasteful evaporation losses and overflow of surplus surface water from minor irrigation dams and ponds, it is advisable to provide number of recharge shafts in the submergence area with the intake level just below the full supply level. The recharge shaft should be designed to recharge the aquifer below the impervious bed of storage tank. The CGWB has prepared a detailed district wise National Master Plan on Artificial Recharge and this needs to be implemented immediately. Promote traditional measures of water conservation using the rural employment programmes such as MGNREGA.The National Rural Employment Guarantee Scheme primarily and all other employment and rural development schemes should be geared to local area specific soil and water conservation activities at a large scale. Simple soil and water conservation techniques and overall watershed development including the rejuvenation of tanks is proposed to be the focus.
4. **Increase water use efficiency in irrigation, domestic and industrial purposes:** Through water authority investigate new regulatory structures with entitlements and prices to adopt water efficient and innovative technologies; identify water wastage and leakage. Also undertake studies to evaluate supply and demand of water sector in the changing climate scenario. Develop ideal PPP models for recycling waste water. Improve efficiency of urban water supply system. Undertake mandatory water audits.
5. **Promote basin level integrated watershed management:** Undertake integrated watershed management in identified areas within a basin where livelihood opportunities are being affected due to changes in water resources due to Climate Change. The studies of CGWB have identified 69 major watersheds in the State in which the declining trend of ground water levels exceeds 0.1 m / year. These watersheds have been identified for construction of suitable artificial recharge structures to augment the depleting ground water resources.

   It has been estimated that the unsaturated zone available for recharge has a storage potential of 2837.49 MCM (based on specific yield of rock types in the watersheds). The total requirement of

water, for creating the sub-surface storage to fully saturate the vadose zone upto 3 m below ground level, works out to 3773.86 MCM at 75% efficiency. In the 69 identified watersheds, the surplus monsoon run-off has been estimated and it was found that 2319.96 MCM can be safely utilised for creation of the sub-surface storage. The major parts of the identified area are covered by hard rocks except some areas of Chambal and Narmada basin. The suitable artificial recharge structures are gully plugs, gabion structures and contour bunds in the upper reaches of the watersheds, percolation tanks, nala bunds in the run-off zones and Recharge shafts, Gravity head wells in the downstream areas.

Promotion of additional research to understand the impacts of Climate Change and for facilitation of various technologies for augmenting the source in the Climate Change context: research on impacts of Climate Change on water flows and storage, impact on quality of water due to Climate Change, assessment of water resource availability, for effective water purification technologies, mapping of areas likely to experience floods.

6. **Capacity Building:** Professionals from various departments /organizations associated with water resources development and management, Panchayati Raj institutions, Urban Local Bodies dealing with water and primary users should be given training to build their capacities in dealing with CC challenges in water sector.

Impact of Climate Change on water resources of Madhya Pradesh

The Climate Change impact assessment on water resources of Madhya Pradesh was conducted [Gosain et al, 2011] as part of the NATCOM Phase II study of MoEF. The analysis pertains to the modeling of River Ganga, Narmada, Godavari and Mahi using the hydrologic model SWAT. Discussion on the water balance components is provided below.

An increase in annual precipitation of about 11% by mid century is projected resulting in increase in runoff, thus contributing to the stream flow but negligible contribution to the ground water recharge. Evapo-transpiration is projected to increase. During the monsoon months (JJAS), increase in precipitation is projected to be about 14%, 92% of which would contribute to the stream flow as surface run off and the rest is contributed to the groundwater recharge.

There is a decrease in evapo-transpiration by 1%. The indication is that, in parts of the basin, surface runoff would be increased under the A1B mid century scenario (Fig. 7.2). Similarly during the Rabi season (OND), precipitation is projected to decrease by 5% resulting in decrease in ground water recharge. Evapo-transpiration is projected to increase and baseflow is projected to decrease.

Increase in annual precipitation of about 29% by end century is projected, resulting in increase in runoff by 86% and about 18 % returns to stream as baseflow, evapo-transpiration is projected to increase by 15%. During the monsoon months (JJAS) increase in precipitation is projected by about 29 %, most of this results in runoff (72%) and baseflow (13%) contributing to the stream flow.

About 9% of this increase in precipitation is contributed to the ground water recharge. Increase in evapo-transpiration is projected by 6%. The indication is that in parts of the basin surface runoff would be increased under the A1B end century scenario and would offer opportunities for increased water harvesting and groundwater recharge.

Similarly during the Rabi season (OND), precipitation is projected to increase by 17% resulting in increase in baseflow contribution to the stream flow. Reduction in ground water recharge and substantial increase in evapo-transpiration is projected by end century (Fig. 7.3).

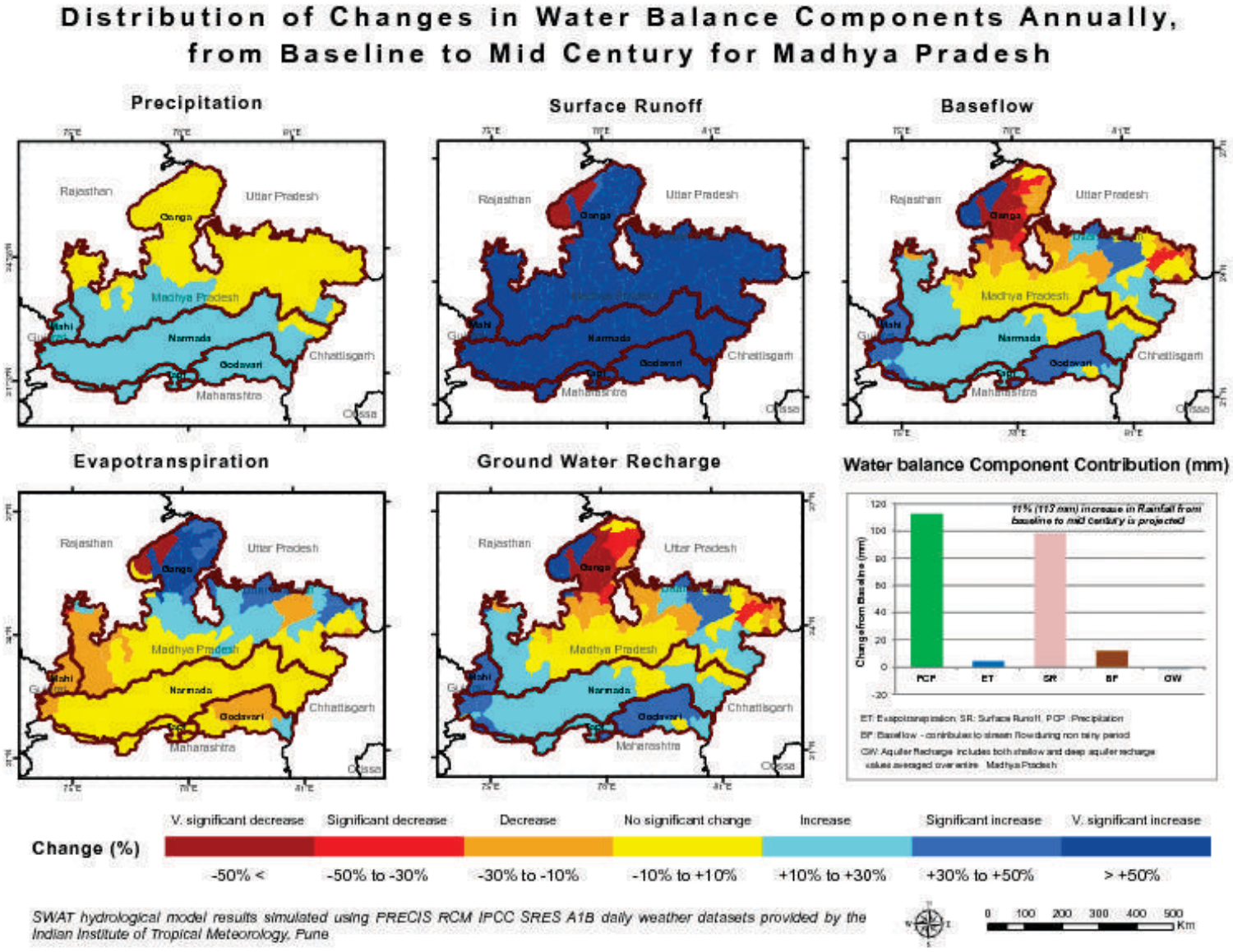


Fig. 7.2 Change in water availability towards 2030s with respect to 1970s (IPCC SRES A1B Scenario) in Madhya Pradesh

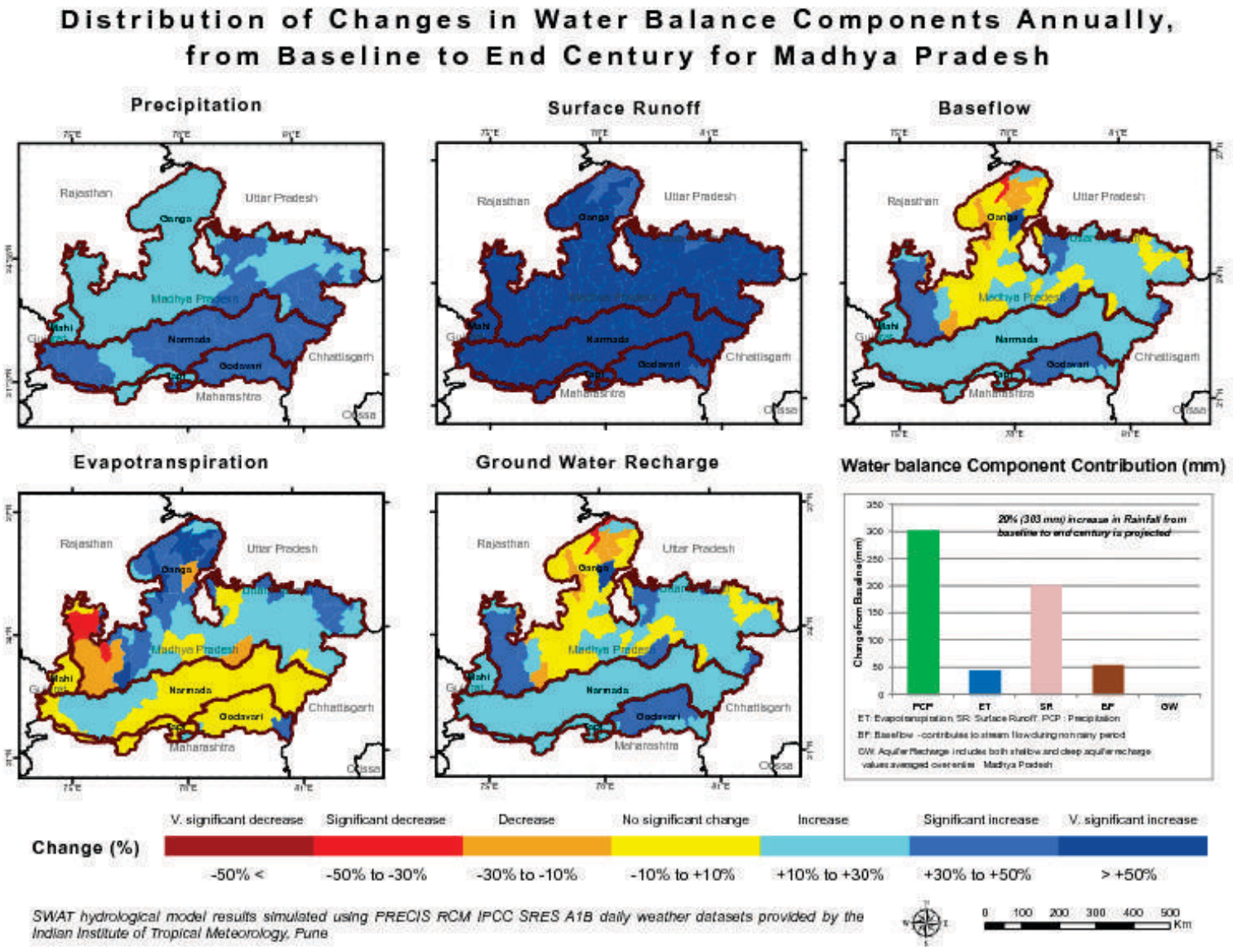


Fig. 7.3 Change in water availability towards 2080s with respect to 1970s (IPCC SRES A1B Scenario) in Madhya Pradesh

8 Agriculture and Allied Services

Agriculture

Background

About 70% of the rural population living in Madhya Pradesh is engaged in agricultural and allied activities covering agriculture, horticulture, fisheries, animal husbandry and dairy development. Apart from the role that agriculture has for food security, this huge dependency on agriculture sector for livelihood also highlights its importance in the upliftment of the socioeconomic status of the state.

The main cereal crops grown in MP are wheat, paddy, maize, jowar and various kinds of millets. The main pulses are red (tuar, masoor), black (urad), green (mung) and Bengal (chana) gram. The main oilseeds are sesamum, groundnut and soybean. Cereals cover 42%, pulses 21%, oil seeds 21% and commercial crops occupy 3% of the total gross cropped area and the rest of the gross cropped area is occupied by vegetables, fruits, fodder plants and medicinal plants.

Madhya Pradesh enjoys an outstanding position in India in terms of agriculture production. It occupies first position in the country in the production of pulses, second position in the production of oilseeds, and third position in the production of Jowar and Mustard.

The production of cereals, sugarcane and cotton are also at the higher side. About 70% of the total cropped area is rainfed. The graphs (Fig 8.1 a - f) show the area and production of total food grains, pulses, oilseeds, cereals, cotton and sugarcane in the state from 1990-1991 to 2005-2006.

Agriculture Statistics of the State

Agro Climatic Zones of MP	11
Total Cropped Area (% of geographical area)	Gross Cropped Area - 64% Net Sown Area - 49%
	Kharif Area - 52% of the cropped area Rabi Area - 42% of the total cropped area
Total Irrigated Area (2005-06)	Net Irrigated Area –5682000 ha Gross Irrigated Area –5878000 ha
Major Crops grown	Kharif–Paddy, Jowar, Maize, Bajra, Small Millets, Tur, Groundnut, Soybean, Cotton
	Rabi - Wheat, Gram, Lentil, Mustard, Sugarcane
Contribution to State GDP	30%
Total Land Holdings	Total land holding – 163.72lakh ha
	Small and Marginal farmers holding – 41 lakhs ha
Types of soils	Alluvial soils, Shallow and Medium Black Soils, Medium and Deep, Black soils
Cropping Intensity	131%
Production of major crops in MP	Kharif – 9047 000 tonnes
	Rabi – 11218 tonnes

Sources : MP Resource Atlas 2007, MPCST, Family Welfare & Agriculture Department, MP, Compendium of Agriculture Statistics , Govt of MP,2006-07

Madhya Pradesh is divided into eleven Agro Climatic Zones (ACZ) based on rainfall, existing cropping pattern and administrative units. The state is also grouped into five major cropping zones, based on the cultivation of major crops. The cropping zones and the corresponding ACZs are shown in Table 8.1 and the map delineating districts and respective ACZs is shown in Fig. 8.2.

Fig. 8.1 Area under cultivation and production of various crops in MP (Between 1990-2006)

Study on Vulnerability and Adaptation Assessment for Madhya Pradesh

An Indo-UK collaborative research programme was initiated by MoEF, GoI and the Department of Energy and Climate Change, UK to study the impacts of climate change in India. Vulnerability and Adaptation Assessment for MP was carried out by Development Alternatives, New Delhi in association with EPCO and Stockholm Environment Institute (SEI) and facilitated by Environmental Resource Management (ERM). The study was conducted in four districts of MP namely Dhar & Ujjain (Malwa Plateau) and Tikamgarh & Datia (Bundelkhand region). Impact assessment on agriculture was done on wheat and soybean in these four districts through CERES-Wheat and CROPGRP-soybean models.

The potential yield is already low due to higher temperature than northern India. The study indicated a decline in wheat and soybean productivity by 14-20% and 14-17% respectively in the selected four districts (PRECIS A1B 2030 scenario). Adaptation assessment suggests that possible changes in sowing dates and hybrid selection can reduce the negative impact of projected climate in 2030s alongwith other options such as wide spread adoption of resource efficient farming practices, promoting and reviving traditional drought coping mechanisms, traditional water harvesting structures, drought resistant crop varieties etc.

Cropping Zones	Agro Climatic Zones
Rice Zone	Chattisgarh Plains, Northern Hill Region of Chhattisgarh
Wheat Rice Zone	Kymore Plateau & Stapura Hills
Wheat Zone	Central Narmada Valley, Vindhya Plateau
Wheat Jowar Zone	Grid Region, Bundelkhand, Stapura Plateau
Cotton Jowar Zone	Malwa Plateau, Nimar Plains, Jhabua Hills

Table 8.1 Cropping Zones in MP

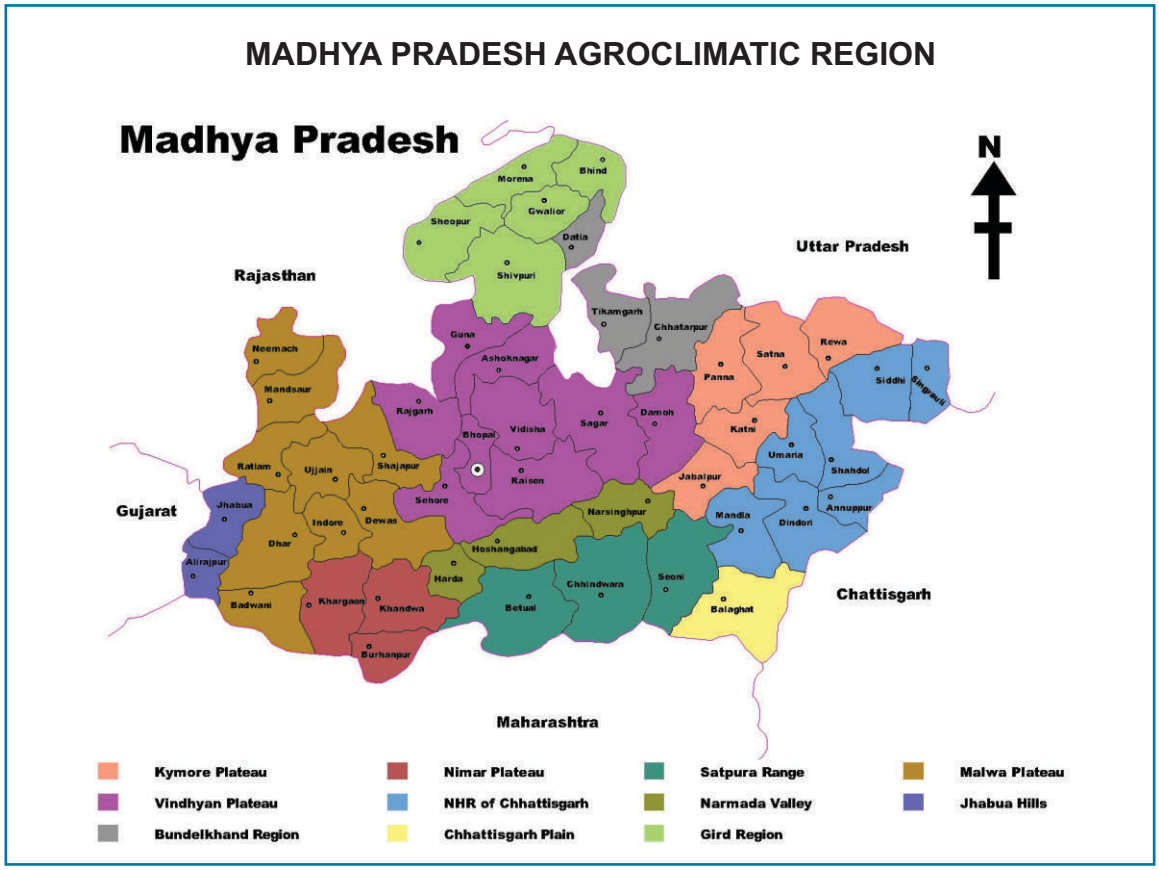


Fig. 8.2 Agro Climatic Zone map of MP

Policies and Programmes

Some of the policies and programmes initiated by the government in agriculture sector include the following:

- Embracing National policies such as the National Agriculture Policy, 2000; National Seeds Policy 2002; Agriculture Martketing Reforms; Protection of plant varieties under Trade related Intellectual Property Rights, 2001.
- Providing subsidies on electricity tariff and pump sets.
- Specific programmes within the state such as the action plan for increasing the productivity in eastern MP, action plan on encouraging organic farming which focuses on improvement of soil quality and reducing cost of farm inputs.

- Undertaken projects which are aiming to enhance women income through adoption of low input costs and effective technologies in watershed development.
- Emphasis on soil and water conservation measures over large areas through integrated farming systems and watershed development through communities' involvement in the management of the resources. Strengthening of the irrigation systems in the state and extending the irrigation facilities to areas dependent on rainfalls.

MP Agriculture Cabinet Highlights

- *Set up demonstration units in all 11 agro-climatic zones for demonstrating the latest farming techniques for maximising production*
- *Enhance the level of farm mechanisation in the state*
- *Enhance storage capacity for agricultural products by 50%*
- *Enhance quality of farm inputs including quality seeds by setting up seed and fertiliser laboratories in all divisions, adopt seed certified by the government and ensure availability of quality seeds*
- *Promote indigenous hardy crops like kodo kutki, ram til, ragi and alsi and request the union government to provide minimum support prices for the same*
- *Enhanced thrust on increasing professionals for management of agriculture*
- *Empower agricultural research by establishing molecular breeding, bio technology laboratories in the state*

Realising that the upliftment of agriculture based economy of the state is a way forward for reducing rural poverty, the Madhya Pradesh Government aims to maximise agriculture production and productivity and to make it a profitable proposition for the farmers, **"Agriculture Cabinet"** in 2011 has been set up. The objective of Agriculture Cabinet is to steer an integrated agriculture development agenda in the state leading to rapid growth and enhanced food security. The key decisions of MP Agriculture Cabinet are presented in the adjoining box.

MP Organic Farming Policy, 2011 has also been drafted with a vision to provide sustainable livelihoods, conserve natural resources and provide employment to villagers. Reasons favoring the organic farming in MP –

- Mechanization in MP is not very popular yet
- Animal Husbandry is also among one of the major livelihood activities
- Large quantity of agriculture waste is available which can be used as organic manure,
- Regional, local and indigenous knowledge is available.

Madhya Pradesh Organic Farming Policy, 2011

Policy Targets

The policy is being implemented to reduce the impacts of climate change and globalization on agriculture products and increase the productivity. While doing so, interests of farmers of remote areas will be kept in mind.

Long Term Targets- By achieving renewable environment through agriculture- ecosystem management, implementation of main schemes as soil carbon storage and metering, enhancing soil health, reducing ground water pollution specially harmful chemicals and enhancing biodiversity.

Medium Term Targets - To standardize agriculture investment and enhance income on investment in present agriculture system. On the other hand, making agriculture a profitable business through enhancing the net income by adopting market based mechanisms.

Short Term Targets - Developing appropriate atmosphere for families dependent on small and marginal agriculture economy by developing technology, market security, developing capable, economic human resources and institutions. Simultaneously, ensuring availability of required quality resources for producing organic products, developing renewable energy sources by utilizing biodegradable resources are also stressed upon.

Concerns of Agriculture Sector

Madhya Pradesh is a heterogeneous state situated on the upper watersheds of 9 river basins with poor quality soils of low soil depth and high slopes and some black soils of medium to deep soil depth with flat slopes with underlying impervious hard rock, making the underlying storage capacity low and subsequently low water availability for irrigation in most of the ACZ regions. The increasing dependence on the ground water for irrigation, though without proper and adequate recharge, is helping to get good productivity but could become a serious threat in future. Over exploitation of ground water for irrigation is also a cause of concern.Though about 43% of the cropped area is irrigated, but the facilities that exist function at 50% of their potential and thus the diversion towards use of ground water for irrigation.

Factors such as underutilisation of large tracts of fallow land and use of land only in one season for many areas in Madhya Pradesh have contributed to under realisation of the potential productivity of crops in the state. Expansion of area of cultivation under monocropping of profitable crops without nutrition management is leading to rapid decline in soil fertility of these farms. It could lead to the extinction of some of the indigenous drought resistant legumes such as oil crops and coarse grains. Mono cropping also makes the crops susceptible to failure if there is any change in the climate conditions for optimal production.

Access to markets and accessibility to high level of mechanization such as tractors, thrashers, grinders that add value to the crop harvested at the moment are not satisfactory. Storage facilities in the state also need to be strengthened and expanded.

Capacity of marginal & small farmers constituting majority of the population engaged in agriculture to utilise the latest technologies for improving production of crops, horticulture, livestock products and fisheries is also minimal. Further, the land holdings of poor and marginal farmers being small and their accessibility to farm inputs being low, majority of the area under this type of land holdings are reporting low productivity year after year.

There could be a short fall in service delivery targets of the government to the rural communities such as quality seed distribution, fertiliser distribution, shortfall in establishment of targeted number of minor and micro irrigation structures, augmentation of ground water, shortfall in coverage of river valley projects, and short fall in farm mechanisation drives .

The state had stagnant production of hardy species of some pulses, oil seeds such as alsi, and millets such as ragi, and minor millets such as kodo-kutki which are mostly grown without fertlisers.These crops are important to maintain food security in the state as they can be grown even in water stress and high temperature conditions. More research inputs on technology from the scientific research stations and linkages with market is required to improve their

Concerns

- Monocropping
- Dwindling Crop Diversity
- Threat of extinction of coarse grains or millets
- Deteriorating soil health
- High rate of pest impact
- Overdependence on groundwater for irrigation
- Lack of awareness about soil nutrition management and irrigation management among farmers at large
- Shift in spatial and temporal distribution of rainfall
- Increase in intensity of rainfall and longer dry spells
- Gradual increase in temperatures across all seasons
- Frequent extreme weather events like frost, droughts, flash floods etc.
- Climate induced shift in cropping patterns
- Burning agri residues in fields
- Use of energy intensive was efficiency water pumps
- Absence of real time data and information management system

Pgs. 141 to 143 of Compendium of Agricultural statistics, 2006-2007, Madhya Pradesh, Farmer Welfare and Agriculture Department

productivity. These could be promoted as climate resilient crops.

Current observations of climate indicate a gradual increase in temperatures across all seasons and decrease in rainfall in all the agro-climatic zones during the monsoon period with erratic and uneven spatial and temporal distribution of rainfall. Climate projections indicate a further increase in temperatures by 2050s and an uneven distribution of rainfall across the state, with perceptible decrease in rainfall during winter period and almost no change in rainfall during monsoon with respect to current climate. However, the frequency and intensity of droughts and heavy rainfall events with respect to the current situation is likely to increase further (MoEF, 2010). These predicted changes could lead to spatial and temporal shift of cropping centres and decline of productivity of crops. Also as the evapo-transpiration rate increases with increase in temperature, it will lead to depletion in moisture retention capacity of the different soil types and can pose a threat to agriculture.

On the other hand, increase in intensity of rainfall is likely to lead to faster run off causing higher soil erosion in the ravine areas with little or no scope of ground water recharge in the alluvial plains causing further depletion in the ground water tables in MP. The status of soil health and its fertility is likely to deteriorate further with increase in soil erosion and higher temperatures, causing stored carbon to be released from the soil. Also it is likely that the onset of monsoon may shift from June to first fortnight of July in the state which would likely to affect the cropping sequence and sowing time. Therefore, even if farm inputs are adequately provided through development of effective delivery mechanism, changes in climate in the future may lead to conditions which may not support sustainable crop production as productivity of crops is an integrated process of favourable climatic conditions as well as farm inputs.

Strategies to address concerns due to Climate Change

1. **Promoting Soil and Water Conservation technologies:** Higher evapo-transpiration rates and higher run offs with Climate Change would further lessen the already low natural water storage in the state. Therefore for sustaining profitable agriculture productivity, it is imperative to avoid water scarce situations. Hence, moving towards more water conservation technologies and avoiding exploitation of ground water is necessary. This would mean promoting measures for soil moisture conservation through development of watersheds and small catchments that would also increase biomass production and increase the fertility of the soil as well. Also measures like SRI for rice, raised bed cultivation, plastic mulching use of cultivars using lower water etc., needs to be encouraged. Alternative and advanced water use technologies needs to be explored for efficient utilization of water. Used of micro/drip irrigation need to be extended to crops like cotton, fruits and vegetables. Construction of tanks and storage structures should be taken up for facilitating two rounds of irrigation during Rabi season and enhancing water recovery and ground water recharge.
2. **Planning cropping systems suitable for each agro-climatic zone:** Since each agro-climatic zone has different soil type, water resources, and climate, that best support a particular type of cropping system, therefore it is imperative that the state moves towards integrating Climate Change concerns in each agroclimatic region. Promoting and managing Agro forestry, Agro-climatic specific crops farming practices and management including that of water, soil, pests, crops, cropping cycle & practices for harnessing the full productivity potential of the different zones should be done on high priority. Also use of various other alternative sources of energy should be promoted.
3. **Capacity building for sustainable agriculture:** Capacity building of planners, extension workers, farmers association etc on sustainable agriculture practices like mulching, agroforestry,

The soil in the state is deficient in key nutrients. Of the total 48 districts, soils of 36 districts are nitrogen deficient, 31 districts have phosphate deficiency and 23 districts are deficient in potash. Ref: SoE, 2006

crop rotation etc. should be strengthened, so as to build better understanding of regional and sectoral Climate Change concerns.

