DISTRICT CLIMATE RESILIENCE PLAN

BARWANI DISTRICT

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South Asia

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District Climate Resilience Plan: Barwani District

July, 2022

An initiative of EFICOR and CAN South Asia
in co-operation with
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Government of Madhya Pradesh

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Foreword Message from CANSA & EFICOR

India accounts for about 17 per cent of the world's population but only 4 per cent of the world's fresh water resources. Distribution of these water resources across the vast expanse of the country is also uneven. Therefore, as incomes rise and the need for water rises, the pressure for efficient use of highly scarce water resources will rise manifold. As per the international norms, a country is classified as Water Stressed and Water Scarce if per capita water availability goes below 1700 m3 and 1000 m3, respectively. With 1544 m3 per capita water availability, India is already a water-stressed country and moving towards becoming water scarce. While the stress on limited water resources in the country is rising, the scarcity is not reflected in the use of water. India uses 2-4 times water to produce one unit of major food crops as compared to other major agricultural countries like China, Brazil, USA (Hoekstra and Chapagain 2008). These variations imply that if India attains water use efficiency of those countries it can save at least half of the water presently used for irrigation purposes.

Climate change brings new uncertainties, adds new risks, exacerbates existing ones and increases vulnerabilities. The most effective way to adapt to climate change is to enhance adaptive capacity of people's life and livelihood by building resilient sectors on which they depend on. In the evolving context of climate impacts at local level, the policies governing climate action need to be grounded, pertinent to people's need and wants while holding on to sustainable management of natural resources and ecosystem restoration.

Global frameworks plays a crucial role to enhance resilience. The post 2015 development agenda is influenced by three global agreements –Sendai framework of Disaster Risk Reduction, Sustainable Development Goals and Paris Agreement. These agreements have raised the political profile of climate resilience. The Paris Agreement inscribes a global goal for adaptation which requires collective climate action at the local, regional, national and international levels. These overlapping agendas complement and reinforce each other. We tried to bring them together to maximise their synergies at the district level so that local communities that are facing negative impacts of climate change would have better coping mechanism to sustain their lives through resilience strategies.

Effective policy making plays a significant role in building resilience to climate change. Policies set the tone to create enabling environment for climate action and dealing with inherent structural inequalities. Speaking of inequalities, a sizeable section of people of Barwani district in Bundelkhand region of Madhya Pradesh survive in degenerated natural resources. In the absence of alternative livelihood options, people rely on subsistent agriculture with diminishing returns. Frequent disasters such as drought, heat waves, water stress and others result in lower performance in all human development indicators.

Being the unit of reference for implementation in India, effective policy making could emerge strongly at the district level. The District Climate Resilience Plan (DCRP) of Barwani district is an attempt to do just that. The DCRP explores the points of convergence – climate concerns into district development plans in climate sensitive sectors. It identifies policy gaps and provides practical, grounded and workable suggestion to improve the status-quo in priority sectors namely agriculture, livestock, irrigation, renewable energy, health and nutrition, forest and land use.

Putting emphasis on effectiveness, we believe that the DCRP will be useful to all the concerned government departments and implementing entities. Throughout the process of putting the plan together, the approach has been consultative and fact-based, whether empirical or from literature. We sincerely hope that the district administration will be able to make efficient use of this exercise.

We acknowledge the support and cooperation of the state, districts and Panchayat Raj institutions in the entire process of preparation of this document. It is a collaborative efforts of Govt. of Madhya Pradesh, CANSA, UNICEF, EFICOR and ERIKS.

Yours truly,

M. Ramesh Babu
Executive Director
EFICOR

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Director
CAN South Asia

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1. District Planning Key to Address Climate Risks and Build Resilience

1.1. Linking District Planning with SDGs and Paris Agreement to Build Resilience

Climate change is a cross cutting theme that needs to be addressed through analysis of risks and opportunities it poses for all sectors. Policies, plans and programmes need careful appraisal and modification to include climate change considerations. Though climate change is a global phenomenon, its impacts are manifested at local level affecting most vulnerable communities. Thus it is essential that local level institutions and plans are geared towards meeting the heightened challenges by climate change. The district as well as panchayat planning needs to decipher measures to safeguard development climate risks while inter linking with state and national level planning.

Resilience informed GPDP provides an edge to the planning capacity of Gram Panchayat. In order to do so, climate risks, exposure level and adaptive capacity of the communities need to be ascertained. The above parameters could be assessed through vulnerability assessment of communities and the physiography of the area need to be studied. The current study assesses the vulnerability of Barwani district of Madhya Pradesh state.

These kinds of extensive impacts can only be addressed through adequate participatory planning, taking in consideration the temperature fluctuations, building capacity of existing institutions and develop climate change mainstreaming guideline into sub-national planning. In essence the planning process itself becomes an exercise in communication and behaviour change. India's development agenda is implemented through various State administered policies and schemes with guidance from the Central Government, however it at 'District level' the implementation decisions are taken along with convergence of sectors. Thus in order to convert the decisions into reality on ground, the district level planning of climate actions aligned with plans at national and state levels are must. The recent ratification of the Paris agreement by India demands coordinated implementation and will test the existing institutional capacity at the state level to plan, implement and monitor targets for climate action in addition to their regular development work and responsibilities. The effective implementation is possible through carefully preparing an action plan that is merged with ongoing development schemes and since Madhya Pradesh has extensive State Action Plans for Climate Change (SAPCCs), involvement of wider stakeholders at district level is next necessary step. The local (SAPCCs),

involvement of wider stakeholders at district level is next necessary step. The local bureaucracy getting connected with mid-level bureaucracy ensures two way flow of vital data and information for implementation of climate resilience strategy of districts. Broad decisions and recommendations in SAPCC needs to localised to the needs and conditions in districts. Resilience building approaches specific to critical sectors at district level need to be elaborated adequately in the action plans.

Structural inequalities on the ground matter when examining the impacts of climate change hazards on people in general and certain communities/regions specifically. People are relatively more exposed and vulnerable to hazards of climate change when –

- their livelihoods depend on natural resources and they have few options for diversifying their income sources;
- they are without appropriate access to insurance and financial markets;
- they have low levels of education and inadequate access to health services;
- persons with disabilities and older persons have inadequate access to appropriate facilities.

To be effective, the building of climate change resilience must entail addressing the causes underlying such structural inequalities.
In this context, effective policy making will definitely have a major role to play. The adoption of the 2030 Agenda for Sustainable Development, with its vision of "transforming our world", provides a unique opportunity to strengthen policy making systems in such a way as to enable them to effectively take the lead in the transformation process required for sustainable development, including the building of climate resilience. Building resilience, therefore, requires a "continuum of integrated policy interventions to address immediate needs and enable the structural transformations needed to build climate-resilient and sustainable societies."

Climate resilience addresses both short-term disruption and long-term trends, and it is important to understand, anticipate and plan for the challenges and opportunities at the local governance levels such as District Administration, Municipalities and Zila Panchayat. These challenges and opportunities could be unique to the local region, nevertheless, there are best practices, traditional knowledge and learning from past interventions in similar context to refer to.
NITI Aayog is providing the thought stewardship on SDGs acting as the basis of multiple schemes launched in India to bring convergence, programmatic approach and holistic view to governance aimed at addressing long-standing

issues of poverty, inequality, and vulnerability which are further exacerbated by climate change.

1.2. District Climate Resilience Planning (DCRP)

District level planning is currently carried out through coordination between District Planning Committee (DPC), Zila Panchayat accumulating Gram Panchayat Development Plans (GPDP) and Municipalities in urban areas. The DPC is mandated to develop a holistic plan for Panchayats and Municipalities including spatial planning, water and other physical/natural resources, integrated infrastructure, and environmental conservation.

Planning for climate change impacts needs to be made an integral part of regular development process with major focus on water availability, natural resources protection and restoration, sustainable farm practices, livelihoods security, education and skills training, healthcare, social welfare, financial inclusion, and maintenance of critical infrastructure. There are multiple co-benefits of climate adaptation strategies for various development priorities as well as in many areas there are benefits of cost reduction and protection of life and property.

To ensure the District Plan by DPC is addressing risks of disruption to local society, economy and environment, a climate vulnerability assessment followed by adaptation strategies need to be built into the plan, and the budgets need to be aligned accordingly. There may be need for new approaches, methods, tools and funding for some aspects of resilience to fulfil the additionality of climate action on top of regular development plan.

1.2.1. F.L.I.P. – Four Principles of Climate Resilience Planning

The situation in Bundelkhand districts requires integrated bottom-up planning, inter-departmental policy convergence, and coordination between high-level experts and middle-to-junior-level functionaries on specific issues. To be successful, however, these highly specific policy responses must be part of a broader development framework, which leads the way to the empowerment of today's vulnerable sections of society by –

- improving their asset positions as well as access to input and product markets;
- extending their access to quality basic services such as health, education and sanitation;
- changing the norms maintaining their social, economic and political weakness.

The framework has already been provided by the Government of India and United Nations SDGs through the mantras of "Convergence" and "Leaving No-one Behind", respectively. Additionally, a set of four guiding principles have been suggested here to F.L.I.P. the projected and expected situation in "business as usual" scenario (aka scenario of no action to address risks from climate change) to address the dynamic nature of the issue –

1. Flexibility
2. Learning
3. Inclusivity
4. Preventive management

1. Flexibility

With increasing uncertainty of weather patterns and local climatic behaviour, flexibility in local planning and implementation is becoming more and more important. The adaptive capacity will ensure all challenges are addressed appropriately and opportunities utilised adequately. The district administration is best suited to demonstrate this needed flexibility to local situations.

2. Learning

A flexible, adaptive governance requires continuous learning to be made available on changing circumstances. While it is the goal during developmental planning to be as accurate as possible to anticipate and plan for a range of climate impacts a region might face, it is not possible to have absolute certainty about the long-term future or to know precisely how successful each plan will be. Therefore, it is necessary to build continuous learning and knowledge-sharing processes into local governance for their agility. Incorporating knowledge produced by various research institutions and local stakeholders including community's traditional knowledge is important for a robust, relevant and cost-effective district plan.

3. Inclusivity

The most under-represented and/or excluded sections of society are often the most vulnerable to impacts of climate change. They face disproportionately high risks while their capacity to withstand impacts is the least, which is further worsened due to non-inclusion in development planning or lack of access to local administration. Thus, they need to be kept at the centre of planning for climate resilience just as with social welfare planning. This principle also applies Convergence of policies/schemes and collaboration between various government departments and other stakeholders helps to ensure inclusive development.

4. Preventive management

Resilience is also about ensuring that we do as much as possible to prevent/ reduce impacts in the first place. Resilience blends adaptation and disaster risk reduction efforts that is, managing the consequences of a changed and changing climate. For example, a resilient community will be one that uses a reliable, renewable, 24x7 power supply to run essential services such as hospitals, schools, anganwadis and community cattle shelters that are built to withstand heat waves, drought, floods, and torrential rain.

The DCRP will apply these principles in the following chapters to demonstrate the approach that can be taken to address climate risks in key areas of development and assist the DPC's task of developing a District Plan that builds climate resilience of Barwani district.

2. DCRP Planning Process

2.1. District Profile

Barwani district is located in the south western part of Madhya Pradesh, occupying an area of 3664.8 sq. km. About 88% of the district lies in Narmada Basin and 12% in Tapti Basin. The district area is drained mainly by the Narmada River and its tributaries like Goi and Deb. No major tributaries of Tapti basin flow in the district. The surface water availability at 75% dependability for both the Basins is 966.70 MCM of which 921.95 Million Cubic Metre (MCM) is from Narmada Basin and 44.75 MCM

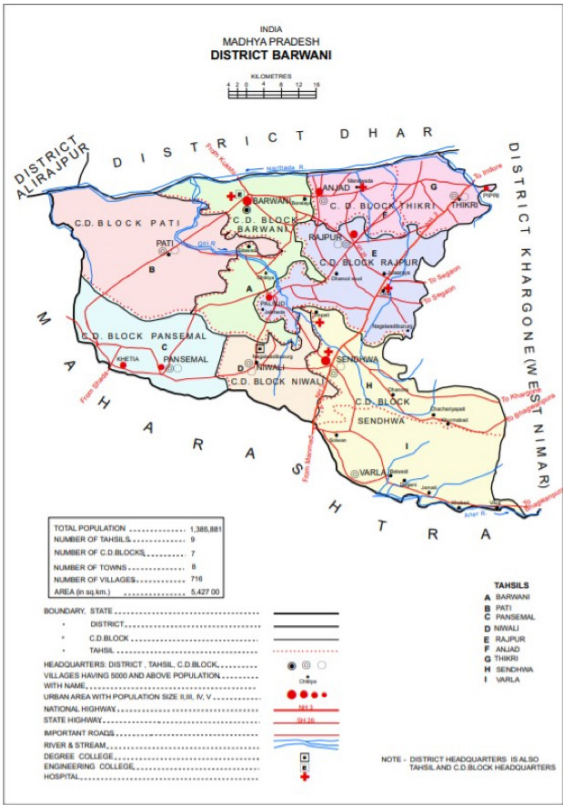


Figure 1: Location map of Barwani district (Source: DCHB, Census of India, 2011)

from Tapti Basin . The district has 97 large, 14 small dams or embankments and 7 lakes.

