



# Climate Resilient Development In Bundelkhand Region of Madhya Pradesh

## Vulnerability and Adaptation Assessment

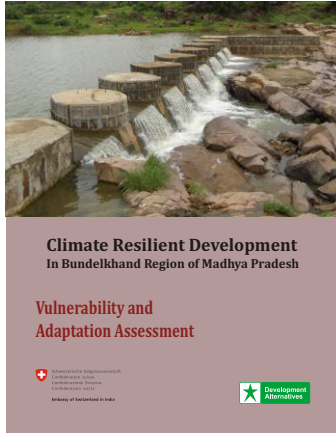


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## Vulnerability and Adaptation Assessment

This report is prepared under the financial support by the **Swiss Agency for Development and Cooperation (SDC)** for the project **Sustainable Civil Societies Initiative to Address Global Environmental Challenges in Bundelkhand** region of India. The objective of the action oriented project was to enhance the adaptive capacities of vulnerable communities in Bundelkhand region, identify strategies for climate resilient development and mainstream climate change in development policy and plans.

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### Design and Layout

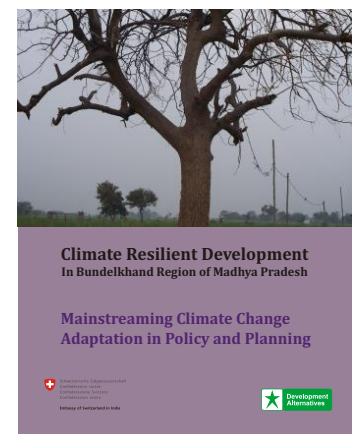
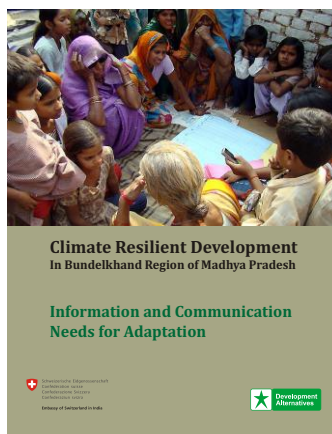
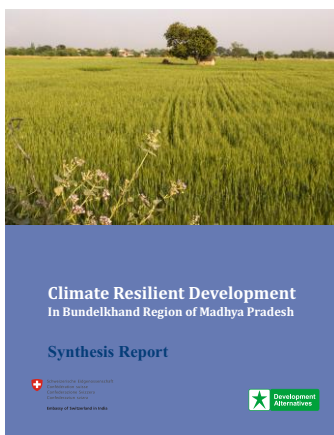
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# 1. Introduction

In central India, regional climate model projections indicate that there are possible changes in future weather patterns that will significantly affect climate-sensitive agriculture, water, and health sectors<sup>1</sup>. Development deficit and widespread reliance on agriculture as a source of nourishment and income makes Bundelkhand region particularly vulnerable to changes in the climate.

The approach of transition from a poverty and vulnerability reduction orientation that primarily addresses development deficit in the region to one that responds to its climate adaptation deficit to promote climate-resilient development presents significant challenge.

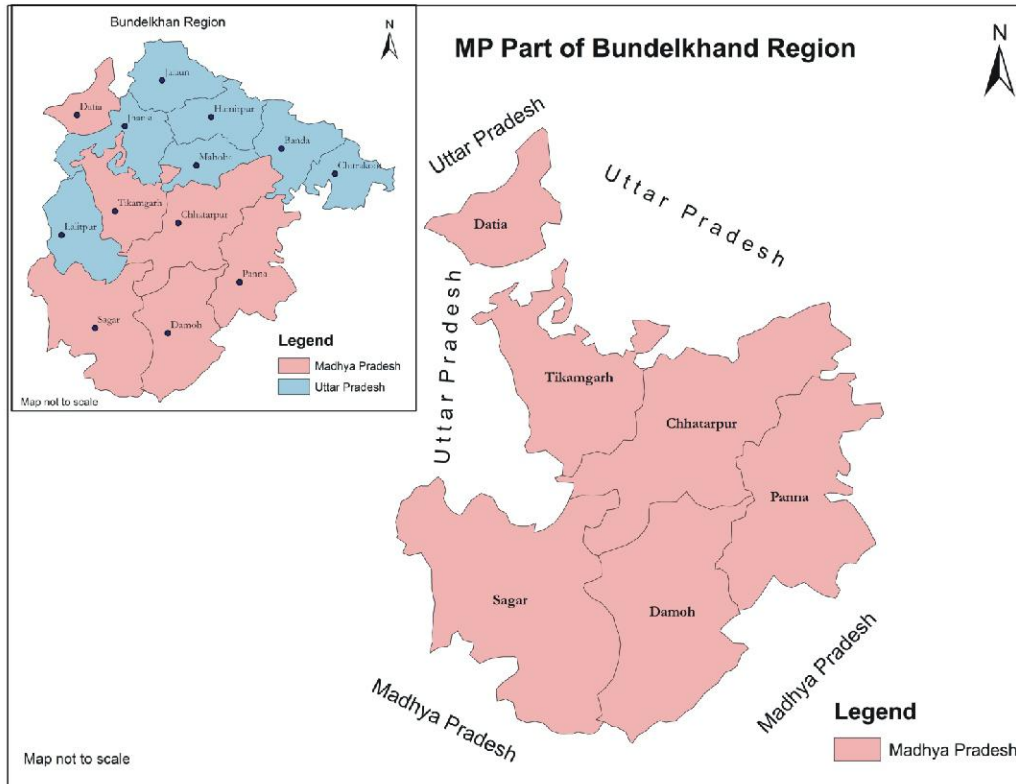


Figure 1: Geographical coverage of the project

## 1.1. Climate Change in India

The IPCC's Fourth Assessment Report and an ever-growing body of scientific research continue to illuminate the perilous nature of global climate change and the need to take action against its potential impacts. In India, climate change is a particularly serious challenge that will significantly impact the Indian economy (and the livelihoods that depend on it) due to a high reliance on climate-sensitive sectors such as

agriculture, forestry, and fishing<sup>2</sup>. Agriculture, on which approximately 70% of the population is completely dependent, will be impacted by the expected change in predictability and variability in the availability of water<sup>3</sup>. Thus, climate change may alter the distribution and quality of India's natural resources

1 Indo-UK Collaborative Project on Vulnerability and Adaptation Assessment of the Madhya Pradesh, 2011

2 Sharma, S. K. & Chauhan, R., 2011. Climate Change Research Initiatives: Indian Network for Climate change assessment. *Current Science*, 101(3), pp.308-311.

3 Gosain, A. K., Rao, S. & Arora, A., 2011. Climate change impact assessment of water resources in India. *Current Science*, pp. 356-371

and adversely affect the livelihood of its people by affecting the agricultural productivity and thereby the quality of human life.

In India the most important climatic factor is the Indian summer monsoon because it plays a critical role in sustaining various economic, social and environmental systems of the country. The current observed climate and projected changes in the country as consolidated by the Second National Communication to the UNFCCC are highlighted below (MoEF, GoI).

### Temperature

The annual mean temperature **has shown a warming trend of 0.56°C per hundred years** during the period **1901-2007**. **Accelerated warming** has been observed in the recent period between 1971 and 2007 and is attributed to intense warming caused in the decade of 1998-2007. Temperatures have increased in the winter season by 0.70°C and in the post-monsoon season by 0.52°C. The **maximum temperature** in the country has shown an **increasing trend of 1.02°C per hundred years**. The highest annual mean maximum temperatures are observed in the central (Madhya Pradesh) and north-western (Rajasthan) parts of the country. The **minimum temperature** has also shown a **warming trend with a rise in temperatures by 0.12°C per hundred years**. In the last thirty years this increase in minimum temperatures has been more pronounced with an increase in the temperature of 0.20°C every 10 years.

### Indian Summer Monsoon Rainfall

The mean rainfall in the country is 848mm with high variability. In a period of 139 years, there were a total of 23 deficient years and 20 excess years. Although no significant trend in rainfall has been observed on an all India basis, **increasing and decreasing trends have been observed on a regional basis**. Certain extreme precipitation trends have been noticed in the country. A trend analysis of extreme rainfall received over a day's period shows that such **extreme rainfall is increasing in many places in India**.

While some climatic changes are already beginning to manifest in India, regional climate models indicate greater impacts in the future. Using the PRECIS climate model (a regional climate model developed by the Hadley Centre, UK) under the IPCC A1B socio-economic scenario, a report released by the Ministry of

Environment and Forests projects the following climate change impacts for India<sup>4</sup>:

- A 3% to 7% increase in summer monsoon rainfall by 2030 as compared to 1970; decreased rainfall during winter and pre-summer periods in all regions except the Himalayan region.
- The frequency of rainy days (2.5+mm) will decrease in most parts of the country.
- Annual mean surface air temperature will increase from 1.7°C to 2°C by 2030, with lowest daily minimum and highest daily maximum temperatures increasing by 1°C to 4°C.

### Potential Impacts at the National Level

Various studies have been conducted to understand the implications of changes in key climate variables in India through projections or scenarios (INCCA, 2010; NATCOM, 2012). Some of the potential impacts will adversely **impact availability of water resources**, increased vulnerability of forest areas through expected increase in **species losses and induced changes in habitat for many species** and a **negative impact on agricultural productivity** and in turn food and livelihood security.

Studies by Indian Agricultural Research Institute (IARI) and others indicate greater expected losses in the Rabi crop. While in certain scenarios some crops such as groundnut and chickpea show an increase in yields with an increase in temperature and CO<sub>2</sub> emissions, the yield of certain crops such as potato could decline.

Scenarios show that every 1 °C rise in temperature will reduce wheat production by 4-5 million tonnes. Small changes in temperature and rainfall will have significant effects on the quality of fruits, vegetables, tea, coffee, aromatic and medicinal plants, and basmati rice. Pathogens and insect populations are strongly dependent upon temperature and humidity, and changes in these parameters may change their population dynamics. Other impacts on agricultural and related sectors include lower yields from dairy cattle and decline in fish breeding, migration, and harvests. Global reports indicate a loss of 10-40% in crop production by 2100.

4 Kothawale, D. R., Munot, A. A., & Krishna Kumar, K. (2010). Surface air temperature variability over India during 1901-2007, and its association with ENSO. *Climate Research*, 42(2), 89104.

Changes in climate may alter the distribution of important vector species (for example, malarial mosquitoes) and may increase the spread of such diseases to new areas. A significant threat is the increase in extreme climatic events such as cyclones, floods, and drought, and large declines in sown areas in arid and semi-arid zones occurring during climate extremes. Large areas in Rajasthan, Andhra Pradesh, Gujarat, and Maharashtra and comparatively small areas in Karnataka, Orissa, Madhya Pradesh, Tamil Nadu, Bihar, West Bengal and Uttar Pradesh are frequented by drought. About 40 million hectares of land is flood-prone, including most of the river basins in the north and the north-eastern belt, affecting about 30 million people on an average each year. Such vulnerable regions may be particularly impacted by climate change.

## 1.2. Climate Change in Madhya Pradesh

Madhya Pradesh is the second largest state of India comprising of fifty districts spread across eleven agro-climatic zones. As of 2011, the total population of the state is 72.6 million, with 72.37% of the population living in rural areas<sup>5</sup>. The rural areas are primarily dependent on climate sensitive sectors such as agriculture making them highly vulnerable to impacts of climate change. In India, the most important climatic factor is the Indian summer monsoon because it plays a critical role in sustaining the economic, social and environmental progress of the country. The rural population heavily relies on primary sectors like agriculture, horticulture, fishery, livestock, poultry and forestry for livelihood. Due to climate change, these natural-resource based livelihood sources are expected to be impacted more than the other sectors.

**Water** is a critical resource in the state because several regions such as Bundelkhand suffer the dual challenges of scanty rainfalls and high run-off rates. The state is drained by rain-fed rivers and receives 1160 mm average rainfall annually (MP Resource Atlas 2007, MPCOST). Thus, the dependence on rain for the rejuvenation of water resources makes the region highly susceptible to the variations in distribution and pattern of rain. This irregular pattern eventually influences the groundwater resources. Already, the groundwater extraction is unsustainable (for reasons such as highly subsidised electricity and diesel based pump sets) which increases the insecurities in future scenario.

5 Government of India. (2011). *Census of India 2011; Provisional Estimates*.

**Agriculture** is pivotal to the state's economy, accounting for about 45% of the State Domestic Product (SDP) and more than 70% of the rural labour force<sup>6</sup>. The state is classified into eleven agro-climatic zones and five cropping zones (based on cultivation of major crops) on the topography, soil type, land-use and climatic conditions. The net area sown is about 150.74 lakh hectares which is half of MP's geographical area. Total irrigation area of the state is 30.5% and about 70% of the area is rain fed. Cropping Intensity<sup>7</sup> of the state is calculated to be 135%, 126% being the national average and 29 districts of the state have a higher net irrigated area than the country average. Also, the state contributes to 7% of the food production in India.

These figures point to the huge weightage agriculture has on the state's economy and livelihoods. The state has a large number of marginal and small farmers. In the semi-arid regions, extended dry season compel people to migrate as the food production and livelihood are becoming increasingly unreliable. Mono-cropping practice, which is prevalent even today in certain farms in the state, makes the crops susceptible to failure if there is any change in the climate conditions for optimal production. Also, a further rise in temperature can lead to pest emergence earlier than usual, making plants susceptible towards insect attacks. The most important crops are wheat, soybean, rice, sorghum (*jowar*), maize, pulses (peas, beans, lentils), and groundnuts<sup>8</sup>.

### Climate Change Projections for Madhya Pradesh

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

6 Indo- UK Collaborative project on Vulnerability assessment and adaptation planning for Madhya Pradesh, 2011

7 MPCOST, Resource Atlas

8 Indian State of Forest Report -2009

**Rainfall:** The climate data analyzed by IITM Pune indicates a declining trend for rainfall over the state of MP from 1901 to 2000. The water availability in the state has been declining. Shifting of rainfall pattern has affected the cropping patterns. Projections of rainfall in Madhya Pradesh for the period 2021 to 2050 indicates that there is likely to be a decrease in winter rainfall as one moves from the eastern part of MP to its western part. The decline in the winter precipitation will impact the wheat crop. In the pre-monsoon period, there is an increase in the rainfall only in the Southern part of MP, with a decrease in rainfall in all other parts<sup>9</sup>.

### 1.3 Impacts and Vulnerabilities: Bundelkhand

In the context of Madhya Pradesh, and especially the Bundelkhand region, exposure to variable climatic conditions causes high physical vulnerabilities. The region being largely rain-fed, it is perturbed with variable precipitation trends. Drought conditions are frequent in the region, leading to unstable socio-economic conditions. The varying temperature conditions influence the crop productivity in summers as well as in winters (due to frost). Monsoon is a critical determinant of the sowing time, which has been varying drastically in the past few years, causing big loss to farmers due to the paucity of correct and timely information.



*Barren, undulating and semi arid geography of Bundelkhand*

Bundelkhand region of Madhya Pradesh is a semi-arid geography, which is significantly sensitive to climate change due to its internal weak conditions. Forest

resources are rich in the central, eastern and southern parts, whereas the western area is susceptible to desertification. 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 rather than urban areas (53.6% in rural areas as against 35.1% for urban areas in 2004-05). The ecosystem stability is at a loss due to deforestation, resource exploitation, and low water recharge and so on. Maintaining and enhancing productivity in agriculture is one of the major challenges faced, due to loss of soil fertility and increasing cost of production owing to the largely rain-fed nature of agriculture in the state<sup>10</sup>.

- Aggregated HDI rank is amongst the lowest in the country
- 10 out of 13 districts classified backward<sup>1</sup>
- 80% population dependent on agriculture and livestock
- 96% farmers' income from agriculture and livestock
- 85% cropped area in Kharif and 55% in Rabi (60% gross) is un-irrigated due to absence of irrigation facilities.
- ~70% irrigation is dependent on groundwater sources
- Migration in normal rainfall years 15-20%, enhanced to 40% in drought years of 2007-08
- Industrial development and tertiary sector contribution to economy is less than 20% (two industrial units registered in UP part between 1991 and 2006)
- Per capita energy consumption 130 Kwh in UP side (All India average 411 Kwh) with industry share being only 18.7%
- Literacy less than 50% (national average 65%) with female literacy less than 20%

*Source: Multiple sources, UNDP Human Development Report, 2012, Report of Drought Mitigation, Inter-Ministerial Team, 2008, [www.Bundelkhandinfo.org](http://www.Bundelkhandinfo.org), ABSSS, <http://bundelkhand-water->*

9 Madhya Pradesh State Action Plan for Climate Change, 2012

10 Madhya Pradesh State Action Plan for Climate Change, 2012



The Bundelkhand region comprising seven districts of Uttar Pradesh State and six districts of Madhya Pradesh State is **complex, diverse, rain-fed, risky, under-invested, vulnerable, socio-economically heterogeneous, culturally unique, agrarian and backward** relative to other regions. It is a hard rock area with limited or inadequate groundwater resources, lacks infrastructure and access to improved technologies.



*Variable precipitation trends and extreme temperatures increases the risks of climate change in the drought prone region of Bundelkhand*

Climate data from 1980 to 2005 period has indicated an increase in the mean maximum temperatures in Bundelkhand region by 0.28°C, as compared to the

baseline period of 1960-1990. Analysis of simulated data generated by the PRECIS Regional Climatic Model predicts that the temperature throughout the year is likely to be higher; in the range of 2 to 3.5°C by mid-century<sup>11</sup>. The major precipitation season is expected to shift by one month (from July to August) and the winter temperatures too are likely to become more erratic in the time slice from 2071 to 2100 with respect to baseline situation of the 1960-1990 period<sup>12</sup>. The shift in the monsoon causes delay in sowing the seeds, which in turn delays harvesting and the potential yield is lesser in drier conditions. Annual average rainfall of the region falls between 800-1000 mm. The continuous drought years in Bundelkhand has severely affected the agricultural productivity and subsequently weakened the livelihood systems.

As per the Indo-UK collaborative project on Vulnerability and Adaptation Assessment of Madhya Pradesh<sup>13</sup>, wheat productivity in the Bundelkhand Region is likely to decline by 14-20% as adjudged through the model under the A1B (2030) scenario.

The recent drought period (2003 - 2009) in Bundelkhand impacted 16 million people; 40% of the region's farms were not sown, while 70% of ponds and tanks dried up. The people with smaller land holdings became prone to the high input costs in agriculture, lower profitability per unit of land and higher risks of crop failures<sup>14</sup>.

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- 11 IITM, Pune; India Second National Communication to the United Nations Framework Convention on Climate Change, MoEF, Govt. of India, 2012.
  - 12 ibid
  - 13 Indo- UK Collaborative project on Vulnerability assessment and adaptation planning for Madhya Pradesh, 2011
  - 14 <http://www.wateraid.org/documents/perspectivebundelkhand.pdf>





## 2. Methodology for Vulnerability Assessment

The IPCC defines climate vulnerability as “the propensity of human and ecological systems to suffer harm and their ability to respond to stresses imposed as a result of climate change effects<sup>15</sup>”. Vulnerability to climate change in the context of rural agrarian livelihoods, like that of Bundelkhand region, is influenced by exposure to climatic (and non-climatic) hazards and the underlying sensitivity of the natural resource base to such hazards. These hazards together impact the human and natural systems adversely. The primary objective of vulnerability assessments is to identify people or places that are most susceptible to harm and to identify vulnerability-reducing actions. Identification of such target groups and their specification in terms of enhanced sensitivity or low adaptive capacity to the exposure aids the decision makers to recommend or implement definite policies to reduce the vulnerability. These assessments include identification of the characteristics of vulnerable systems, type and number of stressors involved, root causes, their effects on the system and the time horizon of the assessment.

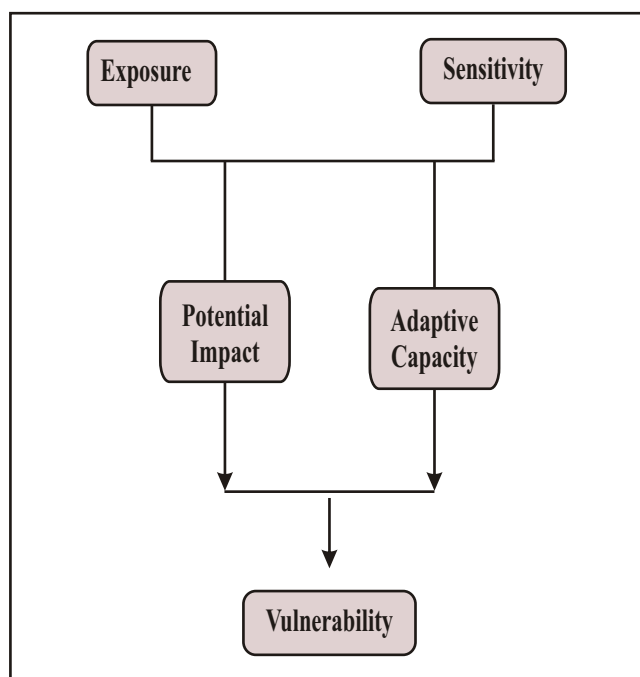


Figure 2: IPCC Framework for assessing vulnerability

The overall approach followed for the vulnerability assessment sought to proactively engage stakeholders/ stakeholder institutions in a process of dialogue through the course of the assignments via workshops, brainstorming sessions, in-depth interviews, observing on-site conditions and Focussed Group Discussions (FGDs). This project was divided into four key components and under each component the major activities were as follows:

- a) **Set Up and Mechanisms for Effective Delivery:** In order to run the project successfully, a short scoping phase had been designed with the following key activities: Situation Analysis for climate change adaptation in Madhya Pradesh and partnership development with EPCO and Planning Department, Government of Madhya Pradesh.
- b) **Vulnerability Assessment**
- c) **Adaptation Planning and Option Assessment**
- d) **Planning and Capacity Development Assessment**

In order to achieve the above mentioned activities, thorough desk research was conducted to collate lessons from secondary information and convergent projects. Using the information vulnerability assessment in the six districts was calculated using the Livelihood Vulnerability Index Methodology (Hahn et al, 2009). In addition to assessing the vulnerabilities in the region the project approach emphasised on the desk research to study and analyze existing policy framework at state and national levels and relevant state public programmes and schemes. This was intended to identify gaps in convergence, requirement of planning support tools and monitoring indicators that enable policy-practice connects from a climate change lens. To validate the study, primary consultations (with line departments and local CSOs in the six districts) and FGDs (with the farmers in a randomly selected village) in each district of Madhya Pradesh part of Bundelkhand were conducted. Finally, the study incorporated a multistakeholder outlook aided by stakeholder consultations at regional, state and national levels. The aim was to share findings with identified stakeholders

15 IPCC, C. C. (2007). Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge Univ. Press, Cambridge.

from nodal agencies for climate change, technical and extension agencies to verify analysis, prioritize the list of adaptation measures, share lessons of vulnerability assessment and define a strategic road map for future initiatives.