4. **Management of risks for sustainable productivity:** In some regions monocropping of soybean-wheat is rendering the soil infertile and may lead to over use of artificial fertiliser which may be detrimental in the long run. It is therefore suggested that practices like inter cropping, multiple cropping, crop rotation, mulching and agro-forestry may be encouraged. Further the use of organic farming may be encouraged by promoting integrated farming where by livestock rearing, horticulture and fisheries are practiced. A detailed agro-climatic zone specific plan for the development of organic farming, certification and marketing aimed at servicing export markets will have to be drawn up and institutional support made available. Providing advance information on local climate that accommodates the changes in temperature, precipitation amounts and onset of monsoon is essential to prepare the action plans accordingly. Promotion of indigenous varieties of crops should be taken up since these varities have the potential of adapting to higher temperatures, drought or flooding situations. Additionally risk management through crop insurance might be a benefit for farmers in the case of total crop failure.

5. **Enhancing dissemination of new and appropriate technologies developed by researchers and strengthening research:** As indicated in the decisions of the agriculture cabinet, setting up of demonstration centres at each agro-climatic zone would ensure smooth dissemination of new technologies related to different farming practices. Also, impetus to research such as establishing molecular breeding centre, DNA finger printing facilities, and bio technology laboratories in the state along with provision of enough support for providing reading material on latest courses would go a long way in increasing agriculture productivity in the state. Further, it would be worthwhile to build and strengthen capacity in the state to run climate models, interpret their projections, and use the same to run the various bio physical models to understand the impact of Climate Change on crops, soils, water etc. and then to design appropriate adaptation strategies. Promotion of farm mechanization through custom hiring servies should be checked so that small and marginal farmer can also take the advantages of new technology. Research coupled with promotion of improved energy use efficiency, to come up with technologies for waste utilization & minimization, and use of clean energy and to develop technology for reduction of methane emissions from paddy fields may be taken up. Pilots on weather index based insurance can be taken up in different regions to reduce the vulnerability.

6. **Agriculture Information management:** For maximising productivity even in the context of challenges posed by Climate Change, it is necessary to establish an integrated data centre where by data related to all aspects of agriculture, such as weather and climate information, crop biodiversity, research, technology, markets, and policy for maximising productivity are available through a single window, with the back end linked to various agencies that actually produce the data. This will be useful not only for the farmers but also for formulating informed decision making by policy makers. Demonstration units should also be set up in various regions to educate farmers about better adaptation practices.

7. **Creation of Rural Business hubs and accessibility to markets:** For generating additional employment and diversification of livelihoods in rural areas, rural business hubs can be set up which actually can increase employment and take away the pressure on natural resources and land of the rural areas. Accessibility to markets need to be developed further and providing institutionalized support in the form of greater infrastructure for taking produce to the markets, needs to be nessarily done.

Horticulture

Background

Horticulture has and will always exist as a matrix of inter-relating areas with overlapping and complex relationships. The broader vision of horticulture embraces PLANTS, including the multitude of products and activities essential for human survival; and PEOPLE, whose active and passive involvement with "the garden" brings about benefits to them as individuals and to the communities and cultures they encompass.

India's per capita availability of horticulture produce is much below the per capita requirement prescibed by World Health Organisation. Horticulture crops bring in the incomes to the small and marginal farmers due to high productivity and high value of produce as compared to food grains.

Horticulture Statistics of the State

Total Area under Horticulture	4.6 lakh hectare
Distribution of area under Horticulture	Spices -2.07 lakh hectare Vegetables – 1.96 lakh hectare Fruits – 46 thousand hectare Flowers -15 thousand hectare Medicinal & Aromatic 3 thousand hectare
Contribution to State GDP	30% (agriculture sector)
Cropping Intensity	131%
Agri processing Mandi Committies	48 notified committees for Fruits and vegetables
Agri export Zones	6 (North western part of Madhya prdaesh)

Sources : Compendium of Agriculture Statistics , Govt of MP, 2006-07

Production of horticultural crops is beneficial for farmers as they could be grown with minimal farm inputs and could also be grown on waste lands (not suitable for agriculture). All the 11 agroclimatic zones in MP are suitable for variety of horticulture crops.

The productivity of vegetables though large, has shown a nominal rise in cropping intensity by 5.9% (between 1982-83 and 2005-06) whereas the cropping intensity of fruits has increased by 57% during the same period. The cropping intensity of spices has increased by 142.9% though amounts of production are miniscule in comparison to production of fruits and vegetables. The cropping intensity of medicinal and aromatic plants has declined by -7.8% mainly due to decrease in area under production of these crops. The graph (Fig. 8.3) shows the comparative production trend of fruits, vegetables and spices from 1991-2006. The vegetables production is showing high fluctuations with a steep rise in production around 98-99 and then a decline, though the production of vegaetables is now increasing.Spices production is showing constant trend. Agroclimatic region wise grown horticultural crops are shown in Table 8.2.

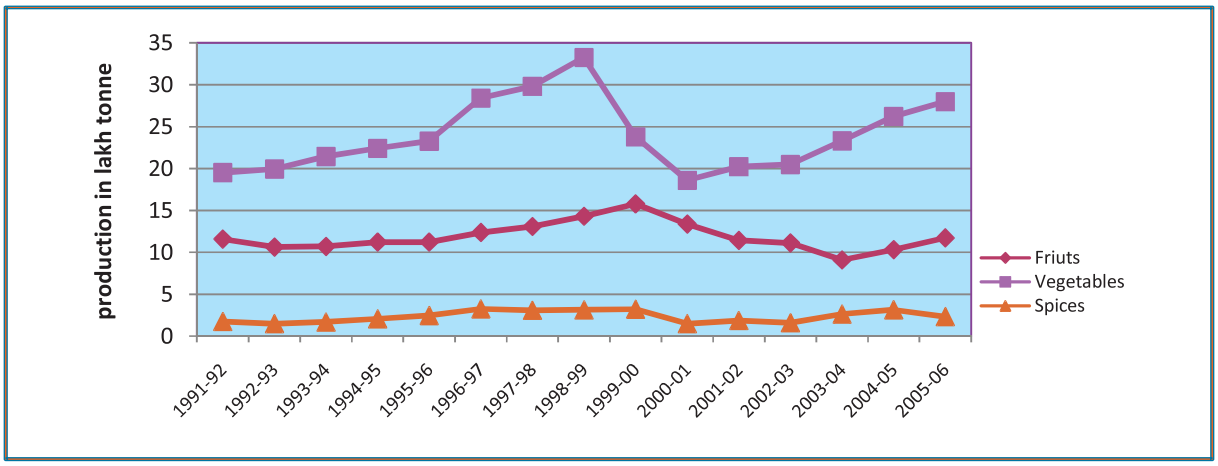


Fig. 8.3 Horticulture production In MP

Policies and Programmes

The programmes and schemes to promote Horticulture in Madhya Pradesh include:

- National Horticulture Mission

Agro-Climatic Zones	Horticultural Crops grown
Chhattisgarh Plains	In Irrigated Condition- Mango, Chiku, Guava, Lime, Banana, Papaya, Munga, Pomegranate, Colocasia, Aonla In Arid Condition- Turmeric, Chillies, Ginger, Jack fruit, Ber, vegetables
Northern Hill Region of Chhatisgarh	Pear, Peach, Litchi, Mango, Jack fruit, Coffee, Turmeric, Ginger, Tree spices, off season vegetables, Medicinal & Aromatic crops
Kymore Plateau Satpura Hills	Mango, Guava, Lime, Ber, Aonla, Chillies, Coriander and other seasonal vegetables
Central NarmadaValley	Mango, Acidlime, Mandarin, Ber, Guava, Aonla, Papaya, Medicinal & Aromatic Plants, all type of seasonal vegetables
Vindhya Plateau	Mandarin, Acidlime, Mosambi, Aonla, Pomegranate, Mango, Ber, Chiku, Papaya, Turmeric, Chillies, Coriander, Ajwine, and all seasonal vegetables
Gird Region	Under assured irrigation- Mandarin and Sweet orange, Lime Under rainfed condition- Guava, Ber, Aonla, Custardapple coriender, Chillies, Garlic & seasonal vegetables
Bundelkhand	Santra, Mosambi, Acidlime, Aonla, Mango, Chiku, Karonda, Ginger, Turmeric, Dioscoria, Colocasia
Satpura Plateau	Santra, Mosambi, Acidlime, Mango, Guava, Ber, Chillies, Turmeric, Flower Marigold, Colecrops & other vegetables
Malwa Plateau	Under irrigated conditions- Santra, Acidlime, Mosambi, Grape, Chiku, Under Rainfed conditions- Ber, Guava, Pomegranate, Coriander, Fenugreek and vegetables
Nimar Plains	Mango, Banana, Grape, Papaya, Chiku, Lime, Guava, Pomegranate Turmeric, Chillies, Colocasia, Fennel and seasonal vegetables
Jhabua hills	Lime, Mosambi, Ber, Guava, Aonla, Custard Apple, Pomegranate, Seasonal Vegetables

Table 8.2 ACZwise Horticulture crops grown in MP

- Integrated fruit development scheme
- Banana orchard development programme
- Thrust on expansion of area under grape cultivation
- Integrated vegetable development programme
- Spices Potato Floriculture development programme
- Development of kitchen garden programme
- Promoting hybrid chillies
- Training of officers and employees of concerned departments
- Training of the farmers
- Supporting CSS Micro Irrigation Scheme

Many contract farming initiatives are taken for crops like potato, white onion and marigold. Creation of more and more food parks in the state are being taken up to encourage and strengthen the market linkages. Apart from these programmes MP is working towards achievement of the vision of National Horticulture Mission. Under this mission the objectives are to enhance acreage coverage, productivity in potential belt,

adoption of end-to-end approach covering production to post harvest management and processing.

Concerns of Horticulture Sector

Water is the major constraint for the horticultural crops in the state, particularly in the water stress conditions and drought like situations. Considering the perennial nature of fruit trees the impacts of droughts are generally visible and recognized in the later stages which is most of the time beyond the control of farmers. Water requirement of horticultural crops is also increasing due to increase in temperatures and thus affecting the production.

Rise in temperature has led to early maturing and fruit fall in the various fruit bearing crops. For example, citrus, grape, melons and mango will mature earlier by about 15 days. Higher temperature will reduce the time period of tuber initiation process in potato, will affect quality of tomatoes and will lead to decrease in pollen viability, pollen release and pollen germination process in many crops. In case of crucifers, it may lead to bolting while anthocyanin production may be affected in capsicum. Specific chilling requirements of pome and stone fruits will be affected hence dormancy breaking will be earlier and thus decrease in the yield and quality. With rising temperatures, photoperiods may not show much variation. Onions, a photosensitive crop, will mature faster leading to small bulb size. Strawberries will have more runners and less fruits. Increase in temperature in winters will affect the crops maturing process of the winter crops. There is also an increase in incidences of damage to horticultural crops due to abnormal storms and hail storms.

Soil temperature may increase in spring hence the planting time may also vary. This can be catastrophic if late frosts occur. The requirement of annual irrigation will increase, not only because of higher evaporation, but also because the trees will develop faster during the twelve month period. Heat units required will be achieved in much lesser time. Soil conditions may pose problems with an expected increase in acidity, alkalinity and salinity.

The state lacks in robust storage and processing facilities which may pose threat to the already dwindling condition of the horticulture crops. Markets linkages are not uniformly present throughout the state and given the shorter shelf life of the produce, the activity has inbuilt risk and farmer's doesn't find it lucrative. The impacts of Climate Change and the systemic lacunae together are of serious concern for the state.

Concerns

* Water stess for irrigation
* Not sufficient storage and cold store facilities
* Weak Market linkages
* Less practice of agro –horticultural systems
* Increased incidences of pest attacks
* Increasing temperature affecting the pollen viability and crop growth
* Frequent unpredicted severe events affecting the crop produce
* Soil moisture stress to the crops leading to their stunted growth
* Decreased seed procution due to increasing temperature.

Strategies for addressing Climate Change concerns in Horticulture Sector

1. Soil and Water conservation through demonstration of best practices: Application of mulching techniques, drip irrigation, and micro irrigation practices etc should be encouraged. As per the requirement of specific horticultural plants, provision for creation of appropriate thermostatic conditions for horticulture crops such as use of shed nets and poly houses for supporting growth of crops should be encouraged. Soil and water conservation technologies will need to be strongly adopted seeing the rising temperatures and decreasing water conditions in the state.
2. Development of agri-horticulture systems for securing livelihoods specially in dryland tribal areas: Encourage crop diversification through intercropping of agri crops- vegetables, agri crops-fruits,

agri crops- spices, agri crops- flowers etc which would inturn also ensure livelihood security. Agri crops and fruits may specifically be encouraged in dry land areas.

3. Developing horticulture policies and plan production centres according to agro climatic conditions: To devise policies for encouraging planting of fruits, vegetables, spices, medicinal herbs, and flowers according to the suitability of different agro- climatic zones.

4. Enhancing accessibility to mechanisation for value addition and access to markets- creating business hubs: Horticultural crops are perishable in nature and subject to post harvest losses. In addition to these inherent problems increasing temperature and humidity are also affecting the quality of these produce. For value addition, processing units and marketing of products need to be developed for rural clusters in different Agroclimatic zones. This would also help in reducing the wastage of the produce.

5. Research and extension support: Adequate research support needs to be provided in the form of better seeds and cropping techniques to the farmers and reaching out to the farmers with the knowledge through extension is essential to ensure productivity even in the Climate Change context.

6. Creating cooperatives for enhancing the livelihoods of small and marginal farmers: Care should be taken to see that the benefits reach the small and marginal farmers who are in need for help. Strengthening of existing and formation of new marketing cooperatives for these farmers could be considered.

SKMCCC, EPCO

Animal Husbandry and Livestock

Background

Livestock rearing, a land based activity, is an alternative income generation activity for the farmers of Madhya Pradesh. This activity is very popular and practised as it does not require much infrastructure. Livestock development is particularly encouraged in the state as it ensures sustenance of rural population living below poverty line, availability of livestock products for masses, self-reliance of female population of villages, organic manures for agriculture etc.

Madhya Pradesh accounts for about 14% of total cattle population and 11% of total milk production in the country [XI Five year Plan, MP].

Livestock Statistics of the State	
State Livestock Population	40.6 million
	Cattle – 21.9 million
	Buffaloes – 9.1 million
	Goat & Sheep 9.38 million
Poultry Population	7.3 million
Contribution to State GDP (at current prices)	12.5%
Animal breeds in the state	Malvi, Nimari, Kenkatha Cattle, Bhadawri Buffalo, Jamnapari, Barbari Goats, Kadaknath Chicken

Sources : XI Five Year Plan, MP

An increase in the population of cattle, buffaloes and goats and a sharp decline in the population of poultry and sheep have been observed in the 2007 Animal Census in comparison with the 2003 Census. The figure graphically represents this shift in animal population.

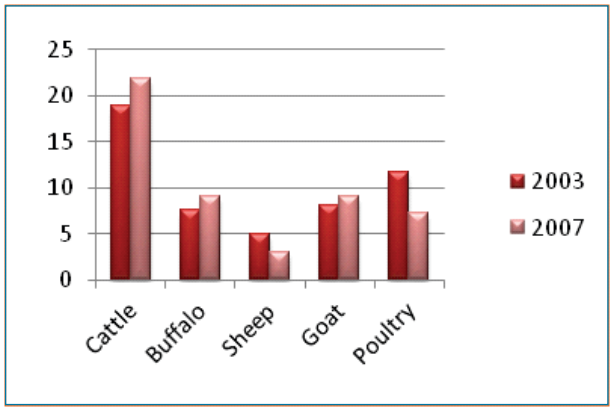


Fig. 8.4 Shift in population of major livestock in state

Despite the 0.8% decline in indigenous cattle population as compared to 2003 Animal Census, there has been an increase of almost 10-12% milk production. This growth can be attributed to 70% and 13.6% growth of cross-bred cattle and buffaloes respectively. Per capita availability of milk in the state is 262 gm/day while that of India is 247 gm/day [XI Five year Plan, MP]. In the context of poultry and goatery, there has been a growth of 24.5% in caprine and 59.7% in poultry from 2003 to 2007 Animal Census.

The agro climatic conditions of the state are favourable for developing dairy, poultry, goatery and piggery. Bullocks of Nimari, Kenkatha and Malvi Breeds of Madhya Pradesh are known for their superior draught power. The crossbreds as well as up-graded bovine, caprine and exotic swines have comfortably adapted to the state's climatic conditions.

Breeding policy of the state recommends indigenous milch breeds like Haryana, Gir, Tharparker, Sahiwal etc, especially in rural areas along with crosses of Jersey as well as Holistein Friesian in urban or semi urban areas. Jamnapari and Barberi breeds of caprine and White York Shire breed of swine have been introduced in different part of the state.

Policies and Programmes

The animal husbandry department aims to achieve overall growth between 6-7% per annum during the 11thplan and developed programmes for animal health care, breed improvement, preservation and development of superior indigenous germplasm, and generate employment through investments in this sector. Some of the programmes and initiatives undertaken to achieve these goals and to prevent the spread

of zoonotic diseases to human population include:

- Special livestock programmes, Intensive dairy cattle projects
- Subsidy on breeding bulls, dairy units, on fodder development plots and chaff cutters, goat units, dairy breed, etc.
- Distribution of poultry units, pig units, bucks on exchange or replacement, construction of silo-pits, bullock pairs, Kadaknath chicks, etc.
- Establishment of veterinary dispensaries and upgradation of veterinary hospitals, strengthening of Artificial Insemination (AI) labs, establishment of controlled cattle breeding farms and strengthening of veterinary institutions and infrastructures amongst others
- The Government, through its organic farming policy, is encouraging the animal husbandry department to promote research and development on bovine diversity and dry dairy farming which in turn will provide organic inputs for farming
- Bovine Breeding Policy of the state recommends indigenous milch breeds of cattle and buffaloes for rural areas and crossbreeds for semi urban and urban areas and sterilisation of non-descript animals.

Concerns for Livestock Development

Changing climatic parameters such as increase in ambient atmospheric temperature, increase in frequency and intensity of extreme events such as droughts and heavy precipitation will have negative impacts on livestock health as well as its productivity. They will also require special care and treatments in order to help them survive through such harsh situations. Like human health, animal health too would be impacted by heat and cold waves, floods and droughts, vector borne and water borne diseases etc which will mean a severe threat to successful and profitable livestock rearing.

THI	Animal Sensitivity
65-72	Favourable
72-78	Mild stress
>80	Severe stress

Fig. 8.5 THI & Animal Sensitivity

Temperature Humidity Index (THI), representing the combined stress of temperature and humidity, affects the productivity of livestock. Animal sensitivity to certain ranges of THI is mentioned in table. THI in Madhya Pradesh varies from 65 to 78 and therefore its cattle population is more productive in comparison to other regions of India. Studies suggest that with rise in temperatures by 2-4°C by 2050, the THI will also rise which will lead to heat stress conditions; longer durations of such stressed conditions may impact animal productivity adversely. However, a rise by 1-2°C temperature may increase milk production from 10% to more than 25%. Heat stress also impairs reproductive functions and efficiency of almost all livestock species. Rising temperatures negatively affect the growth of livestock and also the time to attain puberty. It is likely to slow down the growth rate by 300-400 g/day. Crossbreds are more sensitive to rise in THI than indigenous varieties. Mineral deficiency in animal feed is also said to be a reason for infertility among cattle.

Water stress in the region will also affect the livestock development adversely. An average adult cow or buffalo producing 10-15 litres of milk per day requires about 40-45 litres/day drinking water during hotter days and about 40-60 litres for other requirements thus necessitating a minimum of 100 litres/day/animal. An organized animal farm following standard management practices and disposal of animal wastes requires additional water, about 50-100 litres/day/animal. Water scarcity not only affects drinking water resources for livestock, but it also has a direct bearing on the feed production as well as pasture yields. Rising temperatures also have a negative impact on the digestive system of cattle.

Unavailability of quality feed and fodder keeps animals underfed. Moreover, communities do not have enough awareness about animal breed selection, their nutrient and housing requirement, infections that could be fatal for them. There is a big knowledge gap among community about sustainable and best

practices of animal rearing and development.

Higher temperatures and changing rainfall patterns can enhance the spread of existing vector borne diseases [Bhattacharya et al, 2006] and macro parasites, accompanied by the emergence of new livestock diseases. Temperature and humidity variations could also have a significant association with bacterial, viral and increased helminth infections, protozoan diseases such as Trypanosomiasis and Babesiasis. Some of the viral diseases (PPR) may also reappear affecting small ruminant population as well. Frequency of incidences of mastitis and foot diseases among crossbred cows and other animals with high productivity may increase due to increase in the number of stressful days.

Concerns

* Large number of livestock is used for drought purpose
* Open grazing and underfed livestock
* Reducing fodder production
* Lack of market access and infrastructure for marketing livestock based products
* Deteriorating quality of breed because of inbreeding
* Heat Stress impacting health
* Declining livestock productivity and changing pattern of diseases
* Availability of water for livestock
* Predicted threat of vector borne diseases
* Adverse effects of extreme weather events on livestock health and development
* Impact on seed availability with increasing temperatures
* Suitability of species at particular temperatures
* Seasonal shift in breeding periods

Strategies to address concerns due to Climate Change in Livestock Sector

1. **Ensuring availability of adequate feed, fodder and water for livestock:** In order to promoting quality livestock rearing in the state efforts should be made to remove the basic hindrances like availability of adequate feed, fodder and water. Communities should be encouraged to develop the fallow and degraded land for fodder cultivation. This effort would not only provide fodder to the animals but also would curb further land degradation and soil erosion. More policy and programme level interventions should be undertaken to use forest foliage, agro-industrial by-products like sugarcane tops bagasse etc as feed for animals. Additionally, farming practices like intercropping of fodder crops in agricultural lands could also be explored. Community pastures, wastelands and denuded forest lands can also be developed into silvipastures, to enhance the fodder supply.
2. **Ensuring nutrient solvency in Livestock:** Making feed and fodder available is only one aspect of livestock rearing; more impetus should be on the nutrient requirements of animals in order to keep them healthy and productive. Stall feeding, though not much in practice in the state, is one method of feeding through which nutrient intake could be managed. Stall feeding in addition to grazing should be promoted. Mixed ration or urea enriched molasses mineral blocks should be provided to animals, especially during drought conditions.
3. **Enhanced capacity for disease forecast, monitoring and management:** Emergence of new pests and aggravation of infections of known etiology is also predicted in the context of Climate Change. Serious efforts are needed to make people aware about these diseases, their symptoms/signs and respective preventive medications or vaccinations and associated dosages. At the department level, such prophylactic vaccination programmes, may need to be changed or modified.
4. **Promote research on native species breeding and rearing:** Native species are said to be more tolerant to weather extremities as well as projected emergence of diseases in view of Climate Change. Studies need to be conducted to first evaluate the effects of Climate Change on various native breeds and then efforts should be made to popularise these hardy breeds and prevent their germplasm.

5. **Ensure proper housing and dedicated water bodies for livestock to overcome heat stress:** Animals also require housing that are conducive to weather conditions. Efforts need to be made to motivate people to develop properly ventilated and clean sheds for animals in rural as well as urban areas. Water and waste management in these housings should also be taken care of.

6. **Promote new varities of poultry and native species of small ruminants:** Due to changing climatic conditions, it is required to develop new mono/dual purpose variety of low input technology birds which thrive well in different agro climatic conditions. Disease and heat tolerant small ruminant breeds should also be promoted to enhance productivity in the least available resources, best suited would be the native breeds.

7. **Promote use of livestock and poultry waste for use as organic manure:** Livestock waste is commonly used as organic manure. Such efforts will not only reduce GHG emissions but will also increase the efficiency of communities to do sustainable livestock rearing. In addition to this, communities should also be encouraged to collect, recycle, and re-use the waste waster from such farms. Poultry manure from deep litter and cages can be used as a source of energy for power generation on small scale.

8. **Integrate livestock water requirements in watershed management programmes:** To enhance availability of quality water for livestock for production of milk, efforts will be needed to integrate water demand of livestock within watershed management practices.

9. **Infrastructure for processing, storage and transport of livestock products:** For better linkages of animal products with markets, large scale storage and transport facilities need to be set up through public private partnerships, while extending advisory services to farmers on milk harnessing and delivery norms for delivery centres near villages.

10. **Encouraae formation of cooperatives:** Cooperatives of small and marginal farmers may be set up with public private partnerships to give a boost to milk production in the state. Small commercial poultry models may be promoted as a viable model for income generation and livelihood enhancement in rural areas. Necessary policies interventions and programmes may be devised out in order to encouraging this activity.

11. **Strengthen extension arm of the animal husbandry department:** Efforts should be made to enhance the reach of animal husbandry professional snad services in order to promoting recommended livestock rearing practices and to keep awatch on the veterinary health. Short term trainings in these regards could also be organised for farmers. Out reach hubs like Kisan Call Centers could also be strengthened to provide advisory services on animal husbandry.

SKMCCC, EPCO

Fisheries

Background

Fishery is the mainstay of livelihood of economically weaker and backward communities in Madhya Pradesh. It is also an alternative source of livelihood for many farmers. It has huge potential not only for generating livelihood for rural poor but also for providing food and nutritional security particularly to women and girl child. Aquaculture can contribute significantly to food security and related multi-dimensional aspects of vulnerability associated with nutrient deficiencies and diminished scope for livelihoods.

Fisheries Statistics of the State	
Production (expected in XI plan)	74000 tons
Water Area under fish production	3.14 lakh ha
Major fish species	Indian- Katla, Rohu, Mrigal Foreign- Silver Carp, Grass Carp, Common Carp

Sources : XI Five Year Plan, MP

Madhya Pradesh is endowed with rich surface water availability with many rivers flowing across the state.This huge water resource offers great opportunity for fishing. Besides the free fishing in the rivers, about 99.97% water area of the existing reservoirs and 84% of the water area of existing ponds and tanks has been brought under fish culture, totalling to about 3.14 lakh ha with additional water area of 1 lakh Ha to be brought under fish cultivation through reservoirs being constructed by the NVDA and water resource department. Commensurate with the size of the resource and its pivotal role in inland fisheries development, reservoirs of Madhya Pradesh received considerable research attention, compared to other States. Efforts have been made in the State to develop the reservoir fisheries on scientific lines

Policies and Programmes

The government has taken several steps to boost production of fish in MP, chief amongst them being transferring fishing rights to Panchayati Raj bodies and developing fishing through cooperatives of fishermen. This has made Madhya Pradesh the only state where the water area is being developed through the cooperatives. Table 8.4 shows the system of management of water bodies in MP.

S. no.	Category by ha	Management authority
1	0-10	Gram Panchayat
2	10-100	Janapad Panchayat
3	100-2000	Zila Panchayat
4	Above 2000	MP Matsya Maha Sangh
5	44 reservoirs	Deptt. of Fisheries for breeder storage, R&D and Training

Table 8.3 Management of water bodies in MP for fisheries

The other steps taken by the government include development of PAN culture to raise fish finger lings, renovation of ponds through MGNREGA programme, developing fish seed production and infrastructure near NVDA reservoirs and introducing biotechnology in fish seed and fish production, setting up of solar powered/generator managed units in the fish farms ensuring the energy needs, setting up of indore hatcheries and aerators to maintain the tempatures in the fish farms and rearing of fast growing species. A new Janashree insurance scheme has been approved for implementation in the 11th plan, through which fishermen will be insured for supporting education of their children and support to their families in case of death. The premium amount to be paid will be jointly contributed by the state, the insurance company and the fishermen. This is considered as good adaptation concept.

The Fishery Policy, 2008 of the State focuses on socio-economic development of the fishing community.The policy has provisions for relief to the fish farmers who incurred loss due to natural calamity and disturbance, for crop damage compensation in condition of drought on the basis of assessment, for free fish seeds distribution to raise more fish production, thereby maintaining fish density in rivers of the state.