As per the Census 2011, total population of Barwani district is about 13, 85,881 persons with 75.8% of population belonging to scheduled caste (6.34%) and scheduled tribe (69.4%). The sex ratio is 985 females to every thousand males. The overall population density is 256 persons per square kilometer with over 85 % rural. The scheduled tribe makes 75% of the total population.

For administration purposes, the district has been subdivided into 4 sub divisions, 9 tehsils and 7 panchayat samities or blocks. There are 417 gram panchayats, 597 revenue villages in this district. The whole district is in scheduled area because of predominance of tribal population which means provisioning of special governance mechanisms by union government and safeguarding cultural and economic interests of people.

The per capita income per annum of the district in 2012-13 was Rs. 32,776 against Rs. 9433 in 2004-05[1]. In 2010-11, the per capita income per annum of the district was Rs. 20,536 whereas Madhya Pradesh state per capita income per annum was Rs.32,453[2]. The total number of families Below Poverty Line is 1,65,353 which is 68.02% of total households (DDMP 2012). This shows that a significant proportion of the population lack economic ability to deal with frequent disasters like floods and droughts that the district is prone to. Additionally, the district economy is based on predominantly agriculture with 84.9% of the population depending on it for livelihood.

As per Census 2011, 6.3% of the population are scheduled caste and scheduled tribes (69.4%). Literacy rate of the district is 49% and it occupies 48th position in the state. The female literacy rate of the district is 42.4%. The economy of the district is mainly dependent on agriculture. According to Census 2011, the total number of villages in the district are 716 villages, out of which 696 are inhabited and 20 are un-inhabited. The district has 417 Village panchayats There are two Nagar palikas at Barwani and Sendhawa, five Nagar panchayats - Pansemal, Khetia, Rajpur,Palsud and Anjad and one census town Pipri in the district.[3]

2.2. Climate Risk Profile of Barwani

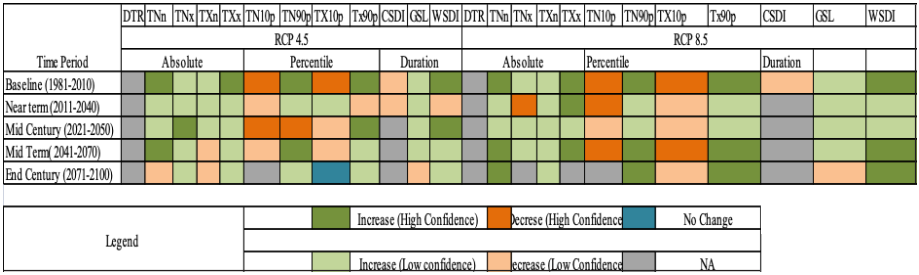
The entire district lies in the basin of Narmada and Tapti rivers with several

[1] https://data.gov.in/catalog/district-wise-capita-income-current-prices?filters%5Bfield_catalog_reference%5D=139643&format=json&offset=0&limit=6&sort%5Bcreated%5D=desc
[2] https://data.gov.in/catalog/capita-income-all-india-and-madhya-pradesh?filters%5Bfield_catalog_reference%5D=153571&format=json&offset=0&limit=6&sort%5Bcreated%5D=desc
[3] https://censusindia.gov.in/2011census/dchb/2324_PART_B_DCHB_BARWANI.pdf

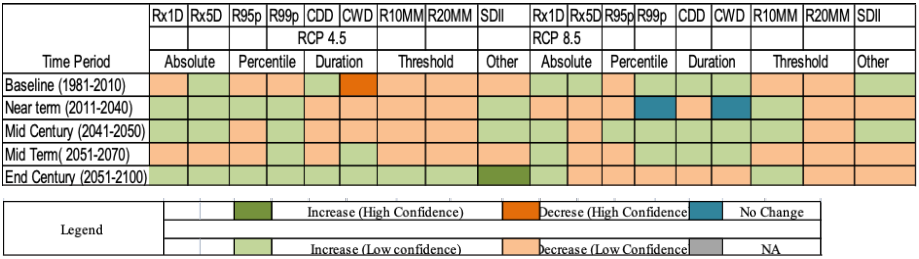
large and small dams. Thus, the district is vulnerable to heavy rainfall incidences. As per the District Disaster Management Plan 2012, the district is both prone to flood and drought. Climatologically the district has hot climate with temperature variation from 42 to 45° C. Drought-like situation occurs almost every year in the district but no incident of heavy damage is recorded. Most of the seasonal rivers dry out before the onset of summer in the month of May – June. Flood occurred in the year 1995 which resulted in loss of life and materials in villages of Anjad, Pansemal and Barwani Tehsils.

2.2.1. Climate Projections & Analysis from the climate portal

Temperature Indices



Rainfall Indices



Multi model Ensemble Mean

RCP	Indices	Annual				Winter (January - February)				Pre Monsoon (MAM)			Monsoon (JJAS)			Post Monsoon (OND)					
		NT-BL	MC-BL	MT-BL	EC-BL	NT-BL	MC-BL	MT-BL	EC-BL	NT-BL	MC-BL	MT-BL	EC-BL	NT-BL	MC-BL	MT-BL	EC-BL	NT-BL	MC-BL	MT-BL	EC-BL
RCP 4.5		6.5	12.6	15.8	24	1.2	1.6	2	2.3	1	1.4	2.1	2.5	0.3	0.7	1	1.2	1	1.2	1.3	1.4
RCP8.5	Max Temp	8.2	10.4	14.3	20.1	1.6	2	3	4.6	1.4	1.8	2.9	5.1	0.8	1	1.6	2.9	1.2	1.4	2	3.5
RCP 4.5		1.1	1.4	2.1	2.7	1.2	1.7	2.3	2.7	1.2	1.6	2.2	2.9	1.2	1.6	2.5	3.1	0.7	1	1.4	1.9
RCP8.5	Min Temp	1.3	1.9	3.2	5.2	1.2	1.7	3.1	5.1	1.6	2.2	3.5	5.5	1.6	2.1	3.7	5.7	0.9	1.3	2.5	4.4

Rainfall	Annual				Winter (January - February)				Pre Monsoon (MAM)			Monsoon (JJAS)			Post Monsoon (OND)					
	NT-BL	MC-BL	MT-BL	EC-BL	NT-BL	MC-BL	MT-BL	EC-BL	NT-BL	MC-BL	MT-BL	EC-BL	NT-BL	MC-BL	MT-BL	EC-BL	NT-BL	MC-BL	MT-BL	EC-BL
RCP 4.5	6.5	12.6	15.8	24	-9	21.7	123.8	29.7	-42.4	-62	-5.6	31.7	8.6	16.1	15.4	22.7	-1.6	-6.2	19.9	36.5

Legend				
	NT	Near term (2011-2040)	MT	Mid Term (2041-2070)
	MC	Mid Century (2021-2050)	EC	End Century (2071-2100)

An ensemble model will be used to look at key indicators – temperature and precipitation, and their predicted changes for the district which will provide an insightful understanding of how best to build the district's climate resilience[1].

The "www.climatevulnerability.in" Portal is a one stop window for climate related information focusing on climate change[2]. The web-based climate information tool provides access to climate data for India related to climate change. Indices for weather parameters such as temperature and rainfall could be easily accessed from the web portal. It provides quick information including mean, trend, change and extreme climate indices. The climate information is intended for practitioners to identify key climate related vulnerabilities and risks and further assist them to better integrate climate resilience in development planning and operations. The precipitation data sources are provided by Indian Meteorological Department (IMD) for the States of India for a period of 63 years (1951–2013). The portal uses high resolution (0.25°x0.25° latitude and longitude) daily gridded rainfall dataset. Similarly, 1.0°x1.0° latitude and longitude daily gridded temperature datasets for temperature grids spanning over 63 years (1951-2013) is used for estimating maximum and minimum temperature.

For climate extremes and projections, the CORDEX South Asia modelled data on precipitation, maximum temperature, minimum temperature and other 26 climate extremes indices have been analyzed for the states in India. The baseline period chosen is from 1981-2010. For climate projections, grid-resolutions used is 0.5°x0.5°. Climate data from the three Regional Climate Models (RCM) of REMO (from MPI), RCA4 (from SMHI) and CCAM (from CSIRO) is used. RCP4.5 (moderate emission scenario) and RCP 8.5 is used for IPCC AR5 climate scenarios. However, the current paper presents the results of RPC 4.5 only.

The "www.indiaobservatory.org.in" portal is led by "Foundation for Ecological Security" through a collaborative effort of several organizations[3]. It aims to demystify and present comprehensive information on social, economic and environmental parameters on various spatial and temporal scales. The information is useful for planning of climate risk informed GPDP to making climate smart policy decisions at national level.

[1] www.climatevulnerability.in
[2] www.climatevulnerability.in
[3] www.indiaobservatory.org.in

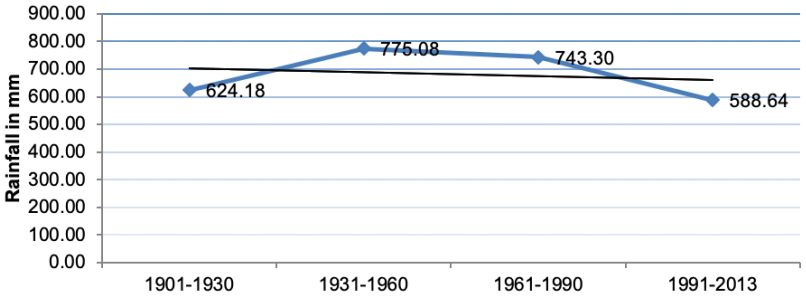


Figure 2: Average annual rainfall in Barwani district

Rainfall pattern plays an important role in drought situation and recharge of ground water system. The rainfall data analysis of Barwani area indicates rise in average rainfall during 1901-1930 by 22.88%. It remains steady during 1931 to 1990 and then declines by 20.8%. Variation indicating both positive and negative trends and recent decline in average rainfall affect the recharge of the ground water system. The average annual rainfall during 1951-2013 in the district is 739.3 mm while the state average rainfall is 1027.3 mm. Consecutive Dry Days (CDD) is set to rise in the district (141.7 days) coupled with decline Consecutive Wet Days. The maximum 5 day precipitation shows positive trend with low confidence. Maximum 1 day and 5 day rainfall in the baseline scenario is observed to be 58.7 mm and 112.7 mm respectively which does not show significant change in RCP 4.5 or 8.5 scenarios. Rainfall in months other than monsoon is expected to be scanty as change from baseline is small and at times is in negative. Thus, irrigation in pre monsoon and post monsoon season is expected to be crucial for crop survival. Water prudent crops need to be promoted that could thrive in less water and provide better yield.

When temperature indices are taken into consideration, both maximum and minimum temperature is set to rise in the district in both (RCP 4.5 and RCP 8.5) emission scenarios. The number of warm days is set to rise to 39.4 in near term (2011-2040) and to 74.3 days in mid century (2021-2050) from 10.5 days in baseline scenario (1981-2010). Thus prolonged warmer days are forecasted in the district.

2.2.2. Hazards

Floods:

Flood came in the year 1995 in which many villages of Anjad, Pansemal and Barwani Tehsils are affected. Many people were affected in that flood, buildings were damaged completely while some were partially damaged. Relief camps were set up in which people took shelter. Funds were distributed as flood relief.

There are several dams in the district which pose quite high risks during heavy rainfall. But no such report of breakage is reported yet in the district. Apart from this, some of the largest dams in India, namely Sardar Sarowar Dam, Maheshwar Dam and Indira Sagar Dam, all built on the river Narmada, are present in the adjacent districts.

Earthquake:

Barwani district is situated on the 3rd seismic zone of earthquake vulnerability. There were incidents of some earthquake shocks in the district but they are of small intensity and no damages have been reported. Some recent earthquakes of varying intensities came in the district in 1997 and 2009; in 1993 and 1985 in Jabalpur; in 1985 in Khargone; in 1984 in Mandla; in 1975 in Dewas; in 1973 in Betul and in 1970 which had their impact in Barwani also but no such damages occurred.

Drought:

Drought-like situation occurs almost every year in the district but no such incident of heavy damage is recorded. Most of the seasonal rivers dry out even before the onset of summer in May – June. District administration fulfills the water need of the community by supplying water through tanks, and drought relief funds are distributed.

