

MADHYA PRADESH STATE ACTION PLAN ON CLIMATE CHANGE

Integrating Concerns- Converging Possibilities



September -2011



Housing and Environment Department
Government of Madhya Pradesh

Climate Change Cell

Environmental Planning and Coordination Organization

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Caveat

“Talent alone cannot make a writer, there must be people behind the book.”

In an effort to draft the Madhya Pradesh State Action Plan on Climate Change (MPSAPCC) we adopted a process of research that relies heavily on dialogues and discussion with variety of stakeholder including professionals, departmental officers, individuals, group of experts specialists and NGO's.

Most of the insights and ideas were originated and further refined, validated and debated in these intellectual discourses. The concerns and issues presented in this draft MP SAPCC are outcome of these dialogue process.

It is worth mentioning here that one more round of iteration remains to be completed. Draft SAPCC is being sent to the respective departments for their comments/ suggestions / improvement at the same time subject experts are being approached for review. Having received the comments the draft SAPCC will than be edited and refined.

In the process of developing draft SAPCC we have not done any GHG inventorization as also no Regional Climate Models were run specifically for Madhya Pradesh. The information given in the document is based on secondary data collected from various sources.

It is by and large a departmental in- house effort with wide scale stakeholder consultations at sectoral level in Bhopal and at ACZ level in 13 district headquarters.

We welcome your constructive suggestions at mpsapcc@epco.in by 30th September 2011.

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

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MP SAPCC is in draft mode hence readers are requested that the contents/ information presented in this document should not be quoted and or used as reference till it is finalized.

Acknowledgement and Disclaimer

While compiling the data for preparing this document and in an attempt to analyze it to facilitate its presentation in the framework suggested by MoEF, the Housing and Environment Department, Government of MP and MP Climate Change Cell, EPCO have drawn upon large number of documents from various sources which are greatly acknowledged. While every care has been taken to ensure accuracy in the information published in the document any error in their accuracy is absolutely unintentional.

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 with possible adverse impacts on food security, natural resources, human health and economic activities.

The state has reason to be concerned about climate change, as we have a large population dependent on agriculture and forestry 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 to respond effectively to the possible impacts of climate change.

The State Action Plan on Climate Change prepared by the Climate Change Cell of EPCO, under the Housing & Environment Department has flagged important issues which require immediate 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 Department of Housing & Environment would continue to strive to mainstream climate change concerns across all the sectors for achieving the objective of sustainable development.

Principal Secretary

Housing and Environment Department
Government of Madhya Pradesh

Executive Summary

1. Background

Significant changes in physical and biological systems across the globe in response to warming of the climate have been conclusively ascertained (IPCC, 2007, AR4-WKG-II). Sustainable development, food and economic security of all countries dependent on the natural resources are at threat; most vulnerable are the regions, countries and communities with minimal access to financial and technological resources to combat the adverse impacts of climate change.

Climate Change in India presents an additional stress on ecological and socio-economic systems which are already under tremendous pressures due to various factors like increasing population, rapid urbanization, industrialization and economic activities. India, naturally, becomes more vulnerable to climate change for its natural resources based economy.

India's concerns about climate change impacts on its resources and sustainable development has lead to the formulation of its National Action Plan on Climate Change (NAPCC, 2008). The National Action Plan outlines eight missions which are envisaged to mitigate climate change and undertake adaptation actions without compromising on its economic growth and sustainable development goals.

Implementation of necessary adaptation actions to abate the adverse impacts of climate change, essentially, needs to be carried out by the different states of the Indian union in response to their respective sensitivity and vulnerability to climate change. These adaptation actions can be in line with the national missions within the NAPCC and can also include additional measures. Further, towards contributing to the global responsibility to mitigate climate change, India has conveyed to the UNFCCC, that it will be able to reduce its Carbon emission intensity by 20-25% by 2020. Mitigation actions by the states can be taken up in line with the policy on energy efficiency in the NAPCC and the policies that relate to enhancing renewable energy mix for generating power.

2. The Madhya Pradesh Context

Madhya Pradesh with 50 districts lying at the centre of India has a population of 72.6 millions, as of 2011. With predominant agrarian economy, forested areas and large tribal belts, Madhya Pradesh becomes more vulnerable to climate change.

75% of the total population of the state is rural and is mainly engaged in climate sensitive activities, namely agriculture and forest dependent livelihoods. The incidence of poverty in the state is among the highest in the country, with people living below the poverty line increasing from 44.6% in 1993-94 to 48.6% in 2004-05. This is more so in rural than in urban areas (53.6% in rural areas as against 35.1% for urban areas in 2004-05).

Practices such as bringing more and more areas under cash crops like soya bean, following mono cropping in Kharif and Rabi seasons, over exploitation of underground water for irrigation are making agriculture vulnerable. Also low quality of soils, poor moisture retention capacities of soils,

high degradation of forests etc are making livelihoods dependent on agriculture and forests further vulnerable.

3. Climate Risks for Madhya Pradesh

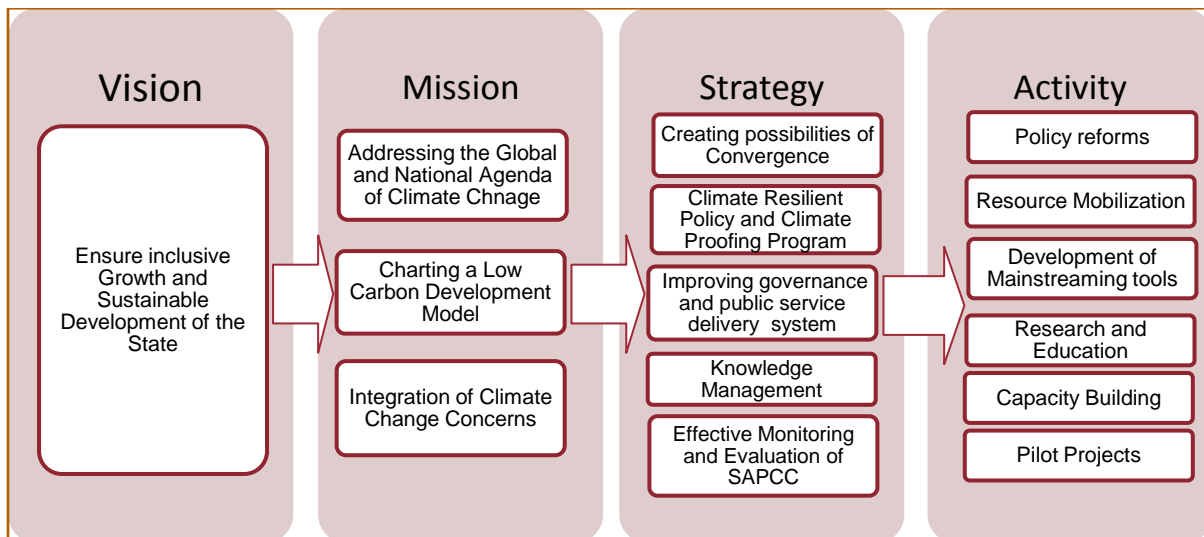
Warming of the climate, increase in intensity and frequency of precipitation, delay in onset of monsoon and projected changes in climate are likely to make the climate sensitive sectors and livelihoods dependent on them more vulnerable in the future. Climate change is not only likely to affect the natural resources such as water, agriculture and forests, but also would impact human health, and growth of habitats in future. Thus climate change has the capacity to impact sustainable development of the state.

Projected climate risks for MP

- Increase in maximum and minimum temperatures
- Increase in frequency and intensity of heavy precipitation events
- Change in onset of monsoon
- Increase in number of rainy days
- Increase in number of hot days

4. Vision, Mission, Strategy and Actions to address Climate Change in MP

In order to enhance the adaptive capacities of its population to climate change and ensure sustainable development with inclusive growth, the Government of Madhya Pradesh has drafted its State Action Plan on Climate Change (SAPCC), in which it envisages to factor in climate change concerns in its developmental planning and chartering a path of low carbon development. The State aims to develop climate resilient policies, develop knowledge management mechanism for informed decision making and undertake effective monitoring and evaluation to identify entry points for climate proof actions and also to identify the lacunae in actions. Thrust is also on to identify steps to improve governance and public service delivery mechanisms. This in turn would mean undertaking policy reforms, resource mobilisation, developing mainstreaming tools, undertake research, build capacity and undertake pilot projects to test innovative strategies prescribed for adaptation or mitigation. The vision, mission, strategy and actions are captured in brief in the diagram below.



5. Process of Preparation of the MPSAPCC

The MP SAPCC has been prepared under the aegis of Department of Housing & Environment, GoMP by the MP Climate Change Cell with the financial support from UNDP India. Specific to the project, the institutional set up comprises of a Project Steering Committee (PSC), under the chairmanship of the Chief Secretary, Government of Madhya Pradesh, a Project Implementation Committee (PIC) under the Principal Secretary, Housing and Environment Department and a Project Management Unit. The Executive Director, EPCO has been designated as the State Project Director (SPD) for the project. The SPD is supported by State Coordinator, Climate Change Cell (MPCCC) for technical assistance.

The MPCCC has prepared the SAPCC, through a participatory stakeholder's consultation process, involving concerned government departments and their officials, scientists and academia from research and educational institutes, civil society representatives including those from NGOs and general public. 26 consultations were carried out in 11 agro-climatic zones, to get a feed back on the issues and concerns of these regions vis a vis climate change, as the climate and climate dependent activities in these zones have distinctively unique characteristics requiring formulation of agro-climatic zone specific policies to address climate change impacts. The sectors that have been reviewed for integrating climate change concerns in their respective planning, for identifying adaptation or mitigation strategies include Agriculture, Horticulture, Animal husbandry, Fisheries, Water, Forest and Biodiversity, Rural Development, Energy, Renewable Energy, Health, Urban Habitat and Transport; Industries and Environment.

Project Steering Committee

- Chief Secretary – Chairman
- ACS Ag.& Farmer Welfare (APC) - Member
- ACS Forests - Member
- PS Agriculture - Member
- PS Rural Development - Member
- PS Housing and Environment - Member
- PS Water Resources - Member
- PS Urban Administration - Member
- PS Health - Member
- Director General, EPCO - Member
- Secretary Energy - Member
- Assistant Country Director, UNDP- Member
- Executive Director, EPCO- Member Convener

The concerns reflected in the SAPCC have been taken as the basis for identifying the adaptation and mitigation strategies for various sectors.

6. Cross cutting issues

While designing the adaptation as well as mitigation strategies, it has been very clear that there are cross cutting approaches. The natural resources, obviously, require efficient management practices to have a sustainable source even in the changing climate scenario. For this, one needs to build institutional capacities; plan processes for implementation of climate resilient interventions; raise awareness, establishing monitoring and evaluation systems; promoting technology resilient to climate change strategies; establishment of weather based early warning systems; empowering people with knowledge of technologies, financial instruments to implement adaptation and mitigation strategies; and improving infrastructure are some of the common activities that run

through this action plan. The following section identifies the key challenges and adaptation/mitigation strategies for each of the developmental sectors reviewed.

7. Key Climate Change Challenges and Strategies

Despite the wealth of its resources and tremendous potential, Madhya Pradesh faces a number of challenges, in reconciling the imperatives of environment and development. Some districts in MP, have been identified as being the most vulnerable in India to the twin challenges of climate change and economic globalization (TERI, 2004). Declining productivity in agriculture is one major cause for this, 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 has been a major constraint for achieving targeted levels of production in recent times. With climate change, this could be expected to increase in the future. Population explosion and developmental needs has caused rapid degradation of its forests, which in turn leads 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 can get aggravated with the stress imposed by climate change. With Madhya Pradesh getting urbanized at fifth highest rate in the country (State Annual Plan, 2011-12), there is need for the growth of the urban centres in a sustainable manner. The state also suffers from energy shortage, which it needs to address for the development of the agricultural and industrial sector and to provide electricity to all. Key climate change concerns identified during the consultations are summarised below.

Forests: Pressure on forest for fuel wood; unsustainable harvesting methods; observed changes in biodiversity type and phenology of plants; increase in forest fires; illegal felling; increase in forest degradation and consequent decrease in forest productivity was raised. Participant in general felt that destructive developmental activities have resulted in huge deterioration of forest whereas there is ample scope for compensatory afforestation. It was informed that incidences of man-wild conflicts have increased while wildlife numbers have also decreased. Participant wanted efficient regulation to check forest lands being converted into farm lands illegally.

Key strategies- Forests

- Develop forest management plans for different forest types to factor in climate change
- Enhancing the levels of forest conservation and afforestation, reforestation through viable PPP models
- Prioritize soil and water conservation measures in forest management to reduce soil erosion and help water recharge in river heads in forests
- Promote Research to understand the impacts of climate change on forest vegetation, forest products and associated livelihoods
- Introduce alternate source of energy for dwellers in and around forests
- Protect livelihoods dependent on forest products
- Prevent forest fires due to increase in temperatures across the years:
- Create corridors for species migration.
- Build personnel and enhance institutional capacities for implementation of climate change action plan

Water: Decrease in monsoon rain fall; Shifting in onset of monsoon; Shifting in spatial pattern of monsoon rain fall, Number of rainy days have decreased and increasing intensity of rainfall during a short period of time has been observed. Extreme weather conditions like drought in Bundelkhand while excess rainfall in other parts of the state is becoming a common phenomenon. Over exploitation of ground water with low capacity of soil for natural recharge; Deterioration and depletion of water resources and minimal conservation and restoration of traditional water bodies; Perennial streams/ rivers have become seasonal; , Unplanned infrastructure has broken the natural flow between various streams which used to provide water to each other.

Key Strategies- Water

- A comprehensive water data base in public domain
- A better understanding of impacts of climate change on water resources in MP
- Accelerated pace of surface water development in the state
- Recharge of ground water with special focus on over exploited areas
- Soil conservation to avoid soil run off, soil degradation and enhance water conservation:
- Improved supply and demand management for efficient and judicious use and need based distribution:
- Basin level integrated water shed management:
- Promotion of additional research on impacts of climate change on water flows and storage, water quality, due assessment of resource availability and demand, water purification technologies, Geo-hydrological mapping etc.
- Capacity building- institutional and professional to integrate climate change concerns in

Agriculture and Horticulture: Over 2/3rd of the population living in Madhya Pradesh are engaged in agricultural and allied activities covering agriculture, horticulture, fisheries, animal husbandry and dairy development. This sector contributes about 30% to the state GDP and the per capita staple food production is amongst the highest in India at 26.62 kg next only to Punjab and Haryana. However, a sizable population engaged in this sector lives below poverty line, which is a matter of concern and a challenge for the state, as even in the near future agriculture is likely to remain the mainstay of livelihood in Madhya Pradesh.

Frost, excess rain, high temperatures have resulted in huge losses in productivity; shifting rainfall pattern has increased dependence on ground water and affected sowing time of many crops; Mono-

Key strategies- Agriculture and Horticulture

- Promoting Soil and Water Conservation technologies
- Promote dry land agriculture and horticulture
- Plan 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
- Impetus to climate change relevant research and development
- Enhanced support from agriculture extension
- Capacity building including Institutional capacity building

cropping dominates the agriculture; Excess cropping of soybean has affected soil and agrobiodiversity; Rapid conversion of Agricultural land into residential, industrial complexes and highway constructions.

Animal Husbandry: Productivity of animals is being affected due to heat stress; New diseases and change in pattern of existing diseases observed; Large number of animals are unproductive and are a competition for resources; Exotic species are less resistant to climatic changes; Lack of sanitation,

Key strategies- Animal Husbandry

- Ensure availability of adequate feed, fodder and water for livestock in drought and flood conditions
- Ensuring nutrient solvency
- Enhance capacity for disease surveillance, forecast, monitoring and management
- Ensure adequate housing and dedicated water bodies for livestock to overcome heat stress:
- Promote research on native species breeding and rearing
- Promote rearing of indigenous species that are adapted to local climate conditions
- Promote use of livestock waste for use as organic manure
- Integrate livestock water requirements in water shed management programmes
- Create infrastructure for processing, storage and transport of livestock products:
- Capacity building of farmers to embrace best practices in livestock rearing
- Improve extension arm of the animal husbandry department
- Building Institutional mechanism for implementing Climate Change Action Plan

improper utilization & storage of dung, lack of balance diet for livestock, fodder and pasture land are the main concern for livestock rearing.

Human Health: The changing climate pattern has both direct and indirect impact on human health. For example extreme temperatures can directly lead to heat stress and loss-of-life and climate-related disturbances in ecological systems such as changes in the range of infective parasites can directly lead to incidences of vector borne diseases (VBDs). Similarly floods can lead to extensive occurrence of water borne diseases. Increasing air and water pollution due to warmer temperatures lead to a gamut of other health issues. Research on health impacts of climate change in India is at an early stage (a limitation) and much more work is needed to develop climate-health impact models.

Increase in incidences of vector borne diseases such as malaria, dengue, chickengunya; increase in percentage of *Pf* (*P-Falciparum* vector) related malaria; increase in incidences of water borne diseases; low disease surveillance; lack of early detection of disease in tribal and remote areas; lack of early weather warning for forecasting; weak disaster management strategies for disease breaks outs are some of the concerns of this sector.

Key Strategies- Human Health

- Develop diseases profile of communities and identify the foci of climate related health vulnerabilities
- Develop weather based Early Warning System
- Upscale Disaster preparedness to abate outbreak of disease
- Upscale Early case detection and quick control- with a focus on areas where coverage is low or has not reached
- Introduce tele-medical advisory services for remote and tribal areas
- Strengthening supportive systems for Environment management
- Monitoring and reporting mechanism to ensure accountability and to optimize inputs and outputs
- Capacity Building of health delivery personnel and institutions

Urban Development and Transport: Issues like lack of proper sanitation and drainage system, open dumping, inadequate drinking water supply, solid waste management are major urban environmental issues which are likely to get exacerbated with climate change. It was observed that poor infrastructure of public transport is leading to increase in carbon emissions. Concerns were raised on the rapid loss of greenery in cities and highlighted the need for judicious use of open spaces and parks in urban areas.

Key strategies - Urban Development and Transport

- Increasing Energy Efficiency in buildings
- Efficiency of appliances used in Residential and commercial sector
- Improve coverage of water supply
- Mandate water audits and promote reuse and recycling of water
- Improve and augment urban storm water management
- Improve solid waste management system
- Promote treatment and use of domestic waste water
- Increase tree cover to get respite from urban heat island effects
- Institute studies to develop climate smart cities in MP
- Capacity building – institutional- for integrating CC concerns in planning
- Developing norms for taxation, clearance congestion, parking, use of public transport, pedestrians, cyclists etc
- Develop integrated rapid transport systems
- Promote and incentivise use of non-motorised vehicles
- Institutional capacity building for developing policies for integrating climate change in planning

Energy: Poor plant load factors in coal field power plants due to old technology and poor quality of coal, fund constraints and economic viability to upgrade these old plants and reduction of T&D losses are some of the prime concerns of the power sector. Poor quality and inefficient pumps used in agriculture and water supply need to be replaced. Effective measures should be taken to strengthen demand side management. Possibilities of T & D losses and possibilities of CDM ability should be explored.

Renewable Energy: The participants were of the view that high production cost of renewable energy and low set of Renewable Purchase Obligation (RPO) could be the reason for discouraging investors and users. Promote the use of non conventional sources like wind energy, solar energy and off-Grid power energy. More research should be done to increase the efficiency of processes using agriculture waste as source; Lack of policies towards investor incentivisation policies etc.

Key strategies- Energy and Renewable energy

- Enhance efficiency in generation of power- Exploration of and feasibility assessment of new technologies using conventional fuel
- Structure green tariff for incentivising the production of clean energy
- Undertake DSM to improve transmission and distribution efficiency and reduce GHG emissions
- De-incentivise use of pumps in agriculture
- Promote efficient street lighting and public spaces
- Promote BBE's ECBC code adoption and *Bachat Lamp Yojana*
- Energy audits for buildings of specific sizes and above
- Market transformation for energy efficiency

Industries: Industry in Madhya Pradesh is largely related to mining of natural resources. The state has abundant natural resources like limestone, coal, bauxite, iron ore, silica etc. The other major industries in state are of textile, cement, steel, soya processing and optical fibre. 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, National Fertilizer Ltd, 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 being given on development of agri food processing and herbal processing.

It was observed that obsolete and inefficient technologies increases fuel consumption; Leakages from septic tanks, release of untreated waste water to nearby water streams are some of the issues identified as impediments for climate friendly growth in this sector.

Key strategies for Industries

- Implementation of Perform , achieve and Trade (PAT) scheme for industries in the state that fall within the chosen 9 industries within this scheme
- Capacity building – Relevant department to implement the PAT scheme in the state
- Assessment of feasibility of implementation of new energy efficiency technologies for different industries

Panchayat and Rural Development: Rural Development is by and large a cross cutting issue and most of the strategies and action are being covered in the respective sectors. However, Rural Development sector provides the opportunity to propel the agenda of convergence and integration of climate change concerns in rural area of Madhya Pradesh. Going by the Census 2011, Madhya Pradesh is home to 5.99% (7.25 crores) of India’s total population of 121.01 crores.

Convergence of RD programmes to address the issue of climate Change in MP; Large scale distress migration is one of the biggest challenges in successful implementation of rural development programmes; rural architecture inadequate to bear the warming; inadequate sources of drinking water; lack of sanitation; receding ground water level mainly in western part of the state which is already overexploited; degraded forest areas should be developed as sacred groves by community participation. Practice of constructing bunding, contour trenching needs to be encouraged in forest area to increase water retention in the soil.

Key strategies- Rural development

- Review of existing rural development programmes with Climate Change focus to check climate resilience if any and to introduce intervention in the policy to integrate the same
- Gearing rural programmes towards development of skills for livelihood diversification
- Identify and promote measures for energy and water use efficiency for inclusion in annual Panchyat Plans
- Ensure credit availability for rural infrastructure for ensuring water security, energy security, protecting soil health etc.
- Explore financial instruments for rural population to enable them from to adapt to the impacts of climate change
- Create climate change cell within the rural development department
- Establish monitoring and evaluation norms for integrating actions conducive adaptation in various programmes of the department

Environment: As climate change advances, it is imperative that the environment is likely to be governed by the imperatives of climate change and its impacts on natural and human systems. The state Government has established a Climate Change Cell in its agency, Environmental Planning & Coordination Organization (EPCO), which is under the Department of Housing & Environment, this cell therefore needs to gear up its activities towards integrating CC concerns in state planning in consultation with all relevant departments. As a part of the Cell's activities, a number of technical studies and plan preparations are being initiated. Some of the strategies for doing the same are outlined below

Key Strategies- Environment

- Establishing a Knowledge Management Centre (KMC) on Climate Change
- Development of state of the art evaluation tools to provide policy makers with choice of strategies to be implemented – e.g Sectoral GHG inventorization and generation of Marginal Abatement Cost Curves (MACC) for each sector
- Assessing vulnerability of the state in context of Climate change
- Assessing various developmental programmes to understand their climate resilient quotient and suggests measures to make them climate proof
- Capacity building of Policy makers, officials, media, NGOs on CC issues by experts
- Assisting departments in Mainstream of Climate Change concern:
- Commissioning of Baseline studies for each sector to evolve appropriate sectoral criteria/ indicators for Monitoring and Evaluation

8. Monitoring and Evaluation

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 has to be participatory process. The MP Climate Change Cell located in 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) and 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. The departments would assess the climate policy goals in terms of strategies laid out for each sector to climate proof the said sector.

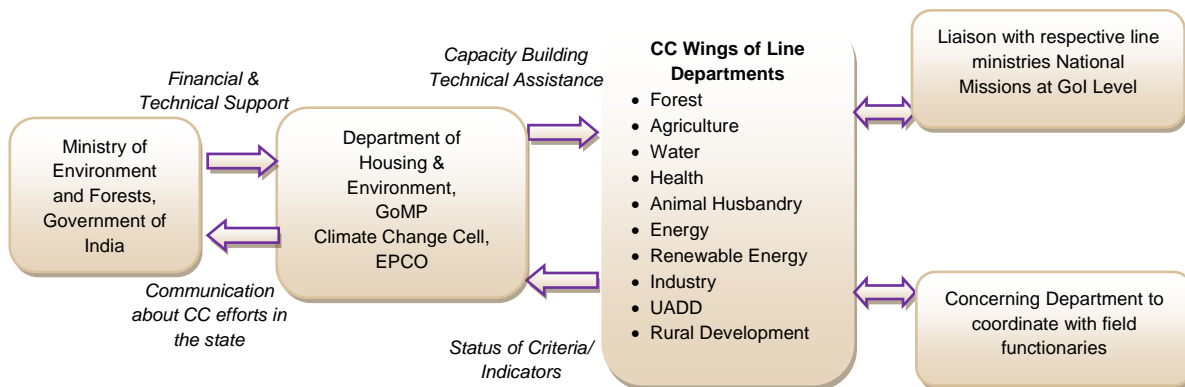


Table of Contents

Abbreviations and Acronyms..... v

List of Figures ix

List of Tables..... ix

1 Introduction 1

 1.1 Background 1

 1.2 Guiding Principles 2

 1.3 State Profile..... 2

 1.4 The Geographical Profile..... 3

 1.5 Topography 3

 1.6 Socio-Economic Profile 3

2 Process for Preparation of MPSAPCC 6

 2.1 Background 6

 2.2 Process 6

 2.3 Summary of Stakeholder Consultations 7

 2.3.1 SAPCC Launch workshop..... 8

 2.3.2 Networking Workshop..... 8

 2.3.3 Sectoral stakeholder Consultations 8

 2.3.4 Agro Climatic Zone Stakeholder Consultations..... 8

 2.3.5 Excerpts of outcomes of Stakeholder Consultations 9

3 Observed Climate Trends and Projected Climate Change 13

 3.1 Observed Climate..... 13

 3.2 Climate Projections 17

4 Vulnerability Assessment..... 20

 4.1 Background 20

 4.2 Vulnerability in context of MP 20

5 Climate Change, Environmentand Development Issues of the State 23

 5.1 Background 23

5.2	Challenges	23
5.3	Policy Framework.....	24
6	Sectoral Issues.....	25
6.1	Forests and Biodiversity.....	25
6.1.1	Background	25
6.1.2	Forests products and livelihoods	26
6.1.3	Policies and Programmes to manage forests.....	26
6.1.4	Key Concerns of Forest Sector	26
6.1.5	Strategies to address concerns of climate change	27
6.2	Water	29
6.2.1	Background	29
6.2.2	Status of water availability in the state	30
6.2.3	Water Supply scenario in the state.....	31
6.2.4	Water for irrigation.....	31
6.2.5	Water policies and programmes.....	31
6.2.6	Current Concerns in water sector	32
6.2.7	Key Concerns in water sector.....	33
6.2.8	Strategies to address concerns of climate change in water sector	33
6.3	Agriculture and Allied Services	36
6.3.1	Background	36
6.3.2	Agricultural Crops.....	37
6.3.3	Horticulture.....	43
6.3.4	Livestock and Livestock Products.....	46
6.3.5	Fisheries	51
6.4	Human Health	53
6.4.1	Background	53
6.4.2	Climate related disease prevalence in MP.....	53
6.4.3	Key Concernsof Health Sector.....	56
6.4.4	Strategies to address Climate change concerns in Health Sector	57
6.5	Urban Development.....	59
6.5.1	Background	59

6.5.2	Key Concerns of Urban Development Sector.....	60
6.5.3	Strategies to address concern due to climate change in Urban Development	61
6.6	Transportation	62
6.6.1	Introduction	62
6.6.2	Urban Transport and Climate Change.....	62
6.6.3	Key concerns of Urban Transport Sector	63
6.6.4	Strategies to address concerns due to climate change in Transport Sector	64
6.7	Energy	65
6.7.1	Background	65
6.7.2	Policies and programmes to ensure energy demand in the future	66
6.7.3	Key concerns for EnergySector	67
6.7.4	Strategies to address concerns due to climate change in Energy Sector	67
6.8	Renewable Energy.....	69
6.8.1	Background	69
6.8.2	Current Policy Initiatives	69
6.8.3	Strategies to address climate change issues in Renewable Energy Sector.....	71
6.9	Industry	72
6.9.1	Background	72
6.9.2	Current policies, programmes, and initiatives.....	72
6.9.3	Key Concerns for Industries	73
6.9.4	Strategies to address climate change concerns in Industry Sector	73
6.10	Rural Development	74
6.10.1	Background	74
6.10.2	Key Concerns.....	74
6.10.3	Strategies to address Climate Change concerns in RD Sector	75
6.11	Housing and Environment.....	76
6.11.1	Background	76
6.11.2	Environment.....	76
6.11.3	Strategies to address the Climate Change concerns in Environment Sector.....	76
6.12	Cross-cutting Issues.....	78
6.12.1	Background	78

7 Strategies 80

7.1 Forests and Biodiversity..... 80

7.2 Water 83

7.3 Agriculture 87

7.4 Horticulture..... 91

7.5 Animal Husbandry..... 94

7.6 Fisheries 97

7.7 Health..... 99

7.8 Urban Development..... 102

7.9 Energy 107

7.10 New and Renewable Energy 109

7.11 Industry 111

7.12 Rural Development 114

7.13 Environment..... 116

7.14 118

8 Monitoring and Evaluation 119

8.1 Background 119

8.2 M&E at development objective level..... 119

8.3 M&E at sectoral level 119

8.4 M&E at project level: 119

Abbreviations and Acronyms

APC	Agriculture Production Commissioner
ACS	Additional Chief Secretary
ACZ	Agro-Climatic Zones
AI	Artificial Insemination
ASHA	Accredited Social Health Activist
BDB	Bio-Diversity 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
CFL	Compact Fluorescent Lamp
CHCs	Community Health Centers
CNG	Compressed Natural Gas
CS	Chief Secretary
DECC	Department of Energy and Climate Change
DMIC	Delhi Mumbai Industrial Corridor
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
DPC	District Planning Committee
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 Regulation Act
GHG	Green House Gas
GIM	Green India Mission
GIS	Geographic Information System
Gol	Government of India
GoMP	Government of Madhya Pradesh
GW	Groundwater
HEPs	Hydro Electric Power
HoDs	Head of the Departments
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
JFMCs	Joint Forest Management Committees
JNNURM	Jawaharlal Nehru National Urban Renewal Mission
KMC	Knowledge Management Center
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
MPCCC	Madhya Pradesh Climate Change Cell
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

MPSMFPP	Madhya Pradesh State Minor Forest Produce Federation
MPUVN	Madhya Pradesh Urja Vikas Nigam
MRTS	Mass Rapid Transport System
MSW	Municipal Solid Waste
MuDSM	Municipal Demand Side Management
NAPCC	National Action Plan on Climate Change
NATCOM	National Communication
NGOs	Non-Governmental Organisations
NMEEE	National Mission on Enhanced Energy Efficiency
NMSA	National Mission on Sustainable Agriculture
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
PGCIL	Power Grid Corporation of India Ltd
PHCs	Primary Health Centers
PHED	Public Health Engineering Department
PIC	Project Implementation Committee
PIM	Participatory Irrigation Management
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 Yojna
RD	Panchayat and Rural Development Department
RE	Renewable Energy
REDD	Reduced Emission from Degradation and Deforestation
RGGVY	Rajiv Gandhi Grameen Vidyutikaran Yojana
RP	
RPO	Renewable Purchase Obligation
S & T	Science and Technology
SGDP	State Gross Domestic Product

SHCs	Sub-health Centers
SPD	State Project Director
SWAT	Soil and Water Assessment Tool
T&D	Transmission and Distribution
TERI	The Energy and Resources Institute
TFR	Total Fertility Rate
THI	Temperature Humidity Index
TOF	Trees Outside Forests
TWs	Transmission Windows
UADD	Urban Administration and Development Department
UIDSSMT	Urban Infrastructure Development Scheme for Small and Medium Towns
ULBs	Urban Local Bodies
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
VERs	Voluntary Emission Reductions
WEG	Wind Energy Generation
WRD	Water Resources Department
WSRP	Water Sector Restructuring Project
WTE	Waste to Energy

List of Figures

Fig. 1.1.1 Trends in monsoon between 1901- 2009 (Source: Climate Profile of India, IMD, 2010)	1
Fig. 1.3.1 Districts of Madhya Pradesh	2
Fig. 1.6.1 Population below poverty line (Source: Planning Atlas, State Planning Commission, GoMP) ..	5
Fig. 2.1.1 Members of Project Steering Committee	6
Fig. 6.2.1 Watershed/river basin map of Madhya Pradesh.....	29
Fig. 6.4.1 (a) Malaria Incidence Trends in MP, (b) Pf% trends in MP and malaria Hotspots. Source: NVBDP (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 <i>Int J Health Geogr.</i> 2009 May 2009...	53
Fig. 6.4.2 Shift in foci of Chikangunya in India.....	54
Fig. 6.4.3 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	56
Fig. 6.4.4 Transmission windows of malaria P-falciparum in the (a) current climate and in (b) in 2050s..	57
Fig. 6.5.1 Projection for Slum Population MP till 2017 (Source - India Stats)	59
Fig. 6.5.2 Population Projection for MP till 2025 Source: IndiaStats	59
Fig. 6.6.1 Vehicular Growth in Madhya Pradesh from 1997-2007 Source: India Statistics (http://www.indiastat.com/table/transport/30/registeredvehicles/16443/421859/data.aspx)	62
Fig. 6.8.1 RPO Comparison between Solar and Non Solar.....	69
Fig. 8.4.1 Flow Diagram of Monitoring and Evaluation of SAPCC.....	120

List of Tables

Table 1.6.1 Socio Economic Profile of Madhya Pradesh vis a vis India	4
Table 3.1.1 List of districts in each ACZ	15
Table 3.2.1 Projected changes in climate between 2021-2050 and 2071 and 2100.....	19
Table 4.2.1 Indicators identified for assessing vulnerability.....	21
Table 4.2.2 Vulnerability of the various agro-climatic zones.....	21
Table 6.2.0.1 Trends of irrigation in MP in '000 ha (Source: Department of Agriculture, GOMP).....	31
Table 6.3.1 ACZ wise Horticulture Crops distribution	44
Table 6.3.2 Indigenous livestock breeds of MP	46
Table 6.3.3 Prevalent disease of Livestocks in MP	47
Table 6.3.4 Management of water bodies in MP	51
Table 6.4.1 Trends of dengue cases and deaths in MP ource: national Vector Borne Disease Control in Madhya Pradesh	54
Table 6.8.1 Potential of energy mix for the state	69
Table 6.8.2 The current projects in pipeline and the the avoided emission.....	69
Table 6.12.1 Adaptation Strategies.....	78

1 Introduction

1.1 Background

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 livelihoods dependent on agriculture, and food security of the country vulnerable to the vagaries of climate. Other sectors dependent on climate, such as forests, human health and habitats are equally vulnerable. In addition, an unequal social and economic development across the state has resulted in differential coping capacities across their population. The changing climate and future climate change is likely to exacerbate the vulnerabilities further unless action is taken now to adapt to the same¹.

India's concerns about the adverse impacts of climate change have been addressed in its National Action Plan on Climate Change in June 2008 (NAPCC, 2008). The Action Plan outlined eight missions that are envisaged to mitigate climate change and undertake adaptation actions without compromising on economic growth required to meet the developmental aspirations of its population. The eight different "National Missions" formulated within the National Action Plan include:

- **National Solar Mission** that aims to promote development and use of solar energy for power generation with the ultimate objective of making solar energy competitive with fossil-based options
- **National Mission for Enhanced Energy Efficiency** in industries
- **National Mission on Sustainable Habitat** to promote energy efficiency, water conservation and waste management as core components of urban planning
- **National Water Mission** to improve water use efficiency by 20% with respect to the current scenario

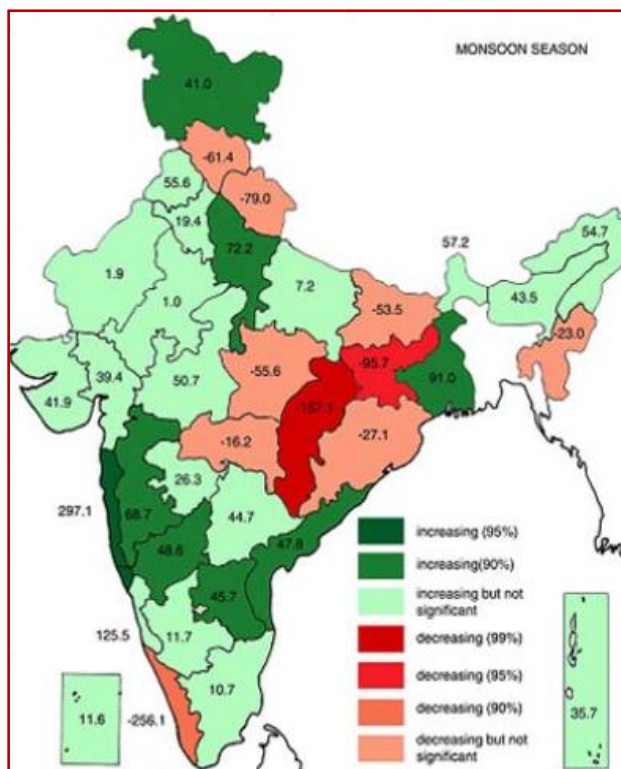


Fig.1.1.1 Trends in monsoon between 1901-2009 (Source: Climate Profile of India, IMD, 2010)

¹The 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).

- **National Mission for Sustaining the Himalayan Ecosystem** for conserving biodiversity, forest cover, and the glaciers that are a major source of India’s water supply
- **National Mission for a “Green India”** for afforesting 6 million hectares of degraded forest lands thereby enabling an expansion of forest cover from 23% to 33% of India’s territory
- **National Mission for Sustainable Agriculture** that supports climate adaptation in agriculture and lastly
- **National Mission on Strategic Knowledge for Climate Change** for a better understanding of climate science impacts and challenges.

1.2 Guiding Principles

In order to implement the action plan successfully, integrating the missions in the planning process at the central and state level is essential. Further, pathways for implementation at state level are likely to be vastly different in different states as the climate and socio economic circumstances within which each of them is developing is different and vary across space, time and population. Increasingly it is being realised that the climate change concerns need to be factored in planning, in order to have a continuous sustained economic development of the state as is perceived now by the state and for enhancing the adaptive capacity of its population. Keeping these concerns in view, the MP State Action Plan for Climate Change (MPSAPCC) therefore envisages to:

- Identify key climate issues and likely risks, assess institutional and planning capacities to manage these risks and vulnerabilities and suggesting corrective adaptive action by identifying key policy and planning gaps at the state level
- Assess and recommend specific measures to strengthen the policy and action framework, for supporting the process of adaptation and mitigation in the face of climate change.
- Identify important agencies with sectoral specialization. Strengthen the capacities of the MP Climate Change Cell to enable it to coordinate with concerned departments and help integrate the strategies and actions on ground without losing the climate change focus.

1.3 State Profile

Madhya Pradesh is the second largest states of the Republic of India. The state is marked by a complex social structure, a predominantly agrarian economy, a difficult and inaccessible terrain, scattered settlements over a vast area, and a large population below poverty line, together pose several formidable problems to service delivery systems. The state is divided into 50 districts that lie over 11 agro climatic zones.

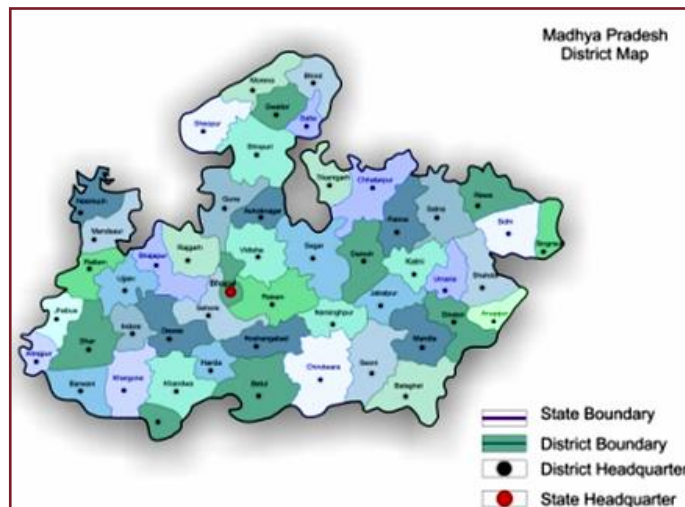


Fig.1.3.1 Districts of Madhya Pradesh

1.4 The Geographical Profile

Madhya Pradesh has an area of 3,08,000 sq.km 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, on the northwest by Rajasthan, on the northeast by Uttar Pradesh, on the east by Chhattisgarh, and on the south by Maharashtra. It has diverse physiography with large plateaus, numerous mountain ranges, meandering rivers and miles of forests supporting rich biodiversity. The state is drained by the Narmada River, which runs east to west between the Vindhya and Satpura hill ranges. These hill ranges and the Narmada have been the traditional boundary between the north and south of India.

1.5 Topography

The state comprises several distinct physiographical regions which have got unique characteristics, including:

- Malwa: a plateau region in the northwest of the state, north of the Vindhya Range, with its distinct language and culture. Indore is the major city of the region, while Bhopal lies on the edge of Bundelkhand region. Ujjain is yet another town of historical importance.
- Nimar (Nemar): the western portion of the Narmada River valley, lying south of the Vindhyas in the southwest portion of the state.
- Bundelkhand: a region of rolling hills and fertile valleys in the northern part of the state, which slopes down toward the Indo-Gangetic plain to the north. Sagar, Chhatarpur are the historic center of the region.
- Chambal: the north-western region. A mountainous region rich in red, soft, and fragile sandstone, harsh climate and ravines.
- Baghelkhand: a hilly region in the northeast of the state, which includes the eastern end of the Vindhya Range.
- Mahakoshal (Mahakaushal): the southeastern portion of the state, which includes the eastern end of the Narmada river valley and the eastern Satpuras. Jabalpur is one of the most important city in the region.
- Central Vindhya and Satpura region. Which has most of the central Narmada river valley and watershed, and has the highest point in the state – i.e. Dhupgarh in Pachmarhi.

1.6 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 on ground and institutional and governance structures. A brief description of all these indicators, as they exist now, is detailed below:

Demography: The population of Madhya Pradesh is 7,25,97,565 (72.6 million, 2011 census). With respect to 2001 there has been an increase of 24.34%. Its population density is 196 people per square kilometer. More than 75% of state population resides in villages whose main occupation is agriculture, while the rest of the population lives in towns. Indore district is the most populated district in MP. Number of females per thousand male (sex ratio) in the state is 919 where as the literacy rate is 63.70%.

The state of Madhya Pradesh also has indigenous tribes that constitute over 20% of the state population and are mainly concentrated in southern part of the state. The lifestyle, culture and

customs of this community is more akin to nature. Gond is the best known tribe and forms the largest group in Madhya Pradesh. They mainly inhabit on both sides of the Narmada in the Mandla, Chhindwara, Betul and Seoni regions and the hilly terrains of the Vindhya and the Satpura region. 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 drawn from the primary sector.

Economy	MP	All India
GSDP as of 2005 – 2006 current prices (Rs.)	118586	79682
Per Capita Net Domestic Product as of 2006 -2007 constant prices (Rs.)	16578	25716
Infrastructure		
Installed Power Capacity (MW)	8524	159398.5
GSM Cellular subscribers (no.)	25,010,843	456,586,162
National Highway Length (km)	4,670	70,548
Social Indicators		
Population (million)	7.26	1210
Sex Ratio (females/1000 males)	919	940
Literacy rate, 2001 (Year 7+)	63.7	65
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
Land Use pattern		
Net sown area (sq km)	1,50,740	14,10,000
Area under notified forests, 2009 (Sq Km)	94689	769512
Permanent pasture and grazing land, 2005 -06 (sq km)	13380	120400
Total livestock, 2007 (Crores)	4.069	30.5
Waste Land (Sq Km)	40,042 (12.99%)	4,72,262 (14.91%)

Table 1.6.1 Socio Economic Profile of Madhya Pradesh vis a vis India

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%. It is the secondary and tertiary sectors which have seen substantial growth in the state, with 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 Pradesh². The distribution is shown in Figure 1.4. As per this study, in 2004-2005, about 48.59% of the population was below poverty line, one of the highest in India. In rural Madhya Pradesh during 2004-05, there were 43,74,657 households living below poverty line and in urban area the number of such households were 10,69,100. The total number of households living below poverty line were 54,43,757.

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 9 Commissioner Divisions, 50 Districts, 272 Tehsils and 313 Community Development Blocks, including 89 Tribal Development Blocks. Under three-tier Panchayati Raj, the state has at present 50 Zila Panchayats, 313 Janpad Panchayats and 23,051 Village Panchayats, 14 Municipal Corporations, 86 Municipalities and 237 Nagar Panchayats. This has effectively improved delivery of key services integrating the administrative, academic units and local bodies. Also a large participation of key stake holders is organised regularly to deliberate on solutions to address key challenges being faced by the people and government of the state. 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.