*Stakeholders from M.P Planning Commission, EPCO, scientific institutions, extension agencies and CSOs at the state level workshop*

## 2.1. Measuring Vulnerability to Climate Change in Bundelkhand

Several researchers have put forward various methodologies to assess the vulnerabilities to climate change. One such methodology is the vulnerability assessment using **Livelihood Vulnerability Index** given by Hahn et al, 2009. The LVI methodology comprehensively evaluates the livelihood risks of the vulnerable communities posed by climate change. The methodology was tailored (using climatic data and secondary information verified by primary consultations) to meet the local rapid assessment needs of the current study. It measures the socio-economic vulnerabilities of a region using IPCC's three contributing factors to vulnerability - **exposure, sensitivity and adaptive capacity**. The reason for the selection of this methodology is that it presents a framework for grouping and aggregating indicators at the district level, which can be critical for development and adaptation planning. In addition, the sub components and weighing measures of the index can be adjusted in relevance to the local community needs of Bundelkhand. This provides an added advantage over other methodologies where these components are more or less fixed. Lastly, it is a socio-economic vulnerability index in which the socio-economic indicators are standardized, therefore it is designed to provide

development organizations, policy makers, and public health practitioners with a practical tool to understand demographic, social, and health factors contributing to climate vulnerability at the district or community level<sup>16</sup>. It is a flexible tool so that researchers and planners can tailor the framework to meet the needs of unique geographic areas such as that of Bundelkhand. Thus, variation and applicability are its biggest advantage<sup>17</sup>.

The vulnerability profiles of six districts of Bundelkhand (M.P. part) were calculated using the climatic data for the region and secondary information obtained from the state's statistical records. The results were further verified by primary data collection in the region. The climate data was used to understand the variability of climate and the long term trend of parameters. For the purpose of conducting vulnerability assessment, indices were computed for all six districts under study. Secondary data was collected and normalized at the district level and census at the block level was used to derive the vulnerability contributing factors - **exposure (E), sensitivity (S), and adaptive capacity (A)** - of each district and census at the block. Each contributing factor was determined using proxy indicators listed in Table 1. The LVI uses a balanced weighted average approach<sup>18</sup> where each sub-component contributes equally to the overall index even though each major component is comprised of a different number of sub-components. The LVI formula uses the simple approach of applying equal weights to all major components<sup>19</sup>. The following equations are derived to calculate the vulnerability of these districts:

16 Hahn, M. B., Riederer, A. M., & Foster, S. O., 2009. The Livelihood Vulnerability Index: A pragmatic approach to assessing risks from climate variability and change A case study in Mozambique. *Global Environmental Change*, 19(1), 7488.

17 *ibid*

18 Sullivan, C., Meigh, J.R., Fediw, T.S., 2002. Derivation and testing of the water poverty index phase 1, Final Report. Department for International Development, UK, 2002.

19 Hahn, M. B., Riederer, A. M., & Foster, S. O., 2009. The Livelihood Vulnerability Index: A pragmatic approach to assessing risks from climate variability and change A case study in Mozambique. *Global Environmental Change*, 19(1), 7488.



Table 1 : Livelihood Vulnerability Index

**Step 1: Indicators**

- Values for all the indicators are to be standardized for all the districts.

- Indicator Index (Ix) = 
$$\frac{I_a - I(\min)}{I(\max) - I(\min)}$$

Where, Ix = Standardized value for the indicator  
 Ia = Value for the Indicator I for a particular district, d.  
 I (min) - Minimum Value for the indicator across all the districts  
 I (max) = Maximum Value for the indicator across all the districts.

**Step 2: Profiles**

- Indicator Index Values are combined to get the values for the profiles

- Profile (P) = 
$$\frac{\sum_{i=1} \text{Indicator Index}_i}{n}$$

where, n - number of indicators in the profile  
 Indicator Index i - Index of the i th indicator.

**Step 3: Components**

- Values of the profiles under a component are to be combined to get the value for that component.

- Component (C) = 
$$\frac{\sum_{i=1}^n W_{pi} P_i}{\sum_{i=1} W_{pi}}$$

where W<sub>pi</sub> is the weightage of the Profile i

- Weightage of the profile will depend on the number of indicators under it such the *within a profile each indicator has equal weightage*

**Step 4: Vulnerability Index**

- The combination of the value of the three components will give the vulnerability Index.
- Vulnerability Index = (exposure - Adaptive Capacity) x Sensitivity
- Scaling is done from -i to +i indicating low to high vulnerability

Table 2: Major components and sub components comprising Livelihood Vulnerability Index for the six districts of Bundelkhand Region of Madhya Pradesh

Contributing Factors	Components	Weightage (Wpi)	Sub-Components
Exposure (E)	Climate	2	Temperature variability
			Annual average rainfall
	Demographics	2	Percentage of rural population to the total population
Sensitivity (S)	Ecosystem	3	Percentage forest cover
			Area of waste land
			net annual groundwater availability
	Agriculture	7	irrigation intensity
			Cropping intensity
			Per capita food grain production
			Livestock population per hectare of net sown area
			Number of cultivators
			Number of small farmers (0-2 hectares landholding)
			Number of agricultural workers
Adaptive Capacity (A)	Socio-economic	9	Total literacy rate
			Number of agriculture credit societies per lakh cultivators
			Number of health care centres per thousand persons
			Number of hand pumps per thousand population
			Per capita rural electricity consumption
			Number of electrified pump sets per thousand hectares of gross cropped area
			Average daily employment in working registered factories per lakh population
			Total no. of BPL families
Number of agricultural machinery			

## 2.2. Selection of Indicators for the Vulnerability Index

A holistic set of indicators have been selected in the current study in order to represent the contributing factors for vulnerability i.e. exposure, sensitivity and adaptive capacity. The indicators are representative of the livelihood and socio-economic vulnerabilities in the six districts of climate sensitive region of Bundelkhand.

### Exposure

#### **Climate**

This factor includes the current climate variability in the region, indicating the temperature and rainfall variability in the region. Higher inter-annual rainfall variability indicates a higher probability of unanticipated amounts of rainfall in a given year. This could mean flooding, drought, or simply below/above average rainfall that impacts agriculture (e.g. farmers planting a crop suited for below- average rainfall, but then receiving above-average rainfall, causing decreased yields and/or the opportunity cost of increased yields with an alternative crop suited for the above-average rainfall). Also, rainfall is crucial in water recharge and in rain-fed cultivation systems. Additionally, temperature variability exposes the region by affecting crop productivity (due to uncertainties), increased evapo-transpiration losses and decrease in soil moisture.

#### **Demographic**

**Percentage of rural population:** More than 70% of the rural labour force is engaged in the agricultural sector and is therefore highly dependent on agriculture for their subsistence and income. Agriculture is one of the most sensitive sectors to a variable climate. Therefore, the rural population percentage acts as a proxy for the degree to which a district's population relies on agriculture for their livelihood, which correlates with climate change sensitivity.

**Sex ratio:** The low sex ratio further increases the sensitivity of women towards climate change due to increased cultural and social pressures additionally increasing their already high vulnerability to climate change. Women and young girls are the responsible for the basic necessities in a household i.e. securing drinking/potable water, food, and fuel. Impacts of climate change such as drought and erratic rainfall will further deteriorate their position. In order to meet these

needs, women (and girls) may have to traverse long distances and spend more of their time collecting water and fuel. Girls may have to drop out of school to help their mothers with these tasks, continuing the vicious cycle of poverty and inequity. This will further limit their access to information and awareness.

### Sensitivity

#### **Ecosystem**

**Forest cover:** The forest resources are highly sensitive to the impacts of climate change. The climatic uncertainties in future may affect the composition and distribution of forest resources. This will disturb the delicate balance of bio-geochemical cycle, making the forests prone to degradation. This will also affect the forest productivity. Lastly, this may result in habitat shifting of fauna in the region (e.g. disturbance in the tiger territories in Panna district of Bundelkhand).

**Area of wasteland:** The wasteland in the region increases the sensitivities due to loss of land's fertility, thus decreasing the land area fit for farming or grazing in the region. The area of wasteland increases with the changing soil moisture conditions, climate change is thus likely to affect the situation of wasteland in the semi-arid geography.

**Net annual groundwater availability:** The variability in rainfall may affect the recharging of groundwater in the region. This may also result in over-extraction of groundwater resources.

#### **Agriculture**

**Irrigation intensity:** Climate variability and impacts such as drought will affect the water resources (e.g. water in wells, dug wells, ponds) available for agriculture. The vulnerability of the irrigation sources makes irrigation highly sensitive.

**Cropping intensity:** It refers to raising a number of crops from the same field during one agricultural year. This indicates the pressure on the same amount of land for farming. Cropping is directly related to the irrigation facilities available, thus indirectly making it sensitive to climate change.

**Per capita food grain production:** Crop productivity is highly sensitive to extreme events in the region, thus increasing the susceptibility in terms of availability/unavailability of sufficient food produce in the region.



**Livestock population per hectare of net sown area:** Livestock - an adaptation option - has itself become highly prone to uncertainties of climate change. Adverse impacts of climate change in the Bundelkhand region (such as increasing extreme temperatures, increased frequency of droughts, scarcity of water resources, and poor availability of fodder) have severely affected the livestock population in the region. Their sensitivity may further increase due to the occurrence of new unidentified diseases, heat strokes and low productivity.

**Number of cultivators:** This indicates the dependency on agriculture as a major source of livelihood, which is one sector that is highly sensitive to climate change.

**Number of small farmers (0-2 ha landholding) and agricultural labour:** Small and marginal farmers are more sensitive to climate variability because they tend to have less resources/means to respond to external pressures. Districts with relatively higher numbers of small farmers will be more sensitive to climate variability.

**Number of agricultural workers:** Agriculture workers are highly sensitive to climate change due to lack of permanent farming resources to sustain themselves. These workers depend on other farmers and work on their lands on a seasonal basis. The temporary nature of their livelihood source further increases their sensitivity to climate change.

## **Adaptive Capacity**

### **Socio-economic**

**Total literacy rate:** The literacy rate acts as a proxy for the general level of human capital (i.e. education) in a district. Higher levels of human capital allow for improved access to information and thus a higher degree of adaptive capacity.

**Number of agriculture credit societies per lakh cultivators:** Agriculture credit societies increase adaptive capacity by providing financial services that can help farmers recover from a poor harvest or losses due to extreme events such as drought.

**Number of health care centres per thousand persons:** Health care facilities increase adaptive capacity by providing infrastructures to respond to the health impacts of climate variability.

**Number of handpumps per thousand population:** The availability of hand pumps indicates access to groundwater resources, an additional source of water for the community. Having access to this type of water resource increases adaptive capacity to drought and related climate stressors.

**Per capita rural electricity consumption:** This indicates the relative state of development in rural areas of each district. More developed areas have a higher adaptive capacity due to greater access to resources such as irrigation pumps (for which rural electricity consumption serves as a proxy) with which to respond to climate variability.

**Number of electrified pump sets per thousand hectares of gross cropped area:** This shows the capability of farmers to source water from nearby irrigation canal or groundwater source. This also reduces the use of diesel based pump sets in the region.

**Average daily employment in working registered factories per lakh population:** This indicates the availability of alternative sources of livelihood, which can act as an appropriate adaptation strategy for agricultural workers.

**Total number of BPL families:** Poor families will be less able to adapt to climate stressors due to lack of resources. Districts with higher numbers of BPL families will have a lower adaptive capacity.

**Agricultural machinery:** Agricultural machinery serves as a proxy for the state of agricultural development in each district. Districts with more agricultural machinery are assumed to be more developed. A more developed agricultural sector will have a higher adaptive capacity to climate variability.

In addition, block level assessments were also carried out for each of the six districts. This was intended to prioritize the vulnerable blocks for future adaptive planning. Various indicators were selected for developing the profile. These indicators include the average number of drought events in past ten years, average rainfall (in mm) average temperature (in centigrade), rural BPL families, per capita forest cover, ground water table (in metres), wasteland (in hectares), work force in agriculture, yield per hectare, net irrigated area, number of pump sets per ha, agricultural land, per capita loan, average land holding, livestock population etc. The vulnerability profile obtained in the

results is in the range of -1 to +1, showing low to high vulnerability. The study, however, faced obstacles due to data constraints.

Block level vulnerability assessment was conducted to prioritize the blocks for rapid primary assessment. Extensive series of consultations were held at the block, district and state levels. State level consultations involved scientific and government bodies to reflect the science-policy connect. Sample surveys were conducted at the block level to contextualize climate induced impacts on agriculture. To conduct the socio-economic vulnerability assessment, a detailed questionnaire was developed to obtain primary information. The questionnaire revolved around the social capital, economic status and natural ecosystems to understand the affect of climate change impacts on livelihood systems of the region. Focused group discussions were conducted with the farming community to understand the current vulnerabilities and information gaps.

Adaptation assessment was done through secondary research, which aided in enumerating the adaptation options. Primary consultations were conducted with the agriculture and water departments at the district level to understand the capacities, gaps and understanding of these officials on climate change. In addition, discussions were also held with Non-Governmental Organizations in the six districts to

validate the study by understanding their experiences on vulnerabilities in terms of exposure, sensitivity and adaptive capacity. **Bundelkhand Knowledge Platform** was also utilized to document the adaptation options through Civil Society Organizations efforts on ground. The Civil Society Organizations working in the region shared their experiences from different parts of Bundelkhand. This helped to analyze the existing adaptation options and the potential adaptation strategies which can be introduced in the region in future.



*Bundelkhand Knowledge Platform used for extensive consultations to share the on ground experiences of local stakeholders and CSOs in the region*



# 3. Results

## 3.1. Vulnerability Assessment of Bundelkhand

The vulnerability assessment done using secondary data, using the LVI approach, brings out the following

vulnerability ranking for the six districts under study. Vulnerability Profile ranges from -1 to +1 depicting low to high vulnerability. It is clear from the calculated LVI that Damoh is the most vulnerable district. (District-wise LVI is indicated in the table below.)

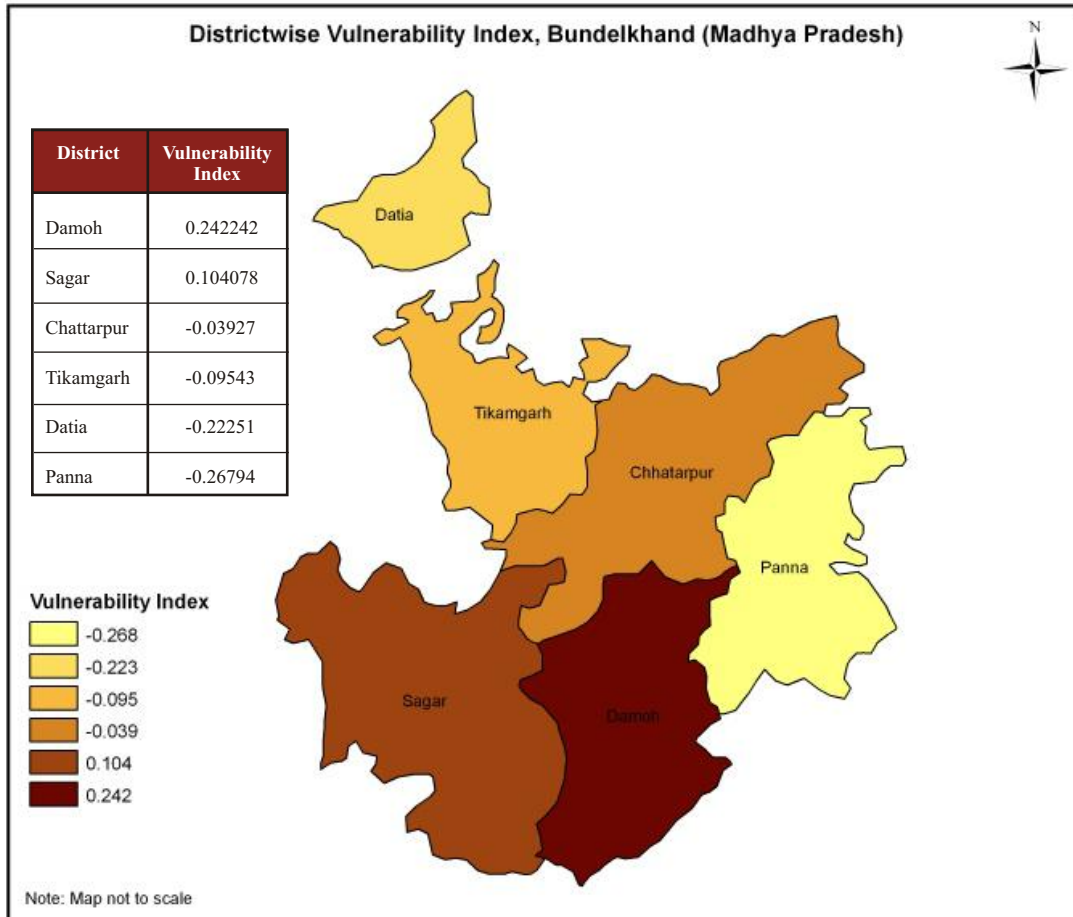


Figure 3: Vulnerability indices of the six Bundelkhand districts

## 3.2. Analysis of Climate Change Vulnerabilities in the Region

### Exposure

It is the magnitude and duration of the climate-related exposure such as a drought temperature variability or change in precipitation<sup>20</sup>. Climate data from 1980 to

2005 period has indicated an increase in the mean maximum temperature in Bundelkhand region by 0.28°C as compared to the baseline period of 1960-1990. Analysis of the simulated data generated by PRECIS Regional Climatic Model predicts that the temperature throughout the year is likely to be higher, in the range of 2 to 3.5° C by mid century<sup>21</sup>. The major precipitation season is expected to shift by one month

20 Ebi K.L., Mills D.M., Smith J.B., Grambsch A., 2006. Climate change and human health impacts in the United States: an update on the results of the U.S. National Assessment. Environmental Health Perspectives 114: 1318-1324.

21 IITM, Pune, India, Second National Communication to The United Nations Framework Convention on Climate Change, MoEF, Government of India, 2002.

(from July to August). The shift in monsoon causes delay in sowing, which in turn delays harvesting and culminates in reduction of the potential yields in drier conditions. The climate science data developed by Indian Institute of Tropical Meteorology, IITM has revealed the climatic change exposure of Bundelkhand region by the end of the century<sup>22</sup>. The data was developed using the PRECIS model run over three time slices (2020s, 2050s and 2080s) using 1970s as the baseline period. A 50 × 50 km resolution was used to develop the results for 5 QUMP (Quantifying Uncertainties in Model Predictions) simulations for A1B scenario. A1B describes a future world of very

rapid economic growth with global population that peaks mid-century and declines thereafter.

The study focussed on two major indicators of climate change - rainfall and temperature in the region. The results from the model predicted variability in climate by the end of the century. The annual average surface temperatures are projected to rise by 1-2°C, shooting up to 3°C and even up to 5°C towards 2020s, 2050s and 2080s respectively, especially in the northern part of Bundelkhand. Projected rise in the minimum temperature is more as compared to the rise in maximum temperature.

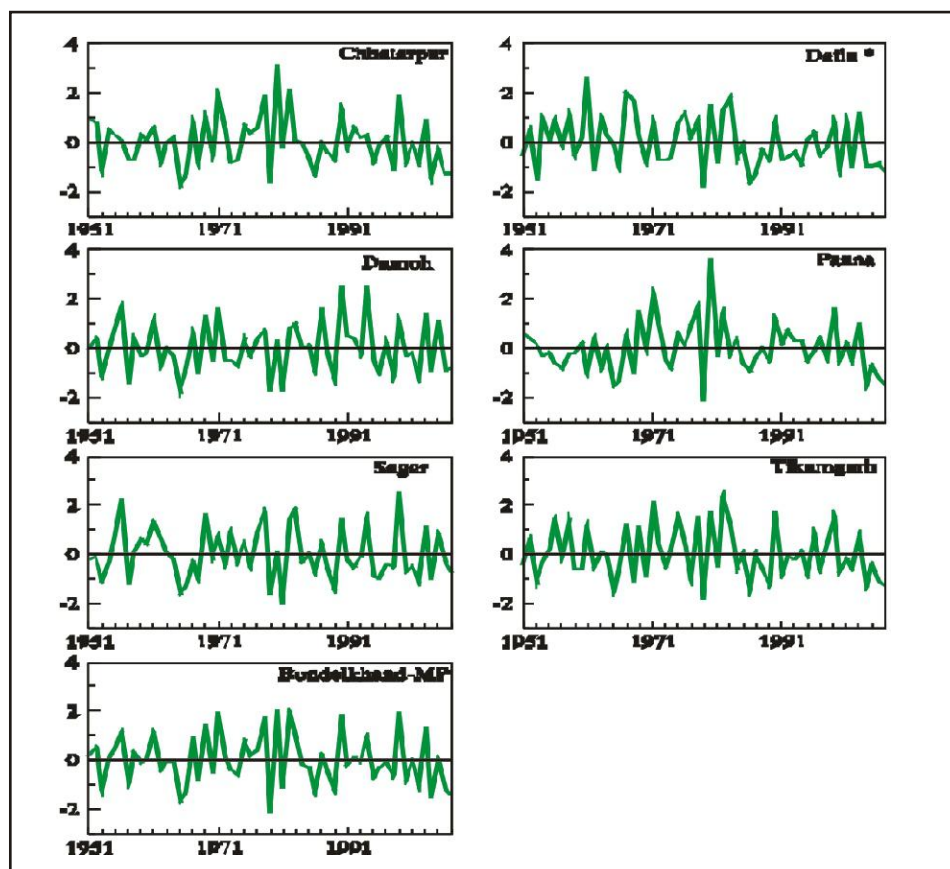


Figure 4: Time series of monsoon rainfall 1951-2007 for Bundelkhand region of M.P. (IITM Pune)

In near future, there may not be much change in the seasonal monsoon rainfall; however, it may increase by 5-10% percent towards 2050s and up to 20% towards

2080s with respect to the baseline. July rainfall is likely to decrease, but other months reveal an increase in the rainfall by the end of the century. The number of cyclonic disturbances may decrease in future but the systems may be more intense with increase in the associated rainfall by 10-15 mm. The number of rainy days may decrease, but they may be more intense in the future.