Fire:

Barwani city and forest areas are mostly vulnerable to the fire accidents but no such big accident is reported yet. There were some minor accidents of fire but they were handled well with little damage.

Epidemic:

In the past, there have been numerous instances of epidemics occurring in the area. In the village of Bawadiya, an outbreak of Chikungunya occurred in 2011. Pipaldhar and Julwaniya are known for high incidence of HIV/AIDS. The bordering region of Maharashtra is vulnerable to epidemics like bird flu.

Table 1: Risk Profiling

Risk profiling of the district							
Blocks	Barwani	Pati	Rajpur	Thikari	Sendhawa	Niwali	Pansemal
Flood							
Drought							
Earthquake							
Source: District Disaster Management Plan – Barwani (2012)							

The district of Barwani is apparently "safe" in terms of disaster. One of the major reasons is the sparse population in the area as compared to other parts of the country. There are very less high rise buildings which are to be taken special care of during the situations such as earthquakes. The only disaster that is stressed upon is 'Flood' and a proper Flood Relief Cell with collaboration of NVDA is working in the district. However no special measures in terms of disasters like droughts are currently in place except reserve stock of food at fair price shops and there are water tankers for provision of water.

2.2.3. Climate Change and Poverty

The per capita income per annum of the district in 2012-13 was Rs. 32,776 against Rs. 9433 in 2004-05[4]. In 2010-11, the per capita income per annum of the district was Rs. 20,536 where as Madhya Pradesh state per capita income per annum was Rs.32,453[5]. The total number of families Below Poverty Line is 1,65,353 which is 68.02% of total households (DDMP 2012). This shows that a significant proportion of the population lack economic ability to deal with frequent disasters like floods and droughts that the district is prone to. Additionally the district economy is based predominantly on agriculture with 84.9% of the population depending on it for livelihood.

As per agricultural contingency plan 2012[6], the cultivable land area of the district is 51.26% of the geographical area. Out of 2,28,990 Ha net area sown, only 37.07% land area (84,900 Ha) has assured irrigation sources such as canal, tube well, lake and others. 62.92% of net sown area is dependent on rain-fed irrigation. Apparently, without ensured irrigation, agriculture in the district may fail during erratic/ unseasonal rainfall or drought conditions. The low cropping intensity (118.59%) suggests that most of the farmland stays fallow after one major crop as evident from the fact that only 42.57 Ha (18.58%) area is sown more than once in a year. Open wells are the main sources of irrigation (39.4%) whereas bore wells (26%) as well as other sources account for 25.8% of other sources of irrigation.

2.2.4. Topography and Hydrology

Physically, the district comprises of three distinct natural divisions viz. Narmada valley in the northern part, uplands along southern and western margins (Satpura Range and highly dissected Deccan Plateau) and Narrow belt of scarp ridges (Vindhyan Hill Range). The area of the district displays undulatory topography which includes highly dissected plateau, linear ridges, residual hills and low lying plains. The highest elevation in the district is 1033 m south of Ramgarh fort in Sendhwa Block. The lowest point is at elevation 149 m amsl near Talwda Deb in Rajpur Block.[7]

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[4] https://data.gov.in/catalog/district-wise-capita-income-current-prices?filters%5Bfield_catalog_reference%5D=139643&format=json&offset=0&limit=6&sort%5Bcreated%5D=desc

[5] https://data.gov.in/catalog/capita-income-all-india-and-madhya-pradesh?filters%5Bfield_catalog_reference%5D=153571&format=json&offset=0&limit=6&sort%5Bcreated%5D=desc

[6] Agriculture Contingency Plan, 2012

[7] http://cgwb.gov.in/District_Profile/MP/Barwani.pdf

The district also lies in the culturable command area of Indira Sagar Canal[8]. Availability of canal water for irrigation has improved the ground water status in the command area of Indira Sagar Canal. However, only 2.3% of the ground water is the main source of water for irrigation and drinking in Barwani district. As per Water Resources Department, Madhya Pradesh, the recharge worthy area of the district is 67.6% of total geographic area[9]. In 2012, pre-monsoon ground water levels were between 10-20 m below ground level (bgl) in 53% of the area of the district while in 41% area, water level was between 5 & 10 m. The post –monsoon ground water level was between 5 & 10 m bgl in 69% area of the district.

The ground water situation of Barwani and Thikari assessment units has shown improvements in 2017 as compared to 2013. The assessment units were over-exploited and the stage of ground water extraction level at 100% and 79% was found in 2013. The ground water stage improved to semi-critical and safe category with stage of ground water extraction level at 81.40% and 34.95% in 2017[10].

	Total Ground Water Recharge					Total Natural Discharges	Annual Extractable GW Resources	Current Annual Ground Water Extraction				Annual GW Allocation for Domestic Use as on 2025	Net Ground Water Availability for Future Use	Stage of Ground Water Extraction (%)
	Monsoon season		Non Monsoon season											
Year	Recharge from Rainfall	Recharge from other sources	Recharge from Rainfall	Recharge from other sources	Total Annual GW recharge			Irrigation	Industrial	Domestic	Total			
2017	43282.48	2592.54	0	28779.9	74654.89	3879.4	70775.53	35659.06	500.13	2834.07	38993.26	3620.9	31065.73	55.09
2013	36922.22	1608.16	0	5775.65	44306.03	2215.3	42090.73	31115.06	*	3242.63	34357.69	4714.6	6201.07	82
2009	35348	1416	0	4913	41677	2084	39593	25250	*	3132	28382	4761	9582	72
2004	36711	709	0	5511	42930	2146	40784	25093	*	1886	26979	3411	12280	66
				*	Domestic water extraction has industrial water supply included in it									

In Barwani, 72% of ground water has been developed by 2013 which would increase further in coming years. When the annual withdrawal of ground water exceeds the natural recharge in a normal monsoon year, water scarcity would occur. As per Central Ground Water Board, natural replenishment is an issue in Barwani[11]. Moreover, the present trend of over exploitation and scanty rainfall pattern depletes the ground water levels. Thus, water harvesting needs to be promoted to reduce pressure on ground water extraction.

The conservation and development of water resources in the state is conducted in coordination with the Water Resources Department (WRD), Narmada Valley Development Authority (NVDA), Rural Development Department (Water Shed Mission) and Agriculture Department (Balram Talab Yojna). The sources of water conservation are conducted through different storage projects run by WRD and NVDA. Agriculture Technology Management Agency provides the agriculture extension services to farmers. The agriculture department contributes towards water harvesting and creation of irrigation potential at the local level[12].

[8] Land use and land cover effect on groundwater storage
[9] Water Resources Department
[10] National Compilation on Dynamic Ground Water Resources of India, 2017
[11] http://cgwb.gov.in/District_Profile/MP/Barwani.pdf
[12] Water Conservation in Madhya Pradesh

2.3. Adaptive Capacity and Vulnerability

Department of Science and Technology (DST, GoI) conducted the district-level climate change vulnerability assessment for Madhya Pradesh.[13] It was based on 18 indicators related to agriculture, biophysical, institutional infrastructure, health, and socio-economic and livelihood practices. Six indicators emerged as the main drivers of vulnerability are lack of area crop insurance, lack of forest area per 1000 rural population, low road density, lack of groundwater availability, a small number of doctors per 1000 population, and lack of horticulture.

Gosain et al. 2017 assessed risks and vulnerabilities of Madhya Pradesh state in a collaborative project with Ministry of Environment, Forest & Climate Change (MOEFCC), Swiss Agency for Development & Cooperation (SDC) and United Nations Development Programme (UNDP). The study calculated Composite Vulnerability Index (CVI) computed for 50 districts of Madhya Pradesh. The index considered 72 indicators from social, economic, water resources, forest and health sectors. With respect to present climate, Barwani falls under very high vulnerability category. Per the study, the current vulnerability of Barwani district in different sectors is as given below.

District	Climate	Agriculture	Social	Economical	Health	Water Resources	Forest	Composite
Barwani	H	M	H	H	H (Heat stress)	VH	VH	VH

The study also provided projected future vulnerability profile of the district for mid century (2021-2050) and end century (2071-2100) in the moderate emission scenario. Vulnerability of the district in projected climatic conditions in RCP 4.5[14] for mid century and end century is represented as below.

District Barwani	**Climate**		**Agriculture**		**Water Resources**		**Forest**		**Composite**	
	RCP 4.5	**RCP 8.5**	**RCP 4.5**	**RCP 8.5**	**RCP 4.5**	**RCP 8.5**	**RCP 4.5**	**RCP 8.5**	**RCP 4.5**	**RCP 8.5**
Mid Century	VH	VH	M	M	VH	VH	M	H	VH	VH
End Century	VH	VH	L	L	VH	VH	VH	VH	VH	VH

Legend	VH - Very High	H - High	M - Moderate	L - Low

[13] DST (2019-20). Climate Vulnerability Assessment for Adaptation Planning in India. https://dst.gov.in/sites/default/files/Full%20Report%20%281%29.pdf

[14] Representative Concentration Pathway (RCP) represents a wide range of possible changes in future anthropogenic Green House Gases (GHGs) and their atmospheric concentrations. RCP 4.5 assumes the GHG emissions peak in 2040 and then decline.

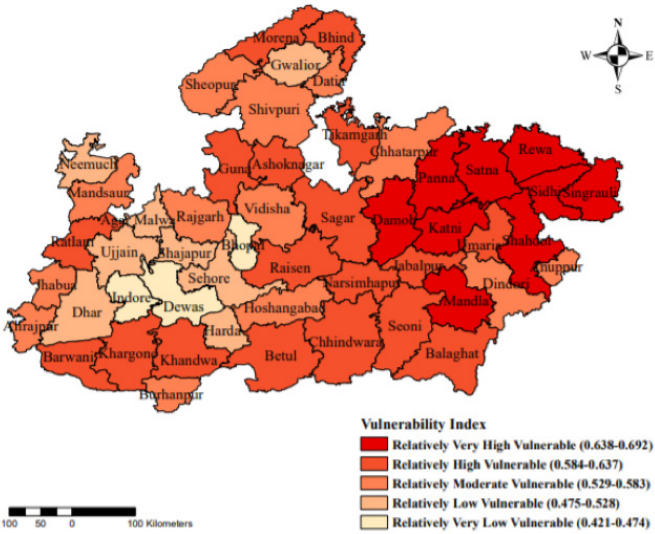


Figure 3: Map showing vulnerability Categories of Madhya Pradesh at district level (Source: DST, 2019-20)

Figure 3 shows that Barwani is a very high vulnerable district in Madhya Pradesh. Other studies also indicate that in Madhya Pradesh, Barwani is one of the districts most vulnerable to climate change.

According to the Risk and Vulnerability Assessment of Indian Agriculture to Climate Change (2019), Barwani is highly vulnerable district in Madhya Pradesh. Projected rise in min temperature, high cyclone proneness, low net irrigated area, and high SC/ST population are the most important factors contributing to the risk.

Table 2: Risk and Vulnerability Ranking

Risk		Exposure	Vulnerability	Historic Hazard	Future Hazard
Key drivers	High	High SC/ST population	Low Net Irrigated Area	High cyclone proneness	Rise in Min T
Rank (out of 573 rural districts of India)	166	321	155	151	463
Source: Risk and Vulnerability Assessment of Indian Agriculture to Climate Change, 2019					

The economy of Barwani district is based on cultivation. Agriculture is the main source of livelihood of the people of the district. 84.9% of the people depend upon agriculture in the district, out of which 44.0% are cultivators and 40.9% are agricultural labourers.[16] Many farmers are small and marginal farmers, who are

[15] Rama Rao, C.A., Raju, B.M.K., Islam, A., Subba Rao, A.V.M., Rao, K.V., Ravindra Chary, G., Nagarjuna Kumar, R., Prabhakar, M., Sammi Reddy, K., Bhaskar, S. and Chaudhari, S.K. (2019). Risk and Vulnerability Assessment of Indian Agriculture to Climate Change, ICAR-Central Research Institute for Dryland Agriculture, Hyderabad, P.124

[16] https://censusindia.gov.in/2011census/dchb/DCHB_A/23/2324_PART_A_DCHB_BARWANI.pdf

mostly into subsistence farming. More than 80% of total households having monthly income of highest earning household member less than Rs. 5000. Socio-economic data also shows that majority of the households do not have sanitation facility and household assets. All of these indicate higher sensitivity and lower adaptive capacity of Barwani.