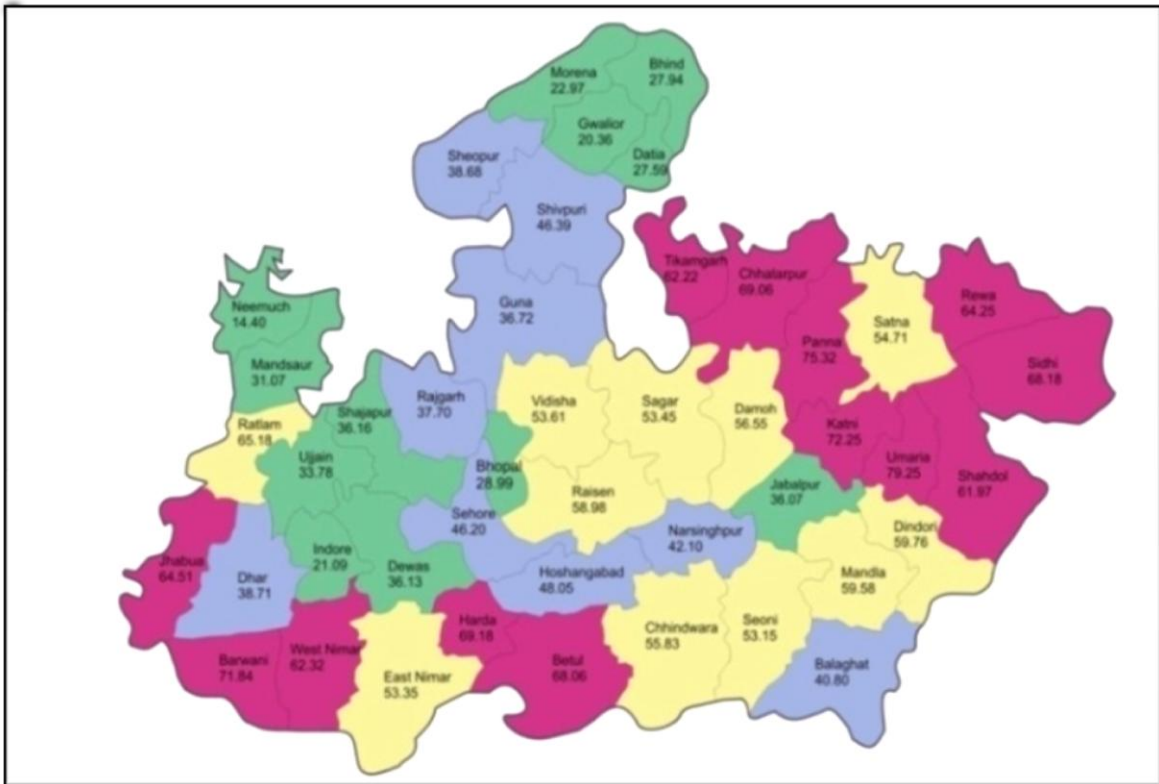


Fig.1.6.1 Population below poverty line (Source: Planning Atlas, State Planning Commission, Government of Madhya Pradesh)

2 Process for Preparation of MPSAPCC

2.1 Background

The Government of Madhya Pradesh has designated Environmental Planning and Coordination Organization (EPCO) as the State Nodal Agency for addressing Climate Change issues and has established Madhya Pradesh Climate Change Cell (MPCCC) in EPCO in 2009. The MPCCC intends to manage the strategic knowledge related to climate change. It would undertake activities that helps to mainstream the climate change concerns in the planning and developmental policies of the state and develop a mechanism to effectively monitor & evaluate the provision of SAPCC.

The MP SAPCC has been prepared under the aegis Department of Housing & Environment, GoMP by the MP Climate Change Cell with the financial support from UNDP India. Specific to the project, the institutional set up comprise a Project Steering Committee (PSC), under the chairmanship of the Chief Secretary, Government of Madhya Pradesh. The function of the PSC is to provide overall policy guidance and ensure ownership amongst the concerned departments and stakeholders. A Project Implementation Committee (PIC) has been formed under the Principal Secretary, Housing and Environment Department. It is responsible for making administrative and financial decisions and to undertake periodic reviews. The Executive Director, EPCO has been designated as the State Project Director (SPD) for the project. The SPD is supported by State Coordinator, Climate Change Cell for technical assistance. A Project Management Unit (PMU) has also been set up.

Project Steering Committee

- Chief Secretary – Chairman
- ACS Ag.& Farmer Welfare (APC)- Member
- ACS Forests - Member
- PS Agriculture - Member
- PS Rural Development - Member
- PS Housing and Environment - Member
- PS Water Resources - Member
- PS Urban Administration - Member
- PS Health - Member
- Director General, EPCO - Member
- Secretary Energy - Member
- Assistant Country Director, UNDP- Member
- Executive Director, EPCO- Member Convener

2.2 Process

The MPCCC has conducted a series of stakeholder consultations through a broad based participatory approach involving concerned government departments and their officials, scientists and academia from research and educational institutes, civil society representatives including those from NGO's and general public.

A total of 26 such consultations were carried out to understand the nature of climate change perceived in general and the strategies that need to be undertaken to combat the likely impacts. The stakeholder consultations were made through workshops organized across the state in 11 agro climatic zones, as the climate and climate dependent activities in these zones have distinctively unique characteristics requiring formulation of agro-climatic zone specific policies to address climate change impacts.

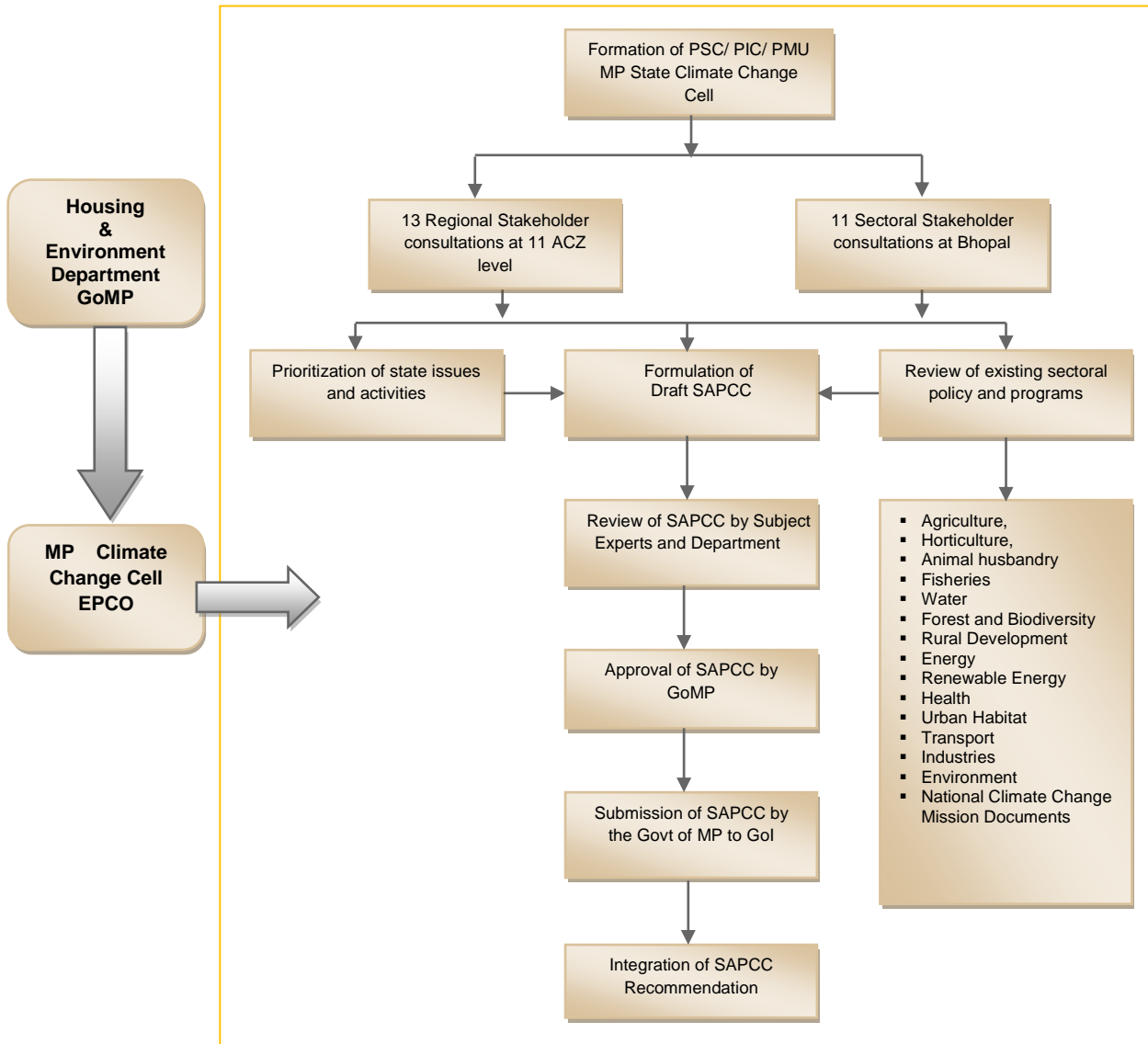


Fig.2.2.1 Process Flow for preparation of MPSAPCC

2.3 Summary of Stakeholder Consultations

Government of Madhya Pradesh accords high priority to environment issues and is among leading states to kick-start the process of SAPCC formulation. The process is quite unique in terms of its design and approach. This includes review of policies and programmes of major climate sectors, and wide-scale stakeholder consultation at sectoral and regional levels.

In order to record people’s perception and to address them appropriately, the State Action Plan on Climate Change (SAPCC) has been developed through a participatory process involving all major stakeholders. It is expected to evoke much wider ownership of the process and product, and go a long way in ensuring the implementation of what is recommended in the SAPCC.

In particular, following are the significant process steps:

1. Consultative meetings and public consultation involving a variety of Govt. agencies at Bhopal and at district level seeking inputs from farmers and other user communities who are directly dependent on natural resources
2. Seeking inputs from a wide range of 'expert' and 'experienced' individuals and organizations working on various aspects of environment and natural resources management, in particular Climate Change including scientists, social activists, academics, students, industrialists, etc.

During the process 26 stakeholders consultation were conducted mainly at two levels i.e., at the departmental level at Bhopal and at the Agro Climatic zone level. The launch workshop of the project provided an opportunity to discuss cross sectoral issues. An institutional networking workshop was also conducted to get academic and research inputs from various institutions working on climate change subject.

2.3.1 SAPCC Launch workshop

The GoMP- UNDP project was launched with fanfare in a state level workshop on 26th – 27th April, 2010 at the State Academy of Administration, Bhopal. The workshop attracted subject experts, administrative officers, academicians etc. from different sectors. Participants were divided into four vital groups i.e Forestry, Wildlife and Biodiversity, Agriculture/ Horticulture/ Fisheries, Health/ Water and Energy/ Industries and outcomes of discussions were presented and discussed. Launch workshop offered the opportunity to disseminate the information about the project to all the government departments about SAPCC process.

2.3.2 Networking Workshop

A networking workshop with academic and research institutes was held on 7th July at Bhopal. Major purpose of workshop was to understand the role of these institutes in the climate change and explore possibilities of future collaboration. 31 institutions participated in the workshop and presented their existing areas of activity and core competence and ability to take up climate change related projects/ studies.

2.3.3 Sectoral stakeholder Consultations

To tackle the challenge posed by Climate Change, 10 climate sensitive sectors were identified and sectoral consultations with these departments were organized. The main objectives of these workshops were to understand the current policies and programmes, future developmental plans, preparedness and strategies with respect to climate change and perceived threats to the sector from changing climatic conditions.

2.3.4 Agro Climatic Zone Stakeholder Consultations

Agriculture represents a core part of the State's economy and mainstay of livelihood. Most of the agriculture in the state is rainfed and any change in rainfall patterns poses a serious threat to agriculture, and therefore to the state's economy.

Nationally Madhya Pradesh falls into Central Plateau and Hills Region and Western Plateau and Hills Region. Based on soil characteristics, rainfall distribution, irrigation pattern, cropping pattern and other ecological and social characteristics, the State has further been classified into 11 agro-climatic zones.

The purpose of the ACZ workshops was to map local issues, ensure participation of local officials and public, develop sense of ownership with the project, motivate departments to integrate CC Concerns in their respective sectors and record people's perception. 13 workshops were held at district headquarters of 11 Agro Climatic Zones of MP. The divisional commissioners/ district collectors provided leadership in hosting these consultations and over 1700 people participated.

The breakup of the participants is given in the figure 2.3 and 2.4. Details of the Regional workshops and list of participants both at Regional & Sectoral levels are appended in Annexure 1 & 2 respectively

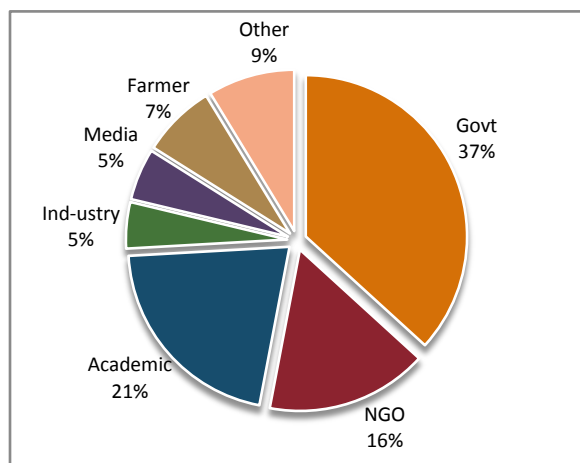


Fig.2.3.1 Regional Stakeholder Participation Breakup

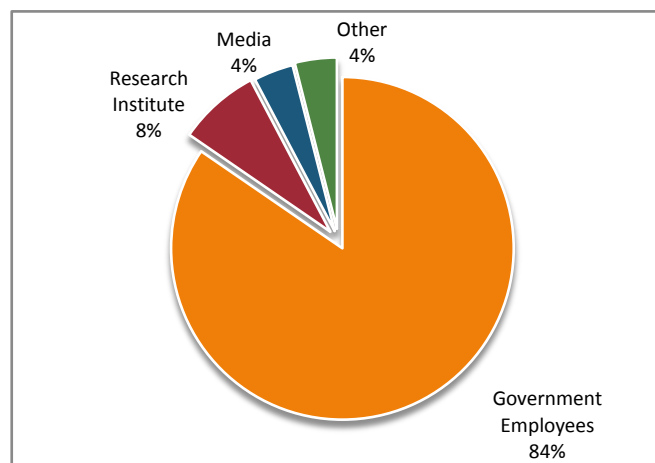


Fig.2.3.2 Departmental Stakeholder Participation Breakup

The consultations with the stakeholders identified the following sectors that are already facing developmental and environmental challenges, which are getting exacerbated by climate change. A brief outcome of these discussions is given in section 2.3.5.

2.3.5 Excerpts of outcomes of Stakeholder Consultations

2.3.5.1 Forest

During the regional consultation the issue of increasing forest degradation and consequent decrease in forest productivity was raised. Participant in general felt that destructive developmental activities have resulted in huge deterioration of forest whereas there is ample scope for compensatory afforestation. It was informed that incidences of man-wild conflicts have increased while wildlife numbers have decreased. Participant wanted efficient regulation to check forest lands being converted into farm lands illegally. In last few years, pressure on forest for fuel wood consumption has increased; unsustainable harvesting methods have resulted in degradation of forests. There has also been observed changes in biodiversity type and phenology of plants. Man made forest fires and illegal felling has emerged as important concern.

It was suggested that community based models for sustainable harvesting and farm forestry model should be promoted to meet the needs of rural people. Biogas, solar energy should be promoted in rural areas. Measures should be taken to strengthen existing conservation initiatives. It was emphasised that sacred grooves should be conserved and expanded, compensatory afforestation should be done in the area near to project site and it should be result oriented rather than target oriented. Participants suggested importance of research studies on impact of climate change on forest types. Need for building capacities in the area of REDD+ and CDM related projects in forestry sector were also emphasized. The participants opined the need for aligning the activities with the provisions Green India Mission.

2.3.5.2 Water

Shifting of monsoon pattern and high intensity of rainfall during a short period of time has been observed in the state. Extreme weather conditions like drought in Bundelkhand while excess rainfall in other parts of the state is becoming a common phenomenon. Given the fact that large part of the state is either in dark or grey zone, withdrawal of groundwater more than the recharge for domestic/ agriculture and other uses also highlighted great concerns. Deterioration and depletion of water resources and conservation and restoration of traditional water bodies were some of the major concerns expressed. It was noted by the participants that perennial streams/ rivers have become seasonal, ground water level has decreased in many areas, numbers of rainy days have decreased and intensity has increased. Unplanned infrastructure has broken the natural flow between various streams.

There was a felt need for scientific assessment and planning of GW development in different hydro geological regions, rainwater harvesting and other traditional as well as scientific methods for GW recharge. Micro as well as larger structures for water storage should be constructed. Participants also emphasised that ridge to valley catchment area treatment for reviving rivers should be promoted. The need for promotion and building of rainwater harvesting structures was highlighted. People suggested that traditional water storage methods should be integrated with modern scientific methods, ground water consumption should be monitored and water cess should be charged from users. Practices of conjunctive use of water should be promoted especially in urban areas.

2.3.5.3 Agriculture and Horticulture

People reported that extreme events like frost, excess rain, high temperatures have resulted in huge losses, shifting rainfall pattern has increased dependence on ground water and affected sowing time of many crops. The issue of practice of residue burning in fields results in GHG emission and mono-cropping dominating the agriculture in the state was vociferously raised. Participants were of the view that excess cropping of soybean has affected agro-biodiversity especially in Malwa which traditionally was known as Cotton-Jowar region. People felt that ground water level decreased due to mono-cropping of water intensive crops and changed rainfall patterns. Concerns were raised on rapid conversion of agricultural land into residential, industrial zones and highway constructions.

There was a felt need for strengthening of early warning system and IEC to provide timely information to farmers to take precautions against extreme events, research should be done to develop drought resistant crops, and check residue burning in the fields and on rotational cropping.

Modern scientific practices like plastic mulching, soil mulching, straw mulching, drip irrigation and water sprinkler methods need to be promoted. Policy support was emphasised for promotion of organic farming should be done in conjugation with integrated nutrient management. Participants suggested that rotational cropping should be encouraged, biomass and vermi-compost should be promoted in farming practices, farm ponds, percolation tank concept should be encouraged through government subsidies etc. Traditional farming practices should be documented and promoted.

Species requiring less water should be developed, technical and financial support should be given for using modern irrigation methods. Advocating the practice of SRI, some of the Agriculture scientist opined that the issue of Methane emission from paddy fields is over exaggerated and there is need to commission scientific studies in Indian context using indigenous methodology to clear the myth. Suggestion was to provide adequate financial and infrastructural resources for persuing scientific research for crop improvement & documentation related activities.

2.3.5.4 Animal Husbandry

Veterinary experts were of the view that productivity of animals is being affected due to heat stress; new diseases and change in pattern of existing diseases. Large numbers of animals are unproductive and there is competition for resources. Exotic species are less resistant to climatic changes hence indigenous and local species should be promoted. Lack of sanitation, improper utilization & storage of dung, lack of balance diet for livestock, fodder and pasture land are the main concern for livestock rearing.

It was suggested that proper shelter should be provided to cattle during extreme weather events, unproductive cattle should be replaced with superior breed, proper nutrition should be given to the cattle health and vaccination should be done at regular intervals. Conservation and development of pasture land for healthy livestock was also identified as one of the key concern. Participants supported the concept of dry dairy in order to meaningfully utilize unproductive livestock.

2.3.5.5 Health

There was general feeling and observation that Health Infrastructure needs to be improved for efficient health service delivery. Improper disposal of biomedical wastes, poor quality of drinking water, increase in incidences of vector borne diseases, poor health infrastructures, increase in incidences of Malaria, Dengue, Chickungunya, Cholera were highlighted as key issues in health sector.

Stringent laws to penalize non-compliance of bio-medical waste management rules. Timely availability of drugs should be effectively implemented, awareness of vector borne-water borne diseases should be generated. Strengthening of ASHA network to provide timely cure in rural areas. Capacity Building of ASHA workers should be done on climate change and related health issues.

2.3.5.6 Urban Development and Transport

Discussing urban issues with respect to Climate Change the participants were of the view that lack of proper sanitation and drainage system, open dumping, inadequate safe drinking water supply, solid waste management are major urban environmental issues. It was observed that poor infrastructure of public transport system leads to increase in carbon emissions. Concerns were raised on the rapid loss of greenery in cities and highlighted the need for judicious use of open spaces and parks in urban areas.

Participants suggested that efforts should focus on Integrated Waste Management and segregation at source, door to door collection should be practiced. Public transport infrastructure needs and fuel efficient vehicles should be introduced.

Need was emphasized on having climate change resilient cities strategy which would entail GHG inventory of cities and assess city carbon footprints. It was also suggested to review the City Development Plans (CPDs) of the cities and explore possibilities of convergence of ongoing schemes and aligning with National Mission on Sustainable Urban Habitats. Rooftop rain water harvesting should be promoted. PPP model can be adopted for drinking water supply. Experts suggested launching a dedicated campaign on DSM in urban areas for both energy and water.

2.3.5.7 Energy

Poor plant load factors in coal fired power plants due to old technology and poor quality of coal, fund constraints and economic viability to upgrade these old plants and T&D losses are some of the prime constraints and concerns of the power sector. Poor quality and inefficient pumps used in agriculture and urban water supply need to be replaced. Effective measures should be taken to strengthen demand side management. T & D losses and possibilities of CDMability should be explored. Use of incandescent bulbs should be discouraged by providing CFLs in rural areas at subsidized rate, infrastructure should be improved to increase efficiency of the system and regulatory mechanism should be strengthened to reduce incidences of electricity theft and pilferages.

The participant were of the view that high production cost of renewable energy and low set of Renewable Purchase Obligation (RPO) could be one of the reason which may discourage investors and users. Promoting the use of non conventional sources like wind energy, solar energy and off-Grid power energy was also recommended. More research should be done to increase the efficiency of processes using agriculture waste as source.

Suitable policies should be formed to motivate investors to invest in this sector, RPO should be increased gradually so that investors don't feel insecure. Government should provide subsidies to both producers and users and grant green tariffs to motivate the use of renewable energy. It was also emphasized that activities under National Solar Mission and NMEEE should be taken up at priority.

2.3.5.8 Industries

It was observed that obsolete and inefficient technologies increases fuel consumption; pollution control regulation should be effectively implemented. Favourable policies should be made to promote use of modern and energy efficient technologies. Thrust is needed to install common waste treatment plants to reduce capital investment and reduce likely GHG emission from industrial effluents.

Leakages from septic tanks, release of untreated waste water to nearby water streams which results in loss of aquatic life as well as causes health problems to humans should be effectively checked. Industrial symbiosis network across the state should be developed ie. system should be made to utilise the waste of one industry as the raw material of another industry. Industry representatives expressed the need for capacity building and hand holding for PAT scheme under the NMEEE and also for CDM.

2.3.5.9 Panchayat and Rural Development

It was realized that there is a need to analyze how each programme/ projects in rural development sector may be impacting to climate change. Participants raised and underlined the need for exploring the possibilities of convergence of RD programmes to address the issue of climate Change in MP. Large scale distress migration is one of the biggest challenges in successful implementation of rural development programmes. Climate Change concerns should be integrated in the Panchayat level development plans. It was informed that Khandwa has already a carbon neutral village which could well be a model for the state. Improvement of rural architecture by making proper ventilation, rainwater harvesting structure and proper drainage should be promoted. Concerns were expressed over the fast receding ground water level mainly in western part of the state which is already overexploited. It was suggested that activities like construction of check dam, stop dam should be taken up under MNREGA to increase for ground water recharge.

3 Observed Climate Trends and Projected Climate Change

3.1 Observed Climate

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 from extending from June to October.

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 in Fig. 3.1.1

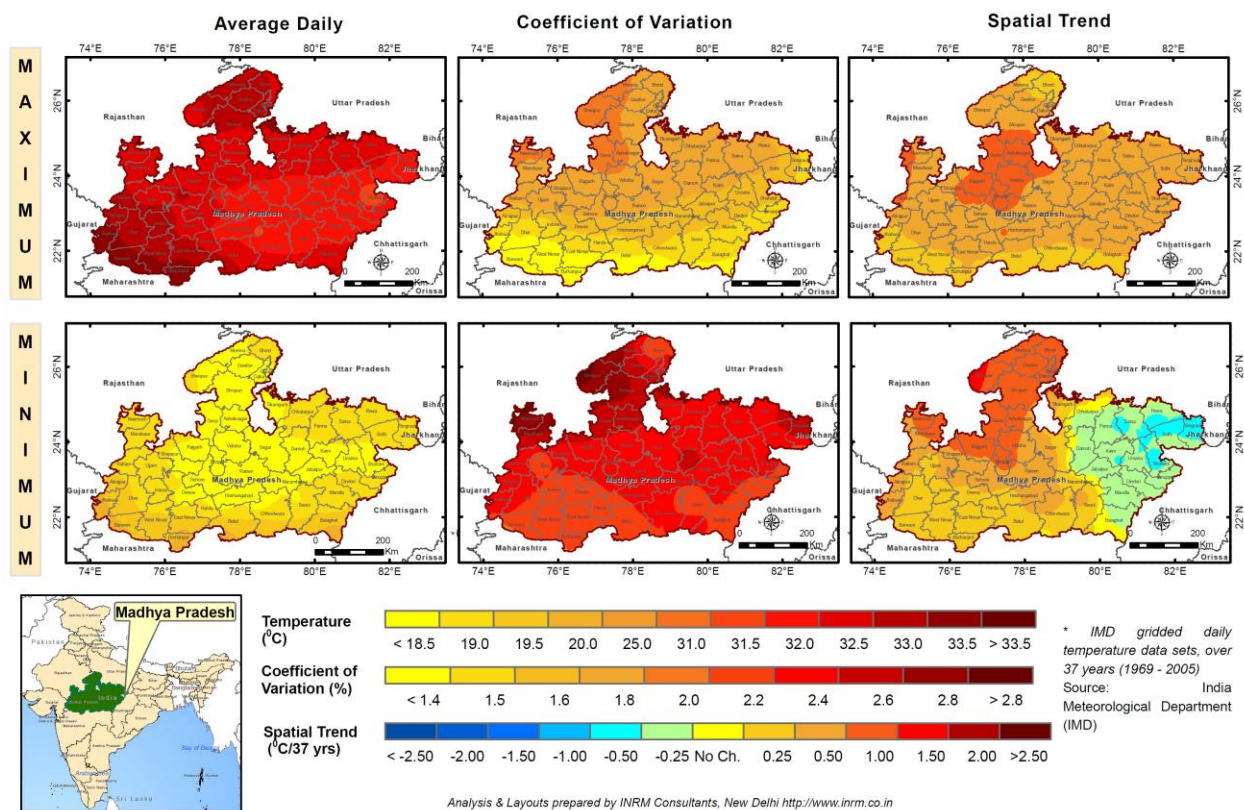


Fig.3.1.1 Average temperature statistics across Madhya Pradesh

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 in the north 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. See Fig. 3.1.2 for season wise distribution of average rainfall

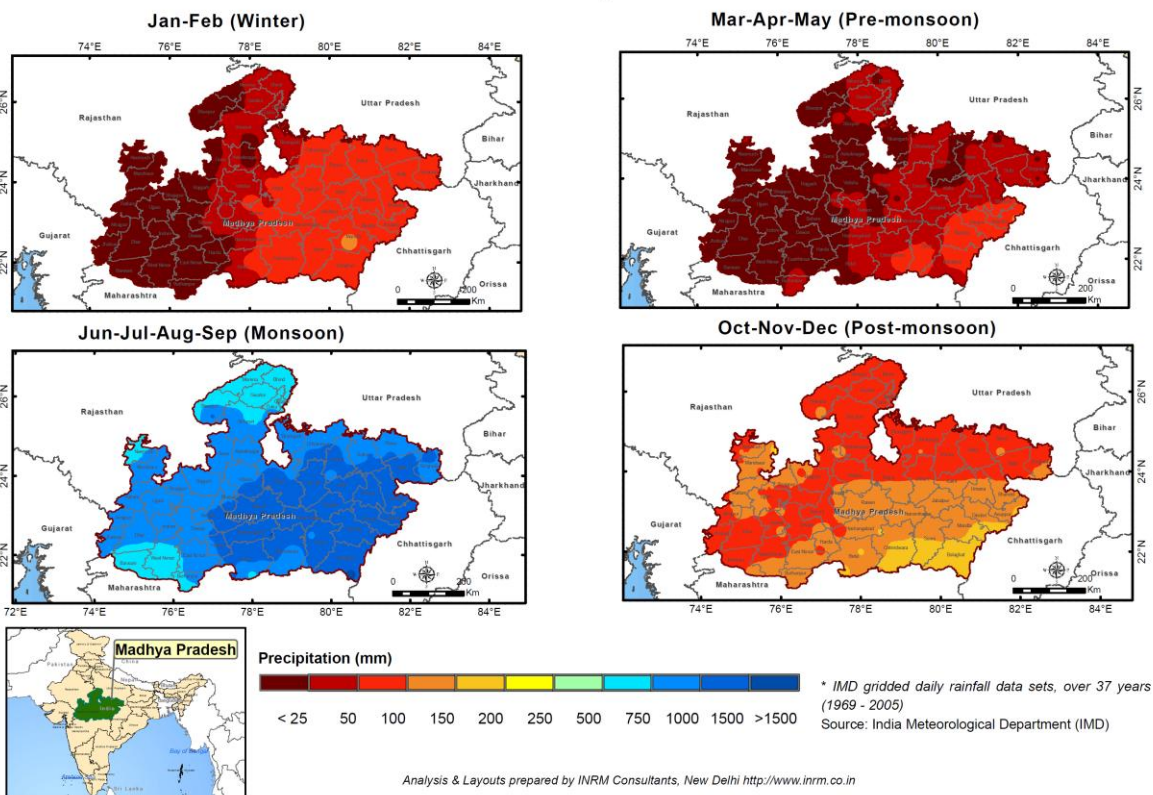


Fig.3.1.2Average monsoon rain fall during winter, pre-monsoon, monsoon and post monsoon periods in Madhya Pradesh

Since monsoon receives the maximum volume of rain, further analysis of the trends of monsoon rainfall is necessary to be analysed as that also forms the main water resource for agriculture and biodiversity in the state. The analysis has been done for the 11 Agro Climatic Zones (ACZ) in Madhya Pradesh which are the basic units that typically define the micro climatic trends of these zones, their cropping patterns, and biological diversity as suited to their respective climate types. The list of districts in each ACZ along with the mean rainfall and temperature is shown in Table 3.1.1.

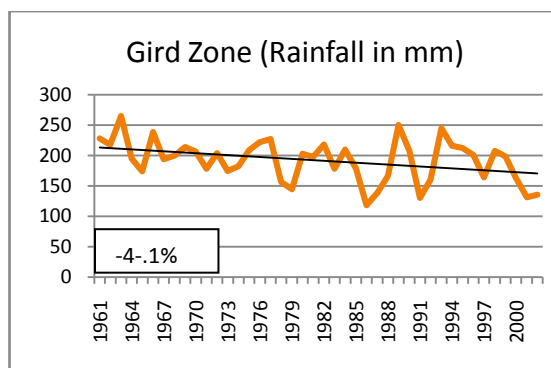
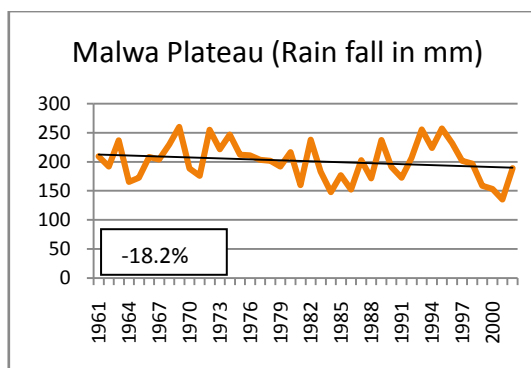
Since the cropping patterns and the biological diversity are distinct in each of the 11 ACZs, an attempt has been made to understand the trends of surface temperature and precipitation across all these zones. For this reason the precipitation data for the period 1961 to 2010, a 40 year period has been analysed³. Monsoon being the period when more than 90% of the annual rainfall happens, the trends of average annual monsoon rain fall is therefore analysed and shown in fig. 3.1.3 and fig. 3.1.4.

³Climate in a narrow sense is usually defined as the average weather, or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. The classical period for averaging these variables is 30 years, as defined by the World Meteorological Organization. The relevant quantities are most often surface variables such as temperature, precipitation and wind. Climate change refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer.

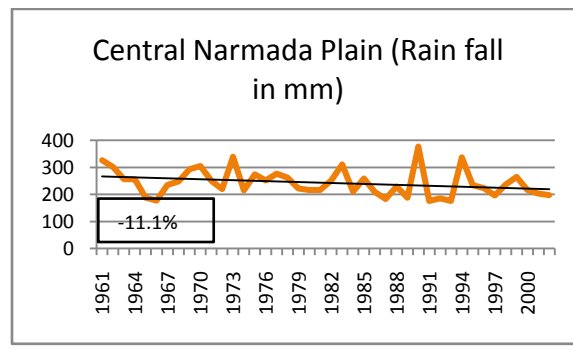
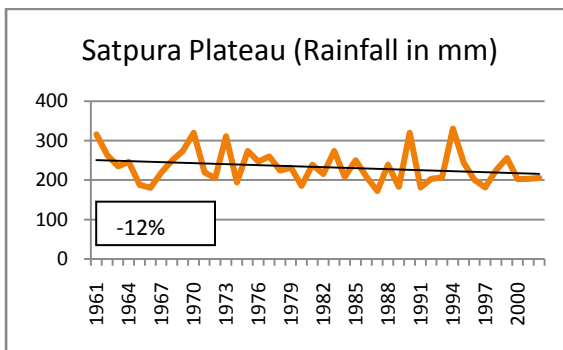
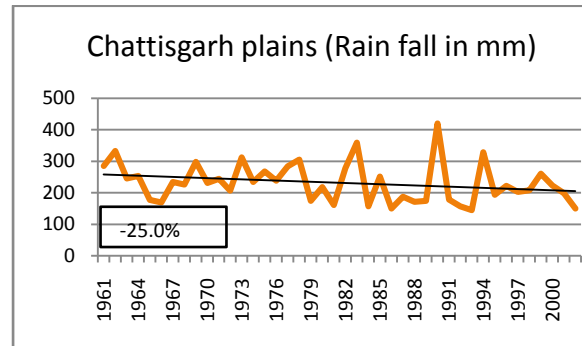
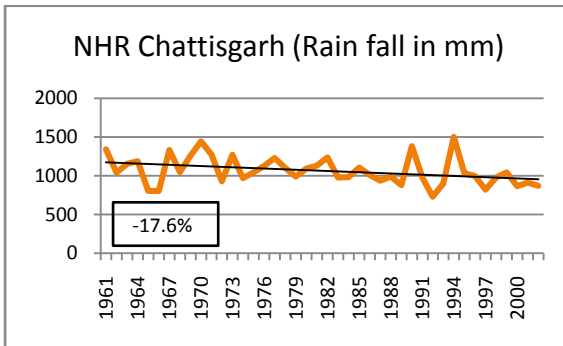
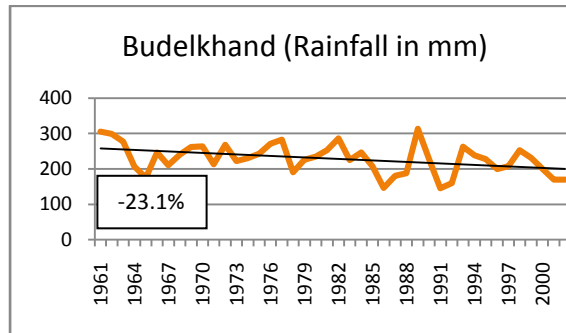
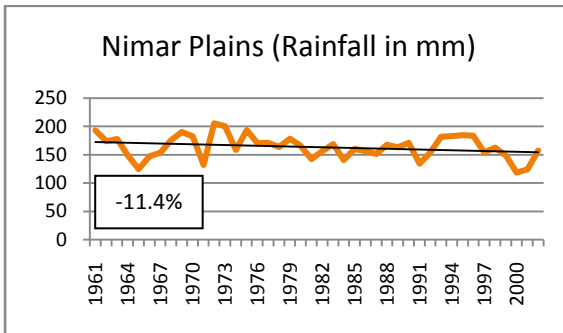
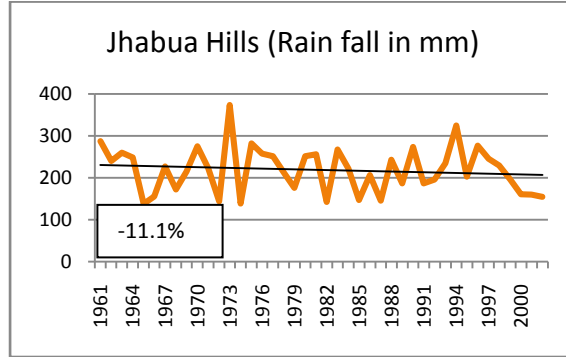
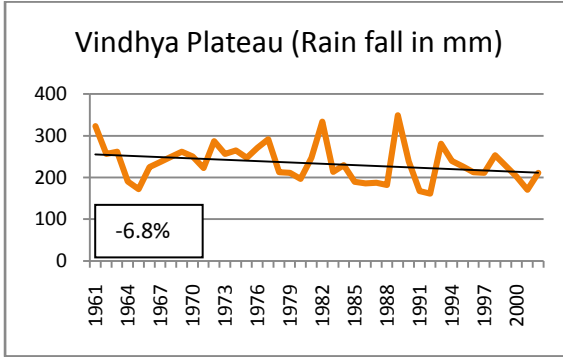
ACZ	Districts	Rainfall (mm)	Min. Temp. (°C)
Vindhya Plateau	Vidisha, Bhopal, Sehore, Raisen, Sagar, Damoh	1200-1400	0-2.5
Jhabua Hills:	Jhabua, Alirajpur	800-1000	0
Nimar Plains	Khandwa, Burhanpur, Khargone, Badwani	800-1000	2.5-5.0
Bundelkhand	Datia, Tikamgarh, Chhattarpur, Shivpuri	800-1400	-
Malwa Plateau	Shajapur, Dewas, Indore, Dhar, Ujjain, Ratlam, Mandsaur, Neemach, Rajgarh	1000-1200	0
Gird Zone	Morena, Bhind, Gwalior, Sheopur, Guna, Ashoknagar	800-1000	Below 0
NHR Chhattisgarh	Sidhi, Shahdol, Dindori, Mandla, Anuppur, Singrauli	1200-1600	0-2.5
Chhattisgarh plains	Balaghat	1200-1600	2.5-5.0
Satpura Plateau	Betul, Chhindwara	1000-1200	0-2.5
Central Narmada Valley	Narsinghpur, Hoshangabad, Harda	1200-1600	2.5-5
Kymore Hills	Panna, Rewa, Katni, Satna, Umaria, Seoni, Jabalpur	1100-1400	0-2.5

Table 3.1.1 List of districts in each ACZ

It is seen that, though there is an inter-annual variability of average monsoon rain fall in the 42 year period that has been analysed (1961-2003) in all the ACZs, the rain fall trend is also decreasing in each of them. Further a study carried out by Goswami et al (2006)⁴, for observations spanning 50 years in the Central Indian region including Madhya Pradesh, indicates that the extreme precipitation events which are above 150mm are increasing in terms of their intensity and frequency, with low and moderate events becoming more and more infrequent (fig.3.1.3).



⁴B. N. Goswami, V. Venugopal, D. Sengupta, M. S. Madhusoodanan, 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



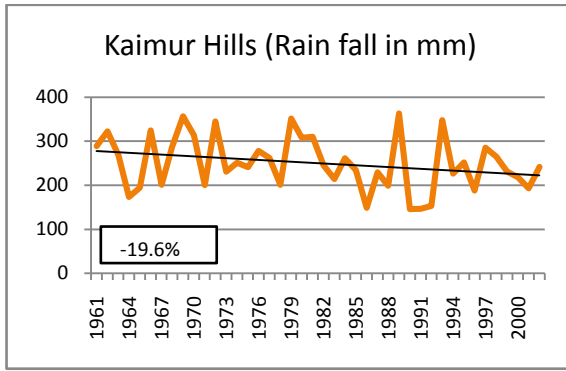


Fig.3.1.4 Average Monsoon Rainfall (June, July, August and September) trends in various Agro Climatic Zones in Madhya Pradesh between 1961-2002. Figures within box indicate the decreasing trend in rain fall in this period. (Source: India water portal [http:// www. indiawaterportal/metdata](http://www.indiawaterportal/metdata), accessed on June 2011)

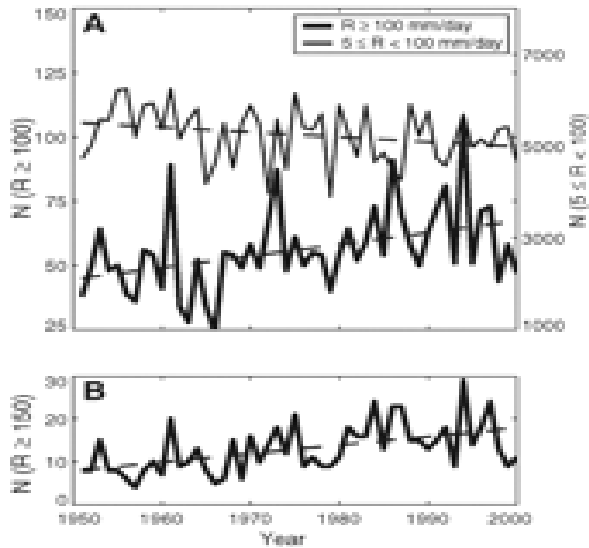


Fig.3.1.3 Increasing trend of heavy precipitation events in the Central Indian region (Source: Goswami et al., 2006)

3.2 Climate Projections

Climate projections for 2050s and 2100 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 mid century (2021-2050) and end of the century (2071-2098) have been derived with respect to 1970s (1961-1990).

Temperature: The average surface daily maximum temperatures, in the period between 2021 to 2050s 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 (fig. 3.2.1). By 2100 i.e between 2071 and 2098, 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 3.2.1).

Rainfall: Projections of rain fall in Madhya Pradesh for the period 2021 to 2050 (Figure 3.2.2), upper panel) indicates that there is likely to be decrease in winter rainfall as one move from eastern part of MP to western part of MP. The ratio of change with respect to base line varies from <0.95 mm in the eastern regions to < 0.25 in the western regions. In pre-monsoon period, the rainfall is increasing only in the Southern part of MP, with decrease in 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.