22 The climatic projections were shared by the IITM in the National workshop on “Climate Resilient Development for semi arid region A case of Bundelkhand region” organized by Development Alternatives and Swiss Agency for Development and Cooperation (SDC)



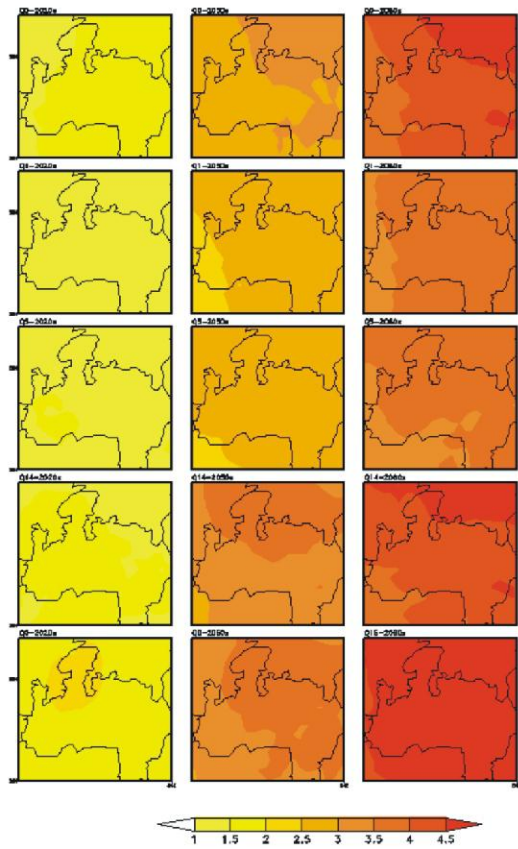


Figure 5: Change ( $^{\circ}$ C) in Annual average Surface Temperature towards 2020s, 2050s and 2080s (IITM, Pune)

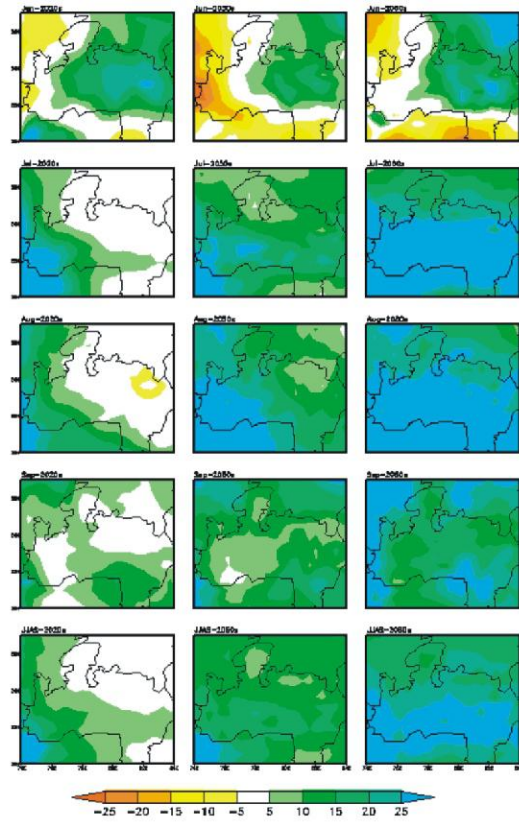


Figure 6: Monthly rainfall change (%) in QUMP simulations towards 2020s, 2050s and 2080s in individual monsoon months and season as a whole (IITM, Pune)

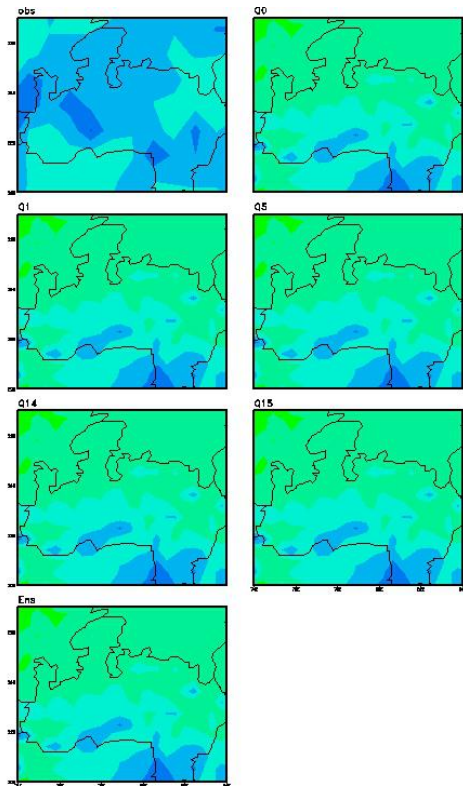
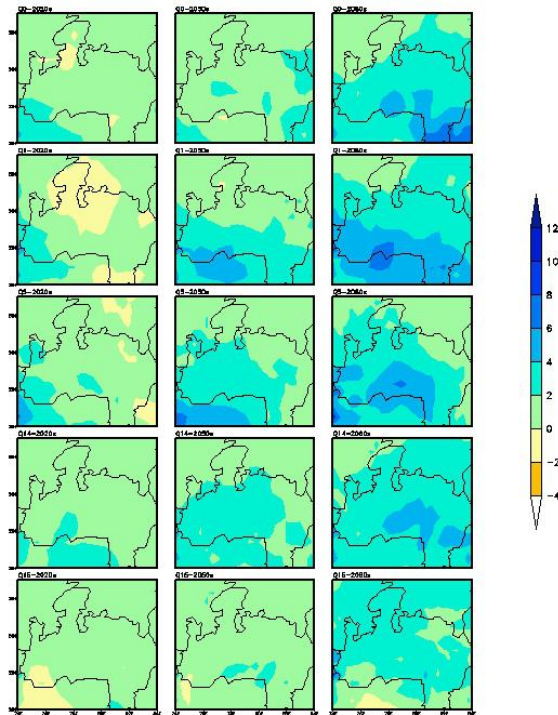


Figure 7: Simulated rainfall intensity (mm/day) and projected changes through 2020s, 2050s and 2080s (IITM, Pune)



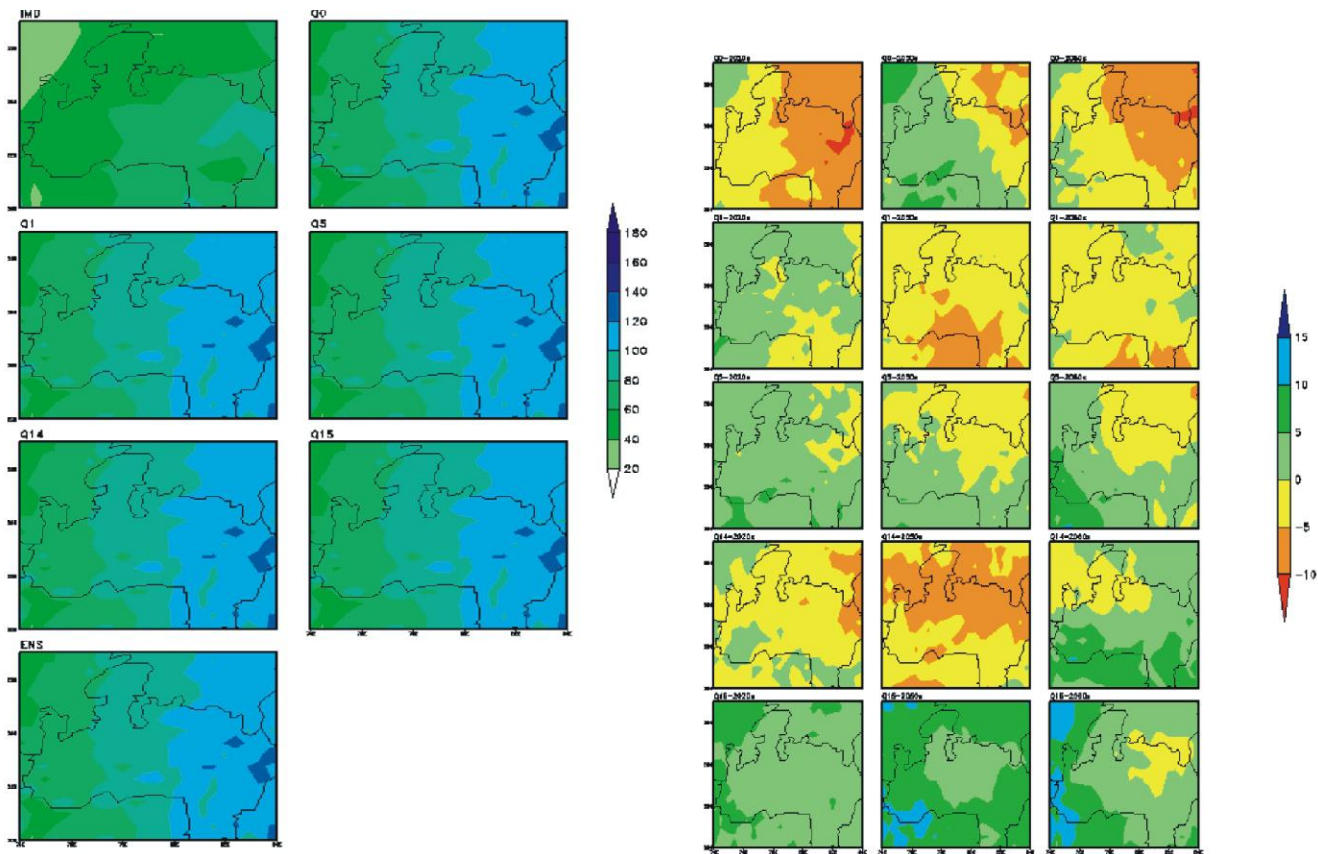


Figure 8: Simulated number of rainy days and projected changes through 2020s, 2050s and 2080s (Source: IITM, Pune)

### High Sensitivity and Low Adaptive Capacity

Sensitivity is defined as the degree to which the system is affected by the exposure, and its adaptive capacity is the system's ability to withstand or recover from the exposure<sup>23</sup>. The parched geography of Bundelkhand is one of the most underdeveloped regions of the country, with poor human development indices. In addition to undulating terrain and climatic variability, the drought-prone region suffers from high socio-economic vulnerabilities marked by increased climatic sensitivities and low adaptive capacities.

### Social Vulnerabilities

The Bundelkhand region is among the most backward regions in the country. Out of the six districts of the Madhya Pradesh part of Bundelkhand, districts like

Chhatarpur, Panna, Tikamgarh and Damoh currently receive funds from the Backward Regions Grant Fund Programme (BRGF) under the aegis of Ministry of Panchayati Raj. 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% in urban areas during 2004-05).

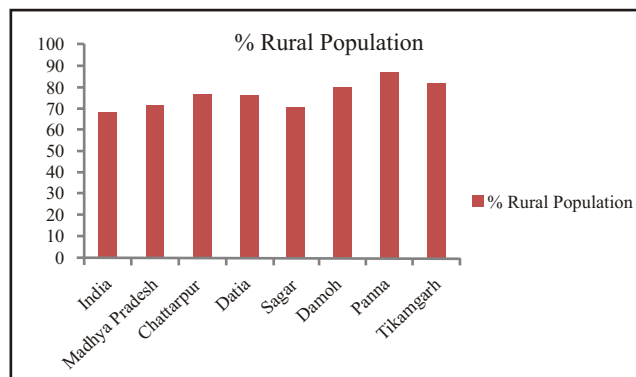


Figure 9: Comparison of percentage of rural population in India, Madhya Pradesh and Bundelkhand region (Source: Census, 2011)

23 Ebi K.L., Mills D.M., Smith J.B., Grambsch A., 2006. Climate change and human health impacts in the United States: an update on the results of the U.S. National Assessment. Environmental Health Perspectives 114: 1318-1324.





Widespread poverty, unbiased socio-economic conditions and high levels of illiteracy increases the vulnerabilities of the communities

There is widespread poverty in the region, with majority of the populace dependent on agriculture as their core source of livelihood. There is an evident social hierarchy existing in the region. Even though there are primary schools in most of the villages, the quality of education is poor with less teachers and irresponsible attitude of teachers towards teaching in some parts of the region. Girls drop out of school past the primary level as the higher level schools are situated far from the village.

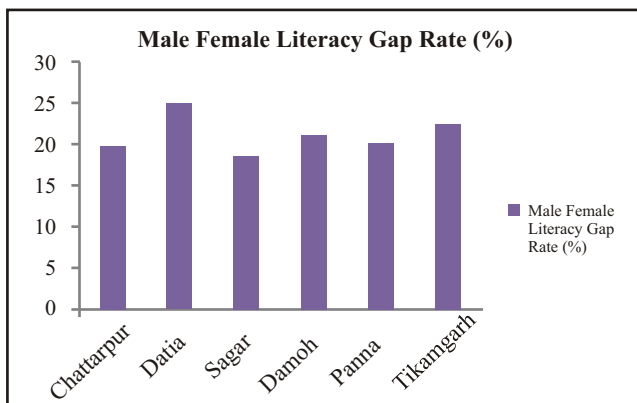
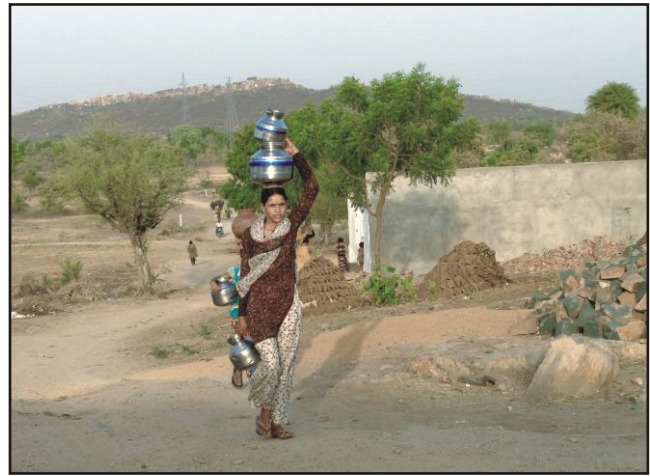


Figure 10: Male Female Literacy Gap Rate (Source: Census, 2011)

There is a general lack of awareness among the community due to illiteracy and lack of support services which could have enabled them through information. The status of women is further low in the region due to cultural and social barriers and low development indices. Water for drinking and other household purposes is fetched from far off sources by the females of the households, adding to their normal work load.



Scarcity and other socio-economic conditions increases the burden on women in the region

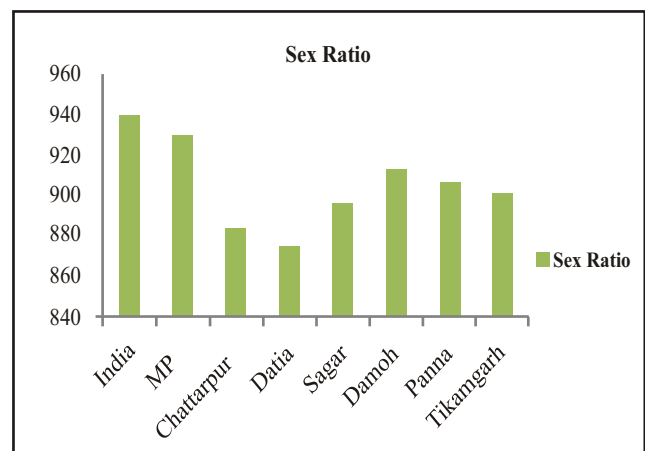


Figure 11: Comparison of Sex Ratio in India, Madhya Pradesh and Bundelkhand (Source: Census, 2011)

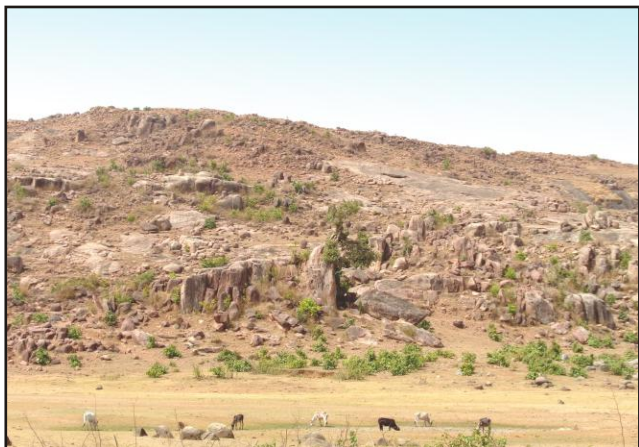
The farmers in the block are small scale with an average land holding size of two hectares. In addition the productivity is low and is dependent on weather conditions. Also, only a very small number of farmers were able to get access to national crop insurance schemes of the government. As wheat was perceived to require a larger quantity of water the farmers have switched to growing lentils and sesame as an autonomous adaptation/coping strategy. Farmers have also diversified their livelihood options and have started small scale enterprises such as selling vegetables in the adjoining urban centres. Most of the farmers are under debt for fulfillment of basic needs. Informal institutions such as money lenders and relatives contribute to about half of the debt.



## Ecological Vulnerabilities

### Natural Resources

The 13 districts of Bundelkhand region consists of 7.08 million hectares of ravenous and undulating terrain, making the region prone to high run-off and increase in loss of soil fertility<sup>24</sup>. Above an impervious layer of rock that is found at depths of 6 to 15 metres, several kinds and grades of soil are found across Bundelkhand. Broadly, the soil falls into two categories: red soil and black soil.



*Rocky, barren, semi arid and undulating topography of Bundelkhand*

loss of soil fertility<sup>24</sup>. Above an impervious layer of rock that is found at depths of 6 to 15 metres, several kinds and grades of soil are found across Bundelkhand. Broadly, the soil falls into two categories: red soil and black soil.

Across Bundelkhand, soils of both categories have poor organic content. Bundelkhand region is rocky and has a high percentage of barren and uncultivable land. According to the Wasteland Atlas of India (2005), Department of Land Resources, Ministry of Rural Development (GoI), a total of roughly over 11,000 sq km, or over a sixth of the area of Bundelkhand (M.P and U.P) falls under four broad categories of wasteland. Wastelands found in Bundelkhand can be grouped as: land affected by shallow, medium or deep gullies; wastelands with or without scrub in lowlands or uplands; degraded notified forest lands and barren, rocky and totally uncultivable land. Over half the total wasteland of the region is with or without scrub, half of

which falls in the Chhatarpur district. Around a quarter of the total wasteland is degraded notified forest land, found mostly in Bundelkhand upland (Chhatarpur, Tikamgarh, and Panna) and Sagar and Damoh plateaus.

### Forests

About 22.53% of the Bundelkhand region consists of forest cover and scrubs. Additionally, population growth, increase in cultivable land, increased extraction of fuel wood, anthropogenic pressures and climatic changes have, all-in-all, affected the quality of forests in the region. Losses in the agricultural produce due to variable climate have also increased people's dependence on forests for other livelihood options. Deforestation has also become rampant, which has led to a slow environmental degradation of the districts. Over the decades, the forested area has shrunk. Due to the declining forest cover, the land is becoming barren because of the increasing rate of erosion. This has also lowered the water holding capacity of the soil. Panna was the only district in the entire country which had a forest area of over 50% with respect to its geographical area. However, the forest resources in this biodiversity-rich region are now under threat. *mahua*, *tendu* leaf, *chironji* and other NTFPs are being taken from the forest. Particularly *mahua* fruit, which is used for alcohol production is a major source of livelihood for the local community. *Bidi*-making also provides a sustainable livelihood to a large number of poor families in the region. Mainly, fuel wood is sourced from nearby forests.



*A women sorting tendu leaves derived from forests for bidi making*

24 Report on Drought Mitigation Strategy for Bundelkhand Region of Uttar Pradesh and Madhya Pradesh, Inter Ministerial Central Team, Government of India, 2008

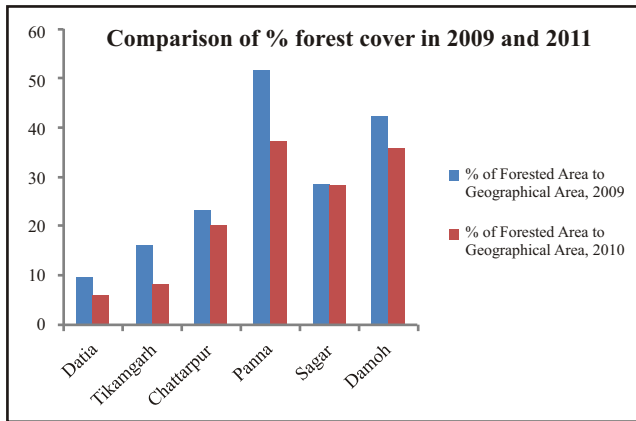


Figure 12: Comparison of % forest cover in 2009 and 2011

(Source: District Statistical Handbooks, 2009 and India State of Forest Report, 2011)

## Water

Sensitivities in Bundelkhand are majorly aggravated by water stress in the region. This is chiefly due to inadequate and erratic rainfall, high run-off rates and poor water retention capacity of the soil. Loss of traditional water management practices and insufficient water harvesting structures have further added to the cause. Most part of the Bundelkhand



Water scarcity in the region forces the communities to obtain water from handpumps located at far off distances

region is covered with an impermeable rocky layer which is found at quite shallow depths. These factors cause low groundwater recharge, making groundwater availability a major issue of concern. Water availability from aquifers is inadequate and non-dependable. The groundwater recharge is a slow process due to physiographic conditions, low porosity of the strata and occurrence of clay layers<sup>25</sup>.

25 <http://moef.nic.in/downloads/public-information/MP-SAPCC.pdf>

The average annual rainfall of Bundelkhand region of Madhya Pradesh is 990.9 mm, with a range of 767.8 to 1086.7 mm. The region witnessed continuous meteorological, hydrological and agricultural drought for six years in the period 2003-2009. According to the Inter-ministerial Report on Drought Mitigation Strategy for Bundelkhand Region (2008), the semi-arid region of Bundelkhand experienced meteorological drought in the years 2004-05 and 2005-06 in the districts of Tikamgarh and Datia. In 2006-07, the region experienced an overall 37% shortfall in five out of six districts receiving deficit rainfall ranging from 27% to 47%. The overall shortfall in precipitation went up to 46% during 2007-08, with all the six districts having more than the threshold deficit of 20% for declaring a meteorological drought.