Concerns of Fisheries Sector

Studies show that aquaculture can provide good quality protein with a much lower carbon footprint than comparable terrestrial animal production systems. Based on the few studies that have been completed and some others that are under way, the potential impacts of Climate Change on global aquaculture may include: rising sea surface temperatures, sea-level rise, increasing ocean acidification, higher incidence of extreme weather events, increasing risks of transboundary pests and diseases, and altered rainfall patterns and river flows [World Aquaculture 2010- FAO: Fisheries and Aquaculture Technical Paper].

Intensive fishing efforts, the potential for exploitation of fish stocks at its limit, dwindling fish resources and several endangered species have set alarm bells ringing within an industry that provides the livelihood to 30 million people. Socio-economic changes and technological progress are increasing competition and the future of the fisheries sector is becoming more uncertain.

About 172 species of fishes have been reported by Zoological Survey of India in the state. However, due to the abstraction of water for irrigation and ecological transformation due to anthropogenic factors, availability of certain fishes in the catches has dwindled. The declining biodiversity of the fishes has to be looked upon. The concern for fisheries cultivation in the dam reservoirs is the open overflow which not only results in loss of fish eggs, but also lets out a considerable number of young fish, depriving the reservoir of its stock strength. Therefore, there is need for a stocking and harvesting schedule, allowing the stocked fish to grow for a maximum period of time during the non-overflow months, even at the cost of some reduction in the size at harvest. The aim is to achieve sustainable catches. Sustainable development is one target in fisheries management. The long-term sustainability of the whole ecosystem related to the fishing activity and the effect on the welfare of those involved in fishery activities and of society in general need to be studied.

In the context of Climate Change, the primary challenge to the fisheries and aquaculture sector is ensuring food supply, enhancing nutritional security, improving livelihood and economic output, and ensuring ecosystem safety. The sector should also prepare itself to face the potential impacts of Climate Change and make special efforts to further assist small-scale producers by organizing them into groups and through promotion of better management practices and co- management.

Some of the impacts on inland fisheries can be as follows: Seed availability might be affected with warming as in general it has been observed that with increase in temperature there is a decrease in fish spawning and hence decrease in fish seed availability. Temperature increase will have an impact on the suitability of species for a given location with warm water fishes surviving more than the others. Growth retardation may take place in different inland water fish species suitable for the different temperature ranges in the 11 agroclimatic zones in MP. Seasonal shifts in the breeding period, as well as shortening or lengthening of breeding periods may occur for different types of fish. Geographical shift of fishes may also happen. Along with these concerns, increase in frequency and intensity of droughts, will decrease fish catch and thus pose a great threat to the communities which are dependent solely on fisheries.

The productivity, distribution and seasonality of fisheries, and the quality and availability of the habitats that support them, are sensitive to these Climate Change effects.

Researchers and policymakers now recognize that the Climate Change impacts on riparian environments, and on the fisheries they support, will bring new challenges to these systems and to the people who depend

on them. Coping with these challenges will require adaptation measures planned at multiple scales. Climate Change stresses will compound existing pressure on fisheries and aquaculture and threaten their capacity to provide food and livelihoods

There is absence of a knowledge network to link local creative communities and lateral consultation among fish farmer, expert and policy makers. Lack of proper documentation of ecological indicators to monitor the health of aquatic ecosystem also lead to information gaps amongst farmers and they are unaware of impending threat of Climate Change on their livelihoods.. There is also no system of sharing this information among stakeholders for taking proper course of action to mitigate impact of Climate Change.

Climate Change poses new challenges to the sustainability of fisheries and aquaculture systems, with serious implications on people who depend on them for their livelihoods and for people for whom fish is an important source of food and nutritional security.

- To help meet these challenges, the aim is to work with partners to:
- Focus Climate Change responses where they are most needed by assessing and mapping the vulnerability of fishery- and aquaculture-dependent people and regions to the impacts of Climate Change
- Reduce people's vulnerability to these impacts by identifying appropriate adaptation strategies
- Build local and regional capacity to implement adaptation and mitigation strategies for fisheries and aquaculture by informing and influencing policy processes.

Strategies to address concerns due to Climate Change in Fisheries Sector

Climate and freshwater systems are interconnected in complex ways. Any change in one of these systems induces a change in the other. The productivity, distribution and seasonality of fisheries, and the quality and availability of the habitats that support them, are sensitive to Climate Change effects (source: Freshwater resources and their management: Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007). Therefore, Fisheries management capabilities to cope with impacts of Climate Change must be developed .There is an urgent need to develop coping mechanism and adaptive responses to combat effect of Climate Changes on fishermen's livelihood. Efforts are also required to reduce people's vulnerability to these impacts by identifying appropriate adaptation strategies; and to build local, national and regional capacity to implement adaptation and mitigation strategies for fisheries and aquaculture by informing policy processes. This can be done by implementing the following strategies.

1. **Study of impacts of Climate Change on inland fisheries:** Aquaculture requires natural resources like water, land, seed, feed and energy, the impacts of Climate Change on these resources would also, in turn, affect the productivity and profitability of communities depending on aquaculture as source of food and livelihood security (source: Climate Change , energy and food – FAO , Technical Background Document). Detailed assessments and studies should be undertaken to understand the effects of increasing temperature and frequent extreme events on the fish. Financial instruments could be developed for livelihood risk management due to Climate Change in a way it benefits the neediest without much complexities.
2. **Promotion Policy and blending of technology for fisherman:** Fisherman community should be strengthened through formation of societies/ cooperatives. To make the fighing business more profit oriented, appropriate technologies should be introduced thorugh proper capacity building
3. **Develop Agroclimatic zone wise plans for fisheries:** Policy makers and stakeholders need to adopt and adhere to best practices such as those described in FAO code of Conduct for Responsible

Fisheries. These practices would build resilience to the effects of Climate Change and derive sustainable benefits. Better Practices Guidelines (BPGs) would be developed on fish rearing and culture practices on small scale aquaculture suitable for different agro climatic zones in MP along with management of ponds, lakes, reservoirs, and watersheds. Promote research on developing fish seeds that are suitable for different water bodies and agro-climatic zones.

4. **Strengthen the existing system of fish management in the state:** a.) Create more fish seed banks for easy availability of fish seed to the fishermen and farmers. Promote fish breed diversification such as Mahaseer, Magur, Common Carp and Indian major Carps like Rohu, Katala, Mrigal etc. and improve storage infrastructure and access to markets to develop arobust system for fish management in the state. (b)Promotion of Community Based Aquaculture Management (CBAM), demand led, community centred small-scale aquaculture in the state.This would encourage community owned management and development of fiseries. Putting community at fore front would lead to pool resources, have better control and management over the resources .It will also promote and foster group working culture among the fishers.

Germ plasm of Common Carp

Common Carp of Bangkok strain was first introduced in India in 1957 and it was distributed to various states of the country by CIFRI, (Central Fisheries Research Institute) for culture. The fish is voraciously omnivorous and can withstand wide fluctuation in temperature .Its hardy in nature and has prolific breeding propensity and matures quickly. It can grow in cold water also and consumers preference makes this fish farmers choice in community ponds as well as in farm ponds. Of late, this species has shown signs of genetic fatigue in India. This has resulted in slower growth, low survival rate and poor health. Genetic fatigue has occurred because of repeated in-breeding and cross breeding with the Gold fish.

Amur Common Carp (Cyprinus carpio haematopterus) may be introduced on select Government owned farms and after trials can be introduced to fish farmers. This fish has known to be more resistance to low temperature and is hardy to survive in adverse conditions.

5. **Co-management approaches are increasingly being used in many countries for the management of resources.** Efforts would be made to initiate principles of co-management and adaptive management practices. The management approach would be people centred and participatory. Fishermen cooperative would play pro-active role in conserving the stock and protecting the breeding grounds during close season, strictly follow the prescribed mesh size and use appropriate gears to catch the fish.

6. **Conservation of the fish biodiversity:** Nearly 22 species in the state are endangered. Steps should be taken for the conservation of the germplasm of these species. Control on introduction of the exotics should be exercised. The introduction of the exotics without proper study of their effect on the ecosystem leads to the extinction of the indigenous species and also other aquatic flora and fauna. Germ Plasm of common carp can also be developed.

9 Human Health

Background

Public health depends on availability of enough food, safe drinking water, a decent home protection against disasters, a reasonable income and good social and community relations (WHO, 2003) and Climate Change is projected to affect all these factors.

Madhya Pradesh is one of the top two states which have high infant mortality rates with Panna standing at 93. MP is next only to UP in high neonatal mortality rates (NNMR) standing at 44. NNMR is significantly high in rural areas than urban [Annual Health Survey 2010-11]. Despite improvements in the coverage of antenatal care, only 4 in 10 women receive them. Only 71% women receive the recommended two doses of tetanus toxoid vaccine during pregnancy [National Family Health Survey-3].

Madhya Pradesh is among the 6 states of India which contributes to 65% of malarial incidences. 25% is contributed by, within MP only, four districts namely Dindori, Mandla, Dhar and Jhabua [RMRCT, 1997-2009] which are predominantly tribal districts. MP is sensitive not only to malaria but also to dengue, chikungunya, and cholera etc.

Indirectly, climate related disturbances in ecological systems such as changes in the range of infective mosquitoes can lead to more incidences of vector borne diseases (VBDs). Increasing temperatures correlate with microorganisms to cause water borne diseases like cholera, diarrhoea etc. Climate Change could increase air pollution levels by accelerating the atmospheric chemical reactions that produce photochemical oxidants due to a rise in temperature. The increase of Chloro Fluoro Carbons (CFCs) in the atmosphere will increase UV radiation affecting the immune systems and leading to infectious diseases. Other minor effects are increased incidences of skin disorders, such as prickly heat and fungal skin disorders such as ringworm and athlete's foot as a result of increased temperature and humidity.

Health Statistics of the State

Life expectancy at Birth	58
Crude Birth Rate (CBR)	25
Crude Death Rate (CDR)	8
Infant Mortality Rate (IMR)	65
Maternal Mortality Ratio (MMR)	310
Health Infrastructure	District Hospital – 48
	Civil Hospital – 54
	Urban FW Centres – 96
	Civil Dispensary – 92
	Urban Health Post – 80
	TB Hospital – 7
	PHC – 1,149
	SHC – 8,834
	CHC - 270

Sources : Census 2011, XI Five Year Plan, MP, HDR India 2011 UNDP

Malaria gets more lethal

Malaria, one of the fatal sicknesses in Madhya Pradesh has assumed more lethal form. The disease is now not manageable with the usual drugs like quinine, chloroquine etc. but a combination of drugs is required for curing the patients. Medical practitioners in the state have also confirmed that even if the diagnosis shows P.vivax infection, patients develop severe complications that almost resemble the signs and symptoms of P.falciparum infections. Adapted from Hindustan Times, Bhopal Edition dated Nov 12, 2011

Directly, the overall increase in temperature and increase in the number of warmer days will increase deaths due to greater frequency and severity of heat waves and other extreme weather events. Major nutritional health impacts are projected via crop failure caused by drought, loss of rain-dependent non-irrigated crops and especially from high night temperatures reducing cereal yields. These impacts are projected to adversely affect a very large number of people.

Climate related disease prevalence in MP

Vector borne diseases

Malaria: 25 districts of Madhya Pradesh are hot spots of malaria. According to the reports of the State Vector Borne Disease Control Programme (VBDCP) operating in Madhya Pradesh, the number of incidences in the state has reduced from 238222 in 1996 to 87165 numbers in 2010, however, percentage of Plasmodium falciparum malaria, which is more dangerous than the Plasmodium vivax is reported to be increasing from 25.6 to 35.7% during the same period [www.nvbdcp.gov.in/Doc/malaria_situation_Juy11.pdf]

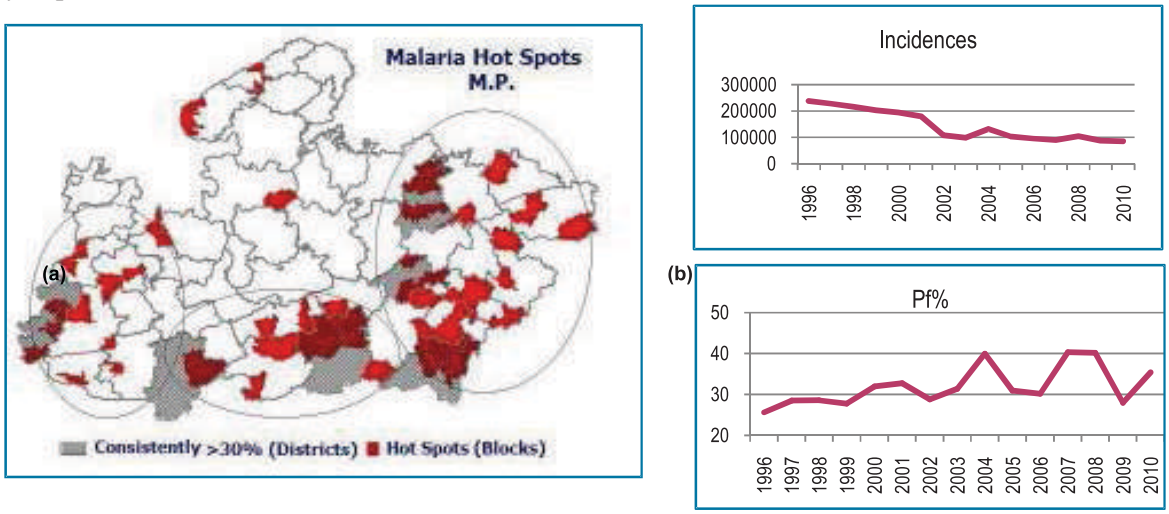


Fig. 9.1 (a) Malaria Incidence Trends in MP, (b) Pf% trends in MP and malaria Hotspots (http://mp.gov.in/health/malaria.htm), Srivastava et al., Identification of malaria hot spots for focused intervention in tribal state of India: a GIS based approach Int J Health Geogr. 2009 May 2009

Dengue: As per the state VBDCP, Bhopal reported 5 confirmed and 85 suspected deaths due to dengue in 2009 in the state. Researches indicate that warmer temperatures shorten the time for mosquitoes to become infectious increasing the probability of transmission [Jetten & Focks, 1997]. The minimum temperature required for survival of dengue viruses is 11.9ºC [IPCC 2001]. Higher temperatures beyond 42ºC are not favourable for survival of the vector for dengue viruses. Table 9.1 indicates the dengue cases and deaths reported in Madhya Pradesh between 2007 and 2010.

2007		2008		2009		2010	
Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths
51	2	3	0	1467	5	175	1

Table 9.1 Dengue death cases reported in MP between 2007-2010

Chikungunya: It was earlier eliminated from India, but has re-emerged in most parts of the state in 2006, refer to Fig. 9.2. About 106 confirmed cases of Chikungunya were reported in 2006 from 21 districts of MP, mainly in the southern part. Presence of virus in the state indicates that transmission occurs in areas with moderate temperatures, not experiencing severe winters. With the projected rise in temperatures, the

disease is likely to spread towards northern India.

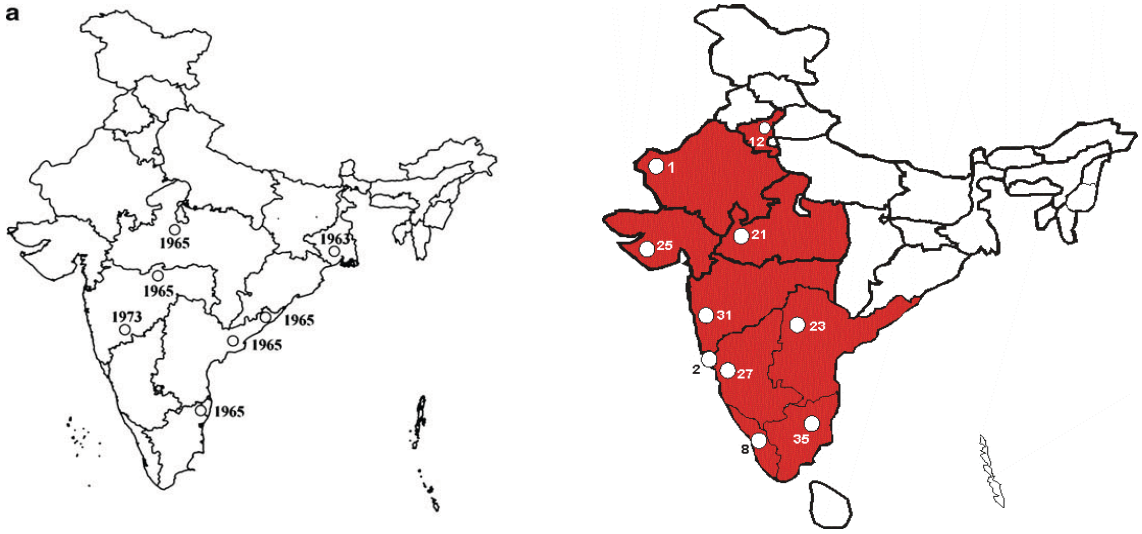


Fig. 9.2 Shift in foci of Chikungunya in India

Water Borne diseases

Cholera: It is caused by Vibrio cholerae and has a direct link with the climate fluctuation and can lead not only to local outbreaks but pandemic ones too. The data available for Madhya Pradesh for the period, 1997 to 2006 indicates that cholera outbreaks had taken place thrice in this period in 2001, 2004 and 2006. According to national health profile 2008, acute diarrhoeal cases in Madhya Pradesh were 57.8 lakhs in 2007; however, only 14 have been reported as Cholera incidence. Cholera cases are hugely underreported mainly because disease surveillance is limited and laboratory capacity inadequate, especially at peripheral health-care centres. Cholera in flooded areas is a concern and with increase in extreme rainfall in the future, flooding may increase. Water management practices, urbanisation, intensified land use and forestry can substantially alter the risks of floods [EEA, 2005].

Heat stress

Heat stress occurs when high temperatures in excess of 40°C persist for a number of days. IPCC reports suggest that hot days, hot nights and heat waves have become more frequent [IPCC, 2007a]. Heat wave conditions are maximum in June, but they start as early as in March while transiting from winter to summer.

In Madhya Pradesh total number of heat wave incidences between 1968 to 1977 was 4, and between 1978 to 1999 they increased to 15. It has been reported that the decade 2001–2010 has been India's warmest decade on record, with an anomaly of 0.4°C — surpassing the previous decadal record set in 1991–2000 by 0.2°C and in 2010 severe heat waves have been reported from Madhya Pradesh from March itself. Fig. 9.3 illustrates the spread of heat wave conditions in India during March 2010.

Kanungo et al., Cholera in India: an analysis of reports, 1997–2006, *Bulletin of the World Health Organization* 2010;88:185-191.
doi: 10.2471/ BLT.09.073460

U.S.De, R.K.Dube and G.S.Prakasa Rao. Extreme Weather Events over India in the last 100 years, J. Ind. Geophys. Union (July 2005), Vol.9, No.3, pp.173-187

http://www.ncdc.noaa.gov/sotc/2010/13

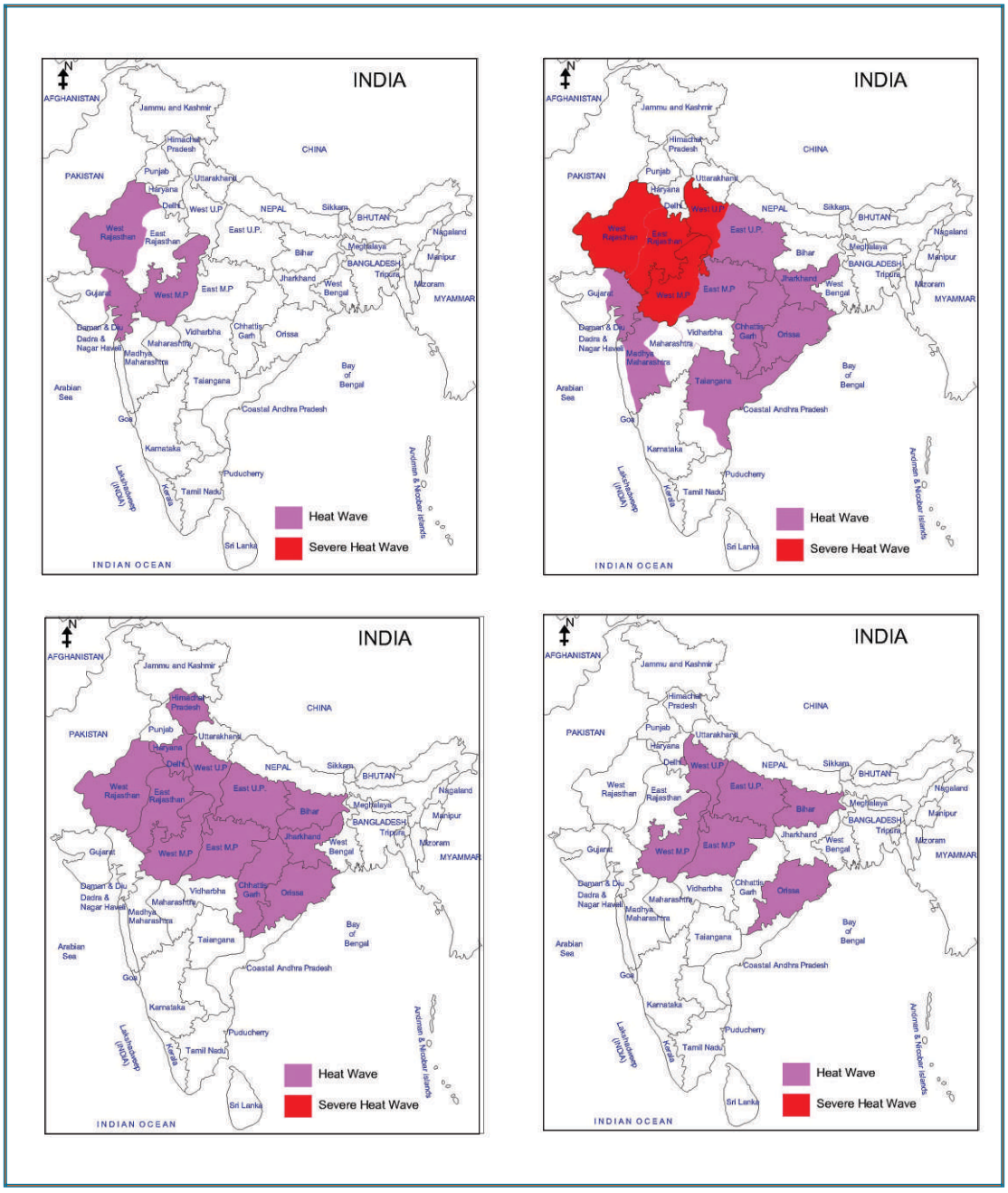


Fig. 9.3 Development and spread of heat wave conditions during March 2010 Source: *Meteorological Analysis of abnormally high temperatures during March 2010*http://www.imd.gov.in/section/nhac/dynamic/march2010.pdf

Policies and Programmes

The State is committed to provide health care facilities to the poorest of the poor in the society through primary health care including preventive, curative and promotive care. Objectives has been to reduce infant mortality rates, universal immunisation of childhood diseases, integrated comprehensive primary health care, provision for village level health activities in underserved villages, preparation of panchayat level health action plan, institutionalising district level management of health, increased utilization of 1st referral units from less than 20% in 2002 to more than 75% now.

Programmes operational on ground- National Programmes – National Tuberculosis Programme, National Vector Borne Diseases Control Programme, National Rural Health Mission, National Family Welfare Programme, National Leprosy Programme, National Programme to Control Blindness, RCH-II programme.

State Welfare Schemes – State Illness Assistance Programme, Rogi Kalyan Samiti, Deen Dayal Antyoday Upchar Yojana, Prasav Hetu Parivahan Evam Upachar Yojana, ASHA and AYUSH.

Other activities- Improving hospital infrastructure in urban and rural areas, human resource development for strategic planning for various programmes and schemes of the state, establishment of New Health institutions, PHCs, SHCs, and CHCs etc.

Concerns of Health Sector

Malaria endemicity in tribal regions remained high inspite of the intensive State Vector Borne Disease Control Programme and the failure of subsequent sustenance programme resulting in an increase in percentage of P.falciparum (Pf) cases over the years indicating increase in drug resistance. Low coverage of disease surveillance/ screening centres in tribal areas and other remote areas adds on the problem. The state health infrastructure is not enough capable to predict any such diseases outbreaks nor the health disaster response system is robust enough to manage the situations. Though the health department of the state is already doing a mapping of diseases but there is still a lacking on early warning systems.

Concerns

* Low diseases surveillance
* Lack of early detection of disease in tribal and remote areas
* Health disaster management strategies weak
* Lack of robust early warning systems besides IDSP
* Lack of efficient drug supply chain management and infrastructure to store medicines
* Lack of a full fledged epidemiology wing in the public health segment
* Poor compliance of prescribed bio-medical waste management practices
* Increase incidences of vector, water and air borne diseases as well as heat & cold strokes
* Re-emergence of vectors that had been eradicated
* Rising urban malaria including dengue
* Heat stress induced morbidity
* Rapidly mutating strains of virus

Transmission windows (TWs) for malaria i.e the appropriate conditions of temperature and humidity in which a vector thrives, is projected to increase (temperature range between 14-40^{o}C, and RH>50%) with Climate Change.

In MP, TW of malaria may increase to 8 months from around 4-5 months in view of the projected 2.5^{o}C rise in temperature by 2050 [NATCOM, 2004]. This may lead to increase in malarial morbidities. Fig. 9.4 illustrates the shift in transmission windows from present to 2050 scenario.

The state is already witnessing re-emergence of eradicated VBDs like Chikungunya. Climate Change may aggravate the problem much more or may lead to emergence of some new vectors. TW shows suitability for less number of months while the occurrence of cases reflects transmission for longer periods. This suggests the presence of a microniche which needs to be studied in detail. There has been a rise in urban malaria and dengue also in the state.

Frequent outbreaks of water borne diseases may happen in the future leading to increase in virulence, mostly due to increase in intense precipitation leading to flash floods and retention of stagnant water.

Variations in day and night temperatures coupled with increase in air pollution have led to rise in cases of allergies and respiratory infections in the state. More pulmonary disorders are being recorded with rise in percentage of particulate matter in the environment due to change in weather. Bronchial asthma has become common among children (Times of India, Bhopal Edition, November 12, 2011).

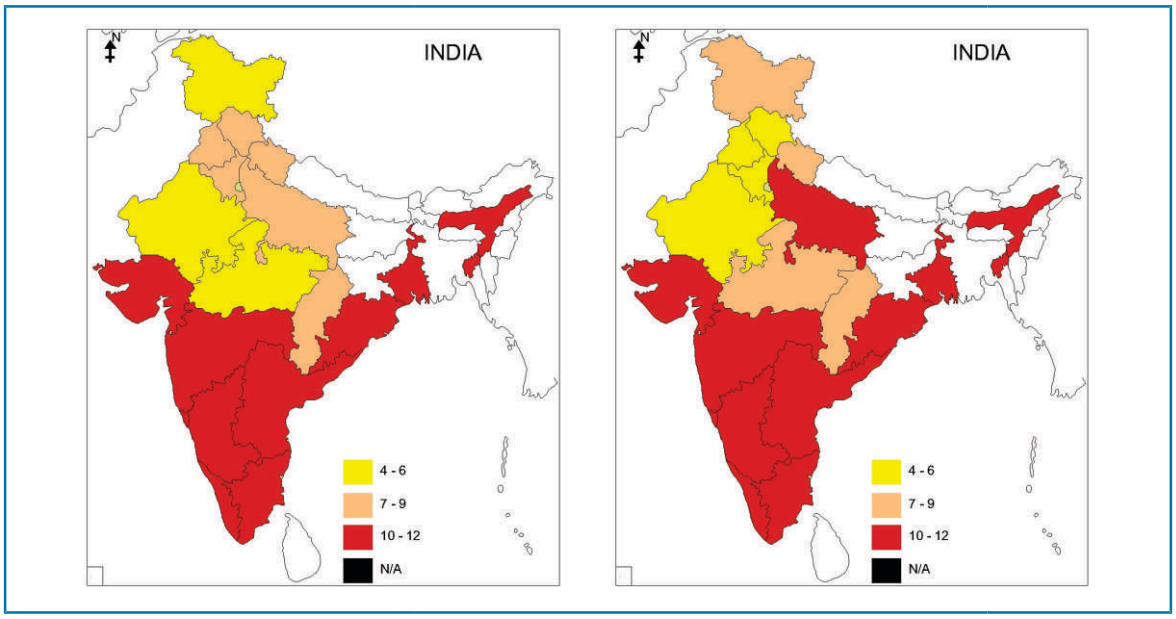


Fig. 9.4 Shift in transmission window (Present and 2050 Scenario)

Anticipation and planning for health sector becomes difficult considering the varying vulnerabilities of different demographics settled in varied geographical locations. There are many uncertainties around adaptive capacities as well which also plays a pivotal role. For this reason, stress was laid on improvements to environmental practices, preparation of health disaster management plans, improving public health infrastructure and disease surveillance and emergency response capabilities, which are expected to lay a sound foundation to cope with Climate Change.