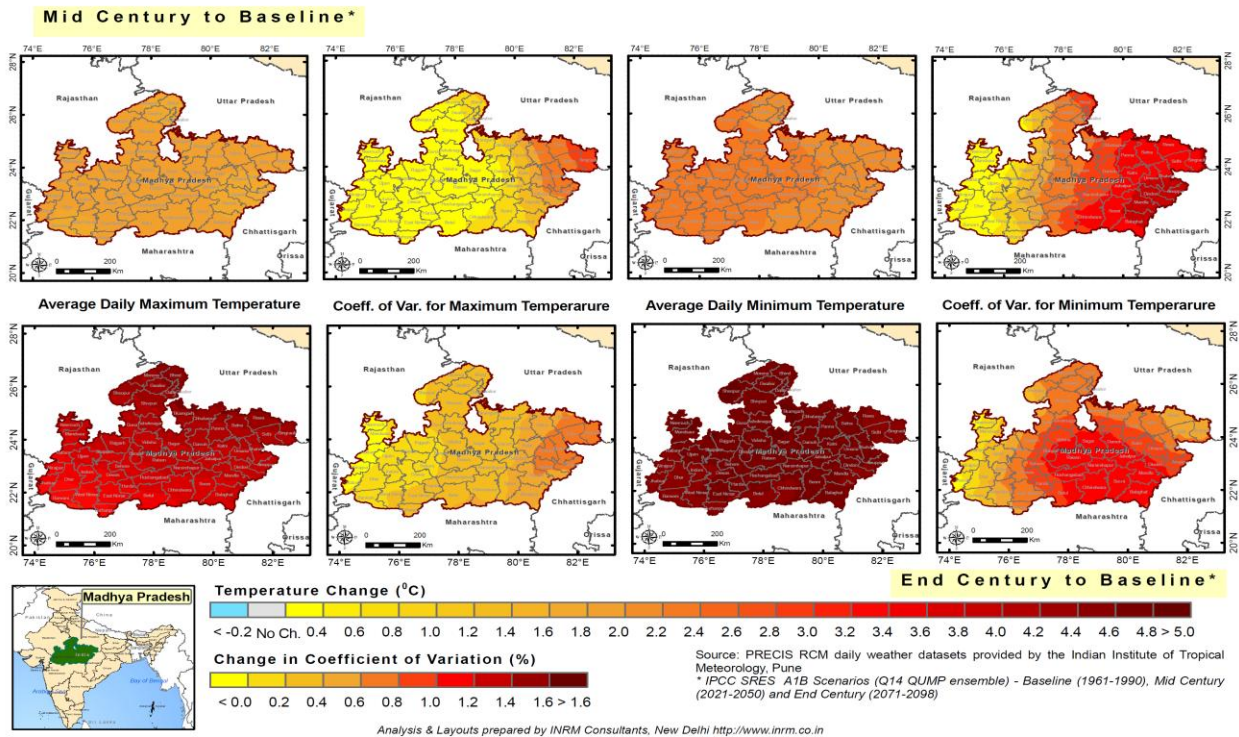


Fig.3.2.1 Change in daily average maximum and minimum temperatures in between 2021-2050 and between 2071-21000 with respect to base line (1961-1990)

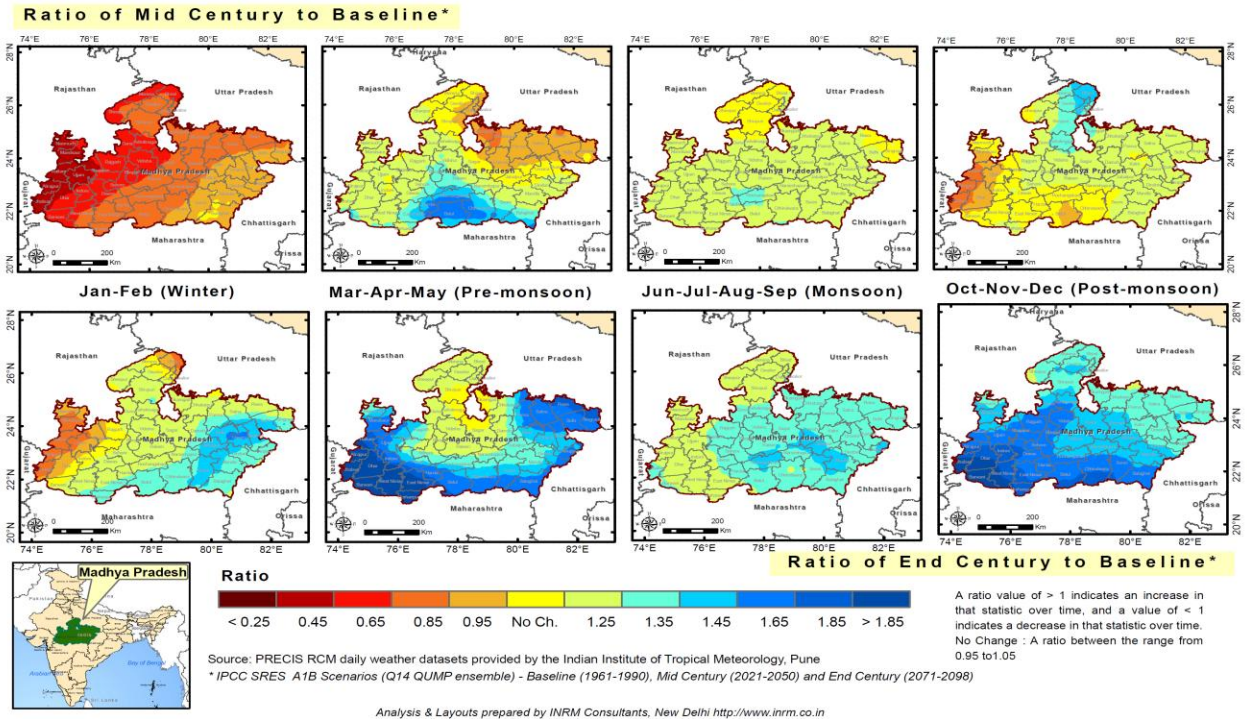


Fig.3.2.2 Change in Average seasonal precipitation in Madhya Pradesh in 2021-2050 and 2071-2100 with respect to base line (1961-1990)

The Table below summarises the projected changes in Climate parameters as derived from PRECIS

Projected Changes in Climate	2021-2050	2071-2100
Daily Maximum Temperatures	1.8-2.0°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 rain fall 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 rain fall 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 3.2.1 Projected changes in climate between 2021-2050 and 2071 and 2100

4 Vulnerability Assessment

4.1 Background

Vulnerability to climate change is generally understood to be a function of a range of biophysical and socioeconomic factors. The relationship between the vulnerability and adaptive capacity of a human system depends critically on the nature of the hazard faced. Adaptation by a system may be inhibited by process originating outside the system; it is therefore important to consider “external” obstacles to adaptation.

Vulnerability to climate change 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 in the context of multiple stresses. In particular, the dramatic economic and social changes associated with globalization themselves present new risks as well as opportunities.

4.2 Vulnerability in context of MP

Climate Change in India represents an additional stress on ecological and socio-economic systems that are already facing tremendous pressures due to rapid urbanization, industrialization and economic activities. With its large and growing population and an economy that is still closely tied to its natural resource base, India’s population is vulnerable to the impacts of climate change.

Madhya Pradesh is an agrarian state with about 70% population dependent on agriculture and forest for their livelihood. The economic development of the state is mainly dependent on these climate sensitive sectors and thus making the population of the state vulnerable to the vagaries of the climate change. Thus it is important to have an in depth assessment of the vulnerability for the state in context to climate change

Box 4.2.1 Limitations of the vulnerability assessment done in this study

The assessment is done solely on the basis of secondary data, is quite subjective as classifications and categorisation is judgemental. The sub-categories chosen are in exhaustive and are chosen on the basis of the availability of the secondary data. The results therefore may not be comprehensive and gives only the broad spectrum of the vulnerability which exist in context of climate change

Districts in Madhya Pradesh were identified as being amongst the highest in India in terms of social vulnerability 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 other part of the state is generally facing drought. There is considerable temporary migration to urban centres during drought periods despite various developmental initiatives. The forest and environmental resources in the state are also under continual pressure and severe pollution of rivers/wetlands, degradation of forests and biodiversity loss is being observed. Poverty 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 in the state. In order to have the broad understanding and overview of the vulnerability situation of the state a rapid and subjective assessment has been done on the basis of the available secondary data. The assessment is not very

a comprehensive one however; it however, helps to get a preliminary understanding on the vulnerability situation across the state of M.P⁵. Table 4.2.1 identifies the limitations of this assessment.

For vulnerability assessment two broad indicators have been taken a) Socio-economic and b) Bio-physical indicators, as depicted in the Planning Atlas of Madhya Pradesh (2009). These data sets are for different districts in the state (See table 4.2.1 for the indicators selected for assessing vulnerability). These parameters in the ATLAS have been categorised into four category namely best or low vulnerability (shown by green), good or medium to high vulnerability (shown by blue), poor or low to medium (shown by yellow) and poorest or low (shown by pink). Districts with maximum number of best rated indicators have been identified as having low vulnerability. Similarly, districts having the maximum number of poorest indicators have been identified as Highly vulnerable. The districts are then clustered under the 11 agroclimatic zones in which they fall. Agro-climatic zones then having the maximum number of highly vulnerable districts have been identified as Highly Vulnerable agro-climatic zone and so on and so forth. The overall vulnerability of the Agro-Climatic Zone is indicated in Table 4.2.1 and the detailed methodology is described in Annexure 4. Figure 4.2.1 pictorially represent the socio-economic and biophysical vulnerability.

Socio-Economic Indicators	Bio-Physical Indicators
Sex Ratio	Forest Area
Scheduled Caste Population	Water Availability
Scheduled Tribe Population	Temperature
Population Density	Rainfall
Literacy Rate	Wasteland
Below Poverty Line Population	Drought Affected years
Urbanisation Level	
Contribution to GDP at Current Prices	
Per capita Income at Current Prices	

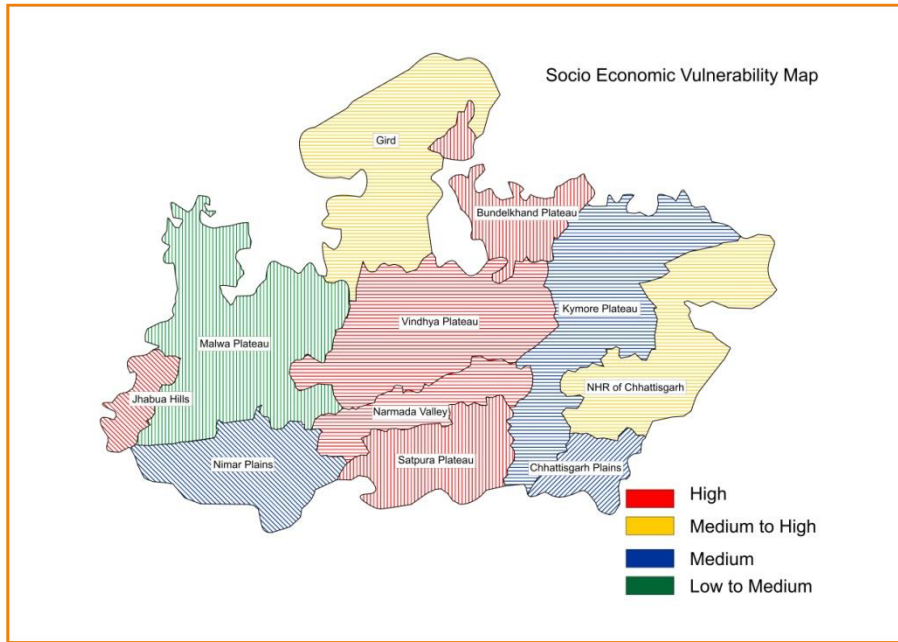
Table 4.2.1 Indicators identified for assessing vulnerability

Agro-climatic Zones	Socio-Economic Vulnerability	Bio-Physical Vulnerability
Gird	Medium to High	Medium
Bundelkhand	High	High
Vindhya Plateau	High	High
Central Narmada Valley	High	Medium
Satpura Plateau	High	Medium
Kymore Hills	Medium	Low to Medium
Nimar Plains	Medium	Medium
Malwa Plateau	Low to Medium	High
NHR of Chhattisgarh	Medium to High	Low to Medium
Jhabua Hills	High	High
Chhattisgarh Plains	Medium	Medium

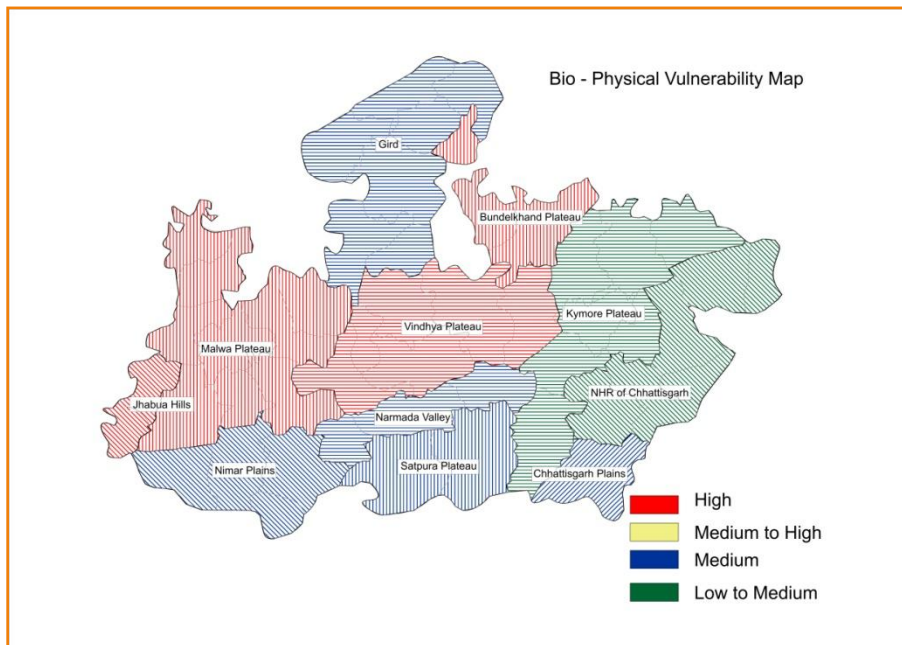
Table 4.2.2 Vulnerability of the various agro-climatic zones

⁵A detailed Project for Vulnerability Assessment for the state is currently underway by Indian Institute for Natural Resource Management (an incubated company of IIT, Delhi) as part of the MoEF-GIZ, CCA-RAI Project.

The vulnerability study gives an indication that most of the agro-climatic zones are moving towards high socio-economic and bio-physical vulnerability. The Bundelkhand, Vindhya Plateau and Jhabua Hills are in the highly vulnerable zone in terms of both socio-economic as well as bio-physical vulnerability.



4.2.1 Socio Economic Vulnerability Map



4.2.2 Bio- Physical Vulnerability Map

5 Climate Change, Environment and Development Issues of the State

5.1 Background

Madhya Pradesh is bestowed with a rich environment and long traditions of symbiotic relationship between people and natural resources. The predominant characteristic of Madhya Pradesh is that it is essentially a rural state with 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 70.00%. The consequences of poverty are visible in several other human development parameters.

Madhya Pradesh is richly endowed with natural resources-forests, wildlife, mineral wealth and water bodies. The state has the largest forest cover in the country, with 94,689 sq. km of legally designated forests (State Annual Plan, 2011-12). It has been aptly named the 'Tiger State', having 20% of the country's and 10% of the world's population of tigers. 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 estimate annual run-off of about 81523 MCM (State Annual Plan, 2011-12). 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 Annual State 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 the near 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 8596.10 MW available for the state. As of March 2010, about 65.70% villages are electrified. 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.

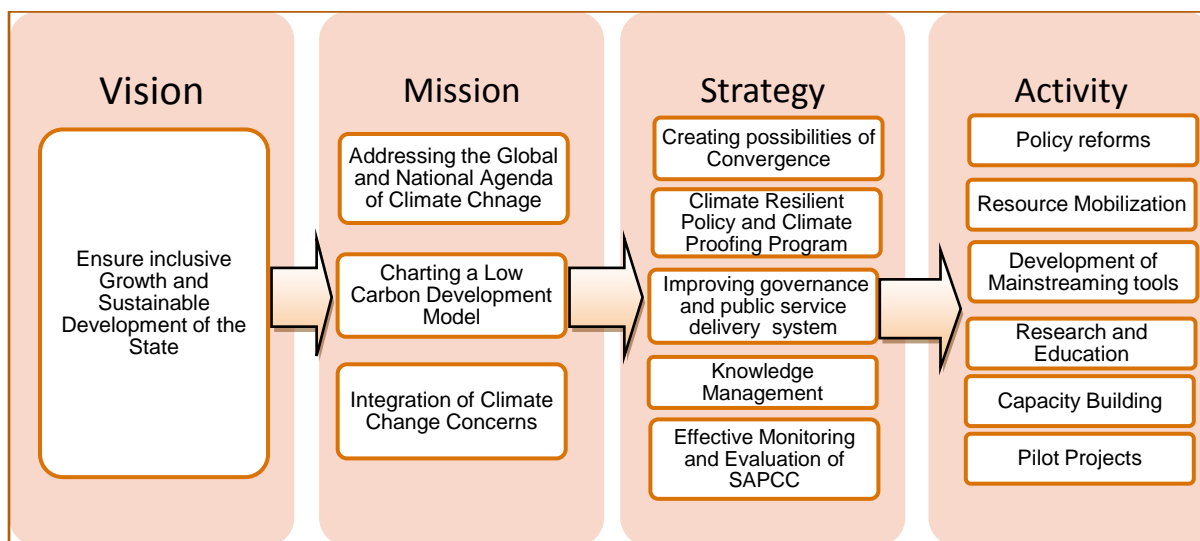
5.2 Challenges

Despite the wealth of its resources and tremendous potential, Madhya Pradesh faces a number of challenges, in reconciling the imperatives 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, 2004). The incidence of poverty in the state is among the highest in the country, with people living below the poverty line increasing from 44.6% in 1993-94 to 48.6% in 2004-05. This is more so in rural than urban areas (53.6% in rural areas as against 35.1% for urban areas in 2004-05). Declining productivity in agriculture is one major cause for this, 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 has been a major constraint for achieving targeted levels of production in recent times.

With climate change, this could be expected to increase in future. Population explosion and developmental needs has caused rapid degradation of its forests, which in turn leads 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 can get aggravated with the stress imposed by climate change. With Madhya Pradesh getting urbanized at fifth highest rate in the country (State Annual Plan, 2011-12), there is need for the growth of the urban centers in a sustainable manner. The state also suffers from energy shortage, which needs to be address for the development of the agricultural and industrial sector and to provide electricity to all.

5.3 Policy Framework

The State of MP has reasons to be concerned about adverse impact 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 MPSAPCC envisages to ensure economic growth which is inclusive and also environmentally sustainable. In accordance of the vision, the SAPCC proposes to address the global agenda of climate change by taking appropriate adaptaion measures and suggeststo develop 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 MP SAPCC proposes to proactively integrate the concerns of Climate Chnage 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 MP SAPCC categorically recommends to setup a mechanism for effective monitoring and evaluation ofthe provisions of SAPCC and impacts of climate change on various sectors for managing knowledge, research and education and capacity building.



6 Sectoral Issues

6.1 Forests and Biodiversity

6.1.1 Background

According to State of the Forest Report (2009), brought out by the Forest Survey of India, the total Forest area of 95221 sq km in Madhya Pradesh constitutes 12.30% of the total recorded forest area in the India. Of the total forest area in the state, 8.55% is dense forest, 45.05% is moderately dense, and 46.39% of the area constitutes of open forests (fig. 6.1.1).

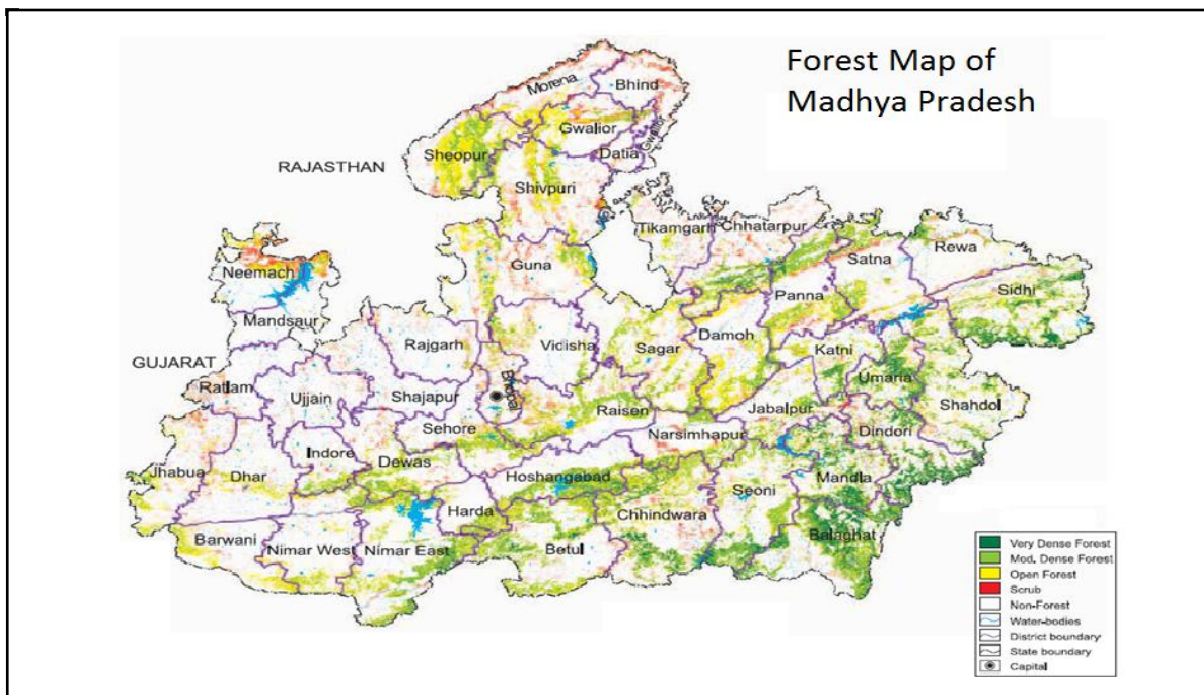


Fig.6.1.1 Forest Density Map of Madhya Pradesh

As per Champion & Seth classification, the state has 18 forest types which belong to the 3 forest type groups, namely, tropical dry deciduous, tropical moist deciduous and tropical thorn forests covering 79.71%, 17.90% and 0.27% of the total forest cover (75137 sq km) of the state. Plantations and trees outside forests comprise of 2.12% of the total forest cover in the state. The total forest & tree cover area being 27.44% of the total geographical area of the state. Tribals in Madhya Pradesh are integrally linked with forests and its produce as 30.34% of the land area of these 18 tribal districts in the state is under forest cover.

The growing stock of forest area in Madhya Pradesh is 249.66 million cubic meter & in TOF (Trees Outside Forests) is 86.49 million cubic meter. Thus, the total growing stock is 336.15 million cubic meter (SFR, 2009). So, though, the state tops in the country in terms of recorded forest area, it only ranks 10th in terms of total growing stock in various states. This has implications on the Carbon sequestration potential of the forests as a whole in the state. The main tree species are teak, sal, tendu, mahua, aonla, bija, khair, tinsa, salai, saja, haldu, lendia and dhavra.

6.1.2 Forests products and livelihoods

The major forest products derived from the forests in Madhya Pradesh are timber, fuel wood and bamboo. The minor produce from the forests include tendu, harra and sal seeds. The state is the largest producer of tendu leaf accounting for 25% of the national production.

6.1.3 Policies and Programmes to manage forests

Forest Management through Working Plans—The state has a long history of scientific management of its forest resource through plan documents called ‘Working Plans’. A territorial division prepares the working plan for 10 years & then it is revised. Similar plans, called “Management Plans” are also prepared for protected areas.

Remote Sensing & IT for Forest Protection & Monitoring —The state forest department is equipped with one of the best Information Technology wings in the country, which is capable of using remote sensing inputs for combating forest fires, monitoring encroachments & the state of forest cover in general. This technological competence of the state forest department is very useful in tackling the adverse effects of Climate Change like the increased incidence of forest fires & also in monitoring the mitigation measures suggested in Green India Mission.

Joint Forest Management —The state has largest numbers of Joint Forest Management Committees (JFMCs) in the country. Though, all the JFMCs cannot be assumed to be equally active & participative, they can prove to be an important asset in the face of adaptation & mitigation of Climate Change. It is through this institutional network that, the actions of GIM can be readily implemented.

Trees Outside Forests, Lok Vaniki Act & Land Revenue Code —Trees outside Forests (TOF) from the point of view of adaptation & mitigation of Climate Change also, can play important roles. 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. Madhya Pradesh is probably the only state having such an enabling statutory provision for TOF. This Act has also passed the scrutiny of the Apex Court of the country & is a very effective tool in encouraging the farmers to grow more trees (Agro-forestry, farm-forestry, silvi-pasture etc) & increase TOF resource to adapt & mitigate Climate Change.

6.1.4 Key Concerns of Forest Sector

Tremendous pressure is created on the forests for meeting the livelihood needs of those residing in or near them. Results suggest that there are as many as 50,000 encroachers occupying 1.43 lakh hectares of forestland. A livestock population of about two crores is also dependent on these forests for grazing. In addition 20 lakh cattle and other animals visit the state from Rajasthan every year. Apart from this there are encroachments for agriculture. Extraction of fuel wood is increasing causing forest denudation.

Degradation of forests and forest land is due to the poor management by population dependent on forests produce and responsible for managing them. Therefore forest ecosystem conservation may assume 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.

Declining forests growing stock as more and more forests are getting degraded with implications on reduced Carbon sequestration potential of forests. This is especially happening in areas where the

indigenous population owning land is not able to effectively manage the forests. Also the minor forest produce of these forests on which their livelihoods are dependent are decreasing. Therefore strengthening of joint forest management is necessary to increase growing biomass stock quality as well as for increasing the earnings from the forest products.

The agro-climatic zone wise vulnerability of the forests is based on topography of the zone, forest cover, population dependent on forest produce, revenue earned from forest produce and the the status of forest cover and biodiversity of forests, analysis indicates that the forests of Jhabua hills, Nimar plains, Bundelkhand , Gird and Satpura plateau are highly vulnerable.

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 may occur covering large areas there by affecting biodiversity and hence reduce forest produce, which in turn will affect the livelihood opportunities.

As more and more forests get degraded, it will be important to assess the carbon sequestration potential of the forests. It is also expected capacity of forest areas to act as catchment areas for different rivers emanating from the forest regions might lessen due to drying up of forests. 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. Extreme precipitation leading to landslides and soil erosion will cause reduction of soil nutrient and hence forest productivity. Habitats of some of the flora likely to be affected and in turn this may affect the food chain of fauna residing in these habitats necessitating them to migrate.

6.1.5 Strategies to address concerns of climate change

The state Forest department is one of the oldest & takes pride in some of the best forest management practices in the country yet there is scope for preparing the department to face the challenges posed by climate variability and climate change.

Being in the tropical region, Madhya Pradesh is endowed with a particularly rich biodiversity which has been a major source of livelihood to a large number of poor people living in & around forests. This very biodiversity is endangered because of climate change & as a result, the large number of rural poor may become vulnerable to the vagaries of nature.

Some of the strategies suggested to address climate change concerns are given below and efforts have been made to align them with the different forest initiatives practiced in India and also with the recently formulated Green India Mission, 2010 (GIM, 2010) which aims to respond to climate change by a combination of adaptation & mitigation measures.

1. **Develop forest management plans for different forest types in view of climate change:** This will entail undertaking detailed study to understand impacts of climate change on forest productivity in different forest types and develop adaptation plans for each forest type according to their biophysical vulnerabilities to climate change. This will enable the development of climate resilient forest management plans. Additionally, development of adaptation plans for each forest type according to their biophysical vulnerabilities to climate change will help in developing not only the adaptation but also augment sequestration.
2. **Enhancing the levels of forest conservation and afforestation, reforestation through viable PPP models:** This will entail 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 envisaged in GIM, 2010). This is envisaged to

lead to conservation and development of Carbon sinks. Undertake surveys to demarcate forest corridors and take measures to protect and develop them Some pilot projects may be undertaken to identify market based opportunities for forest conservation like REDD+ , CDM etc. Further, for creation of livelihood opportunities, activities related to biodiversity conservation like PPA and MPCAs and community conserved areas.

3. **Prioritizing soil and water conservation measures in forest management to reduce soil erosion:**The activities that can be carried out within the strategy can include promotion of soil and water conservation practices, promotion of agro-forestry to increase forest biomass and hence soil moisture. MNREGA activities may be used for water recharging in water head areas in the forests to ensure water flows in rivers originating in forests. Additionally, conservation of lakes and wetlands as outlined in the Green India Mission, may be pursued for improving the soil and water conservation as well as forest and biodiversity conservation.
4. **Promote Research to understand the impacts of CC on forest products and associated livelihoods:** For more understanding of climate change concerns for the states forest types and biodiversity, extensive research is required. Promote research on gene pool conservation, developing policy frameworks for seed certification, biodiversity conservation, forest certification, assessment of sequestration potential of indigenous species, nurseries for conservation of indigenous species, documentation of changes observed in biodiversity and wild life due to CC; and research and documentation of initiatives like PPAs, MPCAs,community conservation areas, ITK etc.
5. **Capacity building:**To integrate climate change concerns in forest planning and policy, training of forest managers is essential for better decision making.
6. **Introduce alternate source of energy**for forest dwellers, to avoid pressure on forests vis a vis over extraction of fuelwood.
7. **Protecting livelihoods dependent on forest products:**Enhance production of forest-based biomass in the form of food, fuelwood, grass/fodder, timber, bamboo, cane and NTFPs. The augmented ecosystem services like water flows, biodiversity and carbon pools would further provide opportunity for augmenting incomes. Rich biodiverse and cultural landscapes could provide the potential to build up community-based eco tourism enterprises.
8. **Enhance green cover outside forests:** This programme needs to give further impetus to social forestry, agro forestry, trees outside forests such as along roads, gardens etc., and community forestry. These actions are expected to lead to enhanced C sequestration.
9. **Prevent forest fires due to increase in temperatures across the years and create corridors for species migration:** Enhanced forecast, and management of forest fires is required.It can be done through linking of protected areas, connecting fragmented forests with “Canopy Corridors” and “Flyways” to assist species migration. Corridors will be prioritized and maintained by local stakeholders. To secure corridors for species migration to adapt to climate change.

6.2 Water

6.2.1 Background

Rainfall is the major source of water in Madhya Pradesh, and it receives on an average about 1162 mm annually, which is relatively a high rain fall amount compared to the receipt by the most of the other states in India. Maximum rainfall occurs in the monsoon period from June to September. The receipt of rainfall is however variable across the state. Very dry areas in the north, north-west and south west receive rainfall as low as about 637mm annually and very wet areas in the south east receive on an average 1673 mm.

The state has a semi arid upstream topography with all the major rivers flowing outward from the state. Further it has poor quality soils of low depth and high slopes and some black soils of medium to deep soil depth with flat slopes. The underlying layer is an impervious hard rock. All these factors make the underground storage capacity low, even if it receives medium to high levels of rain across the state. The soil and river basin distribution is shown in figure 6.2.1 and 6.2.2

Therefore over exploitation of mainly underground water for irrigation has rendered many areas dry, with minimal development of surface water resources. Also water use efficiency in irrigation is generally very low and it is an area of major concern. This makes it imperative to make serious efforts to reduce the gap between potential and actual irrigation.

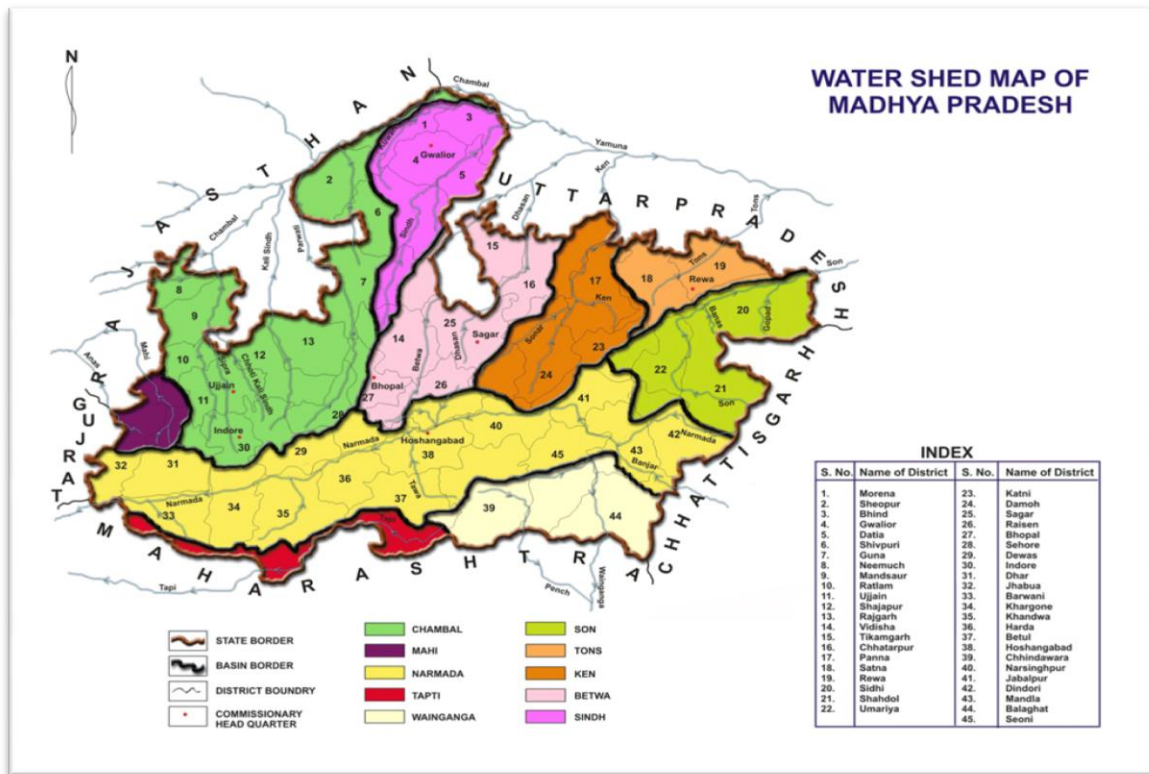


Fig.6.2.1 Watershed/river basin map of Madhya Pradesh

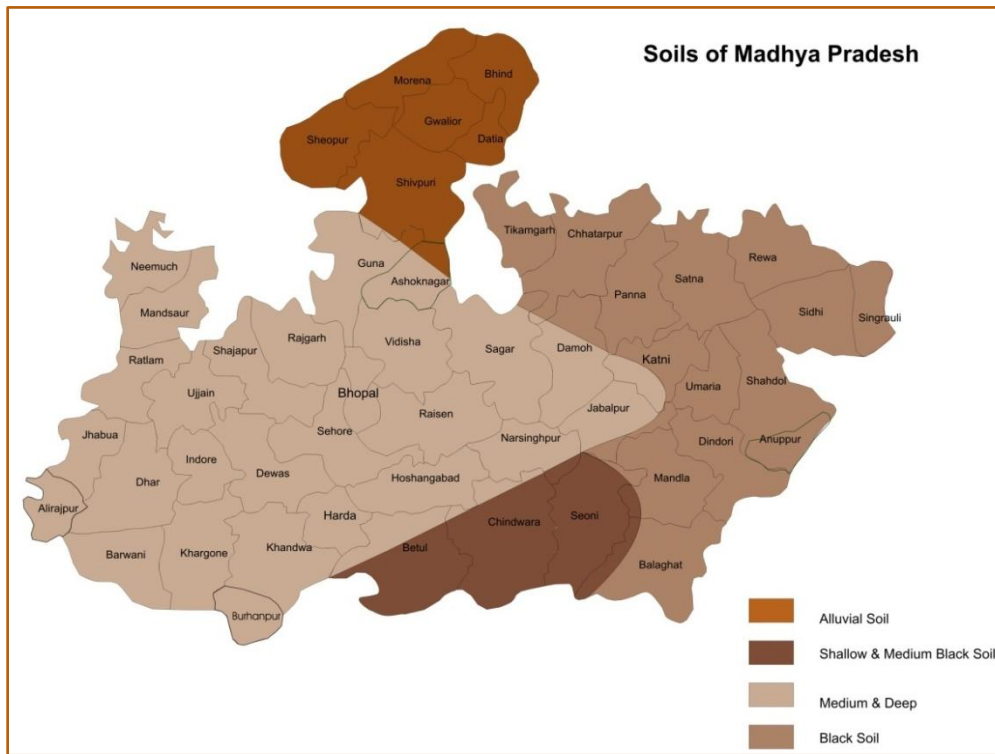


Figure 6.2.2 : Soil Map of Madhya Pradesh

6.2.2 Status of water availability in the state

Surface Water-The annual surface water availability is 81.5 lakh hectare metres with a developed irrigation potential of 20.59 lakh hectares. Ujjain division has the largest number of tanks and village ponds in the state (WRD, GoMP). However, the high annual evapo-transpiration rate 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.

Underground water-The total available ground water resources in Madhya Pradesh have been estimated at 50.5 lakh hectare meters. About half of this is used for irrigation. Groundwater resource conditions vary widely across the state. Most of these are in either gneissic terrain or in old indurated sedimentary areas with low primary porosity with aquifers in fractured zones. These aquifers are often small and dispersed along the fractured zones with secondary porosity. Poor quality aquifers constitute almost 70% of the area while medium quality aquifers cover 21%. Thick alluvial beds are found in the northern part of the state and along the valleys of the major rivers. These form excellent aquifers but constitute only 9% of the area.

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. Dugwells, predominant in this region, often dry up in the summers leaving farmers dependent on a single crop. This may be supplemented with an un-irrigated pulse crop in the winter. The state faces droughts and crop failures almost every year in some part of the state. Till date 7 major, 102 medium and 3237 minor dam irrigation projects have been completed with a design irrigation potential of 37,75,790 ha. and an actual potential of 25,45,970 ha. This low utilization is primarily due to the terrain situation in the state because of which it cannot make use of its share of water resources through canal irrigation from rivers without large investments.

6.2.3 Water Supply scenario in the state

Rural water supply for domestic use including drinking water -Traditionally, the settlements in rural areas have used the surface water sources in their vicinity for the purpose of domestic use which includes drinking water, bathing, washing, and water for animals. Only in the last 25 to 30 years slowly the villages have shifted to the utilization of water from surface water to ground water through wells and hand pumps for their domestic purposes. Stored surface water in terms of lakes and ponds still exist but are used only for washing the animals and washing clothes.

70% of the water supplied to rural areas is from underground sources. Here, drinking water supply is made through hand pumps and through piped water supply schemes. Piped water is normally provided for villages having population above 2000.

In 2003, out of the 1.26 lakh independent habitations in rural MP, 75.31 thousand were fully supplied safe drinking water by the PHE. About 19.49 rural habitations did not receive safe drinking water and therefore fell under not covered category and 31.38 thousand habitations were partially covered. In 2006, the partially covered habitations reduced, this was mainly due to the fact that these habitations were not receiving the adequate amount (40 litres/day/person) as per the norm instituted by the government of India and also due to the fact that in some rural habitats covered by ground water, over exploitation of the same and recurrent droughts had rendered their habitats dry However the full coverage increased in 2006 and a total of 99.86 thousand habitations were fully covered.

Urban water supply -Thirty percent (30%) of the water supply in the urban areas comes from underground sources and the rest from over ground reservoirs and rivers. Out of the 336 town in MP, majority of the town i.e about 40% receive water less than 40lpcd and 26% of the town receive water between 40-60lpcd., Only 8 town receive water between 80-100 lpcd and only four towns, namely Bhopal, Indore, Jabalpur and Gwalior receive water above 100 lpcd.

6.2.4 Water for irrigation

The trends in irrigation are shown in Table 6.2.1 between 1977-78 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. In 2004-2005, irrigation through canals covered only 1/4th of the area covered by ground water.

Year	Groundwater	Canals	Tanks	Others
1977-78	878	1025	147	187
1989-90	1718	1400	147	405
1989-99	3650	1054	142	821
2004-2005	4106	1041	127	919

Table 6.2.1 Trends of irrigation in MP in '000 ha (Source: Department of Agriculture, GOMP)

6.2.5 Water 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 constructed and are underway. 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 main active relevant area, apart from the Narmada Valley Development Authority, is the MP Water Sector Restructuring Project (WRSP) funded by the World Bank (Rs 1919 crores) between 2006-2011. It is aiming 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 link projects (Ken-Betwa, MOU signed) and the Parawit Kalsindh-Chambal links 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.

6.2.6 Current Concerns in 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 underground water. Similarly, 95% of the water used for industries and domestic purposes is also obtained from ground water. 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 and the fact that the underground water earmarked for drinking water are also drying up, the rural water supply from ground water is under stress.

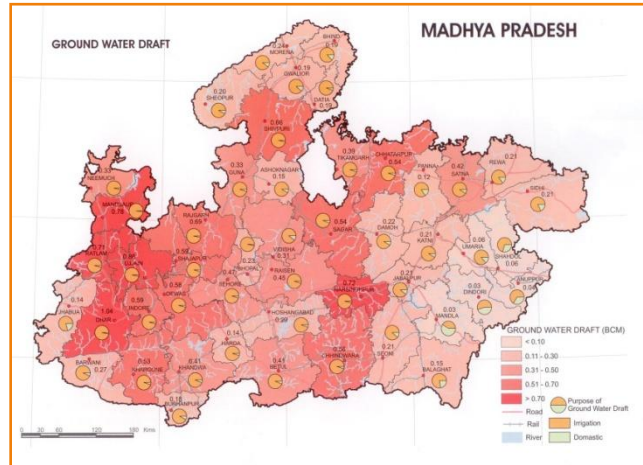


Figure 6.2.3: Ground Water Draft(Source: MP Resource Atlas, MPCST)

Between 1998 and 2004, there has been a 15.3% rise of water draft from underground water sources in MP. Increasing demand for water for human consumption, agriculture and industry, coupled with erratic rainfall which lead to supply problems. Erratic surface run-off during heavy rainfall and uncontrolled disposal of sewage and excessive fertiliser use causing flood and pollution.

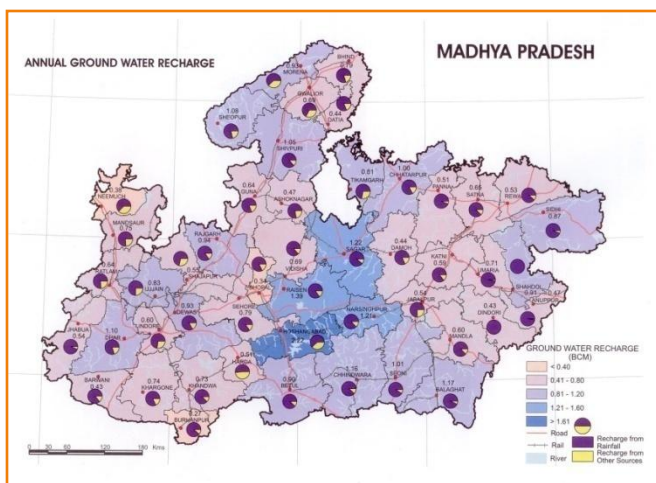


Figure 6.2.4: Annual Ground water Recharge

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

In many regions/districts groundwater is being depleted at an alarming rate-encouraged by highly subsidised electricity etc. and the same needs to be checked

either by law or by tariff. Continuous efforts need to be made to reduce the gap between potential and actual irrigation. The total underground storage of rainfall through major and minor irrigation dams is

quite small. High evapo-transpiration rates of surface water which at times is double the precipitation received, leads to loss of soil moisture and surface water as well. High rates of runoff due to topography also makes most of the rain water received go waste. Low capacity of natural water recharge in the subsoil in most of the areas of Madhya Pradesh is also a major concern.

Trends of over exploitation of ground water are seen in some districts such as Indore, Ratlam, Mandasaur, Sagar, Shajapur, and Ujjain. Districts such as Dhar and Neemuch also have reached a critical stage as they have already drafted more than 90% of the available ground water in their district. About 15 more districts across the state are in semi critical stage as they have exploited more than 50% of their ground water resources. Overall the irrigation in about 50% of the districts in MP is heavily dependent on underground water.

6.2.7 Key Concerns in water sector

Our analysis of observed rain fall data for the period 1961-2003 indicates an already decreasing annual trend (see relevant figure in chapter 4 of this document). 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 underground water recharge over the years, but the increase in heavy precipitation events leading to higher run off are also not facilitating adequate underground water recharge. Therefore overdependence on ground water for irrigation in the state is a matter of concern.

Further, The SWAT model run made by Gosain et al, 2010, to obtain the projections of freshwater components i.e., blue water flow (water yield - quantified rain fall plus deep aquifer recharge), green water flow (actual evapotranspiration), and green water storage (soil water) at a sub basin level with daily weather data for all river basins of India for baseline (1961- 1990) as well as GHG scenarios near term (2021 – 2050, IPCC SRES A1B) and long term (2071 – 2098, IPCC SRES A1B) (see Figure 6.3), indicates that the green water flow, i.e actual evapo transpiration is likely to increase, and the green water flow i.e storage in soils is likely to decrease. Also the water yield plus storage in deep aquifers is also likely to decrease in 2030s i.e 2021-2050s.

6.2.8 Strategies to address concerns of climate change in water sector

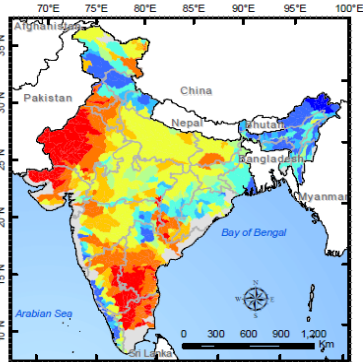
The main goal is to make adequate water available for all uses in the state even in the changing climate scenario. The following strategies and action are likely to ensure water security in the state

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 better adaptation strategies, better management of action plans, and assessment of water availability and demand by various sectors in the future. Detailed actions to be taken are listed in the strategy table at the end.
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 rain water for domestic water use in rural areas needs to be promoted. Additional activities are indicated in the strategy list.

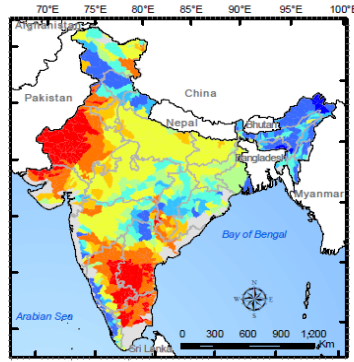
- 3. Promote Recharge of ground water with special focus on over exploited areas and promote soil conservation to avoid soil run off, soil degradation and enhance water conservation:** Particular attention should be given to artificial recharging of groundwater in over exploited regions. Since in most areas of the state the underlying rock layers are poor aquifers, the fractured rock spaces should be identified and shaft recharging techniques adopted to divert the surface water into these after proper filtering. The Central Groundwater Board 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 which have become moribund should be the focus.
- 4. Improve supply and demand management for efficient and judicious use and need based distribution:** Establish water authority Investigate new regulatory structures with entitlements and prices to adopt water efficient, and innovatory 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. Incentivise water efficient technologies. Undertake mandatory water audits
- 5. Promote basin level integrated water shed management:** Undertake integrated water shed management in identified areas within a basin where livelihood opportunities are being affected due to changes in water resources due to climate change
- 6. 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.
- 7. 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.