Increasing temperatures have also led to high evapotranspiration rates which, when greater than the received precipitation, lead to loss of soil moisture and reduction in groundwater recharge and surface water levels. Vulnerability assessment of the region also reveals that the region is also facing the brunt of depleting groundwater resources. In the six districts of Bundelkhand region of MP, the actual filling of 19 reservoirs (storage capacity- 950 MCM) progressively reduced from 52% in 2004 to 10% in 2007. Drying up of 70% of tanks, ponds and dug-wells and fall in the groundwater table in the region clearly indicated hydrological drought situation.



Declining groundwater table in the region

About 44.7% of net sown area (NSA) is irrigated by canals, dug wells, shallow tube wells, lift irrigation and other flows. Major portion of this, i.e. 31.7% of NSA is irrigated by ground water<sup>26</sup>. Irrigation heavily relies on

26 Report on Drought Mitigation Strategy for Bundelkhand Region of Uttar Pradesh and Madhya Pradesh, Inter Ministerial Central Team, Government of India, 2008



the availability of water through rainfalls, which further increases the sensitivities to climate change. A large portion of irrigation depends on extraction of groundwater through diesel based pump set, which is heavy on the pockets of small and marginal farmers. With groundwater levels falling and lakes and ponds drying up, the overall water availability for irrigation has drastically reduced.

Furthermore, the area is witnessing inefficient water management practices such as inadequate rain water harvesting, flood irrigation and insufficient groundwater recharging structures. The recharging of groundwater resources through collecting the rainwater in traditional ponds is not taking place due to degradation of such ponds, encroachment of forest lands, cutting of forests and blocking of the catchment areas of watershed regions. The result is that wells being used for drinking water and irrigation are not providing enough water to serve the purpose for whole year<sup>27</sup>.

### Livestock

In the semi arid geography like that of Bundelkhand, livestock-rearing is a common livelihood option practiced by the communities. People have moved beyond cattle and are taking up poultry and goat-rearing as options. But, the growing unavailability of grazing pastures has added to the woes in livestock rearing.

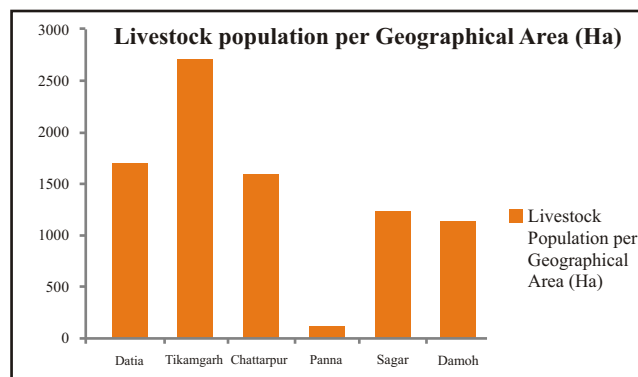


*Increasing demand for resources has affected the livestock rearing practice in the region*

About 50% of the indigenous cattle population is unproductive. Hardly 0.5% of cattle population is

27 [http://planningcommission.nic.in/reports/sereport/ser/bndel/stdy\\_bndel.pdf](http://planningcommission.nic.in/reports/sereport/ser/bndel/stdy_bndel.pdf)

cross-bred as compared to 15% of the national average.<sup>28</sup> Except a few communities, such as the *Yadav* clan which chiefly depend on cattle, others have shown a declining trend in continuing with this livelihood option due to lack of resources to keep the animals healthy. Lack of fodder availability and water has reduced the interest of local communities in livestock-rearing, which has further lowered their adaptive capacities.



*Figure 13: Livestock population per geographical area, 2007 livestock census*

### Agricultural Sector Vulnerabilities

In the predominantly agrarian economy of Bundelkhand, over 80% of the population is dependent on agriculture, livestock rearing, collecting forest produce and outsourcing income by seasonal migration after the Rabi sowing season. Agriculture in the region is chiefly rain-fed, risky and vulnerable. Major crops grown in the region are *soyabean*, *arhar*, *groundnut*, and *sugarcane* during *kharif* and *wheat*, *mustard*, *masur*, *urad* and *mung* during *rabi*.

Agricultural production consists of more than 56% of cereals, 32% of pulses, 8% of oil seeds and 4% other crops. Out of the total number of land holdings, 68% belong to small and marginal farmers who have less than two hectares of land. Majority of these farmers are highly dependent on monsoon rains and modern agricultural practices for efficient water use have not been adopted<sup>29</sup>. The Bundelkhand region faced its worst ever drought from 2004 to 2009, with a rain deficit of about 66%. According to the report of an inter-

28 Report on Drought Mitigation Strategy for Bundelkhand Region of Uttar Pradesh and Madhya Pradesh, Inter Ministerial Central Team, Government of India, 2008

29 DA-Swiss report on "Resource Vulnerability of Semi-Arid Bundelkhand and Recommendations for Policy Response - a brief analysis, 2012"



ministerial central team, headed by Dr. J. S. Samra of National Rainfed Areas Authority (2008), the region could not cultivate even 40% of the farms, leading to about 30% reduction in food grain production. More than two million livestock were abandoned. Around 40% of the region's population had migrated out in search of work. These incidences of drought and high vulnerabilities indicate the negative impacts of climate uncertainties on food security of Bundelkhand.



*High sensitivity of the farmers due to increasing vulnerability of the agriculture sector in the region*

Consultations with farmers revealed that unavailability of seeds, fertilizers and pesticides further cripples their situation. They are facing crisis due to increased agricultural inputs as compared to agricultural outputs and benefits. Over the years, dependence on chemical fertilizers has also increased manifold, which is gradually decreasing soil fertility and also adding to the monetary input requirements for the farm.

During the past 25 years, factors such as promotion of cash crops, changing agro-cycle, forest degradation, over-exploitation of groundwater and damage to traditional water bodies have led to drying up of natural land moisture. Water is being pumped out from the ground using tube wells which has led to drying up of natural water sources in many areas of the region. Now, the water level for tube-wells has gone down to around 600-750 feet in some part of the region. Lack of forests and grass in the region, causes the water to flow with high velocity on the Bundelkhand land that it is slowly turning into a ravine. There is a downfall in the number of rainy days in the entire region and the state as well. In the year 1999, there used to be 52 rainy days during the year, but it has gone down to the level of 35 in a year<sup>30</sup>. The scarcity of water, along with the poor soil quality, adds to the vulnerability in the region. Productivity is

affected by the poor water retention ability of the soil, weather fluctuations and large tracts of wasteland<sup>31</sup>.

Since the crops are mainly rain-fed, monsoons are crucial for sowing and subsequent growth of the crops. It has been experienced that the onset of monsoons has shifted from the end of June to end of July August. This has caused a delay in the sowing time of seeds, which affects the growth and harvest of the crop due to different temperature conditions which the crop has to tolerate. Also, due to sudden downpours, the crops also face water-logging conditions which decay their growth. Recently, during *Kharif* 2012, the farmers considering the delayed monsoons and low rainfall sowed *til* (sesame) seeds, but the delayed heavy rains damaged the standing crop to such an extent that the crop started to decay.

Another issue causing the low yield rate is the non-replacement of seeds. Timely seed replacement is not taking place at the required rate. Foundation seeds work for a maximum period of three years, providing a high yield during this span, after which the produce declines. The farmers are either not aware of this or not ready to change because they have been cheated time and again by the seed companies. On several instances poor farmers were sold grains instead of seeds, as a result farmers incurred heavy losses. Actually, most farmers depend totally on the government, without making much effort on their own.

The average land holding of the region is less than two hectares, meaning that it is mainly the small and marginal farmers who will be impacted with the future implications of climate change. The landless farmers (*Bhumiheen Majdoor*) work in two ways, either they take land from some other farmer to practice agriculture or they work as labour in their farms to till their land and take a meagre share as their income. Around 80 % of the small scale farmers work as agriculture labour.

These farmers depend on agriculture for their own subsistence and seldom have a produce to sell in the market. Their decisions on the agricultural inputs are influenced by the process followed either by large farmers in the village or the market trend. They are deprived of correct information on time, thus forbidding the scope of improvisation in farming practices. Crops are also affected by unavailability of water on time. Fluctuating and discontinuous electricity supply has forced the farmers to invest hugely on diesel pump sets to draw water from nearby canals.

30 IITM, Pune

31 [http://bundelkhandinfo.org/economy/employment/employment\\_sources.html](http://bundelkhandinfo.org/economy/employment/employment_sources.html)

Not just natural climatic conditions affect farmer's vulnerabilities, government's incapacity to disseminate seeds on time and the market trend which fetches the farmers lower returns on produce add to their pathetic conditions.

An increasing trend of distress migration is observed in the region. Due to degrading environment and poor economic conditions, local people are migrating out to other regions in search of better income and opportunities for sustenance. The drought period of 2003-2009 witnessed a migration of 40% of region's population<sup>32</sup>. Typically, migration is sought as an adaptive response once the other sources have been tested for support and proved incapable. Rising input costs and frequent incidence of drought are pushing agricultural labourers and small farmers out of agriculture. Mining of minerals and stone-quarrying has emerged as a major non-agricultural activity. Women also accompany men as they migrate to the cities to work as unskilled labours. Migration has increased to around 70-80% (especially the bread winners), with farmers migrating to cities in search of job opportunities. The migrating population ranges from seasonal to permanent. This leads to migration of large rural population to towns and cities. This has also affected the agriculture practices in villages. The region is also starved with timely information and technological interventions which further cripples their situation.

It was found that though the villages had been electrified, but for the past few years' electricity supply has been disconnected in some villages due to non-

payment of electricity bills. The villagers did not find it feasible to pay rental charges for a connection wherein the supply of electricity was not reliable. For this reason the communities in such villages are not able to pump ground water for irrigation purposes.

### 3.3. District Vulnerability Profiles

#### 3.3.1. Chhatarpur District

Chhatarpur district is located in central portion on the plateau of Bundelkhand in M.P. The district is spread over an area of 8616.82 km<sup>2</sup> and is located at the northern boundary of the state. It is bounded by Mohaba district in U.P in the north and Panna district in the east, Tikamgarh district in the west and Sagar & Damoh districts in the south. Chhatarpur district is divided into six blocks (Gaurihar, Londi, Nowgaon, Chhatarpur, Rajnagar, and Bijawar) and eight development blocks (Gaurihar, Loundi, Nowgaon, Chhatarpur, Rajnagar, Bijawar, Badamalhera & Buxwaha)<sup>33</sup>.

**Climate Profile:** The district witnesses a hot summer and general dryness except during the South- west monsoon season. Weather-wise, the entire year can be divided into four seasons. The cold season ranges from December to February, followed by the hot season from March to middle of June. The period from middle of June to September in the South-west is the monsoon season. October and November form the post-monsoon or transition period. The nearest IMD observatory is in Nowgaon.

Blocks	2001-02	2002-03	2003-04	2004-05	2005-06
Chhatarpur	927.9	924.4	1,423.6	932.9	1060.1
Laudi	1,122.0	850.0	1,392.0	835.0	898.0
Bijawar	1,206.8	927.6	1,588.2	1,110.0	1165.0
Nowgaon	1,081.9	751.0	1,334.8	906.7	768.4
Rajnagar	1,067.2	938.2	1,373.7	1,095.6	868.0
Gaurihar	1,106.2	701.5	981.2	921.3	959.0
Badamalhera	1,119.8	1,123.8	1,542.4	1,056.9	1333.0
Buxwaha	881.2	738.8	1,463.5	1,063.0	1360.5
<b>Avg Year Wise</b>	<b>1,069.7</b>	<b>869.4</b>	<b>1,386.8</b>	<b>990.1</b>	<b>1051.5</b>

Table 3: Average Annual Rainfall from 2001-06 in Chhatarpur District (in mm.)

32 Report on Drought Mitigation Strategy for Bundelkhand Region of Uttar Pradesh and Madhya Pradesh, Inter Ministerial Central Team, Government of India, 2008

33 District Groundwater Information Booklet, Chhatarpur District, Central Groundwater Water Board, Ministry of Water Resources. 2009

The normal annual rainfall of Chhatarpur district is 1068.3 mm. The district receives maximum rainfall during South-west monsoon period i.e. June to September. About 90.2% of the annual rainfall is received during monsoon season. Only 9.8% of the annual rainfall takes place between October to May period. The normal maximum temperature during the month of May is 42.3°C and the minimum ( during the month of January) is 7.1°C. The normal annual mean maximum & minimum temperatures of Chhatarpur district are 32.7°C and 18.1°C respectively. During the South-west monsoon season, relative humidity generally exceeds 88% (during August), whereas the rest of the year is drier. The driest part of the year is the summer season, when relative humidity is less than 30%, in fact, May is the driest month of the year.

**Demographics:** The population of Chhatarpur district

as per the 2011 Census is 17,62,857 (9,35,906 males and 8,26,951 females) with the population density around 203 per km<sup>2</sup>. A total of 77.35% of the population resides in rural areas which implies that the majority population is dependent on agriculture sector. The sex ratio is 884 females per thousand males, which is quite less than the state ratio of 930 and the national figure of 940 respectively. The decadal population growth of the district is 19.5%, which is higher than the state and national averages of 20.3% and 17.64% respectively. The increasing rate of population and subsequent decline in the resource base adds to the susceptibility of the people to be affected by any untoward incident. In 2006, the Ministry of Panchayati Raj named Chhatarpur as one of the country's 250 most **backward districts**. It is one of the 24 districts in Madhya Pradesh currently receiving funds from the **Backward Regions Grant Fund Programme (BRGF)**.

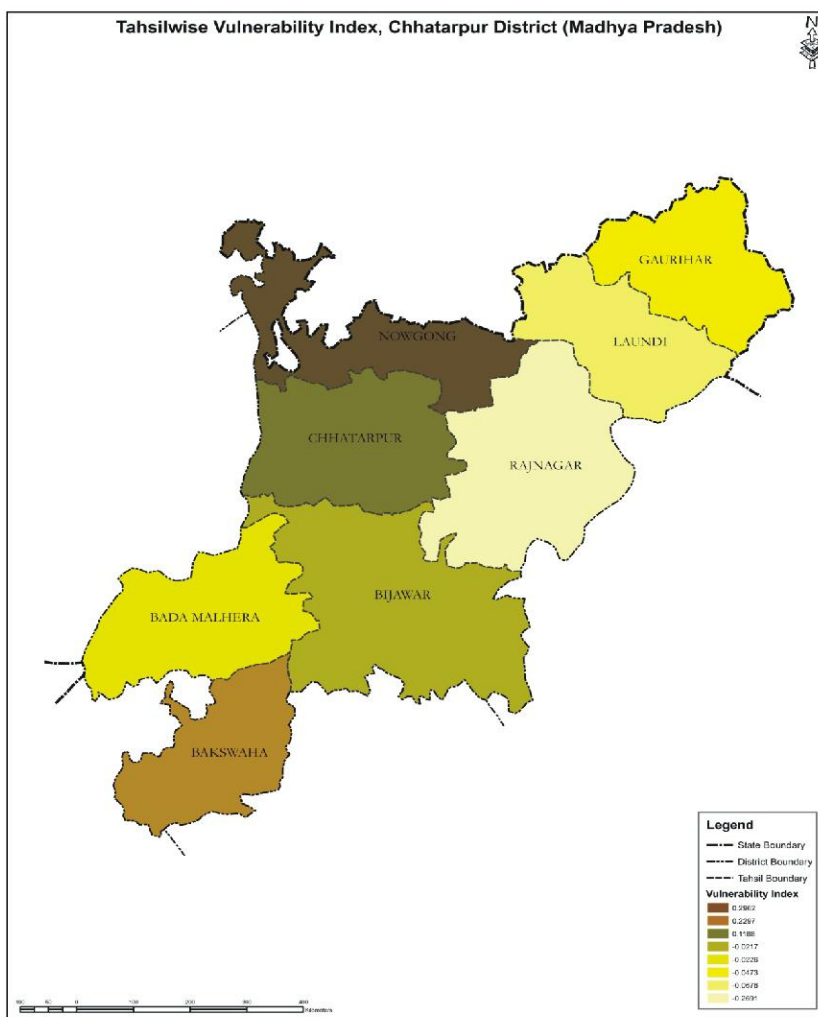


Figure 14: Chhatarpur District Vulnerability Map



Without any robust development scheme the growing population will be increasingly at risk without sufficient capacity to cope with the impacts of climate change on agricultural productivity, water availability, health and other sectors.

**Agricultural Dependence:** In all, 54.8% of total workers are cultivators and 20.5% are agricultural labourers, who will be worst affected by changing climate impacts on crop productivity due to already low adaptive capacities and weak socio-economic status. As mentioned earlier, agriculture is the main occupation in the district. The major crops grown in the district are paddy, *jowar*, maize, *tuar*, *urad*, *til* groundnut, soyabean, sugarcane (*Kharif*) and wheat, gram, *alsi*, mustard, *rai* and vegetables (*Rabi*). Cropping intensity is 116%. The net sown and cultivable areas are 4038.63 km<sup>2</sup> and 651.67 km<sup>2</sup> respectively. Around 47% of the land is under cultivation, with a very small portion under cultivable waste land (8%). Forest and logging activities in the district contribute to 2.07% of the GDP of primary sector. Around 4% of the land is not available for cultivation and 8% constitutes fallow land. Total area under principle crop is 5,113.09 km<sup>2</sup>. The percentage of net sown area to total geographical area is 46.3%, while percentage of Net Irrigated to Net Sown Area is 53.2% (*District Statistical Handbook, 2010*).

**Literacy:** Total literacy rate for the district is 64.9%, which is below the state literacy rate of 70.63% as well as the national literacy rate of 74.04%. The male literacy rate is 74.2% and the female literacy rate is 54.3% with a gap of 19.9%, indicating high vulnerabilities of uneducated women population. The low literacy rates implies to the lower percentage of people employed in the service sector, thus indirectly indicating the burden on the agriculture sector for livelihood.

**Ecosystem:** The forest cover is only 23% of the total geographic area. The district as a whole lies in the Yamuna sub-basin of the Ganga basin and is traversed by the left bank tributaries of Ken and the right bank tributaries of Dhasen. The catchment area of Ken and Dhasen rivers falling in the district are 6033.15 km<sup>2</sup> and (69.99%) and 2594.25 km<sup>2</sup> (30.10%) respectively.

**Irrigation:** Groundwater development for irrigation is through dug wells, dug-cum-bore wells and shallow bore wells. Farmers generally use diesel / electric

engines with 3.00 to 5.00 HP on dug wells and submersible pumps on bore wells to lift water for irrigation purposes. The total irrigated area is 2265.81 km<sup>2</sup>, of which 204.66 km<sup>2</sup> is irrigated by canals, 16.99 km<sup>2</sup> by tube wells and 1707.87 km<sup>2</sup> by open wells. The region is chiefly rain-fed, with inadequate and dwindling irrigation facility. Changes in the rainfall scheme will affect the availability of the water resource.

**Water:** Groundwater is the main source for drinking water supply both in rural and urban areas. And, it is supplementing the surface water supply schemes in more or less all the villages in the district falling under the category of problem villages or drinking water scarcity villages. Only 52.25% of the total habitants have access to safe drinking water in the district. This leaves scope for huge improvement in the water provision which will, in turn, safeguard the health of the local people and reduce the household burden on females due to water scarcity. Measures can be effectively taken to employ water management practices in the area which will benefit the community.

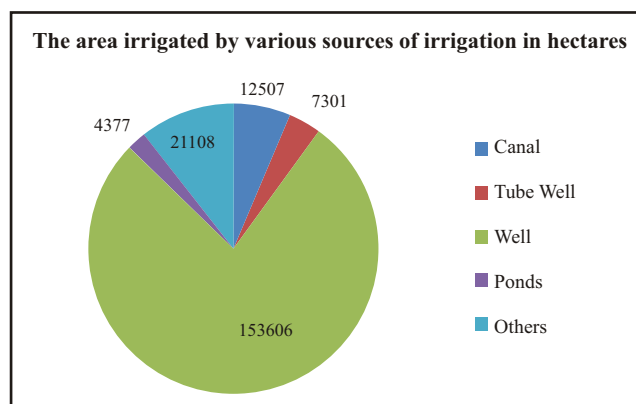


Figure 15: The area irrigated by various sources of irrigation in hectares  
(Source: *District Statistical Handbook, 2010*).

Overall, the socio-economic characteristics of the region indicate low adaptive capacity of the community; this leaves a scope for improvement through implementation of better practices such as those in agriculture which happen to have a major stake in social and economic well being of the communities. The communities can also be encouraged to get involved in alternative sources of livelihood as a secondary option to agriculture, giving them a support in crucial times.

### 3.3.2. Datia District

Datia is bounded by Madhya Pradesh districts of Bhind in the north, Gwalior in the west, and Shivpuri in the south, and by Jhansi District of Uttar Pradesh state in the east. The district is part of the Gwalior division.

**Climate Profile:** The climate of Datia district is characterized by a hot summer and general dryness except the rainfall during the southwest monsoon season. The year can be divided into four seasons. Cold season, December to February, is followed by the hot season (from March to about first week of June) or the summers. May is the hottest month of the year with the maximum temperature of 42.1°C. The minimum temperature during the month of January is 7.1°C. The southwest monsoon starts around middle of June and lasts till end of September. October and middle of November constitute the post-monsoon or retreating monsoon season. The normal annual rainfall of Datia district is 793.8 mm. About 90.4% of annual rainfall is received during the monsoon season. Only 9.6% of annual rainfall takes place between October to May. The humidity is at its lowest in April. It varies between 26% and 83% at different times in different seasons.