Strategies to address concerns due to Climate Change in Health Sector

1. Developing diseases profile of communities: It has been observed that different areas have different degree of vulnerability towards different diseases and have typical disease profiles. Launching intensive programmes for mapping to identify the diseases profile of communities across Madhya Pradesh will help in effective resource allocation and planning for treatment of specific diseases identified for each community.
2. Development of weather based Early Warning System: The climate related diseases generally take place due to unavailability of timely information about the weather events that cause them. There is a need to address this issue through a strong institutional mechanism that integrates short, medium and long term weather forecasting and means to disseminate the same among health professionals and masses.
3. Upscaling Health Disaster management preparedness: Setting up plans for protection of health of population susceptible to break out of diseases due to extreme events, such as floods, droughts, extreme heat, extreme cold, and favourable conditions for vectors. Those areas vulnerable to floods/ droughts should have separate health delivery system and health disaster management plans to quickly limit the spread of disease. Weather related diseases should have specific plans for control that ameliorate specific needs of the disease management.
4. Early case detection and quick control- with a focus on areas where coverage is low or has not reached: There is an urgent need to strengthen the health service delivery mechanism – such as (a) disease surveillance units at the districts, (b) disease diagnosis centres (pathological laboratories) as

many of the remote locations still lack such health facilities, (c) Sensitizing and involving the community for detection of disease (e.g. breeding places for vectors) and their elimination by training them on the same. Along with this existence of (d) Drug Distribution Centres in remote areas for providing easy access to anti- malaria drugs to the community. (e) Alternative medication for drugs resistance vector parasites of P.falciparum malaria should also be made available. (f) Along with this presence of medical professionals at these sites is a necessity. In case of remote areas, measures such as tele-medical advisory services can be devised through the local gram Panchayat to make the tribals and people in remote places access medical help on a regular basis.

5. Strengthening supportive systems for Environment Management: Measures for source reduction for all vector borne, water borne diseases is required. For e.g: filling of the breeding places, proper covering of stored water, channelization of breeding sources etc.

6. Monitoring and reporting mechanism to ensure accountability and optimize outputs: A Monitoring and Evaluation Cell is being set up in the Directorate of Health & Family welfare. This will network with all the districts and will collect and compile information about all the health programmes being run by department. The manpower available in the department under Strategic Planning Unit (SPU) and State Programme Management Unit (SPMU) will be responsible for generating reports and monitoring that will be used as feedback for field observation and corrective actions.

7. Public Awareness on health issues: Enhanced awareness about climate induced diseases reduces the risk and thus public awareness on climate induced health effects should be generated through community level groups, PRI, educational programmes.

8. Research and study on Climate Change and health impacts: The state needs to map the climate induced health vulnerability in different regions of the state. Promotion of research in health sector to draw linkages between Climate Change and health in the state is suggested.

9. Capacity Building of health delivery personnel and institutions: Capacity building of different stakeholders needs to be built on different aspects related to Climate Change and respective health impacts. Health activists and extension workers working in remote areas need to be trained to manage escalated frequency and spread of vector borne/ water borne/ hygiene.

Further, the Health and Family Welfare department needs to have a CC Cell that will coordinate with on CC issues regarding health and also with the relevant line ministry in the centre.

SKMCCC, EPCO

10 Urban Development and Transport

Background

Urban Administration and Development

In Climate Change context, cities play crucial roles in mitigation as well as adaptation. Well-planned, compact cities can be highly resource-efficient and lead to lower greenhouse gas emissions. Cities, as centres of expertise and innovation, can invest in greening transport, buildings and waste management sector, creating jobs and supporting long-term economic growth.

Urban areas of Madhya Pradesh are physically growing. As per census 2011, urban population of MP is 20.05 million recording a decadal growth rate of 25.6% during 2001-2011.Graph in Fig. 10.1 illustrates a trend of decadal population growth and growth rate for the state of Madhya Pradesh.

Urbanization is often referred as the rapid as well as massive growth, contributed by migration to a greater extent, of large cities resulting in both positive and negative consequences which results into urban sprawling and development of slums in cities. Madhya Pradesh had a little more than 15% of the total urban population living in slums, as per census 2001. A projection of MP's slum population till 2017 is depicted in Fig. 10.2 which indicates that slum population would remain on an even and steady rise in the state unless robust plans are implemented to curb this effect of urbanisation.

Urban Development and Transport Statistics of Madhya Pradesh	
Level of urbanisation	27.5%
Towns	364 – Statutory towns 112 – Census towns
Urban Population	20.05 million
Decadal Urban Population growth rate (2001-2011)	25.6%
Total slum dwellers *(Census 2001)*	24,17,091 (15.13% of the total urban population)
Total motor vehicles registered in MP	60,10,691
Road network (km)	73,311 kms
Urban Local Bodies	**360** Municipal Corporation - 14 Municipality - 96 Nagar Panchayat - 250
Sources: Urban Infrastructure Report 2011, Census 2011, Census 2001,Transport Statistics 2008-09,	

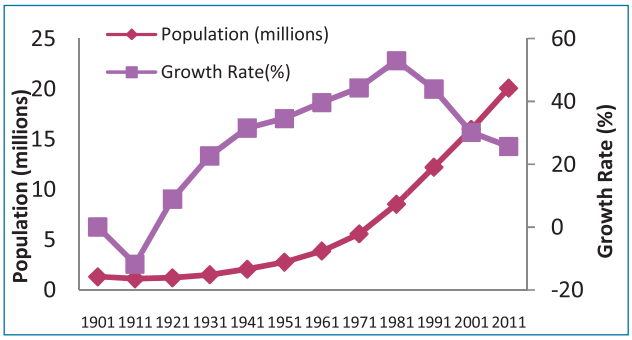


Fig. 10.1 Decadal population and growth rate of Madhya Pradesh (1901-2011)

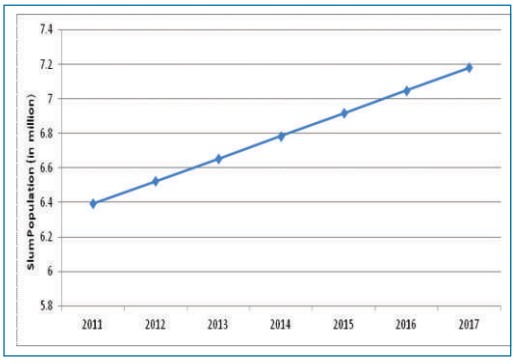


Fig. 10.2 Projections for Slum Population MP till 2017 (Source - India Stats)

Population projections for India 2001-2026 suggests that by 2026 Madhya Pradesh will have an urban population of 31.2 millions [Population Projections for India and States 2001-2026, GoI], which means that the grappling situation to accommodate more and more people in cities in a sustainable manner will remain an everlasting challenge for urban planners.

Urbanisation is a constant process but it can be made sustainable by integrating the three fundamental components consisting of environmental protection, economic growth and social equity in the planning process itself.

Transport

It is also said that invention of the wheel is probably the most important inventions of all time. In today's context, it has become a key component for economic growth and human welfare which is bound to increase. All the modes of transport rely on fossil resources for fuel requirements.

Road transportation is the major mode of transportation in Madhya Pradesh. As per the State Transportation Policy 2010, there had been a rising demand for better transportation facilities in the state and it is expected that in near future, there would be a rise of 10% per year in commercial transportation. A rapid increase in the total number of vehicles has also been recorded in the past decade with an average growth of 12.91% annually. Total number of two wheelers and four wheelers constitute 78% and 21% respectively out of the registered 60 lakh vehicles. Commercial vehicles constitute only 5.85% of the total vehicles in the state. A trend in the registration of commercial and non-commercial vehicles during 1991 and 2009 is depicted in Fig. 10.3. State's transport policy has focussed on promoting efficient public transport services and in this line Bus Rapid Transport System has been introduced in four major cities: Bhopal, Indore, Jabalpur, and Gwalior. Urban Mass Transit Companies (UMTCs) have also been identified to improve the connectivity of public transport. Besides these, Metro Rail services, Intelligent Transport Systems etc are also being considered as potential mass transports in the state.

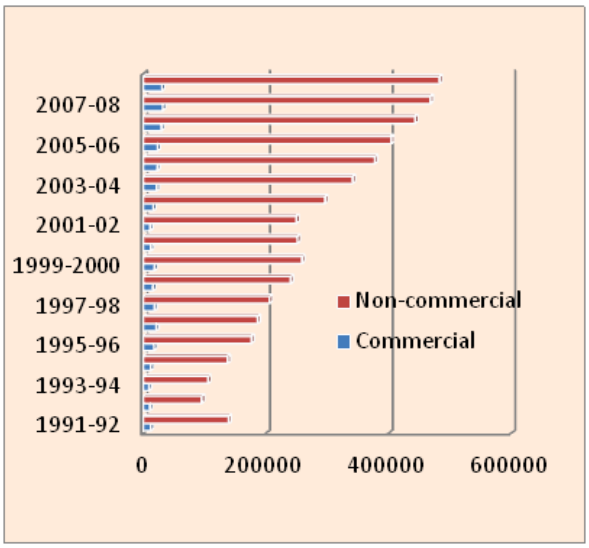


Fig. 10.3 No. of vehicles registered during 1991-2009

It has now become imperative for the state to manage the ever increasing fleet of non-commercial vehicles as well as the sustenance of newly introduced mass transports in order to developing a robust road transport system.

Policies and Programmes

The state is undergoing considerable changes in terms of urban and economic growth and considering the expected intensification of urbanisation, the government is implementing many flagship programmes for urban development as well as transport management. Need of the hour is to evaluate these programmes and associated activities with Climate Change perspective so as to transform them into sustainable developmental practices. State policies governing and guiding guiding the sector are –

Madhya Pradesh Housing and Habitat Policy 2007 – Scope of this policy is very wide which

encompass an ambitious resolution to develop Housing for all ensuring a slumless urban environment, to draft integrated rural development plans in order to Providing Urban amenities in Rural Areas (PURA), to focus on city development plans ensuring sustainability and urban infrastructure & land development.

State Transport Policy 2010 – The Madhya Pradesh Transport Policy 2010 tries to make public transport user friendly by introducing new technology so that more and more people are able to use the public transport system. Since roads are the backbone of state's transport system, the policy talks about improving the road network within the state. It also focuses on introducing faster and safer transport systems like BRTS, ITS etc and encouraging use of cleaner fuels like CNG. Very soon the state would have its Parking Policy also. This initiative is being taken with a view to regulate parking at public places and reducing traffic congestions.

Some of the urban development and transport associated programmes in effect are -

- Jawaharlal Nehru National Urban Renewal Mission (JNNURM)
- Integrated Housing and Slum Development Programme (IHSDP)
- National Urban Infrastructure Scheme (NUIS)
- Urban Infrastructure Development Scheme for Small and Medium Towns (UIDSSMT)
- Rajiv Awas Yojana (RAY)
- Madhya Pradesh Urban Services for the Poor (MPUSP)
- Madhya Pradesh Water Supply and Environmental Improvement Programme
- State Level Urban Sanitation Mission
- Bus Rapid Transport System (BRTS)

Concerns for Urban Administration, Development and Transport

Urban areas have a give and take relationship with Climate Change which is quite vivid. Large cities are huge sources of Green House Gas emissions and also stand to suffer dire consequences of Climate Change.

Urban centres, commercial and residential both, are huge consumers of energy. Excessive / faulty cooling, excess lighting, poor lighting technology and transmission & distribution losses all lead to wastage of energy. About 9% of power resources of the state are consumed by commercial and residential buildings and the T & D losses of the state stood at 32.13% in 2009-2010 [Energy Supply and Demand in MP-Investments and Policies by PwC Report]. Urban living patterns generate huge amounts of solid waste and waste water which are potential sources of methane. Untreated accumulation of wastes are bigger concerns as methane is 21 times more potent a GHG than CO_2.

Transport system thrives on fossil fuels and their combustions lead to generation of gases like CO and NO_x, hydrocarbons, some SO_2 and solid particles. The particulate matter modifies the radiative flux and contributes to change in temperature. Unplanned roads with reduced capacities often lead to traffic congestions, location and length of drives and energy intensive transport systems enhance the rate and level of emissions much more.

Concerns

* Emissions from vehicles
* Inefficient and insufficient public transportation
* Energy consumption, both residential & commercial
* Methane emissions
* Poor water management practices
* Increasing urban atmospheric temperature
* Lack of robust city infrastructure to handle extreme weather events like flash floods
* Rise in urban malaria
* Unplanned urbanisation
* Below average railway network connecting remote districts
* Depleting groundwater levels

At the receiving end, cities are also equally victimised by changing weather patterns. Loss of green cover around urban centres may lead to development of heat islands which may rise the average atmospheric temperatures. The heat stress on infrastructure can damage the material, such as asphalt or rails designed for lower temperatures. Heat stress on human health may lead to morbidities; worst affected would be the urban poor and homeless who are subjected to more heat exposure.

Rising temperatures would also increase the need for artificial cooling. These cooling equipments, on one hand, are energy intensive and on the other hand support vector development. Extreme rise in temperatures do not favour vector development but artificial cooling equipments help in the creation of micro-environments which favour their survival. This could be one of the reasons behind increased urban malaria and dengue incidences.

Madhya Pradesh is a land locked state which has only rain-fed rivers as life support systems. Water stress caused by variations in precipitation patterns would have severe consequences in cities too, which had been experienced in the past. Industrial effluents have also deteriorated the quality of surface water bodies. For insufficient quality tapped water, excess exploration of groundwater has led to its depletion. Water quality associated health impacts are already recorded in the state. Flash floods or deluges often jeopardise urban infrastructure for inefficient storm water disposal and management practices.

Strategies to address concerns due to Climate Change in Urban Development and Transport Sector

1. Increasing Energy Efficiency in Residential and Commercial buildings: Energy sector is the largest emitter of GHG's. Municipal Demand Side Management on commercial as well as residential sector may reduce significant energy consumption. Promotion of green building concept together with adoption of other active and passive methods to reduce energy consumption. Effective implementation of building bylaws, Energy Conservation Building Codes and National Building Code of India and promotion of energy efficient household appliances. Water management and conservation should also be integrated in building design concepts.
2. Urban Water Supply: Providing quality drinking water is now a persistent problem in cities. In order to reducing this issue robust urban water supply system should be facilitated ensuring sufficient per capita availability of quality water. Groundwater levels in the state are already highly depleted especially of western MP, as per the report of Water Resources Department. Groundwater explorations and its commercial selling should be regulated and monitored especially in areas where facilities for piped water supply have been developed. Use of energy efficient water pumps at every level should be encouraged.
3. Urban Storm Water Management: Increased precipitation results in flood like situations in many cities which affects the socio-economic life of people. Urban storm water management plans should be formulated with the help of suitable climate models to avoid flood like situations.
4. Solid Waste Management: With the increasing size of cities, solid waste management has become a big problem. Awareness generation among people about best practices, waste segregation at sources, development of sites to explore waste to energy potential, more investment in research activities for developing different cost effective models to convert waste to energy.
5. Wastewater Management: The demand of water for different purposes is increasing day by day and relevance of 3R principles- reduce, reuse and recycle increases under these conditions. Appropriate low cost technologies for grey water recycling should be promoted at household levels so as to reduce the quantity of black water generation from households and also to reduce conversion of white water to black water.

6. Sustainable Urban Transport Planning and Management: Thrust should be on improving the road networks in the state emphasising on their quality and connectivity, both. Efficient and quality mass transportation systems should be enhanced with stress on route optimisation. Sustainable technologies should be adopted in transportation like emission norms, clean fuel, traffic management etc.

7. Urban Planning: Sustainable development of houses and habitats is already a priority as per the state housing and habitat policy 2007; need is to evaluate the activities with Climate Change perspective. Protection and development of carbon sinks in and around urban centres, compact city planning requiring minimal travels, urban storm water management and proper urban planning with standards for embankment of low lying areas, better disaster warning systems should be emphasised.

8. Green Governance favouring Low Carbon Societies: Policies prescribing the need for low carbon societies and regulations to ensure strict implementation of low carbon technologies need to be introduced. Government schemes incorporating subsidies on green technologies and incentives for adopting them should also be developed.

9. Adoption of service level benchmark: In order to enhance the effectiveness of service delivery mechanisms, suitable benchmarks need to be created and adopted for urban administration.

10. Explore potential of CDM benefits: There is a lot of scope for CDM projects in Waste management and Demand side management of energy in the urabsn areas. A systematic study may be done to explore this opportunity and pilot projects could be taken up to demonstrate the potential.

SKMCCC, EPCO

11 Energy Sector

Background

Energy is a critical resource for economic development as well as for improving the quality of life. Madhya Pradesh is a developing state and thus the need of energy for its social and economic growth is very much evident. The state is endowed with both conventional and non conventional sources of energy resources, but at present the main sources of energy production are Thermal and Hydel. Coal is used for the thermal power generation as well as is being used by the unorganised sector for thermal energy. The state already has installed capacity for wind, biomass and small hydro while for solar the initiatives have been taken and sites have being identified. Apart from these sources fuelwood is also a major source of energy in the rural areas of the state but due to highly unorganised nature of usage the exact consumption is difficult to calculate.

Energy sector of Madhya Pradesh has the goal to augment power availability to facilitate the economic growth. There exist a huge potential for energy generation in the state. It is necessary that this potential is tapped to fill the existing as well as projected gap in the energy demand of the state.

Energy Statistics of the State

Sorces of energy in MP	Conventional –Thermal, Hydro Non Conventional – Wind, Solar, Biomass
State owned power generation	3847.5 MW
Total available capacity in the state (2011)	9001MW, Break up as: a. 3730MW- MP Power Generating Company b. 2371 MW- Joint Venture Projects (ISP,OSP,SSP) c. 2428 MW- Central Sector Project d 472 MW DVC Torrent & RE
Installed capacity in the state	Conventional : Thermal –5190 MW Hydel – 3349 MW Non Conventional : Wind – 213.79 MW Biomass- 32 MW Solar – 2 MW
Maximum Demand and Demand met (2010-2011)	8758 MW Demand met – 8331 (net shortage of 427 MW)
GHG emission from the energy sector (India)	1100.06 millions tons of CO_2 eq

Sources : INCCA, MP TRIFAC

Power sector provides one of the most important inputs necessary for social, economic and industrial development of the country. Inspite of the marvelous growth in the electric supply quantitatively including vast spread of electric power system in industrial metro cities & rural hinterland, different category of consumers continues to face wide-ranging power shortages in varying magnitude both quantitatively & qualitatively. There is a huge demand for energy in the state but the supply is not enough to match the demand.

One of the important factors that led to this situation was the inequitable division of generation capacity

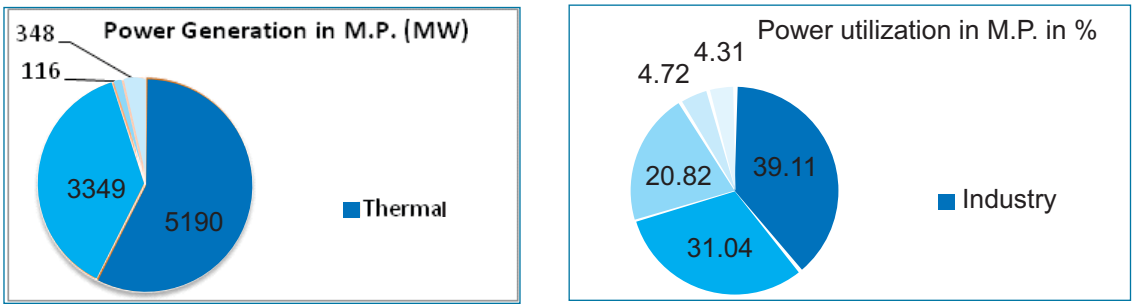
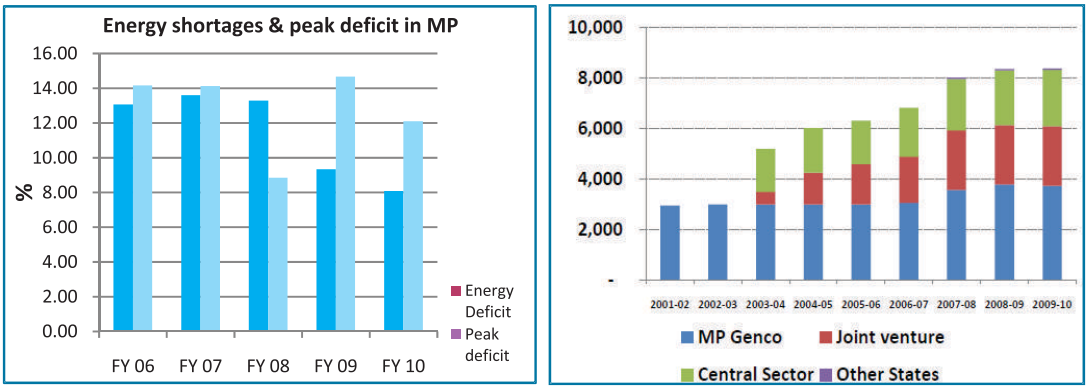


Fig. 11.1 Power generated and utilised in MP

and demand as well as assets and liabilities between Madhya Pradesh and Chattisgarh Electricity Board. After the bifurcation of state in 2000, only 68% of the generation capacity was allotted to Madhya Pradesh while its energy consumption was 78% at that time. The situation has improved since then due to the proactive policies encouraging investments. Currently, State owned MP Power Generating Company's installed capacity is 3847.5 MW out of this; state's share is 3730 MW. Further, the state share in Joint Venture Projects (ISP, OSP and SSP) is 2371 MW and in the central sector projects is 2428 MW. Apart from this, 472 MW power is received from DVC, Torrent and Renewable resources making total available capacity as 9001MW. (not including the Captive power and electricity produced by numerous of small diseal generators.) The total capacity available for the state from various sources and power utilization in MP by different sectors is represented in the pie diagram below. The state has a maximum share of Thermal power with Industries and Agriculture consuming major shrare of the energy.

The graph (Fig. 11.1 a) shows the energy shortage and peak deficit in the state from the year 2006 to 2010. The recent years have seen high peak deficits in the state. The graph (Fig. 11.1 b) shows the sharewise installed capacity of the state by MP Genco, Joint Venture and Central Sector and other installed powers in the state.



a b

Fig. 11.2 Energy Scenario in MP

To match supply and demand, the state has planned many initiatives to increase the energy generation and to reduce the transmission and distribution losses. The figure shows the year wise capacity addition (MW) plans of MP and T&D reduction in the next ten years [Energy Supply and Demand in MP-Investments and Policies, PwC Report]. It is expected that by 2013-14 MP will be able to match the supply and demand of the state and would be able to generate energy in surplus. The Report projected the inatalled capccity till 2020 for the state including nearly all possible sources of energy generation in the state. Contribution of the renewable energy will be increasing in the coming years, also because the state is adopting new policies to promote renewable energy in the state.

Looking at the projections for the 2020 in terms of energy deficit and surplus, it is expected that the state will be able to fill the deficit in the energy demand by 2013 and would then be an energy surplus state. The Table 11.1 below represents the planned capacity generation and unrestricted demand with the Surplus /Deficit figures till the year 2019-20 for Madhya Pradesh [Energy Supply and Demand in MP-Investments and Policies, PwC Report].

Policies and Programmes

To develop a financially viable and competitive power sector that ensures quality power for all at affordable price is objective of the Energy Department - Vision of MP Energy Department.

Years / Statistics	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Capacity addition during the year (MW)	1,082	1,678	2,246	3,265	3,530	4,853	3,755	2,009	237
Availability (Mus)	42004	51412	64004	82308	102099	129307	150359	161622	162951
Unrestricted Demand (Mus)	52038	57242	62966	69263	7,189	83808	92188	101407	111548
Growth rate (%)	-	10%	105	10%	10%	10%	10%	10%	10%
Surplus/ Deficit (Mus)	(10034)	(5830)	1038	13046	25910	45499	58170	60215	51403
Energy Deficit / Surplus	-24%	-11%	2%	16%	25%	35%	39%	37%	32%

Table 11.1 Capacity generated and Deficit and Surplus in MP

As per the annual plan (2011-12), the state aims to meet power demand by setting up new power projects, expand and strengthen transmission system for evacuation of power from Generation Projects of the state, interconnection of state's transmission with National Grid (i.e. PGCIL Projects etc.), to overcome low voltage problem and to avoid overloading of EHV system. Strengthen and system improvement of Sub-transmission and Distribution system, Energy Audit, 100% meterization, separation of rural feeders from agriculture feeders, prevention of theft and bridge the Rural Urban gap by extending the electricity to all the villages and habitation of the state and provide access to electricity to all rural households under Rajiv Gandhi Gram Vidyutikaran Yojna Scheme.

To acheive the aim of the annual plan, GoMP has entered into MoUs with 53 private companies for setting up about 73,000 MW capacities thermal power projects in the state. Out of these projects, construction of eight projects of about 10,000 MW capacities has already been started. In the next 5 years, it is planned that about 5000 MW capacity will be added to the state. Madhya Pradesh Power Generating Company Ltd (MPPGCL) is constructing new power plants viz 2X250 MW extension units no 10 and 11 at Satpura Thermal Power Station, Sarni and 2X600 MW units at Shri Singaji Thermal Power Project, Distt Khandwa for increasing installed capacity.

Beside above, MP Power Trading Company Limited has initiated actions for development of 2X800 MW Bansagar Thermal Power Project in District Shahdol uner case-2 of competitive bidding. In addition, NTPC Ltd has also planned 1320 MW TPP in Narsinghpur District, 1320 MW TPP in Khargone district and 3960MW TPP in Chhatarpur district of Madhya

Other Programs and Policies

- *Madhya Pradesh (Investment in Power Generation Projects) Policy – Under this policy a power project of any capacity based on conventional project will be set up and GoMP will get 10% of power generated from these projects while facilitating and providing the Administration support for land acquisition, fuel sourcing, power evacuation and water allocation.*
- *Feeder Segregation Program*
- *System Strengthening under Asian Development Bank*
- *Genco efficiency Improvement*
- *GoI Scheme – Rajiv Gandhi Gram Vidyuitikaran Yojna and R -APDRP*

Pradesh. 50% from NTPC's above projects in the state has been allocated to the state.

Narmada Valley Development Authority (NVDA) and the Water Resources Department (WRD) are responsible for developing the hydroelectric power in the state. In the Narmada river, NVDA had developed large hydropower projects such as Indira Sagar HEP (1,000 MW) and the Omrakeshwar HEP (520 MW), and also small hydropower projects such as Tawa Project (13.5 MW). NVDA is also in the process of developing other mini and small hydro power sites on the Narmada river such as 15 MW Chindwara, 20 MW Raghavpur, 35 MW Rosra and 60 MW Basania. Generating hydropower in relation to the other rivers in the state - Son, Godawari (Pranhita) and Chambal - is the responsibility of the Water Resources Department. Together, NVDA and WRD are to tap the overall hydropower potential.

Apart from taking the steps increasing the energy capacity of the state, the state is also actively working towards improving the energy efficiency in the state. The PAT scheme by Bureau of Energy Efficiency has identified the 9 most fossil fuel consuming industries including power. Under this scheme, the industries will be given mandatory energy cuts to achieve in terms of efficiency with respect to their base line consumption within a certain number of years. Of the 714 Designated Consumers identified in the PAT scheme, 23 are in Madhya Pradesh. Madhya Pradesh has heavy concentration of energy intensive industries like Cement, Paper Mill and Sugar Industries so the focus will be towards these industries. Therefore it is expected that other than enhancing the operational efficiency of systems (including renovation and modernization of existing plants), more and more clean coal technologies will be utilized to achieve the targets set out in PAT scheme.