Blue Water Flow (mm/yr)

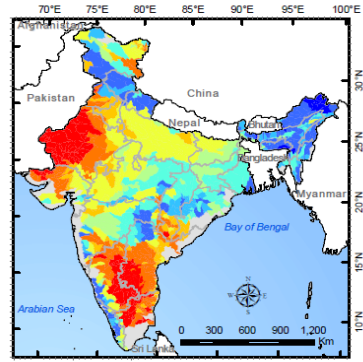
IPCC SRES Baseline *



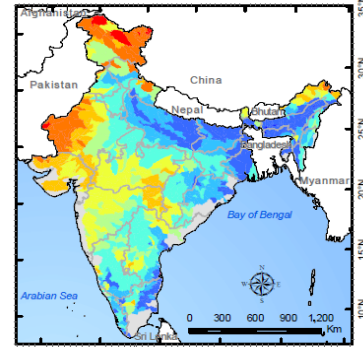
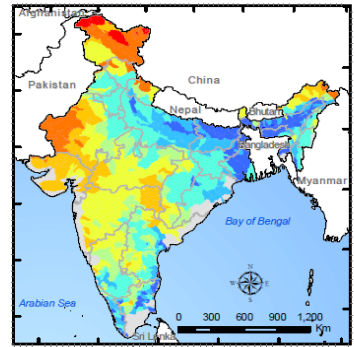
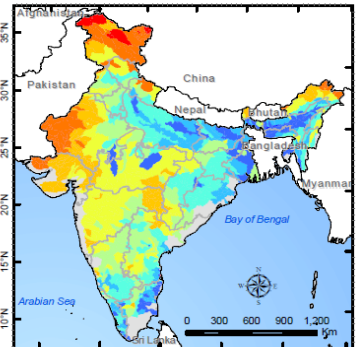
IPCC SRES Mid Century *



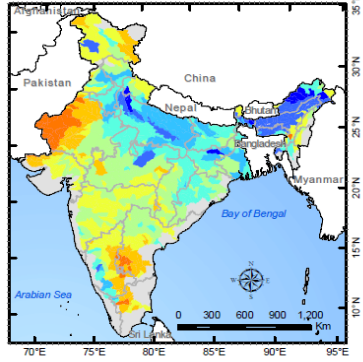
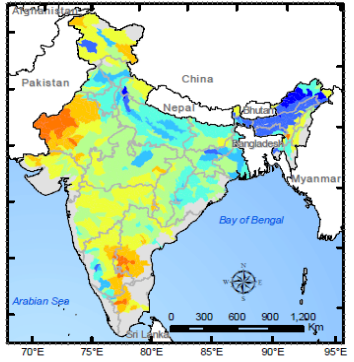
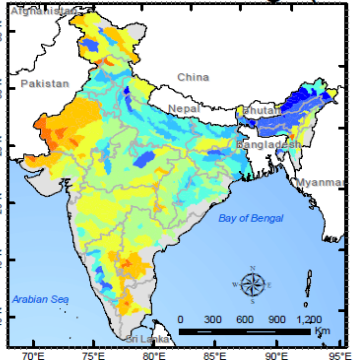
IPCC SRES End Century *



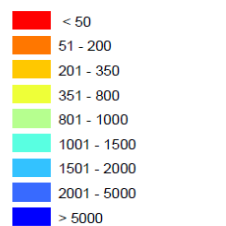
Green Water Flow (mm/yr)



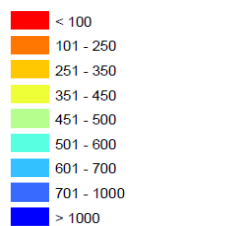
Green Water Storage (mm/yr)



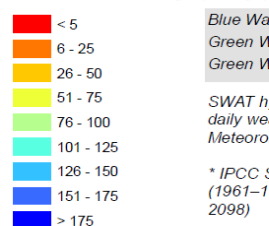
Blue Water Flow (mm/yr)



Green Water Flow (mm/yr)



Green Water Storage (mm/yr)



Blue Water Flow (water yield + deep aquifer recharge)

Green Water Flow (actual evapotranspiration)

Green Water Storage (soil water)

SWAT hydrological model results simulated using PRECIS RCM* daily weather datasets provided by the Indian Institute of Tropical Meteorology, Pune

* IPCC SRES A1B Scenarios (Q14 QUMP ensemble) - Baseline (1961-1990), Mid Century (2021-2050) & End Century (2071-2098)

Analysis and Layouts prepared by IIT Delhi in association with INRM Consultants

Fig.6.2.5 Projections of water flows in 2030s and 2080s, Source: Gosain et al., 2010

6.3 Agriculture and Allied Services

6.3.1 Background

Over 2/3rd of the population living in Madhya Pradesh are engaged in agricultural and allied activities covering agriculture, horticulture, fisheries, animal husbandry and dairy development. This sector contributes about 30% to the state GDP and the per capita staple food production is amongst the highest in India at 26.62 kg next only to Punjab and Haryana⁶. However, a sizable population engaged in this sector lives below poverty line, which is a matter of concern and a challenge for the state, as even in the near future agriculture is likely to remain the mainstay of livelihood in Madhya Pradesh.

The high levels of poverty of the population engaged in this sector are multiple, and mainly due to lower productivity and not enough returns from the sector they are engaged in. The causes of lower productivity can be attributed to agricultural practices and some mal implementation of policies. Factors such as underutilisation of land – large tracts of land are fallow and underutilised including the fact that land is kept fallow in Kharif and only mono cropping in Rabi season for many areas in Madhya Pradesh have contributed to under realisation of potential productivity of crops from the state. Similarly, over exploitation of underground water for irrigation due to subsidies in price of electricity and pump sets has depleted the availability of water for agriculture. Repeated harvesting of cash crops such as soya bean and cotton in some areas has led to deterioration of productivity of the soil. Access to markets at the moment is poor. Capacity of marginal 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.

Realising that the upliftment of agriculture economy of the state is a way forward for reducing rural poverty, the Madhya Pradesh Government aims to maximise agriculture production and productivity and make it profitable proposition for the farmers. In this context it has set up an **“Agriculture Cabinet”** in 2011 with the objective to steer an integrated agriculture development in the state leading to rapid agriculture growth and prosperity of the population associated with this sector. See Box 6.3.1 indicating the key roles of the Agriculture Cabinet.

Box 6.3.1 Policies propagated by MP Agriculture Cabinet

- 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 kudu-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, DNA finger printing facilities, and bio technology laboratories in the state.

⁶ Agriculture statistics of MP, 2009-2010

6.3.2 Agricultural Crops

Of the total geographical area of 307.55 lakh ha in Madhya Pradesh, 66% or 203.6 lakh ha is gross cropped area and 49% or 151 lakh ha is the net cropped area⁷. Cereals cover 42%, pulses 21%, oil seeds 21% and commercial crops occupy 3% of the total gross cropped area. Rest of the cropping area is covered by vegetables, fruits, fodder and medicinal plants. The total irrigated area of the state is 43% and 70% is rainfed.

The Kharif area is 52% of the cropped area Rabi is 42% of the total cropped area. As per Census 2001, the total land holding is 73.60 lakh ha and of this 65% is held by small and marginal farmers, occupying only 26% of the cultivable agricultural land and the per capita land holding has reduced by -33.89% between 1996-97 to 2005-06. The cropping intensity is 135% which is amongst the lower end of the cropping intensity of all states in India, which of course varies across the state from highest value of 176% in Harda to 108% in Bhind district.

The main cereal crops grown in MP are jowar, maize, wheat, rice and various kinds of millets. The main pulses are red (tuar), black (udad), green (mung) and Bengal (chana) gram. The main oilseeds are sesamum, groundnut and soyabean. Cotton is main cash crop Figure 6.3.1 shows the level of yields and production areas of the major crops in MP.

As indicated in Chapter 4, entire Madhya Pradesh region is divided in 11 Agro climatic zones (ACZ), having distinctive climate, soil and water availability, conducive to growth of crops most suitable to the specific conditions. However, with farm inputs such as fertiliser, irrigation, all regions are now in a position to grow most of the crops. However, crop planning, keeping in view the agro-climatic conditions can optimise production potential of all the 11 ACZ. Table 6.3.1 indicates the current status of land use, net irrigated area, soil types, types of crops grown, access to banking and farm mechanisation.

6.3.2.1 Current GoMP policies, programmes, projects and service delivery Institutions

Some of the policies and programmes initiated by the government for improving crop productivity in the state include the following:

- Embracing National policies such as the National Agriculture Policy, 2000; National seeds policy 2002; Agriculture Marketing Reforms; Protection of plant varieties under Trade related Intellectual Property Rights, 2001;
- Extending irrigated areas over the years
- Providing subsidies on electricity tariff and pump sets
- Undertaking 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, reducing cost farm inputs
- Undertaking two externally aided projects which are aimed towards enhancement in women's income through adoption of low input cost and effective technologies and on watershed development
- Propagating soil and water conservation measures over large areas through integrated farming systems and watershed development involving communities in decision making for management of the resources. This is indigenisation of the National Watershed Development Programme for rain fed Agriculture

⁷11th Five year plan, GoMP, 2007

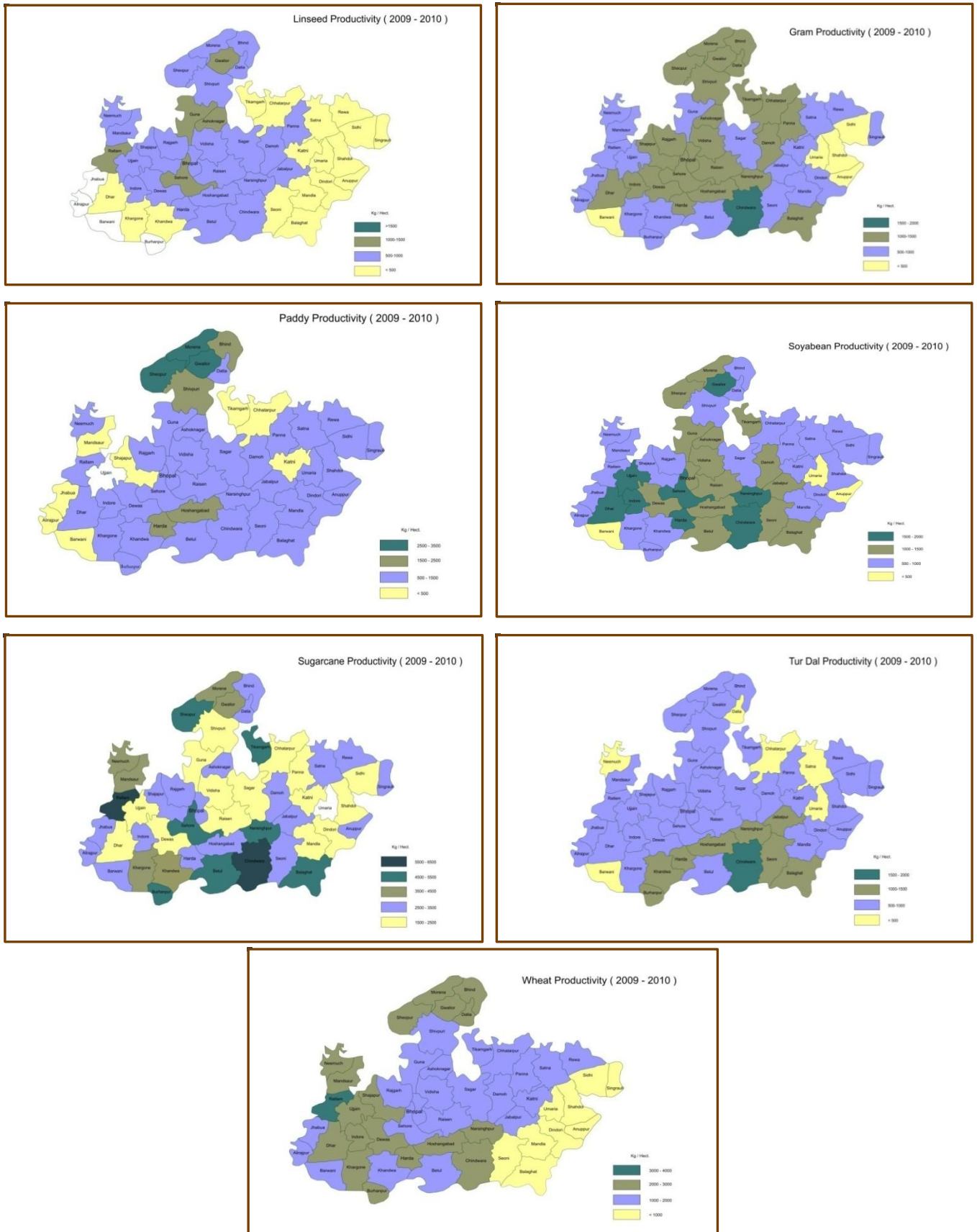


Fig.6.3.1 Yield and Production areas of Major crops in MP

6.3.2.2 Current concerns of Agriculture Sector

Most of the ACZ regions are affected by low availability of water for irrigation. This is mainly because, 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, even if it receives medium to high levels of rain across the state.

The policy thrust on increasing productivity by increasing irrigation has been mainly through underground water exploitation. Providing electricity to framers at a subsidised rate for the operation of pumps and subsidised loans to purchase these pumps and other accessories has led to overexploitation of good water. Consequently the groundwater situation in the state is a cause of concern. Though about 30% of the cropped area is irrigated⁸, but the facilities that exist function at 50% of their potential. 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 exists short fall in service delivery targets of the government to the rural communities such as those of 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 drives⁹.

Some farming practices such as repeated cultivation of certain crops - Soybean, and expansion of area of cultivation under this crop is leading to rapid decline in soil fertility. It is also leading to the extinction of some of the indigenous drought resistant legumes such as oil crops and coarse grains which are being replaced by soyabean, and these varieties could be a tool of adaptation in severe drought conditions to ensure food security. Also mono cropping makes the crops susceptible to failure if there is any change in the required climate conditions for optimal production. Therefore intercropping and crop diversification might be an useful adaptation practice that should promoted across the state.

The policy of organic farming of the government is a welcome more to avert the ill effects of synthetic fertilisers, however, unless integrated farming practices followed by integrating with livestock rearing, fisheries and horticulture, these programs may be jeopardised as adequate organic fertilizer may not be available otherwise

The state has had stagnant production of hardy species of some pulses, oil seeds such as ram til and alsi, and millets such as ragi, and minor millets such as kodu-kutki which are grown using organic fertilisers. 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 productivity.

Also accessibility to high level of mechanization such as tractors, thrashers, grinders that add value to the crop harvested, are not very well developed in the different agro-climatic zones of Madhya Pradesh. This in tandem with accessibility to markets is the requirement for improving livelihood of the population associated with crop husbandry. A brief description of some of the concerns affecting agriculture in the different agro-climatic regions in Madhya Pradesh

⁸ Pg. 12, Compendium of Agricultural statistics, 2006-2007, Madhya Pradesh, Farmer Welfare and Agriculture Department

⁹Pgs. 141 to 143 of Compendium of Agricultural statistics, 2006-2007, Madhya Pradesh, Farmer Welfare and Agriculture Department

Box 6.3.2: Current concerns of the 11 ACZ in Madhya Pradesh

Chattisgarh plains and Northern Hill region of Chattisgarh: In both the ACZs, the soil type and high slopes limit agricultural production in this region. The net sown area is low and the irrigation percentage even lower. Access to farm mechanisation and banking is low. Fertiliser application is low. The regions has a substantial tribal population with very low landholdings and a high proportion of forest area.

Kaymore Plateau: Agricultural potential is higher. The net sown area is 45% and the irrigation percentage too is better at 28.8%. Mechanisation in farming and access to banking and fertiliser application are higher though still well below desirable levels. The region has a fairly high tribal population with very low landholdings and the proportion of forest area is high.

Central Narmada Valley: Has deep black soils of very high quality and produces the highest quality and quantity of wheat of both the irrigated and the dryland variety. This area is also the highest producer of soyabean. The net sown area is 54% and the irrigation percentage is 65.5% primarily due to canal irrigation from the Tawa dam. Mechanisation and access to banking is high. Introduction of soyabean - irrigated wheat monoculture has led to a decline in the diversity of crops sown and also leaching of soils due to over application of water and chemical fertilisers. The region has a relatively high scheduled caste population that is mostly landless or with marginal and small landholdings.

Vindhya Plateau: This region has a mixture of medium and deep black soils of moderately high quality. The net sown area is high at 49.6% and the irrigation percentage is good at 40.6% and is mostly from ground water which is a cause for concern. Mechanisation and access to banking is high. Here too the soyabean - irrigated wheat monoculture has led to a decline in the diversity of crops sown and also leaching of soils due to over application of water and chemical fertilisers.

Gird: Has a light alluvial soil of moderate quality. The net sown area is high at 57.8% and the irrigation area is 45.8%. Mechanisation and access to banking is high. The region also has a relatively high land less scheduled caste population or has marginal and small landholdings working for large land holders. The region is well connected with national and international markets.

Bundelkhand: Has mixed red and black soils of medium depth and moderate quality. The net sown area 51.8% and the irrigation percentage too is 57.3%. Mechanisation and access to banking is good. The region also has a relatively high scheduled caste population that is mostly landless or with marginal and small landholdings. The region is well connected with national and international markets that should facilitate a shift to organic agricultural production.

Satpura Hills: The soil is shallow black and of medium quality. Agricultural production is at middle level. The net sown area is on the lower side and the irrigated area even lower. Mechanisation and access to banking is of a medium level. The region has a substantial tribal population with very low landholdings and a high proportion of forest area. The tribals of this region have been subjected to displacement repeatedly due to the construction of dams, power plants and mining projects and the setting up of national parks and wildlife sanctuaries.

Malwa Plateau: This region has black soils of medium depth and moderately high quality and has an agricultural pattern that is unique and the most advanced in the state. The net sown area is very high at 65.8% and the irrigation percentage too is good at 35.9% though it is mostly from groundwater and this region has been declared over exploited. Mechanisation and access to banking high. Soyabean - irrigated wheat monoculture has led to a decline in the diversity of crops sown and also leaching of soils due to over application of water and chemical fertilisers. The region also has a high population of landless, or marginal and small landholdings

Nimar Plains: This region has black soils of medium depth and moderately high quality and has an agricultural pattern that has retained the bio-diversity in the kharif crops. The net sown area is very high at 49.2% and the irrigation percentage too is good at 44.6%. In Harda it is mainly through canal irrigation from the Tawa dam but elsewhere it is mostly either from ground water or from lifts from the River Narmada. Some districts in this region have been declared over exploited in terms of ground water extraction. Mechanisation and access to banking is moderate. The region also has a high scheduled tribe population that has marginal and small landholdings of lower quality lands.

Jhabua Hills: This region has shallow black and skeletal soils of moderate to low quality and so agricultural production is low. The net sown area is very high at 54% but the irrigation percentage is only 15.1% through ground water and lifts. Mechanization, access to banking and use of fertiliser is low indicating that the tribal dominated region is lagging in agricultural development.

6.3.2.3 Key Concerns in Agriculture Sector

Current observations of climate indicate a gradual increase in temperatures in all seasons and decrease in rainfall in all the agro-climatic zones during the monsoon period (figure 4.1a and b of this document), with erratic and uneven spatial and temporal distribution of rainfall with increase in frequency of heavy precipitation events¹⁰. Records since 1991-1992 to 2005-2006 show that MP is affected by droughts quite frequently, in fact since 2001-2002 droughts have been occurring every year covering 32 to 33 districts, including districts like Balaghat which is a high rainfall area¹¹.

Climate projections indicate further increase in temperatures by 2050s and an uneven distribution of rainfall across the state, with perceptible decrease in rain fall during winter period and almost no change in rainfall during monsoon (Figure 4.6, this document) 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). Gradual increase in temperature, increase in frequency and intensity of droughts is likely to shift the cropping centres and have severe impacts on the productivity of crops as evapo-transpiration rates increase leading depletion in moisture retention capacity of the different soil types.

On the other hand, increase in intensity of rain fall is likely to lead to faster run off causing higher soil erosion in the ravine areas and with little or no scope of ground water recharge in the alluvial plains causing further depletion in the underground water tables in MP. The status of soil health¹² and its fertility is likely to deteriorate further with increase in soil erosion and higher temperatures, causing C 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 is likely to affect the cropping sequence and sowing time. Therefore even if the farm inputs are continued to be provided adequately through development of an effective delivery mechanism, but as productivity of crops is an integrated process of right conditions of climate as well as farm inputs, the changes in climate in the future may lead to conditions which may not support sustainable crop production.

6.3.2.4 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 potential for natural water storage in the state. Therefore for sustaining agriculture productivity that is profitable, it is imperative to avoid a water scarce situation. Hence, moving towards a more water saving 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 increasing the fertility of the soil as well. Also measures like *SRI* for rice, use of cultivars using lower water etc., may be encouraged. Alternative water use technologies have to be explored to lower utilization of water for sugar cane farming.

2. Planning cropping systems suitable for each agro-climatic zone: Since each agro-climatic zone has different soil type, water resources, and climate, that supports best a set of crops and cropping system, therefore it is imperative that the state moves towards integrating climate change concerns of each agroclimatic region that range from dry land to humid and forest-linked agriculture and promote agro-climatic specific practices and management including that of water, soil, crops, cropping cycle, cropping practices, and management of pests and diseases to harness the full productivity potential of the different zones. This would also mean capacity building

¹⁰ Goswamy et al., 2006

¹¹ Pg 144, Compendium of agricultural statistics, 2005-2006, , Madhya Pradesh, Farmer Welfare and Agriculture Department

¹² 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

of the officials managing agriculture in the state for integrating climate change concerns in their planning as well as implementation and management of programmes. Similarly capacity building of extension workers to factor in climate change concerns in their extension trainings for farmers to understand the implication of changing climate in the short term and climate change projections in the long run and the different measures that they need to use for sustainable crop husbandry in their respective agro climatic zones.

3. Capacity building for sustainable agriculture:Capacity building of planners, extension workers, farmers association etc on sustainable agriculture practices should be plan so that they have better understanding of regional and sectoral climate change concerns.

4. Management of risks for sustainable productivity:In some of the regions the monocropping of soyabean-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 traditional practices like *inter cropping, multiple cropping and crop rotation* may be encouraged. Further the use of organic farming may be encouraged by promoting *integrated farming* where by livestock rearing, horticulture and fisheries is practiced. A detailed agro-climatic zone specific plan for the development of organic agriculture, certification and marketing aimed at servicing export markets will have to be drawn up and institutional support made available. Provide *advance information on local climate* that accommodates the changes in temperature, precipitation amounts and onset of monsoon. Also capacities should be built to provide related information to the farmers through agrinet media such as cell phones and radio. Promotion of indigenous varieties of crops may be taken up in the state that has 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. Promote *forest linked farming systems* in areas where forest cover is substantial.

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, 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 increase capacity in the state to run climate models, decipher 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. to design appropriate adaptation strategies.

6. Agriculture Information management: For maximising productivity even in the context of 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, but it might be at the back end linked to various agencies that actually produce the data. This will be necessary not only for the farmers to access but also for formulating informed decision making.

7. Additional impetus to mechanization and accessibility to markets:Accessibility to markets need to be developed further and provided institutionalized support in the form of greater infrastructure for taking produce to the markets.

8. Creation of rural business hubs: 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.

9. Impetus to climate change relevant research and development:Training of planners, extension workers, farmers association etc. on sustainable agricultural practices in the context of climate change for better understanding of the agro-climatic zone specific understanding of climate change concerns and concerns and for integrating CC concerns in planning for agriculture.

6.3.3 Horticulture

6.3.3.1 Background

Crop diversity is essential for agriculture economy, and cropping of horticulture crops brings in the incomes to the small and marginal farmers. The productivity and production of these crops is gainful for these farmers even with minimal farm inputs, as these being perennial, they check soil erosion and provide high density green cover to the soil, enabling cultivation of some of the crops even in waste land not suitable for agriculture. All the 11 agroclimatic zones in MP are suitable for horticulture production. However in the national scenario Madhya Pradesh is only number one producer of oranges and garlic, therefore production of other horticultural crops can be expanded further.

In 2005-2006, the total area covered under horticultural crops in MP was 3.25% of the total cropped area comprising of 646.0 '000 ha. Of this 309.81 '000 ha were under spice cultivation, 246.22 '000 ha under vegetable cultivation, 63.23 '000 ha under fruit cultivation, 22.9 '000 ha under medicinal plants and 3.80 '000 ha under floriculture.

The productivity of vegetables though large, its cropping intensity between 1982-83 and 2005-06 by 5.9% has increased nominally. Where as the cropping intensity of fruits has increased by 57% during the same period. The cropping intensity of spices indicate whopping increase 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 however is showing a decline by -7.8% mainly due to decrease in area under production of these crops. Flowers such as roses, gladiola, tube rose, marigold, chrysanthemums, glardia and aster are mainly grown in Bhopal, Indore, Ujjain. Dewas, Dhar, Betul and Ratlam.

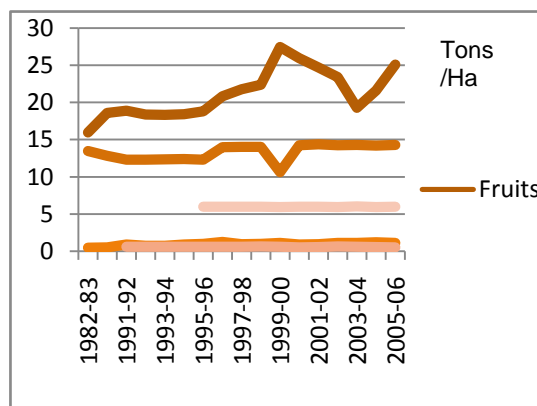


Fig.6.3.2 Cropping Intensity of Horticulture Crops

Agro-climatic region wise production of horticultural crops such as fruits, vegetables and spices is shown in Table 6.3.2

Agro-climatic region	Horticultural Crops grown
Chhattisgarh Plains	Mango, Chiku, Guava, Lime, Banana, Papaya, Munga, Pomegranate, Colocasia, Aonla in irrigated Condition, Turmeric, Chillies, Ginger, Jack fruit, Ber, in arid condition (all type of 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 Narmada Valley	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	Mandarin and Sweet orange, Lime, under assured irrigation

	and Guava, Ber, Aonla, Custardapple under rainfed condition 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, Chhillies, Turmeric, Flower Marigold, Colecrops & other vegetables
Malwa Plateau	Santra, Acidlime, Mosambi, Grape, Chiku under irrigated conditions, Ber, Guava, Pomegranate, Coriander, Fenugreek and vegetables
Nimar Plains	Mango, Banana, Grape, Papaya, Chiku, Lime, Guava, and Pomegranate in irrigated condition Turmeric, Chillies, Colocasia, Fennel and seasonal vegetables
Jhabua hills	Lime, Mosambi, Ber, Guava, Aonla, Custard Apple, Pomegranate, Seasonal Vegetables

Table 6.3.1ACZ wise Horticulture Crops distribution

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

- 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

6.3.3.2 Current Concerns of the Horticulture sector in Madhya Pradesh

Water is the major constraint for the horticultural crops in the state, particularly during droughts. Considering the perennial nature of fruit tree the impact of droughts is only recognized in the late stage which is most of the time beyond the control of farmers. The rise in temperature has lead to fruit fall in the state in the various fruit bearing crops. There has been increasing incidences of damage to horticultural crops due to abnormal storms and hail storms. Also incidences of diseases such as wilting and top dying have been observed over a period of time and this is mainly attributed to the rising temperatures.

Also horticulture in all the agro-climatic regions is underdeveloped, greater potential of productivity exists. Horticulture processing using such as fruit pulp processing units are scarce. so are the access to markets for horticulture products. Except for oranges and garlic, the markets are not well developed.

6.3.3.3 Key Concerns in Horticulture Sector

A rise in a temperature of above 1°C may shift a major area of potential suitable zones for various horticultural crops. Studies conducted at IISR, Calicut using GIS models have shown that many suitable areas of spices will become marginally suitable for new areas, which are presently unsuitable, become highly suitable for cultivation of spices. This holds good to a variety of horticultural crops, medicinal plants grown in tribal areas.

Because of rise in temperature, crops will develop more rapidly and mature earlier. For example, citrus, grape, melons and mango will mature earlier by about 15 days. Higher temperature will reduce tuber initiation process in potato, reduced quality in tomatoes and poor pollination in many crops. In case of crucifers, it may lead to bolting; anthocyanin production may be affected capsicum. Specific chilling requirements of pome and stone fruits will be affected hence dormancy breaking will be earlier. Tip burn and blossom end rot will be common in tomatoes.

While temperature rises, photoperiods may not show much variation. Onions, a photosensitive crop, will mature faster leading to small bulb size. Strawberries will have more runners at the expense of fruits. Increase in temperature in winters will affect the crops maturing in the winter period. Also pollination will be affected adversely because of higher temperature. Floral abortions will occur.

Soil temperature will increase much earlier in spring hence the planting time also will advance. 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 develop more fasters during the 12 month period. Heat units required will be achieved in much lesser time. Soil conditions may pose problems with an increase in acidity, alkalinity and salinity are expected. Coastal regions can expect much faster percolation of sea water in nland water tables causing more salinity.

6.3.3.4 Strategies for addressing climate change concerns in Horticulture Sector

1. **Promotion of Soil and water conservation technologies and plant protection technologies for improving productivity:** Application of mulching techniques, drip irrigation, micro irrigation practices and other approaches as mentioned in section. As per the requirement of specific horticultural plants, provision for creation of appropriate thermostatic conditions for horticulture plants such as use of shed nets and poly houses for supporting growth of horticulture crops may be encouraged as this is the requirement as temperatures increase.
2. **Develop agri-horticulture systems for securing livelihoods:** Encourage crop diversification and hence promote livelihood security through intercropping of agri crops- vegetables, agri crops-fruits, agri crops- spices, agri crops- flowers etc. Agri crops and fruits may specifically be encouraged in dry land areas.
3. **Develop horticulture policies to 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:** For value addition, processing units and marketing of products need to be developed for rural clusters in different agro-climatic zones.
5. **Adequate 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 of the above strategies reach the small and marginal farmers who are most in need of such help through the formation of cooperative production and marketing cooperatives for these sections.

6.3.4 Livestock and Livestock Products

6.3.4.1 Background

Rearing of livestock in Madhya Pradesh has been a way of diversification of livelihoods by farmers within their agrarian practices. In fact this sector accounts for 12.5% of the overall State Gross Domestic Product. As of 2007 census the total number of livestock in MP stand at 35.6 million including cattle, buffalo, goats, sheep, horses, mules, camels, and swines. Of this population cattle, buffalo, goat and sheep were 21.9, 9.1, 9.0, and 0.38 million respectively. Additionally the population of poultry was 7.3 million. The large population of goat in MP, a small ruminant, and that of poultry reflects the livelihood support it provides to small and marginal farmers.

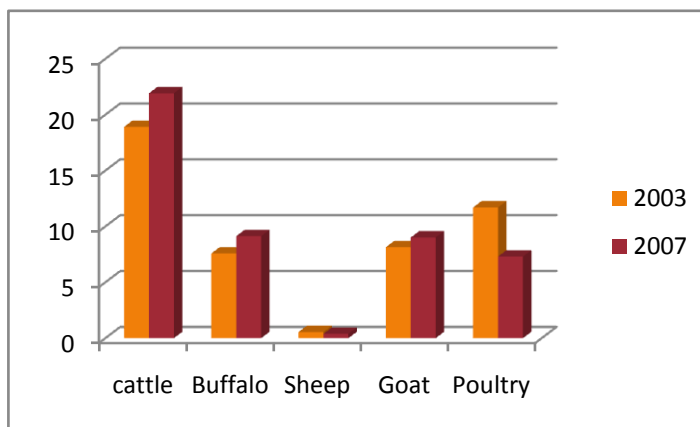


Fig.6.3.3 Livestock Population between 2003-07, Source Annual Report 2010-11, DoAH, GoMP

The trends of growth of key livestock species is shown in figure. There is an appreciable decrease in population of sheep and poultry between 2003 and 2007, and decrease in population of indigenous cattle. The large population of goat in MP, a small ruminant, reflects the support it provides to small and marginal farmers.

The thrust amongst the farmers in MP has been to maximise the milk production and as a result the population of cattle and buffalo is increasing. The growth is mainly attributed to increase in cross bred cattle and buffalo, as the indigenous cattle population has decreased. With increase in cross bred population, the milk production has gone up by 10-12% between 2003 and 2007 with per capita milk availability being one of the highest in India at 262 gm/day. In fact the cattle population in MP accounts for 14% of the total cattle in India and it produces 11% of the total milk in India. There are indigenous species of livestock available in Madhya Pradesh which are adapted to the various agro-climatic conditions of the various regions. Table 6.3.3 lists the different indigenous species.

Breeds	Characteristics	Location	Used for
Malwi Cattle	Muscular body, black colour, sloping back, straight raunches and long tufted tails	Malwa Plateau	Draught power
Nimari Cattle	Long body, red and white mixed colour, long head with raised forehead, straight raunches and strong hooves.	Nimar plains	Good for draught power
Badawri Buffalo	—	Bhind	Milk production (fat-content being 8%)
Kenkatha Cattle	Short muscular body, dark or light slatish colour, strong hooves.	Ken river valley in Bundelkhand	Exotic species of poultry
Jamnapari Goats	Long and high body, long legs, raised head, long ears and hair	Bhind district	Milk
Barbari Goats	—	Western parts of MP	—
Karaknath Chicken	Black colour, squat shape and slatish	Jhabua district	Human food

Table 6.3.2 Indigenous livestock breeds of MP

6.3.4.2 Policies and programmes

The animal husbandry department aims to achieve overall growth between 6-7% per annum during the 11th plan and therefore has devised programmes towards animal health care, breed improvement, preservation and development of superior indigenous germ plasm, and generate employment through investments in animal husbandry sector. Some of the programmes and initiatives it has undertaken to achieve these goals and to prevent the spread of zoonotic diseases to human population include:

- Special livestock programme ,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, of silopits, bullock pairs, Kadakanth chicks etc.
- Establishment of veterinary dispensaries and upgradation of veterinary hospitals, strengthening of Artificial Insemination (AI) labs, establishment of controlled cattle breeding farm and strengthening of veterinary institutions and infrastructures amongst others
- The government through its organic farming policy is encouraging animal husbandry department to promote research and development on bovine diversity and dry dairy farming which in turn will provide organic inputs for farming
- Breeding policy of the state recommends indigenous milch breeds of cattle and buffalo for the rural areas and cross breeds for semi urban and urban areas; and sterilisation of non-descript animals.

6.3.4.3 Current concerns of the livestock sector

The large numbers of livestock do not translate into income, as about 50% of this number is for draught purpose. Poor quality breeds raised on open grazing in general render the livestock underfed as well as nutrient deficient. This is mainly because the agricultural land is in completion for producing crops rather than producing the same along with quality fodder. Further, lack of easy market and infrastructure facilities for livestock based products does not allow this comparatively higher per capita availability of livestock to get translated into money value.

A plethora of diseases is affecting livestock in Madhya Pradesh. Breeding is done in an indigenous manner in rural areas though the government has a strong artificial insemination programme for improving the breeds.

Type of livestock	Prevalent disease
Cattle and Buffalo	Bull cirrhosis, Haemorrhagic septicaemia, Black quarter, Foot and Mouth Disease, Pedis Petis Ruminant
Small Ruminants	Enterotoxaemia, Goat pox, Trypanosomiasis, Babesiosis
Poultry	Ranikhet disease. Gumboro disease, Merek's disease, Fowl Pox, Avian influenza (Bird flu)

Table 6.3.3 Prevalent disease of Livestocks in MP

Infertility cases are reported due to mineral deficiency. Indigenous cattle keeping is becoming uneconomical due to longer inter-calving period. Low productivity despite having good germ-plasm due to lack of awareness on good practices. Further the nutrient in the feeds of the livestock is not enough as mostly the farmers leave their animals to graze instead of stall feeding them with feed having enough nutrients. The agriculture operations in MP is mainly depend on draught power. With decline in male animal population it is becoming difficult to manage agriculture.

There is lack of awareness amongst farmers on good practices of livestock rearing. Quality of livestock has deteriorated because of inbreeding, though policies of the government are otherwise.

The policy of the government promoting cross bred in urban areas and indigenous cattle and buffalo in rural areas seems flawed in the face of decreasing population of indigenous varieties. Therefore the small ruminants largely remain the backbone of livelihood support for the rural agrarian population, mainly that of small and marginal farmers and the landless.

The policy of the government is towards sterilising non-descript livestock instead of improving their lot by providing better quality feed. In fact this might be possible if forest litter is also made available to the livestock as feed in addition to feed available from agricultural land.

Water for livestock is also an issue. The demand of water for domestic and agricultural use overlooks the demand for livestock rearing. Large scale rearing involving stall feeding would require arrangement for dedicated water sources for the livestock.

Availability of infrastructure for cold processing, storage and transport of livestock products is not available so that the products can be marketed at far flung areas within the state, within the country and exported abroad.

Large scale migration of livestock from neighbouring states also creates a competition for feed available for the local population. Further, there is a need for effective coordination between departments that affect livestock rearing.

6.3.4.4 Key concerns of Livestock Sector

The climate change signals such as increase in ambient atmospheric temperature, increase in frequency and intensity of extreme events such as droughts and heavy precipitation events have all negative impacts on the livestock health as well as its productivity. This may mean severe heat and cold waves, increase in floods and drought intensities and frequencies leading to loss of grazing land, depletion in water resources, adjusting to new feed types etc. With climate change there might be increase in insects and pests and emergence of new pests and diseases. All this will mean adopting to new or changed management practices. Some of the perceived impacts are as follows

- When the Temperature Humidity Index (THI) representing the combined stress of temperature and humidity is between 65 and 72 the animals are fine and they achieve optimal levels of productivity. But are under mild stress when THI is between 72 to 78 and they are under severe stress when it is above 80. In Madhya Pradesh, the THI index varies between 65 to 78 and therefore its cattle population is more productive with respect to the some other regions in India. However, with climate change, with temperatures rising by 2-4°C by 2050s, the THI index will also rise, leading to heat stress conditions and if the duration of the stress condition are long they are likely to adversely impact productivity in most of the regions in Madhya Pradesh, especially in the summer and monsoon periods. With a rise in temperature of even 1-2°C, the milk production may reduce by 10% to greater than 25%. The heat tolerance levels of the exotic species being low, they will be most affected.
- MP has important native breeds of cattle, buffalo, sheeps and goats in its various districts which can be promoted to whether the climate change risk as they are hardy and can tolerate changes in climate.
- An average adult cow or buffalo producing 10-15 lit milk per day requires about 40- 45 lit/day as drinking water on hot days and about 40- 60 lit for other related work thus requiring a

minimum of 100 lit/ day/ animal. An organized animal farm following standard management practices and disposal of animalwastes requires additional water about 50- 100 lit/day/animal. Any loss in water availability will certainly lead to decline in milk productivity.

- Heat stress due to temperature or temperature -humidity rise impairs reproductive functions and efficiency of almost all livestock species. Rising temperatures negatively impact growth and time to attain puberty of livestock species; it is likely to slow down from a growth rate of 500g/day or more to 300-400 g/day of growing cattle. Crossbreds are more sensitive to rise in THI than indigenous varieties. So the government’s policy of promoting cross breeds might be in jeopardy in the climate change context.
- Water scarcity not only affects livestock drinking water resources, but also it has a direct bearing on livestock feed production systems and pasture yield. Rising temperatures also have an additional impact on the digestibility of plant matter. This not only affects the health of an animal but also results in the reduction in livestock production which in turn has an effect on food security and incomes of small livestock keepers.
- 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 and circulation of new livestock diseases. Climate change will modify the dispersal, reproduction, maturation and survival rate of vector species and consequently alter viral and bacterial disease transmission. In some areas, climate change is likely to generate new transmission models. Temperature and humidity variations could also have a significant increase in helminth infections, protozoan diseases such as Trypanosomiasis and Babesiasis. Some of the viral diseases (PPR or RP like diseases) may also reappear affecting both small ruminant population as well. Frequency and incidence of mastitis and foot diseases affecting crossbred cows and other high producing animals may increase due to increase in number of stressful days.

6.3.4.5 Strategies to address concerns due to climate change in Livestock Sector

1. **Ensuring availability of adequate feed, fodder and water for livestock:** Large tracts of land that lie fallow, degraded land, and forest leaves through cut and carry system can be used for upscaling fodder availability in the state. Additionally integrated farming practices can be introduced for farmers to have intercropping of fodder on their lands. Utilisation of agro-industrial byproducts such as sugar cane tops, bagasse etc, which can be another source of feed for the livestock. Impetus can be given for azolla farming and for fodder conservation in the form of hay and silage for use in the days when fodder is not available.
2. **Ensuring nutrient solvency in Livestock:**Can be promoted through Stall feeding in addition to grazing to ensure nutrient solvency in livestock feed. Also total mixed ration/ complete feed block of urea enriched molasses mineral blocks especially for consumption during drought periods when grazing might not be possible.
3. **Enhanced capacity for disease forecast, monitoring and management:**Enhance the scale and frequency of prophylactic vaccination programmes
4. **Ensure adequate housing and dedicated water bodies for livestock to overcome heat stress:** Encourage keeping livestock under sheds in rural areas and encourage establishment of systematic livestock rearing in urban areas where they are reared within livestock farms.

5. **Promote research on native species breeding and rearing:** Promote breeding of indigenous varieties of bulls, cows, buffaloes, goats, and chicken by giving impetus to research in this area. These are tolerant to increase in temperature as well as some emerging diseases due to climate change. This will entail impetus to research and development for improving the productivity of local indigenous species of livestock, Protection of indigenous germ plasm in its original form, and upgradation of non descript livestock with exotic and cross bred gerpasm.
6. **Promote use of livestock waste for use as organic manure:** Since the state is promoting organic farming, the waste from livestock which is non productive can be used as an important source of organic manure for crops.
7. **Integrate livestock water requirements in water shed management programmes:** To enhance availability of quality water for livestock and hence for production of quality milk, efforts will be needed to integrate water demand of livestock within water shed management practices.
8. **Infrastructure for processing, storage and transport of livestock products:** For better linkages of animal products with markets, set up large scale storage and transport facilities through public private partnerships, Extend advisory to farmers on milk harnessing and delivery norms to delivery centers near villages.
9. **Encourage formation of cooperatives:** with public (farmer associations, the government) and private partnerships that would provide boosting production of milk in the state
10. **Improve extension arm of the animal husbandry department:** For effective penetration of right livestock rearing practices, and easy accessibility to markets, impart short-term trainings to the farmers on different aspects of Animal Husbandry and Strengthen the “Kisan call centres”



6.3.5 Fisheries

6.3.5.1 Background

Fisheries is the mainstay of livelihood of economically weaker and backward communities in Madhya Pradesh. 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. The state proposes to bring in additional water area of 1 lakh ha in the 11th year plan through reservoirs being constructed by the NVDA and water resource department. Additionally the states river system and tributaries also free for fishing, and uncontrolled fishing in these have brought down the population of riverine fish substantially over the years. The various policies of the MP government has resulted in production of 66000 tons of fish from reservoirs and river during the 10th plan and hopes to achieve a record production of 74000 tons of fish in the 11th plan.

6.3.5.2 Current policies and programmes of Fisheries

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. Below table shows the management of water bodies in MP. The other steps taken by the government include development of PAN culture to raise fish finger lings, renovation of ponds through NREGA programme, developing fish seed production and infrastructure near NVDA reservoirs and introducing biotechnology in fish seed and fish production. 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 can be good adaptation concept.

Sr 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 Snagha
5	44 reservoirs	Deptt. of Fisheries for breeder storage, R&D and Training

Table 6.3.4 Management of water bodies in MP

6.3.5.3 Key concerns of fisheries sector

In the context of climate change, the primary challenge to the fisheries and aquaculture sector is to ensure food supply, enhance nutritional security, improve livelihood and economic output, and ensure ecosystem safety. 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. Increase in frequency and intensity droughts, will decrease fish catch.

6.3.5.4 Strategies to address the concerns of due to climate change in Fisheries Sector

1. **Abating risk to climate change and ensuring livelihoods:**A series of activities can be carried out under this strategy, namely, (a) Study of impacts of Climate Change, and extreme events on inland fisheries to protect fish production in rivers, lakes, ponds and reservoirs, (b) Explore financial instruments for climate change for livelihood risk management, (c) Develop best practices of fish rearing suitable for different agro climatic zones in MP along with management of ponds, lakes, reservoirs, and watersheds (d) Capacity building of fishery managers/ farmers on technologies/techniques to circumvent negative impacts of climate change, (e) Promote research on developing fish seeds that are suitable for different water bodies and agro-climatic zones (f) Create fish seed banks for easy availability to fishermen and farmers (g) Promote fish breed diversification such as like Mahaseer, Magur, Singh, Rohu, Katala, Mrugal etc., (g) Provide storage infrastructure and access to markets Access to markets through PPP mode

2. **Build institutional capacity to integrate climate change risk in planning:** Create CC cell within the department the function of which will be to liaise with EPCO on issues related to CC and MP, and its function will be to liaise with the line ministry (Agriculture) to carry out activities in line with the issues identified in the NAPCC Mission on Sustainable Agriculture



6.4 Human Health

6.4.1 Background

The changing climate pattern has both direct and indirect impact on human health. For example extreme temperatures can directly lead to heat stress and loss-of-life and climate-related disturbances in ecological systems such as changes in the range of infective parasites can directly lead to incidences of vector borne diseases (VBDs). Similarly floods can lead to extensive occurrence of water borne diseases. Increasing air and water pollution due to warmer temperatures lead to a gamut of other health issues. Research on health impacts of climate change in India is at an early stage (a limitation) and much more work is needed to develop climate-health impact models.