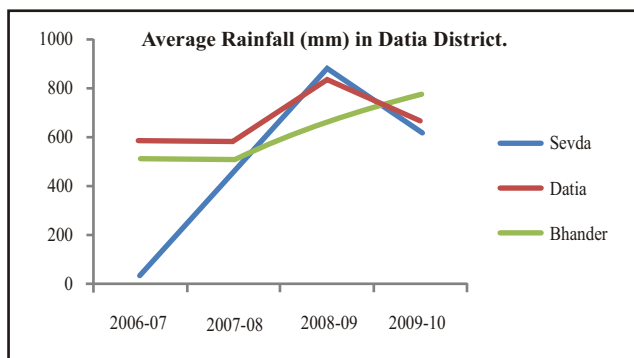


Figure 16: Average Rainfall (mm) in Datia District.  
(Source: District Statistical Handbook, 2010)

**Demographics:** The population of Datia is 786,375 (419,432 males and 366,943 females) as per the 2011 Census and the district population density is 292 persons per sq. km. In all, 76.83% of the population resides in rural areas indicating the inclination towards the agriculture sector. The sex ratio is 875 females per thousand males which is much less than the state ratio of 930 and the national figure of 940 respectively. The decadal population growth of the district is 18.4%, which is lower than that of the state (20.3%) and little higher than the national average of 17.64%. The increasing rate of population and subsequent decline in

the resource base adds to the susceptibility of the people to be affected by any untoward incident. Without any robust development scheme, the increasing population will be constantly at risk without sufficient capacity to cope with the impacts of climate change on agricultural productivity, water availability, health and other sectors.

**Literacy:** Total literacy rate for the district is 73.5% which is above the state literacy rate (70.63%) but slightly less than the national literacy rate (74.04%). The male literacy rate is 85.15% and female literacy rate is 60.21%, with a significantly high gap of 25%. Higher literacy rates indirectly indicate a better score in adaptive capacity, as the educated lot would be better informed and could vouch for alternative livelihoods through their high adaptive capacity. In order to improve its access to information, the state further needs to strengthen the education system and literacy rate.

**Agricultural Dependence:** In all, 62.1% of the total workers are cultivators and 16% are agricultural labourers, who will be worst affected by changing climate impacts on crop productivity. A major segment of the working population is involved in agriculture. In fact, 87.5% of the rural working population is involved in cultivation and agricultural activities in the district. Cropping intensity is 135%. Major crops grown in the region are wheat, gram, sesame and other pulses. The share of agriculture and allied activities in Datia has reduced over the years. Between 2005-06 and 2008-09, net sown area decreased from 1,97,200 hectares to 1,96,000 hectares. The production output of wheat has gone down from 266 thousand metric tonnes in 2006-07 to only 29.08 thousand metric tonnes in 2009-10. This is attributed to below average rainfall in the district (Source: District Statistical Handbook, 2010).

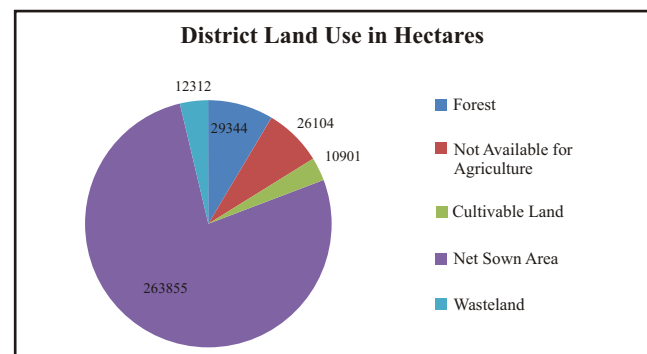


Figure 17: District Land Use in Hectares  
(Source: District Statistical Handbook, 2010)

**Ecosystem:** Only 9.8% of the total geographic area is covered under forest. This indicates that forest as a source of livelihood option is ruled out in the district. Also, the ecosystem service forests provides is inadequate, leading to environmental implications. Datia district comes under the Gangetic drainage system and is drained by the Sind, Pahuj, Mahuar and River Betwa. The former two, however, form drainage system of main body of the district. The rivers are almost seasonal and have a heavy run-off only during the peak period of July and August in the rainy seasons. During the dry season, most of the streams become dry and water is available only in some channels of the main stream. The erratic rainfall pattern causes the river channels to remain dry for most parts of the year, with the increasing impacts of climate variability.

**Irrigation:** The area is irrigated by tube wells, dug wells and tanks. Total area irrigated from all the sources is 175364 hectares. Groundwater is the main source of irrigation in the area.

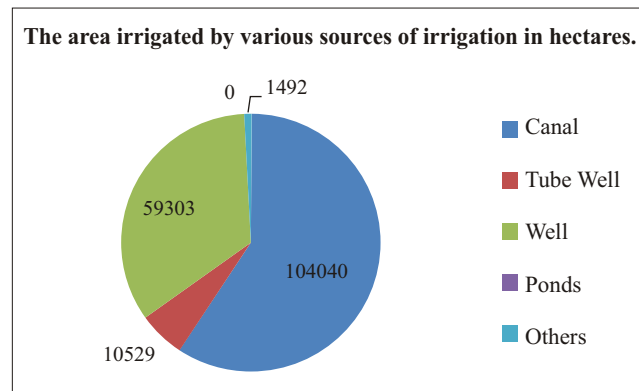


Figure 18: The area irrigated by various sources of irrigation in hectares.

(Source: District Statistical Handbook, 2010)

As the rainfall distribution and pattern changes with the changing climate, the groundwater resources are also under threat. Along with the geological conditions, the climatic variables also impose threat to the resources. It is essential that water management practices are adopted in the region for water security reasons.

**Water:** In Datia district, except Datia, Bhandar Seonda and Indergarh, rest of the area falls under the rural region. Groundwater is the main source of water except in Datia town where water is supplied for drinking purposes from a small tank and the Ramsagar Dam<sup>34</sup>.

<sup>34</sup> District Groundwater Information Booklet, Datia District, Central Groundwater Water Board, Ministry of Water Resources. 2009

The drinking water supply in the district by Municipal Corporation and Panchayat in the rural areas is met through bore wells and tube wells. The long-term water level trend depicts a significant decline of 0.221-0.839 and 0.379 -0.959 m/yr during the pre monsoon and post monsoon periods respectively. The long-term water level trend shows a rise of 0.054-0.251 and 0.007-0.027 m/yr during the premonsoon and post-monsoon periods respectively, in the command canal area in the north-central part of the district. Only 59.94 % of the total habitants have access to drinking water in Datia district.

There is a huge scope for improvement in water provision to safeguard the health of local populace and reduce the burden of water scarcity. Effective measures could be taken to employ water management practices in the area to benefit local community. The socio-economic conditions of the district have huge scope for improvement in terms of enhancing the adaptive capacities of the communities.

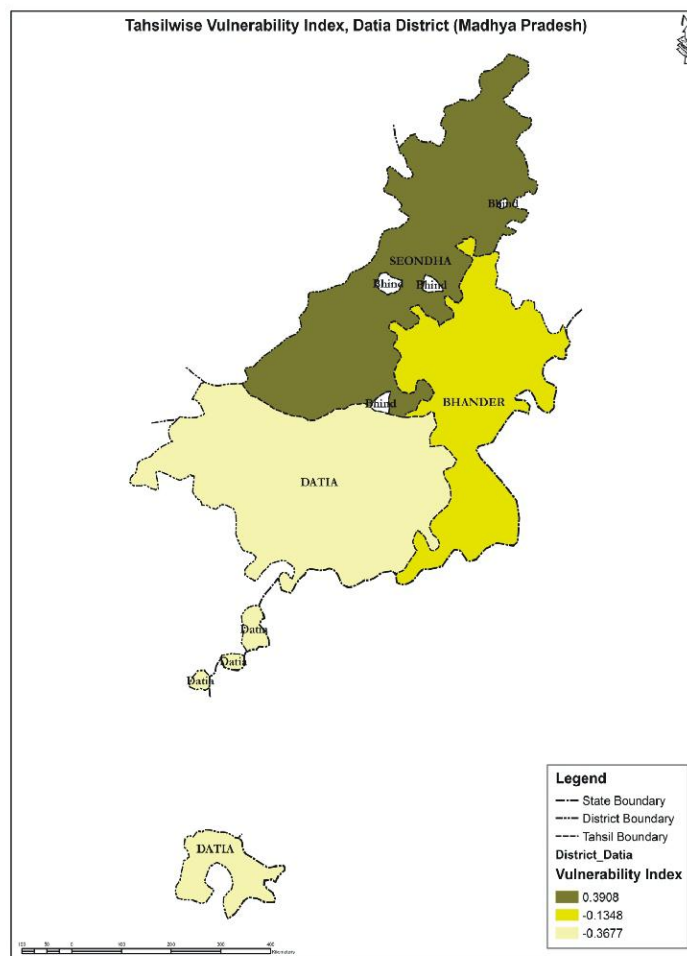


Figure 19: Datia District Vulnerability Map



### 3.3.3. Sagar District

Sagar district is located in the north- central part of the state of Madhya Pradesh and occupies an area of 10252 km<sup>2</sup>. The district is bound in the north by the state of Uttar Pradesh, in the north-east by Chhatarpur district, in the south-west by Raisen, in the south-east by Narsimhapur district, in the north-west by Guna district and in the east by Damoh district.

**Climate Profile:** There are six rain gauge stations in Sagar district<sup>35</sup>. A heavy amount of rainfall occurs along the south-western boundary of the district and decreases towards the north and tapers slightly towards the east. In the south-western part of the district, Rehli gets a marked amount of low rainfall mainly due to its location in the valley on the leeward side of the hill range. The normal annual rainfall of the district is 1234.8 mm. About 90% of the annual rainfall takes place during the south-west monsoon period i.e. June to September. Only 5.5% of annual rainfall takes place during the winters and about 4.5% of rainfall occurs during the summer months. The month-wise readings of rainfall at six stations show that maximum rainfall occurs during the month of July, followed by August. The climate of Sagar district can be classified mainly into three seasons. Winter season starts from the middle of November to end of February. March to May constitute the summer season and the monsoon season starts from the second week of June to end of September. During the winter season, January is the coldest month with temperature falling as low as 11.6° C and maximum going up to 24.5°C. During the month of May, the temperature shoots up to 40.7°C (maximum).

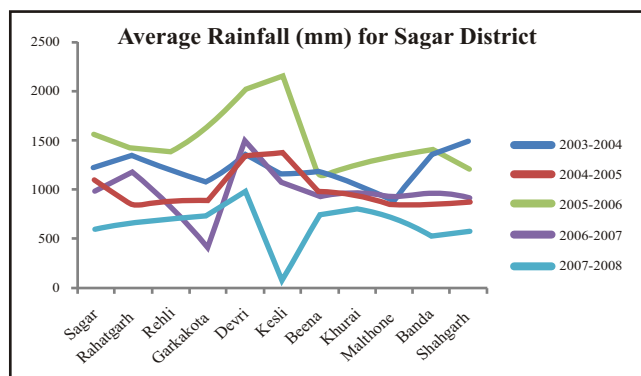


Figure 20: Average Rainfall (mm) for Sagar District

(Source: District Statistical Handbook, 2009)

35 District Groundwater Information Booklet, Sagar District, Central Groundwater Water Board, Ministry of Water Resources. 2009

**Demographics:** The population of Sagar district is 2,378,295 (1,254,251 male and 1,124,044 female population respectively) as per the 2011 Census and the district's population density is 232 persons per km<sup>2</sup>. In all, 70.77% of the population resides in rural areas, depicting the pressure on agriculture sector. The sex ratio is 896 females per thousand males is much less than the state ratio of 930 and the national figure of 940 respectively. The decadal population growth of the district is 17.6% which is lower than that of the state (20.3%) and almost equal to the national average of 17.64%.

**Literacy:** The total literacy rate for the district is 77.5%, which is above the state literacy rate of 70.63% as well as the national literacy rate of 74.04%. A considerably large percentage of people are literates in the district. This is a good indicator of human development in the region. Unfortunately, the difference between the education of women and men is still significant, with 67.7% female literacy and 86.3% male literacy in the district showing a gap of 18.6%.

**Agricultural Dependence:** In all, 26.6% of the total workers are cultivators and 25.8% are agricultural labourers, who will be worst affected by changing climate impacts on crop productivity; but, these figures are much lower than that of other districts, indicating that there are other livelihood sources prevalent in the region.

Wheat is the principal crop in the district, which is grown over an area of 1,637.78 km<sup>2</sup> with the other major crop gram, which is sown over an area of 2,015.87 km<sup>2</sup>. Other crops like linseed and *jowar* are also grown in the district. In fact, the district is predominantly a Rabi area<sup>36</sup>. Mixed cropping is resorted to as a measure of insurance against the vagaries of nature. Rabi is the main cropping season, though the proportion of Rabi to Kharif has been varying from time to time. Occasionally, *Kharif* crop exceeds the Rabi when wheat crop was badly affected by rust or frost or when bad season hampers *Rabi* sowing. When the climatic conditions normalize, the *Rabi* crops gradually restore their original position of prominence. Conversely, whenever there are heavy and continuous rains through July and August, which prevent the ploughs from functioning or *Kharif* crops decay (particularly in low-lying and water-logged areas), they are ploughed and diverted to *Rabi* sowings.

36 <http://sagar.nic.in/new/About/gen.html>

The climatic conditions thus largely determine the relative weightage given to Kharif and Rabi crops in a particular year. Cropping Intensity of the district is 150%. Chilli, *aonla* and mango are the key horticulture crops grown in the Sagar district, thus providing an alternate adaptation option to local communities and increasing their adaptive capacities.

**Ecosystem:** Of the total geographic area, 28.54 % is the forest area. The southern-most tip of the district is drained by the Narmada River. However, major part of the area falls in the Ganga basin. The drainage of the district is towards north and north east. The five rivers, from west to east, are the Bina, Dhasan, Bewas, Sonar and Bamner. Kopra and Bewas are tributaries of the Sonar. Sonar joins Bamner and then both rivers join the Ken River, which is a tributary of the Yamuna River.

**Irrigation:** Irrigation in the district is mainly from dug wells (11.69 km<sup>2</sup>), tube wells (398.52 km<sup>2</sup>), canals (48.25 km<sup>2</sup>), ponds (25.64 km<sup>2</sup>) and from other sources (724.35 km<sup>2</sup>). There are 52190 dug wells, 6558 tube wells, 34 tanks/ponds, 43 canals in the district. So, the net irrigated area is 2366.35 km<sup>2</sup>. There seems to be

huge dependence on groundwater for irrigational purposes.

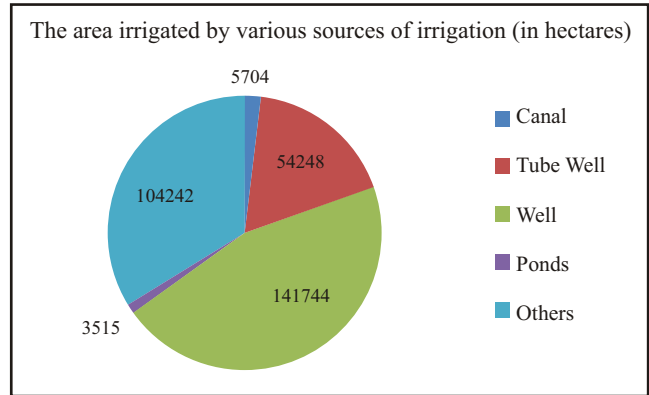


Figure 21: The area irrigated by various sources of irrigation (in hectares)

(Source: District Statistical Handbook, 2009)

In all, 89.1% of the total habitants have access to drinking water in the district. Groundwater is the main source of irrigation and drinking water in Sagar district. The net annual ground water availability in all the blocks of Sagar is 115.61 MCM.

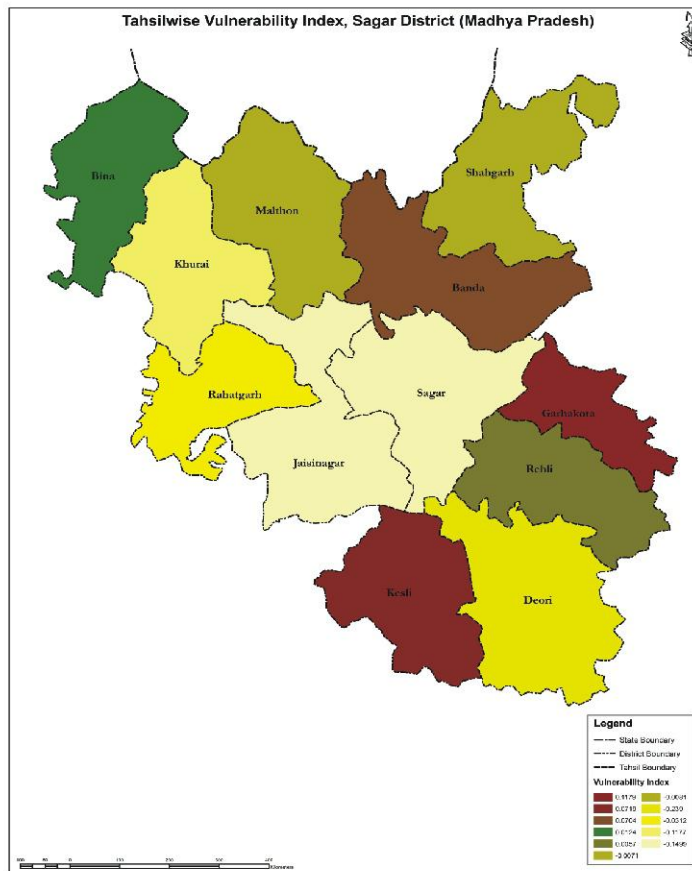


Figure 22: Sagar District Vulnerability Map

### 3.3.4. Tikamgarh District

Tikamgarh district encompasses an area of 5048 km<sup>2</sup>. The district is situated in the northern part of Madhya Pradesh. It is bounded in the north and west by Jhansi and Lalitpur districts of Uttar Pradesh respectively, in the east by the Chhatarpur district and separated by River Dhasan. The district has been divided into six blocks.

**Climate Profile:** Climate of Tikamgarh district<sup>37</sup> is characterized by a hot summer and general dryness, except during the south-west monsoon season. The entire year may be divided into four seasons. The cold season, December to February, is followed by the hot season from March to about the middle of June. The period from the middle of June to September is the south-west monsoon. October and November form the post-monsoon or transition period. The normal annual rainfall of Tikamgarh district is 1057.1 mm. Tikamgarh district receives the maximum rainfall during the south-west monsoon period, i.e. June to September. About 90.3% of the annual rainfall is received during the monsoon season. Only 9.7% of the annual rainfall takes place during the October-May period. Thus, surplus water for groundwater recharge is available only during the south-west monsoon period. The normal maximum temperature received during the month of May is 41.8°C and the minimum during the month of January is 7.0°C. The normal annual mean maximum and minimum temperatures of Tikamgarh district are 32.4°C and 17.5°C respectively. During the south-west monsoon season, the relative humidity generally exceeds 87% (August month). In the rest of the year it is drier. The driest part of the year is the summer season, when relative humidity is less 35%. May is the driest month of the year.

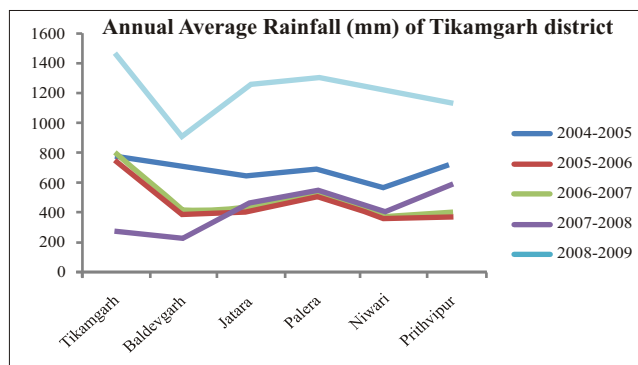


Figure 23: Annual Average Rainfall (mm) of Tikamgarh district  
(Source: District Statistical Handbook, 2010)

37 District Groundwater Information Booklet, Tikamgarh District, Central Groundwater Water Board, Ministry of Water Resources. 2009

**Demographics:** The population of Tikamgarh District is 14,44,000 (7,59,891 males and 6,85,029 females respectively) and as per the 2011 Census, the district population density is 286 persons per km<sup>2</sup>. In all, 82.3% of the population resides in rural areas, indicating huge dependence on the agriculture sector. The decadal population growth of the district is 20.1%, which is not very different from that of the state (having an average of 20.3%) but higher than the national average of 17.64%. The increasing rate of population and subsequent decline in the resource base adds to the susceptibility of the people to be affected by any untoward incident. Without any robust development scheme, Tikamgarh's burgeoning population will be increasingly at risk without sufficient capacity to cope with the impacts of climate change on agricultural productivity, water availability, health and other sectors. The sex ratio of 901 females per thousand males is quite less than the state ratio of 930 and the national figure of 940 respectively.

**Literacy:** The total literacy rate for the district is 62.6% which is below the state literacy rate of 70.63% as well as the national literacy rate of 74.04%. Gender disparities in literacy rates is yet another concern for the district, with significantly low female literacy rate of 50.7% in comparison to the male literacy rate of 73.3% and a gap of 22.6%.

**Ecosystem:** The entire district comes under Betwa sub-basin of Ganga basin. Dadhni, Janmi, Bargi, Ur and Dhasan are the major rivers draining in the district area which ultimately join in the north with Betwa River. Dhasan, Jamni and Sadhni are perennial rivers whereas Ur, Bargi, Gorar and Supihar are ephemeral rivers. The overall drainage pattern in the district is dendritic. Irrigation facilities in Tikamgarh are still at a developing stage. 67.63% of net sown area is irrigated and rest of the area is rain-fed. Surface water irrigation in the district is constituted to be 14.73%.

**Agricultural Dependence:** About 64.4% of the total workers are cultivators and 16.9% are agriculture labourers, who will be severely affected by the changing climate impacts on crop productivity. Tikamgarh is predominantly an agrarian economy, with agriculture being the prime source of livelihood in the district. The district has a proportionally high cultivable area, with nearly half the total geographical area cultivated at least once in a year. Along with wheat, pulses like *urad*, gram, *jowar*, and soyabean are grown in the black humus soils of the district. Livestock-



rearing is an additional source of income to communities in the district.