Concerns of Energy Sector

Energy is an important factor for the economic development and growth of the country. In Madhya Pradesh inspite of continuous increase in the generation of electricity increase many people in the state has no access to electricity. This constrained energy access is also reflected in the low Human Development Index of MP. Economic growth is generally hampered by peak shortfalls of electricity power, average shortfalls of electricity power and high T&D losses. The end users of electricity like households, farmers, commercial establishments, industries are confronted with frequent power cuts, be it scheduled or unscheduled. Power cuts, erratic voltage and low or high supply frequency have added to the 'power woes' of the consumer. These problems emanate from mainly:

- Inadequate power generation capacity;
- Lack of optimum utilization of the existing generation capacity;
- Inadequate inter-regional transmission links;
- Inadequate and aging sub-transmission & distribution network leading to power cuts and local failures/faults;
- Large scale theft and skewed tariff structure;
- Slow pace of rural electrification;
- Inefficient use of electricity by the end consumer
- Lack of grid discipline

Concerns

* Plant load factors, ageing plants and old technology
* Transmission and distribution losses
* Lack of awareness on energy use efficiency
* Energy Deficit

Inspite of increase in the state generation capacity and availability, the peak shortage and energy shortage (Restricted & Unrestricted) is still in the range of 8%-13% and 30%-35% respectively. The challenges confronting the power sector today are:

- Meeting up with the requirements of coal especially during the peak energy demand periods

- Arranging financial resources to increase power generation capacity and renovation & modernization of plants
- Transmission and distribution of electricity from new projects and augmentation of new ones
- Rising climate variability will lead to increased electricity demand, thus putting more pressure on the existing resources and
- Investments to upgrade the existing electrical equipments.

In the context of Climate Change the most important concern is the Green House Emission contributed by the energy sector. According to the Low Carbon Strategies for inclusive growth report by Planning Commission, 2011 the emissions for the country in 2007 stood at 1100.06 million tons of CO_2 equivalent. Major contributors were the Electricity sector (65%) followed by Transport sector (14%). The energy sector emissions include emissions from: fuel combustion in electricity generation, solid fuel manufacturing, petroleum refinery, transport, resedential & commercial activities, agriculture & fisheries, fugitive emissions due to coal mining and handling of oil and natural gas.

Strategies to address concerns due to Climate Change in Energy Sector

A two pronged approach is being taken to reduce GHG emissions from power. Since coal continues to be the primary option, the first strategy to reduce GHG emissions would be by increasing generation efficiency which means increasing the generation of power per unit of coal consumed. This will be applicable to other industries as well. Another strategy can be to increase the share of renewable sources in the total power generation of the state.

1. **Enhancing efficiency in power generation:** As energy sector is the largest emitter of GHGs and fossil fuels constitute the major share, efficiency of the present power generation system need to be enhanced through formulation of favourable policies which promote green technologies, renovation and maintenance of existing power plants.
2. **Undertake demand side management to improve efficiency and reduce GHG emission:** There exists a huge potential in demand side which can reduce the GHG emission in the state. Reduction of transmission and distribution losses, feeder separation, energy efficient service delivery systems, use of energy efficient home appliances can reduce energy consumption upto a large extent. Strict regulations and their implementations are needed to bring down the energy usage. Energy audit of commercial and government buildings can be made compulsory to bring down the consumption. More programmes like Bachat Lamp Yojana with CDM potential could be taken up under government schemes/ programmes.
3. **Market Transformation for Energy Efficiency:** Projects should be designed with a view to link them with ongoing market based mechanisms like CDM in order to bring finances in more sustainable manner. Energy efficiency can play a key role as Madhya Pradesh stives to meet its development goals under resources constraint. Policies are proposed to be reformed to offer more incentives for the use of energy efficiency appliance.
4. **Development of Low Carbon Society Pathway:** To transform Low Carbon concept into reality, policy level actions are required. Sustainable transport, low carbon electricity including viable Carbon Capture and Storage technique, switching to clean fuel, material substitution and recycling are a few steps which needs attention.
5. **Capacity Building and Research & Development:** Capacity building of professionals working in this sector to be able to understand the new technologies and work with them is essential. Besides these research and development in the energy efficiency should be promoted. Investor and Environment friendly policies are suggested.

12 Renewable Energy

Background

MP has a rich natural resource base with huge renewable energy generation potential. The major sources of renewable energy in Madhya Pradesh are: Wind, Biomass, Small Hydro and Solar. Based on various promotional efforts put in place by the Ministry of New and Renewable Energy, GoI and New and Renewable Energy Department, GoMP, significant progress is being made in power generation from renewable energy sources in the state.

Renewable Energy Statistics of the State	
Generation Potential from renewable energy sources	3264.04 MW
Installed capacity	Grid Connected 300.05 MW
	Off Grid – 32.74 MW (wind energy constitutes more than 71.25% of total grid connected installed capactiy.)
Sources : MNRE, 2011	

At present total installed capacity of RE sources is 2.95% of total installed capacity of state. The topography and climatic conditions of the state offer enormous potential for harnessing the wind and solar energy. The vast river stretches also offers huge potential for the small hydro plants. Table 12.1 compares harnessed RE against potential in the state for different forms. It clearly shows that there is still a large potential to be harnessed.

MP has an installed capacity of about 214 MW of wind power, about 0.8 MW of solar power and about 32 MW of biomass-based power. As the assessed potential is significantly higher (wind – about 1200 MW, solar – about 20 MW/Sq Km and biomass – about 1242.4 MW), there are plans to expand the renewable power generation capacity in the state (Departmental inputs). It has been proposed to install neraly 400 MW of wind energy in the state in the next three years (MP TRIFAC).

RE Technology	Potential (MW)	Total Installed Capacity MW
Wind	1200	213.79 (MPUVNL)
Biomass	1242.4	32.04 (MPUVNL)
Solar	20 MW/Sq km	0.80 (MPUVNL)
Small Hydro	803.64	86.16 (MNRE)
Total	3246.04	332.79
Source : MPUVNL,GoI,GoMP, MNRE,GoI,		

Table 12.1 Potential of energy mix for the state (Departmental inputs)

MP Urja Vikas Nigam (MPUVN), a GoMP agency functioning under New and Renewable Energy Department has been entrusted with the task to promote development of Renewable Energy in the state. MPUVN has also initiated work on promoting energy-efficiency in the state and has estimated an energy-saving potential of 500 MW. Opportunities are being explored for realising the potential of coal-bed methane.

State government has also planned very attractive Renewable Purchase Obligation (RPO) structure to attract investment in RE sector. A snapshot of proposed RPO from solar and non solar sources is shown in Fig. 12.1. The figure shows that investment in Renewable Energy Sector will boost in coming years through favourable policies. CDM is the additional benefit that can be harnessed from RE projects. In terms of GHG reduction, with the current projects in pipeline, the avoided emissions are shown in the Table 12.2.

RE Source	Capacity in pipeline to be installed by 2012 MW	Avoided Emission Tonnes
Wind	250	394200
Solar	5.25	9519.93
Biomass	170	938196
Small Hydro	99	273180.6

Table 12.2 The current projects in pipeline and the the avoided emission (PwC Report, 2011)

Policies and Programmes

Realizing the potential of RE in the state, State Government has taken concrete initiatives to harness these forms of energy and to attract investment in this sector. Draft policies for solar energy, biomass energy and wind energy have been formulated. A snapshot of efforts of MP Government to boost investment in the state is shown in the box below. State government provides favourable condition to invest in RE sector through duty exemption, subsidy on loans, concessional land for mega projects and tax exemption.

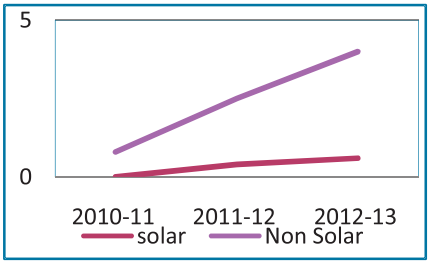


Fig. 12.1 RPO Comparison between Solar and Non Solar

Various efforts of MP Government to boost investment in the state

- Industrial investment promotion assistance - 50 to 75% of commercial tax for 4-5 years
- 5 year electricity duty exemption on captive power generation
- For thrust sector industries - 25 % capital subsidy
- Interest Subsidy of 3 - 5 % on term loan for 5-7 years
- Concessional registration charges & stamp duty exemption for term loan
- Land on 75 % concessional rate for mega projects
- Entry tax exemption for 5 years
- Project Reports Cost Reimbursement scheme
- Subsidy on ISO Certification, patent registration & technology acquisition
- VGF funding of upto 40%(20% GoI+additional 20% State Government.
- Special Packages for Mega projects

Wind Power

Gross potential for power generation from Wind Energy in the state is 5500 MW out of which technically proven sites have cumulative potential to generate 1200 MW of energy. At present, 213.79 MW of wind capacity has been installed and an additional 400 MW is expected to be installed in next 3 years and another 400 MW projects are in pipeline (MP TRIFAC). Potential sites for wind power generation have been shown in the Fig. 12.2.

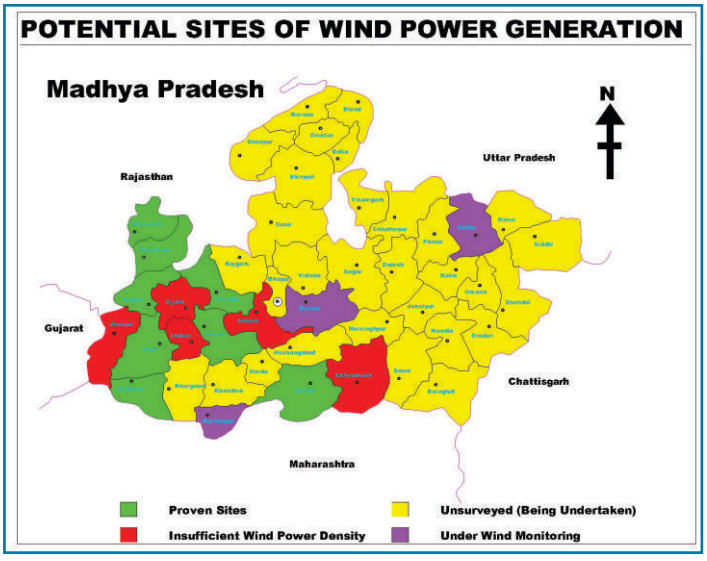


Fig. 12.2 Potential sites for wind power generation

Biomass Power

The estimated biomass potential in the state is 1242.4 MW against which 25 MW is installed. All the projects are based on PPP mode. Proposals for setting up Biomass plants of 450 MW cumulative capacities have been registered (MP TRIFAC).

Solar Energy

The State is endowed with high solar radiation with around 300 days of clear sun. The mean annual temperature in the state varies from 22°C to 27°C indicating opportunity to harness solar energy.

Good sites have the potential in the range of 5.5 to 5.8 kwh/ sq.m. which is ideal for installation of Solar based power projects. A solar energy park is also being developed in Rajgarh district. High solar radiation with investor friendly policies in the state provides huge investment potential for solar projects.

Small Hydro Energy

The state, with many small rivers and streams flowing offers good opportunity for small hydro projects. M.P. has about 803.64 MW potential for small hydro projects. At present the installed capacity is nearly 86.16 MW with the projects mainly on Son, Narmada, and Tapi and Godavari rivers.

Concerns of Renewable Energy Sector

Madhya Pradesh is highly dependent on thermal and partially on hydro energy. Though the thermal source of energy causes GHG emissions yet the contribution of RE can be increased gradually. Thus the role of Renewables is limited; MP is taking proactive steps to promote Renewable energy in the state.

Apart from the above limitation another concern is the high per unit cost of energy generation from Renewable Sources as compared to the conventional energy generation resources. Renewable Purchase Obligation (RPO) was revised in 2010 from 10% to 0.80% which may also impact the development of RE Projects in the state.

Concerns

* High production cost and low set of Renewable Purchase Obligation (RPO) by the State Government
* Unawareness among public about energy conservation and renewable energy sources
* Cost of technology

Strategies to address concerns due to Climate Change in Renewable Energy Sector

1. **Increase the mix of renewable energy in total energy consumption of the state:** MP Government realizes the potential of Renewable Energy and has formulated draft policies for solar, wind and biomass energy to promote investment in the state. Though MP Government has set ambitious Renewable Purchase Obligation (RPO) targets, their implementation in the long run need to be ensured to bring more investment through policy incentives.
2. **Awareness and Capacity Building:** Capacities of different stakeholders need to be built on renewable energy aspects i.e. generation, handling, maintenance, operations. Research and Development activities need to be accelerated to develop cost effective handy products Since RE projects have a high potential for developing as CDM Project, capacities of stakeholders can be built on CDM through MP CDM Agency.
3. **Promoting Research and exploring more possibilities of RE in the state:** Exploring ways for institutionalising the biomass, biogas energy generation and possibilities of geothermal energy generation in the state. Adopting new technologies which are now showing declining cost trends, especially in solar enegy technologies the focus could be on use of silicon rather than thin film technologies.

13 Industry

Background

Madhya Pradesh has great potential for the sustainable industrial development and growth with its abundant mineral resources, high agriculture production, rich forest cover, established social infrastructure, good transport connectivity and strong telecommunication penetration. Being a rural and agrarian state, opprutunities for food processing and small and mediun enteriprises based on natural resources are enormous.

Industry Statistics of the State	
Major Industries of M.P.	Cement, Heavy electrical, Pharmaceuticals , Automobiles, Crockery Industry, Paper mill, Bidi Industry, Wood based Industry, Cotton Textile Industry, Sugar Industry, Soyabean Oil, Traditional Industries, Leather Industry
Number of industrial Growth Centers	19 IGC under five Audyogik Kendra Vikas Nigam, MP
Contribution to GDP of the State (2010-2011)	23%
Industrial Units	Large and Medium Scale - 670
	Small Scale – 370607
Sources : MP Resource Atlas 2007, MPCST	

On this strong base, Large and Medium Scale (LMI) industrial units are working in the state. Major central public undertakings having manufacturing facilities in state are BHEL, Bhopal, National Fertilizer Ltd, Vijaypur, Guna, Security Paper Mill, Hoshangabad, Currency Printing Press, Dewas, Alkaloid Factory Neemach, Ordinance Factory Itarsi, Gun Carriage Factory Jabalpur etc. are located in the state. As the state is a leading in terms of agriculture production, thrust is beinggiven on development of agri food processing and herbal processing.

Nineteen Industrial growth centres have been established in the state with a view to attract industries towards Madhya Pradesh. Currently (up to Jan 2011) the state has 733 Large and Medium industrial units providing direct employment to about 1.75 lakh people. Also, in the year 2011-12, about 14563 new Micro and Small enterprises were established in the state providing employment to about 30842 people (Departmental inputs).

In future, growth in pharmaceuticals, auto industries, manufacturing, consumer goods, food processing, tourism and textile is seen to be happening given the policy support. Minerals as well as cement production hold a great production promise in the state. The fact that M.P is centrally located makes a good geographic allocation for transport to the entire state.

Policies and Programmes

The MP Industrial Promotion Policy, 2010 which aims to ensure faster economic development & employment generation by sustainable use of the resources available in the state, with special attention on promotion of Small & Medium enterprises to avert the adverse impact of global recession on industrialization in MP.

Besides this MP Small Scale Industries Revival Scheme, 2010 is working towards the revival of the sick units in the state also addressing the issues of outdated technology, lack of skilled workers, inefficient management, lack of professionalism etc.

The GoMP has given thrust on development of Agriculture & Food processing industries including herbal processing. As MP has large area under forest, raw material for such industries is available in plenty. Also these industries will help in securing livelihood to forest dependent communities. A separate policy for agro-based industries is also being developed.

Under new scheme two industrial regions namely Ratlam-Nagda and Pithampur-Dhar-Mhow and two industrial areas of Neemuch-Nayagaon & Dhar-Mhow have been included in the DMIC with a vision to create strong economic base. This will also help in providing livelihood opportunities for the rural communities who are vulnerable to Climate Change due to low agriculture productivity of the region. The state is running many supporting schemes for promoting rural industries with incentives and subsidies.These schemes have direct implication for strengthening the adaptive capacity of the rural vulnerable people of the state. The Industrial Promotion policy, 2010 focuses on development and promotion of industries in the state. The main linkages of the policy with Climate Change are listed below:

- Earmarking of land bank for industries in farmlands and non-forest lands. This will help in conserving various Carbon Pools and also will help in sequestering.
- Reviewing and starting various employment generation schemes like Rani Durgavati Self Employment Scheme and Deendayal Employmnnet Scheme aiming towards development of SC/ST population and for welfare of unemployed youth respectively. Such schemes will certainly help in reducing vulnerability of the beneficiaries towards Climate Change. Also in the point 12.6 the policy ensures that sustainable livelihood is provided to the families, whose lands have been taken for the project by providing permanent jobs to at least 1 person each of the affected family.
- With waste management becoming a menace day by day the policy has given special attention to this issue. The policy aims to promote industries dealing in recycling of waste materials, urban waste management and industrial waste management. The policy provides various incentives to encourage entrepreneurs in investing in these areas.

Concerns for Industries Sector

Industries account for over 40% of global GHG emissions and around one third of the global usage of energy. In India also over 35% of total energy consumptions is by industries.Madhya Pradesh also the largest consumer of power is the industrial sector. Cement industries which are the largest consumer of the electricity in India are important part of the Industry sector of Madhya Pradesh. Energy demand is of greatest concern for the world and thus need of energy effciciency is of utmost importance.

Concerns

* Energy intensive industrial units
* Inefficient technologies consuming excess fuel
* Industrial emissions
* Less adherence to environment protection laws
* Less awareness of carbon markets and associated schemes like CDM, PAT etc

Besides major consumers of energy, industries also have major share in emission of GHGs, thus causing concern for Climate Change. Industries which are directly dependent for the input materials on natural resources (especially those which are higly vulnerable and threatned due to Climate Change) would face challenge in the changing climate conditions. Agro based industries, paper industries, small and medium industries (fisheries, wood based industries, handloom industries etc) real estate sectors would be the most impacted ones due to the threats posed by Climate Change. Other concerns for this sector include competition for the water, land and energy access & usage.

Strategies to address concerns due to Climate Change in Industry Sector

1. **Review of M.P. Industrial Policy 2010 to address CC Concerns:** As industrial sector is a large emitter of Green House Gases, Climate Change aspects could be integrated in the industrial policy to promote low carbon technologies.
2. **Implementation of Perform, Achieve and Trade Mechanism:** As part of the NMEEE Government of India has introduced PAT mechanism in energy intensive industries and have

identified organizations in different states. State Government should facilitate the implementation of PAT in the identified sectors and among 23 designated consumers. The organizations and learning can be incorporated in the state policy.

3. **Capture the opportunities existing in the carbon market for mitigation:** Capacities of industries should be built on CDM, clean technology aspects and technical and policy support may be provided to develop such projects.
4. **Devise an integrated water management plan for industrial clusters:** Industrial sector is among one of the largest consumer of water and effective measures should be taken to enhance efficiency, recycle and reuse of water to reduce the current consumption pattern.
5. **Effective Industrial Waste Management and Pollution Control:** Industrial waste management needs to be strengthened through enhanced networking between different organizations, using more efficient technologies, strict implementation of norms. Industries should undertake plantation activities as part of their CSR activities
6. **Involvement of industries in plantation activities:** Industries are among the major emitters of Green House Gases, development of Green belt and adoption of water harvesting structures would help in addressing the problem. There is also a need to incourage industries to align CSR activities towards GHG reduction.
7. **Capacity Building and Awarenes programmes:** Capacities of different industries should be built for better decision making and efficient operations. Awareness program should be focused on carbon and water footprints and devising audit systems in all organisations for monitoring their usages per unit of production. Involve State Industrial units in a dialogue on Climate Change issues by emphasising on the cost effectiveness of the initiatives taken in this direction.
8. **Research and Development:** Industries should pool the resources in research activities to develop state specific eco-friendly technologies. Stress should be laid on developing industrial networks based on recycling and reuse of the materials. Energy efficient technologies should be developed and adopted to reduce the energy usage.

SKMCCC, EPCO

14 Rural Development

Background

Madhya Pradesh is a largely agrarian state. 72% of its population [Census 2011] lives in villages and they contribute about 30% to the state GDP [Agriculture Statistics MP, 2009-2010]. The Human Development Indices of the state are also not very encouraging. Rural areas especially areas in its south-west, southeast, and north-west, and central belts are more backward than the rest of the state. These are also the regions which are forested and have a large tribal population. The undulating topography prevents advanced agricultural practices.

In terms of economic groups, the landless labourers, the marginal and small farmers, the forest produce collectors, the construction workers and the household based artisans are the ones who are engaged in the most economically insecure livelihoods. Agriculture, the prime occupation of 70% of the rural population, is also under threat because of Climate Change.

There is scope for improvement in the Health indicators of the state. High IMRs, the deficient ante-natal and post-natal care, the neonatal mortality rates (NNMR) in rural areas are some of the prime concerns. Despite all the efforts, only 4 in 10 women receive proper antenatal care resulting in substantially high MMR. Vector borne and water borne diseases are also of great concerns for the state.

Rural Sector Statistics of the State	
Total Rural Population	52.5 millions
Decadal population growth	18.4%
Literacy rate	65.3%
Total no. of villages	54,903
No. of total development blocks in M.P.	313
No. of Tribal Development Blocks in M.P.	89 (28.43%)
No. of Gram Panchayats	23,040
No. of Zila Panchayats	50
Livelihoods	Predominantly agriculture
Land Holdings	Total - 163.72 La Hectares Small and Marginal Farmers – 41 La Hectares

Source: Census 2011, Compendium of Agricultural Statistics, Govt. of MP, 2006-07,

Lack of proper health delivery services in remote areas coupled with poor sanitary and hygienic conditions adds to the miseries. According to HDR 2007, only about 8.9% households in rural MP have access to in-house sanitation facilities and only 62% of the rural households had facilities for safe drinking water, leaving others on different sources.

Studies suggest that Climate Change may have major impacts on the rural sectors. It will affect human livelihood and food security mainly through impacts on ecosystems. For the very reason that most of the rural livelihoods are natural resources dependent, Climate Change may make them environmentally insecure. Higher degrees of exposure and reduced biophysical, socio-economic as well as technological adaptive capacities make rural communities most vulnerable to Climate Change. Opportunities need to be explored to engage rural communities in mitigation of Climate Change as well as in adaptation to its foreseeable effects.

Policies and Programmes

Basic objectives of rural development programmes have been alleviation of poverty and creating employment opportunities through creating basic social and economic infrastructure, self employment of rural poor and to provide wage employment to marginal farmers and landless labourers so as to discourage

seasonal and permanent migration to urban areas.

- National Rural Employment Guarantee Scheme
- Swarna Jayanti Gram Swarozgar Yojana
- Indira Awas Yojana
- Integrated Waste Land Development Programme
- Mid Day Meal Scheme
- MP Rural Livelihood Programme (MPRLP)
- Indira Gandhi Garibi Hatao Yojana (DPIP)
- Pradhan Mantri Gram Sadak Yojana
- Mukhya Mantri Awas Yojana

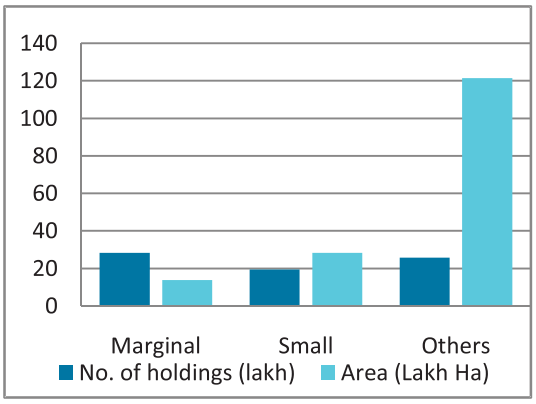


Fig. 14.1 No. of land holdings and respective areas

Concerns for Rural Development

Madhya Pradesh has 54,903 villages in which 52.5 million people reside [Census 2011]. 70% of this rural population, dependent on agriculture for livelihood could be at threat from climatic sensitivity.

As per Agriculture Census 2000-01, about 48 lakh land holdings (43 lakh Ha area approx) belong to small and marginal farmers accounting to per head operational land holding of only about 0.8 Ha. Fig. 14.1 llustrates the no. of land holdings and respective areas of holdings. These small and marginal farmers tend to become more vulnerable to Climate Change for their reduced adaptive capacities and increased sensitivities to increased exposures. Multiple stresses force them to migrate to urban areas in search of better livelihood and end up being daily wagers settled in urban slums.

Similarly, on health front, higher birth rate, death rate IMR, NNMR and MMR indicating the gaps in the health services. Drinking water stress particularly in summers has been a persistent problem, for some time now, in the state. Besides this, water shortage for cattle rearing and irrigation are other facets of this crisis. In such conditions, dependence on groundwater increases thus depleting the groundwater levels further. Vector borne diseases like malaria in tribal regions, dengue, chikungunya are other big concerns which could aggravate with changing climatic conditions.

Concerns

* Lack of literacy and education
* Poverty
* Distress migration
* Lack of sanitation
* High dependence on natural resources for livelihood
* Unsustainable practices of harvesting, irrigation, agri residue elimination etc
* Infrastructural deficits for alternate income generation activities or non-agriculture based livelihoods
* cropping patterns
* Water scarcity owing to disturbed distribution of rains and longer dry spells
* Increased indences of extreme weather events and less capacities to cope up with them
* Predicted increase in vector borne and water borne diseases

Life in rural ecosystem is largely environment friendly barring some activities that contribute to GHG emissions. Nearly 80% of the rural population uses firewood as cooking fuel and rest others depend on cowdung cake, crop residues, coal, charcoal etc. Only 2.2% of the rural households had access to LPG [Census 2011].

It is important to identify the weak links in rural ecosystem and try to strengthen them in order to building their resilience to Climate Change. This will help to halt the process of ecosystem degradation and make the communities, who are dependent on the ecosystem services for their survival, less vulnerable.

Strategies to address concerns due to Climate Change in Rural Development Sector

Panchayat & Rural Development Department of M.P. implements a number of central & state schemes targeting – enhancing the rural employment, (individuals & groups) through providing direct employment & also through capacity building for self-employment. Some of the schemes are also for improving rural infrastructure & hygiene/sanitation, primarily targeted towards BPL (Below Poverty Line).

1. Review of existing rural development programmes with Climate Change focus: Many programmes are already being implemented to uplift the socio-economic status of rural lives and to reduce distress migration. Need of the hour is to evaluate these programmes with Climate Change perspective and introduce appropriate actions to make them climate resilient.
2. Training and capacity building of rural communities: Training is the most important aspect which should be taken up. Development of skills for alternate income generation activities to reduce climate induced vulnerabilities is needed so that the rural communities could switch to other livelihoods when they are not able to get benefit from their existing livelihood. Awareness on various programmes, schemes and benefits would enable the community to take better informed decisions for their income opportunities. There is also need of documenting the indigenous knowledge so that knowledge could be used to provide the insights for adaptation and check possibilities of value addition to enhance adaptive capacities.
3. Climate Change Concerns to be institutionalized in the annual plans of Panchayat There is need to incorporate measures to encourage communities in adapting to new technologies that are energy efficient and pro low carbon economy. Promotion of water efficiency in agriculture and other uses, promotion of energy efficiency measures, bio gas and solar energy applications etc.
4. Credit Availability for rural infrastructure development and insurance against climate induced vulnerabilities: This type of intervention would strengthen their capacities to construct needed infrastructure for maintaining a safe and clean life and also would safeguard them from economical insecurities particularly at the time of natural calamities and crop failures.
5. Convergence and integration with the CC action plans of departments like forest, water, agriculture, energy and health: Since the rural community is the most vulnerable community and dependent directly on variety of natural resources for their livelihood, it is of utmost importance that these sectors should work in close tandem with the rural development department. Possibilities of convergence of development oriented programs exist and opportunities should be explored to make them happen. This could be one of the effective mechanisms for Climate Change adaptation and safeguard against Climate Change.

SKMCCC, EPCO

15 Cross-cutting Issues

Background

This section contains a rapid assessment of cross-cutting aspects: energy and low carbon development; adaptation, generic institutional and planning dimensions; MP state institutional and planning dimensions and next steps.

This sector-driven approach has benefits in that it is comprehensive and will enable the sector specialists to engage and refine the potential actions in their areas to identify actions. But it was an ambitious decision with the resources available to start across the whole Climate Change action agenda. The study has overviewed not just those sectors which are likely to be impacted by Climate Change due to historic and projected global emissions, but also to those energy-using sectors in MP which are developing and contributing to the emissions. It has produced a very substantial programme of actions which need to have a timescale and perspective of delivery over the next set of plans.