Table 3: Socio-economic Variables Comparison

Socio-Economic Variables	Barwani	Madhya Pradesh Average
Household size - > 5 members (%)	48.1	32.7
Women headed household (%)	6.9	9.4
Population below age 15 years (%)	36.5	30.3
Scheduled Caste and Scheduled Tribe population (%)	75.8	36.7
Illiteracy rate (%)	74.6	48.2
Agricultural dependency (%)	84.9	69.8
Households with no land (%)	53.5	54.7
Households having monthly income of highest earning household member - less than Rs. 5000 (%)	90.1	83.5
Marginal worker (%)	19.6	28.1
Non-worker (%)	52.8	56.5
Households without electricity connection (%)	9.8	10.1
Households without an improved drinking-water source (%)	15.4	15.3
Households without an improved sanitation facility (%)	78.7	66.3
Households without assets (%)	54.5	32.6
Households without any usual member covered by a health scheme or health insurance (%)	72.6	82.3
Data Source: Census of India, 2011; Socio Economic Caste Census, 2011; National Family Health Survey - 4, 2015-16		

2.3.1. Community Perception of Climate Change

The data collected were from the Gudi, Rosar, Chouki, Budi, Megha and Harla villages. Besides Hirakari and Derwalia villages in the respective Gram panchayat are also visited for reconnaissance. The hamlets comprised of households ranging from 45 to 60 families of Bhil tribal community. Most of the households are marginal to small farmers with landholdings ranging from 1 to 3 Acres. Only 50% of the land is irrigated through diesel pumpsets with the river being the source of water. The tribal communities mostly grow Maize, Wheat, Groundnut, Jowar (Sorghum), and Bajra (Pearl Millet) in irrigated and dry land conditions.

In Harla (f) panchayat, total population is 1467 with 49.4% male and 50.6% female population. 95.6% of the population belongs to scheduled tribe. Both male and female literacy rate is 14%. 1.29% of households of the panchayat are mobilized into SHGs and with no access to bank loans. 70% of the area is cultivable with 3% as forest area. 2% of land area in the panchayat is unavailable for cultivation. The net sown area is 49.57% of the total area of the panchayat with no irrigation available for agriculture. 85% of the households are engaged in farm related activities. Only 50% of the households are connected to Public Distribution System which facilitates distribution of food grains such as wheat, rice, sugar and essential fuels such as

kerosene through a network of fair-price shops. Only 50% villages of the panchayat are connected to all weather roads. The villages are connected with electricity for domestic use but only 0.64% of households use clean energy such as LPG. The households are not supported by any agricultural and village based livestock extension workers.

In Harla village, the total population is 674 with 103 households. The village is composed of 51.2% male and 48.8% female population with 14% literacy rate for male and 9% for female. 99.1% of the population belongs to Scheduled Tribe. The total land is 159 Ha and the whole land area is unirrigated. 36% of the area is cultivable. 8% of the village area is forest while 6% of the land is unavailable for cultivation. 90% of the households are engaged in farming related activities. The village lacks community Waste Disposal System or Community Biogas System. Only 1.94% of the households in the village use clean energy for cooking and heating purpose. Out of 164 households, only 1.94% is mobilized into 6 self help groups. The village is not supported by any agricultural and village based livestock extension workers.

In Chouki panchayat, total population is 2673 with 49.4% male and 50.6% female population. 95.6% of the population belongs to Scheduled Tribe. Both male and female literacy rate is 14%. 2.11% of households of the panchayat are mobilized into SHGs and 45% of the SHGs accessed bank loans. 49% of the area is cultivable with no forest area. 42% of the land area in the panchayat is unavailable for cultivation. Only 1.39% of the total area is irrigated where as 46.98% of land are unirrigated. The net sown area is 48.36% of the total area of the panchayat. 85% of the households are engaged in farm related activities. Only 33.33% of the households are connected to Public Distribution System which facilitates distribution of food grains such as wheat, rice, sugar and essential fuels such as kerosene through a network of fair-price shops. The villages of the panchayat are connected to all weather roads. The villages are connected with electricity for domestic use but only 0.7% of households use clean energy such as LPG. The households are not supported by any agricultural and village based livestock extension workers.

In Chouki village, the total population is 890 with 164 households. The village is composed of 50.3% male and 49.7% female population with 20% literacy rate for male and 21% for female. 86.9% of the population belongs to scheduled tribe. The total land is 346.53 Ha with 96% unirrigated and remaining 4% is irrigated land. 89% of the area is cultivable. With 1% of the village area is forest while 1% of the land is unavailable for cultivation. 85% of the households are engaged in farming related activities. The village lacks community Waste Disposal System or Community Biogas system. Only 1.83% of the households in the village use clean energy for cooking and heating purpose. Out of 164 households, only 1.83% is mobilized into 5 self help groups. The village is not supported by any agricultural and village based livestock extension workers.

In Rosar panchayat, the total population is 4985 with 49.4% male and 50.6% female population. 80.8% of the population belongs to Scheduled Tribe. The male and female literacy rate is 12%. 1.43% of households of the panchayat are mobilized into SHGs and 3.57% of SHGs accessed bank loans. 38% of the area is cultivable with 47% of the panchayat area is forest. Only 6.81% of total area is irrigated where as 30.13% of land is unirrigated. The net sown area is 36.76% of the total area of the panchayat. 64.9% of the households are engaged in farm related activities. Only 20% of the households are connected to Public Distribution System which facilitates distribution of food grains such as wheat, rice, sugar and essential fuels such as kerosene through a network fair-price shops. Only 40% villages of the panchayat are connected to all weather roads. The villages are connected with electricity for domestic use but only 0.65% of the household use clean energy such as LPG. Only 0.26% of the households are supported by any agricultural and village based livestock extension workers.

In Rosar village, the total population is 2733 with 485 households. The village is composed of 49.3% male and 50.7% female population with 11% literacy rate. The total land is 618.65 Ha with 84.6% unirrigated and remaining 15.4% is irrigated land. The village has 56% cultivable area and 6% forest area. 16% of the land is unavailable for cultivation. 70% of the households are engaged in farming related activities. The village lacks community Waste Disposal System or Community Biogas system. Only 0.62% of households in the village use clean energy for cooking and heating purpose. Out of 485 households, only 0.62% are mobilized into 38 self help groups. Only 0.21% of the households are supported by any agricultural and village based livestock extension workers.

In Gudi panchayat, total population is 2348 with 51.4% male and 48.6% male population. 1.63% of households of the panchayat are mobilized into SHGs and 9.52% of SHGs accessed bank loans. 8.77% of total area are irrigated where as 34.29% of land are unirrigated. 90% of the households are engaged in farm related activities. Only 50% of the households are connected to Public Distribution System which facilitates distribution of food grains such as Wheat, rice, sugar and essential fuels such as Kerosene through a network fair-price shops. Only 50% villages of the panchayat are connected to all weather roads and public transport. The villages are connected with electricity for domestic use but only 0.27% of household use clean energy such as LPG.

The total population of Gudi village is 2730 with 283 households. The village consists of 98.5% of tribal population with 51.2% of male and 48.8% are female with literacy rate is 14% for male and 12% female. Only 55% of the land area is cultivable and 19% is uncultivable. The village has 24% of land under forest. The village has 1% culturable wasteland. The total land is 771.53 Ha with 84.7% unirrigated and remaining 15.3% is irrigated land. 90% of the households are engaged in farming related activities.

The village lacks community Waste Disposal System or Community Biogas system. Only 24.73% of the households in the village use clean energy for cooking and heating purpose. Out of 283 households, only 1.06% are mobilized into 14 self help groups. The farming households are not supported by any agricultural and village based livestock extension workers.

In Budi panchayat, total population is 4593 with 50.2% male and 49.8% female population. 0.54% of households of the panchayat are mobilized into SHGs and 23.08% of SHGs accessed bank loans. 45.16% of total land area belongs to net sown area of the panchayat. 8.55% of total area are irrigated where as 36.61% of land are unirrigated. 90% of the households are engaged in farm related activities. All the households are connected to Public Distribution System which facilitates distribution of food grains such as Wheat, rice, sugar and essential fuels such as Kerosene through a network fair-price shops. The villages are connected to all weather roads and public transport. The villages are connected with electricity for domestic use but only 0.27% of household use clean energy such as LPG.

The total population of Budi village is 3357 with 541 households. The literacy rate of the population is 19% for male and 16% for female. The total land is 1306 Ha with 81.8% unirrigated and remaining 18.2% is irrigated land. 90% of the households are engaged in farming related activities. The village has 47% of cultivable area with no forest land. 38% of the area is unavailable for cultivation. The village lacks community Waste Disposal System or Community Biogas system. Only 0.37% of households in the village use clean energy for cooking and heating purpose. Out of 541 households, only 0.37% are mobilized into self help groups. The farming households are not supported by any agricultural and village based livestock extension workers.

Megha village belongs to Budi gram panchayat. In Megha village, the total population is 1236 with 202 households. The village is composed of 51.2% male and 48.8 % female population with 20% literacy rate for male and 12% for female. 98.4% of the population belongs to indigenous tribes. 97% of the water requirement is met through handpump. The total land is 786.41 Ha with 79.8% unirrigated and remaining 20.2% is irrigated land. 44% of the area is cultivable. The village has no forest while 45% of the land is unavailable for cultivation. 90% of the households are engaged in farming related activities. The village lacks community Waste Disposal System or Community Biogas system. Only 0.99% of households in the village use clean energy for cooking and heating purpose. Out of 202 households, only 0.99% is mobilized into 14 self help groups. The village is not supported by any agricultural and village based livestock extension workers.

The primary data collected from the villages and interaction with community members indicate understanding of climate and climate related impacts at the

community level. The community representatives recognize gradual but significant changes in climate variability. All the respondents have identified rise in temperature, in both day and night time as the most significant change in last 20 to 30 years. The respondents have also observed rainfall getting erratic which affected seasonality of agriculture of farmers. The respondents identified severity of changes as well. The change in diurnal and night temperature is identified as the most significant followed by change in rainfall. The farmers having rainfed agricultural land suffered losses in crop productivity while farmers with irrigation facilities are better off than others. 50% of the farmers have both irrigated and rainfed agricultural land.

2.3.2. Adaptation Responses

80% of the farmers have undertaken adaptive responses. In order to compensate losses in agriculture and related activities, 30% of the farmers have initiated seasonal vegetable cultivation. Vegetable farming acts as a cash crop and is traded locally. The farmers also use it for own consumption which improves nutritional needs of the family members. Farmers also reported of relying on kitchen gardens that provide essential nutrition during lean agricultural period. There are a few encouraging examples of kitchen garden becoming a source of income for the farmers. 90% of the farmers are benefited from the government schemes. All the farmers reported that Krishi Vigyan Kendra (Agriculture Science Centre) in the district assists them by providing seeds, fertilizers and insecticides. The farmers obtain free electricity for farming as well. The KVK also imparts training on various aspects of agriculture, horticulture and animal husbandry. The farmers are aware of government schemes and programs due to community mobilization and series of training programs organized by civil society organisations. They obtain livelihood related training and material assistance from local offices of National Rural Livelihood Mission through SHGs. Regarding the household energy needs, most of the households are dependent on crop residue and fuel wood collected from the neighborhood.

However, 40% of the farmers have reported that the benefits of training and others does not reach them as NRLM and Panchayat offices are close to 10 KM from the village. Shortage of staff at NRLM offices results in inadequate attention to the community needs. 30% of the respondents mentioned that the functioning of panchayat could be improved so that the benefit of the schemes/programs could reach them. The farmers have positive responses to CSO interventions particularly the training and capacity building exercises.

2.4. Integrating Climate Concerns in District Development

Barwani has featured in India's 283 most backward districts list. Climate impacts put the district at further risk of loss of income, social welfare services and human development. The Human Development Index (HDI) was developed by the United Nations Development Programme (UNDP) for ranking the countries according

to their performance in the area of Health, Standard of living and Education. The Planning Commission, Govt. of India used somewhat different indicators but followed a similar approach and calculated the HDI and accordingly ranked all the States and UTs. In the Planning Commission report, it was found that the Empowered Action Group (EAG) States namely Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Odisha, Uttar Pradesh and Uttarakhand had relatively the lower ranks.

Table 4: Socio-economic Variables Comparison

State/District	Health	Education	Standard of Living	HDI values
Madhya Pradesh	0.6225	0.6440	0.459	0.5687
Barwani	0.5371	0.4662	0.4533	0.4842
Source: Development of Human Development Index at District Level for EAG States, 2016				

A closer look at the data reveals high heterogeneity in the living standards in MP. There are significant inter-district variations in the state. By uplifting the districts, which have shown relatively lesser progress in achieving key social outcome, MP can move ahead in the human development index. The District Climate Resilience Plan (DCRP), chooses to focus on the following criteria as key priorities that are detailed later in the plan –

- Drinking water sufficiency
- Agriculture and livestock resilience
- Livelihood options and security
- Nutrition and access to healthcare
- Access to information, local R&D, and knowledge
- Disaster risk reduction and critical infrastructure
- Forests, wildlife and land use
- Governance capacity of Municipalities and PRIs to address climate risks

3. Climate Resistance Priorities

The District Climate Resilience Plan (DCRP) aims to support the District Administration with –

- Effective management of vagaries of nature and climate change impacts through convergence of inter-departmental development planning and collaborative management of natural resources;
- Make a participatory and inclusive action plan with adequate scope for traditional knowledge and practices that hold the potential to make planning by district administration durable and relevant to an area under severe stress.