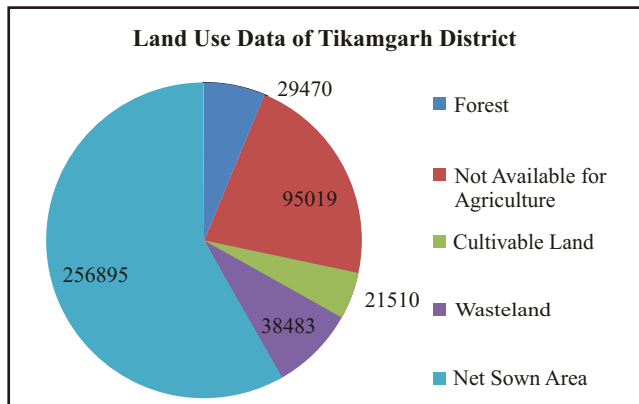


Figure 24: Land Use Data of Tikamgarh District  
(Source: District Statistical Handbook, 2010)

**Irrigation:** Total area irrigated by surface water and ground water is 240.11 km<sup>2</sup> and 1324.47 km<sup>2</sup> respectively. Groundwater is the main source of irrigation and constitutes 81.27% of the total agricultural land in the district. There are 1925

tube wells and 76,215 dug wells in the district for irrigation purposes. As the rainfall distribution and pattern changes with the changing climate, the groundwater resources are also under threat. Along with the geological conditions, climatic variables also impose grave threat to the resources. Decadal water trend analysis reveals a declining trend in the water level during pre and post monsoon seasons. It is essential that water management practices are adopted in the region to attain water security.

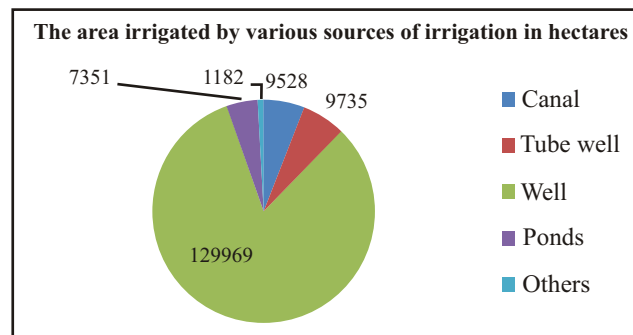


Figure 25: The area irrigated by various sources of irrigation in hectares.  
(Source: District Statistical Handbook, 2010)

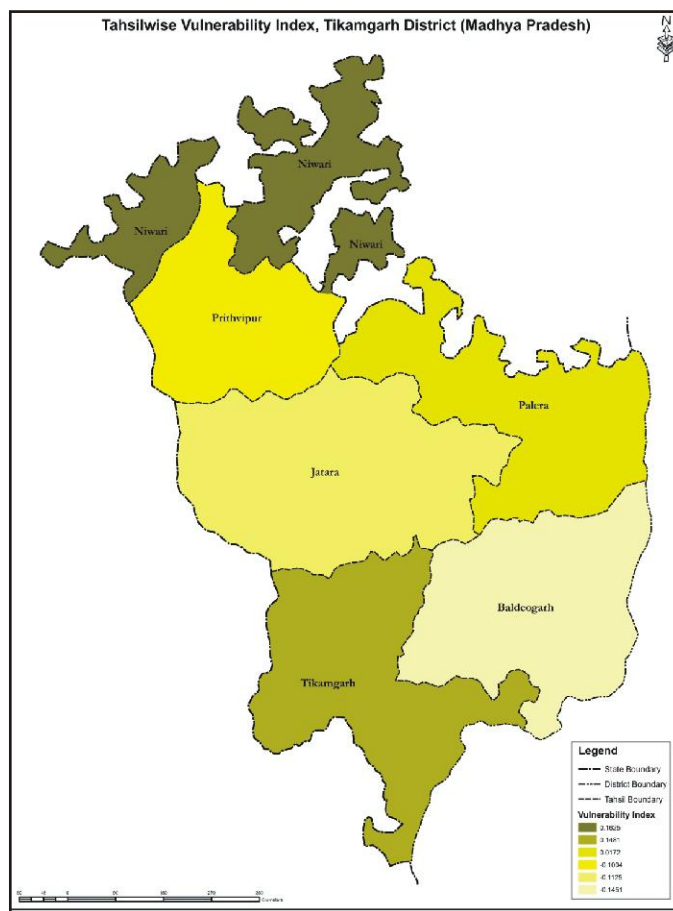


Figure 26: Tikamgarh District Vulnerability Map

### 3.3.5. Damoh District

The tropic of cancer passes through the southern part of district. Damoh is located in the revenue division of Sagar, among rising hills and flowing rivers, in the central part of Madhya Pradesh. The districts of Jabalpur, Panna, Chhatarpur, Tikamgarh, Sagar, Katni, and Narsingpur surround Damoh.

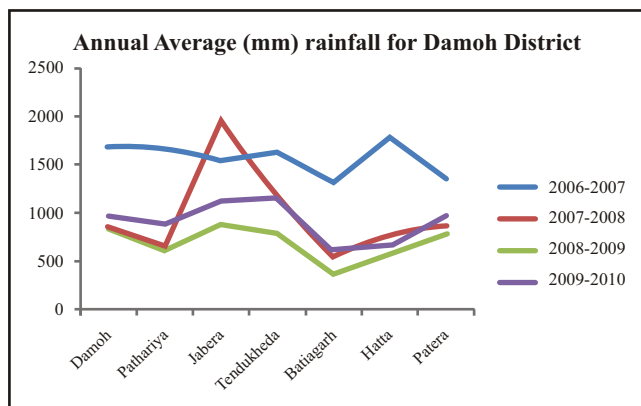


Figure 27: Annual Average (mm) rainfall for Damoh District  
(Source: District Statistical Handbook, 2010)

**Demographics:** The population of Damoh district as per the 2011 Census is 12,63,703 (660478 males and 603225 females respectively) with population density 173 persons per km<sup>2</sup>. 80.2% of population resides in rural areas which implies that the majority population is dependent on agriculture sector. In 2006 the Ministry of Panchayati Raj named Damoh one of the country's 250 most backward districts (out of a total of 640). It is one of the 24 districts in Madhya Pradesh currently receiving funds from the Backward Regions Grant Fund Programme (BRGF). The sex ratio is 913 females per thousand males is very less than the state ratio of 930 and the national figure of 940 respectively. The decadal population growth of the district is 16.6% which is lower than the state and national average of 20.3% and 17.64% respectively. The increasing rate of population and subsequent decline in the resource base adds to the susceptibility of the people to be affected by any untoward incident. Without any robust development scheme the increasing population will be increasingly at risk marked by insufficient capacity to cope with the impacts of climate change on agriculture productivity, water availability, health and other sectors.

**Literacy:** Total literacy rate for the district is 70.9% which is a little higher than the state literacy rate 70.63% and lesser than the national literacy rate

74.04%. The female literacy rate is 50.9% is way below male literacy rate is 80.5%. The literacy rate gap between males and females is 21.1%, which indicates the increased socio-economic and climatic vulnerabilities of women in this region.

**Agricultural Dependence:** In all, 28% of the total workers are cultivators and 29.7% are agriculture labourers who will be worst affected by changing climate impacts on crop productivity. Damoh district comprises of a primarily agrarian economy. A major segment of the working population is involved in agriculture. wheat, rice, *jowar*, maize and soyabean are the major crops sown in the district. Around 42.91% of the land is under cultivation, with 2% land area under cultivable waste land. Around 13% of the land is not available for cultivation and 2% constitutes follow land. The percentage area under cultivation is 42.91% and has witnessed a miniscule increase of 0.34% during the period 2005-09. There has been a significant increase in dual cropped land as it has increased from 28.17% in 2005-06 to 45.07% in 2008-09. Forest and logging activities in the district are also alternate sources of livelihood in the district. Additionally, export of beetle leaf and livestock rearing support the rural communities of Damoh. In the horticulture sector, Damoh district's rainfall and soil type are favourable for cultivation of mandarin, acid lime, *mosambi*, *aonla*, pomegranate, mango, *ber*, *chiku*, papaya, turmeric, chillies, coriander, *ajwain* and all seasonal vegetables. It also has a considerable cattle-market as well as several home grown small industries such as weaving, dyeing and pottery making<sup>38</sup> are also present in the district.

**Ecosystem:** Black cotton soil is also found in the Damoh plateau, which belongs to the Vindychal-Baghelkand region, and is part of a series of stepped plateaus girdled by massive hill ranges called Bharner and Kaimur. A part of this upland, traversed by a river called Sonar, is relatively level. Damoh town is located in this portion.

**Irrigation:** Underground water has an important role for irrigation in this district due to lack of perennial rivers. The percentage irrigated area of the land under cultivation is 37.58%, which increased by 1.69% during the period 2005-09<sup>39</sup>.

38 <http://www.madhyapradesh.co.in/damoh-district/>

39 <http://www.nsdindia.org/pdf/madhya-pradesh-sg.pdf>

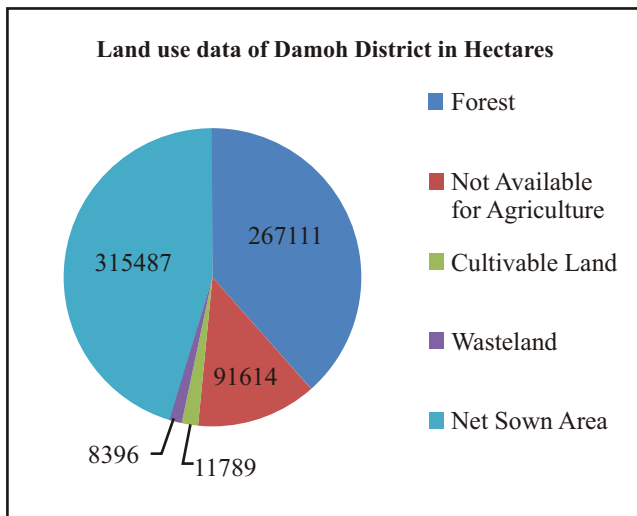


Figure 28: Land use data of Damoh District in Hectares  
(Source: District Statistical Handbook, 2010)

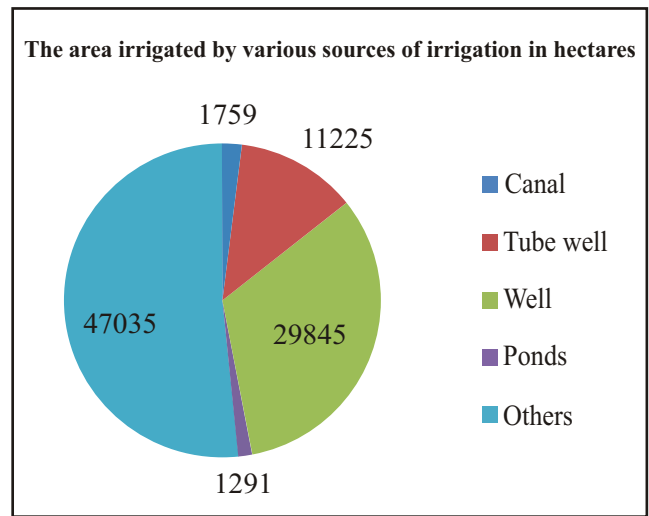


Figure 29: The area irrigated by various sources of irrigation in hectares.  
(Source: District Statistical Handbook, 2010)

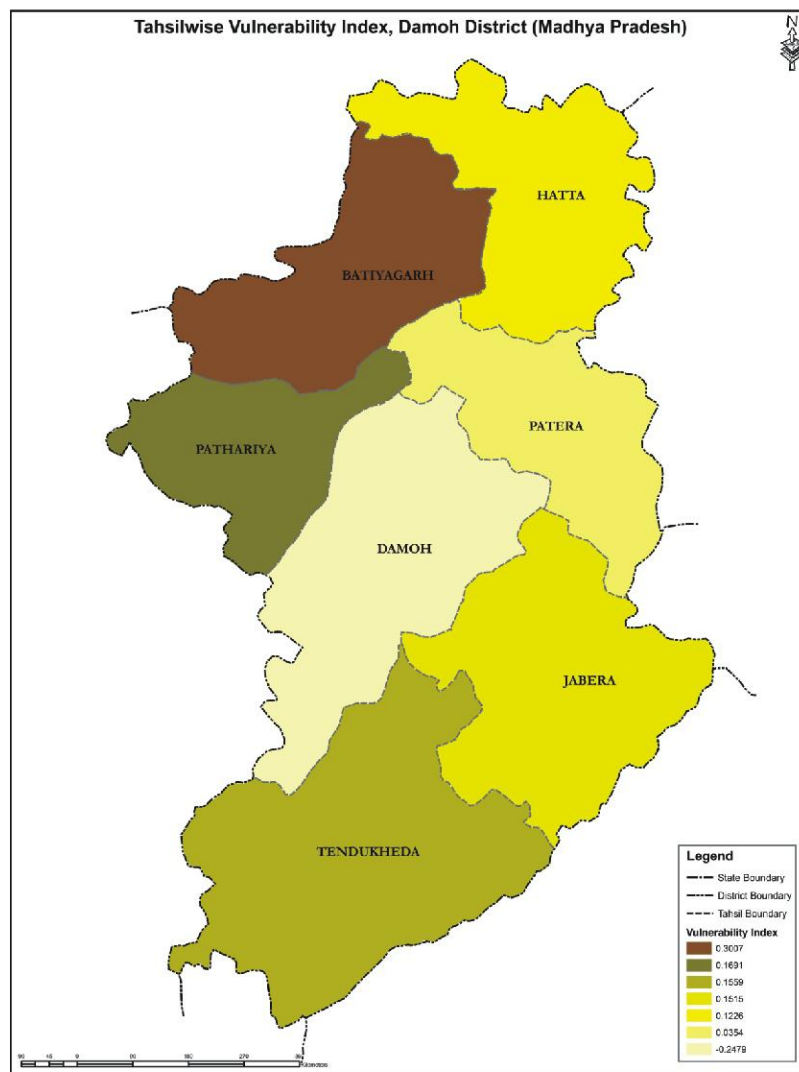


Figure 30: Damoh District Vulnerability Map



### 3.3.6. Panna District

Panna is situated in the Vindhyan Range and spreads over Panna and Chhatarpur districts in the northern part of Madhya Pradesh (M.P.) state of India. One of the most significant ecological aspects of the reserve is that Panna district makes the northern-most boundary of natural distribution of teak and the eastern limits of teak-kardhai mixed forests.

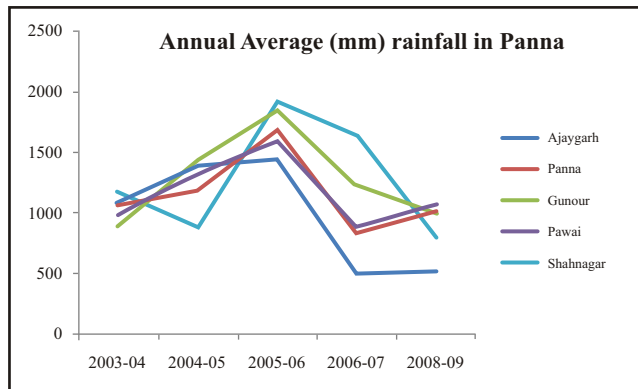


Figure 31: Annual Average (mm) rainfall in Panna

(Source: District Statistical Handbook, 2010)

**Demographics:** The population of Panna District is 10,16,028 (532866 male and 483162 female population respectively) as per the 2011 Census, with a population density of 142 persons per km<sup>2</sup>. In all, 87.7% of the population resides in the rural areas, which implies that majority population is dependent on agriculture sector. The sex ratio is 907 females per thousand males, which is quite less than the state ratio of 930 and the national figure of 940 respectively. The decadal population growth of the district is 18.6% which is lesser than the state and higher than the national average of 20.3% and 17.64% respectively. The increasing rate of population and subsequent decline in resource base adds to the susceptibility of people to be affected by any untoward incident. Without any robust development scheme, the increasing population will be increasingly at risk marked by insufficient capacity to cope with the impacts of climate change on agriculture productivity, water availability, health and other sectors. In 2006, Ministry of Panchayati Raj named Panna one of the country's 250 most backward districts (out of a total of 640). It is one of the 24 districts in Madhya Pradesh currently receiving funds from the Backward Regions Grant Fund Programme (BRGF).

**Literacy:** The total literacy rate for the district is 66.1% which is below the state literacy rate of 70.6% as well as the national literacy rate of 74.04%. The female literacy

rate of 55.55% is significantly less than the male literacy rate of 75.63%, with a gap of 20.1%. The low literacy rate implies to the lower percentage of people employed in the service sector, thus indirectly indicating the burden on agriculture sector for livelihood.

**Ecosystem:** The Ken River, which flows through the reserve from south to north, is home for long snouted crocodile (*garial*) and marsh crocodile (*maggar*) and other aquatic fauna. It is one of the sixteen perennial rivers of M.P. and is truly the life-line of the Panna Reserve. It offers some of the most spectacular sceneries, while it meanders for about 55 km. through the reserve. The terrain of the Reserve is characterised by extensive plateaus and gorges. The topography in Panna district part of the Reserve can broadly be divided into three distinct tablelands - the upper Talgaon Plateau, the middle Hinouta Plateau and the Ken valley, while there are series of undulating hills and plateaus on the other side of Ken River in the Chhatarpur district.

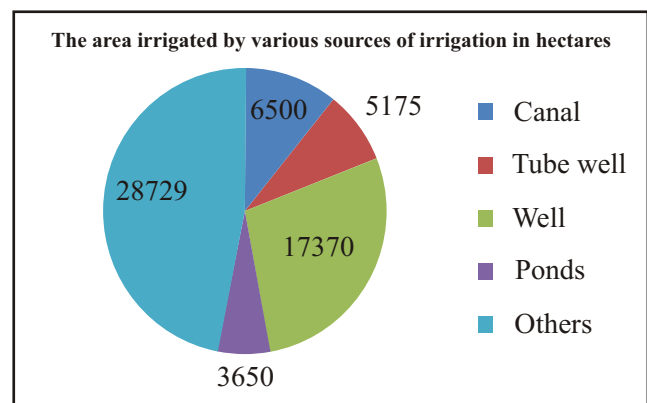


Figure 32: The area irrigated by various sources of irrigation in hectares

(Source: District Statistical Handbook, 2010)

The population has grown manifold in the surrounding areas, including towns like Panna, Amanganj, Bamitha, etc., bringing additional demand for cultivable land, grazing area, water and forest produce. Around 47.7% of the total workers are cultivators and 31.1% are agriculture labourers which will be worst affected by changing climate impacts on crop productivity. Unemployment is high and the level of education is low.

The main crops of Panna district are wheat and rice. There has been almost no change in the percentage of double-cropped land and has remained 17.9% during

the period 2008-2009. In the horticulture sector, Panna district's soil and rainfall is suitable for cultivation of fruit crops like *santra*, *mosambi*, acid lime, *aonla*, mango, *chiku* and *karonda* and also cultivation of vegetables like *Dioscoria* and *Colocasia*, and spices like ginger and turmeric. In the sericulture sector, Panna has mulberry plantations which are suitable for sericulture. Mulberry plantation is done under the silk project Raipura, spread over 140 hectares of land. Another important attraction of Panna is the Panna National Park. It is one of the major tiger reserves of the country. The national park has been a major tourist

attraction of the state and boasts of a very efficient management team. *Cheetal*, *Sambar*, *Nilgai*, *Chinkara*, *Chowsingha*, *Langoor*, *Wildboar*, *Jackal*, are some of the important animals found in the Panna National Park. These dynamic dry deciduous forests undergo a dramatic change - from lush green in monsoon to desolate dry grey in summer.

Ground water plays a vital role in irrigation in the district. The percentage of irrigated area of land under cultivation is 35.5%, whereas the percentage of the area under cultivation is 32.4%.

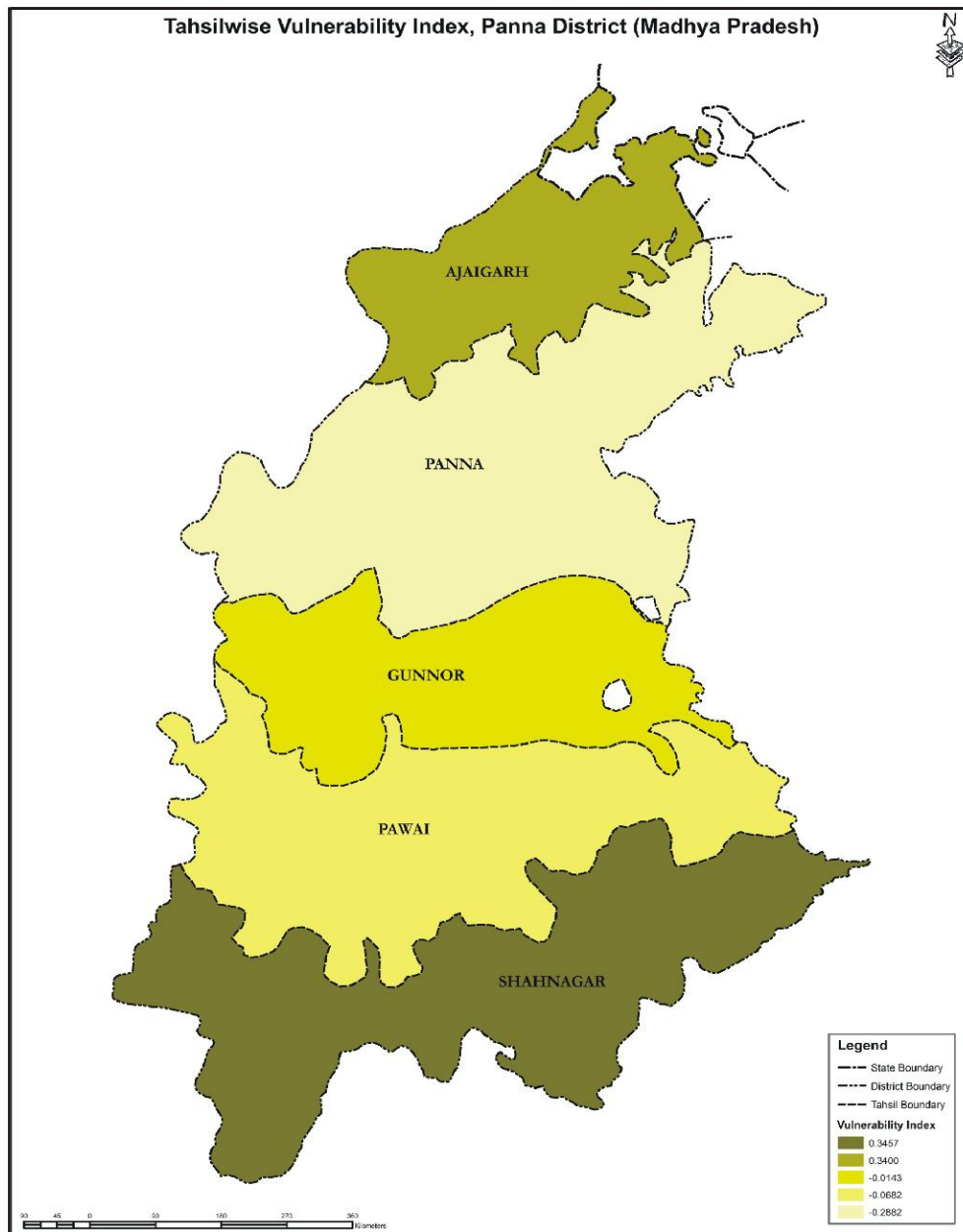


Figure 33: Panna District Vulnerability Map

## 4. Adaptation Measures for Bundelkhand

The long-term nature of climate change and significant impacts it can have on agricultural systems requires future agricultural development policy and practices to include both short-term and long-term planning that incorporates climate change knowledge and understanding in order to adequately respond to the reality of a changing climate process referred to as **climate change adaptation**.