6.4.2 Climate related disease prevalence in MP

6.4.2.1 Vector borne diseases

Malaria: MP is among 6 states in India which contributes to 65% of malarial incidences in the country. Out of total 50 districts consisting 58 blocks falling in 25 districts are Hot Spots of malaria in MP. Malaria flares up from these pockets whenever favourable conditions for transmission occurs (See figure 6.5.1). According to the reports of the National Vector Borne Disease Control Programme operating in Madhya Pradesh, the number of incidences in the state have reduced from 238222 in 1996 to 5512 numbers in 2010, however, the Pf% (*Pf*- the Falciparum malaria, which is more dangerous than the *Vivax*) is increasing from 25.4 to 38.28 during the same period. See Figure 6.4.1.

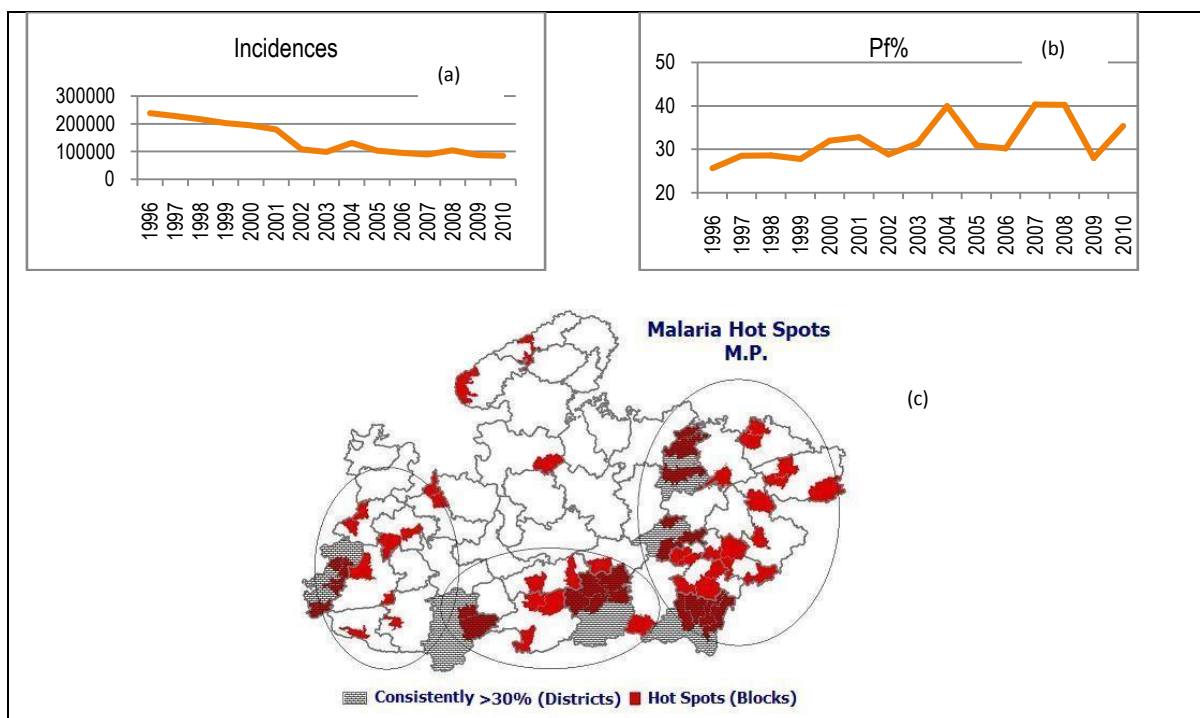


Fig.6.4.1 (a) Malaria Incidence Trends in MP, (b) Pf% trends in MP and malaria Hotspots. Source: NVBDP (<http://mp.gov.in/health/malaria.htm>), Srivastava et al., Identification of malaria hot spots for focused intervention in tribal state of India: a GIS based approach *Int J Health Geogr.* 2009 May 2009

Dengue:MP is also very sensitive for dengue transmission. 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 11.9°C (IPCC 2001). Higher temperatures beyond 42°C are not favourable for survival of the vector for dengue viruses. Table 6.4.1 indicates the dengue cases and deaths reported in Madhya Pradesh between 2007 and 2010.

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

Table 6.4.1 Trends of dengue cases and deaths in MP source: national Vector Borne Disease Control in Madhya Pradesh

Chikungunya: Was earlier eliminated from India, but has re-emerged in most parts of the state in 2006 (Fig 6.4.2). About 106 confirmed cases of Chikungunya were reported in 2006 from 21 districts of MP, mainly in the Southern part of MP. 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.

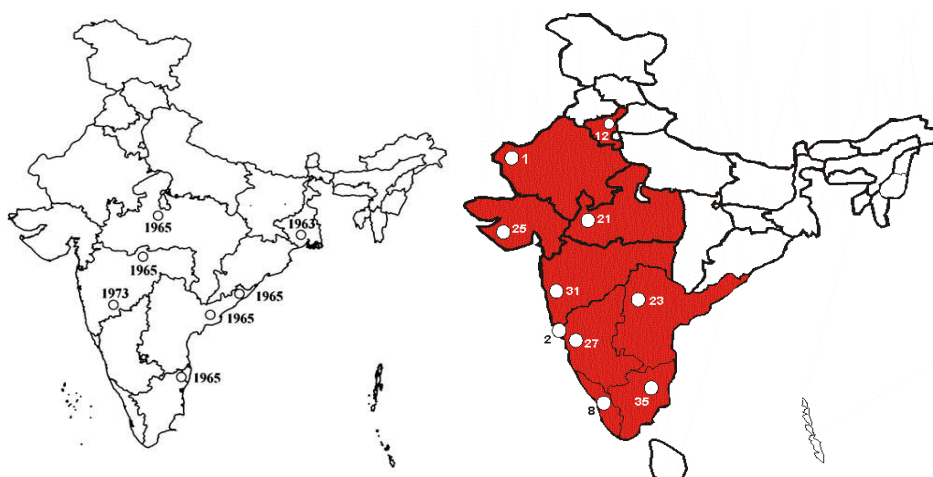


Fig.6.4.2 Shift in foci of Chikungunya in India

6.4.2.2 Water Borne diseases

Cholera: It is caused by *Vibrio cholerae* has a direct link with the climate fluctuation and can lead to not only local outbreak but world wide pandemic. The data available for Madhya Pradesh for the period, 1997 to 2006 indicates that cholera outbreaks have taken place 3 times within this period in 2001, 2004 and 2006¹³. According to *National health profile 2008*, acute diarrhoeal cases in Madhya Pradesh were to be about 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, laboratory capacity is inadequate, especially at peripheral health-care centres. These might be under-reported mainly on account of poor reporting by private health-care services. 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).

¹³Kanungo 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

6.4.2.3 Heat stress

Heat stress occurs when high temperatures in excess of 40°C temperatures persist for a number of days. 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 waves between 1968 to 1977 were 4 in numbers, and between 1978 to 1999 they increased to 15¹⁴, indicating 7.5 number of heat waves per decade, an increase over the previous decade. 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°C¹⁵.and in 2010 severe heat waves have been reported from Madhya Pradesh from March itself (see figure 6.4.3).

Policies and Programmes for combating diseases in MP

Policy: 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.

Objective: Reduction of Infant mortality rates, Universal immunisation of childhood diseases, integrated comprehensive primary health care, provision for village level health activities in underserved villages, preparation of Panchayta 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 Smiti, Deen Dayal Antyoday Upchar Yojana, Prasav Hetu Parivahan Evam Upachar Yojana, ASHA, AYUSH amongst others

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 according 2001 population statistics.

Box 6.4.1 Policies and Programmes for combating disease in MP

¹⁴U.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

¹⁵ <http://www.ncdc.noaa.gov/sotc/2010/13>

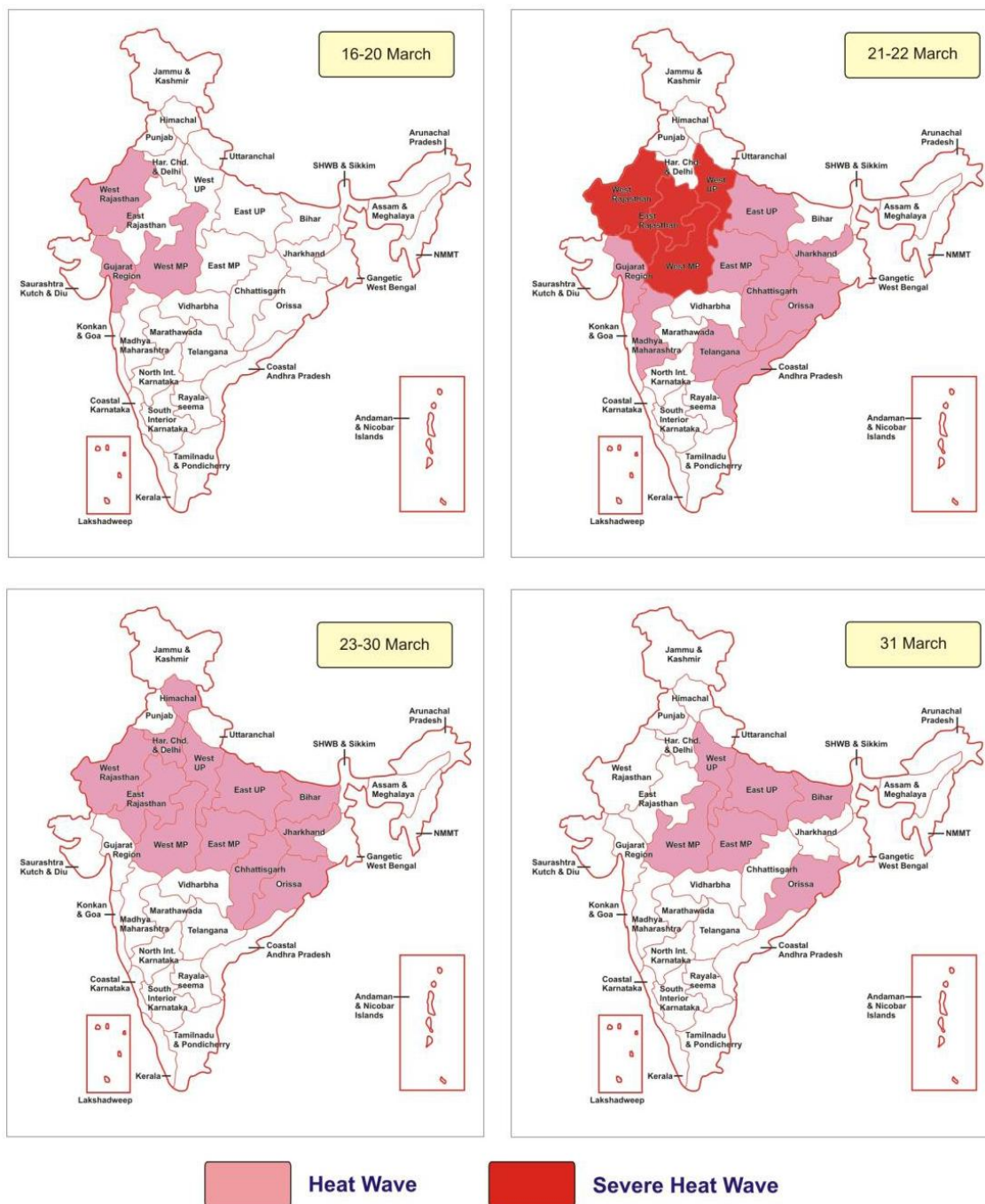


Fig.6.4.3Development and spread of heat wave conditions during March 2010 Source: Meteorological Analysis of abnormally high temperatures during March 2010 <http://www.imd.gov.in/section/nhac/dynamic/march2010.pdf>

6.4.3 Key Concerns of Health Sector

Vector Borne diseases:

- Endemicity in tribal regions remain, in spite of the intensive National Vector Borne Disease Control Programme and the subsequent sustenance programme of the government
- Increase in percentage of P-Falciparum cases (Pf) over the years indicating its reaction to drug resistance and increase in its population

- Lower penetration of disease surveillance/ screening centres in tribal areas and other remote areas
- Transmission windows (TWs) for malaria i.e the appropriate conditions of temperature and humidity in which the vector thrives, is projected to increase (temperature range between 14-40°C, and RH>50%) with climate change. In MP, TW of malaria may increase to 8 months from around 4-5 months which is the case now. (Fig 6.4.4) from the present average of 7 months in view of the projected 2.5°C rise in temperature by 2050 (NATCOM, 2004). This may lead to increase in incidences and deaths due to malaria
- Emergence of vectors that have been eradicated or emergence of new vectors due to changing climate.
- Rising urban malaria including dengue

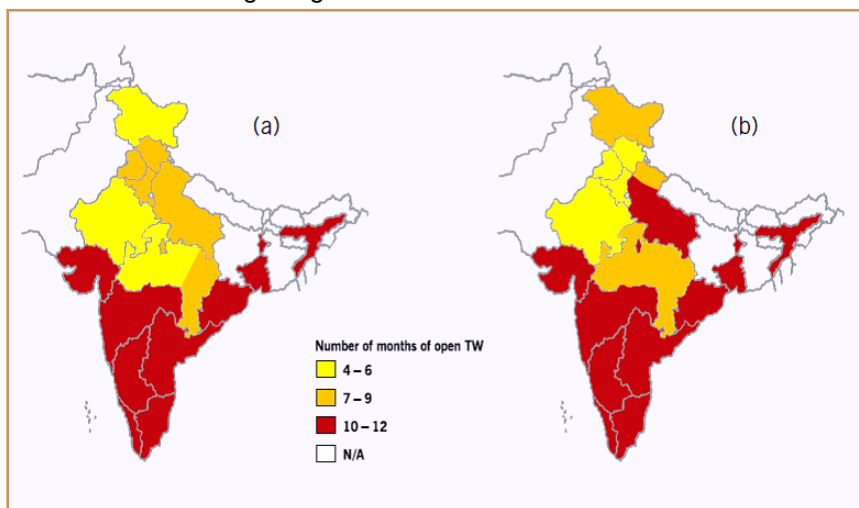


Fig.6.4.4 Transmission windows of malaria P-falciparum in the (a) current climate and in (b) in 2050s.

Water Borne diseases

- 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
- Low coverage of diseases surveillance
- No early warning system to make the department plan on measures to be taken in advance to ameliorate the outbreaks

Heat Stroke:

Increase in maximum temperatures greater than 40°C for longer period of times may lead to more morbidity and may be more deaths, especially affecting the old and young population with less immunity.

The First NATCOM, 2004 recognised that the complexity of factors about varying vulnerabilities of different demographic and geographic sections of the population as well as uncertainties around adaptive measures make anticipation and planning difficult for the health sector. For this reason, stress was laid on improvements to environmental practices, preparation of 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.

6.4.4 Strategies to address Climate Change concerns 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 uses means to dissemination of the same amongst the masses through appropriate communication technologies with maximum reach suitable for different communities.
3. **Upscaling Disaster management preparedness:** Setting up plans for protection of health of population susceptible to break outs of diseases due to extreme events, such as floods, droughts, extreme heat, extreme cold, and conducive conditions for vectors. Those areas vulnerable to floods/ droughts should have separate health delivery system disaster management plans to quickly limit the spread of disease. Each weather related diseases having 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-vector drugs to the community. (e) Alternative medication for drugs resistant vector fevers such as 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 will be 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 for feed back to itself on field observation for corrective actions.
7. **Public Awareness on health:**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. **Strengthen Research:**The state needs to map the climate induced health vulnerability in different regions of the state and Government should promote research in health sector to draw linkages between climate change and health in the state.
9. **Capacity Building of health delivery personnel and institutions:** Capacity building of different stakeholders needs to be build 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 liaison with EPCO on CC issues regarding health and also with the relevant line ministry in the centre.

6.5 Urban Development

6.5.1 Background

An economy in transition is characterised by accelerated rate of urbanization and development. The urbanisation in India is associated with increasing pressure on natural resources and increasing social, economic and environmental problems. Degradation of the environment coupled with impact of climate change increases the vulnerability of the people to adapt and respond to such changes. Three out of eight missions of the National Action Plan on Climate Change viz. National Mission on Sustainable Habitat, National Water Mission and National Mission on Enhanced Energy Efficiency delineate an urgent action required for addressing climate change concerns in urban areas. These missions are to guide on policy framework needed to encourage investment in climate change mitigation and adaptation projects needed for climate resilient cities and urban development in compliance with low carbon initiatives.

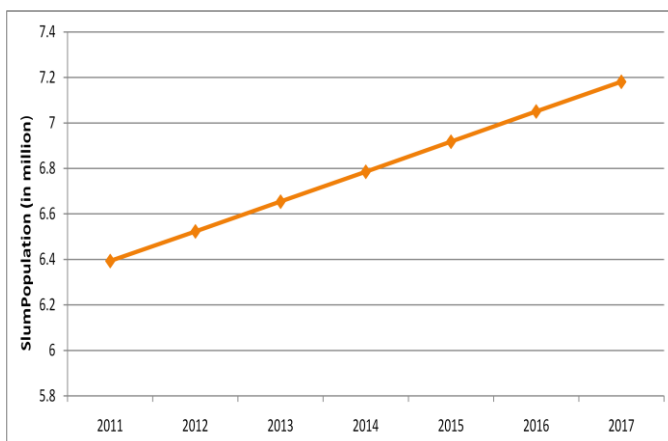


Fig.6.5.1 Projection for Slum Population MP till 2017 (Source - India Stats)

Besides these missions addressing specific climate change concerns, the government is pursuing flagship programmes of urban development such as Jawaharlal Nehru National Urban Renewal Mission (JNNURM), Urban Infrastructure Development Scheme for Small and Medium Towns (UIDSSMT), Rajiv Awas Yojana (RAY), etc. To achieve the goals of these missions and other developmental programmes, an integrated and concerted action agenda is needed in MP to upgrade these interventions with NAPCC guidelines. As per 2001 census MP had total population of 603.48 lakhs out of which 443.81 lakhs was rural and 159.67 was urban population. As per census 2001, 1.2 lakh people live in slums whereas as per state study the numbers of people live in slums is 4.35 lakhs. According to state BPL survey 288 lakhs families are homeless whereas census report mentions merely 37,827 families as homeless. Endowed with rich natural resources, MP is the third poorest state in the country with 14.2 million rural population below the poverty line and 6.9 million urban population from its total population of 73.62 million, which is expected to grow around 90 million based on the trend illustrated in Figure 6.5.2. The state is also undergoing rapid development and urbanisation. It is the need of the hour to plan for a low carbon economy and climate resilient society and to develop a set of action priorities, and identify processes by which climate concerns can be mainstreamed into urban development policies and programmes.

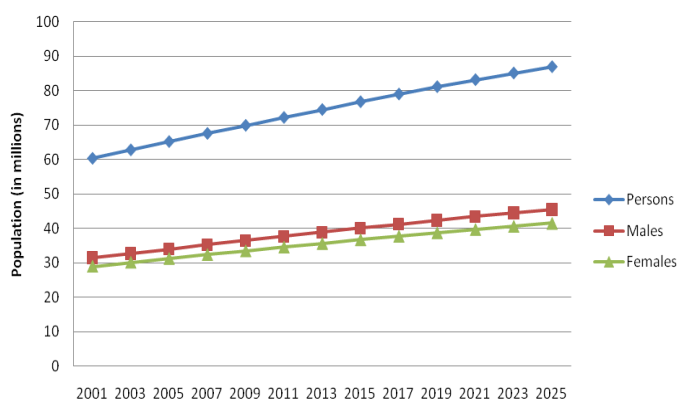


Fig.6.5.2 Population Projection for MP till 2025 Source: IndiaStats

With the increasing population and increasing migration into cities, the people living in slums are also going to increase thus putting additional pressure on the existing urban infrastructure as shown in Figure 6.5.1. With more and more people coming towards urban areas it will become difficult to control their

impact on the natural environment. Also with more people adopting urban living style the GHG emissions might increase to alarming levels. The State of MP has third number of urban agglomerates (42) followed by Gujarat (41). There are 45 urban agglomerates in M.P. out of 100 most populous metropolitan cities of India, Madhya Pradesh has five such cities viz.; Indore (15th),

Bhopal (18th), Jabalpur (32nd), Gwalior (47th) and Ujjain (89th). The fast pace of urbanisation in the state should have climate issues factored in while developing developmental schemes for its increasing populations.

6.5.2 Key Concerns of Urban Development Sector

Large cities are huge sources of Green House Gas emissions and also stand to suffer dire impacts of climate change. Following are the major urban sources of GHG emissions which depend heavily on how cities are managed:

Emissions from Vehicles: The character of public transport, location and length of drives, idling time at jams and poor road infrastructure all contribute substantially to increase in emissions from vehicles.

Energy Consumption: Buildings, both offices and residences are huge consumers of energy. Excessive/ faulty cooling, excess lighting, poor lighting technology and transmission and distribution losses all lead to wastage of energy beyond what is required.

Methane Emissions: Urban centres contribute huge amounts of solid waste and waste water. If this waste is left untreated in dump sites, or discharged in the open as is the case in many cities, it leads to large amount of methane being emitted in the atmosphere. Methane is 21 times more potent a GHG than CO₂, making this a cause of huge concern.

By building large centralised waste water treatment plants, we spend a lot of energy transporting waste water over large distances, making the treated water unusable as it would again take a lot of energy to supply it back to houses. The impacts of climate change projected on the cities are uncertain as it varies from region to region. Some of the impacts of climate change on the urban development are enumerated as follows:

Change in temperature: With dense urbanization and less of green space around heat islands can be formed, which would create a negative impact on the human health. The heat stress on infrastructure can damage the material, such as asphalt or rails, designed for lower temperatures. Also in some areas decrease in temperature would be experienced, which would affect the health and the infrastructure unsuitable for such conditions.

Increase in energy consumption: There would be an increase in the demand for cooling for domestic and commercial purposes which would have high energy requirement. It is thus anticipated that in the coming years the demand on energy generation which is mostly thermal in our country would increase and there is an urgent need to diversify the energy generation through renewable sources of energy.

Change in precipitation and water scarcity: An increase in the frequency and the intensity of droughts, floods and other extreme weather events and the changed precipitation pattern would result in limiting water quantity and quality in many areas. The impacts are interrelated hence with increase in temperature the rate of evaporation from the surface of water bodies would lead to increased water loss. And with growing demand for water, the ground water resource is bound to be depleted. Water shortages may affect electricity generation, disrupt human consumption, industrial processes, water-borne transport and neighbouring agricultural activities.

Impact on health: Due to increase in temperature, change in distribution of vector-borne diseases can be expected. Infectious diseases could spread particularly fast in densely populated urban areas

6.5.3 Strategies to address concern due to climate change in UrbanSector

1. **Increasing Energy Efficiency in Residential and Commercial Sectors:**Energy sector is the largest emitter of GHG's and demand side management on commercial as well as residential sector may reduce significant energy consumption. Development of state specific building standards in line with ECBC, Mandating energy audit of buildings, promotion of green building construction, use of energy efficient pumps, lighting and harnessing CDM potential in these sectors may reduce the energy demand. Awareness about best practices among different age groups will educate people to use energy wisely.
2. **Urban Water Supply:**Most of the urban water supply facilities have low efficiency pumps, inadequate infrastructure which results in inefficient system. Introduction of more efficient pumps, checking leakages, introduction of water audit system, capacity building and awareness generation on best practices may increase efficiency of urban water supply system.
3. **Urban Storm Water Management:**Water logging in cities in rainy season is common phenomenon these days. Proper urban planning with standards for embankment of low lying areas, better disaster warning systems may help in addressing the issue.
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 exploit waste to energy potential, more investment in research activities for developing different scale cost effective models to convert waste to energy.
5. **Wastewater Management:**The demand of water for different purposes is increasing day by day and role of recycling and reuse increases under these conditions. Capacities Development of ULBs, awareness generation among masses about 3R principles is needed.
6. **Sustainable Urban Transport:**Development of suitable policies, norms, infrastructure to motivate public transport is needed. Aware generation is needed among different age groups about use of public transport.
7. **Urban Planning:**Incorporation of climate change issues in Town and Country Planning Acts is needed.

6.6 Transportation

6.6.1 Introduction

Transport or transportation can be defined as movement of people and goods from one place to another. An efficient transport system is an indicator of economic development. Ensuring a resilient transport system is therefore necessary to avoid large and costly disruptions which might occur because of Climate Change. However transportation sector is a major contributor to GHG emissions and hence we cannot undermine the importance of a sustainable transport network that is energy efficient and has least impact on environment.

In M.P. road transport is the base of transport. Demand for road transport facility has been steadily growing, and the Transport policy (2010) of the state projects 10% growth in road transport facilities. There has been a rapid increase in number of major vehicles registered, 78% are two wheelers, and 21% are four wheelers. In the state, percent of transport vehicles is 5.85% of total number of vehicles. Number of buses is about 12,781, and in future, there is a possibility of further increase.

Further demonstrates that in the last decade the number of vehicles in Madhya Pradesh have grown tremendously thus, with increasing population and vehicles the emissions are bound to increase exponentially. Also with growth in number of vehicles the road infrastructure also needs to be expanded which further leads to emissions because of the Land Use Changes that occur because of the new infrastructure that is put in place so as to accommodate the increased vehicles. Bus Rapid Transport system (BRTS) or Mass Rapid Transport System (MRTS) can be a solution to reduce the number of vehicles on road.

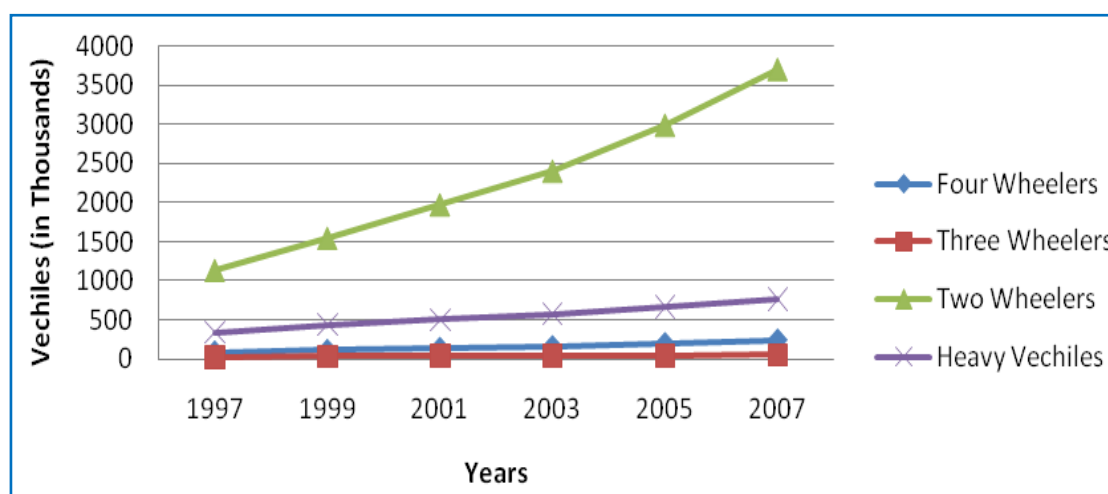


Fig.6.6.1 Vehicular Growth in Madhya Pradesh from 1997-2007 Source: India Statistics
(<http://www.indiastat.com/table/transport/30/registeredvehicles/16443/421859/data.aspx>)

6.6.2 Urban Transport and Climate Change

The transport system of the city is an integral part of the urban infrastructure and hence the impacts mentioned above can have a domino effect on the other urban systems. By understanding the interconnectivity of transport to urban development the impacts of climate change on the system have been classified as follows:

Impact on the transport infrastructure: Infrastructure like road, rail etc. would be affected by higher temperatures, intense storms, heavy rainfall and flooding.

Impact on the vehicles: The efficiency and comfort of the vehicles would drastically reduce as they would not be suitable to run in the changed environment.

Impact on the mobility behaviour: Behaviour will mainly be affected on days of extreme weather, such as heat waves, floods, intense rains, high wind speeds and storm activity.

In the worst case, transport systems may not be able to recover between such events, resulting in exponential damages. Hence, building a climate-resilient urban transport system is vital to safeguard transport infrastructure and its embedded value, ensure reliable mobility and economic vitality/development and guarantee the health and safety of urban residents. An effective transport system should include a plan for inclusive high-quality public transport and prepare for potential alternative routes and identify critical infrastructure.

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. In this regard the BRTS, has been introduced in Bhopal and Indore.

Main Area of Focus: means of public transport for passengers to be encouraged by arranging buses in all areas, effective control so that goods shall be carried easily, national highways, district highways and rural roads shall be continuously developed and built to ensure means of transport everywhere, high priority to safety measures to ensure road safety and to avoid road accident.

Specifically Madhya Pradesh Transport Policy proposes measures like Bus rapid transit system in big cities, encouragement of CNG and Auto LPG to reduce pollution in Metros, provisioning of public transport system and permits to the beneficiaries of governmental schemes, traffic survey in every five years in Metros to evolve city transport policies and transport management.

Intelligent Transport system (ITS) to provide improved safety, reduction in vehicular wear, reduce transportation time and fuel consumption. Permits on new city roads, automatic vehicle locator: online tracking and bus monitoring, passenger information system- online schedule display, stop arrival destination indicators, electronic fare collection, vehicle guidance: perfect docking of bus at platforms, traffic signal priority to avoid delays at intersection, to fortify, national permit system to encourage interstate goods transport.

6.6.3 Key concerns of Urban Transport Sector

Increase in emissions due to fuel combustion: the exhaust gases from petrol engines contains CO and NOx, hydrocarbons, some SO₂ and solid particles, while diesel engines emit less toxic gases (e.g. 20 times less CO, 8 times less hydrocarbons) but many more particles. The particulate matter modifies the radiative flux and contribute to change in temperature.

Increase in no. of vehicles: More number of vehicles running would mean higher green house gases (GHG) emissions and higher contribution to climate change.

Bus Rapid Transport System (BRTS): A sustainable Option

Indore is the largest city and commercial capital of Madhya Pradesh. With a population of 1.8 million people, Indore faces the daunting task of providing a modern and efficient public transit system to accommodate its exploding growth, which brings with it increased congestion, travel delays, traffic accidents and environmental degradation.

As it stands now, the average Indore resident prefers to ride a bike over a bus, though the city teems with mini-buses, three-wheelers and auto-rickshaws. Efforts have been made through public-private partnerships to improve the city's transportation infrastructure. The city's new high-tech bus system, which features electronic ticketing and "live" information displays, currently operates on 277 kilometres of road.

The buses are funded by the Jawaharlal Nehru National Urban Renewal Mission (JNNURM),

6.6.4 Strategies to address concerns due to climate change in Transport Sector

Looking to the increasing number of vehicles to take climate change based policy decisions for proper management of the sector and for economic and social development of the state, it is necessary to have a complete view of the urban transport scenario. Accordingly, Public transport be evolved for public welfare to encourage means of public transport for passengers like buses, effective control transport of good, continuous development of cemented national highways, district highways and rural roads such that means of transport can be made available everywhere and which is climate suitable as well. Further safety measures to ensure road safety and to avoid road accident should be given high priority.

The Common mobility card, a smart card for across all types of service providers /operators– govt or private (public transport like bus, metro, taxi, autos, trains, ferries) as well as for other payments like, tax collection, toll fees, parking charges, retail and utility payments may be introduced besides exploring the possibility of Sky metro system. Eventually an integrated approach shall be desired to adapt and mitigate the impacts of climate change and variability in the urban transport sector.

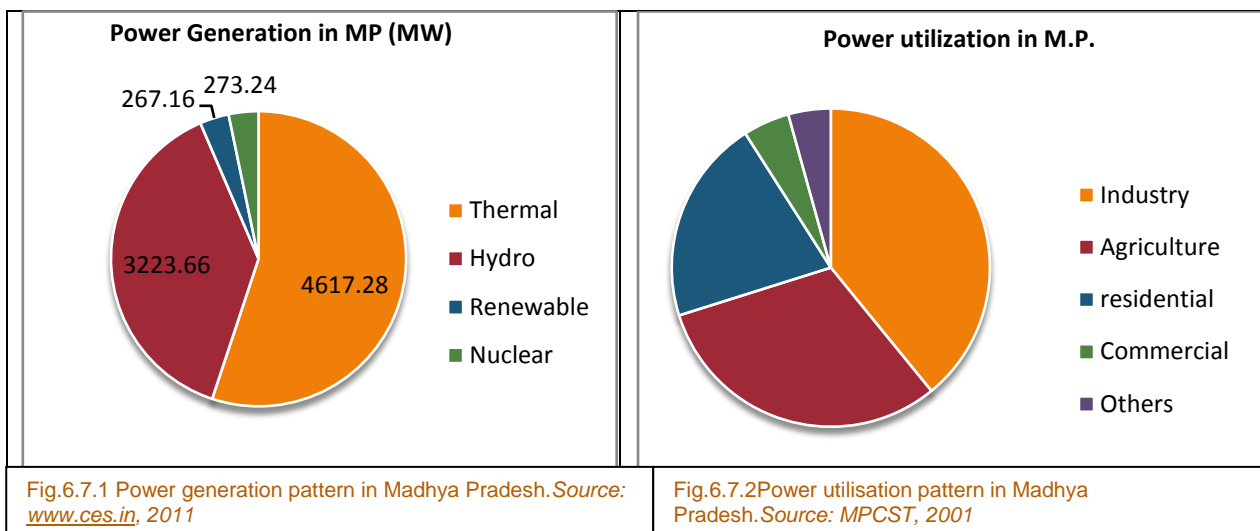


6.7 Energy

6.7.1 Background

Main objective for the power sector in Madhya Pradesh is to augment power supply and to facilitate economic growth. When the state of MP was divided into MP and Chhattisgarh in 2000, there was an uneven split with 78 per cent of energy consumption in MP and only 68 per cent of the generation capacity. Chhattisgarh claimed ownership of assets located in its region and resulted in having a power surplus, whereas MP had a power deficit and also had to purchase power at higher costs.

Currently, Madhya Pradesh has a total installed capacity of 8381.34 MW, out of which, state's share is of 4537.92 MW. Thermal power sector has a total inventory of 4617.28 MW, Hydro power sector of 3223.66 MW, Renewable energy sector of 267.16 and Nuclear energy 273.24 MW as shown in Figure 9.1. Which means about 58% of the energy generated is from thermal energy of the power is thermal power based and 42% of energy is generated from renewable sources (mainly hydro-electric). The state contribution to total power generation is 4537.92 MW whereas contribution from central is 3603.02 MW. Private sector contributes only 240.4 MW, confined to renewable energy. However, in the future, the fuel mix ratio is most likely to change and become more coal heavy as many new coal-based thermal plants have been planned and there is an unlikely commensurate increase in the hydel power development



The Unrestricted maximum demand during 2007-08 was 6780 MW (excluding Power House auxiliary of 205 MW) while the demand met during the same time period was 4,424 MW (Including net overdrawal of 186 MW). A load shedding of 2,356 MW was done. Thus, there was a net shortage of 2,356 MW (34.75%) against the unrestricted maximum demand of 6,780 MW (Planning Economics and Statistics Department, 2008). This figure is very high when compared with the national average of 14% in peak power shortage (International Finance Corporation, 2010). Transmission and distribution losses in the state are differentially reported ranging from 30% (EPCO, 2011) to 45% (livemint.com, 2010).

As indicated in figure 9.1b, the maximum power consumption is by the industrial sector (39.11%), followed by agriculture sector (31.04%), household consumption (20.82%), commercial use (4.72) and other areas (4.31) during 2005-6 (MPCST, 2007). However, there has been sharp increase in the number of consumers between 2002 and 2009. Interestingly, the electricity sale to residential and

agriculture consumers increased by 85% and 117%, respectively (Asian Development Bank, 2010). The consumption of electricity will be further increased due to climate change, especially for the agriculture sector

As per the annual plan 2009-10, the state aims to Remove power shortage by setting up new generating power projects to meet the ever increasing power demand, expand and strengthen Transmission System for evacuation of power from Generation Projects of the State, interconnection of State transmission system 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% meterisation, separation of rural feeders from agricultural feeders and 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 RGGVY scheme.

A two pronged approach is being taken to reduce GHG emissions from power. Since coal continues to be the cheaper option, the first strategy to reduce GHG emissions would be towards increasing efficiency of production of electricity, which means increasing the generation of power per unit of coal consumed. This will be applicable to other industries as well. The Bureau of Energy Efficiency already has come with a PAT scheme, where by they have 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 needs to 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 cleaner coal technologies will be utilized to achieve the targets set out in PAT scheme.

6.7.2 Policies and programmes to ensure energy demand in the future

GoMP has signed 42 new MoUs and with a total capacity creation of about 55,000 MW. Of these, the construction of four power projects - total of about 3,000 MW - has already started. In the next 5 years, about 5,000 MW of additional capacity within the state is expected. Madhya Pradesh Power Generating Co. Ltd. (MPPGCL/ MP Genco) is a wholly owned company of the state Government engaged in generation of electricity. MP Genco operates and maintains its existing units, and is also constructing new power plants for increasing capacity.

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. The total hydropower potential of Madhya Pradesh from major and medium hydroelectric project has been assessed as 2775 MW. Out of this, 65 per cent power potential has already been developed or is under development at various stages. Thus 35% of hydro power potential through major and medium hydropower projects is yet to be harnessed. Besides the above, most of the power potential from small and micro hydropower is yet to be tapped.

Apart from hydro-electric, MP has an installed capacity of about 160 MW of wind power, about 2 MW of solar power and about 20 MW of biomass-based power. As the assessed potential is significantly higher (wind – about 800 MW, solar – about 1000 MW and biomass – about 250 MW), there are plans to expand the renewable power generation capacity in the state. This is being done through the MP Urja Vikas Nigam (MPUVN), a Government agency dedicated to promote 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. There are sectoral demand-side initiatives under way and also initiatives in industry clusters e.g. steel re-rolling in Indore, to promote energy-efficiency. Explorations are under way for realising the potential of coal-bed methane that are recognised to be present in the coal mines in the state.

6.7.3 Key concerns for Energy Sector

The current ratio of state-generated power is tilted in favour of hydroelectric power but the proposed plans will change that. In the next 5 years, about 11,000 MW of power will be generated for the state. Assuming that about 70 per cent, i.e. 7,500 MW will be coal based, the total carbon emissions will be 37.50 million tons of carbon per year. This is a substantial contribution and, therefore, will be the focus in the context of climate change. MP is also looking at developing Singarauli as a coal-based energy hub of India. Identified as the fourth largest coal mine in India, thermal power development in this area seems inevitable taking into account economic considerations. Not only in Singarauli but also in other districts -Narsinghpur, Khargone and Jabalpur - thermal power plants are being planned. Thus challenges confronting the power sector today therefore are

- a) to ensure the increasing supply of coal,
- b) meet peak demand shortage and an energy requirement shortage,
- c) funds for further power generation, rehabilitation & modernisation,
- d) transmission and distribution of electricity from new projects and augmentation of new ones. In addition, support is required for further loss reduction strategies (about 15 per cent achieved over the last 2-3 years) and to recover arrears from municipalities & town panchayats,
- e) Addressing the carbon emissions arising from the existing plants as well as the new ones will be a focus in the context of climate change; and
- f) Given that a number of plants are being planned in Singarauli, there may also be critical local environmental and social concerns that need to be considered.
- g) Rising climate variability will lead for increasing demand of electricity, thus putting more pressure on the existing resources and (g) Finding funds for investment in upgrading existing electrical equipments with energy efficient electrical equipments.

There are a number of initiatives in the energy sector being undertaken in the state that are eligible for generating carbon credits either in the Certified Emission Reductions (CER) or Voluntary Emission Reductions (VER) markets. However, these initiatives are not being considered from that perspective. The Climate Change Cell should consider these initiatives from a CDM lens, particularly through the use of the small-scale methodologies and programmatic CDM, and explore whether these carbon credits can be generated through either the CER or VER markets.

6.7.4 Strategies to address concerns due to climate change in Energy Sector

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 thermal 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 implementation is 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 should be started under government schemes/ programmes.

3. **Market Transformation for energy efficiency:** The project 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.

6.8 Renewable Energy

6.8.1 Background

Madhya Pradesh has a rich natural resource base which has huge renewable energy generation potential in all forms. The estimated power generation potential from renewable sources in MP is 3208.84 MW (EPCO, 2011). At present, total Grid connected installed capacity is 165.1 MW and wind constitutes more than 50% of this. Off- Grid installed capacity is 108.99MW and wind energy constitutes more than 69% of the installed power. Projects based on biomass energy belong to off-grid.(EPCO, 2011). The potential and current installed capacity for various renewable sources is given below.

Total installed capacity of RE sources is still 2.95% of total energy. Rich forest cover, agriculture based economy, sub-tropical climate, 10 river basins enrich MP with a huge RE potential most of which is still to be harnessed. Table 6.8.1 compares harnessed RE against potential in the state for different forms. It clearly shows that there is still a large potential to be harnessed. If we see in terms of GHG reduction then with the current projects in pipeline, the avoided emission is shown in Table 6.8.2 .

Source	Potential	Exploited
Wind	1200 MW	169 MW
Biomass	1040 MW	25 MW
Small Hydro	410 MW	79 MW
Solar	20 MW/ Sq Km	Yet to be harnessed

Table 6.8.1 Potential of energy mix for the state

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 6.8.2 The current projects in pipeline and the the avoided emission

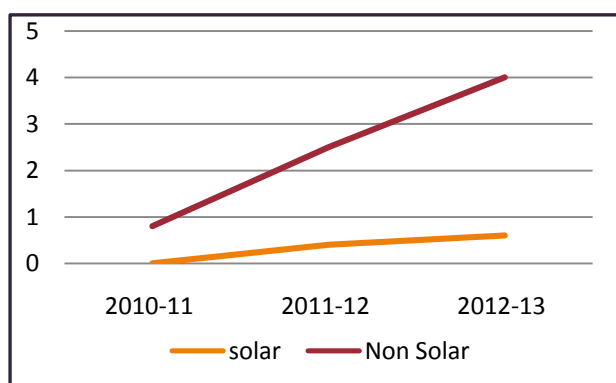


Fig.6.8.1RPO Comparison between Solar and Non Solar

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 the graph below

The figure 6.8.1 shows that investment in Renewable Energy Sector will boost in coming years through favourable policies. Increasing urbanization increases the possibilities of energy generation from solid waste. Five cities in MP i.e. Gwalior, Indore, Bhopal, Jabalpur and Rewa have the potential to exploit this form of

energy. Clean Development Mechanism (CDM) is the additional benefit that can be harnessed from RE projects. To promote CDM business in the state, state government has constituted MP CDM Agency.

6.8.2 Current Policy Initiatives

Realizing the potential of RE in the state, State Government has started actions and formulating policies for different forms of energy to boost investment in RE. Draft policies for solar energy,

biomass energy and wind energy have been formed. A snapshot of efforts of MP Government to boost investment in the state is shown in the fig. State government provides favourable condition to invest in RE sector through duty exemption, subsidy on loans, concessional land for mega projects and tax exemption. A snapshot of different forms of energy in MP is presented in Box 6.8.1

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 loans	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 Govt.	Special Packages for Mega projects	Incentives by Government of MP

6.8.2.1 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, 169 MW energy is being produced and an additional 40 MW is expected to be installed in next 3 years. The State has signed 2 MoUs with WEG Manufacturers & Power Developers for developing 400 MW of wind energy projects. Potential sites for wind power generation have been shown in the Box 6.8.2

6.8.2.2 Biomass Power

The estimated biomass potential in the state is 1040 MW against which 25 MW is installed and an additional 30 MW is expected to be commissioned by 2011. All the projects are based on PPP mode. Proposals for setting up Biomass plants of 450 MW cumulative capacity have been registered.

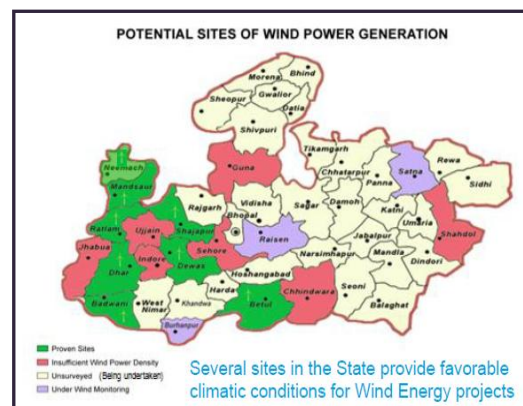


Fig 6.8.2 Potential sites of Wind Power Generation

6.8.2.3 Solar Energy

The State is endowed with high solar radiation with around 300 days of clear sun. 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 to boost solar energy in the state. It is proposed to generate 500 MW energy from solar.

6.8.3 Strategies to address climate change issues in Renewable Energy Sector

Increase the share of renewable energy in total energy consumption by 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. These policies should be finalized at the earliest.

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. Capacities of different stakeholders need to be built on renewable energy aspects i.e. generation, handling, maintenance, operations. Awareness should be generated through solar parks, demonstration, academic activities in schools. Research and Development activities need to be accelerated to develop cost effective handy products.



6.9 Industry

6.9.1 Background

Industry in Madhya Pradesh is largely related to mining of natural resources. The state has abundant natural resources like limestone, coal, bauxite, iron ore, silica etc. The other major industries in state are of textile, cement, steel, soya processing and optical fibre. 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, National Fertilizer Ltd, 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 being given on development of agri food processing and herbal processing (considering state's ample resources of minor forest produce). A separate policy for agro-based industries is also being developed.