In the following sections, key climate resilience priorities are elaborated using the context of the Barwani district on current challenges, expected issues in future and the suggested approach to addressing risks.

3.1. Drinking Water Sufficiency

Ground water is the main source of irrigation and drinking water in Barwani district. Out of a net sown area of 2289.90 sq km, only 849 sq km is under irrigation. The total number of dug wells and tube wells in the district, in the year 2010, was 26728 and 4970 respectively. There has been a steady rise in the development of ground water. The development of ground water resources of Barwani district is increasing every year. The development, so far, has been mostly through dug wells. However, in recent years, the number of tube wells is also increasing. The availability of ground water for irrigation in the district is 41301 ham and the stage 12 of ground water development in the district is 72%. However, this rate is bound to increase in the future and may lead to a situation wherein the annual withdrawal of ground water may exceed the natural recharge in a normal monsoon year. This may happen since the cropping intensity and hence, number of ground water abstraction structures is likely to increase. This, coupled with increased drinking water requirement would create a stress on the existing ground water resources. It is thus essential that the available resources are utilised judiciously. Based on the availability of ground water for future irrigation, dug wells in the depth range of 10-20 m with diameter of 4-8 m and tube wells in the depth range of 30-100 m may be feasible except in Pansemal block where stage of ground water development has already exceeded 100%.

3.1.1. Current situation and challenges

The District Barwani is one of the under stress, rapid exploitation of ground water resources in the district, ground water resources in the area are under continuous depletion. Thus there is an urgent need for taking up suitable water management interventions based on integrated approach, which on one hand includes augmentation of ground water resources through appropriate techniques, and on the other hand requires the adoption of suitable water conservation measures, such

as ensuring water use efficiency through creation of additional water storage facility, maintenance/ renovation of existing water bodies etc.

Drought: natural and human-induced causes

A 2014 study by National Institute of Disaster Management (NIDM) talks of three kinds of droughts - meteorological, agricultural and hydrological – in India wherein usually the meteorological drought - rainfall much below average - happens first. It leads to agricultural drought in the same year because India depends on monsoons for agricultural production. If the meteorological drought continues for the second consecutive year, then the hydrological drought – below average water availability - occurs.

The study indicates with evidence that in Bundelkhand this pattern [cycle of drought] has been broken many times. For instance, in 2011 people faced hydrological drought in the region even though there was ample rainfall as water was not conserved and lost to run-off on the rocky surface, instead of recharging surface water tanks that have not been maintained.

3.1.2. Relevant and timely scientific information at the district level

In India, data related to climatic variables are available only for a single point within a district, making it difficult to provide localised information to villages and towns across the district. Additionally, the institutions responsible for declaring drought and flood events are different from those that generate hydrological and climatic information. Thus, in District Administration and community making adaptive decisions need to rely on a multiplicity of sources providing information that is limited in geographical scope and timeliness

3.1.3. Way Forward

The Public Health Engineering Department (PHED) in Madhya Pradesh has historically had project-oriented approach concerned with physical progress of water supply projects and financial disbursement, instead of programmatic approach required for long-term water availability. There has been little interaction with communities to involve them in planning, implementation and management of schemes. As a result, the dominant approach to service delivery has remained supply-driven characterised by large investments in schemes and works, followed by deterioration of the infrastructure and long periods with low levels of service while communities wait for the government to restart the schemes.

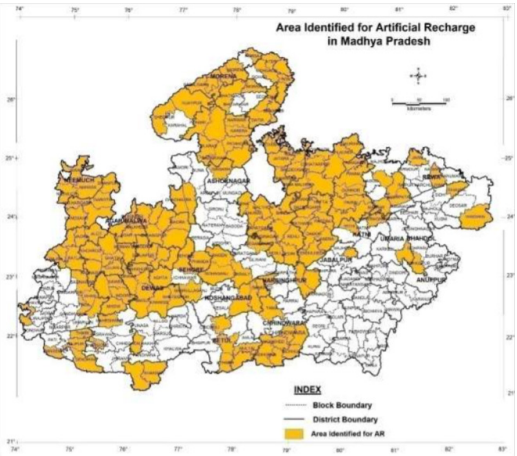
Bringing accountability and programmatic approach in the system to ensure water availability will be instrumental to ensure results. Decentralisation puts planning, implementation, operation and maintenance in the hands of beneficiaries. This creates ownership and commitment to action. Through programmes such as NRDWP, District Administration should access and extend continuous support

including training, technical support, access to professional services and financing to GPs to supplement their own resources. Results-based financing schemes for drinking water security such as the new Atal Bhujal Yojana (ABHY) will strengthen decentralised governance.

As per the provisions of the National Water Policy, drinking water has the first priority in allocation, of all available water. The District Administration should prepare through public consultation a district water conservation and usage guidance document to map water sources and accordingly suggest conservation measures and prioritised uses. This document should also provide for review and reallocation of water resources as per budgeting among competing user groups giving primacy to drinking water supply and agriculture (and allied) activities.

Traditional surface water tanks ensured drinking water supply in rocky subregions and interior villages for centuries whereas borewells and hand pumps relying on depleting groundwater have not been durable solutions. The priority focus of government's development spending needs to be re-adjusted to solutions suitable to the topography such as rejuvenation of existing ponds while building new ones along with their maintenance including their catchment area. Considering the potential of quantity of water supply and the natural sustainability of tanks and ponds, attention needs to be refocused on them, though many studies on these tanks have shown that the work involved in doing so is substantive requiring both administrative and political will along with people's support.

The CGWB Master Plan 2020 has identified blocks for artificial recharge of groundwater through various recharge techniques and structures. CGWB has prepared draft guidelines, which stipulates existing & new industries, infrastructure & mining projects etc. to obtain 'No Objection Certificate (NOC)' for ground water extraction after paying a water conservation fee. The rates of water conservation fee have been proposed based on the quantum of ground water extracted, category of ground water assessment unit and use of ground water.



Water Conservation Fee collected from that district needs to be utilised by the respective State Governments for implementation of ground water recharge/ water conservation measures in that district. Any water extraction policy implementation needs to be as per the proposed district water usage guidance document prepared in consultation with the public to allow citizens of the district control over water usage in their district.

In urban areas, rooftop rainwater harvesting structures through incentives for retro-fitting in existing building and mandatory provision in new construction would ensure self-sufficiency. Water metering with graded tariff for various levels of usage and an overall quantitative ceiling on groundwater extraction will enhance efficiency and sustainable consumption in urban areas. The streams and nallahs in the southern and south-eastern parts of the district should be selected for sub-surface dyke cum check dam which will enhance the groundwater level and yield of wells.

An integrated drought monitoring and communications plan that uses early warning system to enable proper planning of adaptation strategies for the district needs to be developed. In normal conditions also, there needs to be systematic monitoring and recording of groundwater levels and rainfall at sub-block or GP level.

NGOs and companies with financial resources keen to work on water sufficiency need to be encouraged, invited and guided to invest in the district to -

- build rainwater harvesting and artificial recharge structures,
- support water tanks' rejuvenation and maintenance,
- support training and facilitation of community/industry WUAs for water use efficiency and groundwater monitoring,
- build green belts, and
- support R&D for district-specific climate variables and projected water availability data.

Refer to Chapter 4 for relevant schemes and Annexure 1 for specific climate-resilience solutions to drinking water challenges in Barwani district

3.2. Agriculture Productivity & Livestock Resilience

As per agricultural contingency plan 2012[17], the cultivable land area of the district is 51.26% of the geographical area. Out of 2,28,990 Ha net area sown, only 37.07% land area (84,900 Ha) has assured irrigation sources such as canal, tube well, lake and others. 62.92% of net sown area is dependent on rain-fed irrigation. Apparently, without ensured irrigation, agriculture in the district may fail during erratic/ unseasonal rainfall or drought conditions. The low cropping intensity (118.59%) suggests that most of the farmland stays fallow after one major crop as evident from

[17] Agriculture Contingency Plan, 2012

the fact that only 42.57 Ha (18.58%) area is sown more than once in a year. Open wells are the main sources of irrigation (39.4%) whereas bore wells (26%) and other sources account for 25.8% of other sources of irrigation.

The total forest cover in the district is 244.09 sq. km[18] which is 6.66% of the total geographical area. But as per Census 2011, 1888.35 sq. km area or 34.83% of the total geographic area was under forest cover. The district is surrounded by south-eastern ranges of Satpura. Vindhya forest range runs along northern boundary. Ramgarh forest is in western and northern parts of the district[19].

As per Census data 2011, only 35.6% of rural and 53.34% urban households have access to banking services. Apart from vulnerability, it highlights the need for financial inclusion in the district. To support agriculture based livelihood system, the cultivators need access to credit, crop loan, insurance and weather based insurance. In the absence of the above services, farming communities and especially agricultural laborers would find it hard to overcome from climate induced disasters. In the district, Barwani, 64.44% of the rural and 31.7% of the urban households use firewood to meet the requirementof household fuel. Crop residue and cow dung cake is still prevalent as household fuel in 28.98% and 1.93% of the rural households. LPG was being used in 3.9% of rural households whereas 58.97% of the urban households use LPG/PNG. High dependence on biomass based fuel in rural areas is a threat to the vegetation in the area and also is a health hazard for women and children of the district. As per the analysis of Petroleum Planning and Analysis Cell, penetration of LPG in the district is 28%[20].

Migration is another socio-economic issue prevalent in the district. It is observed that migration has increased from 30% in 1998 to 45% of households in 2006. The common destinations for migration are Malwa, Dhar, Indore, Gujarat and Maharashtra. The migrants are engaged for up to 30-45 days in soybean fields in Malwa during October and November. The migrants are engaged in non-farm activities such as construction, masonry, road work for four to six months. However, improvement in agricultural extension services such as availability of fertilisers, seed and more tube wells/ lift irrigation and horticulture has reversed the trend of migration in the district. Cotton, sugarcane, chillies, vegetables and soybean cultivation in Barwani have reduced migration in the district. The duration of migration has decreased to one to two months[21].

3.2.1. Vulnerability from Climate Change Impacts and Farm Practices

Underground water has an important role for irrigation in this district due to lack

[18] http://www.mpsdma.mp.gov.in/uploads/media/Barwani_DDMP_final.pdf
[19] http://censusindia.gov.in/2011census/dchb/DCHB_A/23/2324_PART_A_DCHB_BARWANI.pdf
[20] Assessment report: Primary survey onhousehold cooking fuel usage and willingness to convert to LPG
[21] https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/3934.pdf

of perennial rivers. The net irrigated area is 84.9 thousand Ha as compared to 144.1 thousand Ha that is rainfed.[22]

Irrigation and Water-use Efficiency

Agriculture practiced today in Barwani is largely rain-fed as dug wells and borewells either don't hold groundwater through the year and/or are expensive to set up. Depending on the availability of water, farmers differ in their farming systems. Under rain-fed conditions, farmers prefer to integrate cereal cultivation with agroforestry, whereas under irrigated conditions, agroforestry is replaced with vegetables and orchards. Those who have farmlands on the riverside mainly opt for vegetable cultivation.

Irrigation By Different Sources	Area (Sq. km)	No. of Structures
Dug wells	367	26728
Tube wells/Bore wells	217	4970
Tanks/Ponds	51	106
Canals	76	109
Other Sources	179	
Net Irrigated Area	849	
Gross Irrigated Area	849	

Central Water Commission (CWC) has identified poor maintenance of canals, lack of water control structures in distribution system and lack of awareness in farmers as key causes of low water use efficiency.

The total irrigation potential created (IPC) from major, medium and minor irrigation schemes have reached 81% of India's ultimate irrigation potential, so the scope for further expansion of irrigation infrastructure on a large scale is limited. Therefore, priority must be given to improving the utilisation of irrigation potential (IPU) of the existing irrigation potential. The National Water Mission (NWM) Comprehensive Mission Document states that there is a need to increase water use efficiency by 20%, whilst it also advocates a policy of "more crop per drop". NITI Aayog suggests that area under irrigation can be doubled in the country without requiring extra water through efficient management of water resources, such as those practiced in China and Brazil. The relatively lower double cropping in Barwani has to do with both the local practice of 'anna pratha' as well as insufficient/ineffective irrigation facilities when rain is less than needed.