In the context of global climate change, other authors have defined adaptation as "adjustments in ecological-socio-economic systems in response to actual or expected climatic stimuli, their effects or impacts"<sup>40</sup>.

The practical components of anticipatory climate change adaptation include improving information, strengthening institutions, and devising strategies for reducing the negative impacts on vulnerable population groups. This can be achieved by first understanding the impacts of various climate change scenarios and then choosing future development strategies that incorporate this understanding with due appreciation of social costs and benefits. In semi-arid regions, such as Bundelkhand, climate change adaptation measures need to address changes in hydro-meteorological trends, climate variability, and extreme weather events, in particular. Resilient development of vulnerable communities also requires embedding adaptation strategies within the existing national policy and institutional framework, enabling integration of climate change issues with other issues that drive the economic and social sectors. Involvement of multiple stakeholders is equally important in adapting to climate change as adaptation at one level can strengthen or weaken the adaptive capacity at another level. For this reason, it is essential to have national, sub-national and local level interactions.

In Bundelkhand, the growing population and parallel increase in demand for natural resources has left the region susceptible to any untoward calamity, even more so due to region's low adaptive capacity, which may only become worse in future if no appropriate measures

are taken. The current state of the farming community is alarming and any productivity decline will result in mass scale migration to urban areas in search of other potential opportunities. For the same reason, the social capital has depleted due to long term climatic stress particularly due to prevalent drought conditions in the region. The farmers have been unable to repay their loans to the lending institutions and have become defaulters for raising fresh crop loans.

There are several adaptation measures available in the short term and long term perspective which, if incorporated well for the present geography, can create significant change in the lives and livelihoods of the communities. Currently, there are many existing schemes, policies, and practices that have been formulated, implemented, and deployed to enhance the livelihoods of rural communities. These actions can be further retrofitted and efficiently implemented to serve the purpose of climate-resilient development. Some of these practices and policies are detailed below.

### 4.1 Assessment of Climate Change Adaptation in Bundelkhand

As a semi-arid agricultural region, one of the main challenges Bundelkhand faces (both historically and more-so under a changing environment) is maintaining and increasing agricultural productivity under varying degrees of water scarcity. For this reason, many of the adaptation practices currently being discussed, developed, or implemented in the Bundelkhand region relate to water resource management and/or agricultural improvements.

#### 4.1.1. Institutional Capacity Assessment

Madhya Pradesh at present is one of the most climate change conscious states in the country and its government is taking several measures to protect the communities of climate sensitive regions such as Bundelkhand. Efforts taking place under MP-SAPCC, Bundelkhand Package and National Initiative on Climate Resilient Agriculture (NICRA) are some attempts in this direction. However, gaps in the institutional mechanism have significantly negated these efforts. Currently, the government is making significant efforts for ensuring water and food security

40 Smit, B., Burton, I., Klein, R. J. T., & Wandel, J. (2000). An anatomy of adaptation to climate change and variability. *Climatic Change*, 45, 223251.



of the region through various schemes and policies, but evidence from primary consultations indicates that implementation at the ground level is limited. Given the level of vulnerability of blocks/districts of MP's Bundelkhand region, this chapter/section maps the capacity to address the vulnerabilities faced by the communities.

### **Agriculture Contingency Plan**

The agriculture departments of each district prepare a contingency plan to advise farmers on appropriate adaptation responses in the situation of a delayed or deficient monsoon. The plan advises the farmers on drought-resistant and short duration crop varieties, improved crop management techniques, and soil nutrient and moisture conservation measures that can help to mitigate potential impacts of different rainfall situations. However, responses received during primary consultations signalled that dissemination of this information to the grassroots farming communities is limited due to:

- Inadequate implementation of the policies
- Lack of institutional capacity and manpower
- Weak agricultural support delivery mechanisms
- Poor outreach to interior villages
- Limited number of information centres

### **Krishi Vigyan Kendra (KVK) Extension Services**

The KVKs have established several model villages to demonstrate improved agricultural and water management techniques. KVK also conducts exposure visits for farmers to villages in other states with similar agro-climatic zones, such as Maharashtra, for exchange of knowledge and experience. These focussed model demonstrations and exposure visits are a good platform for farmers to understand and adopt new and advantageous technologies. The primary consultations with line departments and other stakeholders suggest that such demonstrations and training visits need to be scaled up to larger masses to enhance the efficiency and adaptive capacity of small farmers. The underlining problem with this framework is that far-off villages are left unaware.

### **Outreach**

There were strong recommendations from stakeholders to strengthen the information flow from government

departments to villages. From ground level fieldwork, there is evidence that the dissemination of this information to the grassroots farming communities is limited for several different reasons. First, there are staff shortages in extension agencies. There are not enough Rural Agriculture Extension Officers (RAEOs), at grassroots level to meet the information needs of the entire region for which they are responsible. Each RAEO is in charge of providing extension services to around one to five villages, but these agents often do not adequately serve these villages because of lack of dedication and adequate skills. Focus group discussions revealed that for many farmers, their only option to receive beneficial information and scheme assistance is to travel directly to the appropriate extension agency. Unfortunately, the spatial distribution of the locations where farmers can access information directly such as KVK, ATMA, or Agricultural and Irrigation Department offices is widespread. Often, farmers find out that the cost in terms of time and money of travelling to these distant locations is not worth the perceived benefit that they will receive from their efforts.

Additionally, in order to receive assistance in many cases, farmers feel that they must navigate many administrative obstacles such as lengthy paperwork and procedures. This barrier, in addition to the long travel distances, further reduces farmers' interest in seeking these benefits. Further more, the group discussions with farmers revealed that toll-free agricultural help lines operated by the KVKs are largely unutilized due to general unawareness among farmers. The farmers also stated that information received from KVK's agricultural SMS service is often lacking in clarity or usefulness in its totality.

### **Weak Delivery Mechanisms**

Extensive fieldwork and consultations in Bundelkhand districts of MP reveal that scheme implementation and resource allocation at the local level is not efficiently distributed and that long-term planning, as is required to address climate change, is not present. This deficiency is driven by a variety of factors including lack of climate change related information and communication capacity at the district and community level, insufficient scheme and policy outreach, and top-down budget allocation processes that do not necessarily reflect the needs on the ground. Thus, even though currently, there is a framework in place to allow planning to occur in a decentralized manner where

information and plan formation flows from the ground level to the state level, the climate change perspective is still missing. Though this framework develops perspective district plans for five years it does not highlight climate adaptation.

### **Weakened Market Situation For Agricultural Produce**

Community farmers also stated that they face difficulties in selling their agriculture produce to *mandis* due to:

- Excessive competition
- Time consuming procedures
- Low transparency in the process
- Weakened market system for vegetables as in Chhatarpur
- Weak market linkages

In another initiative, the agricultural department is promoting low-input technologies such as vermi-composting and bio-fertilizers. The focus group discussions, however, indicated that majorly of large farmers were the primary beneficiaries of the agricultural department's outreach efforts due to higher levels of awareness and the financial ability to adopt such measures.

#### **4.1.2. Primary Evidence of On-the-Ground Practices**

From stakeholder consultations, there is evidence of many of the aforementioned agricultural and water resource management techniques currently being practiced in the project area.

- In Panna, the Irrigation Department reported the creation of 46 *nallas* as part of a gravity fed irrigation system that has increased irrigable land by 10,000 ha in 2012. Additionally, construction of the Lipri Dam has stored water that can be used for irrigation. The dam has allowed access to water even in the case of a late monsoon and has helped increase productivity on affected lands. The Irrigation Department also mentioned that fish production was becoming an alternative livelihood source in Banod village within the district, wherein some farmers were utilizing multi-cropping and inter-cropping techniques. Upon consultation, the Panna Agricultural Department stated that some farmers in the district were utilizing the ridge and furrow

method to cultivate soya bean. Additionally, the department described different forms of knowledge-sharing activities: bringing agricultural experts to different villages as well as taking farmers to other states to share and receive agricultural knowledge.

- In Chhatarpur, the Agricultural Department indicated the use of the ridge and furrow method for the cultivation of soya bean and broad bed and furrow methods for cultivation of wheat. There has also been knowledge-transfer under the Yantradoot scheme that provides trainings and demonstrations for farm mechanization. Darshana NGO operating in Chhatarpur stated that some farmers are utilizing multi-cropping techniques such as planting *urad* with *til*, and wheat with *chana*, and in some areas, farmers are planting three crops together (*urad*, *til*, and soya bean). The NGO also discussed several alternative livelihoods that are practiced by some groups in the area including creating handicrafts (such as bamboo baskets) as well as producing alcohol from local forest resources like *mahua*. Finally, an interview with the KVK in Chhatarpur indicated that drought resistant crop varieties are being grown and check dams and stop dams are being used for watershed management. The interview also provided evidences of additional knowledge and information transfer activities in the form of farmer's exchange programmes, KVK training events, and weather information disseminated via mobile phones in the model villages.
- Farmers have adopted new seed varieties, seeing practical examples on field. One issue raised by the officials was that the farmers are not ready to implement the new technology due to non- risk taking behaviour. Front Line Demonstrations are being taken up by KVK where before sowing seeds, training is given to the farmers by KVK.
- Another scheme, ATMA (Agricultural Technology Management Agency), gives free seeds to farmers. The seeds are first demonstrated on field and then if the outputs are worthy, these are then purchased by the farmers.
- In 2012, KVK provided sprinklers to farmers and also trained the farmers through training camps on the mulching technique in different

districts of Madhya Pradesh. KVK also encourages deep summer ploughing to be done once in three years.

- Another useful mechanism of information delivery was through toll free numbers wherein the farmers could call in to inquire. Also, weather information is delivered to around 1000 farmers through SMSs.
- In recent years, menthol-farming has increased in Chhatarpur, which is purely a market-driven activity. Earlier, it was done only in Mahoba belt but now it is done in Chhatarpur also. But now due to the increase in production, the rates of menthol oil have gone down. From Rs 3000/litre, the rates have come down to Rs 1300-1400/litre.
- A measure of adaptation taken by the farmers is mixed-cropping. In *Kharif* season, soybean, *til* and *urad* are grown and wheat and gram are grown in *Rabi*. The mixed-cropping pattern helps the farmers to cope as now the communities understand that they don't have to rely totally on one-crop type.
- In collaboration with the Government, several NGOs working in the region under Tejaswini project, are training communities on how to conduct wood work or carpentry. Earlier, this was done only by people of Badhai caste, but now other castes from different communities are breaking the social norms and taking up these activities.
- The farmers have received successful outcomes from the Crop Insurance Schemes. Moreover, in providing crop loans, the credit societies provide compulsory crop insurance to the farmers. Few farmers have witnessed advantage from crop insurance schemes in case of crop failure, giving them inevitable financial security. However the scheme is largely unpopular due to incomplete understanding and preconceptions. To some extent, schemes such as Kisan Credit Card have proved to be a boon for the framers in times of financial distress as it has widely offered loan amounts up to one lakh immediately to the farmers.

## 4.2 Suggestive Adaptation Measures

- *Enhancing Water use efficiency to improve efficiency and accessibility of*

**water:** In face of drought and continued water shortage due to the inherent semi-arid characteristics of the region, it is crucial that water management practices are incorporated rampantly throughout the region for water security. Agricultural systems which are less water-intensive and water harvesting techniques must be widely promoted in the region for enhanced water availability. Measures such as farm ponds are good options for the farmers for continued water availability.

### **Water Lifting System by Akhil Bharti Samaj Seva:**

In Tikamgarh, 40 families of *adivasis* ( or tribals) were unable to receive water from the nearby lake. Water from the lake went through channels to surrounding areas but it could not reach the land of *adivasis* which is around 70 acres in size and situated on an elevation. The CSO helped the community through traditional methods of serpentine pipe system (on the lines of contour irrigation) where water was pumped from the lake to the village area. Consequentially, the productivity of the land increased. And the *adivasi* community also saved water through usage of traditional water efficient methods. Besides, the community was also trained on adoption of mulching and alternate irrigation options which reduced the usage of water to 50%.

### **Garhkundar-Dabar Watershed Project:**

The National Research Centre for Agroforestry (NRCAF) developed and tested a water conservation model in the Garhkunda-Dabar, UP (55km from Jhansi) in an area that represents the typical geological, physiographical, and ecological conditions of the Bundelkhand region<sup>41</sup>. The project included the construction of check dams, gabions, drainage structures, water spreaders, and fielding bunding. Overall, the project created a water storage capacity of 24,103m<sup>3</sup> that is capable of reaching an area of 40,302m<sup>2</sup>. From these actions, the soil loss and runoff have decreased as compared to untreated areas; the water levels in 53.3% of regional wells have increased by at least two metres; and dry wells have declined from 86% of all the wells in 2006 to only two percent in 2009. Water is

41 <http://www.apnabundelkhand.com/successstories.html#agri>



now available year-round for irrigation, while previously it was only available for approximately four months per year.

- **Encourage multi-cropping and crop diversification to reduce risk:** Diversification of crop types in the field decreases the crop loss chances in case of weather variability as few out of the multiple crops sown may resist the change, hence reduce the risk.



*Sustainable agricultural practices to promote climate resilient development in the region*

In addition to the utilization of various water resource management techniques, the Garhkunda-Dabar Watershed project included other practices such as using improved seed varieties, agro-forestry, alternative livelihood development, and **knowledge-sharing**. With combination of improved seeds and increased water availability, cropping intensity increased to 116% in the project area compared to 96% in untreated areas and wheat and groundnut yield increased from 1180 to 1320 kg/ha to 2424 to 2845 kg/ha in the treated area. Five farmers adopted the agro-forestry techniques by cultivating *aonla*, guava, and citrus in a four hectare area and about 6000 tree saplings were planted along the irrigation *nallah* in addition to various agro-forestry awareness and visit programmes. Various livelihood development activities helped farmers learn about gum and resin tree cultivation, fish farming in check dams, and goat rearing.

**System of Rice Intensification (SRI):** In drought-affected areas of India, mainly in

Bundelkhand region, People's Science Institute is up-scaling SRI in four districts Damoh, Panna, Chitrakoot and Banda. Great success has been achieved in Damoh and Panna districts of Bundelkhand region. During the 2011 *Kharif* season, 1200 farmers practiced SRI in the Tendukheda block of Damoh district. The average increase in income per farmer was measured at Rs 18,000. The maximum yield that has been achieved by SRI in the Damoh District is 17 tonnes per hectare, while on the other hand an average of 77% increase in paddy yield has been observed in Panna and Chitrakoot district area as compared to the traditional method. In Banda District, a 47% increase in yield has been achieved.

**Ashok Sansthan, NGO** also shared the adaptation story of Rice Intensification System on agricultural fields of villages in Banda district<sup>42</sup>. This practice was conducted with 100 farmers and as the result, the yield of farm produces increased up to twice from their past production. The process was based on organic farming. This was also experimented with wheat, *chana* and rice crops. To showcase the comparative result, an experiment was done on the same field. Chemical fertilizers and organic manure (cowdung, *gud* and coconut) were used in different sides of the field and showed contrasting results with doubling of the productivity in the latter case. Timely application of manure with local seeds requires lesser quantity of water. This practice was promoted among the farmers for scaling up. As a result, in Banda district, 64 Gram Panchayats implemented the intensification technique with other crops such as *arhar*, mushroom and tomatoes.

- **Groundwater recharging structures:** Groundwater is essential for maintaining the ecological balance of water resources. Measures should be taken to increase groundwater recharge to address the drinking water crisis. In regions of overexploitation of groundwater, water conservation practices such as drip irrigation or sprinkler irrigation should be used. This information is essential to study aquifers and sub-surface geological

42 Participating member of Bundelkhand Knowledge Platform

characteristics. It is this variability in geology which poses challenges for construction of water harvesting structures. Systematic understanding of precipitation received, infiltration, run-off, and recharge should be taken in consideration for developing groundwater recharge structure. Pump capacity regulation has to be kept in mind and the wells should be constructed at an appropriate distance from each other.

Currently, importance of groundwater as a resource is neglected. The development projects do not understand the geological conditions of complex topography of regions like Bundelkhand before constructing dams. In traditional practices the base flow was given importance, but today it is completely neglected. Therefore, situation analysis for construction of dams, wells and other such structures needs to be given importance. Therefore, the purpose of water harvesting structure should be crystal clear (water collecting structure/ recharging structure). If the level of water in a water recharge structure declines is indicative of a recharge structure.

- ***Provision for weather based crop insurance and fortification of the existing credit scheme linked with insurance:*** Weather indexed crop insurance will be better suited to the region as the current insurance is against loss of crops which is difficult and non-transparent. Also, the number of farmers who are able to avail the facility of insurance schemes is limited. Efforts are needed to bring a larger number of farmers within the ambit of insurance schemes. Kisan credit card scheme was found to have better acceptance among the farmers in the region. The scheme simultaneously insured the farmers against crop loss. Such similar insurance mechanism for the farmers in the region can benefit them in case of crop damage due to the weather variability.
- ***Strengthening knowledge sharing platform for better information dissemination for community empowerment:*** The backward regions have always suffered from lack of information, which has quite often termed them susceptible

to extreme events. It is important that knowledge sharing network of civil society organizations, government authorities and scientific community is strengthened for better communication to benefit the grassroots. Only with the validated and relevant information can the communities adapt to the change.

- ***Farmer's Adaptation Cluster:*** Farmers Adaptation Cluster is an initiative by Development Alternatives<sup>43</sup>. The initiative started with an initial limited sample of 100 small and marginal farmers in Bundelkhand to explore and adopt, on a pilot basis, measures that would increase adaptive capacity to drought conditions through the use of sustainable agriculture practices and efficient use of energy and water.



*A member of the Farmer's Adaptation Cluster showing the increase in his agricultural yields*

The project included different measures involving knowledge communication, water resource management, and agricultural adaptation practices. Under knowledge communication, agricultural training sessions were broadcasted to the region via radio; street plays with climate change information were conducted; wall messages and paintings were displayed; and, workshops regarding different practices were held. For water resources, flood irrigation was replaced with sprinkler-based irrigation, resulting in a 29% reduction in water use for irrigation. Finally, agricultural adaptation practices included the

43 Development Alternatives. (2011). *Farmers Adaptation Cluster*.

implementation of line and dry sowing, mixed cropping, agro-forestry, and utilization of improved seeds.

- **Enhancing the institutional capacities:** the region lacks robust institutional mechanisms for better deliverance of the existing policies and schemes due to which many farmers are devoid of the information on government initiatives. There is a clear gap in the connectivity between implementing agencies and the beneficiaries. The government officials mostly lack clear understanding of climate change and thus are unable to consider long term adaptive planning for the future.

### 4.3 Conclusion

**Some of the short and medium term (2-3 years) measures which may be suggested are:**

- Promotion of efficient irrigation, soil conservation methods and agro-forestry involving demonstration plots and exposure visits of farmers. Although single interventions have limited impacts; putting together



*Sustainable irrigation practices to promote climate resilient development in the region*

different available technical options coupled with institutional strengthening demonstrate significant impacts. Farmers are ready to adopt 'demonstrated beneficial practices' even if these are not formally validated by research / Government institutions.

- Extension of crop insurance to cover more farmers as the current penetration of the insurance scheme is not adequate.

- Establishment of “Farmers Adaptation Clubs/Clusters” to bring farmers together to respond to threats of climate change by connecting them to local markets.
- Enhancing the access to information of farmers by use of innovative platforms such as radio based Rural Reality Shows and mobile telephony. Access to knowledge and information and cooperative action will enable farmers to enhance productivity, reduce input costs and bring about a quick change in strategy when the monsoon variability threatens the *Kharif* sowing.
- As exchange of knowledge is critical to adaptation, there is a need to set up or strengthen the existing knowledge platforms.
- No cost options such as change in sowing dates have been shown to minimize losses or to actually increase the yields of agricultural crops. Such measures need to be tested at a pilot level for research purposes and then if found feasible, be scaled up.
- Increasing the number of information wherein the farmers can attain information about the weather, schemes, agricultural inputs and climate resilient adaptation options viable in Bundelkhand region.

**In the long run, there needs to be a systematic approach to the problem that may consist of:**

- Conducting research to identify the best approach to adapt agriculture to climate change by determining crop mix which would be most resilient to the impacts of climate change in different regions of the state.
- Establishment of a meteorological network in the state to provide customized local information and forecasting services to the farmers that will help in reducing the impacts of climate variability.
- Institutional capacity building will play a crucial role in climate change adaptation by providing appropriate direction and channelization of funds and efforts. Therefore, there is a need of a long term programme for capacity building on key aspects of climate change adaptation.



- The Government of MP needs to review its procurement policy to include/enhance quota for alternate crops such as sesame for preferential purchase in drought prone areas.

For decision makers, it has been observed that it is very important for them to understand the relevance of suggested adaptation options in case the predictions made by modelling exercises do not happen or happen at a magnitude which was lesser or more than that predicted. Below is a matrix which presents the various adaptation options and their relevance under different scenarios (in case the impacts of climate change are less than that predicted, impacts are as they were predicted and impacts are more than they were predicted to be).

Robustness of each of the adaptation options has been derived from a combination of expert views, consultations and direct on ground observations.

It is clear that the options are such that they do not result in allocation of resources into assets which become immobilized in event of climate change impacts not happening. That is these are options which in any case will be useful for the farming community.

Though, the departments have been identified it needs to be mentioned that the support of Civil Society Organizations, Research Institutions and Private Sector will be vital for large scale application of adaptation options.