Climate Change provides challenges around both fronts for development in the state: in the rural and urban areas. The state is marked with a complex social structure, a predominantly agrarian economy, a difficult and inaccessible terrain, and scattered settlements over vast area that together pose several formidable problems to service delivery systems. Climate Change has the potential to undermine existing efforts to tackle the mountain of poverty removal in the state and the complex social development problems faced. Drought, lack of investment to produce year round cropping, a degrading forest resource will all be exacerbated by Climate Change and make the problem of delivering more and better livelihoods more difficult. Economic growth around the state's mineral resources is likely to continue and provide engines of growth providing problems associate with rapid urbanisation and providing more power from coal can be tackled.

There are significant opportunities at this time to ensure pathways allow for advanced energy efficient technologies and infrastructure that can provide the basis for sustainable development. For the majority of its population who have no or little contact with the commercial energy sector- and need access to energy for economic and social development, there may be new opportunities to tackle long standing problems with a new focus on these issues at national and international levels. There are opportunities to link up with the GoI NCCP Missions of policy development on: enhanced energy efficiency; sustainable habitat; conserving water; and, a Green India.

Both of these Climate Change challenges around the urban and rural nexus, could benefit from having a strategic integrated cross-sectoral approach devised at state level, with reference to the national and global frameworks a the next stage.

For long-term economic development opportunities in MP which has a growing industrial sector which needs to be globally competitive, it might be advantageous to devise a strategy which promotes the most cost-effective and efficient technologies across the sectors.

Generic institutional and planning dimensions

Moving from SAPCC to actually charting an implementable action plan and then organising its delivery will be a major challenge. More detailed planning work and analysis will be necessary. SAPCC could provide the starting point.

A preliminary identification has been made of institutional and planning capacities within MP through discussions with some key officials and project staff. There is a need to assess these more precisely and then monitor to plot progress. It is suggested that a systematic capacity assessment as to manage these risks and vulnerabilities is undertaken identifying key institutional and planning gaps at the state level and

their inter linkages with national and local level planning.

Environment and Climate Change

In Madhya Pradesh the subject of "Environment" is dealt by Housing and Environment Department. Madhya Pradesh is leading in terms of defining the state organisational arrangements and in doing analytical work and technical studies pertaining to Climate Change. The State Government had established a Climate Change Cell in its agency, Environmental Planning & Coordination Organization (EPCO), which is under the Department of Housing & Environment. EPCO has also been declared as State Designated Agency for Climate Chage Issues in MP. As a part of the Cell's activities, a number of technical studies and plan preparations have been done. These include the preparation of the State Action Plan on Climate Change with support from the UNDP, a project on Climate Chage Adaptation in Rural Areas of India (CCA-RAI) with GIZ support and a vulnerability assessment study in selected districts with support from the British Government's Department of Energy & Climate Change (DECC) have been carried out. All of these initiatives highlights that Madhya Pradesh has demonstrated its proactiveness and taken the lead in addressing Climate Change issues in a systematic fashion.

Gender and Climate Change Concerns

Empowerment of women and socially excluded groups by facilitating greater involvement in governance, opportunities for financial inclusion and through better targeting is the priority of the State Government. Weaker sections of the society like women and children are the most vulnerable to Climate Change impacts and so, there is a need to address concerns of these sections of the society in a focussed manner. To understand the impacts of CC on women/ children, there is a need of focussed research and based on the outcomes, participatory planning should be done to design the policies/ programmes. Capacity Building of women should be done on Climate Change, adaptation, decision making, and entrepreneurship to address future challenges.

Strategies to address Cross Cutting concerns

1. State Knowledge Management Centre on Climate Change: In order to impart knowledge to stakeholders, a State Knowledge Management Centre on Climate Change (SKMCCC) in EPCO is being established.
2. State of the art research to provide policy makers with tools to evaluate and respond to the threat of Climate Change: Need is felt to enhance the comprehension of Climate Change at policy level which could inadvertently help the decision making at all levels. Climate Change status report to be prepared at regular interval to take an account of the change of climatic parameters for the State.
3. Strengthening of monitoring systems of various initiatives of the climate sensitive sectors: Technological upgradation of monitoring tools like MIS and advanced satellite monitoring technologies like Remote Sensing needs to be strengthened within vulnerable departments.
4. Create awareness among masses about Climate Change: More awareness is required to be generated among the masses for better implementation of adaptation and mitigation efforts.
5. Capacity Building: Capacity building of Policy makers, officials, media, NGOs etc on mitigation and adaptation to Climate Change to be imparted by experts in order to promote best practices in the state for effective and better planning.
6. Integration of Gender Issues in the adaptation planning: Focussed research studies need to be conducted to understand the impacts of Climate Change on women and children and accordingly efforts to be taken to address these issues. Measures need to be taken to integrate these concerns in the existing programmes.

7. Urban landscape monitoring to mitigate and adapt to Climate Change, especially for the vulnerable: Regular monitoring and documentation of urban landscape (including change in land-use pattern), population growth, settlements (especially slums) is required to ensure a sustainable habitat development.

8. Mainstream Climate Change concerns: Workshops or other interactive sessions to be organised at District level and a Climate Change Resource Book on each ACZ to be developed for sensitising the DPC members on CC issues and respective vulnerabilities so that Climate Change concerns could be integrated and addressed at planning level.

9. Monitoring and Evaluation: Commissioning of Baseline studies for each sector is required to evolve appropriate sectoral criteria/ indicators for M&E in association with respective departments.

Section-III

"In light of all the Stakeholder Consultations undertaken during the process of preparation of State Action Plan on Climate Change, many concerns were shared and possible solutions were suggested by the participants. The solutions that were suggested have been categorised as strategies and activities. This section details out the strategies, activities, indicative list of implementing organisations/departments, priority of the strategy, indicative cost to undertake the strategy and possible sources for mobilising technical/financial resources.

16 Strategies & Budget Matrix

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
Forests & Biodiversity					
FBD/ S-1 Develop forest management plans for different forest types in view of CC	1. Undertake / Commission detailed study to understand impacts of Climate Change on forest productivity in different forest types using different climate and biodiversity models	FD, MPCST	High	3.00	GOI/ Bilateral
	2. Integration of Climate Change concerns in working plans for each forest type according to their biophysical vulnerabilities to Climate Change	FD, MPCST	High		GOI/ Bilateral
FBD/S-2 Forest conservation and afforestation / reforestation through viable models including PPP models	3. Effective demarcation of forest boundaries to be undertaken on high priority in view of the vulnerability of forest areas to encroachments and the new challenges emerging due to implementation of FRA, 2006 (as also envisaged in GIM, 2010)	FD, DoA, DoAH, MNREGA, MPCST	High	535.00	GoI
	4. Undertake surveys to demarcate forest corridors and take measures to protect and develop them	FD	High		GoI
	5. Undertake pilot projects to capture the Market based opportunities for forest conservation like REDD+, CDM etc	FD, MPCDMA, RD	Low		GoMP/GOI
	6. In addition to the PAs, PPAs and MPCAs, Community Conserved Areas etc should also be conserved. More of such areas should be identified at Divisional /	FD, RD	Medium		Bilateral/ GOI

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
	District level and be conserved				
	7. Enhance MGNREGA activities to forest areas near head reaches of rivers in forests	FD, RD, WRD	High		GoMP/GOI/ Bilateral
	8. Afforestation and reforestation of identified degraded forests in MP	FD	High		GIM/ GOI/ Multilaterals
FBD/S-3 Ensure soil and water conservation measures in forest management	9. Identify critical areas within forests for soil and water conservation	FD, WRD, RD, MoEF	High	100.00	NREGA/ GoMP/ otherfunds of GOI
	10. Promote agro forestry to increase forest biomass and hence soil moisture	FD, RD	High		GIM/ CAMPA funds
	11. Lakes/wetlands conservation in forest areas as outlined in GIM 2010	FD, BDB, DoH&E / SKMCCC	High		GIM / CAMPA funds
FBD/S-4 Research on impact of Climate Change on forest types and forest based eco-system services	12. Strengthen existing or develop new **'centers of excellence'**, to undertake regional analysis for the entire spread of the forest type, CC related threat analysis using CC models	FD, MPCST, Research Institutes	Medium	34.00	GIM
	13. Undertake studies on indigenous tree species to assess their vulnerabilities to Climate Change, their carbon sequestration potential and their adaptability to changing climatic parameters	FD, DoH&E / SKMCCC	High		GoI/ Bilateral
	14. Develop model forest nurseries to conserve indigenous species of trees and to develop promote climate resilient varieties	FD, BDB	High		GoI/GIM
	15. Assess and strengthen	FD	High		GIM

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
	fire management strategies with respect to CC				
	16. Documentation and assessment of threats to Forest, Biodiversity and Wildlife due to Climate Change	FD, BDB, Research institutes	High		Bilateral / GoI
	17. Research and documentation of initiatives like PPAs, MPCAs, Community Conserved Areas, ITK etc	FD, BDB, Research institutes	Medium		Bilaterals
FBD/S-5 Capacity Building	18. Impart training to forest officials to help integrate CC concerns in Forest planning and management	FD, RD	High	10.00	GoI/GIM/Bilaterals
	19. Impart training to communities on various schemes/ programmes/ benefits associated with social forestry, PPA, water conservation, market instruments etc.	FD, RD	High		GIM/GoMP/ Bilaterals
FBD/S-6 Promote alternate source of energy in forest villages and adjoining revenue villages	20. Initiate programmes to promote use of renewable energy amongst forest communities using fuel wood	FD, NRED, RD, DoH&E / SKMCCC	High	11.00	MNRE/ Bilaterals
	21. Explore the potential of utilization and consumption demand for a mix of renewables (such as solar photovoltaics and solar thermal) including LPG	FD, NRED, PRDD, DoH&E / SKMCCC	High		MNRE /Bilaterals
FBD/S -7 Livelihoods security of forest dependent communities	22. (a) NTFP focused forest management to help forest dependent communities adapt to Climate Change through emphasis on multiple utility species (b) Impart training to	FD, RD, DoH, MPSMFPF	High	5.00	GIM/ GoMP/ Bilaterals

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
	communities on sustainable harvesting practices of NTFPs and grazing methods in order to reduce pressure on forests.				
FBD/S-8 Biodiversity Conservation	23. Strengthening of Biodiversity Conservation Institutional Mechanism	State Biodiversity Board and Biodiversity Department	High	80.00	GoMP/GIM
	24. Revision of State Biodiversity Action Plan				
	25. Early preparation of PBRs, periodic documentation of Biodiversity of state				
	26. Information, Education and Communication on Biodiversity Conservation, Sustainable use of biodiversity should be taken up.				
	27. Assessment of ecofragile areas, RET species, BD Loss, spread of AIS etc disturbing the succession pattern of ecosystem				
FBD/S-9 Enhancing green cover outside forests	28. Promoting social forestry, agro-forestry, ToFs, community forestry	FD, RD, UADD	High	100.00	GIM/GoMP
FBD/S-10 Building Institutional mechanism for Climate Change Action Plan	29. (a) Create CC division in the department	FD	High	5.00	GoMP/GIM/ Bilateral
	(b) Integrate CC concerns with the departmental activities	FD, DoH&E / SKMCCC	High		
	(c) Coordinate/liaison with National Green India Missions	FD, MoEF	High		
		FD, GoMP SKMCCC M&EA	High		

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
	(d) Coordinate/liaison with GoMP SAPCC Monitoring and Evaluation Agency				
Total Budget for Forest & Biodiversity				**883.00**	
Water Sector					
WRD/S-1 Comprehensive water data base in public domain and assessment of the impact of Climate Change on water resources of the State	1. (a) Collection of necessary additional hydro-meteorological, hydrogeological and hydrological data and ensure availability on public domain. (b)Development of Water Resources Information System(except the data of sensitive and classified nature, all information to be in public domain),adding Climate Change scenarios to Water Data Analysis Centre and Hydrology Info Systems	WRD, MoWR, CWC, CGWB	High	18.00	NWM / Bilaterals/ Multilaterals
	2. Assessment of basin wise surface water availability in present and future climate scenario including water quality	WRD, MoWR	High		NWM/Bilaterals/ Multilaterals
	3. Comprehensive Reassessment of the ground water resources up to Block level	WRD, MoWR, CGWB	High		NWM/Bilaterals/ Multilaterals
	4. Develop ,revise and update inventory of wetlands, lakes on GIS platform	WRD, DoH&E / MP SKMCCC, MPCST	High		MoEF, GIM

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
	5. Promote scientific planning of groundwater development and conservation methods				
	6. Expansion of groundwater monitoring stations	WRD, MoWR	High		CWC/WRD
WRD/S-2 Promote accelerated pace of surface water development in the state	7. Accelerated Command area development , completion and renovation of canal systems, field channels and land levelling covering the entire state	WRD, Irrigation Department, RD, MoWR	High	110.00	Multilaterals
	8. Effective implementaion of participatory irrigation management (PIM) Act 2006.	WRD, ID, RD	High		Bilaterals/ GoMP
	9. Climate proofing of irrigation projects in areas that are sensitive to Climate Change-identification of areas and undertaking pilot projects	WRD	High		NWM/ Bilateral/ Multilateral
WRD/S-3 Water conservation, augmentation and preservation with special focus on areas with over-exploited conditions of ground water	10. Establish State Water Authority to monitor regulation, management and allocation of water for different purposes	WRD, MoWR	High	416.00	NWM/ GoMP
	11. Promotion of traditional system of water conservation by implementation of programme for repair, renovation and restoration of water storing bodies viz wetlands, lakes, well and baoli's in areas that are sensitive to Climate Change in a mission mode approach	WRD, RD, PHE, H&ED	High		NWM, NREGA
	12. Expeditious implementation of programme for conservation of water	WRD, RD, PHED, UADD, DoH&E	High		NWM, NREGA

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
	through recharge of ground water including rainwater harvesting and artificial recharge in areas / situations sensitive to CC				
	13. For effective management of water involve the communities through PRI's in rural areas and WUA's in urban areas.	WRD, DoA, RD	Medium		NWM, GoMP
	14. Legislation for use of GW regulation & management.	WRD	High		GoMP
	15. Develop a convergence basesd viable Panchayat/District level model using NREGA funds towards GW conservation especially in over exploited areas	WRD, RD, MoWR	High		GoMP, NREGA, NWM
WRD/S-4 Increase water use efficiency in irrigation, domestic and industrial purposes	16. Development of PPP Model for recycling of waste water	RD, UADD, PHE, H&ED	High	30.00	NWM, NMSH
	17. Undertake pilots for developing technical & financial support for common waste water treatment & recycling plants(industrial as well as urban residential colonies)	DoF, UADD, DoC&I	High		GOI/GoMP
	18. Build capacity for improvement of efficiency of urban water supply system	UADD, PHED	High		NWM
	19. Promote wise water practices and harvesting techniques				
	20. Establish mechanism for coordinated use of surface and ground water				

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
	21. Development and enforcement of appropriate pricing policy for water usage in industrial, agricultural, domestic aspects	WRD, UADD, DoF, DoA, DoC&I, DoH&E	Medium		GoMP/NWM
	22. Adopt better design practices like closed conduit, cement lined carrier canals etc.	WRD, UADD, DoF, DoA, DoC&I, DoH&E	High		GoMP
	23. Incentivising adoption of water efficient technologies.				
	24. Mandatory water use audit for industries and allied sectors	DoF, DoC&I, DoH&E	Medium		NWM
WRD/S-5 Promote basin level integrated watershed management	25. Review of State Water Policy in view of National Policy and National Water Mission	WRD, DoH&E / MP SKMCCC	High	83.00	NWM
	26. Developing guidelines for different uses of water particularly in context of basin-wise situations and ensuring adoption/application of these guidelines.	WRD, DoH&E / MP SKMCCC	Medium		NWM
	27. Assess scope and implications of further inter basin connections and thus adopt integrated water resource management and encourage basin development				
	28. Enhance activities within Integrated Watershed Development and management in climate sensitive areas	WRD, RD, DoA	High		NWM

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
	29. Giving due attention to water scarce areas and under developed basins develop management plans for the river basins of MP				
	30. Research studies on all aspects related to impact of CC on all water resources using Climate Change water resources modelling including quality aspects of water resources with collaboration of research organizations	WRD, MoWR, Research Institutes	High		NWM/ MoWR
	31. Mapping of areas likely to experience floods, establish hydraulic and hydrological models and developing comprehensive schemes for flood management & reservoir sedimentation	WRD, MoWR, Research Institutes, SDMA	High		NWM/GoI –MHA /NDMA
	32. Map the deep aquifers and facilitate natural recharge of these aquifers using remote sensing	WRD, MoWR, Research Institutes	High		CGWB/NWM
	33. Research / pilot projects in water stressed areas to enable improved efficiency in water use and maintaining its quality in agriculture, industry and domestic sector	WRD, MoWR, Research Institutes	High		NWM/ Bilateral/ Multilateral
WRD/S-7 Capacity building	34. Training of Professionals from various departments /organizations/ PRI/ULBs associated with water resources development and management.	WRD/ RD / WALMI	High	5.00	
WRD/ S-8	30. (a) Create CC division in the department	WRD	High	5.00	

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
Building Institutional mechanism for Climate Change Action Plan	(b) Integrate CC concerns with the departmental activities	WRD, DoH&E / MP SKMCCC	High		
	(c) Coordinate with National Water Missions and programmes	WRD, MoEF	High		
	(d) Liaison with GoMP SAPCC Monitoring and Evaluation Agency	WRD, GoMP SKMCCC M&EA	High		
Total Budget for Water Sector				**667.00**	
Agriculture Sector					
Agri/ S/1 Promoting use of soil and water Conservation technologies	1. Promote use of surface water resources for irrigation and launch integrated micro water sheds in Climate sensitive areas	DoA, WRD, RD	High	150.00	NAM/ MoA
	2. Promote use of water and soil conservation techniques, namely dry land farming, drip irrigation, intermittent flooding, dry sowing, SRI technologies, use of high yielding drought resistant cultivars as appropriare etc. in different areas	DoA, RD	High		NWM/ NMSA/ MRD
Agri/S/2 Planning cropping systems suitable for each agro-climatic conditions	3. Integrate Climate Change in planning for each agro- climatic zone	DoA, DoH&E / SKMCCC	High	110.00	MoA/GoI/NMSA/ Bilaterals
Agri/S/3 Capacity	4. Capacity building of planners, extension workers, farmers associations etc on	DoA , KVK, Agri Universities	High	60.00	NMSA/MoA

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
Building for sustainable agriculture	sustainable agricultural practices				
	5. Integrated Organic Farming and nutrient management	DoA, KVK, Agri Universities	High		NMSA/MoA
	6. Awareness and Capacity Building about adaptation practices like mulching, agro-forestry, crop rotation	DoA, KVK,			
Agri/S/4 Management of climate risk for sustainable productivity	7. Promote traditional practices like inter cropping, multiple cropping and crop rotation - training +pilot	DoA, RD	High	55.00	NMSA
	8. Promote practices for managing emerging pests and diseases-training+pilot	DoA	High		
	9. Promote integrated farming practices	DoA	Medium		
	10. Promote indigenous varieties of crops by providing access to market	DoA	Medium		
	11. Effective implementation of recommendations of MP Organic Farming Policy-2011 to promote Organic Farming Policy in the state	DoA	High		
	12. Enhance coverage of information on agriculture practices to farmers through agriculture extension including through cell phones	DoA	Medium		
	13. Promote production of nuclear and breeder seeds and its accessibility to farmers through village seed	DoA	Medium		

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
	banks				
	14. Promote forest linked farming systems in areas where forest cover is substantial	DoA	Medium		
	15. Study and take up pilot projects for weather index based crop insurance mechanism	DoA	High		
	16. Undertake and revise soil resource mapping at village level	DoA	High		
Agri/S/5 Enhancing dissemination of new and appropriate technologies developed by researchers and strengthening research further	17. Set up *demonstration centres* at each agro-climatic zone to educate farmers about climate resilient crop varieties and better adaptation practices	DoA	Medium	270.00	
	18. Soil testing- practice and packages (soil kit to the farmers)	DoA IISSc, ICAR	Medium		MoA/NMSA
	19. Ensure Seed quality improvement and efficient distribution system	DoA	High		MoA/NMSA
	20. Establish molecular breeding centers and bio technology laboratories	DoA	Medium		MoA/NMSA
	21. Provide adequate research facilities to existing agriculture universities and state agriculture research laboratories	DoA	Medium		MoA/NMSA
	22. Develop capacity to run agriculture related climate models, decipher their projections, to understand the impact on crops, soils, water etc.	SKMCCC /DoA/ Universities	High		MoA/NMSA
	23. Promotion of energy	DoA, NRED,	High		BEE

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
	efficient water pumps	BEE, MNRE			
	24. Promotion of organic farming practices training, demonstration, marketing	DoA	High		NMSA
	25. Strengthening of Agro-met network & Kisan Call Centres to provide early warning systems about weather and feedback	DoA	High		NMSA
Agri/S/6 Agriculture Information Management	26. (a) Set up a knowledge management network to avail information on Land-use pattern, soil types, weather, genotypes of crops, water availability, pasture, off-season crops and Agro-forestry practices etc.	DoA, DoH&E / SKMCCC, WRD	Low	10.00	NMSA/DoA/ Bilaterals
	(b) Based on the inputs received from this network, set up a single window information dissemination platform / website	SKMCCC, DoA	Low		NMSA
Agri/S-7 Creation of rural business hubs and accessibility to markets	27. (a) Provide additional mechanisation facilities for value addition of products such as thrashers, grinders, packaging and storage facilities	DoA, DoH	Medium	100.00	
	(b) Continue to encourage marketing of forest products such as honey, herbs, forest derivatives including soaps and cosmetics	DoH, DoF DoA,MPSMF PF, FD	Medium High		
	(c) Continue to encourage rural crafts men and provide access to markets through these village business hubs	DoA, RD, FD	High		
Agri/S-8	28. Study on impacts of Climate Change on	DOA, DoH&E / MP	High	5.00	NMSA/GoM/ Bilaterals

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
Research & Development	major crops and livestock in all agro climatic zones based on regional climate modelling & projections	SKMCCC			
	29. Development and Promotion of climate resilient crop varieties	DoA, Agri Universities	High	20.00	NMSA/ MoA
Agri/S-9 Building Institutional mechanism for Climate Change Action Plan	30. (a) Create CC division in the department	WRD	High	5.00	NMSA/MoA
	(b) Integrate CC concerns with the departmental activities	WRD, DoH&E / SKMCCC	High		
	(c) Coordinate/liaison with National Mission on Sustainable Agriculture	WRD, MoEF	High		
	(d) Coordinate/liaison with GoMP SAPCC Monitoring and Evaluation Agency	WRD, SKMCCC M&EA	High		
Total Budget for Agriculture Sector				**785**	
Horticulture Sector					
HC/ S-1 Soil and water conservation through demonstration of best practices	1. Promotion, demonstration and incentivising of mulching techniques, drip irrigation etc.	DoFWAD, DoH, Agri Universities	High	100.00	NHM
	2. Encourage micro irrigation practices	DoFWAD, DoH, Agri Universities	High		
	3. Encourage use of shednets and poly-houses	DoH	Low		
HC/S-2 Develop agri-horticulture systems to secure livelihoods especially in	4. Encourage crop diversification and develop cropping systems of agri crops-vegetables, agri crops-fruits, agri crops- spices, agri crops- flowers etc.	DoFWAD, DoH, Agri Universities	High	100.00	NHM

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
dryland tribal areas					
HC/S-3 Develop horticulture policies and plan production centres according to agro climatic conditions	5. Undertake an assessment of potential of productivity of different horticulture crops in the 11 agro-climatic zones	DoFWAD, DoH, Agri Universities	High	8.00	NHM/ Bilaterals
	6. Capacity building of horticulture officials to factor in Climate Change in horticulture planning for each agro-climatic zone	DoFWAD, DoH, Agri Universities	High		NHM/ Bilaterals
	7. Capacity building of farmers to accept the research results for maximising productivity of horticultural crops	DoFWAD, DoH, Agri Universities	High		NHM/ Bilaterals
	8. Provide access to farm inputs through affordable credits by creating appropriate institutional mechanism	DoFWAD, DoH,	High		NHM
HC/ S-4 Enhancing accessibility to mechanization for value addition and access to markets-creating business hubs	9. Provide credits for setting up agro-processing units	DoFWAD, DoH, RD, MoFP	Medium	111.00	MoFP
	10. Develop institutional support for developing business hubs and access to markets in different agroclimatic zones	DoFWAD, DoH, Agri Universities, RD, MoFP	Medium		MoFP
HC/ S-5 Research and extension support	11. Promote research on horticulture-biotechnology for better cultivar, seeds etc.	DoFWAD, DoH, Agri Universities	High	13.00	NHM
	12. Encourage research on better horticulture farming techniques	DoFWAD, DoH, KVK , Agri Universities	High		NHM

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
	13. Ensure effective extension for carrying information from lab to field	DoFWAD, DoH, KVK , Agri Universities	High		NHM
HC/ S-6 Creating cooperatives for enhancing the livelihoods of marginal farmers	14. Create cooperatives for marketing horticultural products produced by small and marginal farmers	RD, DoFWAD, DoH	Medium	11.00	NABARD, NHM
HC/ S-7 Building Institutional mechanism for Climate Change Action Plan	15. Create CC division in the department	DoH	High	NHM	
	16. Integrate CC concerns with the departmental activities	DoH, SKMCCC	High		
	17. Coordinate/liaison with National Missions and programmes	DoH, MoEF	High		
	18. Coordinate/liaison with GoMP SAPCC Monitoring and Evaluation Agency	DoH, GoMP SKMCCC	High		
Total Budget for Horticulture Sector				**348**	
Animal Husbandry Sector					
AH/S -1 Ensuring availability of adequate feed, fodder and water for livestock	1. (a) Develop policy and promote use of large tracts of fallow land and degraded land for raising fodder	FD, RD, DoAH	Medium	120.00	MoA/GoMP
	(b) Develop policy and promote use of forest foilage (cut and carry system) for enhancing feed availability	FD	High		
	2. Promote integrated farming for intercropping of fodder crops in agricultural lands	DoFWAD, DoAH	Medium		MoA/GoMP
	3. Develop policy and	DoFWAD,	Medium		MoA/GoMP

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
	promote utilisation of agro-industrial by products such as sugar cane tops, bagasse etc, as livestock feed.	DoAH			
	4. Promote sustainable fodder development and management practices	DoFWAD, DoAH	Medium		MoA/ GoMP
	5. Impetus for azolla farming and for fodder conservation in the form of hay and silage	DoFWAD, DoAH	Low		MoA/GoMP
AH/S. 2 Ensuring nutrient solvency in Livestock	6. Promote Stall feeding with grazing	DoAH, FD, RD	High	30.00	MoA/ GoMP
	7. Make available mixed ration/ complete feed of urea enriched molasses mineral blocks.	DoFWAD, DoAH	Low		MoA/GoMP
	8. Promotion of locally available feed ingredients like jowar, bajra, rice, kani, soybean etc for poultry consumption.				
	9. Promote utilization of unconventional feed in sheep and goat.				
AH/S. 3 Enhanced capacity for disease forecast, monitoring and management	10. Enhance the scale and frequency of prophylactic vaccination programmes in the state	DoAH	High	52.00	MoA/GoMP
	11. (a) Develope models for early warning of animal disease	DoAH, SKMCCC, MPCST	Medium		MoA/GoMP
	(b) Create cadres for monitoring of animal disease spread	DoAH	Medium		MoA/GoMP
AH/ S. 4 Ensure adequate housing and dedicated	12. Encourage keeping livestock under sheds in rural areas	DoAH	High	65.00	MoA/GoMP
	13. Identification and	DoAH, RD	High		MoA/ GoMP

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
water bodies for livestock to overcome heat stress	management of dedicated water bodies for the cattle to cool off				
	14. Encourage/ incentivise establishment of livestock farms in urban areas where cooler sheds, water, and stall feeding can be done	DoAH	Low		MoA/ GoMP
	15. Encourage building of cages to provide night shelter for backyard poultry so as to help them combat heat and cold stress	DoAH			
AH/ S. 5 Promote research on native species breeding and rearing	16. Promote breeding of indigenous varieties of bulls, cows, buffaloes, goats, and chicken by giving special impetus to research following a cluster approach.	DoAH, Veterinary Universities of GoMP	High	145.00	MoA/ GoMP
	17. Protect indigenous germplasm in its original form	DoAH, Veterinary Universities of GoMP	High		MoA/ GoMP
	18. Upgradation of nondescript livestock with exotic and cross bred germplasm	DoAH, Veterinary University of GoMP	Medium		MoA/ GoMP
	19. Promote research on understanding impacts of Climate Change on different livestock in the state and their productivity	DoAH, Veterinary University of GoMP	Medium		MoA/ GoMP
AH/ S - 6 Promote use of livestock and poultry waste for use as organic manure	20. Promote use of waste from livestock and poultry as an important source of organic manure for crops. Poultry manure which is rich in nitrogen can be used for various crops like sugarcane potato etc for enhancing crop production.	DoAH , DoFWAD	Medium	17.00	MoA/ GoMP