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 about 14000 new Micro and Small enterprises are being established in the state annually providing employment to about 33000 people.

In the future growth in pharmaceuticals, auto industries, manufacturing, consumer goods, food processing, tourism and textile is seen to be happening given the policy climate. Minerals including cement production holds a great production promise in the state due to its mineral rich status and also the fact that it is centrally located makes the transport costs to different part of the country less. Figure 9.2 indicates the factor advantage of the various industries in the state.

6.9.2 Current policies, programmes, and initiatives

The GoMP has given thrust on development of Agri. & 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.

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 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 farm and non-forest lands. This will help in conserving various Carbon Pools and also will help in sequestering more carbon
- Reviewing and starting various employment generation schemes like Rani Durgavati Self Employment Scheme and Deendayal Employment Scheme aiming towards people from SC/ST category and for 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 on each 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.

6.9.3 Key Concerns for Industries

The mineral-based industries are energy-intensive. There is potential for improving energy efficiency through the use of cleaner production technologies, methods and practices. This will contribute towards mitigating green house gases. The mineral-based industry, cement, is not only energy-intensive but also a direct emitter of carbon dioxide.

Among the non-mineral based industries, soya processing is large and can be adversely affected due to rainfall / precipitation variations. MP has a few chemicals-based industry clusters, e.g. in Ujjain. It is likely that these industries may emit chemicals that may have a higher greenhouse gas potential.

6.9.4 Strategies to address climate change concerns in Industry Sector

1. **Review of M.P. Industrial Policy 2004 to address CC Concerns:**As industrial sector is a large emitter of Green House Gases, climate change aspects should be integrated in the industrial policy to promote low carbon technologies.
2. **Implementation of Perform, Achieve and Trade Mechanism:**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 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 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 consumption.
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.
6. **Involvement of industries in plantation activities:** Industries should undertake plantation activities as part of their CSR activities
7. **Capacity Building:** Capacities of different industries should be built for better decision making and efficient operations
8. **Research and Development:** Industries should pool the resources in research activities to develop state specific eco-friendly technologies.

6.10 Rural Development

6.10.1 Background

Rural Development is by and large a cross cutting issue and most of the strategies and action are being covered in the respective sectors. However, Rural Development sector provides the opportunity to propel the agenda of convergence and integration of climate change concerns in rural area of Madhya Pradesh. Going by the Census 2011, Madhya Pradesh is home to 5.99% (7.25 crores) of India's total population of 121.01 crores.

Rural Development Indicators	
Number of Villages	54903
% Rural Population	73.51%
% Scheduled Caste Population	15.17%
% Scheduled Tribe Population	20.27%
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
Total literacy in M.P.	64.10%
Male	76.50%
Female	50.60%
Rural literacy in M.P.	46.8 %

6.10.2 Key Concerns

- Tribal Population:** M.P. houses highest tribal population in any state in India. Out of 313 Development Blocks, 89 (28.43%) are Tribal Development Blocks. 3 primitive tribes (Sahariyas, Bharias & Baigas) live in Madhya Pradesh. Most of these communities are concentrated in well-forested districts of M.P. Traditionally, most of the tribal communities are dependent upon forests (in various degrees) for their livelihood. As the forests & other natural resources of the state are quite vulnerable to climate change, so are these communities which are dependent upon them for their very livelihood.
- Poverty:** The per-capita income comparison of M.P. with National indices, M.P. shows a huge poverty stricken population – more so in rural areas. The unemployment level is also quite high compared to India average. Because of these reasons, the rural population of Madhya Pradesh, in general, is very vulnerable to climate change.
- Infrastructure:** Compared to 82.10% electrified villages in India, only 64.21% villages in M.P. are electrified. Similarly, on health front, higher birth rate, death rate & infant mortality rate (compared to National figures) are indices indicating towards the gaps in the health front. Similarly, state per capita food-grain production of 187.5 Kg against the national average of 200 kg. indicates sub-normal agricultural practices & productivity. All these conditions make them more vulnerable to climate change.
- Water:** Many rural area in the state suffers from water crisis, particularly in the summers. Besides the drinking water problem, water shortage for cattle & irrigation are other facets of the same crisis. Dehydration due to contaminated water is one of the major causes of mortality, especially child mortality, in the villages of the state. Water shortage is going to pose a major challenge in the rural parts of Madhya Pradesh due to climate change.
- Regional disparities/Parameters/Variables** – The western part (Malwa & Jhabua – Alirajpur) as well as Bundelkhand region are already facing the wrath of nature in many ways. As a result, large scale forced migrations is happening. Similarly, the well-forested Satpuda region districts are witness to “Tribal Malaria”- a vector borne disease. The predominant SC-ST populated districts of the state also suffer from waterborne diseases like gastro-enteritis diseases like

Box 6.10.1 Rural Development Indicators

Tuberculosis. All these diseases are predicted to proliferate due to climate change & thus can be predicted to worsen the already struggling rural population of the state. Thus on the basis of the foregone discussions, it can be easily surmised that the rural poor of M.P. are much more vulnerable to Climate Change compared to the average rural poor of India.

6.10.3 Strategies to address Climate Change concerns in RD 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 of PRDD are also for improving rural infrastructure & hygiene/sanitation. Many of the PRDD schemes are meant for the BPL (Below Poverty Line) & SC/ST target groups.

1. Evaluation of existing rural development programmes with climate change focus

Rural community is the most vulnerable community since it is more sensitive as well as has less adaptive capacity. The rural programmes which are aimed to uplift the rural community should now also focus on how to make these communities more adaptive to face the vagaries of the climate change. To build this in the existing programmes it is needed that the impact assessment of the rural programmes is taken up and acclimate resilient check is done .after doing this a strategy would be build to link the rural programmes with the climate change.

2. Training and capacity building of rural communities: Training is the most important aspect which should be taken up given its importance in the light of making the system resilient. 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 the measures which would support and help in promoting the communities to adapt to new technologies and this could be done only when the climate change concerns are institutionalized in the annual plans of Panchayat. Promotion of water efficiency in agriculture and other uses, promotion of energy efficiency measures, bio gas and solar energy applications promotion are some of the important measure which should be strongly build in the annual plans of the Panchayat

4. Credit Availability for rural infrastructure development and insurance against climate induced vulnerabilities: This would motivate the rural community to build their ecosystem resilient and would also help them in times of calamities.

5. 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: Since the rural community is the most vulnerable community and dependent directly on other sectors for their livelihood, it is of utmost importance that those sectors should work directly with the rural development department.

6.11 Housing and Environment

6.11.1 Background

Madhya Pradesh is unique in its richness of both the material and human resources and is endowed with extraordinary agro-climatic and biological diversity. The challenge before the state is to fully harness this potential. The state has to catch up with the frontline areas of modern Science & Technology (S&T) on the one hand and improve upon its strengths in traditional S&T, on the other to achieve specific objectives of social, economic and cultural development and prosperity.

Research on the impacts of climate change in India is at a nascent stage and much more work is needed to develop climate impact models for Madhya Pradesh focused particularly on the vulnerable sections of society. Most of these researches will be across sectors/departments etc. Dedicated state of the art research on issues like water, food security, land use changes, disease transmission, green house gases, CDM etc will be critical in providing policy makers with new tools to evaluate and respond to the threat of climate change. Triangulation and analysis of data at different levels across various departments could be of very high value. Monitoring the impacts of various initiatives of the climate sensitive sectors at village levels by creating integrated database is another area worth considering. Popularisation of scientific research, remote sensing applications, information technology etc in the schools, colleges, universities, R&D institutions, panchayati raj institutions, voluntary organizations and capacity building of the various stakeholders is another grey area. Documentation and scientific validation of traditional knowledge (TK) would also be a step in the right direction.

As climate change will impact a large number of sectors across different agro-climatic zones in the state, it becomes essential to ensure that Science & Technology becomes an important and integral component of all development plans and activities in the State through a nodal centre. State of the art research (especially in climate sensitive sectors), popularization of science, dissemination of scientific knowledge, capacity building of various stakeholders etc are some of the roles that the nodal centre needs to play with great efficiency.

6.11.2 Environment

In Madhya Pradesh the subject of "Environment" is governed 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 has established a Climate Change Cell in its agency, Environmental Planning & Coordination Organization (EPCO), which is under the Department of Housing & Environment. As a part of the Cell's activities, a number of technical studies and plan preparations are being initiated. These include the preparation of the state Climate Action Plan with support from the UNDP, an adaptation study focusing on rural areas with GIZ support that will feed into the Action Plan preparation, and a vulnerability assessment study in selected districts with support from the British Government's Department of Energy & Climate Change (DECC) are being initiated or under progress. All of these initiatives are clearly indicative that Madhya Pradesh has demonstrated its proactiveness and taken the lead in addressing climate change issues.

1. **Strategies to address the Climate Change concerns in Environment**
Knowledge Management Centre (KMC) in Climate Change: In order to imparting knowledge to the stakeholders, it is envisaged to establish a state level Climate Change KMC in EPCO.

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. A Sectoral GHG inventorization and generation of Marginal Abatement Cost Curves (MACC) for each sector is envisaged to be done and a Climate Change status report to be generated every five years to take an account of the change of climatic parameters for the State.
3. **Mainstreaming traditional science:**Documentation, authentication and mainstreaming traditional science is highly recommended, especially in line with National Innovation Foundation.
4. **Strengthening of monitoring systems of various initiatives of the climate sensitivesectors :**Technological upgradation of monitoring tools like MIS and advanced satellite monitoring technologies like Remote Sensing needs to be strengthened within vulnerable departments.
5. **Increase of general awareness of people by educating them about climate change** More awareness is required to be generated among the masses for better implementation of adaptation and mitigation efforts.
6. **Popularization of scientific research:**Popularisation of scientific research, remote sensing applications, information technology etc in schools, colleges, panchayati raj institutions, voluntary organizations etc for dissemination of information
7. **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
8. **Regular monitoring of critical ecological parameters, such as air, water, forests etc:**Regular monitoring of air (GHG, suspended particles etc), quality and quantity of water, forests etc. for maintaining a cleaner environment
9. **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
10. **Mainstream of Climate Change concern:**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.
11. **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



6.12 Cross-cutting Issues

6.12.1 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 SAPCC 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 needs to be endorsed and followed up by the respective departments as per timescale and perspective of delivery over the next few years.

Adaptation Strategy	Description
Changing Natural Resource Management Practices	Emphasises new or different natural resource management practices (e.g., for managing water, land, protected areas, fisheries) as adaptation strategies.
Building Institutions	Creates new or strengthens existing institutions (e.g., establishing committees, identifying mechanisms for sharing information across institutional boundaries, training staff responsible for policy development).
Launching Planning Processes	Sets in motion a specific process for adaptation planning (e.g., developing a disaster preparedness plan, convening stakeholders around vulnerability assessment findings)
Raising Awareness	Raises stakeholder awareness of climate change, specific climate impacts, adaptation strategies, or the environment in general.
Promoting Technology Change	Promotes implementation or development of a technology new to the location (e.g., irrigation technology, communications technology).
Establishing Monitoring /Early Warning Systems	Emphasises the importance of creating, implementing, and/or maintaining monitoring and/or early warning systems.
Changing Agricultural / forest utilisation practices	Focuses on new or different agricultural / forest utilisation practices as adaptation strategies.
Empowering People	Emphasises literacy, gender empowerment, or the creation of income generation opportunities as a basis for adaptation.
Promoting Policy Change	Promotes establishing a new policy or adjusting an existing policy.
Improving Infrastructure	Focuses on creating or improving built infrastructure (e.g., roads, sea walls, irrigation systems).
Providing Social Protection	Creates, modifies and promotes insurance, credit, asset transfers and safety nets (NREG).
Other Strategies	Adaptation in disaster relief, eradication of climate-related diseases, assisted migration schemes etc.

Table 6.12.1 Adaptation Strategies

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 as the next stage.

The table below sets out a typology of adaptation practises that has been established through the research literature and provides potentially some integrating themes for the sectors. Many of the sectors have similar activities such as research, awareness raising and capacity-building and these could be delivered at state level in an integrated way.

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 for low carbon development model of the State. MP's decentralised approach to its service delivery will support development of climate change strategies at all levels. Following are the proposed key activities:

- Identify CC champions in each department (CC cells)
- Embed an effective cross-departmental committee.
- Ensure that climate change roles and responsibilities are clear in each Department and Agency
- Raise awareness and capacities down through Districts and Panchayats
- Increasing access to CC projections
- Create State level capacity to interface with climate change science and to act as an intermediaries across Government departments and decentralised levels of Government
- Undertake specific scientific studies on key gaps e.g. changes in distribution and intensities of rainfall
- Create baselines to monitor change and evaluate effectiveness of interventions
- Create professional and scientific networks within and to connect them externally
- Create easy to read summaries of climate change information
- Create information on technology solutions, economic tools and policy measures
- Create trainers and then networks of trainers
- Work with existing institutions and systems 3 audiences: scientific and technical staff generalist policy-makers; and field officers

7 Strategies

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
7.1 Forests and Biodiversity								
FBD/S-1	Develop forest management plans for different forest types in view of CC	1. Undertake detailed study to understand impacts of climate change on forest productivity in different forest types	Development of climate resilient forest management plans (M)	FD, MPCST	High	2-5 yrs		
		2. Adaptation plans for each forest type according to their biophysical vulnerabilities to climate change	(A)	FD, MPCST	High	2-5 yrs		
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 envisaged in GIM, 2010)	Conservation and development of carbon sinks (M)	FD, DoA, DoAH, MNREGA, MPCST	High	1-2 yrs		
		4. Undertake surveys to demarcate forest corridors and take measures to protect and develop them	(M)	FD	High	2-5 yrs		
		5. Undertake pilot projects to capture the Market based opportunities for forest conservation like REDD+, CDM etc	(M)	FD, MPCDMA, RD	Low	5-10 yrs		
		6. In addition to the PAs, PPAs, MPCAs, and Community Conserved Areas etc should also be conserved. More of such areas should be identified at Divisional / District level and be conserved	Creation of livelihood opportunities (A)	FD, RD	Medium	2-5 yrs		
		7. Enhance MNREGA activities to forest areas near head reaches of	Augmentation and conservation of	FD, RD, WRD	High	3-5 yrs and to continue		

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
		rivers in forests	water and maintaining river flows (A)					
FBD/S-3	Soil and water conservation measures in forest management	8. Promote soil and water conservation measures	Soil enrichment and reduction of sheet erosion (A)	FD, WRD, RD, MoEF	High	3-5 yrs and to continue		
		9. Promote agro forestry to increase forest biomass and hence soil moisture	(M) Livelihoods/ Local needs	FD, RD	High	3-5 yrs and to continue		
		13. Lakes/wetlands conservation in forest areas as outlined in GIM 2010	Better wetland management in forest areas and biodiversity conservation (A)	FD, BDB, DoH&E / MP CC Cell	High	5 –10 yrs and to continue		
FBD/S-4	Promote research to understand the impacts of climate change on forests	15. Develop ‘centers of excellence’, at least 1 in each forest type, undertaking regional analysis for the entire spread of the forest type, CC related threat analysis.	More understanding on climate change concerns for the state’s forest types and biodiversity (A)	FD, MPCST, Research Institutes	Medium	3-5 yrs and to continue		
		16. Undertake studies on indigenous tree species to assess their vulnerabilities to climate change, their carbon sequestration potential and their adaptability to changing climatic parameters	Conservation of indigenous germplasm (A)	FD, DoH&E / MP CC Cell	High	3-5 yrs		
		17. Develop model forest nurseries to conserve indigenous species of trees and to develop climate resilient varieties	(A)	FD, BDB	High	3-5 yrs and to continue		
		18. Assess fire management strategies wrt CC	Reduced GHG emission (M)	FD	High	3-5 yrs		
		19. Documentation and assessment of threats to biodiversity and wildlife due to climate change	Better management and prevention of species loss (A)	FD, BDB, research institutes	High	3-5 yrs		
		20. Research and documentation of	Documentation of	FD, BDB,	Medium	5-10 yrs		

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
		initiatives like PPAs, MPCAs, Community Conserved Areas, ITK etc	good practices which could be replicated (A)	research institutes		and to continue		
FBD/S-5	Capacity Building	21. Impart training to forest officials to help integrate CC concerns in Forest planning and management	Better decision making in view of CC (A)	FD, RD	High	1-2 yrs		
		22. Impart training to communities on various schemes/ programmes/ benefits associated to social forestry, PPA, water conservation, market instruments etc.	Awareness about schemes and associated benefits and SFM (A & M)	FD, RD	High	1-2 yrs and to continue		
FBD/S-6	Promote alternate source of energy in forest villages and adjoining revenue villages	23. Initiate programmes to promote use of renewable energy amongst communities using fuel wood	Reduced pressure on forests (A & M)	FD, NRED, RD, DoH&E / MP CC Cell	Medium	3-5 yrs		
		24. Explore the potential of utilization and consumption demand for a mix of renewables (such as solar photovoltaics and solar thermal) including LPG	Reduced pressure on forests (A & M)	FD, NRED, PRDD, DoH&E / MP CC Cell	High	5-10 yrs		
FBD/S-7	Sustainable livelihoods for forest dependent communities	25. NTFP focused forest management to help forest dependent communities adapt to climate change through emphasis on multiple utility species	Reducing pressure on forest and increase SFM practices (A & M)	FD, RD, DoH, MPSMFPP	High	1-2 yrs and to continue		
		26. Impart training to communities on sustainable harvesting practices of NTFPs and grazing methods in order to reduce pressure on forests	Reducing pressure on forest and increase SFM practices (A & M)	FD, RD, DoH, MPSMFPP	High	1-2 yrs and to continue		
FBD/S-8	Enhancing green cover outside forests	27. Promoting social forestry, agro-forestry, ToFs, community forestry,	Developing ownership to green cover and reducing pressure (A & M)	FD, RD, UADD	High	1-2 yrs and to continue		
FBD/S-9	Building Institutional mechanism for Climate Change Action Plan	28. Create CC division in the department	More emphasis on CC concerns and effective	FD	High	1-2 yrs and to continue		

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
			management (A & M)					
		29. Integrate CC concerns with the departmental activities	Better addressing of CC concerns (A & M)	FD, DoH&E / MP CC Cell	High	3-5 yrs and to continue		
		30. Coordinate/liason with National Green India Missions	Alignment of departmental actions plans	FD, MoEF	High	3-5 yrs and to continue		
		31. Coordinate/liason with GoMP SAPCC monitoring and evaluation agency	Maintaining backward and forward communication linkages (A & M)	FD, GoMP SAPCC M&EA	High	1-2 yrs and to continue		
7.2 Water								
WRD /S-1	Comprehensive water data base in public domain and assessment of the impact of climate change on water resources of the State (NWM, 2009)	1. Collection of necessary additional hydro-meteorological and hydrological data and ensure availability on public domain.	Development of database for state water resources to assist in forecasting and research for developing better adaptation strategies	WRD, MoWR	High	3-5 yrs		
		2. Development of Water Resources Information System(except the data of sensitive and classified nature, all information to be in public domain)		WRD, MoWR	High	5-10 yrs		
		3. Reassessment of basin wise water situation in present scenario including water quality	(A)	WRD, MoWR	High	3-5 yrs		
		4. Comprehensive Reassessment of the ground water resources up to Block level	Control GW deterioration and promotion of conjunctive use (A)	WRD, MoWR	High	3-5 yrs		
		5. Develop ,revise and update inventory of wetlands, lakes on GIS platform	Better management water Resources(A)	WRD, DoH&E / MP CC Cell	High	3-5 yrs		

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
		6. Expansion of hydrometeorological stations	Assessment of water availability (A)	WRD, MoWR	High	5-10 yrs		
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	Effectively coping with the water stress situation (A)Increase in agriculture production	WRD, ID, RD, MoWR	High	5-10 yrs		
		8. Effective implementaion of participatory irrigation management (PIM) Act 2006.	Better Management Conservation (A)	WRD, ID, RD	High	1-2 yrs		
		9. Expeditious implementation of major, medium and minor irrigation projects	water availability Enhancement (A)	WRD	High	3-5 yrs and to continue		
		10. Expeditious implementation of ERM of irrigation projects in areas / situations sensitive to climate change	(A)	WRD	High	5-10 yrs		
WRD /S-3	Water conservation, augmentation and preservation with special focus on areas with over-exploited conditions of ground water (NWM, 2009)	11. Establish State Water Authority to monitor regulation, management and allocation of water for different purposes	Judicious & need based distribution of water resources for different purposes (A)	WRD, MoWR	High	3-5 yrs		
		12. Promotion of traditional system of water conservation by implementation of programme for repair, renovation and restoration of water storing bodies in areas / situations sensitive to climate change	Water conservation (A)	WRD, RD	High	1-2 yrs and to continue		
		13. Conservation and preservation of wetlands/ Lkaes/ wells/ Bawadi	(A)	WRD, FD, RD, DoH&E, BDB	High	5-10 yrs and to continue		
		14. Expeditious implementation of programme for conservation of water through recharge of ground water including rainwater harvesting and artificial recharge in areas / situations sensitive to CC	(A)	WRD, RD, PHED, UADD, DoH&E	High	3-5 yrs and to continue		

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
		15. Promote soil and water conservation through rural employment programmes	(A)	WRD, RD, DoA	High	1-2 yrs and to continue		
		16. Empowerment & involvement of PRIs, urban water bodies etc in management of water facilities, WUA.	Effective water management through community participation (A)	WRD, DoA, RD	Medium	3-5 yrs		
		17. Legislation for use of GW regulation & management.	(A)	WRD	High	3-5 yrs		
		18. Promotion of a Panchayat/District level model for GW regulation and to orient investment under NREGA towards GW conservation especially in over exploited areas	(A)	WRD, RD, MoWR	High	3-5 yrs		
WRD /S-4	Increase water use efficiency in irrigation, domestic and industrial purposes (NWM, 2009)	19. Development of ideal PPP Model for recycling of waste water		WRD, RD, DoA, UADD	High	1-2 yrs		
		20. Provide technical & financial support for common waste water treatment & recycling plants(industrial as well as urban residential colonies)	(A)	WRD, DoF, UADD, DoC&I	High	3-5 yrs and to continue		
		21. Improve efficiency of urban water supply system	(A)	WRD, UADD, PHED	High	1-2 yrs and to continue		
		22. Development and enforcement of appropriate pricing policy for water usage in industrial, agricultural, domestic aspects	(A)	WRD, UADD, DoF, DoA, DoC&I, DoH&E	Medium	5-10 yrs and to continue		
		23. Incentivising adoption of water efficient technologies.	(A) DSM	WRD, UADD, DoF, DoA, DoC&I, DoH&E	High	3-5 yrs and to continue		
		24. Mandatory water audit for industries and allied sectors	(A)	WRD, DoF, DoC&I, DoH&E	Medium	5-10 yrs and to continue		
WRD /S-5	Promote basin level integrated water shed management	25. Review of State Water Policy in view of National Policy and Water Mission	Addressing the gaps in the policy	WRD, DoH&E / MP CC Cell	High	1-2 yrs		

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
	(NWM, 2009)	26. Participation in developing guidelines for different uses of water particularly in context of basin-wise situations and ensuring adoption/application of these guidelines.	(A)	WRD, DoH&E / MP CC Cell	Medium	5-10 yrs		
		27. Promote Integrated watershed development and management	Better and holistic development of the Watersheds (A)	WRD, RD, DoA	High	5-10 yrs and to continue		
WRD /S-6	Promote Research studies	28. Commission pilot studies on river basin/ catchment management with reference to climate change	Enhanced water availability in streams throughout the year (A)	WRD, RD, PHE, MP CC Cell, Research Institutes	High	3-5 yrs		
		29. Research studies on all aspects related to impact of CC on water resources including quality aspects of water resources with collaboration of research organizations	Better understanding on the existing water scenario of the state (A)	WRD, MoWR, Research Institutes	High	3-5 yrs		
		30. Projection of water resources availability based on regional climate model as a result of impact of climate change which would inter-alia include the likely changes in the characteristics of water availability in time and space	(A)	WRD, MoWR, Research Institutes	High	3-5 yrs		
		31. Research for development of safe and cost effective water purification technologies	(A)	PHE, WRD, MoWR, Research Institutes	High	3-5 yrs		
		32. Mapping of areas likely to experience floods, establish hydraulic and hydrological models and developing comprehensive schemes for flood management & reservoir sedimentation	(A)	WRD, MoWR, Research Institutes	High	3-5 yrs		
		33. Map the deep aquifers, and facilitate natural recharge of these aquifers	(A)	WRD, MoWR, Research Institutes	High	3-5 yrs		

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
		34. Map dried up water storing structures and convert them into ground water recharging structures	Use defunct aquifers(A)	WRD, MoWR, Research Institutes	High	3-5 yrs		
		35. Research / pilot projects in area of increasing water use efficiency and maintaining its quality in agriculture, industry and domestic sector	(A)	WRD, MoWR, Research Institutes	High	3-5 yrs		
WRD /S-7	Capacity building	36. Training of Professionals from various departments /organizations/ PRI/ULBs associated with water resources development and management.	Better decision making and implementation ability in view of climate change (A)	WRD	High	1-2 yrs		
WRD / S-8	Building Institutional mechanism for Climate Change Action Plan	32. Create CC division in the department	More emphasis on CC concerns (A&M)	WRD	High	1-2 yrs		
		33. Integrate CC concerns with the departmental activities	Better addressing of CC concerns (A & M)	WRD, DoH&E / MP CC Cell	High	3-5 yrs and to continue		
		34. Coordinate with National Water Missions and programmes	Alignment of departmental actions plans with national sectoral objectives (A & M)	WRD, MoEF	High	3-5 yrs and to continue		
		35. Liason with GoMP SAPCC monitoring and evaluation agency	Maintaining backward and forward communication linkages (A & M)	WRD, GoMP SAPCC M&EA	High	1-2 yrs and to continue		
7.3 Agriculture								
Agri/ S/1	Promoting use of soil and water Conservation technologies	1. Promote use of surface water resources for irrigation and launch micro water sheds in each village	Reduced dependency on ground water	DoA, WRD, RD	High	3-5 yrs and to continue		

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
		2. Promote use of water and soil conservation techniques and promote dry land farming and technologies like drip irrigation, intermittent flooding, etc.	Sustainable agriculture practices	DoA, RD	High	3-5 yrs and to continue		
		3. Promote dry sowing practices in semi-arid areas	Sustainable yield in extreme temperatures	DoA, RD	High	3-5 yrs and to continue		
		4. Promote SRI techniques	Water DSM (M)	DoA	High	3-5 yrs		
		5. Promote use of high yielding drought proof cultivars	Food Security	DoA	High	3-5 yrs		
		6. Enhanced Integrated watershed management practices	Enhanced soil moisture content, water table	DoA, WRD	High	3-5 yrs and to continue		
Agri/S/2	Planning cropping systems suitable for each agro-climatic conditions	7. Integrate climate change in planning for each agro- climatic zone	Climate Proofing of Agriculture and enhanced knowledge among different stakeholders about CC & its linkages with Agriculture	DoA, DoH&E / MP CC Cell	High	3-5 yrs and to continue		
Agri/S/3	Capacity Building for sustainable agriculture	8. Capacity building of planners, extension workers, farmers associations etc on sustainable agricultural practices	Better understanding of the regional and sectoral climate change concerns among all the stakeholders	DoA	High	3-5 yrs		
Agri/S/4	Management of climate risk for sustainable productivity	9. Promote traditional practices like inter cropping, multiple cropping and crop rotation	Reduced risk of crop failure against extreme climates	DoA, RD	High	3-5 yrs		
		10. Promote practices for managing emerging pests and diseases		DoA	High	3-5 yrs		
		11. Promote integrated farming practices		DoA	Medium	3-5 yrs		
		12. Promote indigenous varieties of crops by providing access to market		DoA	Medium	3-5 ys		

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
		13. Enhance coverage of information on agriculture practices to farmers through agriculture extension including through cell phones	Sustainable yield in changed climate scenarios	DoA	Medium	3-5 yrs		
		14. Promote production of nuclear and breeder seeds and its accessibility to farmers through village seed banks	Sustainable forest mgmt & enhanced knowledge about linkages between forest & agriculture	DoA	Medium	5-10 yrs		
		15. Promote forest linked farming systems in areas where forest cover is substantial	Risk reduction	DoA	Medium	5-10 yrs		
		16. Strengthen weather based crop insurance	Enhanced resource planning	DoA	High	3-5 yrs		
		17. Undertake and revise soil resource mapping at village level		DoA	High	3-5 yrs		
Agri/S/5	Enhancing dissemination of new and appropriate technologies developed by researchers and strengthening research further	Set up <i>demonstration centres</i> at each agro-climatic zone	Build confidence in adopting latest technologies	DoA	Medium	1-2 yrs		
		19. Soil testing- practice and packages (soil kit to the farmers)	Soil quality monitoring Improved seed quality withstanding extreme temp.	DoA	Medium	5-10 yrs		
		20. Seed improvement and management		DoA	High	3-5 yrs		
		21. Establish molecular breeding centers		DoA	Medium	5-10 yrs		
		22. Establish bio- technology laboratories support		DoA	Medium	5-10 yrs		
		23. Provide adequate research facilities to existing agriculture universities and state agriculture research laboratories		DoA	Medium	5-10 yrs		
		24. Increase capacity to run climate models, decipher their projections, use to run the various bio physical	Advance preparedness for the climatic	DoA	High	3-5 yrs		

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
		models to understand the impact of CC on crops, soils, water etc.	changes (A)					
		25. Promotion of energy efficient water pumps	Reduce GHG emissions	DoA, NRED	High	3-5 yrs		
		26. Promotion of organic farming	Prevention against soil contamination	DoA	High	3-5 yrs		
		27. Develop climate forecasts for agriculture and strengthen agrimet services and systems	Risk reduction Adaptation measures	DoA	High	3-5 yrs		
Agri/S/6	Agriculture information management	28. 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.	Enhanced decision making	DoA, DoH&E / MP CC Cell, WRD	Low	5-10 yrs		
		29. Based on the inputs received from this network, set up a single window information dissemination platform / website		DoA	Low	5-10 yrs		
		30. Develop knowledge packages for dissemination to specific stakeholders	Awareness	DoA	Low	5-10 yrs		
Agri/S-7	Additional impetus for accessibility of markets	31. Providing access to roads/ railways for carrying goods to markets	Better returns to farmers and market access	Various departments and agencies of state and central government	Medium	5-10 yrs and to continue		
		32. Provide access to credits for buying vehicles – mechanized or manual	Risk reduction	DoA, DoF	Medium	5-10 yrs		
Agri/S-8	Creation of rural business hubs	33. Provide additional mechanisation facilities for value addition of products such as thrashers, grinders, packaging and storage facilities	Enhanced market for rural products will motivate farmers to adopt the stated	DoA, DoH	Medium	5-10 yrs		

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
		34. Encourage marketing of forest products such as honey, herbs, forest derivatives including soaps and cosmetics	Alternative livelihood support	DoH, DoF DoA,MPSMFPF, FD	Medium High	5-10 yrs		
		35. Encourage rural crafts men and provide access to markets through these village business hubs	Alternative livelihood support	DoA, RD, FD	High	5-10 yrs		
Agri/ S-9	Research & Development	36. Study on Climate change impacts on crop based regional climate modelling & projections		DOA, DoH&E / MP CC Cell	High	3-5 yrs		
		37. Implications of CC on rain fed agriculture		DOA, DoH&E / MP CC Cell	High	3-5 yrs		
Agri/ S-10	Building Institutional mechanism for Climate Change Action Plan	36. Create CC division in the department	More emphasis on CC concerns t (A & M)	WRD	High	1-2 yrs		
		37. Integrate CC concerns with the departmental activities	Better addressing of CC concerns	WRD, DoH&E / MP CC Cell	High	3-5 yrs and to continue		
		38. Coordinate/liason with National Mission on Sustainable Agriculture	Alignment of departmental actions (A & M)	WRD, MoEF	High	3-5 yrs and to continue		
		39. Coordinate/liason with GoMP SAPCC monitoring and evaluation agency	Maintaining backward and forward communication linkages (A & M)	WRD, GoMP SAPCC M&EA	High	1-2 yrs and to continue		
7.4 Horticulture								
HC/ S-1	Soil and water conservation:	1. Application of mulching techniques, drip irrigation	Better soil moisture and reduced use of water (A)	DoFWAD, DOH, Agri Universities	High	1 – 2 yrs		
		2. Encourage micro irrigation practices	(A)	DoFWAD, DOH, Agri Universities	High	1 – 2 yrs		
		3. Encourage use of shednets and poly- houses	Favorable conditions for crops	DOH	Low	5 yrs & continue		

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
HC/S-2	Develop agri-horticulture systems and secure livelihoods especially in dry land tribal areas	4. Encourage crop diversification and develop cropping systems of agri crops- vegetables, agri crops-fruits, agri crops- spices, agri crops-flowers etc.	Enhanced profits from agriculture and better resilience against changed climatic conditions	DoFWAD, DOH, Agri Universities	High	1 – 2 yrs		
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	(A)	DoFWAD, DOH, Agri Universities	High	1 – 2 yrs		
		6. Capacity building of horticulture officials to factor in climate change in horticulture planning for each agro-climatic zone	Enhanced decision making (A)	DoFWAD, DOH, Agri Universities	High	1 – 2 yrs		
		7. Capacity building of farmers to accept the research results for maximising productivity of horticultural crops	Better yield (A)	DoFWAD, DOH, Agri Universities	High	1 – 2 yrs		
		8. Provide access to farm inputs through affordable credits	Risk Reduction (A)	DoFWAD, DOH, Agri Universities	High	1 – 2 yrs		
HC/S-4	Enhancing accessibility to mechanization for value addition and access to markets-creating business hubs	9. Provide credits for setting up processing units	Better economic status, reduction in risk (A)	DoFWAD, DOH, Agri Universities, RD, MoFP	Medium	3 – 5 yrs		
		10. Develop institutional support for developing business hubs and access to markets in different agroclimatic zones for a cluster of rural settlements	(A)	DoFWAD, DOH, Agri Universities, RD, MoFP	Medium	3 – 5 yrs		
HC/S-5	Adequate research and extension support	11. Promote research on horticulture-biotechnology for better cultivar, seeds etc.	Sustainable/enhanced yields against changed climatic conditions	DoFWAD, DOH, Agri Universities	High	1 – 2 yrs		

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
		12. Encourage research on better horticulture farming techniques	(A)	DoFWAD, DOH, Agri Universities	High	1 – 2 yrs		
		13. Provide adequate research support to farmers for enhancing their productivity	(A)	DoFWAD, DOH, Agri Universities	High	1 – 2 yrs		
		14. Ensure effective extension for carrying information from lab to field	(A)	DoFWAD, DOH, Agri Universities	High	1 – 2 yrs		
HC/S-6	Creating cooperatives for enhancing the livelihoods of marginal farmers:	15. Create cooperatives for marketing horticultural products produced by small and marginal farmers	Better market access and price for products and reduction in per unit cost (A)	RD, DoFWAD, DOH	Medium	3 – 5 yrs		
HC/S-7	Building Institutional mechanism for Climate Change Action Plan	16. Create CC division in the department	More emphasis on CC concerns (A/ M)	DoH	High	1-2 yrs		
		17. Integrate CC concerns with the departmental activities	Better addressing of CC concerns (A & M)	DoH, EPCO	High	3-5 yrs and to continue		
		18. Coordinate/liason with National Missions and programmes	Alignment of departmental actions plans with national sectoral objectives (A & M)	DoH, MoEF	High	3-5 yrs and to continue		
		19. Coordinate/liason with GoMP SAPCC monitoring and evaluation agency	Maintaining backward and forward communication linkages (A & M)	DoH, GoMP SAPCC M&E	High	1-2 yrs and to continue		

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
7.5 Animal Husbandry								
AH/S -1	Ensuring availability of adequate feed, fodder and water for livestock	1. Develop policy for using large tracts of land that are fallow and degraded for raising fodder	Development of pasture land (A)	FD, RD, DoAH	Medium	3 – 5 yrs		
		2. Develop policy for use of forest foilage (cut and carry system) for enhancing feed availability	A	FD	High	1 – 2 yrs		
		3. Promote integrated farming for intercropping of fodder crops in agricultural lands	(A)	DoFWAD, DoAH	Medium	3 – 5 yrs		
		4. Develop policies for utilisation of agro-industrial by products such as sugar cane tops, bagasse etc, as feed for livestock.	Improved nutritious fodder (A)	DoFWAD, DoAH	Medium	1 – 2 yrs		
		5. Impetus for azolla farming and for fodder conservation in the form of hay and silage	(A)	DoFWAD, DoAH	Low	5 yrs & continue		
AH/S . 2	Ensuring nutrient solvency in Livestock	6. PromoteStall feeding with grazing	Improved nutritious fodder & reduction of pressure on forests (A)	DoAH, FD, RD	High	5 yrs & continue		
		7. Make available mixed ration/ complete feed of urea enriched molasses mineral blocks.	(A)	DoFWAD, DoAH	Low	5 yrs and continue		
AH/S . 3	Enhanced capacity for disease forecast, monitoring and management	8. Enhance the scale and frequency of prophylactic vaccination programmes in the state	Combat threat disease (A)	DoAH	High	3 – 5 yrs		
		9. Create capacities for developing models for early warning of disease	(A)	DoAH, CC Cell EPCO, MPCST	Medium	3 – 5 yrs		
		10. Create cadres for monitoring disease spread	(A)	DoAH	Medium	3 – 5 yrs		

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
AH/S. 4	Ensure adequate housing for livestock to overcome heat stress	11. Encourage keeping livestock under sheds in rural areas	Sanitation and mitigate heat stress(A)	DoAH	High	1 – 2 yrs & continue		
		12. Provide dedicated water bodies for the cattle to cool off	(A)	DoAH, RD	High	1 – 2 yrs & continue		
		13. Encourage establishment of livestock farms in urban areas where cooler sheds, water, and stall feeding can be done	(A)	DoAH	Low	1 – 2 yrs & continue		
AH/S. 5	Promote research on native species breeding and rearing	14. Promote breeding of indigenous varieties of bulls, cows, buffaloes, goats, and chicken by giving special impetus to research in this area.	Saving indigenous species gene pool (A)	DoAH, Veterinary Universities of GoMP	High	1 – 2 yrs & continue		
		15. Protect indigenous germplasm in its original form	(A)	DoAH, Veterinary Universities of GoMP	High	1 – 2 yrs & continue		
		16. Upgradation of nondescript livestock with exotic and cross bred germplasm	(A)	DoAH, Veterinary Universities of GoMP	Medium	3 – 5 yrs & Continue		
		17. Promote research on understanding of impacts of climate change on different livestock in the state and their productivity	(A)	DoAH, Veterinary Universities of GoMP	Medium	3 – 5 yrs		
AH/S - 6	Promote use of livestock waste for use as organic manure	18. Promote use of waste from livestock as an important source of organic manure for crops	Development of organic manure (M)	DoAH , DoFWAD	Medium	3 – 5 yrs		
		19. Research on easy methane harvesting technology	(H)	DoAH , DoFWAD	High	3 – 5 yrs		
AH/	Integrate livestock water requirements in water shed	20. Enhance availability of quality water for livestock and hence for production of quality milk through	Available of quality	WRD, RD	Medium	3 – 5 yrs		

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
S - 7	management programmes	watershed management practices.	water (A)					
AH/ S - 8	Infrastructure for processing, storage and transport of livestock products:	21. Set up large scale storage and transport facilities through public private partnerships	Better linkage animal product with market (A)	DoAH, RD	Medium	5– 10yrs		
		22. Extend advisory to farmers on milk harnessing and delivery norms to delivery centers near villages	(A)	DoAH, RD	Medium	3 – 5 yrs		
AH/ S - 9	Encourage formation of cooperatives	23. Form Cooperatives of small and marginal farmers to be formed with assistance of NGOs	Integrity of Livestock rearer (A)	RD, DoAH	Low	3 – 5 yrs		
AH/ S - 10	Strengthen the extension arm of the Animal Husbandry Department	24. Strengthen the “Kisan call centres”	Easy accessibility to market (A)	DoAH , DoFWAD	Medium	3 – 5 yrs		
		25. Speeding up short-term trainings to the farmers on different aspects of Animal Husbandry	Good ways of rearing Livestock (A)	DoAH, RD	Medium	3 – 5 yrs		
AH/ S - 11	Building Institutional mechanism for Climate Change Action Plan	26. Create CC division in the department	More emphasis on CC concerns and effective management (A /M)	DoAH, GoMP SAPCC M&EA	High	1-2 yrs		
		27. Integrate CC concerns with the departmental activities	Better addressing of CC concerns (A & M)	DoAH, MP CC Cell	High	3-5 yrs and to continue		
		28. Coordinate/liason with National Missions and programmes	Alignment of departmental actions with National Mission (A & M)	DoAH, MoEF	High	3-5 yrs and to continue		
		29. Coordinate/liason with GoMP SAPCC monitoring and evaluation	Maintaining backward and	DoAH, GoMP	High	1-2 yrs and		

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
		agency	forward communication linkages (A & M)	SAPCC M&EA		to continue		
7.6 Fisheries								
F/S - 1	Study on Climate Change and inland fish practices	1. Identify parameters to develop models for protecting fish production in rivers, reservoirs and ponds with climate change	Enhanced decision making (A)	Fisheries Dept / MP CC Cell	High	1-2 yrs		
		2. Including impact of droughts and heavy precipitation	(A)	Fisheries Dept / MP CC Cell	High	1-2 yrs		
		3. Identify species that will adapt to changing climate scenario	(A)	Fisheries Dept / MP CC Cell	High	1-2 yrs		
F/S - 2	Promotion policy and blending of technology for fisherman	4. Capacity building of fishery managers	Enhanced decision making (A)	Fisheries Dept / MP CC Cell	High	1-2 yrs		
		5. Capacity building of fisheries to make them understand the plausible changes	(A)	Fisheries Dept / MP CC Cell	High	1-2 yrs		
		6. Promotion of health and sanitation activities and fisherman Welfare activities	(A)	Fisheries Dept / MP CC Cell	Medium	3-5 yrs		
F/S - 3	Strengthening fish rearing practices in integrated manner with management of reservoirs, and watersheds	7. Disseminate best practices of fish rearing suitable for different agro climatic zones in MP and types of water bodies including cleaning of ponds	Sustainable Fish Rearing (A)	Fisheries Dept/ RD/ NGOs	Medium	3-5 yrs		
F/S - 4	Make quality fish seeds available to fishers	8. Promote research on developing fish seeds that are suitable for different water bodies and agro-climatic zones	Risk reduction (A)	Fisheries Dept, Research	High	1-2 yrs and to continue		

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
				Institutions				
		9. Create fish seed banks for easy availability to fishermen and farmers	Easy availability of seeds will promote fish rearing(A)	Fisheries Dept	Low	5– 10yrs		
F/S - 5	Increase in fish species diversity	10. To protect livelihood of farmers, diversified culture of local fish such as like Mahaseer, Magur, Singh, Rohu, Katala, Mrugal should be promoted.	Risk Reduction	Fisheries Dept, Research Institutions	Medium	3 – 5 yrs		
F/S - 6	Provide access to markets	11. Access to markets will lead to greater export of fish from the state thus increasing the revenue from this sector	Reduction in vulnerability	Fisheries Dept	High	1 – 2 yrs		
F/S - 7	Building Institutional mechanism for Climate Change Action Plan	12. Create CC division in the department	More emphasis on CC concerns (A & M)	Fisheries Dept	High	1-2 yrs		
		13. Integrate CC concerns with the departmental activities	Better addressing of CC concerns (A & M)	Fisheries Dept, EPCO	High	3-5 yrs and to continue		
		14. Coordinate/liason with National Missions and programmes	Alignment of departmental actions with National Mission (A & M)	Fisheries Dept, MoEF	High	3-5 yrs and to continue		
		15. Coordinate/liason with GoMP SAPCC monitoring and evaluation agency	Maintaining backward and forward	Fisheries Dept, GoMP SAPCC M&EA	High	1-2 yrs and to continue		

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
7.7 Health								
HD/S-1	Developing disease 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	Evidence based health vulnerability assessment leading to better preparedness and planning to deal with situations, strengthening decision making system (A)	DoHFW, Research institutes	High	1 – 2 yrs		
		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 – 5 yrs		
		3. Strengthen IDSP to act as an early warning system based on climate projections		DoHFW, IT Dept, Research institutes	High	3 – 5 yrs		
HD/S-2	Development of weather based early warning system	4. Develop short, medium and long term weather forecasting capacities for local communities, district and for the state as a whole	Informed decision making for planning to mitigate/abate/ameliorate disease intensity and spread	MoHFW, state IMD, Agro—met stations in districts				
		5. Establish research wing that will undertake the analysis						
		6. Establish communication mechanisms for dissemination of forecasting						
HD/S-3	Upscaling disaster management preparedness	7. Prepare separate 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	Protecting population from breakouts of large scale climate related diseases					
HD/S-4	Early case detection and quick control	8. Set up disease diagnosis centres in remote and tribal areas (pathological laboratories)	Early detection will reduce disease burden	DoHFW, PRIs, NRHM, Research Institutes, NVBDCP	High	3-5 yrs		
		9. Sensitising Communities to detect disease						