3.2.2. Relevant Information and Scientific Advice

Downscaled temperature-rise projections and accordingly mid-to-long-term forecast of climate change impacts on agriculture are not available at the district level. Adaptation strategies such as altering the sowing dates or the choice of crops

[22] http://www.nicra-icar.in/nicrarevised/images/statewiseplans/madhya%20pradesh/MP1-Badwani-26.6.2012.pdf

altogether, which can produce high returns on investment by farmers, are tricky to be recommended because the potential for failure can be significantly higher when climate change variability information is not accurate or specifically relevant to the district. The information gap between scientists, planners and intended beneficiaries due to gaps in relevance, time and coherence needs to be bridged. Rural farmers have more difficulty understanding the idea of longer-term changes in the climate, thus, use of innovative media is needed.

The climatic vulnerabilities models are based on several assumptions and have inherent uncertainties. Crop Weather Watch Group (CWWG) under Indian Council of Agricultural Research (ICAR) was organised to provide only current information/ recommendations to farmers across the state as per short-term crop weather forecast that is neither comprehensive and district-specific nor does it help design and implementation of agricultural and water management schemes. The short-term information provided by CWWG is yet to ensure its timely reach to each farmer and at times the farmer has already invested resources in certain farm inputs.

In the agriculture area under University of Agriculture and Technology located in Banda, research projects are proposed to be carried out through which can give a momentum to correct farm technique through crop development, crop and plant safety techniques and seed production. Krishi Vigyan Kendra (KVK) has also been established in the district by Indian Council of Agriculture Research, New Delhi for extension of improved crop varieties and techniques through demonstration and exposure visits. The results and recommendations from these institutions either have not reached all farmers or there are other socio-economic reasons for non-application by farmers.

Locally-relevant, accurate and timely information on climate variables across a district to make decisions on suitable climate change adaptation practices in agriculture is not available and since farming practices and physical conditions vary across the region, it is difficult to generalise climatic observations and adaptation solutions. Additionally, the reach of communications and regular interface with farmers in each Gram Panchayat is still a challenge.

3.2.3. Way Forward

Sectoral policies like subsidies for irrigation (water, power, pumps) and other inputs in agriculture sector indirectly have adverse impact on water resources. Relief measures such as low or no cost power to farmers leads to over-reliance and exploitation of groundwater to irrigate farms. The uptake of alternatives such as drip irrigation is stymied either by low water/energy prices or provisions in the irrigation scheme that filter out many farmers such as requirement of pre-existing assured water supply.

High-yielding varieties of seeds do not necessarily mean higher net returns in the same proportion, as farmers also have to make higher investments towards purchase of quality seeds, balanced supply of nutrients, etc. Promotion of large-scale industrial farming leads to degradation of soil and water quality. The environmental cost arising out of these practices is not internalised.

The restrictions on selling of agriculture produce, role of intermediaries, fragmented/ missing access to markets, market and storage infrastructure issues, lack of incentives for small-scale private enterprise and excessive dependence on pricing policy (MSP) for some crops will also limit the benefits to small farmers from altering their farm and crop practices intended to adapt to changing climate conditions.

Crop insurance policy and scheme suffer from inaccurate assessment of loss; inadequate and delayed compensation especially unsuitable to small farmers; exclusion of sharecroppers and tenant farmers as well as many crops; exclusion of damage from unforeseen weather events, etc. are the accountability for all line departments related to agriculture and rural areas development.

Major constraints faced by the farmers that need to be addressed on priority for climate resilience are: soil micro- and macro-nutrient deficiency, low organic carbon, low water-use efficiency and non-adoption of resource conservation techniques, inadequate supply of low-cost high-quality seeds and planting material, need for diversification through dryland agriculture and integrated small plot farming, inadequate agriculture extension support as well as post-harvest and marketing infrastructure covering the entire district, as well as lack of a strong programme to promote arid horticulture and livestock development.

Irrigation

Agricultural water withdrawal accounts for 44 percent of total water withdrawal in OECD countries, while it is 84% in India. Minor Irrigation Department to mobilise youth and civil society as 'groundwater army' indicates the urgency as despite government schemes, water level has been going down consistently. This needs to be complemented with participatory water-use and management planning by district administration to inform annual budget allocation as well as demand-side management. The data from monitoring of groundwater aided with technology and equipment across the district needs to be disclosed to public for sensitizing them of the issue and encouraging cooperation with district authorities.

In addition to minor irrigation projects and schemes, it is necessary to re-generate old ponds and conserve catchment area to ensure water availability at every farm. These interventions need to be aided with effective and planned control over

activities like sand mining, encroachment of water bodies, and urban expansion (including new construction) to correct the imbalance. Flood water management in surrounding flood-prone areas can help bring surplus water from there to water-scarce Barwani.

Farm inputs quality, availability and cost

The input costs need to be reduced through management of seeds, manure, fertilisers, pesticides, water resources, energy et al in a decentralised manner by farmer groups – this shall also provide additional allied livelihood opportunities in the form of small-scale local enterprises, and ensure consistent, timely supply of low-cost inputs.

Schemes such as KUSUM can bring sustainable energy to farmers while also enhancing their net income potential through reduction in input costs. The use of solar irrigation systems should be accompanied with training for maintenance and repairs at the Gram Panchayat level. Drought relief funds should be mobilised for provision of water and water-efficient irrigation equipment at early signs of less rainfall.

Organic, diversity-based and dryland farming reduce input costs and healthcare expenses substantially in rain-fed and small-holding agriculture areas while enhancing soil health and fetching higher price for the produce. The district administration should set target of at least 10% per year of cultivable land to be converted to ecologically sustainable, climate-resilient, organic farming. This will also reduce pollution of groundwater and surface water bodies from agro-chemicals thereby reducing pressure on district administration for clean water supply.

Seed sovereignty is an integral part of sustainable and profitable farm livelihoods – this requires farmer community managed seed banks hosted and supported with R&D by local research institutions receiving government grants.

Livestock

Livestock is an important component in drought resilience as it decreases the need for large quantities of water for farm income and helps in managing a sustainable livelihood. Native species of livestock or breeds that can sustain in heat and drought should be promoted as well as measures are to be taken to improve their health and hygiene. Livestock that is let loose due to being non-productive or lack of fodder can be given shelter homes through an enterprise model by interested entrepreneurs for production and sale of organic fertiliser and other by-products. Animal fodder distribution centres for registered small and marginal farmers with landholdings up to 2 hectares would help ensuring healthy livestock.

Market-and-farmer-oriented agriculture policies

Changing incentives for the market through policy will lead to behaviour shift at the farmer level – for example, Soil Health Card listing soil carbon, organic matter and moisture to be considered when deciding sale value of a piece of agricultural land, thus, sustainable and organic practices become essential; the dedicated supply chains for organic will become reality once consumers and farmers are aided by policies and incentives such as – special bonus, enhanced medical cover and old age pension for farmers producing organic crops and dairy; enhanced medical cover for customers of organic produce living in the district purchasing locally from organic farms. The administration can support organic farming with quality input-supply, quality testing, certification and processing facilities. Farmer co-operatives and local entrepreneurs can bring value addition and market access to organic produce.

Mobilising private investments, including farmer organisations, in decentralised marketing and storage infrastructure will enable farmers to be more confident of their returns and that will enhance efficient utilisation of cultivable land. Building systems to allow vegetable and fruit buyers to compete in collection and purchase of fresh produce from farmer producer groups at the village level, and the farmers supplying these directly to retailers including e-retailers in towns and cities will help the farmers achieve suitable prices and encourage efficient water management.

Disaster compensation and crop insurance

Minimal amount should be transferred to affected farmers immediately in case of a disaster while detailed assessment is carried out for fuller compensation. The insurance should cover all important crops, tenant and sharecroppers, all-natural disaster events, group insurance of small landholding farmers, and ensure that assessment is made accurately and comprehensively. This requires capacity building at PRI and district administration levels for credible assessment.

Knowledge creation and dissemination

Local and national agriculture institutions should collaborate with farmer producer organizations and marketing groups in the district to produce cutting-edge relevant knowledge on existing and projected climate impacts as well as locally suitable, sustainable and low-cost agriculture production and marketing practices. A district level observatory should be established in institutions located in the neighbouring districts to produce timely and relevant information that is effectively disseminated to each village of Barwani. Farmer needs on media used for information dissemination are varied based on their literacy and gadget-friendliness implying need for a robust public information team at the block level.

The mutually symbiotic connection between smallholding farmers, ecological agriculture, farm input elements sovereignty, climate resilience and SDGs needs policy, schemes and budget recognition through special incentives and support for

smallholder farmers. Economies of scale can be achieved through collectivisation of organic farmers for production and sale.

At the district level, it is possible to bring convergence and customisation amongst various policies and schemes in consultation with the local stakeholders, especially the vulnerable faming households. Several potential issues could be avoided through free, prior and informed consent from citizens in the district.

Refer to Chapter 4 for relevant schemes and Annexure 2 for specific climate-resilience solutions to irrigation challenges in Barwani district.

3.3. Livelihood Options & Income Security

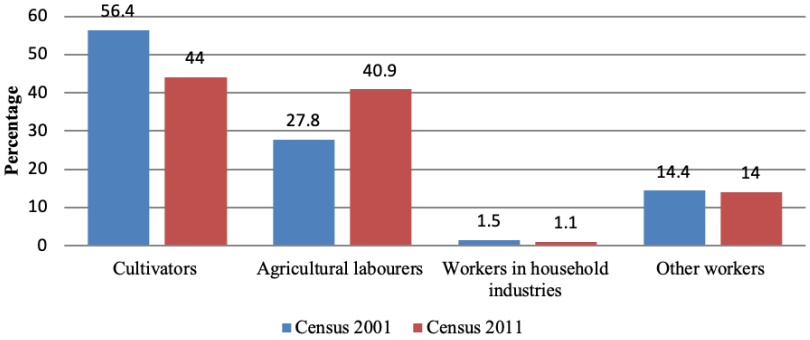


Figure 4: Socio-economic Variables Comparison

The workers of the district are divided into four broad categories i.e. cultivators, agricultural labourers, workers in household industries and other workers[23]. The percentage of agricultural labourers (40.9%) is comparable to the cultivators (44.0%) which show skewed land distribution in the district. As per Census 2001, the percentage of cultivators was 56.4 which have been reduced to 44% in 2011. The negative growth of 12.4% cultivators shows that farmers have shifted to non-agricultural activities due to unpredictable weather parameters and inadequate farm income. Percentage of agricultural labourers has increased significantly by 13.1% from 27.8% in 2001 to 40.9% in 2011[24]. The overall high percentage of agricultural labourers is an indicator of poor state of agriculture in the district. A large population of the district is vulnerable when agriculture fails during drought and flood situation. Out of total area sown of 2325.82 sq. km only 28.17% is sown by assured irrigation sources

[23] A person who is engaged in an economic activity other than cultivator, agricultural labourer and household worker is categorized under other workers. The type of workers that come under this category include all government servants, municipal employees, teachers, factory workers, plantation workers, those engaged in trade, commerce, business, transport, banking, mining, construction, political or social work, priests, entertainment artists, etc.

[24] http://censusmp.nic.in/censusmp/Data/PCA_DATA/006%20-%20Chapter%20-%204%20-%20WPR%20.pdf

such as canal, tube well, lake and others. 72% of the total sown area is dependent on rainfed irrigation. Apparently, without ensured irrigation, agriculture in the district may fail during erratic/unseasonal rainfall or drought conditions.

3.3.1. Way Forward

Given very high vulnerability of the district to climate change impacts, incomes need to be diversified beyond small holding agriculture and MGNREGS. Excess dependence on agriculture for livelihood needs to be reduced through diversification such as micro-enterprises/cottage industries in rural areas, for example, processed food products which are sold to nearby markets. There are Chinese models of village and town level enterprises that helped to increase scale of operations and efficiency. So small-scale SEZs with relevant infrastructure, financial services and skills training centres need to be dedicated to develop an ecosystem of micro and small enterprises producing complementary products that are sold locally and/or made using local agro-economy and natural resources. These SEZs could have -

1. Training Institutes and Entrepreneurship Development Centres to generate skilled employment for district residents in sectors that are suitable and sustainable for the local economy;
2. Regular consumption products produced locally to generate employment, develop local economy, reduce dependence on transportation of goods from farther areas and, thus, reduce harmful GHG emissions polluting the air;
3. Minimal procedural requirements, reduced credit costs and processes;
4. Common marketing agency/advisory support.

Refer to Chapter 4 for relevant schemes and Annexure 3 for specific climate-resilience solutions to livelihood challenges in Barwani district.