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
	21. Research on easy methane harvesting technology.	DoAH , DoFWAD	High		MoA/ GoMP
	22. Biogas promotion and proper utilization & storage of dung				
	23. Model project may be taken up in government poultry for demonstration				
AH/S-7 Promote new varieties of poultry and native species of small ruminants	24. Different varieties of low input technologies birds can be tried out for their adaptability in different agro climatic zones.	DoAH , DoFWAD	Medium	10.00	MoA/ GoMP
	25. Upgradation of local stock by ensuring availability of good indegineous breeding males.				
	26. Promotion of artificial insemination activities in goat breeding				
	27. Ensure production of quality semen by setting up goat frozen semen bank				
AH/ S - 8 Integrated approach to livestock development	28. Enhance availability of quality water for livestock through watershed management practices.	WRD, RD, SKMCCC	Medium	5.00	MoA/ GoMP
	29. Promote mixed farming and Agrosilvi Pasture	DoA, DoAH	Medium		MoA/GoMP
AH/ S - 9 Infrastructure for processing, storage and transport of livestock products:	30. (a) Set up large scale storage and transport facilities through public private partnerships	DoAH, RD	Medium	100.00	MoA/ GoMP
	(b) Extend advisory to farmers on milk harnessing and delivery norms to delivery centers near villages	DoAH, RD	Medium		

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
AH/ S - 10 Encourage formation of cooperatives	31. Form Cooperatives of small and marginal farmers with assistance of NGOs.	RD, DoAH	Low	20.00	MoA/ GoMP
	32. Small commercial poultry model as a viable model for income generation and livelihood enhancement in rural areas.				
AH/ S - 11 Strengthen the extension arm of the Animal Husbandry Department	33. Strengthen "Kisan Call Centres"	DoAH , DoFWAD	Medium	20.00	MoA/ GoMP
	34. Speeding up short-term trainings to the farmers on different aspects of Animal Husbandry including poultry	DoAH, RD	Medium		MoA/ GoMP
AH/ S - 12 Building Institutional mechanism for Climate Change	35. (a) Create CC division in the department	DoAH, SKMCCC M&EA	High	5.00	MoA/ GoMP
	(b) Integrate CC concerns with the departmental activities	DoAH, SKMCCC	High		MoA/ GoMP
	(c) Coordinate/liaison with National Missions and programmes	DoAH, MoEF	High		MoA/ GoMP
	(d) Coordinate/liaison with GoMP SAPCC Monitoring and Evaluation Agency	DoAH, SKMCCC	High		MoA/ GoMP
Total Budget for Animal Husbandry Sector				**589**	
Fisheries Sector					
F/S - 1 Study on Climate Change impacts and	1. (a) Identify parameters to develop models for protecting fish production in rivers, reservoirs and ponds with Climate Change including impact of droughts and heavy precipitation	Fisheries Dept / SKMCCC	High	2.00	MoA/NMSA

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
inland fish practices	(b) Identify fish species that will adapt to changing climate scenario	Fisheries Dept / SKMCCC	High		
F/S -2 Promotion policy and blending of technology for fisherman	2. Capacity building of fishery professionals	Fisheries Dept / SKMCCC	High	6.00	NMSA/MoA/ Bilateral
	3. Capacity building of fisher men societies to make them understand the plausible changes	Fisheries Dept / SKMCCC	High		
F/S -3 Strengthening fish rearing practices in an integrated manner with management of reservoirs, and watersheds	4. Disseminate best practices of fish rearing suitable for different agro climatic zones in MP and types of water bodies. 5. Cleaning of fish ponds, reservoirs etc 6. Promote research on developing fish seeds that are suitable for different water bodies and agro-climatic zones	Fisheries Dept/ RD/ NGOs	Medium	5.00	NMSA/MoA
F/S -4 Strengthening the existing system of fish management in the State	7. Create fish seed banks for easy availability to fishermen and farmers	Fisheries Dept, Research Institutions	High	15.00	NMSA/MoA
	8. To protect livelihood of farmers, diversified culture of local fish such as like Mahaseer, Magur, Singh, Rohu, Katala, Mrugal should be promoted.	Fisheries Dept, Research Institutions	Medium		NMSA/MoA
	9. Co-management approaches to conserve the stock and protect the breeding grounds during close seasons	Fisheries Dept,RD, NGOs	Medium		NMSA/MoA
	10. Access to markets leading to greater export of fish from the state	Fisheries Dept	High		NMSA/MoA
F/S -5 Conservation of fish biodiversity	11. Conservation of germplasm of endangered species 12. Control on introduction of	Fisheries Dept, Biodiversity		1.00	

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
	exotics	Department			
F/S -5 Building Institutional mechanism for Climate Change	13. Create CC division in the department	Fisheries Dept	High	5.00	NMSA/MoA
	14. Integrate CC concerns with the departmental activities	Fisheries Dept, SKMCCC	High		
	15. Coordinate/liaison with National Missions and programmes	Fisheries Dept, MoEF	High		
	16. Coordinate/liaison with GoMP SAPCC Monitoring and Evaluation Agency	Fisheries Dept, SKMCCC	High		
Total Budget for Fisheries Sector				**34.00**	
Total Budget for Agriculture and Allied Sectors				**1756**	
Health Sector					
HD/ S-1 Developing diseases profile for communities	1. Develop a disease and health surveillance unit which could be positioned at divisional level encompassing a research wing within the department that analyses the data for decision making	DoHFW, Research institutes	High	56.00	MoHW/DHFW
	2. Mapping of diseases outbreaks to assess the health vulnerability of the state with respect to Climate Change with special focus on communities in remote areas and tribal communities	DoHFW, Research institutes	High		
	3. Strengthen IDSP to act as an early warning system based on climate projections	DoHFW, IT Dept, Research institutes	High		
	4. (a) Develop short,				

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
HD/ S-2 Development of weather based early warning system	medium and long term forecasting capacities for local communities, district and for the state as a whole	MoHFW, state IMD, Agro—met stations in districts	High	10.00	MoHW/DHFW
	(b) Establish research wing that will undertake the analysis				
	(c) Establish/Strengthen communication mechanisms for dissemination of forecast projections				
HD/ S-3 Upscaling health disaster management preparedness	5. Prepare separate health disaster preparedness plans for areas that are susceptible to extreme rain, extreme temperatures, floods and droughts, with specific plans for each disease related to different climate triggers	DoHFW/SDMA	High	5.00	NRHM/NVBDCP/ RNCP etc.
HD/ S-4 Early case detection and quick control with a focus on areas where coverage is low or has not reached	6. Set up disease diagnosis centres in remote and tribal areas (pathological laboratories)	DoHFW, PRIs, NRHM, Research Institutes, NVBDCP	High	150.00	NRHM
	7. Sensitising Communities for early detection of disease and diagnosis				
	8. Establishment of drug distribution centres with provision of availability of alternative medicines				MoHFW
	9. Establish system for telemedical advisory				
HD/ S-5	10. Identify Measures for	MoHFW,	High	51.00	NVBDCP/NRHM

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
Strengthening supportive systems for environment management	source reduction for all vector borne, water borne diseases and plan intervention measures according to their respective shift of transmission months	DoHFW			
	11. Strengthening of Public Health Infrastructure specially in most vulnerable regions	MoHFW, DoHFW	High		MoHFW
	12. Train and build the capacities of NGOs for detecting disease source and reducing source	DoHFW, NGOs	high		NRHM
HD/ S-6 Monitoring and Reporting mechanism to ensure accountability and optimizeoutputs	13. Establish a Strategic Planning Unit at the Directorate of Health & Family Welfare Services in order to provide policy inputs for all health care sectors	DoHFW	High	60.00	NRHM
	14. Integration of IT enabled monitoring and surveillance systems like HMIS, Hospital MIS, Malaria data, GIS etc	DoHFW	Medium		IDSP
	15. Control measures in areas hitherto free from malaria	DoHFW	Medium		MoHFW
	16. Establish a research unit that will design the M&E system for integrating CC concerns and other concerns 17. Evaluate the results of M&E and identify intervention strategies for effective outcome of health delivery systems	DoHFW	Medium		NRHM
HD/ S-7 Public Awareness on health	18. Health education about various vector-borne, water-borne and other climate related diseases to general public	DoHFW, PRIs, NRHM, Research Institutes, NVBDCP	Medium	10.00	NVBDCP
	19. Community level	DoHFW,	Medium		NRHM

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
	groups, and institutions to be supported for information, education and communication about climate related diseases	PRIs, NRHM, Research Institutes, NVBDCP			
HD/ S-8 Research and study on Climate Change and health impacts	20. Develop predictive models to estimate the future burden of infectious diseases under projected CC scenarios	Research Institutes, MoHFW	High	57.00	NVBDCP
	21. Improve understanding of health impacts of Climate Change and land use change patterns on different vector-borne diseases	DoHFW, Research Institutes, Medical colleges	High		NVBDCP
	22. Dedicated research to provide health policy makers with new tools to respond to the threat of Climate Change	DoHFW, Research Institutes, Medical colleges	High		MoHFW
	23. Preparation of Village level Health Action Plans.	DoHFW, PHE, RD	Medium		NRHM
	24. Review of Draft State Health Policy with emphasis to integrate Climate Change concerns	DoHFW, SKMCCC	High		DoHFW
HD/ S-9 Capacity Building	25. (a) Training & Education of Health professionals on Climate Change issues	DoHFW	High	6.00	NRHM
	(b) Capacity building of PRIs to implement village level health action plans				
	26. Training of rural health activists on vector & water borne diseases as well as techniques to purify drinking water	DoHFW	High		NRHM
HD/ S-10 Building	27. (a) Create CC division in the department	DoHFW	High	5.00	MoHFW

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
Institutional mechanism for Climate Change	(b) Integrate CC concerns with the departmental activities	DoHFW, SKMCCC	High		
	(d) Coordinate/liaison with National Missions and programmes	DoHFW, MoEF	High		
	(e) Coordinate/liaison with GoMP SAPCC Monitoring and Evaluation Agency	DoHFW, SKMCCC	High		
Total Budget for Health Sector				**410**	
Urban Development & Transport					
UD/S-1 Enhancing Energy Efficiency in Residential and Commercial Buildings	1. (a) Development of model building bylaws with incorporation of state specific standards for energy efficiency and provision of ECBC to mandate minimum energy performance standards for Buildings	UADD,DoH&E, MPCDMA, MoP	High	65.00	NMEEE
	(b) Mandating energy audit and certification of energy performance for all commercial buildings	UADD,DoH&E, MPCDMA, MoP	High		
	2. Pursue MuDSM programme of BEE in urban water supply, sewage treatment facility, street lighting and and infrastructure	UADD,DoH&E, MPCDMA, MoP, MPUVN	High		BEE/NMSH
	3. Adoption of energy efficiency measures for urban water supply and sewerage equipments, street lights and buildings of ULBs	UADD,DoH&E, MPCDMA, MoP	High		BEE/NMSH
	4. Capatilize possibilities of developing a programmatic CDM proposal for	UADD,DoH&E, MPCDMA, MoP	High		MPCDMA

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
	implementation of energy efficiency in ULBs				
	5. Promotion of green building concept and incentivising best green building construction projects	UADD,DoH&E, MPCDMA, MoP	Medium		BEE/NMSH
	6. Preparation of IEC material in hindi and launching statewide outreach programme for consumer awareness on energy efficiency in urban areas	UADD, MPUVN, MPCDMA	High		NMSH
	7. Demonstration projects for energy efficient construction technologies	UADD, NRED, DoE	Medium		NMSH
	8. Increase energy auditing and develop monitoring mechanisms to ensure energy efficiency	UADD, NRED, DoE	High		NMSH
	9. Capacity Building of city managers/UADD officials and consumers on best practices in energy efficiency in building and Climate Change impacts/cities and Climate Change	UADD, NRED, DoE	High		NMSH
UD/S-2 Urban Water Supply	10. Mandating water audits and energy audit of water utilities	UADD	High	63.00	NWM/NMEEE/NMSH
	11. Promote water efficient garden irrigation techniques, reduce leakage in domestic supply system, water recycling	UADD	High		NMSH
	12. Refurbishment of distribution system and control of UFW through replacement of GI pipes with HDPE pipes	UADD	High		JNNURM/NMSH

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
	13. Developing regional/local manual for GW recharge and RWH techniques	UADD/ SKMCCC	High		UADD
	14. Policy level interventions to promote and incentivise RWH	UADD, DoH&E, WRD	High		UADD/NMSH
	15. Awareness among people about Reduce and Recycle techniques for waste water	UADD, DoH&E, WRD	High		NMSH/ NEAC-EPCO
UD/S-3 Urban Storm Water Management	16. Developing plans for urban sanitation and capacities of existing drainage system in context of changed climatic & Demographic scenario	UADD, MoUD	High	5.00	UADD/NMSH
UD/S-4 Solid Waste Management	17. R & D in the areas of development of process and separation of different components of MSW for energy recovery and other types of WTE processes	UADD, MoUD	High	67.00	NMSH
	18. Preparation of integrated SWM plans for ULBs and consider legal measures for non compliance with Municipal Solid Waste Rules 2000	UADD, MoUD	High		NMSH
	19. Promotion of PPP model for segregation, collection, transportation and disposal of solid waste management	UADD, MoUD	High		JNNURM
	20. Prepare Projects Bio-remediation of existing landfill sites and methane gas recovery from existing landfills	UADD, MoUD, DoH&E, MPPCB,MPC DMA	High		JNNURM / NMSH
	21. Creation of treatment facilities and Energy	UADD, MoUD,	High		JNNURM

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
	recovery methods like bio-methanation, RDF, from segregated biodegradable waste	DoH&E			
	22. (a) Demonstration projects for recycling of construction waste Awareness programme for segregation and disposal of bio-degradable waste through vermicomposting and bio-gas generation at household / community levels	UADD, MoUD, DoH&E	High		NMSH/JNNURM
	(b) Develop suitable norms and policy for marketing of municipal compost and energy from waste	UADD, MoUD	High		
	23. Developing CDM projects relevant to Urban sectors like SWM, EE, Transport etc	UADD, MoUD, MPCDMA	Medium		MPCDMA, Bilaterals (GIZ)
UD/S-5 Wastewater Management	24. Pilot project for segregation at the household level of black and grey water	UADD, MoUD, SKMCCC	Medium	6.00	JNNURM
	25. Strengthening institutional and technical capacities of ULBs for effective O&M of sewerage system and for recycling and reuse of waste water for non-potable uses	UADD, MoUD	Medium		JNNURM/NMSH
UD/S-6 Sustainable Urban Transport	26. (a) Development of norms integrating measures related to movement of traffic taxation, parking, congestion charges, public carriage specifications and service norms to encourage public transport	UADD, DoT, MoUD	Medium	17.00	NMSH/ JNNURM

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
	(b) Development of norms for pedestrianisation/cycling	UADD, DoT, MoUD	Medium		
	(c) Model regulations for integrating transport planning with spatial planning (Master plan) working on extensive Public transport system on Regional scale	UADD, DoT, MoUD	Medium		
	27. Launch dedicated awareness drive on use of public transport	UADD, DoT, MoUD	High		NMSH/ JNNURM
	28. Ensure that old vehicles phased out from one region are not used at any other place	DoT	Medium		
	29. Capacity Building in transport planning and land use integration, optimization of various public transport modes.	UADD, DoT, MoUD	High		NMSH/ JNNURM
	30. Promoting and incentivising use of non-motorised vehicles	UADD, DoT, MoUD	Low		NMSH/ JNNURM
UD/ S-7 Urban Planning	31. (a) Consider modification of urban development for promoting urban renewal, environment management, spaces for plantation at plot level for increasing tree cover, structural safety, hazard and risk mitigation, transport planning (b) Identification of sensitive areas (geologically, hydrologically & geographically) (c) Identification of areas for Peripheral urban Development along with possible organic growth areas of hinterland	UADD, DoH&E	Medium	11.00	NMSH/ JNNURM

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
	(d) Studies to determine the Carbon Sequestration potential of Urban Lakes				
	32. Create Educational Programmes and Capacity Building activities for students and professionals on aspects related to Sustainable Urbanization/ Cities and Climate Change in association with Technical Universities/Institutions, Colleges	UADD, DoH&E	Medium		NMSH/ JNNURM
	33. Develop strategies for Climate Change resilient cities or climate smart cities and take up pilot projects.	UADD, DoH&E, SKMCCC	Medium		NMSH
UD/ S-8 Green Governance favouring low carbon societies	34. Policies promoting the low carbon societies	UADD, MoUD	High	8.00	
UD/ S-9 Adoption of service level Benchmarks	35. (a) Creation and Adoption of benchmarks for sustainable management of water supply, wastewater, storm water drainage and solid waste management	UADD, MoUD, SKMCCC	Medium	5.00	NMSH/ JNNURM
	(b) Development of service level benchmarks for urban sectors	UADD, MoUD	Medium		
	(c) Mandating adoption of sustainable habitat standards	UADD, MoUD	Medium		
UD/ S-10	36. (a) Create CC division in	UADD, DoT	High	5.00	NMSH

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
Building Institutional mechanism for Climate Change	the department				
	(b) Integrate CC concerns with the CDPs/ departmental activities	UADD, DoT, SKMCCC	High		
	(c) Coordinate/liaison with National Missions and programmes	UADD, DoT, MoEF	High		
	(d) Coordinate/liaison with GoMP SAPCC Monitoring and Evaluation Agency	UADD, DoT, SKMCCC	High		
Total Budget for Urban Development & Transport				**252**	
Energy Sector					
E/S- 1 Enhancing efficiency in power generation	1. Assess viability and updation to latest technologies like supercritical, ultrasupercritical boilers and IGCC	DoE, DoC&I	Medium	6.00	Bilateral
	2. Assess viability of carbon-capture technology and its commercial application in thermal power plants	DoE, DoC&I UVN, MoP, NRED	Medium		Bilateral
	3. Green Tariff should be designed to motivate clean energy generation in the state	DoE, DoC&I UVN, MoP, NRED	Medium		Bilateral
	4. Development of policy framework for generating clean energy through clean coal approaches/ technologies	DoE, DoC&I UVN, MoP, NRED	High		Bilateral
	5. Explore possibilities of use of fluidised bed boiler and coal gasification for refurbishment of old units	DoE, DoC&I UVN, MoP, NRED	Medium		Bilateral
	6. Assessment of life cycle analysis of existing	DoE, DoC&I			

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
	thermal power plants and resource mobilization for implementation of O & M measures	MoP, NRED			
	7. Augmentation of distributed power generation	DoE, MoP, MPUVN	High		Bilateral/BEE
	8. Promotion of Off grid power generation				
E/S- 2 Undertake demand side management to improve efficiency and reduce GHG emissions	9. Development of operational plan for reduction of T & D losses in Power Discoms, Transcoms	DoA, DoE, MoP	High	40.00	Bilateral/.MOP
	10. Development and implementation of feeder separation in rural areas	DoA, DoE, MoP	High		Multilateral
	11. Use of energy efficient pumps and giving subsidy to farmers to motivate them in replacing old pumps to new pumps	DoA, DoE, MoP	High		Bilateral/NMEEE
	12. Promote Energy Efficiency in Street lighting and Water Pumping, Buildings	UADD, DoE MPCDMA	High		BEE/NMEEE, MoUD
	13. Promote aggressively Energy saving in domestic sector through Energy Efficient Equipments, creating awareness about best practices for energy conservation	BEE, UADD,	High		BEE , MoUD, MoP
	14. Consider to make compulsory energy audit and more buildings should be brought the existing notification	DoE, DoC&I,	Medium		BEE, MoP
	15. Promote effective utilization and distribution of energy: Load shifting or	DoE, DoC&I,	Medium		MoP/DoE , BEE,

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
	differential pricing during peak hours in industries				
	16. Increase the outreach and coverage of Bachat Lamp Yojana programme	DoE, DoH&E / MP CDMA	Medium		BEE/NMSH
	17. Promotion of BEE's ECBC Codes for adoptation in the State	DoE, MPCDMA	Medium		BEE/NMSH
E/S- 3 Market Transformation for Energy Efficiency	18. Undertake scoping study for Leveraging international financing instruments for promoting energy efficiency	DoE, NRED MoP,	Medium	2.00	NMSH/BEE
	19. Explore the avenues to capitalize on CDM opportunities	DoE, MNRE, MPCDMA	High		MPCDMA
E/S-4 Development of Low Carbon Society Pathway	20. Formulation of favourable policies to promote Low Carbon Society policies	DoE, MPCDMA	High	10.00	MoP
	21. Awareness Generation about good practices and energy efficient equipments	MPCDMA, DoE	High		MoP
	22. Harmonize Renewable Purchanse Obligation upto commercial levels	DoE, MPUVN	Medium		MNRE, MoP
E/S-5 Capacity Building	23. Capacity Building of department of officers about CDM and latest technologies as well accelerate Research & Development activities for more energy efficient technologies	MPCDMA, DoE	High	5.00	
E/S- 5 Building Institutional	24. (a) Create CC division in the department	DoE, NRED	High	5.00	MoP
	(b) Integrate CC	DoE, NRED	High		

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
mechanism for Climate Change	concerns with the departmental activities	SKMCCC			
	(c) Coordinate/liaison with GoMP SAPCC Monitoring and Evaluation Agency/ NMEEE/National Solar Mission	DoE, NRED, SKMCCC	High		
Total Budget for Energy Sector				**68.00**	
New & Renewable Enegy Sector					
NRE/S- 1 Promoting and incentivising Renewable Energy	1. Formulate favorable policies to attract investors to invest in RE sector	NRED	High	300.00	NSM, MNRE
	2. Harmonize Renewable Purchase Obligation (RPO) upto commercial levels.	NRED, MPERC	High		NSM, MNRE
	3. Public Private Partnership (PPP) approach may be used to attract infrastructure investment in RE Projects	NRED	High		NSM, MNRE
	4. Solar power should be promoted in phases and institutions should be covered at first (as they can easily be mapped and reached)	NRED	High		NSM
	5. Review and assess impact of subsidizing Renewable Energy use	NRED , MPERC	Medium		
	6. Promotion of wind energy generation according to the potential in MP	NRED	High		MNRE
	7. Evolve PPP model in promotion of quality, user friendly solar equipments	DoE, NRED	Medium		NSM
NRE/S- 2 Awareness and Capacity	8. Capacity Building of UVN/department of NRE officers about renewable energy, CDM, latest technologies	DoE/ NRED	High	10.00	

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
Building					
	9. Promote energy plantation in forest areas for biomass generation and Training to villagers about pellet formation to enhance their incomes	NRED, FD	Medium		MNRE
	10. School/ College students should be educated about RE technologies.	NRED, Higher Education Department	Low		NSM
	11. Awareness among people and industries about use of New/ Green Technologies				
	12. Start initiatives like lighting a billion lamps campaign in the state to promote renewable energy in rural areas	NRED, MNRE, SKMCCC	High		NSM
NRE/S- 3 Promoting research and exploring more possibilities of RE in the state	13. Research & Development activities should be accelerated in the field of RE	NRED, MPUVN, Universities	Medium	15.00	NSM
	14. Develop Solar Parks demonstration sites including other RE sources should be developed.	NRED	Medium		NSM
NRE/S- 4 Building Institutional mechanism for Climate Change Action Plan	15. (a) Create CC division in the department	NRED	High	5.00	MNRE
	(b) Integrate CC concerns with the departmental activities	NRED SKMCCC	High		
	(c) Coordinate/liaison with National Solar Missions and NMEEE	NRED, BEE MNRE	High		
	(d) Coordinate/liaison with GoMP SAPCC Monitoring and Evaluation Agency	DoE, NRED, SKMCCC	High		
Industries Sector					
IND/ S-1	1. Build strategy to	DoC&I, H & E,	High	12.00	NMSH/

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
Review of M.P. Industrial policy 2010 to addressed the Climate Change Concern	integrate Climate Change concerns leading Industrial Development	Dept, Research Institutes			NMEE/GoI/
	2. Develop criteria and indicators for Effective monitoring and strict compliances of ISO 14001 compliant company		High		NMSH/ NMEE/GoI/ Bilateral
	3. Build a mechanism to incentivize actions taken by industries towards mitigation and to promote industries to take up ISO certifications	H & E Dept, MoEF	Medium		
	4. Build strict rules and regulations for upcoming industrial zone in the state keeping in view optimum management of natural resources like minerals, land, water and air	MPPCB, H & E Dept,	Medium		MoEF
IND/S-2 Implementation of Perform, Achieve and Trade (PAT) Mechanism	5. Facilitate implementation of PAT by the designated consumers	DoC&I, MPUVN, MoP	Medium	-	BEE
	6. Incorporation of the learning of the PAT in the state industrial policy	DoC&I, MPUVN, MoP	Medium	-	
IND/S-3 Capture the opportunities existing in the carbon Market for Mitigation	7. Increase efforts and investments in CDM projects	DoC&I, MPUVN, MPCDMA	Medium	7.00	MPCDMA
	8. Exploring possibilities for investment in Green and New Technology	DoC&I, MPUVN, MoP	Medium		GoI/GoMP
	9. Incentivise & reward GHG reduction efforts	H & E Dept, MoEF, MPCDMA	Low		GoMP
	10. Promoting energy efficiency in industrial clusters		Medium		
IND/S-4	11. (a) Compulsory water	DoC&I,	High	45.00	MPPCB/

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
Devise an integrated water management plan for industrial clusters	& waste water Audit	WRD, Industrial Association			PHED/WRD
	(b) Promotion of water efficiency measures				
	(c) Waste water treatment, recycle and reuse	DoC&I DoC&I, WRD	High High		
	(d) Promotion of water harvesting in industrial clusters				
IND/S-5 Effective Industrial Waste Management and Pollution Control	12. (a) Develop Eco – Business model	DoC&I, MoP	Medium	45.00	MPPCB/NMSH
	(b) Promote networking among industries for recycling and reuse of wastes				
	(c) Use of more efficient technology to reduce pollution				
IND/KS-6 Involvement of industries in CSR activities	13. Promoting CSR budgets to bring about greates climate awareness			5.00	NMSH/GIM
	14. (a) Regular training to the industries on technology upgradation and cleaner technologies	DoC&I	High		
	(b) Creation of green zones and water harvesting structures in industrial clusters	DoC&I	High		
	(c) Encourage industries to align CSR activities towards GHG Reduction	DoC&I, MPUVN, MPCDMA	High		
IND/S-7	15. (a) Regular training to the industries on	DoC&I,	High	5.00	NMSH/

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
Capacity building and entrepreneurship development	technology upgradation, clean technologies, CDM and GHG mitigation	MPUVN, MoP, Research and Training Institute, FIIND			
	(b) Training on calculating and managing carbon footprint of the industry		High		
	(c) Training to entrepreneurs on eco business model	Research and Training Institute, FIIND, MoP DoC&I	High		
IND/S-8 Research and Development	16. Resource Pooling to development state specific eco-friendly technology 17. Industrial networks should be developed based on recycling and reuse of the materials	Research and Training Institute		10.00	
IND/ S-8 Build institution mechanism for SAPCC action plan	18. (a) Create CC division in the department	DoC&I	High	5.00	
	(b) Integrate CC concerns with the departmental activities	DoC&I, SKMCCC	High		
	(c) Coordinate/liaison with National Missions and programmes	DoC&I, MoEF	High		
	(d) Coordinate/liaison with GoMP SAPCC Monitoring and Evaluation Agency	DoC&I, SKMCCC	High		
Total Budget for Industries Sector				**134·00**	
Rural Development Sector					
RD/S-1	1. Impact assessment of				

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
Review of existing rural development programmes with Climate Change focus	the programme and climate resilience check of the works in process	DoRD, SKMCCC	High	2.00	Bilaterals/MoRD
	2. Micro level Vulnerability Assessment at district and block level, using GIS, to take up informed policy decisions 3. Develop Climate compatible Rural Development programme	DoRD, SKMCCC	High		Bilateral/MoRD
RD/S-2 Training and Capacity Building of rural communities	4. Development of skills for alternative income generation activities to reduce climate induced vulnerabilities	DoRD, DoRI	High	46.00	MoRD/ NRLM
	4. Awareness on various programmes/schemes/benefits favouring enhanced income opportunities	DoRD	High		NRLM
	5. Documentation of traditional / indigenous knowledge to be done as it can provide insights for adaptation and assess possibilities of value addition to enhance adaptive capacities. 6. Preperation and implementation of Gender centric Local Action Plans on Adaptaion (LAPA) through PRIs	DoRD, DoH&E/ SKMCCC	High		Bilateral/NRLM
RD/S-3 Climate Change concerns to be institutionalized in the annual plans of Panchayats	7. Promotion of water efficiency in agriculture and other uses	DoRD, DoH&E	High	10.00	
	8. Promotion of Energy efficiency measures, bio-gas and Solar energy applications	DoRD, UADD, NRED	High		
	9. Take up ecosystem and community based climate adaptation projects in rural areas	DoRD	High		