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
		10. Establishment of drug distribution centres with provision of availability of alternative medicines			High	3-5yrs		
		11. Strengthen medical staff –by training local people on diagnosis and treatment			High	3-5 yrs		
		12. Establish telemedical advisory			High	3-5 yrs		
HD/S-5	Strengthening supporting systems for environment management	13. Identify Measures for source reduction for all vector borne, water borne	Decreasing likely disease burden	MoHFW, district health departments,	High	3-5 yrs		
		14. Train NGOs for detecting disease source and redcing source		District health departments, NGOs,	high	3-5 yrs		
		15. Train Communities		NGOs, communities	High	3-5yrs		
HD/S-6	Monitoring and Evaluation and feed back mechanism	16. Establish a Strategic Planning Unit at the Directorate of Health & Family Welfare Services in order to provide policy inputs for all health care sectors	To ensure integration of CC concerns, accountability and optimisation of inputs and expected outputs(A)	DoHFW	High	1 – 2 yrs		
		17. Integration of IT enabled monitoring and surveillance systems like HMIS, Hospital MIS, Malaria data, GIS		DoHFW, IT Dept	Medium	3 – 5 yrs		
		18. Esatblish a research unit that will design the M&E system for integrating CC concerns and other concerns evaluate the results of M&E and and identify intervention points and strategies for effective outcome of all health delivary systems						
HD/S-7	Public Awareness on health	19. Health education about various vector-borne, water-borne and other climate related diseases.	Preparedness to address possible threats through education (A)	DoHFW, PRIs, NRHM, Research Institutes, NVBDCP	Medium	2– 5 yrs		
		20. Community level groups, PRIs and institutions to be supported for information, edu. nd communication about climate related diseases	(A)	DoHFW, PRIs, NRHM, Research Institutes, NVBDCP	Medium	3 – 5 yrs		

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
HD/S-8	Research and study on climate change and health impacts	21. Triangulation and analysis of data at different level	Better understanding of cause – effect analysis between health and climate change leading to effective preparedness and management	DoHFW, Research Institutes, Medical colleges	High	3 – 5 yrs		
		22. mprove understanding of health impacts of climate change (eg. conducting studies impact of land use change patterns on vector-borne diseases)			High	3 – 5 yrs		
		23. Dedicated research to provide policy makers with new tools to evaluate and respond to the threat of climate change		DoHFW, Research Institutes, Medical colleges	High	1 – 2 yrs		
		24. Preparation of Village level Health Action Plan.		DoHFW, PHE, RD	Medium	3 – 5 yrs		
		25. Review of Draft State Health Policy with emphasis on health impacts of climate change		DoHFW, MP CC Cell	High	1 – 2 yrs		
HD/S-9	Capacity Building	26. Training & Education of Health professionals on Climate Change issues	Better equipped human resources within the department (A)	DoHFW	High H	1 – 2 yrs		
		27. Capacity building of PRIs to implement village level health action plans						
		28. Training of rural health activists on vector & water borne diseases as well as techniques to purify water for drinking purposes	(A)	DoHFW	High	1 – 2 yrs		
HD/S-10	Building Institutional mechanism for Climate Change Action Plan	29. Create CC division in the department	More emphasis on CC concerns and effective management (A & M)	DoHFW	High	1-2 yrs		
		30. Integrate CC concerns with the departmental activities	Better addressing of CC concerns (A & M)	DoHFW, EPCO	High	3-5 yrs and to continue		

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
		31. Coordinate/liason with National Missions and programmes	Alignment of departmental actions plans with national sectoral objectives (A & M)	DoHFW, MoEF	High	3-5 yrs and to continue		
		32. Coordinate/liason with GoMP SAPCC monitoring and evaluation agency	Maintaining communication linkages (A & M)	DoHFW, GoMP SAPCC M&EA	High	1-2 yrs and to continue		
7.8 Urban Development								
UD/S-1	Increasing Energy Efficiency in Residential and Commercial Sectors	1. 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 residential and commercial buildings	Clear policies and bylaws will help in developing the pathway for achieving energy efficiency in buildings (M)	UADD,DoH&E, MPCDMA, MoP	High	1-2 yrs		
		2. Mandating energy auditing of certification of energy performance for all buildings (administration and commercial)	(M)	UADD,DoH&E, MPCDMA, MoP	High	1-2 yrs		
		3. Pursue MuDSM programme of BEE to study energy consumption of urban water supply, sewage treatment facility, street lighting and urban water supply and infrastructure	(M)	UADD,DoH&E, MPCDMA, MoP	High	1-2 yrs		
		4. Adoption of energy efficiency measures for urabn water supply and sewerage equipments, street lights and buildings of ULBs	(M)	UADD,DoH&E, MPCDMA, MoP	High	1-2 yrs		
		5. Explore possibilities of developing a pragmatic CDM proposal for implementation of energy efficiency in ULBs through MuDSM	(M)	UADD,DoH&E, MPCDMA, MoP	High	1-2 yrs		
		6. Promotion of green building construction and incentivising best green building demonstration	Motivate consumers to achieve energy	UADD,DoH&E, MPCDMA, MoP	Medium	3-5 yrs		

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
		projects	efficiency in buildings (M)					
		7. Conceptualization and preparation of IEC material in regional languages and launching state outreach programme for consumer awareness on energy efficiency in urban areas	(A)	UADD	High	3-5 yrs		
		8. Demonstration projects for energy efficient construction technologies for housing	(M)	UADD, NRED, DoE	High	5-10 yrs		
		9. Increase energy auditing and develop monitoring mechanisms to ensure energy efficiency and implementation of recommendations	(M)	UADD, NRED, DoE	High	5-10 yrs		
		10. Capacity Building of UADD officials and consumers on best practices in energy efficiency in building and climate change impacts	Enhanced Decision Making (A)	UADD, NRED, DoE	High	1-2 yrs		
UD/S-2	Urban Water Supply	11. Mandating water audits and energy audit of water utilities	Safe water to people for consumption (A)	UADD	High	3-5 yrs		
		12. Promote water efficient garden irrigation techniques, reduce leakage in supply system, water recycling		UADD	High	3-5 yrs		
		13. Providing treated water to uncovered population		UADD	High	3-5 yrs		
		14. Refurbishment of distribution system and control of UFW through replacement of GI pipes with HDPE pipes		UADD	High	3-5 yrs		
		15. Developing regional/local manual for GW recharge and RWH techniques		UADD	High	3-5 yrs		
		16. Favourable policy level interventions to promote and incentivise RWH	Motivate citizens to adopt rainwater harvesting enhanced water efficiency supply	UADD, DoH&E, WRD	High	3-5 yrs		

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
		17. Awareness among people about Reuse, Reduce and Recycle techniques for waste water management and better utilisation of resources		UADD, DoH&E, WRD	High	3-5 yrs		
UD/S-3	Urban Storm Water Management	18. Developing plans for urban sanitation and capacities of existing drainage system considering climate change impacts	Reducing the risk of disasters	UADD, MoUD	High	3-5 yrs		
		19. Development of standards for better disaster warning systems and construction of shelters in urban areas		UADD, MoUD	High	5-10 yrs		
UD/S-4	Solid Waste Management	20. R & D in the areas of development of process / equipment for separation of different components of MSW for energy recovery and other types of WTE processes	Reduction in per unit cost of energy production	UADD, MoUD	High	3-5 yrs		
		21. Preparation of integrated SWM plans for ULBs and consider imposition of penalty for non compliance with Municipal Solid Waste Rules 2000	Enhanced decision Making	UADD, MoUD	High	5-10 yrs and to continue		
		22. Promotion of PPP model for segregation, collection, transportation and disposal of solid waste	Better compliance to standards	UADD, MoUD	High	5-10 yrs and to continue		
		23. Bio-remediation of existing landfill sites and methane gas recovery from existing landfills	(M)	UADD, MoUD, DoH&E	High	3-5 yrs and to continue		
		24. Creation of treatment facilities and Energy recovery methods like bio-methanation, RDF, incineration etc from segregated biodegradable waste	Reduction in GHG emission and alternate source of energy (M)	UADD, MoUD, DoH&E	High	3-5 yrs and to continue		

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
		25. Awareness programme for segregation and disposal of bio-degradable waste through vermicomposting and bio-gas generation at household / community levels	Enhanced decision Making	UADD, MoUD, DoH&E	High	1-2 yrs		
		26. Develop suitable norms and policy for marketing of municipal compost and energy from waste	Better compliance to standards	UADD, MoUD	High	5-10 yrs and to continue		
		27. Developing CDM projects relevant to Urban sectors like SWM, EE, Transport etc	Additional source of revenue which would motivate investors to invest in these projects	UADD, MoUD	Medium	1-2 yrs and to continue		
		28. Demonstration projects for recycling of construction waste	Additional source of revenue which would motivate investors to invest in these projects	UADD/ MoUD	Medium	Ongoing		
UD/S -5	Wastewater Management	29. Pilot project for segregation at the household level of black and grey water	Reduction in wastewater locking	UADD, MoUD	Medium	5-10 yrs		
		30. 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	Build confidence among people to adopt these technologies	UADD, MoUD	Medium	5-10 yrs		
		31. Promotion of recycling and reuse of treated wastewater		UADD, MoUD	Medium	3-5 yrs		
		32. Demonstration projects for promoting use of decentralised waste management systems for community, housing complexes and buildings	Improved planning and implementation	UADD, MoUD	Medium	3-5 yrs		
UD/S -6	Sustainable Urban Transport	33. Development of norms integrating measures related to taxation, parking, congestion charges, public carriage specifications and service		UADD, DoT, MoUD	Medium	3-5 yrs		

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
		norms to encourage public transport						
		34. Development of norms for pedestrianisation/ cycling	Motivate people to use public transport	UADD, DoT, MoUD	Medium	3-5 yrs		
		35. Model regulations for integrating transport planning with spatial planning (Master plan)		UADD, DoT, MoUD	Medium	5-10 yrs		
		36. Launch dedicated awareness drive on use of public transport		UADD, DoT, MoUD	High	1-2 yrs		
		37. Capacity Building in transport planning and land use integration, optimization of various public transport modes, strengthening of institute of urban transport	Enhanced decision making	UADD, DoT, MoUD	High	1-2 yrs		
		38. Promoting and incentivising use of non-motorised vehicles		UADD, DoT, MoUD	Low	5-10 yrs		
UD/S-7	Urban Planning	39. Consider modification of Town and Country Planning Act/ DCR for promoting urban renewal, environment management, spaces for plantation at plot level for increasing tree cover, structural safety, hazard and risk mitigation, transport planning and optimal urban reforms		UADD, DoH&E	Medium	2-5 Years		
		40. Create Educational Programmes for students and professionals on aspects related to Sustainable Urbanization in association with RGTU and other associated institutions		UADD, DoH&E	Medium	1-2 yrs Years		
		41. Develop strategies for climate change resilient cities or climate smart cities		UADD, DoH&E	Medium	1-2 yrs Years		

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
UD/S-8	Adoption of service level Benchmarks	42. Adoption of benchmarks for sustainable management of water supply, wastewater, storm water drainage and solid waste management		UADD, MoUD	Medium	3-5 yrs		
		43. Development of service level benchmarks for urban services	Enhanced service delivery	UADD, MoUD	Medium	3-5 yrs		
		44. Mandating adoption of sustainable habitat standards by JNNURM		UADD, MoUD	Medium	3-5 yrs		
UD/S-9	Building Institutional mechanism for Climate Change Action Plan	45. Create CC division in the department	Emphasis on CC concerns and effective management (A & M)	UADD, DoT	High	1-2 yrs		
		46. Integrate CC concerns with the departmental activities	Better addressing of CC concerns (A & M)	UADD, DoT, EPCO	High	3-5 yrs and to continue		
		47. Coordinate/liason with National Missions and programmes	Alignment of departmental actions plans with national sectoral objectives (A & M)	UADD, DoT, MoEF	High	1-2 yrs and to continue		
		48. Coordinate/liason with GoMP SAPCC monitoring and evaluation agency	Maintaining backward and forward communication linkages (A & M)	UADD, DoT, GoMP SAPCC M&EA	High	1-2 yrs and to continue		
7.9 Energy								
E/S-1	Enhancing efficiency in generation of power	1. Assess viability and consider switching over to super critical boilers	Improve Plant efficiency and thereby GHG reduction(M)	DoE, DoC&I	Medium	3-5 yrs		
		2. Assess carbon-capture technology and its commercial application in thermal power plants	(M)	DoE, DoC&I UVN, MoP, NRED	Medium	3-5 yrs		
		3. Green Tariff should be designed to motivate clean energy generation in	(M)	DoE, DoC&I UVN, MoP, NRED	Medium	3-5 yrs		

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
		the state						
		4. Development of policy framework for generating clean energy through clean coal approaches	To utilize mines and coal washery rejects (M)	DoE, DoC&I UVN, MoP, NRED	High	5-10 yrs		
		5. Use of fluidised bed boiler and coal gasification	(M)	DoE, DoC&I UVN, MoP, NRED	Medium	3-5 yrs		
		6. Assessment of life cycle analysis of existing thermal power plants and implementation of R & M measures	(M)	DoE, DoC&I MoP, NRED	High	3-5 yrs		
E/S-2	Undertake demand side management to improve efficiency and reduce GHG emissions	7. Development of operational plan for reduction of T & D losses	Enhanced Energy Efficiency (M)	DoA, DoE, MoP	Medium	3-5 yrs		
		8. Development and implementation of feeder separation in rural areas	Reduction in GHG emission (M)	DoA, DoE, MoP	Medium	3-5 yrs		
		9. Improve Energy Efficiency in Agriculture sector by replacing agri pumps	(M)	DoA, DoE, MoP	Medium	3-5 yrs		
		10. Consider to modify the subsidy mechanism can be modified and energy efficient equipments may be subsidized	(M)	DoA, DoE, MoP	High	3-5 yrs		
		11. Promote Energy Efficiency in Street lighting and Water Pumping (ESCO model)	(M)	UADD, DoE MoUD, BEE, ESCOs	High	3-5 yrs		
		12. Promote aggressively Energy saving in domestic sector through Energy Efficient Equipments, creating awareness about best practices for energy conservation	(M)	BEE, UADD, MoUD, MoP	High	3-5 yrs and to continue		
		13. Promote effective utilization and distribution of energy: Load shifting or differential pricing during peak hours can be implemented in industries	Enhanced Energy efficiency(M)	DoE, DoC&I, BEE, MoP	Medium	3-5 yrs and to continue		

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
		14. It may be made compulsory to implement the suggestions of energy audit and more building should be brought under this notification	(M)	DoE, DoC&I, BEE, MoP	Medium	3-5 yrs and to continue		
		15. Increase the outreach and coverage of Bachat Lamp Yojana programme	(M)	DoE, DoH&E / MP CC Cell	Medium	1-2 yrs and to continue		
		16. Promotion of BEE's, ECBC Codes for adoption in the State	Wise use of energy(M)	DoE	Medium	3-5 yrs and to continue		
E/S-3	Market Transformation for Energy Efficiency	17. Leveraging international financing instruments for promoting energy efficiency	Accelerate investment in energy efficiency(M)	DoE, NRED MoP,	Medium	3-5 yrs		
		18. Promotion of Programme of Activities of CDM in various sectors	(M)	DoE, NRED MoP,	High	3-5 yrs		
		19. Identification of CDM Potential in energy efficiency projects	(M)	DoE, MNRE, MPCDMA	High	1-2 yrs		
E/S-4	Building Institutional mechanism for Climate Change Action Plan	20. Create CC division in the department	More emphasis on CC concerns (A & M)	DoE, NRED				
		21. Integrate CC concerns with the departmental activities	Better addressing of CC concerns (A & M)	DoE, NRED EPCO	High	3-5 yrs and to continue		
		22. Coordinate/liason with GoMP SAPCC monitoring and evaluation agency	Maintaining backward and forward communication linkages (A & M)	DoE, NRED, GoMP SAPCC M&EA	High	1-2 yrs and to continue		
7.10 New and Renewable Energy								
NRE/S-1	Increase the mix of renewable energy in total energy consumption by the state	1. Formulate favorable policies to attract investors to invest in RE sector	Increased share of RE (M)	DoE,NRED	High	3-5 yrs and to continue		
		2. Harmonize renewable purchase upto	(M)	DoE,NRED	High	3-5 yrs and		

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
		commercial levels. RPO which is 0.8% this year should be increased gradually				to continue		
		3. Public Private Partnership (PPP) approach may be used to attract infrastructure investment	(M)	DoE,NRED	High	3-5 yrs and to continue		
		4. Solar power should be promoted in phases and institutions should be covered at first as they can easily be mapped and reached	(M)	DoE,NRED	High	3-5 yrs and to continue		
		5. Review and assess impact of subsidizing Renewable Energy use	(M)	DoE,NRED	Medium	1-2 yrs		
		6. Promote energy plantation in forest areas for biomass generation	(A & M)	DoE,NRED, FD	Medium	3-5 yrs		
		7. Training should be given to villagers about pallet formation to enhance their incomes	(A & M)	DoA, RD	Medium	1-2 yrs		
		8. Capacity Building of UVN officers about renewable energy, CDM, latest technologies	(M)	DoE/ NRED	High	1-2 yrs		
		9. Promotion of wind energy generation	(M)	NRED	High	5-10 yrs		
		10. Evolve PPP model in promotion of quality, user friendly solar equipments	(M)	DoE, NRED	Medium	5-10 yrs		
		11. Develop Solar Parks (Rajgarh) and other demonstration sites for other RE sources should be developed.	(M)	NRED	Medium	5-10 yrs		
		12. School/ College students should be educated about RE technologies.	(M)	NRED, Higher Education Department	Low	1-2 yrs		
		13. Research & Development activities should be accelerated in the field of RE	(M)	NRED	Medium	3-5 yrs		
		14. Start initiatives like lighting a billion lamps campaign in the state to promote rene energy in rural areas	(M)	NRED, MNRE, MP CC Cell	High	1 – 2 yrs and to continue		

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
E/S-2	Building Institutional mechanism for Climate Change Action Plan	15. Create CC division in the department	More emphasis on CC concerns and effective management (A & M)	NRED				
		16. Integrate CC concerns with the departmental activities	Better addressing of CC concerns (A & M)	NRED EPCO	High	3-5 yrs and to continue		
		17. Coordinate/liason with National Solar Missions and NMEEE	Alignment of departmental actions plans with national sectoral objectives (A & M)	NRED, BEE MNRE	High	3-5 yrs and to continue		
		18. Coordinate/liason with GoMP SAPCC monitoring and evaluation agency	Maintaining backward and forward communication linkages (A & M)	DoE, NRED, GoMP SAPCC M&EA	High	1-2 yrs and to continue		
7.11 Industry								
IND/S-1	Review of M.P. Industrial policy 2004 to addressed the Climate Change Concern	1. Build strategy to integrate climate change concern leading Industrial Development	Develop a policy framework favouring low carbon Industrialization (M)	DoC&I, H & E Dept Research Institutes	High	1 – 2 yrs		
		2. Effective monitoring and strict compliances of ISO 14001 compliant company			High	1 – 2 yrs		
		3. Build a mechanism to incentivize actions taken by industries towards mitigation and to promote industries to take up ISO certifications	Developing sense of responsibility towards environment (M)	H & E Dept, MoEF	Medium	3 – 5 yrs		
		4. Build in strict rules and regulations for upcoming industrial zone in the state keeping in frame optimum management of natural resources like minerals, land, water and air	(M)	MPPCB, H & E Dept, MoEF	Medium	3 – 5 yrs		

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
IND/S-2	Implementation of Perform, Achieve and Trade (PAT) Mechanism	5. Facilitate implementation of PAT in the identified companies	Development of industries in an energy efficient way leading towards mitigation (M)	DoC&I, MPUVN, MoP	Medium	3 – 5 yrs		
		6. Incorporation of the learning of the PAT in the state industrial policy		DoC&I, MPUVN, MoP	Medium	3 – 5 yrs		
IND/S-3	Capture the opportunities existing in the carbon Market for Mitigation	7. Increase efforts and investments in CDM project	Encourage entrepreneurs to adopt low carbon technologies which will eventually help in reducing the state's GHG emissions (M)	DoC&I, MPUVN, MoP	Medium	3 – 5 yrs		
		8. Investment in Green and New Technology		DoC&I, MPUVN, MoP	Medium	3 – 5 yrs		
		9. Incentivise, reward GHG reduction efforts		H & E Dept, MoEF	Low	5 – 10 yrs		
IND/S-4	Devise an integrated water management plan for industrial clusters	10. Compulsory water & waste water Audit	Effective and better utilization of water in view of impact of climate change on water resources (M)	DoC&I, WRD	High	ST		
		11. Promotion of water efficiency measures						
		12. Waste water treatment, recycle and reuse of waste water	(A/M)	DoC&I	High	1 – 2 yrs		
		13. Promotion of water harvesting in industrial clusters	(A/M)	DoC&I, WRD	High	1 – 2 yrs		
IND/S-5	Effective Industrial Waste Management and Pollution Control	14. Develop Eco – Business model	Clean environment and reduced GHG emissions	DoC&I, MPUVN, MoP	Medium	3 – 5 yrs		
		15. Promote networking among industries for recycling and reuse of wastes						
		16. Use of more efficient technology to reduce pollution	(M)	DoC&I, MPUVN, MoP	Medium	3 – 5 yrs		

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
IND/ KS-6	Involvement of industries in plantation activities	17. Develop eco friendly industry campus with periphery plantation	Promotion of CSR towards green environment (M)	DoC&I, MPUVN	High	1 – 2 yrs and to continue		
		18. Creation of green zones and water harvesting structures in industrial clusters		DoC&I, MPUVN	High	1 – 2 yrs		
		19. Encourage industries to align CSR activities towards GHG Reduction		DoC&I, MPUVN, MoP	High	1 – 2 yrs and to continue		
IND/ S-7	Capacity building and entrepreneurship development	20. Regular training to the industries on technology upgradation and cleaner technologies	Enhanced capacities of industries to understand clean and low carbon industrialization technologies and market financial tools (M)	DoC&I, MPUVN, MoP, Research and Training Institute, FIIND	High	1 – 2 yrs		
		21. Training on calculating and managing carbon footprint of the industry			High	1 – 2 yrs		
		22. Training to entrepreneurs on eco business model		Research and Training Institute, FIIND, MoP	High	1 – 2 yrs		
		23. Promote communication between MP Chamber of Commerce, FIIND and Industries for better knowledge sharing on policies and trainings		DoC&I, FIIND, MoP	High	1 – 2 yrs		
IND/ S-8	Research & Development	24. Promote industries to network with research institutes for financing technological research	Development of new and improved industry specific eco friendly technologies (M)	DoC&I, MPUVN, Research Institutes	Medium	3 – 5 yrs		
		25. Strengthening R & D in the department of industries to involve in development eco friendly technologies		DoC&I, MPUVN, Research Institutes	Medium	3 – 5 yrs		

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
IND/S-9	Build institution mechanism for SAPCC action plan	26. Create CC division in the department	More emphasis on CC concerns and effective management (A & M)	DoC&I	High	1-2 yrs		
		27. Integrate CC concerns with the departmental activities	Better addressing of CC concerns (A & M)	DoC&I, MP CC Cell, EPCO	High	3-5 yrs and to continue		
		28. Coordinate/liason with National Missions and programmes	Alignment of departmental actions plans with national sectoral objectives (A & M)	DoC&I, MoEF	High	3-5 yrs and to continue		
		29. Coordinate/liason with GoMP SAPCC monitoring and evaluation agency	Maintaining backward and forward communication linkages (A & M)	DoC&I, GoMP SAPCC M&EA	High	1-2 yrs and to continue		
7.12 Rural Development								
RD/S-1	Review of existing rural development programmes with Climate Change focus	1. Impact assessment of the programme and climate resilience check of the works in process	Reduction of climate induced vulnerabilities and enhanced adaptive Cap. (A)	RD, DoH&E/MPCC Cell	High	3-5 yrs		
		2. Assess climate vulnerability of the area and develop a robust strategy to integrate CC concerns in the existing and upcoming programmes	(A)	RD, DoH&E/MP CC Cell	High	3-5 yrs		

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
RD/S-2	Training and Capacity Building of rural communities	3. Development of skills for alternative income generation activities to reduce climate induced vulnerabilities	Information and education to reduce climate induced vulnerabilities and enhanced adaptive capacities(A)	RD, DoC&I	High	5-10 yrs and to continue		
		4. Awareness on various programmes/schemes/benefits favouring enhanced income opportunities	(A)	RD,	High	1-2 yrs		
		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	(A)	RD, DoH&E/MP CC Cell	High	3-5 yrs and to continue		
RD/S-3	Promote use of technology to combat CC in the annual plans of Panchayats	6. Promotion of water efficiency in agriculture and other uses	Climate resilience building in plans of panchayats (A)	RD, DoH&E	High	5-10 yrs and to continue		
		7. Promotion of Energy efficiency measures, bio-gas and Solar energy applications	(A)	RD, UADD, NRED	High	3-5 yrs and to continue		
RD/S-4	Credit availability for rural infrastructure development and insurance against climate induced vulnerabilities	8. 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	Climate resilience building and Sustainable livelihoods and resilient ecosystem (A)	RD, DoF, , NBFCs	High	5-10 yrs		
RD/S-5	Building Institutional mechanism for Climate Change Action Plan	9. Create CC division in the department	More emphasis on CC concerns and effective management (A & M)	RD	High	1-2 yrs		

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
		10. Integrate CC concerns with the departmental activities	Better addressing of CC concerns (A & M)	RD, EPCO	High	3-5 yrs and to continue		
		11. Coordinate/liaison with National Missions and programmes	Alignment of departmental actions plans with national sectoral objectives (A & M)	RD, MoEF	High	3-5 yrs and to continue		
		12. Coordinate/liaison with GoMP SAPCC monitoring and evaluation agency	Maintaining backward and forward communication	RD, GoMP SAPCC M&EA	High	1-2 yrs and to continue		
		13. Preperation and implementation of Gender centric Local Action Plans on Adaptaion (LAPA) through PRIs	Adaptation	RD/ W&CD/ MP CCC	High	3-5 Years		
7.13 Environment								
E/S-1	Knowledge Management Centre (KMC) in Climate Change	1. Set up a state level Climate Change KMC in EPCO and prepare DPR	Imparting knowledge to Stakeholder (A/M)	MP CC Cell, EPCO	High	1 – 2 yrs		
E/S-2	Dedicated state of the art research to provide policy makers with tools to evaluate and respond to the threat of climate change	2. Improve understanding of climate change as more emphasis may be required at policy level on- water, food security, land use change, disease transmission, GHG, CDM etc. in collaboration with relevant institutes/departments	Comprehension of Climate Change knowledge (A/M)	MPCST	High	1 – 2 yrs		
		3. Sectoral GHG inventorization and generation of Marginal Abatement Cost Curves (MACC) for each sector	Enhanced decision making	MP CC Cell, EPCO	Medium	3 – 5 yrs		

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
		4. Preparation of Climate Change Status Report every five years			Low	5 yrs		
E/S-3	Strengthening of monitoring systems of various initiatives of the climate sensitive sectors	5. Monitoring the impact of various initiatives of the climate sensitive sectors at village levels by creating integrating database. Remote sensing may (e.g. forest fire detection system of M.P forest department)	Creating MIS and Remote Sensing for easier/ effective monitoring (A/M)	MAPCOST, H & E Deptt, IIRS	High	3 – 5 yrs		
E/S-4	Increase of general awareness of people by educating them about climate change	6. Community level groups, PRIs and institutions (including educational) may be supported for information, education and communication about climate change	More awareness in grassroot level (A/M)	MP CC Cell EPCO, Regional Science Center, Universities	Medium	3 – 5 yrs		
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.	Effective and better plan (A/M)	H&E Deptt	High	3 – 5 yrs		
E/S-6	Regular monitoring of critical ecological parameters, such as air, water, forests etc	8. Regular monitoring of air (GHG, suspended particles etc), quality and quantity of water, forests etc.	Effective monitor pollution emission (A/M)	H&E Deptt, MPPCB	High	3 – 5 yrs		
E/S-7	Urban landscape monitoring to mitigate and adapt to climate change, especially for the vulnerable	9. Regular monitoring and documentation of urban landscape (including change in land-use pattern), population growth, settlements (especially slums).	Initiate Green Building and Urban Master Plan (A/M)	H&E Deptt	High	3 – 5 yrs		
E/S-8	Mainstream of Climate Change concern	10. Prepare ACZ and district specific Climate Change resource book and training to sensitize district officials and DPC members to integrate Climate Change concern	Stakeholder capacity building and web portal on climate change (A/M)	EPCO CC Cell, MoEF	High	3 – 5 yrs		
E/S-9	Monitoring and Evaluation	11. Commissioning of Baseline studies for each sector, departments	Give the updated sectoral CC status (A/M)	All the concerned departments	Medium	3 – 5 yrs		
		12. Evolving appropriate sectoral criteria/ indicators for M&E in association with respective departments			Medium	3 – 5 yrs		

Code	Strategies	Activities	Implications	Departments / Organisations	Priority	Duration	Cost	Funding Source
		13. Gender Centric Participatory Assessment	Adaptation	All the concerned Departments	High	3-5 yeras		
E/S-10	Building Institutional mechanism for Climate Change Action Plan	14. Create CC division in the department	More emphasis on CC concerns and effective management (A & M)	H&E Deptt	High	1-2 yrs		
		15. Integrate CC concerns with the departmental activities	Better addressing of CC concerns (A & M)	H&E Deptt	High	3-5 yrs and to continue		
		16. Coordinate/liasion with National Missions and programmes	Alignment of departmental action plans with national sectoral objectives (A & M)	H&E Deptt, MoEF	High	3-5 yrs and to continue		
		17. Coordinate/liason with GoMP SAPCC monitoring and evaluation agency	Maintaining backward and forward communication linkages (A & M)	H&E Deptt, GoMP SAPCC M&EA	High	1-2 yrs and to continue		

8 Monitoring and Evaluation

8.1 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 learning by doing process and it has to be participatory process. A dynamic process may allow an effective and active monitoring and evaluation of the performance of an 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

8.2 M&E at development objective level

It is important to monitor and evaluate the policies governing the national developmental goals as most of them are likely to be affected by climate change. For example the goal of reducing poverty of the Madhya Pradesh government may be affected by variability in rain fall, increase in temperature, increase in extreme events etc that reduce agriculture productivity, increase spread of diseases, depletion in forest products etc leading to loss in livelihoods and hence enhance poverty. Therefore devising climate sensitive policies for each of the developmental goals of the state is a necessity. However, it is equally important that monitoring and evaluation of the climate sensitive policies needs to be put in place to monitor achievement as well as incorporate corrective action.

8.3 M&E at sectoral level

The monitoring and evaluation stage at sectoral level consists of the assessment of progress against set targets and objectives. Monitoring and evaluation instruments include an array of reporting tools, including budget execution reports as well as gender-based budgeting. An increasingly important monitoring and evaluation tool is the Performance Assessment Framework (PAF) used for assessing governance performance under sector budget support. The important aspect here is to assess climate justified mitigation and adaptations policies. Some benefits of the climate adjusted policies can be seen very soon after implementation, especially those of mitigation. However, adaptations designed to address infrequent events may not have sufficient data upon which to fully evaluate them. Until the climate changes, it may be difficult to fully evaluate the effectiveness of such adaptations. Monitoring programmes will require the careful selection of criteria and indicators to ensure they are both effective and efficient. Data on trends, building on existing systems and methods so that historic data can be incorporated, evaluation of these data sets is required which means strengthening the existing research and development community. In turn this would mean an evaluation of achievement of these institutions as well.

8.4 M&E at project level:

Monitoring and evaluating the integration of mitigation actions and adaptation into projects will require several actions. First, the implementation of the options identified will need to be specifically monitored. This will involve assessing whether the identified options are actually put

in place, what unexpected problems arose in the implementation process. In case of adaptation, whether the options had any adverse or positive impacts on other sectors or regions, and whether costs of adaptation exceeded those anticipated. In case of mitigation actions, energy efficiency achieved and the GHG emission reduced wrt to the base line need to be assessed and monitored through the project cycle and after it is over. In both the cases, evaluation should assess whether the project delivered the intended benefits and whether it caused adverse outcomes that were not anticipated. This last intervention can also contribute to providing suggestions for improving future mitigation and adaptation planning and design.

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:

MPCCC: The cell 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) and 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.

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.

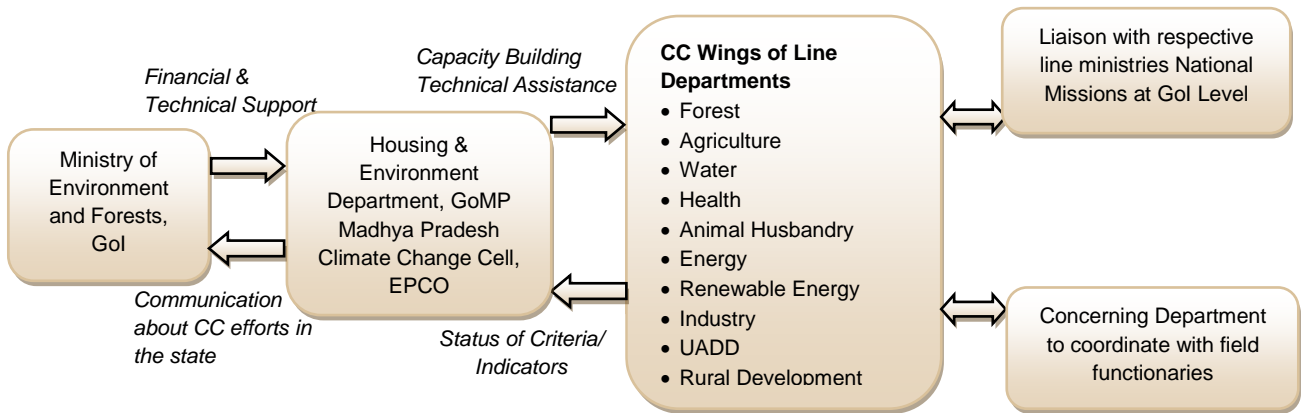


Fig.8.4.1 Flow Diagram of Monitoring and Evaluation of SAPCC

Annexure 1: Details of Sectoral Workshops

S. No.	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. H. 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 Turkey, Secretary, Panchayat and Rural Development Department, GoMP, Shri Umakant Umarao Director, Rajiv Gandhi Watershed Mission	31

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, Khargoon, 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 March 2011 Bhopal	Bhopal, Guna, Rajgarh, Vidisha, Ashoknagar, Sehore	44

Annexure 2:List of Participants inSectoral Workshop

Name	Sector	Name	Sector	Name	Sector	Name	Sector
Dr. U.P.S Bhadauria	Agriculture	Dr.K.S.Baghel	DoAH	Dr. T. P. Vaidya	DoAH	Satish Awale	Research Institute
Dr. G.K. Koutu	Agriculture	Dr.M.K.Shrivastava	DoAH	Dr. A.K. Likhi	DoAH	Dilip Kumar Singh	DML
R.K. Ganeshe	Agriculture	Dr.A.K.Dixit	DoAH	Dr. M S Patel	DoAH	Dr. Atul Shrivastav	Forest
G.S. Gurjar	Horticulture	Dr.G.Das	DoAH	Dr. D. R. Ahirwar	DoAH	Manmohan Kapshe	SFA, Bhopal
Sunil Kumar Dubey	Horticulture	Dr.M.M.Maney	DoAH	Dr. B. L. Verma	DoAH	H S Malviya	MPPCB
Rajesh Chavan	R-Energy	Rajendra Kumar	Horticulture	Shaan Bahadur	Media	Mr A K Verma	Forest
Dr. D.N. Sharma	Agriculture	Dr.C.K.Dubey	DoAH	Dr. S. K. Gurondia	DoAH	A C Karera	MPPCB
Dilip Chakravarty	NGO	Dr.Purandare	DoAH	Dr. Mamta Dixit	DoAH	Dr. P V Borde	RMRCT, Jabalpur
D.K. Dubey	Agriculture	Dr. Vijay Sharma	DoAH	Dr. D. K. Nigam	DoAH	Prof. R K Trivedi	Sagar University
Meenal Selukar	LCA	Dr.N.S.Akhade	DoAH	Dr. A. K. Agrawal	DoAH	Dr. Sunita	DoAH
Joseph Kujur	NGO	Dr.Vani Pandey	DoAH	Dr. S. Ekka	DoAH	Dr. P L Singh	CIAE
Dr. Arvind Bijalwan	IIFM	Dr.Neena Tripathi	DoAH	Dr. Seema Jain	DoAH	K C Tiwari	IGNOU
Rashmi Arun Shami	Horticulture	Dr.Jagdish Bawistak	DoAH	Dr. Ramadhar Singh	CIAE	Gyan Chand	RMRCT,Jabalpur
Dr.Neelsh Shah	DoAH	Dr.Seema Bhudwale	DoAH	Dr. A. Banerjee	DoAH	Ravi Shrivastav	MFP Federation
Akhilesh Kekre	UNDP	Dr. D K Gutam	DoAH	Priyanka Dubey	MPJAP	Dr. Hegde	Research Institute
S.C. Singadia	Agriculture	Dr. A K Sharma	DoAH	Dr. Rangnekar	Retd. DoAH	Archana Soni	Research Institute
K.S. Tekam	Agriculture	M E Khan	DoAH	Dr. R. H. Rokde	DoAH	Saroj Rangnekar	Research Institute
B.D. Sharma	Agriculture	Dr. Ritu Vijay Jain	DoAH	S.N. Roy	NGO	Prof.L. P. Chourasia	Sagar University
O.P. Jharbade	Agriculture	Dr. Pankaj Dubey	DoAH	Dr. J. Shana	DoAH	Varghese Paul	TCPSU, MPRLP
Dr. HS Singh	Research Institute	Dr. SK Sirohi	Research Institute	Er. S.S.Kushwaha	Research Institute	Er.S.S. Kushwah	Research Institute
Dr. Mulesh Mishra	Horticulture	SNS Mehra	Agriculture	Dr. Manghnani	DoAH	Dr. Rakesh Sharan	MPCST
Mr. Hemraj Singh	Agriculture	Dr. Piyakant Pathak	DoAH	Deepak Patidar	Farmer	Dr. Sandeep Goyal	MPCST
Dr. H.B.S Bhadoria	Agriculture	Dr. Arti Saxena	DoAH	Dr. Babita	DoAH	Dr. Bhaskar Sinha	IIFM
S.M. Balpimde	Agriculture	Dr. Mohd. Asgar	DoAH	Dr. Seema Rao	DoAH	Anita Thakur	ZARS(AAS)
Sudha Singh	Limnologist	Dr. Ajay Gupta	DoAH	Dr. Lokesh Verma	DoAH	Dr. S C Dubey	HSADL,IVRI
U.S. Tomar	Fisheries	Dr. S K Bajpai	DoAH	Dr. G.G.Goswami	DoAH	Dr. Anamika Mishra	HSADL,IVRI
A.K. Shrivastava	Fisheries	Dr. R K Soni	DoAH	Dr. S.K.Shrivastava	DoAH	Dr. Elizabeth Thomas	MPSBB
Dr. P.C. Mishra	Research Institute	Dr. S.S. Tomer	Research Institute	Abbas Ahmed	DoAH	Dr. R B Lai, Director	IIFM
Dr. Deeplata Majhi	DoAH	Dr. Neelsh Desai	DoAH	Dr. A.K.Singh	DoAH	Dr. V R Khare	EPCCO
A.S. Prajapati	Research Institute	Dr. R. K. Jain	Research Institute	Dr. Arvind Bijalwan	Research Institute	Sanjay Sharma	DFID
Dr. Vinita Vipat	LCA	Dr. S. S. Tomar	Research Institute	Dr. K.D.Sharma	DoAH	Dr. Ramadhar Singh	Research Institute
Dr. K.K. Agrawal	Research Institute	Dr. S. S. Patil	DoAH	Dr. R.K.Jain	DoAH	Dr. M Verma	IIFM
Dr. U K Subuddhi	EDB	Dr. S. D. Shrivastava	DoAH	Utam Nayurshi	DoAH	Dr. K K Agrawal	JNKVV,Jabalpur
Rajeev Issar	Agriculture	Dr. Tejinder Kaur	DoAH	Dr. P.K.Sharma	DoAH	Dr. S D Upadhyay	JNKVV
Dr. S.K. Sharma	Research Institute	Dr. S. K. Sakalle	DoAH	Dr. Manish Vyas	DoAH	Dr. O P Chaubey	SFRI, Jabalpur
Dr. B. Khan	LCA	Dr. Pragya Chaurasee	DoAH	Dr. R.K. Shrivastav	DoAH	Mr V R Khare	Retd. Forest
P. Chaudhary	MP Biogas Bhopal	Dr. Shyam Kali Patel	DoAH	Dr. Anwar Alam Khan	DoAH	Umashankar Gantayat	PWC
Rajneesh Kumar	MP Biogas Bhopal	Dr. S. K. Kapoor	DoAH	Dr. R C Upadhyay	Research Institute	Paras Jain	UADD
Dr. R.K.Dilawory	DoAH	Dr. D.S.Jadon	DoAH	Dr. U.C.Sharma	DoAH	Rakesh Sharma	Archaeology
Dr. R.D.Dubey	DoAH	Dr. R.K.Pathak	DoAH	Dr. M. Sharma	DoAH	Savita Vyas	RGPV
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U K Ghosh	Senior Engineer	Navneet Thind	Research Institute	Dr. M.P. Jain	Research Institute	Rajeev Keskar	DGM TradeCO
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R K Khare	Energy	Neeraj Agarwal	Energy	Rahul Raizada	PWC	Bala	MPJAP
S K Deshpande	Energy	Mukul Dhariwal	Energy	Dr V K Sethi	Energy	V K Sharma	Research Institute
Ravi Nema	Energy	P Nema	Energy	Dr. D P Dubey	IMD	Dr. K S Sharma	MVM Bhopal
K K Saxena	Energy	Kafi	Energy	Ashok	Archaeology	Dy. Director	State Museum
Saurabh Jain	Energy Auditor	Vikas Kumar Bramhawat	RD	Naresh Singh Yadaav	RD	Prof Prashat Jadhav	IIFM
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Rahul Sakseena	R-Energy	H.S.Panwar	Forest.	R.K.Nabdeo	Horticulture	Mayank M Verma	SFRI, Jabalpur
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Dr C B Solanki	Health	Dr B N Chouhan	Health	Dr Kuldeep Verma	Health	Dr R B Lal	IIFM
Dr P V Barde	Health	Dr L B Asthana	Health	Shri Gaurav Jain	Health	Mr Varghese Paul	MPRLP
Dr SAS Kazmi	Health	Dr S Kishnani	Health	Dr Anamika	Health	Mr Manoj Tiwari	Health
Dr B S Ohri	Health	Dr C Joshi	Health	Dr Rashmi	Health	Mr Mayank M Verma	SFRI
Dr Fanindra Sharma	Health	Dr Pankaj Shukla	Health	Dr S K Meena	Health	Mr Abhilash Dubey	MPSBB
Dr Mrs A Bhadonia	Health	Dr Nidhi Patel	Health	Dr Masood	Health	Dr. Seema Shrivastav	MANIT
Dr C M Tripathi	Health	Dr R S Vijayvargiya	Health	Dr O. P. Gupta	Health	Mr. Amod Khanna	WRD
Dr S P Khare	Health	Dr C L Goswami	Health	Dr Ratna Malay	Health	Mr. Jayanta Bora	PWC
Mr. Ajit Sonakia I.F.S	Forest	Ms Rita Agrawal	Health	Dr. Mubal Kulshrestha	MANIT	Dr. H. Dafal	PSM, GMC