Measures	Adaptation options	Climate change impacts less than predicted	Climate change impacts as predicted	Climate change impacts more than predicted	Action required	Relevant department
Short term measures	Efficient irrigation	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	Large scale application of technology in farmers' fields	Agriculture, Irrigation
	Crop insurance	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	Wider dissemination	Finance, Agriculture
	Establishment of "Farmers Adaptation Clubs/Clusters"	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	Mobilization of farming community	Agriculture
	Access to information	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	Conceptualize and plan for programs	Information Technology, Telecom, Information Broadcasting
	Knowledge exchange	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	Set up/support platforms	Information Technology, Telecom
Long term measures	Change in sowing dates	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	Pilot level tests	Agriculture
	Research and development for determining crop mix	✓ ✓ ✓	✓ ✓ ✓	✓	Plan and initiate field level experiments	Agriculture, Irrigation, Power
	Establish meteorological network	✓	✓ ✓ ✓	✓ ✓ ✓	Plan and implement network	Meteorology
	Institutional capacity building	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	Develop curriculum	Human Resources
	Procurement policies	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	Review existing policy	Planning

✓ ✓ ✓ = robust; ✓ ✓ = less robust; ✓ = not robust

# Annex: Policies & Programmes Related to Adaptation for Bundelkhand

While there is evidence of various practices being implemented in the Bundelkhand region that address climate adaptation issues, the region as a whole is still very susceptible to current and future climate change. There is a need for national, state, and district level policies that address these issues. Currently, the central government of India and the state government of Madhya Pradesh have both developed action plans that explicitly address climate change. In addition, there are many national and state level policies and schemes currently in place that address different aspects of climate-adaptive capacity without explicitly citing climate change adaptation as an objective. These policies may be retrofitted to help address climate change adaptation issues in a more comprehensive manner. A review of these policies is presented below.

## National Action Plan on Climate Change

Released in 2008, the pre-eminent national policy instrument is the National Action Plan on Climate Change (NAPCC) which outlines countrywide goals that increase climate adaptive capacity while maintaining the economic growth that allows for an ever-increasing standard of living within the country. Subsequently, the plan takes an approach that makes a directional shift in the development pathway<sup>44</sup>. NAPCC contains eight primary “National Missions” that address climate change mitigation and adaptation, including missions focusing on solar energy, energy efficiency, human habitats, water resources, forestry, agriculture, the Himalayan ecosystem, and climate change knowledge and information. In addition, it directs various states to develop and submit State Action Plans on Climate Change (SAPCC) that detail the region-specific policies and strategies to address climate change mitigation and adaptation.

## Madhya Pradesh State Action Plan on Climate Change

In accordance with the NAPCC, Government of Madhya Pradesh has released a draft SAPCC that incorporates regional climate change projections and vulnerability assessment that inform policy recommendations that address these imminent issues. The plan integrates climate change concerns in sectors

such as agriculture, horticulture, animal husbandry, fisheries, water resources, forests, biodiversity, rural development, energy, renewable energy, health, urban habitat and transport, industries, and environment.

Since vulnerability and adaptation have been underlined as the key concerns for Bundelkhand, the focus of MP's SAPCC is on devising appropriate adaptation strategies based on vulnerability assessment and subsequently integrating and mainstreaming them into respective policies and programmes. The efforts of MP SAPCC towards agriculture and allied areas are as follows:

### Water

The MP SAPCC lists six strategies to address climate change concerns within the state's water sector:

1. Development of a comprehensive water data base in a public domain and assessment of the impact of climate change on water resources of the state
2. Promote recharge of groundwater with special focus on over-exploited areas and promote soil and conservation to avoid soil runoff, soil degradation, and enhanced water conservation
3. Improve supply and demand management for efficient and judicious use and need- based distribution
4. Promote basin level integrated watershed management
5. Promote additional research
6. Promote capacity building

*These strategies broadly address the key issues of increasing water scarcity under climate change through three primary methods:* increased information gathering and analysis (water database, additional research), increased water resources (groundwater recharging, supply / demand management, integrated watershed management), and training (capacity building). The proposed policies mirror some of the practices currently being implemented in isolated areas of Bundelkhand, but they also introduce new measures such as establishment of a water database.

44 Government of India. (2008). National Action Plan on Climate Change. Retrieved from <http://pmindia.nic.in/Pg01-52.pdf>

## Agriculture

The MP SAPCC lists the following eight strategies to address climate change concerns within the state's agricultural sector:

1. Promoting Soil and Water Conservation technologies
2. Planning cropping systems suitable for each agro-climatic zone
3. Management of risks for sustainable productivity
4. Enhancing dissemination of new and appropriate technologies developed by researchers and strengthening research
5. Agriculture Information management
6. Additional impetus to mechanization and accessibility to markets
7. Creation of Rural Business hubs
8. Capacity building for sustainable agriculture

The report contains brief elaborations under each strategy that reveal many similarities between the proposed strategies and some of the practices currently observed on-the-ground in isolated areas. Under the first strategy, promotion of soil and water conservation technologies, the plan includes the implementation of SRI, raised bed cultivation, and drip irrigation. The second and third strategies list intercropping, multi-cropping, livestock rearing, horticulture, and agro-forestry as appropriate practices to pursue. Other policies and practices enumerated in the remaining strategies include increasing knowledge-sharing through enhanced agricultural information management and increasing sustainable livelihood opportunities through rural business hubs.

The MP-SAPCC has a dedicated section for horticulture that lists six strategies to address climate change concerns within the sector:

1. Promotion of soil and water conservation technologies and plant protection technologies for improving productivity
2. Development of Agro-horticulture systems for securing livelihoods
3. Developing horticulture policies to plant production centres according to agro-climatic conditions
4. Creating business hubs
5. Adequate research and extension support
6. Creating cooperatives for enhancing the livelihoods of small and marginal farmers

While the strategies suggested for horticulture sector mirror the strategies for agricultural sector, inclusion of a separate section dedicated to horticulture signifies the importance the plan places on horticulture in MP's overall climate change adaptation plan.

## Existing National and State Level Schemes in Madhya Pradesh

In practice, policies that address climate vulnerability and those that address agriculture and rural development often have overlapping goals and mechanisms. With this in mind, there are many policies emanating from both the central and state governments that do not explicitly address climate change vulnerability but may be contributing to enhancement of the adaptive capacity within the MP Bundelkhand region. Following is a brief review of national and state policies that address various issues related to climate vulnerability.

## Agriculture

### Madhya Pradesh Agriculture Cabinet

Realizing that improving the agricultural economy of the state is a way forward in terms of reducing rural poverty, Madhya Pradesh Government aims to maximise agricultural production and productivity and make it a profitable proposition for the farmers through the creation of an "Agriculture Cabinet" in 2011. The objective of Agriculture Cabinet is to steer an integrated agricultural development agenda in the state, leading to rapid growth and enhanced food security. The key decisions of MP Agriculture Cabinet are as follows:

- 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 seeds certified by the government and ensure availability of quality seeds
- Promote indigenous hardy crops like kodokutki, ram til, ragi and alsin 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.

The main goal of the Agriculture Cabinet, reduction in rural poverty, directly addresses climate-adaptive capacity issues. Through increasing income and reducing poverty, communities and individuals will have more resources at their disposal to adapt to the impacts of climate change.

### **MP Organic Farming Policy, 2011**

The Organic Farming Policy has also been drafted with a vision to provide sustainable livelihoods, conserve natural resources, and provide employment to the villagers. Reasons favouring organic farming in MP include animal husbandry since mechanization is not very popular as yet in MP. In fact, animal husbandry is among one of the major livelihood activities for which large quantities of agricultural waste is available, which can be used as organic manure. Regional, local, and indigenous knowledge is also available and could be easily tapped to attain the vision of creating sustainable livelihoods utilizing local material, local skills and local manpower.

### **Rashtriya Krishi Vikas Yojana (RKVY)**

Launched in 2007, RKVY provides 'additional central assistance' to Central Government and State Government schemes related to agriculture. Its mission is to incentivise States to draw up plans for their agriculture sector more comprehensively, taking agro-climatic conditions, natural resource issues and technology into account, and integrating livestock, poultry and fisheries. Among the projects funded by RKVY is region-specific agriculture research and preparation of district agriculture plans, taking into account the local needs and conditions. Comprehensive agricultural plans that include region-specific research and take into account the local needs and conditions can help reduce climate change vulnerability. Since climate change vulnerability is a function of climate change exposure, sensitivity, and adaptive capacity, it will be vital to develop plans that take this into account. Exposure, sensitivity, and adaptive capacity can vary significantly from location to location, necessitating location-specific climate change vulnerability responses that account for these differences.

### **National Agriculture Insurance Scheme (NAIS)**

Under the NAIS, farmers can get their crops insured in case of crop damage due to any of the enlisted reasons. The objectives of the NAIS/RKBY include:

- Providing insurance coverage and financial support to the farmers in the event of failure of any of the notified crops as a result of natural calamities, pests and diseases.
- Encouraging the farmers to adopt progressive farming practices, high value in-puts and higher technology in Agriculture.
- Assisting in stabilizing farm incomes, particularly in disaster years.
- Under the scheme, small and marginal farmers are given subsidy on the insurance premium. In all, 423,000 farmers have been given a total of 2550 million rupees under the scheme. The impacts of climate change may culminate in crop failure. Therefore, supporting the income of farmers, especially small and marginal farmers, through insurance schemes can be a significant tool to increase the adaptive capacity.

### **Annapurna Yojana**

This provides financial assistance to SC/ST farmers for quality seeds. Crops covered in the scheme are *Jowar*, *Paddy*, *Bajra*, *Maize*, *Ragi*.

### **Sooraj-Dhara Yojna**

Sponsored by the State Government, *Sooraj-Dhara Yojana* is aimed at improving financial conditions of SC and ST farmers through profitable seeds.

### **Gramin Bhandaran Yojana**

*Gramin Bhandaran Yojana* is a Central Government scheme aided by National Bank for Agricultural and Rural Development, National Cooperative Development Corporation and additional cooperative banks and cooperative societies. The main objectives of the scheme include creation of scientific storage capacity with allied facilities in rural areas to meet the requirements of farmers for storing farm produce, processed farm produce and agricultural inputs. It also promotes grading, standardization and quality control of agricultural produce to improve their marketability.

The ability of farmers to store farm produce allows them more flexibility in terms of selling their produce in the market. Instead of being forced to sell directly

after the harvest, when prices could be low, farmers with access to storage can wait until market prices are higher, thus increasing their income. Increased, income can give individuals and communities more resources and options for adapting to the impacts of climate change.

### **Jersey Calf Rearing Scheme**

The objective of this scheme is to improve the economic status of small /marginal farmers and agricultural labourers by enhancing the attributes of Jersey cross-breed calves. The aims of this scheme are improvement of breeds and increase in milk production. In this scheme, small /marginal farmers and agricultural labourers are given a balanced feed for female Jersey cross-Bred calves on loan/ subsidy basis to rear them from the age of 4 month to 32 months.

### **Micro-management of Agriculture**

Micro-management of Agriculture is a centre/state scheme with an objective to increase the production/productivity through promotion of agricultural equipment.

### **Rashtriya Jalgrahan Kshetra Vikas Karykram**

*Rashtriya Jalgrahan Kshetra Vikas Karykram* aims at the protection, management, development and utilization of natural resources, with the focus on increasing the production and productivity of agricultural crops, utilizing appropriate technology. It also provides employment opportunities for the rural society, especially the landless farmers and labour.

### **Special Livestock Breeding Programme (SLBP)**

It is a State Government sponsored scheme. The objective of the Scheme is to provide financial assistance to all types of farmers for the improvement of cross-breed cattle and milk production.

## **Water Resources**

### **Bundelkhand Package**

The Bundelkhand Relief Package is primarily targeted at drought mitigation in Bundelkhand and is being implemented in seven districts of Uttar Pradesh and six districts of Madhya Pradesh states. The major agenda covered under this package comprises optimization of water bodies through rainwater harvesting and proper utilization of river systems, canals and other territorial

water bodies. The package is diversified and covers various sectors within agriculture such as watershed management, animal husbandry, fisheries, horticulture etc. Convergence of various flagship schemes like MGNREGA, IWMP, NAP, RKVY and BRGF are effectively being achieved in implementation of the package. Thus, the package has great potential for mitigating the impacts of climate change on agriculture, water and other natural resources of the region.

### **Integrated Watershed Management Programme (IWMP)**

IWMP provides a good platform for conservation and management of water resources and drought- proofing the semi-arid region of Bundelkhand against the cascading effects of adverse climatic conditions. This programme integrates the Drought Prone Areas Programme (DPAP), Desert Development Programme (DDP) and Integrated Wastelands Development Programme (IWDP) of the Department of Land Resources with key objectives of drought risk mitigation, augmentation of land productivity and harness the water storage potential of the region. Integrated Wastelands Development Programme (IWDP) focuses on restoration of cultivable wastelands through afforestation of degraded forests and non-forest wasteland. The Drought Prone Areas Programme (DPAP) identifies drought-prone blocks and functions to minimize the adverse effects of drought on production of crops, livestock, and the productivity of land, water, and human resources through development of watersheds, percolation tanks, check dams and other measures. It works towards enhancing the adaptive capacity of the communities by introducing soil and moisture conservation measures, promoting agro-forestry and horticulture, superior drainage structures and rainwater harvesting. The Desert Development Programme (DDP) has been conceived as a long-term measure for combating desertification and restoring ecological balance by conserving, developing and harnessing land, water, livestock and human resources. It seeks to promote the economic development of the village community and strengthen the disadvantaged sections of society in the rural areas.

### **National Watershed Development Project for Rain fed Areas (NWDPR)**

The NWDPR was launched in 1990-91 for the benefit of blocks where the area under assured means of irrigation was less than 30% of the total cultivable area.

NWDPRA's main guiding principles are: conservation of natural resources, integrated development of natural as well as social resources, in-situ moisture conservation, sustainable farming systems, adoption of ridge to valley approach, production- enhancement activities for land owners and livelihood support for landless families. The programme lays stress on democratic decentralization in decision-making, transparency in transactions, and mobilization of community at the village level. Watershed development is to be first planned theoretically and then implemented, monitored, and maintained by the communities.

Rain-fed agricultural areas are particularly vulnerable to rainfall variability. With increasing rainfall variability under climate change, priority attention to conserving water resources, adopting climate resilient agricultural techniques, and providing livelihood support will need to be provided to these agricultural areas, which is the prime objective of NWDPRA.

### **Artificial Recharge of Groundwater Through Dug Wells (ARGTDW)**

The ARGTDW supports recharging groundwater resources by collecting rain water and diverting it to the existing dry or almost dry open wells. Recharge pits with de-silting chambers are constructed near the open well; de-silted water is then led from the pits to the bottom of a well via a PVC pipe. The Central government provides a 100% subsidy for construction of these structures to small and marginal farmers who have lands in 'over-exploited', 'critical' and 'semi-critical' blocks; the last category of blocks are found in Tikamgarh, Chhatarpur and Datia districts. The subsidy is provided through NABARD.

The artificial recharge of groundwater is one strategy to increase the agricultural adaptive capacity to climate change. In areas currently practicing rain-fed agriculture, increasing groundwater resources through artificial recharge will allow farmers to adapt more easily to droughts due to the availability of more water sources. Additionally, the artificial recharge of groundwater may allow for additional land to be cultivated using groundwater irrigation systems. The overall increase in production can help cushion the impacts of climate change through the resulting increase in food production and/or income generation.

### **Bhoojal Samwardhan Yojna**

The *BhooJal Samwardhan Yojna* is a combined central-state government initiative, focusing on controlling groundwater levels by developing percolation tanks in the surrounding areas of wells/tube wells of farmers to stop the uncontrolled wastage from extra-flowing water from the wells. Increasing groundwater recharge and reducing water wastage through the use of percolation tanks around existing wells can help farmers more efficiently use their water resources. With increasing rainfall variability under climate change, the efficient use of water resources will be an important adaptation strategy.

### **Jal Abhishek Abhiyan**

The *Jal Abhishek Abhiyan* scheme falls under the Department of Panchayat and Rural Development. It is a campaign, launched by State Government to take up water conservation activities such as rainwater harvesting, recharging groundwater aquifers, on priority basis. Such activities are being implemented through various government-sponsored schemes. The community is also mobilized through a participatory model for their possible contribution and to take up water conservation activities with their own resources. The planning and implementation of the programme is done in coordination with other line departments like Agriculture Department, PHE Department, Water Resources Department etc.

### **Balram Tal Yojana**

The objective of *Balram Tal Yojana* is to conserve rainwater in the field for irrigation; every beneficiary is given 25 per cent subsidy for digging ponds under this Yojana. Balram Talabs are larger water tanks, which can irrigate up to 50 hectare area. So far 7,158 Balram Tal reservoirs have been constructed.

### **Khet-Talab Yojana**

The objective of this scheme is to make surface and ground water available for all around agricultural development. Fifty per cent subsidy is given to all categories of farmers under the scheme. The ponds dug in farmers' fields have proved quite successful in stopping and conserving rainwater, which was wasted earlier. One tank under the scheme irrigates quite a considerable area. So far, one Lakh ponds have been dug under *Khet-Talab Yojana*.



## Kapildhara Yojana

Under the *Kapildhara Yojana scheme*, irrigation facilities are provided to the beneficiary families including digging of new wells, ponds in fields through water recharging, check-dam, stop-dam, RMS and digging of small ponds. The beneficiaries of the scheme are those farmers on whose lands there is no irrigation facility. So far, 34,366 agricultural pumps have been made available under the scheme and 360,080 wells have been sanctioned, out of which the construction of 166,416 wells has been completed while the work for the rest is underway.

Under the *Kapildhara Yojana scheme*, irrigation facilities are provided to the beneficiary families including digging of new wells, ponds in fields through water recharging, check-dams, stop-dams, RMS and digging of small ponds. The beneficiaries of the scheme are those farmers on whose lands there is no irrigation facility. Feedback after consultations with village communities suggests that *Kapildhara Yojana* has been successfully implemented in the region and has widely benefitted the farmers. Various wells have been constructed in a large number of villages under MNREGA and have reduced the burden of water availability to the farmers. But due to the diminishing ground water levels, these wells have low water levels in the peak summer months. Thus, there is a need for the government to focus on ground water recharge, aquifer mapping, water budgeting and water auditing too in order to initiate water conservation measures in the region.

## Ponds Construction Scheme for Irrigation

Ponds Construction Scheme for Irrigation is a State Government sponsored scheme for developing farm ponds.

## Rajiv Gandhi Mission For Watershed Management

This is a broader mission catering to the following sub-campaigns:

- *Jal Abhishek Campaign* - Under the Jal Abhishek campaign, rural masses are motivated to take up soil, moisture and water harvesting activities in their private land.
- *River Revival* - River Revival works on water harvesting and revival of traditional rivers through community based approach.

- *Bhagirath Krishak* - Under this campaign, framers are motivated to take up water harvesting activities in their own land with their own resources.
- *Rewa Sagar* - It emphasizes on the harvesting of rain water through construction of appropriate cost effective and locally managed structures.

## National Rural Employment Guarantee Scheme (NREGS)

It is the largest source of development funds for backward regions. As a 'demand-driven' scheme, NREGS theoretically has no funding limit. While activities to be primarily undertaken under the scheme, like soil and water conservation and tree plantation, are priority needs in rain-fed and backward areas. NREGS has a good scope for 'convergence' with related central government schemes like watershed programmes, and state government schemes. Convergence can increase the benefit of works and assets generated through NREGS and provide opportunities even for unrelated programmes. For example, a pond created under the scheme can be tied to a fisheries development programme.

## District Poverty Initiative Programme (DPIP)

DPIP is a programme of the MP government, run with a loan from the World Bank, that provides funds to groups of poor people, especially women, in around 3000 villages in 14 northern districts of the state. The groups have to be organised under common interests and problems, and funds are available for a wide range of activities aimed at increasing income opportunities, by supplementing local infrastructure and resources. In Bundelkhand, the programme is limited to 138 villages within two blocks of Damoh district (Patera, Tendukheda), 124 villages within three blocks of Sagar (Kesli, Deori, Jaisinagar), 267 villages within five blocks of Chhatarpur (Nowgaon, Bijawar, Rajnagar, Bakswaha, Badamalhera) and 291 villages within four blocks of Panna (Pawai, Shahnagar, Ajaygarh, Panna).

The overall goal of DPIP to increase income opportunities for the rural poor, can contribute to increasing climate adaptive capacity within the target areas by potentially creating livelihoods that are less sensitive to climate change than agriculture.

45 <http://www.scribd.com/doc/73664372/Overcoming-Poverty-and-Hunger-in-Bundelkhand#download>

Additionally, by helping create more sustainable livelihoods, the DPIP may help increase the overall income in its project areas, thereby giving individuals and communities more resources that could be utilized to adapt to a changing climate.

### **The Antyodaya Anna Yojana**

It is aimed to provide affordable food to the below poverty level (BPL) households. AAY contemplates identification of ten million poorest of the poor families from amongst the number of BPL families covered under TPDS within the States and providing them food grains at a highly subsidized rate of two rupees per kg for wheat and three rupees per kg for rice. About 600,000 people in Bundelkhand were issued BPL & Antyodaya cards<sup>47</sup>.

### **NABARD Micro Credit Initiatives**

NABARD is giving grant support to NGOs, farmers clubs and individuals for training and capacity building relating to implementation of Micro-Credit schemes. To the Micro Finance Institutions (MFI), it is giving credit support. Expenditure incurred by the MFIs for

obtaining ratings is also being reimbursed. For the districts that did not benefit from Operation Flood a rural development programme to benefit dairy farmers, a Venture Capital Fund has been set-up. Dairy Venture Capital Fund has been changed from interest free loan to capital subsidy and a revised scheme Dairy Entrepreneurship Development Scheme (DEDS) has come into effect from 1 September, 2010. Under DEDS, 25% (33.33% for SC/ST) capital subsidy of the total outlay is provided. Farmers, individual entrepreneurs, NGOs, companies, groups of unorganised and organised sector etc are eligible for this scheme.

**In Tikamgarh district, 107 villages have been identified by the NABARD for implementing Micro-Credit schemes. Scheduled Caste areas have been prioritised.** The aim is to upgrade the quality of the breed of livestock. In the discussion, it was pointed out that at some places interest rate on Micro Credit is as high as 24-36 percent annually. Hence, monitoring and regulation of Micro Credit rate of interest is highlighted as an important issue.







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