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
RD/S-4 Credit availability for rural infrastructure development and insurance against climate induced vulnerabilities	10. Coordination and integration with the CC action plans of departments like forest water, agriculture, energy and health so that climate resilience of the communities is ensured on pilot basis	DoRD, DoF, NBFCs	High	40.00	NABARD/Bilaterals
RD/S-5 Convergence and integration with the CC action plans departments like Forest, Agri, Water, Health, RD, Energy etc	11. Following integrated planning approach for effective convergance 12. Create capacity for CDM/Rural Energy project development: develop PoA for CDM (or its replacement)			10.00	
RD/ S-6 Building Institutional mechanism for Climate Change Action Plan	13. (a) Create CC division in the department	DoRD	High	5.00	NRLM/MoRD/ GoMP
	(b) Integrate CC concerns with the departmental activities	DoRD, SKMCCC	High		
	(c) Coordinate/liaison with National Missions and programmes	DoRD, MoEF	High		
	(d) Coordinate/liaison with GoMP SAPCC Monitoring and Evaluation Agency	DoRD, SKMCCC	High		
Total Budget for Rural Development				**113**	
Environment Sector					
E/S-1 Knowledge Management Centre (KMC) in Climate Change	1. Set up a state Climate Change KMC and prepare Detail Project Report	SKMCCC	High	15.00	Bilateral/ MoEF/ MST
E/S-2	2. Improve understanding of	SKMCCC	High	3.0	Bilaterals

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
Dedicated state of the art research to provide policy makers with tools to evaluate and respond to the threat of Climate Change	Climate Change at policy level on- water, food security, land use change, disease transmission, GHG, CDM etc. in collaboration with relevant institutes/departments	MPCDMA			
	4. Preparation of Climate Change Status Report	SKMCCC MPCDMA	High		
E/S-3 Strengthening of monitoring systems of various initiatives of the climatesensitive sectors	5. Monitoring the impact of various initiatives of the climate sensitive sectors at village levels by GIS based creating integrated database.	MPCOST, H & E Deptt, IIRS, SKMCCC	High	5.00	Bilaterals
E/S-4 Increase of general awareness of people by educating them about Climate Change	6. Support for Community level groups, PRIs and institutions (including educational) for information, education and communication about Climate Change	SKMCCC Regional Science Center, Universities , MPCDMA	Medium	1.00	GoMP/GoI
E/S-5 Capacity Building	7. Capacity building at various levels (eg. Policy makers, officials, media, NGOs etc) on mitigation and adaptation to Climate Change by experts.	H&E Deptt, SKMCCC, MPCDMA	High	4.00	Bilaterals
E/S-6 Integration of Gender Issues in the adaptation planning	8. Focussed research to understand impacts of Climate Change on women/ children in different context like urban/ rural	DoRD, FD, H&ED, UADD	High	37.00	MoRD, Bilaterals, MoEF

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
	9. Developmental Planning/ Adaptation Planning should ensure participation of women to address issues is a focussed manner 10. Gender Issues should be integrated in ongoing/ new projects 11. Capacities of women should not only be strengthened on Climate Change and adaptation but also on decision making and entrepreneurship to reduce their vulnerability				
E/S- 7 Urban landscape monitoring to mitigate and adapt to Climate Change, especially for the vulnerable	12. Regular monitoring and documentation of urban landscape (including change in land-use pattern), population growth, settlements (especially slums).	H&E Deptt, SKMCCC	High	1.00	Bilaterals
E/S- 8 Mainstream of Climate Change concern	13. Prepare ACZ and district specific Climate Change resource book and training to sensitize district officials and DPC members to integrate Climate Change concern	SKMCCC	High	5.00	Bilaterals
E/S- 9 Monitoring and Evaluation	14. Commissioning of Baseline studies for each sector, departments	All the concerned departments	Medium	1.00	Bilaterals/ GoMP/GoI
E/S- 10 Building Institutional mechanism for Climate Change Action	15. (a) Create CC division in the department	H&E Deptt	High	15.00	
	(b) Integrate CC concerns with the departmental activities	H&E Deptt	High		
	(c) Coordinate/liasion	H&E Deptt,	High		

Strategies	Activities	Department/ Organisation	Priority	Cost (Rs. in Cr)	Possible Technical/Financial Sources (but not limited to)
Plan	with National Missions and programmes	MoEF			
	(d) Coordinate/liaison with GoMP SAPCC Monitoring and Evaluation Agency	H&E Deptt, SKMCCC	High		
Total Budget for Environment Sector				**87.00**	
GRAND TOTAL*				**4700.00**	

* The costs mentioned against each sector are indicative. Detail cost for each of the activity can be ascertained after deciding the scope and scale of activities.

17 Monitoring and Evaluation

Background

For measuring the effectiveness of the State Climate Change Action Plan it is necessary to have a monitoring and evaluation framework in place. This essentially identifies the successes and failures of the overall objective of the action plan, and, enables one to make, as appropriate, midterm course changes to the adaptation and mitigation strategies identified, correcting past mistakes and improving practices suggested in the action plan.Monitoring and evaluation for addressing Climate Change concerns in policies, actions and projects has to be participatory and learning by doing process.

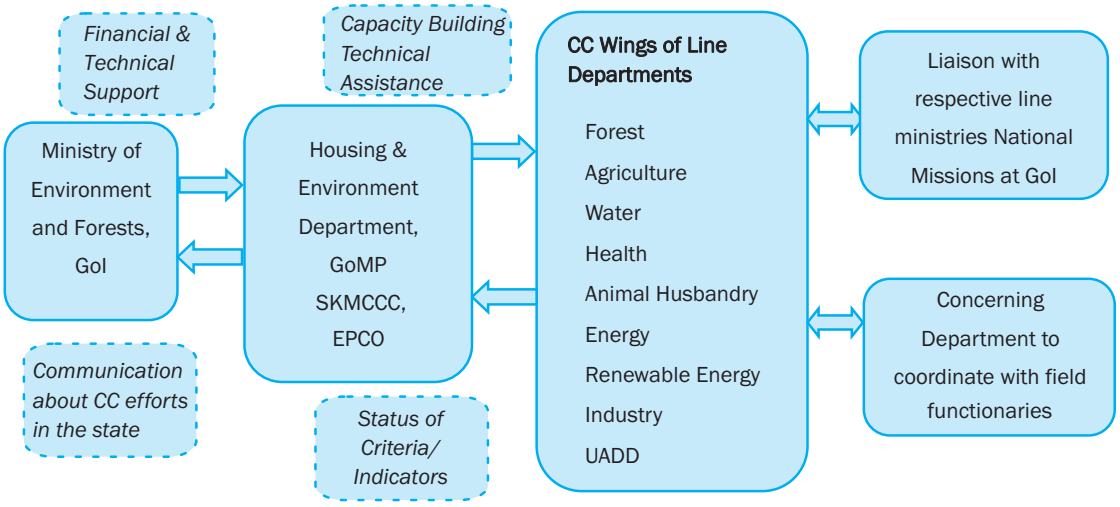
A dynamic process may allow an effective and active monitoring and evaluation of the performance of a project with respect to its objectives. The process can allow for lessons learned to be actively incorporated in a monitoring and evaluation framework as a new step for the adoption and mainstreaming of effective adaptation interventions.

In the context of Madhya Pradesh, the aspects that would require monitoring and evaluation would be in terms of:

- M&E of state developmental goals vis a vis their integration of climate concerns in planning for achieving these goals
- M&E of sectoral level climate policies, programmes and actions
- M&E of the projects undertaken to achieve the strategies

It is imperative that a set of indicators would be required to monitor progress, achievement and to incorporate corrective measures. These need to be done through extensive consultations with relevant stake holders. The roles of the various agencies in monitoring and evaluation, namely the departments, including EPCO will be as follows:

The SKMCCC, EPCO will monitor and evaluate the progress of achievement of (a) integration of climate concerns in various developmental policies and planning of the government, and (b) monitor and evaluate capacity development of the various line departments and their personnel to internalize the Climate Change concerns for climate proofing their developmental plans.



Flow Diagram of Monitoring and Evaluation of SAPCC

The Line Departments would assess the climate policy goals in terms of strategies laid out for each sector to climate proof the said sector. An assessment of the progress and hence achievement of the climate policy/strategy and that of various actions identified therein as a part is required, including an assessment of the actions taken as a part of the missions of the National Action Plan on Climate Change.

In order to evolve a robust monitoring and evaluation framework, the State Action Plan proposes to develop sectoral baseline for each of the climate sensitive sectors in Madhya Pradesh. This would be followed by evolving appropriate sectoral criteria and indicators. The entire exercise is proposed to be participative and consultative, ensuring engagement of the concerning departments and stakeholders.

The monitoring and evaluation exercise demands an acceptable mechanism of reporting. This would enable the concerned departments to report the targets in a uniform manner. Having developed sectoral baselines criteria and indicators and a uniform reporting framework, it is proposed to evolve a mechanism of verifying the information received from respective departments. Initially SKMCCC, EPCO, the State designated Agency for Climate Change would be responsible for verification however, if need be and agreed by all third party verifications may also be considered.

SKMCCC, EPCO

ANNEXURE - 1

Details of Sectoral Workshops

	Sector/ Department	Date	Chaired by	No. of Participants
1	Launch Workshop	26 – 27th, April 2010	Shri Rajendra Shukla, Hon'ble Minister Energy and Mineral Resources, Shri Alok Srivastava, Principal Secretary, Housing & Environment Department	250
2	Forest, Biodiversity	5th June 2010	Dr. H.S. Panwar, Shri Alok Srivastava, Principal Secretary, Housing & Environment Department Shri Ashok Shah, ED EPCO, Shri. V. R. Khare Advisor Climate Change EPCO, Dr. H. S. Pabla, PCCF, Shri. A. K. Dubey PCCF,	67
3	Institutional Networking Workshop	7th July 2010	Shri Ashok Shah, ED EPCO, Shri V R Khare, Advisor Climate Change Cell, EPCO, Dr. R. B. Lal, Director, IIFM Bhopal	65
4	Animal Husbandry and Livestock	27th – 28th September 2010	Shri. Manoj Goyal, Principal Secretary Animal Husbandry Department GoMP, Shri Praveen Garg, ED EPCO, Shri V R Khare, Advisor CC Cell, Dr. R. K. Rokde Director, Veterinary Services GoMP	96
5	Water Resources	11th October 2010	Shri Alok Srivastava, Principal Secretary, Housing & Environment Department, GoMP, Shri Radheshyam Julania, Principal Secretary, Water Resources Department, GoMP, Shri Praveen Garg, Executive Director, EPCO	75
6	Department of commerce, Industry and Employment	26th October 2010	Shri Satyaprakash, Additional Chief Secretary, Department of Industries, Government of Madhya Pradesh, Shri. Praveen Garg, Executive Director, EPCO and Shri. V R Khare, Advisor CC Cell, EPCO	58
7	Energy	3th January 2011	Shri Iqbal Singh Bains, Director General, EPCO, Shri Mohd. Suleman, Secretary, Energy Department, Shri Praveen Garg, Executive Director, EPCO, Dr V.K. Sethi, Rector and Director, UIT, RGTU	40
8	New & Renewable Energy	5th January 2011	Shri Iqbal Singh Bains, Director General, EPCO, Shri Praveen Garg, Executive Director, EPCO, Shri Neeraj Mandloi, Managing Director, Urja Vikas Nigam	37
9	Agriculture	11th January 2011	Shri. Iqbal Singh Bains, Director General, EPCO, Shri Praveen Garg, Executive Director, EPCO, Smt. Rashmi Arun Shami, Director Department of Horticulture, GoMP, Dr. D N Sharma, Director Agriculture Department, GoMP	36
10	UADD &Transport	22nd January, 2011	Shri Iqbal Singh Bains, Director General EPCO, Shri Praveen Garg, Executive Director EPCO, Shri V.R. Khare, Advisor EPCO, Shri S.P.S. Parihar, Principal Secretary, UADD, Shri S N Mishra, Commissioner, UADD	37
11	Health	27th April, 2011	Shri Iqbal Singh Bains, Director General, EPCO, Shri Praveen Garg, Executive Director, EPCO, Shri J N Kansotia, Commissioner, Department of Public Health and Family Welfare, Shri V.R. Khare, Advisor, Climate Change, Dr Neeru Singh, Director, RMRCT, Jabalpur	39
12	Panchayat & Rural Development	18th May, 2011	Shri Iqbal Singh Bains, Director General, EPCO, Shri Ajay Tirkey, Secretary, Panchayat and Rural Development Department, GoMP, Shri Umakant Umarao Director, Rajiv Gandhi Watershed Mission	31

ANNEXURE - 2

Details of Agro Climatic Zone Workshops

S. No	ACZ	Date and Place	District Covered	No of Participants
1	Jhabua Hills	14th Feb 2011 Jhabua	Jhabua, Alirajpur	111
2	Malwa Plateau	15th Feb 2011 Indore	Indore, Dewas, Dhar	67
3	Malwa Plateau	21st Feb 2011 Ujjain	Ujjain, Ratlam, Mandsaur, Neemach, Shajapur	110
4	Vindhayan Plateau	22nd Feb 2011 Sagar	Sagar, Raisen, Damoh	194
5	Bundelkhand	23rd Feb 2011 Chhatarpur	Tikamgarh, Datia, Chhatarpur	64
6	Central Narmada Valley	24th Feb 2011 Jabalpur	Narsinghpur, Hosangabad, Harda	123
7	Nimar Plains	26th Feb 2011 Khandwa	Khandwa, Burhanpur, Khargoan, Barwani	144
8	Kymore Hills	28th Feb 2011 Rewa	Rewa, Panna, Katni, Jabalpur Satna, Umaria	92
9	NHR Chhattisgarh	1st Mar 2011 Shahdol	Mandla, Sidhi, Shahdol, Singrauli,Dindori, Anuppur	70
10	Satpura Plateau	4th Mar 2011 Seoni	Seoni, Betul, Chindwara,	110
11	Chhattisgarh Plains	5th Mar 2011 Balaghat	Balaghat	–
12	Gird Zone	9th Mar 2011 Gwalior	Gwalior, Morena, Bhind, Shivpuri, Sheopur	122
13	Vindhayan Plateau	25th Mar 2011 Bhopal	Bhopal,Guna, Rajgarh, Vidisha, Ashoknagar, Sehore	44

ANNEXURE - 3

List of Experts who reviewed the SAPCC

Sector/Role	Sectoral Expert
Forest	Dr RamPrasad, Retd. PCCF, Govt of MP Shri V R Khare, Retd. PCCF Govt of MP Shri P C Kotwal, Professor IIFM
Water	Shri B O Joshi, Retd. Secretary, Water Resource Dept., GoMP Dr Saleem Romani, Retd. Chairman, C.G.W.B
Agriculture & Horticulture	Dr G S Kaushal, Retd. Director, Agriculture Department, GoMP Dr. U P S Bhadauria, Professor & Head, Department of Agrometeorology, JNKVV Jabalpur Dr. Sunil D Upadhyaya, Prof. & Officer-in-charge Technical Cell, JNKVV Jabalpur
Animal Husbandry	Dr H S Singh, Head of Department of Physiology and Biochemistry, College of Veterinary Science and Animal Husbandry, Jabalpur Dr. N. Hegde, Trustee, BAIF Development Research Foundation
Fisheries	Shri Prasanna Khemaria, Ex. Fisheries Expert, MPDPIP, Independent Consultant
Health	Dr Neeru Singh, Director, Regional Malaria Research Center for Tribal, (ICMR), Jabalpur
UADD & Transport	Dr Alka Bharat, Professor, Deptt. of Architecture & Planning, MANIT, Bhopal
Energy	Dr V K Sethi, Head, Dept. of Energy, RGPV, Bhopal Mr S K Bajpai , Retd. ED, MP Power Transmission Company Ltd., Jabalpur
Renewable Energy	Dr S P Singh, Prof and Head, Department of Energy, DAVV, Indore
Industries	Mr Pratap Verma, Member Secretary, MP FCCI
Rural Development	Shri P K Biswas, Professor, IIFM, Bhopal
Climate Projections & Trends	Dr. Ashwini Kulkarni, IITM Pune Ms Savita Patvardhan, IITM, Pune
Gender Mainstreaming	Ms Aditi Kapoor, Alternative Futures, New Delhi
Overall Review of Sectoral Issues & Strategies	Ms Sumana Bhattacharya, Independent Consultant, Climate Change

ANNEXURE - 4

Order Constituting Project Steering Committee

मध्यप्रदेश शासन
सामान्य प्रशासन विभाग
मंत्रालय
वल्लभ भवन,भोपाल 462004

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::आदेश::

भोपाल, दिनांक 13जनवरी, 2010

क्रमांक एफ–19–01/2010/1/4 म.प्र जलवायु परिवर्तन विषय पर कार्य करने के लिए राज्य शासन द्वारा आदेश क्रं. एफ–19–143/2007/1–4 दिनांक 13 नवंबर 2007 के माध्यम से एप्को को राज्य नोडल इकाई का दायित्व सौंपा गया है। जलवायु परिवर्तन विषय से संबंधित एप्को–यू.एन.डी.पी परियोजना के सफल संचालन हेतु राज्य शासन द्वारा Project Steering Committee (PSC) का गठन निम्नानुसार किया जाता है :–

1.	मुख्य सचिव	– अध्यक्ष
2.	अतिरिक्त मुख्य सचिव, किसान कल्याण एवं कृषि विकास	– सदस्य
3.	अतिरिक्त मुख्य सचिव, वन एवं जैव विविधता	– सदस्य
4.	प्रमुख सचिव, जल संसाधन	– सदस्य
5.	प्रमुख सचिव, किसान कल्याण एवं कृषि विकास	– सदस्य
6.	प्रमुख सचिव, ग्रामीण विकास	– सदस्य
7.	प्रमुख सचिव, नगरीय प्रशासन एवं विकास	– सदस्य
8.	प्रमुख सचिव, आवास एवं पर्यावरण	– सदस्य
9.	महानिदेशक, एप्को	– सदस्य
10.	सचिव, लोक स्वास्थ्य एवं परिवार कल्याण	– सदस्य
11.	सचिव,ऊर्जा	– सदस्य
12.	असिस्टेंट कंट्री डायरेक्टर, यू. एन. डी. पी, नई दिल्ली	– सदस्य
13.	कार्यपालन संचालक, (एप्को यू. एन. डी. पी परियोजना संचालक)	– सदस्य

समिति का उद्देश्य परियोजना में अंतर्विभागीय समन्वय स्थापित करना, नीतिगत मार्गदर्शन प्रदान करना एवं परियोजना की समीक्षा करना है। समिति की बैठक प्रत्येक 6 माह में एक बार होगी।

मध्यप्रदेश के राज्यपाल के नाम से तथा
आदेशानुसार
....Sd....

(आर. डी. साहू)
अपर सचिव
म.प्र. शासन, सामान्य प्रशासन विभाग

ANNEXURE - 5

Abbreviations of Indicators used for Vulnerability Assessment

No	Indicators	Abb	Conceptual Basis	Unit	Source	Base line Year
Socio-economic Indicator						
Social						
1	Density of Population	DP	Sensitive	Persons/Sq Km	Census of India	2011
2	Sex-ratio	SR	Sensitive	Number of females/1000 males	Census of India	2011
3	Literacy Rate	LR	Adaptive Capacity	Percentage	Census of India	2011
4	Proportion of Child Population In The Age Group 0-6	CP	Sensitive	Percentage	Census of India	2011
5	Proportion of elderly population aged 65 and above	ELPO	Sensitive	Percentage	Census of India	2001
6	Percentage of People Below Poverty Line	BPL	Sensitive	Percentage	State Planning Commission, Madhya Pradesh	2005
7	Percentage of Households With Access To Safe Drinking Water	DW	Adaptive Capacity	Percentage	Census of India	2001
8	Percentage of Households With Access To Sanitation Facilities	SF	Adaptive Capacity	Percentage	Census of India	2001
9	Percentage of Households With Access To Electricity	EL	Adaptive Capacity	Percentage	Planning Atlas, State Planning Board, GoMP	2007
10	Number of Slum Dwellers Per Slum	SD	Sensitive	Number of Persons	Madhya Pradesh HDR,2007	2004
11	Percentage of Households owning Radio ,Transistor, Television And Telephones	RTT	Adaptive Capacity	Percentage	Madhya Pradesh HDR,2007	2001
12	Percentage Share of Marginal Workers	MGW	Sensitive	Percentage	Census of India	2001
13	Road density	RL	Adaptive Capacity	km of road per 100 sq. km of land area	Madhya Pradesh HDR,2007	2003
14	Population served per Health Centre (Community, Primary and Sub Health Centres)	HC	Adaptive Capacity	Number of Persons	Madhya Pradesh HDR,2007	2006
15	Number of Primary ,Middle, High and Higher Secondary Educational Institutions Per Lakh of Population	EI	Adaptive Capacity	Number/Lakh of population	Madhya Pradesh HDR,2007	2006
16	Level of urbanization	UR	Adaptive Capacity	Percentage	Planning Atlas, State Planning Board, GoMP	2001
17	Percentage of Schedule Tribes population	ST	Sensitive	Percentage	Planning Atlas, State Planning Board, GoMP	2001
18	Percentage of Schedule Caste population	SC	Sensitive	Percentage	Planning Atlas, State Planning Board, GoMP	2001
Economic						

No	Indicators	Abb	Conceptual Basis	Unit	Source	Base line Year
19	Per Capita Income At Current Prices	PCI	Adaptive Capacity	Rupees	Economic Survey of MP, 2010-11	2001 - 2009
20	Net District Domestic Product At Current Prices	NDDP	Adaptive Capacity	In Lakh Rs	Economic Survey of MP, 2010-11	2001 - 2009
21	Scheduled commercial banks per lakh of population	CB	Adaptive Capacity	Number	Planning Atlas, State Planning Board, GoMP	2005 -06
22	Agricultural credit societies per lakh of population	ACS	Adaptive Capacity	Number	Planning Atlas, State Planning Board, GoMP	2005 -06
23	Loan disbursed by agricultural credit societies per cultivator	LACS	Adaptive Capacity	Rupees	Planning Atlas, State Planning Board, GoMP	2005 -06
Environmental						
Agriculture						
24	Percentage of Net Irrigated Area To Geographical Area By Ground Water	IAGW	Sensitive	Percentage	Commissioner of Land Records, Madhya Pradesh	2006 - 2007
25	Percentage of Net Irrigated Area To Geographical Area By Surface Water	IASW	Adaptive Capacity	Percentage	Commissioner of Land Records, Madhya Pradesh	2006 - 2007
26	Fertilizer Consumption	FC	Adaptive Capacity	Kg/ha	Directorate Farmer welfare & Agriculture Development	2006 - 2007
27	Yield of All Crops	YI	Adaptive Capacity	Kg/ha	Department of Agriculture, GoMP	2005 - 2008
28	Percentage of Land Holdings below 1 Hectare	LH	Sensitive	Percentage	Commissioner of Land Records, Madhya Pradesh	2001
29	Percentage Share of Agricultural And Cultivators Main Workers	ACMW	Sensitive	Percentage	Census of India	2001
30	Percentage of Bio-Farming villages in total villages	BFV	Adaptive Capacity	Percentage	Department of Agriculture, GoMP	2004
31	Electrified pump sets per thousand hectares of gross cropped area	ELP	Adaptive Capacity	Numbers	Planning Atlas, State Planning Board, GoMP	2005 - 2006
32	Crop diversity (number of crops grown)	CRD	Adaptive Capacity	Numbers	Department of Agriculture, GoMP	2006
33	Cropping intensity	CI	Adaptive Capacity	Times	Planning Atlas, State Planning Board, GoMP	2005 - 2006
34	Livestock Population	LP	Adaptive Capacity	Numbers per household	Administrative Reports of Department of Animal Husbandry, GoMP	18th census, 2007
35	Poultry Population	POP	Adaptive Capacity	Numbers per thousand household	Administrative Reports of Department of Animal Husbandry, GoMP	18th census, 2007
36	Milk production per capita	MP	Adaptive Capacity	gms/day	Administrative Reports of Department of Animal Husbandry, GoMP	2006 - 2009

No	Indicators	Abb	Conceptual Basis	Unit	Source	Base line Year
37	Egg Production per capita	EP	Adaptive Capacity	eggs per year	Administrative Reports of Department of Animal Husbandry, GoMP	2006 - 2009
Forest						
38	Percentage of High Density Forest area to geographical area	HDFA	Adaptive Capacity	Percentage	Forest Survey of India	2004
39	Percentage of Medium Density Forest area to geographical area	MDFA	Adaptive Capacity	Percentage	Forest Survey of India	2004
40	Percentage of Low Density Forest area to geographical area	LDFA	Adaptive Capacity	Percentage	Forest Survey of India	2004
41	Sites developed as ecotourism sites	ECT	Adaptive Capacity	Numbers	M.P. Eco-tourism Board	2011
42	Number of JFM Communities	JFM	Adaptive Capacity	Numbers	Forest Department, GoMP	2010
43	NTFP Diversity(no of varieties)	NTFP	Adaptive Capacity	Numbers	Forest Department, GoMP	2010
44	Percentage of wasteland to geographical area	WL	Sensitive	Percentage	Commissioner Land records , Madhya Pradesh	2004 - 2007
Water Resource						
45	Surface Water Availability	SW	Adaptive Capacity	mm	IIT Delhi, MoEF (NATCOM)	1961-1990
46	Ground Water Availability	GW	Adaptive Capacity	mm	IIT Delhi, MoEF (NATCOM)	1961-1990
47	Crop Water Stress (Evapo-transpiration/Potential Evapo-transpiration)	CWS	Sensitive	mm	IIT Delhi, MoEF (NATCOM)	1961-1990
Climate						
48	Cool nights- days when minimum temperature < 10th Percentile	CN	Exposure	Percentage	Analysis of PRECIS climate data (IITM, Pune)	1961-1990
49	Warm nights- days when minimum temperature > 90th Percentile	WN	Exposure	Percentage	Analysis of PRECIS climate data (IITM, Pune)	1961-1990
50	Cool Days - Cool nights- days when maximum temperature < 10th Percentile	CD	Exposure	Percentage	Analysis of PRECIS climate data (IITM, Pune)	1961-1990
51	Warm Days - Cool nights- days when maximum temperature > 90th Percentile	WD	Exposure	Percentage	Analysis of PRECIS climate data (IITM, Pune)	1961-1990
52	Frost Days (Annual count when TN(daily minimum)<0°C)	FD	Exposure	Number of Days	Analysis of PRECIS climate data (IITM, Pune)	1961-1990
53	Warm Spell Duration Indicator (Annual count of days with at least 6 consecutive days when maximum temperature>90th percentile)	WSDI	Exposure	Number of Days	Analysis of PRECIS climate data (IITM, Pune)	1961-1990
54	Average annual rainfall	RF	Exposure	mm	Analysis of PRECIS climate data (IITM, Pune)	1961-1990

No	Indicators	Abb	Conceptual Basis	Unit	Source	Base line Year
55	No. of Rainy Days	RD	Exposure	Number of Days	Analysis of PRECIS climate data (IITM, Pune)	1961-1990
56	Extremely Wet Days-Annual total rainfall when rainfall>99th percentile	EWD	Exposure	mm	Analysis of PRECIS climate data (IITM, Pune)	1961-1990
57	Consecutive Dry Days-maximum number of Consecutive Days With Rainfall Less Than 1 mm	CDD	Exposure	Number of Days	Analysis of PRECIS climate data (IITM, Pune)	1961-1990
58	Frequency of Drought	DR	Exposure	Number of weeks	IIT Delhi, MoEF (NATCOM)	1961-1990
59	Flood discharge	FL	Exposure	cumecs	IIT Delhi, MoEF (NATCOM)	1961-1990
Health						
60	Percentage of People Having Diarrhoea	DH	Sensitive	Percentage	Department of Health & Family Welfare, Government of Madhya Pradesh	2006
61	Index of Malaria	MA	Sensitive	Number of reported cases/Population	http://www.nvbdcp.gov.in/images/MadhyaPrd.jpg	2010

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