Navneet Ladla	FMPPCI	R R Gourkhede	Industries	M M Kher	Industries	Dr. H. Ahirwal	WRD
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Aditya Dubey	Executive	Bharat Joshi	Industries	Pranav Bhargava	BEE	Dr U C Pandey	SoGG
Dr D K Joshi	Health	Baldev Singh	Industries	Mohan Chaturvedi	Industries	Dr S M H Rizvi	SoGG
Dr. S.K. Katiyar	MANIT	S C Gupt	Industries	C P Chourasia	Industries	Mr Anand Kumar	Forest
R C Kuril	Industries	R K Shrivastava	MPPCB	Shashi Maurya	Media	Dr Atul Srivastava	Forest
Subhash	Industries	Pankaj Shukla	Media	Bhukendra	Media	Mr O P Khare	Forest
R K chourasia	Industries	S K Gujar	Industries	H S Gupta	IIFM	Mr R R Okhandiyar	Forest
A K Shardana	Industries	Ashutosh Gupta	Industries	G P Malviya	Industries	Mr Satyanand	Forest
Pratap Verma	Industries	S K Uprity	Industries	Baba Salve	Industries	Mr G P Verma	Forest
B M Sharma	Industries	Aditya Shrivastav	Industries	M L Khan	Media	Mr Sudip Singh	Forest
Rajesh Gagar	Industries	Rajendra Kothari	Industries	A K Dwivedi	Industries	Rajneesh Sharma	PWC
Dr Anil Sharma	IIFM	C S Dhurve	Industries	S S Kushwar	Research Institute	Pankaj Vijay Vargiya	BMC
Dr M S Chouhan	MANIT	Santosh Kumar Jain	Industries	Alok Kumar Jain	MPPCB	Jayanta Bora	PWC
Harsangeet Kaur	Research Institute	A K Bidwai	Industries	H U Khilji	Industries	B.M. Namho	M.P.Tourism
Gyanendra Saxena	Energy Auditor	Dr.S.K.Shrivastav	Research Institute	Ajay Raj Vaidy	Industries	Dr. Avinash Jain	Research Institute
Neerja Upadhyaya	RD	Y.K. Srivastava	Energy	Mangliar Sharma	WRD	S.D. Valmiki	WRD
Varghese Paul	RD	Dilip Kumar	Transport	Sanjiv Das	WRD	Dr.V.S.Bhatia	Research Institute
Prof. PK Biswas	IIFM	S.R. Saxena	Transport	Anil Punase	WRD	Sarode	Horticulture
Garima S. Sundaram	RD	R.M. Sayni	AE W/W Ratlam	Dr M K Khanna	WRD	A.K. Shrivastav	Scientist
Anupam Sharma	RD	R.K. Misra	I/C HO	R S Jataw	WRD	Dr. Neeru Singh	Director
Dr. Amitabh Pandey	IIFM,	B. L. Choudhary	UADD	R C Maheshwari	WRD	N K Singh	WRD
Shriman shukla	RD	Anup Karanth	Consultant	Y N Pradhan	WRD	Dr. Rajesh Singh	Health
Nayan Ranjan	RD	Zajeev Issar	TARU	Mrs S Sultan	WRD	Mr. L.M. Belwal	RD
LM Belwal	RD	Megha Burney	TARU	P K Gupta	WRD	Mr. N.S.Yadav	RD
Pankaj Darathiya	RD	Dr. Gunavant Joshi	MPPCB	Rajan Shrivastava	WRD	Mr. Rituraj Ranjan	RD
Abhay Kumar Patil	IIFM	Dr. NK Subu	UADD	Mukesh Chaturvedi	WRD	D.K.Dubey	Agriculture
Paritosh Rai	RD	V.P. Kullshustha	City Planner	Dr Arun Singh	Consultant	S.N.S.Mehra	Agriculture
Devendra Parashar	RD	Ashok Kune		J Shukla	WRD	P. S.Shakya	Agri Engg
Akhilesh Kekre	UNDP	Pravin Bhagwat	UADD	A K Kesharwani	WRD	Dr.M.C.Manna	Research Institute
Vikas Brahmawat	RD	HK. Hayaran	Media	R P Tiwari	WRD	Priti Dave Sen	Health
Shikha Singh	RD	Dr. Madhu Verma	IIFM	R K Jain	WRD	Shubhra Jain	Health
Prabha Kant Katare	RD	MJS. Tulsi	UADD	Akhilesh Khare	UNDP	Harsangeet Kaur	Research Institute
S.K. Upadhyay	RD	Suresh Sejkar	UADD	J S Ronawal	SDO WRD	Dr. Sandeep Goyal	Scientist
Vivek Dave	RD	S.K. Pandey	UADD	R P Gupta	DDHM	Mr. Paul Varghese	RD
V.K. Brahmawat	RD	S Shrivastava	UADD	S K Shrivastava	WRD	Dr.M Kulshreshtha	Research Institute
H.S. Gupta	Prof. IIFM	K.P. Sharma	UADD	Neerai Kesharwani	UADD	Mr. S.K. Pathak	Research Institute
Dr. RK Agne Hotri	Retd. DGP	Ramadhan	UADD	Dr Jitendra Jain	WRD	Mr. Abhay Saraf	WRD
Mansha Jelay	MPUSP	Anil Shukla	UADD	M K Verma	WRD	Mr. S.K. Mehra	WRD
S K Sharma	WRD	H S Gupta	IIFM	Dr SS Tomar	WRD	Ms. Rajshri Shukla	WRD
S K Nigam	WRD	B O Joshi	WRD	R K Baghel	WRD	Dr. Gunwant Joshi	WRD
R K Saxena	WRD	B C Purandare	WRD	R K Jain	WRD	Mr. R.R. Sengar	WRD
Rajni Choube	WRD	Pratap Wagde	WRD	R B Chouiya	WRD	Mr. A.K. Bisen	WRD
Reeta Thakur	WRD	B L Chaturvedi	WRD	A K Shinde	WRD	Dr. Sunil Sudhara	Scientist
Dr D B Dubey	WRD	H P Tiwari	WRD	B Gosavi	WRD	Mr. Rajesh Jain	Scientist
HD Ahirwar	WRD	Ashok Parwal	WRD	MS Shah	WRD	Mr. O.P. Keswani	IMD
P K Verma	WRD	D K Pathak	WRD	Ravi Galkate	WRD	Dr. C.M. Snehi	WRD
Dr M R Khan	WRD	H N Singh	WRD	B D Ratmele	WRD	Mr. Vinay Verma	WRD
SSP Mishra	WRD	Alok Kulshreshtha	WRD	Sunil Vijayvergiya	WRD	Dr.Ritu Jain	DoAH
N K Dixit	WRD	Yuvraj Warke	WRD	Er M K Jain	WRD	Dr.Sumita Maravi	DoAH
A K Upadhyaya	WRD	P K Yadav	WRD	Er I A Siddiqui	WRD	Dr. Vikas Saxena	DoAH
P K Khare	WRD	Dr.A.K.Gupta	NCHSE	Dr.V.C.Pandey	Research Institute	Dr.K.K.Agarwal	Research Institute
Dr. C.K.Dubey	DoAH	Mr.H.S.Diwede	Horticulture	S.K.Chourasia	Agri Engg	Dr.V.K.Gaur	Research Institute
Dr.Nilesh Shah	DoAH	Shri.P.K.Singhal	Horticulture	R.L.Hanwat	Agriculture	U.S.Tomar	Fisheries
D.P.Sahu	Fisheries	Shri.Mukesh.Mishra	Horticulture	Dr Saleem Romani	WRD	Smt.Shashikala	Fisheries

Annexure 3 : Detail list of Regional Consultation Participants

Name	Sector	Name	Sector	Name	Sector	Name	Sector
Mr. Rakesh	Media	Jitendra Singh	DMI	Mustaq Gani	Student	D.K.Nayak	NGO, Chhatarpur
Anindya Sengupta	PWC	Dr. Lal Singh	Horticulture	Dilip Chakravarty	NGO	Praveen Prakash	NGO
Dr. M.L. Gupta	MPPCB	Manik Lal Gupta	Research Institute	Joseph Kujur	NGO	Dr. Balendru Shukla	NGO, Chhatarpur
Susheel Kumar	NGO, Chhatarpur	Mustaq Gani	Student	Dr.G.P.Rajore	Institute	Lakhan Lal Asati	Institute
Arun Sataalkar	NGO	Bhaskar Sinha	IIFM	S.S. Tekam	NGO	Upkar Kaur	NGO
R.S. Meena	Deputy Director	A.IK Patil	IIFM	S.S.Khan	NGO	Raju Patel	NGO, Chhatarpur
Umesh Sanodiya	F.P.A.I. R.T.C.	Mr. Ashok		Dr. S.r.Mishra	D.D.V.S Office	Sanjeev Khare	IWMP
Earol Williams		Dr. S. K. Lal	MUEF, Bhopal	Satish Mishra	NGO	Anirudh Mishra	Team Leader
Rajeev Mathur	BTV News	Rajita Kurup	EPCO , Bhopal	Chhaya Chouhan	NGO	Devendra Nagar	IWMP – 04
Aditya	Public Relation	Manish Singh	EPCO , Bhopal	Abhay Kumar Jain	WRD	Sachin Masih	IWMP – 03
Vinod Tiwari		Ashung Ngalung	EPCO , Bhopal	D.P. Kori	Jan Sampark	Rajeh Rai	Rural Development
Dr. Mukesh Dixit	MPLCA	K. P	NGO	Balram Phatak	NGO	Devendra Gupta	NGO
Chandan Khanna	Consultant	Raj Kumar Tiwari	Devri , Sagar	Krishn Kumar Pateria	NGO	Anoop Singh Rajput	Forest
Hanif Shaikh	DF, Rajgarh	Deepak Bhatt	NGO	Dr. B.P. Singh	DDA	N.K.Choubey	NGO
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Blayisan	Press	Akhiesh Kekre	UNDP , Bhopal	Ashish Gupta	RD	Yogendra Rai	Zila Panchayat
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Amol Adholiya	M.T. Distt. , Bhopal	Sanjeet Singh	Student	Devendra Sahu	Media	Pawan Awasthi	Dainik Jagran
BP Mishra	NGO	Mrs. Pratima Mishra	Zila Panchayat	R.S.Kudape	Zila Panchayat	Dr. Vijaykanti Singh	Zila Panchayat
R.P.Nayak	Zila Panchayat	Usha Yadav	Zila Panchayat	Rajeev	Zila Panchayat	S.S. Mishra	A O
Vivek Kumar Ojha	Zila Panchayat	Sudhir Kumar	Health	Rishvardhan Sharma	Zila Panchayat	Sudhir Kumar	Health
H.K Dewedi	Chairman Pehal	P.N.Gaur	PHE	G.P Maghre		Manoj Nayak	DPM
B. Singh	DDA	Swami Deen Patel	Zila Panchayat	Saurabh	Clean & Green	Bhavna Waleembe	Zila Panchayat
Vikas Pachori	Dainik Bhaskar	Shailendra Mishra	DTICMorena	Chitranjan	Farmer	Dr. E.Ramesh Kumar	Collector
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Tol Singh	Damor	Kamlesh Rathore	NGO	Mukesh Parmar	NGO	Rama	V.S.D.S
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Govind Singh	FarmerJhabua	K.P.Verma	PHE Alirajpur	Ashok Deshwal	CollectorAlirajpur	Gopal Pandya	NGO
R.M.Bamania	Govt. Dept	Ashok Kumar	Health	Amar Singh	CEOZP Jhabua	R.K.Acharya	Alirajpur
Punia Ratna	Farmer	Anil Tawar		S.K.Kumrawat	MPEB	Ravi Bharti	
Girdhari Patel		Jagdish Patel	D.C.J.A.D	B.K.Singh		Mukesh Patidar	
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Vesta Dalla	Farmer	Rajneesh Mishra		Lekhnath Acharya	Media	Rakesh Singh	DoAH
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R.S. Jamera	DUCDO	Vivek Vyas		Kamal Khzar	NGO	Shubhash	Media
Rajesh	UADD	Dinesh Verma	Media	Shafique Khan	NGO	Kalicha Teja	
N S Pawar	NGOJhabua	Narendra Kumar Patel	NGOJhabua	Narendra Kumar Patel	NGO	R Kushwaha	Farmer
GSThakar	Media	Mahesh Kumar		S.Dixit	DPO	R.P.Malviya	PHE
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Suryabhan Mishra		Ravindra Verma		D.K.Mishra	Assit. Food Control	A.Prasad	Rewa
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S.P.Tiwari	Forest	Dr. S.K. Bhatt	Research Institute	Ratan Singh Thakur	Farmer	G.S.Thakur	PRO
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Daroga Prasad		Rajesh Mishra	NGO	A.Singh	DTO , Damoh	Ravish Badkul	Agriculture
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Chhote Lal		Ajay		Manmohan Singh		Manik Yadav	LLSS
Dwarka Prasad		Basant Soni		J.K.Shrivastav	Industries	Santosh Shukla	Research Institute
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Dharnidhar Patel	BORL	G.P.Prajapati	JOA	Dr. G.M.Dubey	Research Institute	B.L.Verma	Principal
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Sheetal Prasad		Mahendra Rahangdale	NGO	A.P.Bhandarkar	Agriculture	Bhoram Singh Uikey	MPJAP
Tulsi ram	PHE	Dr. Ansh Sharma	Health	Khina Ram Deshmukh	Institute	Sahdeo Singh Mezari	Institute
Amrit Singh Thakur		Abhisek Solanki	Research Institute	Manoj Patle	Research Institute	Rajesh Kumar Dubey	Institute
G.P. Raje		Gourav Jaiswal	NGO	Ravi Singh Baghel	Institute	Gitesh Rahangdale	NGO
P.R.Baghel	Institute	Dr. Rajesh Thakur	DoAH	Rajesh Baghel	NGO	Akhilesh Kekre	UNDP , Bhopal
Amaranth Sadafal	Govt. Dept	Dr. D.P.Namdeo	Research Institute	Mrs. Suman Jain	Institute	Dinesh Rahangdale	NGO
S.S.Bhalavi	NGO	Santosh Kumar Tiwari	Research Institute	Kashiram Karmkar	Forest	Ashok Singh Ghuriyya	Govt. Dept
Vijay Jain	Institute	M.K.Malviya	Govt. Dept	A.K.Verma		K.P.Bhagat	Govt. Dept
D.L.Tiwari	GHS Khairi	S.K.Jain	EE PHE	T.C.Patle		S.K.Tiwari	NGO
Ramchandra Morya	Institute	Swarnlata Cleepda	MPJAP	Vijay Shukla	RD	Digvijay Singh	NGO
Mangilal Deheriya	Member FDA	Shailendra Kumar	Govt. Dept	A.K.Shivhare	Govt. Dept	C.S.Thakur	NGO
D.K.Pandey	Agriculture	U.K.Sharma	Prof IIFM	Ravi Gajbhaye	D.D. Fisheries	P.K.Khare	Zila Panchayat
S.Sharma	Private	N.K.Patwari	Agriculture	S.K.Bakshi	Fisheries	R.P.Harindrawar	WRD
Rajesh Daheriya	Member SYSS	Manohar Patil	EPCO	Bharti Thakre	Forest	P.R.Kulhade	Media
K.R.Masarkar	Govt. Dept	Hirderam Yadav	NYC Chhapara	R.S.Uikey	Govt. Dept	Tekchand	RD
S.R. Maravi	I/C DPO Seoni	Laxmichand Manwatkar	Institute	P.R.Soni	Transport	Narayan Sanodiya	Institute
G.S.Gaulai	Forest	Mahakaushal	Media	Pratik Kumar Mehto	Zila Panchayat	Akhilesh Kulhade	NGO
Bharti Thakur	Forest	Rakesh Singh	CEO ZP , Seoni	Manohar Dubey	Collector Seoni	R.B.Singh	Forest
Shiv Prakash Yadav	NGO	Pradeep Khadtamar	Media, Seoni	Rahul Saxsena	Media, Seoni	B.P.Tiwari	Forest
SK Digarse	NGO	Balram Chandravanshi	Farmer	Umrati Singh Yadav	Research Institute	Ramesh Ramteke	Forest
Ashutosh Dubey		Dr. U.K Shirma	IIFM	S.K. Jahagirdar	NABARD	L.K.Choudhary	Forest
Pradeep Dhogdi	Media	G.L.Sahu	Govt. Dept	R. Paraste	Van Vibhag Seoni	Ajay Singh	Forest
Kapil Suryavanshi	Media	Rajesh Vihwakarma	Nai Dunia	D.K.Shrivastav	Working Plan Seoni	Murli Krishna	Forest
Vickey Karpet	Media	Vinod	Hari Bhoomi	Rakesh	Media	Anoop Tiwari	RD
O.P.S. Narwariya	Agriculture	Bhanu Pratap Singh	Agronomist	Adarsh Tiwari	Research Institute	Rakesh Bais	NGO
B.P.Tripathi	Agriculture	B.P. Tiwari	D.D.A Shahdol	Dr. Sanjay Tripathi	Orient Paper Mill	R.K. Sinha	L.D.M. Shahdol
S.K.Shakya	AgricultureShahdol	Amit Kumar Sharma	MPRLP Shahdol	R.B. Sharma	DFO Sidhi	Akhilesh Kekre	UNDP , Bhopal
Santosh Singh	Agriculture	Amitabh Tiwari	MPRLP Shahdol	Ravindra Kiyawat	Collector , Anuppur	K.K. Tiwari	D.D. Agriculture
T.S. Chaturvedi	Forest	T.S.Pantode	Govt. Dept	K.N. Mishra	Paper Mill Amlai	Dr. G.P. Bedi	DoAH
Akhilesh Namdeo		Dr. A.K. Dubey	Scientist	S.R. Kulestey	Health	Prashant Kumar	Forest
Dr.K.P.Tiwari	Govt. Dept	A.K. Jain	PHEShahdol	Dr. U. Nandi	CHMO Shahdol	Manoj Kumar Patel	RD
Prakash Dubey	JK Trust Anuppur	A.S. Tiwari	Govt. Dept	Ratnakar Bharti	Govt. dept	Dr. Umesh Dwivedi	RD
I.C.Tripathi	RD	Ajay Shrivastav	RD	Khirendhar	AIK Shahdol	D.C. Sayyam	IWDP
Khadna Singh	NGO	R.L. Mishra	Fisheries	S.S. Sharma	Media	M.K. Prajapati	Research Institute
M.K. Mishra		S.L. Choudhary	PHEShahdol	K.B. Bagri	RD	Neeraj Dubey	Collector , Shahdol
Dr. M.M.Mishra	DoAH	Dr. Amit Niqam	Research Institute	Dr. Mrigendra Singh	KVK Shahdol	R.B. Rajodia	Horticulture
R.S.Chandel	Forest	K.P. Tiwari	WRD , Shahdol	Ashok Patel	Farmer	B.S. Dhurve	Horticulture
S.P. Tripathi	Forest	B. Chandrashekhar	Collector , Dindori	Khub Chand Patel	NGOI	Ashok Dwivedi	Horticulture
Sunil Patel	MPRLP	Abhiman Singh	Farmer	Shivcharan	Farmer	Dr. P.K. Dwivedi	Media , Shahdol
Ajay Singh	Govt. Dept	Ghanshyam Deshmukh	Agriculture	Devendra Singh	Research Institute	KS Makwana	Research Institute
Syed Zulfiqar Ali	N.G.C. Shahdol	Pradeep Khare	Commissioner	V. Kaushik	Farmer	V.K. Tiwari	PHE
N.K. Dwivedi	Agriculture	R.K. Patel	Farmer	Ram Chandra	Media	Yogesh Kumar Shukla	Research Institute
Dr. Sapan Patel	Research Institute	Dr. Tripta	Institute	Shahab Ansari	Media	Dr. Madhu Purohit	Institute
Dr. D. M.Kumawat	Research Institute	Dr. Suman Jain	Institute	Manoj Tilak	Media	Jitendra Singh Thakur	Media
R. Kumar	Zila Panchayat	Dr. H.S.Dewedi	Institute	Sunil	Patrika	Lokesh Kumar	NGO
Ranjana Gupta	Institute	Bhavisya Tiwari	Institute	Kirtiman Awasthi	DNDP	Dr. N.K.Mehta	ICAINew Delhi
Ramesh Ahirwar	Research Institute	Dr. Sushil Manderia	Research Institute	Dr. Balkrishn Sharma	Research Institute	Dr. S Sharma	Research Institute
Dr. Alka Vyas	Research Institute	Mukesh Makwana	Research Institute	Dr. Seema Trivedi	Institute	Dr. Uma Parhihar	Research Institute
BK Shukla	Research Institute	H.B.Mathur		R.S. Vishwakarma	NGO	Dr. S.K.Mishra	Research Institute
Shaila Sharma	Research Institute	Rajesh Varshney		Sapna Goyal	Research Institute	Dr. Santosh Sharma	Research Institute
Kundana More	NGO	Dr. Harish Vyas	Research Institute	Pratibha Shrivastav	Research Institute	Dr. Anurag	
Prof. Tapan Choure	Research Institute	Manish K. Sharma	Research Institute	Arpan Bhardwaj	MVM , Ujjain	K.S. Vshwakarma	Institute
Prof. B.K. Mehta	Research Institute	Dr. Dharmendra Mehta	Research Institute	Anish Ghurajiy	MVM ,Ujjain	Dr. Shehla Ishaque	Institute
Vijay Kumar Yadav	Research Institute	Hemant Dubey	RD	Prof. Aneesh Shaikh	MVM ,Ujjain	Dr. S.K. Tiwari	Research Institute
S.Singh	Research Institute	Mrs. Punita Yadav	Research Institute	Parakaram Singh		Uday Raj Pawar	Forest
Rajeev	NGO, Ujjain	Ashwin Singh Rahi		Prof. Sheela Kumar	MVM ,Ujjain	Rajesh Kumar Jha	Research Institute
SK Choudhry	Research Institute	Prashant Puranik	Research Institute	Abhay Kumar Patil	IIFM	Gokul	Research Institute
Kinsheck Soni	Research Institute	Vinod Kumar Sunar	Research Institute	MTNGC	Research Institute		

Annexure 4 :Orders Constituting PSC and PIC and MP CCC at EPCO

मध्यप्रदेश शासन
सामान्य प्रशासन विभाग
मंत्रालय
वल्लभ भवन, भोपाल-462004

:: आदेश ::

भोपाल, दिनांक 13 जनवरी, 2010

फ-19-01/2010/1/4 म0प्र0 जलवायु परिवर्तन विषय पर कार्य करने के लिए राज्य शासन द्वारा आदेश क्रमांक एफ-19-143/2007/1-4 दिनांक 13 नवंबर 2007 के माध्यम से एफको के राज्य नोडल इकाई का दायित्व सौंपा गया है। जलवायु परिवर्तन विषय से संबंधित एफको-यू0एन0डी0पी0 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. | सचिव, लोक स्वास्थ्य एवं परिवार कल्याण | सदस्य |
| 10. | सचिव, ऊर्जा सदस्य | सदस्य |
| 11. | असिस्टेंट कंट्री डायरेक्टर, यू0एन0डी0पी0, नई दिल्ली | सदस्य |
| 12. | कार्यपालन संचालक, (एफको-यू0एन0डी0पी0 परियोजना संचालक) | सदस्य सयोजक |

2/ 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।

✓ फ. ए0 एफको में प्रतिलिपि भेजी।

22 JAN 2010
PA/DS(A)

मध्यप्रदेश के राज्यपाल के नाम से
तथा आदेशानुसार

(आर0डी0 साहू)
अपर सचिव

म0प्र0शासन, सामान्य प्रशासन विभाग

मध्य प्रदेश शासन
आवास एवं पर्यावरण विभाग
"मंत्रालय"
वल्लभ भवन, भोपाल - 462004

:: आदेश ::

भोपाल, दिनांक 23 दिसंबर 2009

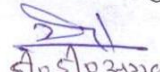
क्रं. एफ-5-8/32/2009/ : : म.प्र. में जलवायु परिवर्तन विषय पर कार्य करने के लिए राज्य शासन सामान्य प्रशासन द्वारा आदेश क्रं.एफ-19/143/2007/1-4 दिनांक 13 नवंबर 2007 के माध्यम से समिति का गठन किया गया है तथा एफको को राज्य नोडल इकाई का दायित्व सौंपा गया है। इस आदेश के संदर्भ में एफको द्वारा जलवायु परिवर्तन संबंधी जन-जागृति एवं वैज्ञानिक अध्ययन कार्य किये जा रहे हैं। इसी तारतम्य में एफको-यू.एन.डी.पी. जलवायु परिवर्तन परियोजना हेतु प्रमुख सचिव, आवास एवं पर्यावरण की अध्यक्षता में Project Implementation Committee (PIC) का गठन निम्नानुसार किया जाता है-

प्रमुख सचिव	आवास एवं पर्यावरण विभाग	अध्यक्ष
संचालक	नगर तथा ग्राम निवेश	सदस्य
कार्यपालन संचालक	एफको (एफको-यू.एन.डी.पी. परियोजना संचालक)	सदस्य संयोजक
अपर सचिव	वित्त विभाग	सदस्य
राज्य प्रतिनिधि	यू.एन.डी.पी., मध्य प्रदेश, भोपाल	सदस्य

समिति का उद्देश्य -

1. परियोजना के लक्ष्यों को निर्धारित समय-सीमा में प्राप्त करने हेतु दिशा-निर्देश।
 2. परियोजना भौतिक एवं वित्तीय प्रगति की समय-समय पर समीक्षा।
 3. परियोजना की वार्षिक कार्य योजना को स्वीकृति प्रदान करना।
- उक्त समिति की बैठक प्रत्येक 3 माह में आयोजित की जायेगी।

मध्य प्रदेश के राज्यपाल के नाम से तथा आदेशानुसार


(डी०डी०उ०अ०स०)
उप सचिव

मध्य प्रदेश शासन
आवास एवं पर्यावरण विभाग
भोपाल, दिनांक 23-12

पृ.क्रं. एफ-5-8/32/2009/

प्रतिलिपि-

समिति के अध्यक्ष/सदस्यगण/सदस्य संयोजक


उप सचिव

मध्य प्रदेश शासन
आवास एवं पर्यावरण विभाग

मध्य प्रदेश शासन
आवास एवं पर्यावरण विभाग
"मंत्रालय"
वल्लभ भवन, भोपाल - 462004

:: आदेश ::

भोपाल

दिसंबर 2009

क्रं. एफ-5-8/32/2009/ : : म.प्र. में जलवायु परिवर्तन विषय पर कार्य करने के लिए राज्य शासन सामान्य प्रशासन विभाग द्वारा आदेश क्रं.एफ-19/143/2007/1-4 दिनांक 13 नवंबर 2007 के माध्यम से Environment Resource Monitoring समिति का गठन किया गया है तथा एफको को राज्य नोडल इकाई का दायित्व सौंपा गया है। इस आदेश के संदर्भ में एफको द्वारा जलवायु परिवर्तन संबंधी जन-जागृति एवं वैज्ञानिक अध्ययन कार्य किये जा रहे हैं। मध्य प्रदेश में जलवायु परिवर्तन से संबंधित ज्ञान प्रबंधन एवं संबंधित कार्यों को विधिवत निष्पादित करने के लिए कार्यपालन संचालक, एफको के नियंत्रण में एफको में राज्य जलवायु परिवर्तन प्रकोष्ठ (State Climate Change Cell) की स्थापना की जाती है।

मध्य प्रदेश के राज्यपाल के नाम
से तथा आदेशानुसार

(आलोक श्रीवास्तव)

प्रमुख सचिव

मध्य प्रदेश शासन

आवास एवं पर्यावरण विभाग

भोपाल, दिनांक 21-12-

पृ.क्रं. एफ-5-8/32/2009/
प्रतिलिपि-

1. सचिव, माननीय मुख्यमंत्रीजी, म.प्र. शासन, मंत्रालय, भोपाल
2. मुख्य सचिव के अपर सचिव, मंत्रालय, भोपाल
3. समस्त अतिरिक्त मुख्य सचिव/प्रमुख सचिव/सचिव, म.प्र. शासन
4. समस्त विभागाध्यक्ष, म.प्र. शासन
5. समस्त संभागायुक्त, मध्य प्रदेश
6. कार्यपालन संचालक, एफको, भोपाल
7. समस्त जिलाध्यक्ष, मध्य प्रदेश
8. संयुक्त संचालक, जनसंपर्क, मंत्रालय प्रकोष्ठ की ओर सूचनार्थ एवं आवश्यक कार्यवाही हेतु।


उप सचिव

मध्य प्रदेश शासन

आवास एवं पर्यावरण विभाग

Bio-Physical Vulnerability

Agro Climatic Zone	District	Number of drought years since 1991-07	Forest Area	Water Availability	Winter-Temperature (Increase in Average Temperature Since 1960)	Pre-Monsoon(Increase in Average Temperature Since 1960)	Monsoon (Increase in Average Temperature Since 1960)	Post Monsoon (Increase in Average Temperature Since 1960)	Rainfall change (Jan-May) mm	Rainfall change (June-Sep) mm	Rainfall change (Oct-Dec) mm	Wasteland (% of District Area)	Vulnerability	ACZ Vulnerability
	Morena	1	10.16	Safe	-0.1266	0.1552	-0.034	0.2147	0.28	-66.217	-3.881	12.8	Low	
	Bhind	2	2.02	safe	-0.1393	0.2413	0.1434	0.28055	1.07904	-68.533	-2.38693	25.57	Medium	
Gird	Gwalior	3	24.34	Safe	-0.03875	0.25213	0.103775	0.26225	1.03766	-60.730	-3.4296	29.59	Medium	Medium
	Sheopur	3	43.78	safe	-0.0433	0.2942	0.226	0.4488	-0.015	-55.34	-3.548	20.58	Medium	
	Shivpuri	2	33.27	Semi-Critical	0.0922	0.3535	0.2841	0.38225	-1.111	-59.103	-4.962	39.19	High	
Bundelkhand	Datia	4	8.45	Safe	-0.00055	0.2997	0.25135	0.3256	-0.381556	-65.429	-4.33083	29.78	High	
	Tikamgarh	8	13.69	critical	0.1495	0.3663	0.4275	0.4117	-1.9271	-61.58	-8.013	21.99	High	High
	Chhatarpur	7	24.8	semi critical	0.1504	0.2476	0.3581	0.5676	1.54272	-56.925	-6.98	49.79	High	
Vindhya Plateau	Vidisha	1	14.93	safe	0.4109	0.5073	0.6337	0.681	1.96	-18.28	-9.429	5.09	High	
	Raisen	1	39.34	semi critical	0.4779	0.4705	0.5523	0.65315	-0.4583	-39.134	-8.5404	13.42	High	
	Sagar	2	29.03	semi critical	0.3821	0.4141	0.494	0.562	2.5952	-25.176	-9.902	11.72	High	
	Guna	2	16.01	safe					0.62838	-13.778	-6.7159	25.08	High	High
	Damoh	1	36.68	safe	0.24775	0.2359	0.3576	0.554	-1.55478	-17.579	-8.25594	13.73	Medium	
	Bhopal	0	15.83	semi critical	0.4435	0.5876	0.612	0.6827	4.75304	-17.813	-11.4431	31.28	High	
	Sehore	0	26.37	semi critical	0.4514	0.5659	0.5135	0.69885	3.031	-22.680	-11.186	20.56	High	
	Rajgarh	7	2.92	semi critical	0.388	0.5464	0.5805	0.7996	-0.247	-27.247	-10.608	24.97	High	
Central Narmada Valley	Narsinghpur	1	26.46	safe	0.3204	0.1531	0.3323	0.57	1.266	-21.428	-8.561	14.72	Medium	
	Hosangabad	1	39.37	safe	0.469	-0.588	0.279	2.21	1.9337	6.1099	-7.1691	4.75	Low	Medium
	Harda	1	31.82	safe	0.32	0.4421	0.367	0.6707	-0.997	-14.882	-8.39337	8.8	Medium	
Satpura Plateau	Betul	3	39.38	semi critical	0.1833	0.2854	0.3198	0.5416	2.0785	-6.7735	-2.3778	11.79	Medium	
	Chhindwara	8	40.42	over exploited	0.2011	0.1138	0.266	0.4804	0.57172	-42.408	-1.76567	12.15	Medium	
Nimar Plains	Khandwa	5	39.87	semi critical	0.3298	0.3801	0.2669	0.7484	1.563	-11.262	-9.4878	13.99	Medium	
	Khargone	4	11.73	critical	0.48715	0.452	0.2889	0.8263	-0.013	-4.4675	-6.6299	24.57	Medium	Medium
	Badwani	3	50.5	over exploited	0.4479	0.4155	0.2994	0.7844	-1.20207	-37.907	-2.82093	20.19	High	
Jhabua Hills	Jhabua	4	19.58	safe	0.34485	0.4246	0.31445	0.7849	-0.072	-8.496	-1.181	24.42	High	High
CG Plains	Balaghat	7	54.59	safe	0.4109	0.50733	0.6337	0.681	1.95996	-18.277	-9.42883	8.96	Medium	Medium
NHR of Chhatti	Sidhi	4	41.67	safe	-0.0039	0.0179	0.0618	0.9	0.1543	-51.025	-3.217	12.37	Low	
	Dindori	2	6.96	safe	0.0328	0.012	0.1717	0.78115	-3.26864	-57.168	-2.75837	17.57	Medium	
	Mandla	4	61.39	safe	0.0303	-0.054	0.102	0.618	-4.39	-33.870	-6.6258	22.18	Medium	Low to Medium

sgrh	Shahdol	4	40.64	safe	0.0911	-0.0753	0.11675	0.4519	-1.083	-36.12	-4.31	8.57	Low	
Malwa Plateau	Indore	1	13.58	over exploited	0.5877	0.5818	0.3781	0.9795	1.2828	-9.746	-4.963	17.2	High	
	Shajapur	3	0.97	critical	0.4599	0.5541	0.513	0.8743	1.2598	-27.34	-12.301	20.99	High	
	Dewas	1	29.53	critical	0.5193	0.5683	0.4253	0.8467	-1.54316	-27.728	-11.3631	18.3	High	
	Ujjain	4	0.49	over exploited	0.5064	0.5424	0.4245	0.9792	2.181	-12.85	-9.385	17.33	High	
	Neemuch	2	23.86	over exploited	0.2389	0.4206	0.5026	0.9548	-1.0328	-28.237	-6.759	37.97	High	High
	Mandsour	3	6.88	over exploited	0.34	0.4709	0.4867	0.9757	-0.7483	-26.013	-7.5032	25.11	High	
	Ratlam	8	7	over exploited	0.4038	0.4869	0.4062	0.956	0.08	-12.593	-5.821	18.65	High	
	Dhar	3	14.76	over exploited	0.516	0.52	0.3263	0.912	-0.42068	-5.3228	-4.97637	12.02	High	
Kymore Hills	Satna	3	27.49	semi critical	0.0073	0.0041	0.127	0.7046	-0.88172	-40.624	-3.915	13.29	Low	
	Katni	3	20.28	safe	0.04285	-0.012	0.15	0.6169	-4.855	-26.785	-6.9604	24.81	Medium	
	Panna	7	42.67	safe	0.125	0.136	0.309	0.67	-2.1305	-50.706	-5.581	13.99	Medium	
	Rewa	4	13.51	semi critical	-0.029	-0.0203	-0.0316	0.7646	-1.733	-45.279	-0.206	11.88	Low	Low to Medium
	Umaria	2	52.67	safe	-0.011	-0.0477	0.1081	0.7139	-2.44672	-30.828	-3.756	11.89	Low	
	Jabalpur	4	15	safe	0.10025	0.0202	0.1556	0.519	0.287	-18.158	-4.927	13.36	Low	
	Seoni	5	37.49	safe	0.0911	-0.0753	0.11675	0.4519	-1.617	-33.291	-4.03	18.52	Low	Medium

Socio Economic Vulnerability

Agro Climatic Zone	District	Sex Ratio (2001)	SC Population (%)	ST Population (%)	Population Density	Literacy Rate	BPL population (04-05)	Urbanization level (%)	Contribution in GDP at current prices (07-08)	Safe drinking water Availability (%)	Per Capita Income at Current Price (Rs.)	Vulnerability	ACZ Vulnerability
Gird	Morena	822	21.08	0.81	319	64.7	22.97	21.6	1.82	56.1	12873	Medium	
	Bhind	829	21.48	0.47	320	70.5	27.94	23.7	1.43	54.9	11563	Medium	
	Gwalior	848	18.91	3.49	358	69.4	20.36	60.2	3.74	82.7	24039	Low	Medium to High
	Sheopur	895	16.16	21.53	85	46.4	38.68	15.8	0.61	82.9	12209	High	
Bundel khand	Shivpuri	858	18.78	11.19	140	58.9	46.39	16.6	1.49	58.6	11483	High	
	Datia	857	35.95	1.59	233	71.8	27.59	21.9	0.83	68.1	15137	Medium	
	Tikamgarh	886	24.29	4.32	238	55.7	62.22	17.7	1.2	35.1	10947	High	High
Vindhya Plateau	Chhatarpur	869	23.26	3.5	170	53.3	69.05	22	1.65	38.1	12384	High	
	Vidisha	875	19.85	4.88	165	61.8	53.51	21.4	1.73	74	16177	High	
	Raisen	881	17.44	3.78	133	72.2	53.45	18.4	1.6	80.6	15377	High	
	Sagar	884	20.54	9.72	197	67.7	58.98	29.2	2.73	57.6	15161	Medium	
	Guna	885	17.61	12.22	151	59.5	36.72	21.3	2.28	73.9	15076	High	
	Damoh	901	19.5	12.56	148	61.8	56.55	18.9	1.44	55.7	15110	High	High
	Bhopal	895	14.2	3.29	665	74.6	28.99	80.4	6.43	95.1	34964	Low	
Central Narmada Valley	Sehore	909	20.49	10.76	164	63.1	46.2	18	1.44	73.6	14703	High	
	Rajgarh	932	16.37	15.74	204	53.7	37.7	17.3	1.66	72.7	14716	Medium	
	Narsinghpur	909	16.14	13.17	187	77.7	42.1	16	1.44	93.1	17375	High	
Satpura Plateau	Hosangabad	896	15.75	15.13	162	70	48.05	30.8	2.45	78.6	25043	Low	High
	Harda	919	16.06	26.63	142	66.5	69.18	21.3	0.87	70.1	20991	High	
Nimar Plains	Betul	965	10.58	39.41	139	66.4	68.06	18.6	2.27	72.9	17592	High	
	Chhindwara	952	11.58	34.68	157	65.8	55.83	24.5	3.23	73.3	20220	Low	Medium
	Khandwa	936	11.07	29.68	159	61.8	62.37	26.8	2.74	85.3	18808	Medium	
Jhabua Hills	Khargone	950	11.41	35.48	192	63	62.32	15.4	1.96	83.9	13866	Medium	Medium
	Badwani	971	6.33	67.02	199	41.5	71.84	14.6	1.08	78.2	10915	High	
CG Plains	Jhabua	986	2.82	86.85	206	36.9	64.51	8.7	1.41	79.2	11621	High	High
NHR of Chhatti sgrh	Balaghat	1022	7.75	21.8	162	68.7	40.8	12.9	2.07	54.4	16783	Medium	Medium
	Sidhi	932	11.85	29.89	174	52.3	68.18	14.3	4.35	35.9	22944	Medium	
	Dindori	991	5.83	64.48	78	54.2	59.76	4.6	0.48	47.5	12125	High	
	Mandla	996	4.62	57.23	154	59.6	59.58	10.3	1	55.2	11619	High	Medium to High
	Shahdol	957	7.36	44.48	158	58.7	61.97	25.3	2.68	38.6	18997	Medium	

Malwa Plateau	Indore	913	15.75	6.65	633	75.2	21.09	70.2	9.71	94.2	38830	Low	
	Shajapur	927	21.98	27.35	208	70.9	36.16	18.5	1.74	78.4	15411	Medium	
	Dewas	930	18.26	16.45	186	60.9	36.13	27.4	2.07	79.1	17141	Medium	
	Ujjain	938	24.72	3.11	281	70.9	33.78	38.7	3.75	88.5	23117	Low	
	Neemuch	950	12.55	8.51	171	66.2	14.4	28	1.2	71.8	18720	Low	Low to Medium
	Mandsour	956	17.93	3.17	214	70.3	31.07	18.6	1.99	62.4	18248	Low	
	Ratlam	958	13.41	25.89	250	67.2	55.18	30.3	2.37	86.3	21221	Low	
Dhar	955	6.49	54.5	213	52.5	38.71	16.6	2.7	81.8	16812	Medium		
Kymore Hills	Satna	925	16.27	14.34	249	64.6	54.71	20.6	2.49	54.6	14154	Medium	
	Katni	941	11.48	23.07	215	63.6	72.25	21.2	1.73	67.8	17815	Medium	
	Panna	901	20	15.39	120	61.4	75.32	12.6	0.94	49.2	12423	High	
	Rewa	941	15.57	12.87	313	62	64.25	16.2	2.22	45.9	12061	Medium	Medium
	Umariya	946	6.81	44.04	127	59.1	79.25	16.1	0.63	41.1	13375	High	
	Jabalpur	908	12.73	15.01	413	75.7	36.07	57.1	4.82	88.9	24298	Low	
	Seoni	982	10.34	36.78	133	65.6	53.15	10.3	1.5	66.4	15321	High	

Agro-climatic Zone/ Districts	Total Area (sq km)	Net sown area (%)	Net irrigated area (%)	Forest Area (%)	Area Unavailable for cult (%)	Waste /fallow area (%)	Av. land hold-(ha)	Crops grown	Yield (kg/ha)	Soil type	population having Access to Bank %	Tractors /10 village	Fertiliser use (kg/ha)
1. Chattisgarh Plains													
Balaghat	9229	27	44.6	54	6	13	1.2	Paddy Kodo/Kutki Pulses Tur Maize Wheat Gram Linseed Rape/Mustard Toera	1576 471 701 954 1819 888 735 410 746 547	Red and yellow and medium quality	14.4	9.1	37.6
2. Northern Hill region of Chhattisgarh													
Shahdol, Mandla, Dindori, Anuppur and Umaria	27298	39	4.8	33.7	9.3	18	2.0	Paddy Pulses Kodo/Kutki Udad Maize Tur	883 399 954 261 953 517	Red and yellow soil of medium quality with high slopes	12.6	7	9.2
3. Kymore plateau and Satpura Hills													
Rewa, Satna, Panna, Jabalpur, Seoni, Katni and Sidhi	50396	45	28.2	28.3	10.7	15.7	1.8	Paddy Pulses Kodo/Kutki Udad Maize Sesamum Wheat Gram Linseed- Rape/Mustard Masoor Barley	968 473 313 277 1153 291 974.5 718 369 534 432 804	Mixed red and black soil of medium quality with Jabalpur area having good quality of black soil	18.5	20.1	
4. Central Narmada Valley													

Agro-climatic Zone/ Districts	Total Area (sq km)	Net sown area (%)	Net irrigated area (%)	Forest Area (%)	Area Unavailable for cult (%)	Waste /fallow area (%)	Av. land hold-(ha)	Crops grown	Yield (kg/ha)	Soil type	population having Access to Bank %	Tractors /10 village	Fertiliser use (kg/ha)
Narsinghpur, Hoshangabad and Harda	18418	54	65.5	30.3	6.3	9.7	2.7	Paddy Pulses Tur Soyabean Wheat Gram Masoor Peas	1399 958 1021 1314 2209 1104 644 518	Deeps black soil of very high quality	22.7	69.3	55.0
5. Vindhya Plateau													
Bhopal, Sagar, Damoh, Vidisha, Raisen and Sehore	36167	49.6	40.9	27	8.8	10.2	2.7	Paddy Pulses Udad Soyabean Wheat Gram Masoor Peas	1399 469 345 1042 1611 993 544 560	Mixture of medium and deep black soil of moderately high quality	19.3	68.9	37.0
6. Gird													
Gwalior, Bhind, Morena, Sheopur-Kala, Guna and Ashoknagar	25073	57.8	45.8	12.5	18.0	11.8	2.0	Paddy Pulses Udad Soyabean Bajra Wheat Gram Masoor Rape/Mustard	2212 524 482 1193 1749 2091 982 635 1316	Light alluvial soil of moderate quality	17.8	91.1	46.4
7. Bundelkhand													
Chhattarpur, Datia, Tikamgarh	26703	51.8	57.3	20.0	11.5	17.3	2.3	Jowar Pulses Udad	1019 314 299	Mixed red and black soil of	23.9	60.3	32.9

Agro-climatic Zone/ Districts	Total Area (sq km)	Net sown area (%)	Net irrigated area (%)	Forest Area (%)	Area Unavailable for cult (%)	Waste /fallow area (%)	Av. land hold-(ha)	Crops grown	Yield (kg/ha)	Soil type	population having Access to Bank %	Tractors /10 village	Fertiliser use (kg/ha)
and Shivpuri								Soyabean Sesamum Wheat 'Gram Masoor Rape/Mustard Peas	873 392 166.3 1106 397 582 502	medium depth and moderate quality			
8. Satpura Plateau													
Betul & Chhindwara	21858	40.5	24.0	39.5	7	13.5	7.4	Jowar Pulses Udad Soyabean Maize Tur Paddy Wheat Gram Cotton	1333 752 256 1005 392 1039 857 1545 852 1334	Shallow Black and of medium quality	29.5	37.0	37.1
9. Malwa Plateau													
Mandsaur, Neemuch, Ratlam, Ujjain, Dewas, Indore, Shajapur Dhar and Rajgarh	44009	65.8	35.9	10.8	13.6	11.5	2.4	Jowar Pulses Udad Soyabean Maize Wheat Gram Cotton Rape/Mustard	1422 436 412 1010 1821 2039 825 768 912	Black soil of medium depth and high quality	32.4	55.7	44.9
10. Nimar plains													
Khandwa, Burhanpur, Khargone,	35714	49.2	44.6	31	11.4	8.6	3.3	Jowar Pulses Udad	898 350 236	Black soil of medium depth and	32.4	24.6	60.5

Agro-climatic Zone/ Districts	Total Area (sq km)	Net sown area (%)	Net irrigated area (%)	Forest Area (%)	Area Unavailable for cult (%)	Waste /fallow area (%)	Av. land hold-(ha)	Crops grown	Yield (kg/ha)	Soil type	population having Access to Bank %	Tractors /10 village	Fertiliser use (kg/ha)
Barwani								Soyabean Maize Ground nut Tur Wheat Gram Cotton	942 1218 704 595 1705 769 1078	moderately high quality			
11. Jhabua Hills													
Jhabua	6778	54	15.1	19	21	6	2.0	Jowar Pulses Udad Soyabean Maize Ground nut Wheat Gram Cotton	868 41.3 420 641 1246 969 1891 577 459	Shallow black soil and skeletal soil of moderate to low quality	23.9	8.6	36.2