3.4. Nutrition Security & Access to Healthcare

Households in the district are becoming vulnerable as more and more youngsters are migrating, leaving elderly relatives on their own and sometimes leaving young children also to their care. The children are in need of proper parental care, apart from clearly needing more and better food, which under climate impacts is at risk. The infant mortality rate is already quite high in the state while women work in a weakened physical state much beyond their capacity. As per National Family Health Survey (NFHS) 2015-16,[25] only 3.6% children under 2 years (6-23 months) in Barwani are receiving an adequate diet while out of all children under 5 years, approximately 52% are stunted (height-for-age), 28.3% wasted (weight-for-height), 55% underweight (weight-for-age), and a massive 82% anemic. As we can see nearly half of the children are not under weighted and stunted. Women and men whose

[25] http://rchiips.org/nfhs/FCTS/MP/MP_FactSheet_441_Barwani.pdf
[26] http://rchiips.org/nfhs/FCTS/MP/MP_FactSheet_441_Barwani.pdf

Body Mass Index (BMI) is below normal are 40.8% and 39.7%, respectively, while 65% women were found anemic.[26]

Rise in temperature and other climate impacts can exacerbate effects on human health, water resources and critical infrastructure. There is a marked relationship between human mortality and thermal stress. Lack of water also leads to sanitation and hygiene issues.

The health infrastructure is under-staffed and under-equipped standing below the national average on multiple criteria. The diseases and health issues from climate impacts such as increased mosquito prevalence, heat strokes, consequences of malnutrition, etc. are expected to rise. The healthcare system including medical insurance is required to provide support to the people.

3.4.1. Way Forward

Water for sanitation and hygiene, suitable buildings to protect from heat, and nutrition supplements in case of chronic malnutrition need to be ensured. Training of medical professionals and communities to manage health impacts needs to be arranged. Also, public place institutions such as schools, offices and industries need to be advised on making provisions for care regarding these issues. The electricity utility companies need to be advised on ensuring electricity at peak heat times of the day.

All food security schemes such as PDS, ICDS/National Nutrition Mission, Mid-day Meals, etc. need to be based on decentralised systems of food choices, production and procurement feasibility, storage, processing and distribution. This implies that locally sustainable, diverse and nutritious foods such as local green vegetables, fruits, millets, pulses, oilseeds etc. need to be included in these schemes.

Food security and nutrition programmes should encourage a proportion of farmers to include in their cropping calendar millets, vegetables and fruits that can be grown through dryland agriculture, agro-forestry and low input costs. Efforts should be made towards strengthening community-based systems and mechanisms ensuring active participation of women as more and more women are joining the agricultural work force. Investing in knowledge development of these community action groups and encouraging them to grow nutritious foods in public places such as schools, anganwadis, hospitals and parks can be an effective step towards ensuring food security. Forest produce such as uncultivated foods are important sources of nutrition in normal times and during drought for certain communities and their access should be ensured.

NGOs and corporate CSR initiatives could support the government's efforts in ensuring food and water for the poor through community kitchens and grain banks managed by local women groups.

3.5. Ecological Balance

Area covered with vegetation is managed by the Forest department. Due to less rainfall and land, nature provides the scattered and unmanageable greenery which remains under the forest area protected and unprotected forests. Mixed type of forests is found in the district. These forests are spread in Sendhwa, Pansemal ranges and also in parts of Barwani ranges. The trees found in the forests are teak, moyen, dhovan, haldu, ledia, neem, palash, amla, tensa, belawar and behda etc. The main teak associate floras are; anjain, salai, jhingan, while saj, tendu and mahuwa etc. are found in low-lying moist area. Other main species found in the canopy are phansi, bija, mokha, kaim, kari, bijasal, rohan, arjunshisham, kalasiris, chichwa, pangrachirolgamari and semal.

As per Forest Survey of India Report[27], 17.10% of geographical area in 2019 of Barwani district is forest. This is a decrease of -6.01% from 2017. However, it is clear that the quality of forest is poor. There is no dense forest, it only has open (76%) and moderate (19%) respectively. About 4% of the Barwani forest region consists of shrubs. 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.

3.5.1. Way Forward

The various departments need to come together to set targets for forests and buffer zones area increase every year to ensure development projects are implemented with safeguards and in consultation with the public stakeholders. Conservation of native species through seed banks and gene banks need to be invested in as long term resilience building measure given the pressure of urbanisation and industrialisation on natural resources. No-go zones for critical natural resources and species conservation need to be defined in consultation with direct stakeholders with strict monitoring and penalty for breach. Land use change outside of no-go zones is a matter of public concern for which free, prior informed consent should be taken through both online and offline methods.

[27] http://fsi.nic.in/isfr19/vol2/isfr-2019-vol-ii-madhya-pradesh.pdf

4. Building Climate Resilience

Given the mix of livelihoods in the district, appropriate recognition to the potential of climate-resilient development in those sectors needs to be accorded by the state government. This would inform and enable customised implementation of schemes, budget allocation and skill development in those areas. The district of Barwani is primarily relying on agriculture and tourism, hence, it would benefit the people if these are made preferred sectors of support and intervention by all government and extension service agencies.

4.1. Institutional Set-up for DCRP at District Level

There exist various policies, schemes and institutions at the centre, state and district levels, which can be leveraged to implement actions that will contribute to building resilience. To coordinate convergence amongst various departments for a holistic resilient development of the district, District Environment Department needs to be empowered, strengthened and elevated by the office of the District Magistrate. The Environment Department will need an informed officer/ team to work in close coordination with District Planning Committee (DPC), Municipalities and Zila Panchayat to enable integration of climate resilience elements in the District Plan across all schemes and administrative affairs.

The DCRP will need to build on the State Action Plan on Climate Change (SAPCC) of Madhya Pradesh as well as integrate any special initiatives launched for the district such as drought relief package and Smart City to perform its role of informing the District Plan by the DPC. Its position in the organogram and district administration approach is suggested to be that of an advisory role, which is regularly updated every 3 years in consultation with stakeholders, facilitated by nodal officer of Environment Department, while adopted formally by the DPC as an input. See Annexure 4 for institutional set-up required in district planning.

4.2. Planning & Implementation with Indicators for Climate Resilience

Mapping of existing planning against the approach needed for each climate resilience priority can provide the basis/framework for continuously evaluating the status of alignment between administration planning and community resilience needs in the context of changing climate. The gaps can be framed in the form of action steps and progress on each resilience priority can be monitored on the basis of targets and proposed indicators. The following sections provide the resilience framework with indicators and steps for district departments while the targets need to be set in consultation with the public stakeholders in the district.

4.2.1 Resilience Planning Framework for Barwani District

S.No.	Climate Resilience Priority	Programmatic Approach to Building District Climate Resilience	Indicators of Climate Resilience
1.	Drinking Water Sufficiency	(i) Assessment of existing and future water requirements in the district along with mapping of water sources for existing and projected deficit; (ii) Participatory development of a district water conservation and usage guidance document "Jila Jal Sanrakshan Aevam Upyog Niti (JJSUN)" for community participation and inter-departmental convergence in planning, implementation and monitoring of water-works; (iii) Setting goals, targets, indicators of progress, transparency, user responsiveness and accountability mechanism applicable to Jal Sansthan and Gram Panchayats within the implementation framework of JJSUN; (iv) Making adequate provision for technical capacity, results-based financing, and professional advisory support to Jal Sansthan and Gram Panchayats for them to meet their goals set as per JJSUN; (v) Enhancing water availability through holistic interventions combining – • topology of the district • green cover requirement • traditional and modern methods with low infrastructure costs for decentralised groundwater recharge, drought-proof supply system, and waste/ contaminated water treatment; (vi) Integrated monitoring and communications plan to keep track of groundwater and surface water availability during normal and drought conditions at block and GP levels; (vii) Engaging stakeholders from private sector philanthropy and NGOs for coordinated planning and investment of resources to enhance water availability at the district level.	(i) water availability for priority uses exceeds usage and increasing trend in population receiving safe and adequate water for drinking and sanitation; (ii) increasing trend in ratio of water treated, recycled and reused with water available to the district and decreasing trend in expenditure per litre of water made available; (iii) increasing trend in proportion of existing water bodies rejuvenated, new construction of traditional water storage structures, and population supported by each water source; iv) Participation and adoption of JJSUN by district departments and WUAs as well as ratio of functional WUAs at municipal ward and GP levels; (v) public disclosure of annual action plan and performance report by Jal Sansthan and GPs as per JJSUN; (vi) amount invested in district-specific R&D as well as status of implementation of recommendations for enhancing water availability; (vii) performance of monitoring and communications plan to support timely response to falling water availability levels; (viii) amount invested from government, private and NGO sources in water availability under the JJSUN guidance framework.
2.	Agriculture Productivity and Livestock Resilience	(i) Focus needs to be on climate suitability, efficient use and quality of farm input elements and livestock including native resilient seeds, fertilisers and livestock breeds to meet farmer nutrition needs and target income; (ii) Ensuring water to each farm through regular, rigorous and participatory evaluation of all options such as watershed development, canals and minor irrigation projects or traditional water tanks rejuvenation; (iii) Ensuring real access to cost-effective, innovative farm equipment and farming methods suitable to the district's average farm size and inputs availability, respectively; (iv) Ensuring access to locally-relevant knowledge of value-added, arid zone agri-pastoral farm forestry options in the form of organic fruit trees, high-value crops, climate-resilient indigenous seeds, horticulture, animal husbandry, poultry, fisheries, et al that would thrive in changing climate conditions; (v) Making provision for required extension and financial services as well as subsidised/ low-cost RE-powered storage infrastructure; (vi) Participatory and customised implementation of C-DAP, SAPCC and JJSUN through convergence amongst various schemes related to agriculture, irrigation and livestock; (vii) Risk response measures for reducing risks from climate impacts as well as for comprehensive compensation/ quick relief to affected farmers; (viii) Encouraging clustering of small plots and farmer cooperatives/SHGs for achieving economies of scale through integrated dryland agriculture, seed banks and livestock rearing; (ix) Reforming land leasing laws, pricing policies, and market access rules to increase returns on investment to farmers while addressing excessive presence of supply chain intermediaries; (x) Promoting local agro-economy based small and medium enterprises for quick, low-cost and customised supply of organic farm inputs as well as marketing of organic farm products.	(i) Average monthly income increased to level of national average income of workforce employed in manufacturing and skilled jobs; (ii) Proportion of farms consuming water at par with agriculture producing countries of OECD, China, etc; (iii) Proportion of farmers diversifying crops and agriculture systems, adopting organic and dryland farming; (iv) Proportion of farmers reporting crop loss from climate impacts; (v) Proportion of farmers benefitted from one or more schemes as well as average time taken to receive benefit per scheme; (vi) Proportion of smallholding farmers active in producer cooperatives as well as proportion of SMEs in local agro-economy; (vii) Adequate nutrition levels measured periodically (vii) Efficiency of irrigation projects for water supplied and utilised per unit of rupee spent as well as area covered; (viii) Livestock coverage by health camps and hospitals as well as ratio of resilient native to hybrid breeds with farmers; (ix) Average time taken to disseminate, accuracy of forecast, and relevance of information on weather for farming as well as design of schemes;
3.	Livelihood Options and Income Security	(i) Livelihood, access to food and water, and rural healthcare need coordinated, complementary and mutually informed interventions to address distress migration. Additionally, district priority livelihood development planning required in participatory and exhaustive evaluation of options; (ii) All registered farmers to get minimum days of employment every crop season at skilled workforce rate per day if their farm income projection is going to be lower than national average income of skilled workforce; (iii) Survey required of villages prone to migration every cropping season for urgent interventions regarding food and water security, healthcare as well as interim livelihoods/ unemployment benefit. This includes support to ensure eligibility for livelihood oriented schemes such as MGNREGS; (iv) District-level livelihood transition planning is needed till local economy with secondary livelihoods and SMEs picks up as well as agriculture becomes climate-resilient. This includes interim jobs/ seasonal livelihoods, daily wage labour, migration helpdesk and unemployment benefit; (v) Promotion of local enterprises at micro and small scale through required infrastructure, financial services, market access and skills training. This will enable successful implementation of schemes in sectors identified as priority, viz. agriculture and allied livelihoods, marketing of agro produce, solar panels and irrigation systems; (vi) Resilient breeds of livestock to be promoted for enterprise and nutrition; (vii) Encourage competition in purchase of farmers produce, especially vegetables, fruits and flowers to end consumers for higher returns and livelihood creation; (viii) Banks in the district to be sensitised for benefits to their business from inclusion and nurturing of financial finesse in local population. Preferred status in banking and financial services to be given to ventures involving local farmers.	(i) Average monthly income of farmers increased to level of national average income of workforce employed in manufacturing and skilled jobs; (ii) Average monthly income in the district increased to level of national average; (iii) Migration in absolute numbers and percentage as well as temporary vs permanent form declines year on year; (iv) Increase in proportion of MSMEs for identified priority sectors in local economy; (v) Increase in sale options for farmers keen to sell their produce; (vi) Proportion of farmers and their enterprises accessing financial services.

4.	Nutrition and Access to Healthcare	(i) Focus of nutrition and food security programs to be on locally diverse food systems and native foods for resilience and health as well as streamlining of government processes to ensure timely and adequate access to nutritious food by seeking families across the district; (ii) Mechanism to disseminate information, including in interiors, at every seasonal change regarding projected weather and vector issues along with remedies and preventive measures; (iii) Healthcare facilities, including traditional medicines and systems, of a wide variety to be made available to complement government health schemes in a cost-effective way covering 100% of the population; (iv) Preferred status to organic farmers and consumers through social welfare, free education to children, healthcare, market access and retirement income incentives to promote organic farming; (v) Encouraging optimal use of space and time through women SHGs growing nutritious foods and cooking in schools, anganwadis, offices, and other public spaces; (vi) Forest produce with nutritious value and availability in drought periods to be preserved.	(i) Number of schools with mid-day meal, health check-ups and other incentives such as free uniforms and books for higher attendance enhancing the BMI of children; (ii) Number of villages covered by information dissemination mechanism (iii) Coverage ratio of population by healthcare facilities for all medicine systems and government schemes; (iv) Proportion of organic farmers and women SHGs producing organic food in the district; (v) Proportion of forest dependent communities benefitting from government providing monitored access to nutritious foods (vi) Year-on-year improvement in BMI average for various age groups and gender categories of the district population, with special focus on malnutrition and stunting.
5.	Ecological Balance	(i) Development and land use plans to be integrated with sustainable development goals (SDGs) through participatory processes for restoring balance; (ii) Open, inclusive, transparent and recurring consultations in regional language to ensure public concerns to land use change and natural resource exploitation are incorporated in district policy; (iii) Livelihood development investments to be informed by local preferences and skills with preference to sustainable micro and small enterprises over large-scale industrialisation; (iv) Population management and community engagement to reduce pressure on natural resources.	(i) Year-on-year targets to enhance forestland area and wildlife count are being achieved; (ii) Relevant SDG indicators are being achieved; (iii) Every major infrastructure and industrial project is backed by public consent; (iv) Natural resources key to protect farm productivity; nutrition and health impacts of climate change are proportionate to population requirements.

4.2.2. Resilience Plan Implementation by District Departments & Officials

This table provides action steps by concerned departments to implement the Resilience Planning Framework. These steps are proposed in brief while their details are provided in respective sections for each Climate Resilience Priority from sections 3.1 to 3.5.

Climate Resilience Priority	Actions Needed to Build Resilience	Implementing Departments & Schemes Applicable
Priority 1: **Drinking Water Sufficiency**	(i) Facilitate creation of "JJSUN" and WUAs at ward/block levels after assessment of existing and projected water requirements as well as available quantity; (ii) Establish MoUs with agencies of expertise and financial institutions (FIs) for provision of technical, financial and advisory support to Jal Sansthan and Zila Parishad; (iii) Apply Water Conservation Fee on industries and households with ceiling on extraction, requiring NOC from affected WUAs and Jal Sansthan; (iv) Build traditional water tanks, ponds, sub-surface dykes/ check dams as well as ensure maintenance and anti-encroachment drives; (v) Promote rain-water harvesting (RWH) and groundwater recharge through incentives and laws in old and new construction; (vi) Monthly monitoring of groundwater levels with real time communication to WUAs and Jal Sansthan; (vii) Organise events inviting NGOs and companies to learn about JJSUN and district challenges to coordinate research, projects and interventions for enhancing water availability;	Departments - (i) District Planning Committee (ii) Jal Sansthan Schemes/ Missions - (i) NRDWP & IWMP (ii) NURM (iii) District Water & Sanitation Mission
Priority 2: **Agriculture Productivity and Livestock Resilience**	(i) Establish District Agriculture Income Task-force for convergence between various policies and schemes by relevant departments connected to agriculture and allied sectors performance and climate resilience; (ii) Facilitate creation of "JJSUN" and WUAs including GPs/elected village leaders at block levels for assessment of existing and projected water requirements as well as available quantity to plan suitable irrigation and watershed development projects as well as inform schemes design and implementation suited to local context; (iii) Facilitate creation of farm cooperatives for clustering of farms, develop efficient farming methods and farm input supplies, achieving economies of scale with equipment and marketing to end consumers, and incentivise district and block-specific research and training on risks and climate-resilient solutions; (iv) Organise block level fairs and camps on climate-resilient solutions for farm inputs, livestock, horticulture and other allied activities, as well as financial services for agro-economy based micros, small and medium enterprises (MSMEs); (v) Regular training for officers and elected leaders on risks, solutions, schemes, participatory decision-making and tools, as well as approach to ensure convergence for efficient use of resources.	Departments - (i) Agriculture (ii) Horticulture (iii) Irrigation (iv) Animal Husbandry Schemes/ Missions - (i) National Mission for Sustainable Agriculture (ii) National Program on Organic Farming (iii) KUSUM, PMKSY (iii) C-DAP and SAPCC
Priority 3: **Livelihood Options and Income Security**	(i) Develop district priority livelihood development plan including transition from singular livelihood to secondary choices in public consultation to inform schemes, incentives and projects; (ii) Establish process for survey of projected farm incomes per cropping season and distress migration prone villages in collaboration with KVK and technical institutions as well as set up helpdesks at various public spaces in the affected season; (iii) Establish livelihood schemes awareness, credit and eligibility documentation camps in every village; (iv) Establish 'Gram Innovation' festivals to promote breakthroughs in rural economy in all forms and stages of the supply chain with credit, market access and technical expertise support; (v) Skill training institutes to be set up for affordable and/or free of cost training;	Departments - (i) Agriculture (ii) Horticulture (iii) Animal Husbandry (iv) Skill development Schemes/ Missions - (i) Mission Antyodaya (ii) MGNREGS

5. Annexures

Annexure 1: Sustainability of Water Sources

Sustainability of drinking water sources is the most important climate resilience priority. Interventions to ensure source sustainability include user-oriented actions (raising awareness on need for recharge, avoiding wastage of water and the need to plan for balancing availability and consumption) and infrastructure-oriented tasks (building physical structures which can capture rainwater and surface water runoff, and/or help recharge ground water like ooranis, check dams, sub-surface dykes, etc.). The following steps are suggested for the preparation of a Sustainability Plan with a view to appropriately locating sustainability structures to sustain drinking water sources -

1. All habitations should move from dependence on a single source to conjunctive use of rainwater, groundwater and surface water sources;
2. Prioritising difficult areas - Identification of over-exploited, critical and semi-critical blocks, areas with water stress in the whole or part of the year and quality affected areas, identification and testing of all sources there;
3. Identifying the respective micro watershed/aquifer/hydrological unit - hydro-geomorphological study of the area;
4. Preparation of a plan for recharge, water impounding (optimising evaporation losses) and roof top harvesting with people's participation;
5. Preparing estimates, building capacities (including through provision of expert services) and institutionalising the system;
6. Financing the Plan by converging NRDWP-Sustainability, MNREGS and Watershed Development Programmes;
7. Water Users Associations (WUAs) for every water body need to be formed for judicious and equitable use of water;

a) Guards to be employed by WUAs for monitoring of the water bodies;
b) Build "water ATMs" and (water holes for wildlife) along with multi-village (or forest) supply grids for ensuring safe drinking water availability;
c) Establish cost-effective organic/inorganic wastewater treatment plants as per the waste generated and promote grey water recycling.

CASE STUDY 1:

Beneficiary Groups executing and maintaining schemes

Under the Jalanidhi Rural Water Supply Project in Kerala, instead of engaging contractors to build the water supply systems, Beneficiary Groups (BGs) directly procure materials and construct the schemes on their own, employing local workers – both skilled and unskilled. The community contracting system adopted in the implementation of the Jalanidhi Rural Water Supply Project in Kerala has successfully demonstrated the value of empowering communities to be responsible for the implementation and management of the water supply systems. Community contracting resulted in substantial reduction in the construction costs (about 15 percent less than the approved estimates), ensuring good quality construction and transparency. This approach also helped in mobilising local resources, especially manpower for construction, and making the beneficiaries actively involved in the entire process whereby their ownership and sustainability of the schemes are enhanced. Equally important, the water supply schemes completed and commissioned are now being operated and maintained (many of these now for more than five years) by the BGs. Water tariffs have been fixed appropriately, corresponding to O&M expenditures, and are being levied and collected in all the schemes.

CASE STUDY 2:

Conjunctive Use of water

Jepar of Chuda Taluka in Surendranagar District, Gujarat, is a village that embraced the decentralised community managed water supply system in 2006. It has developed a water distribution system, which allows all 160 households to have tap connections and enjoy 24x7 water supply. The village's two sources of water – a well and Narmada pipe water supply system – supplement each other to ensure regular safe water supply to the village. The total storage capacity is an Elevated Storage Reservoir (ESR) of 50,000 litres and one sump of 20,000 litres. Before the village adopted 24x7 water supply system in 2006, the supply was available for about two hours a day and the average consumption of water was around 400 litres per day per household. When each household was assured of 24x7 supply, the consumption per household reduced to 250 litres per household, thus saving 25,000 litres per day which represents 38 percent of the water previously distributed. Power consumption reduced too by 4.39 units per day or a decrease in one-third of the previous electricity bill; an annual saving of about Rs. 7,900. The reduction in consumption of water occurred primarily because people abandoned the practice of storing water to cover several days' needs. Now, 125 villages in Gujarat are successfully operating the 24x7 water supply system.

Annexure 2 – Irrigation under Climate Change Constraints

1. There is a need to reduce gap between irrigation potential created and utilised through restoration/re-modelling of existing projects and completion of new ones, with special focus on masonry check dams;
2. To reduce loss of water during distribution in canals, lining of canals and reducing their surface area exposure by increasing their depth is needed;
3. In order to reduce evaporation losses from water bodies, surface area can be reduced by increasing storage depth; storage of water in a compartmented reservoir and pumping the water from one compartment to another as the water is used, so that there are some full compartments and some empty, instead of a single shallow sheet when the reservoir is partly used; develop shelter belts of suitable tree species around water bodies or by artificially shading of water surfaces;
4. Based on soil health card, promote water and soil moisture conservation practices like contour bunding, vegetative barriers, and percolation ponds/ trenches in drought prone areas, to reduce evaporation losses from soil;
5. Promote drip and sprinkler irrigation technologies over traditional farm flooding method
6. Canals water monitoring for discharge, silt management, timely repairs etc. needs to be established through real-time data collection and complaint redressal system.

CASE STUDY 1:

Active community and PRI participation in villages at a watershed or aquifer or a hydrological unit level

Andhra Pradesh Farmer Managed Groundwater Systems (APFAMGS) project's key premise is behavioural change leading to voluntary self-regulation. In seven drought prone districts of Andhra Pradesh, thousands of farmers residing in 638 habitations have voluntarily taken a number of steps to reduce groundwater pumping for tiding over the problem of groundwater depletion. The main intervention of the project is the capacity building of the farmers in the catchment Hydrological Units (HUs) on water budgeting and collective decision making. The project introduced two key measurement devices. The first is the rainwater gauge to measure the rainfall in their areas. The second is the long rope scale to measure the depth of groundwater in observation wells. The farmers' groups were trained to collect and use data from these two sources to calculate the potential ground water availability in each season. This knowledge has empowered the farmers to collectively make their own decisions on water entitlements, crop water budget (CWB), changing crops to suit the water availability and planning recharge measures to enhance groundwater recharge potential. The efforts have led to significant changes in the overall situation in a short 3-year period from 2005 to 2008. Out of 53 Hydrological Units (HUs) the groundwater balance has increased in 57% HUs, remained constant in 34% HUs and

decreased only in 9% HUs. Similarly, out of 58 HUs the groundwater pumping has reduced in 55% HUs, remained constant in 31% HUs and increased only in 14% HUs. About 4800 farmers in the 638 habitations have voluntarily adopted water saving methods in one form or the other without losing the income from agriculture. This project demonstrates the power of building capacity of local organisations to collect real time data, process it and make local decisions and regulate water use.

Annexure 3: Livelihood Options

Goatery

Goatery is quite popular in rural households and most households keep a few goats for milk and sell them, when required, providing them relatively quick and assured income with relatively low investment. Large sized goatery is not common though it is extremely suitable to the undulating terrain of Bundelkhand, with a large variety and growth of bushes and shrubs. Profits from local mixed breeds have been better, since they survive better. Local breeds are easily fed in the open jungle, while it is expensive to feed foreign breeds. In 2011-12, through the Bundelkhand Package, goats were distributed to farmers free of cost and they had to pay for the insurance. Goat units of local breeds flourish while those provided with hybrid ones have discontinued due to mortality.

Sheep

The Jalauni sheep is one of the best recognised sheep breeds of India, and there was traditionally a high sheep population, in Jhansi district, which had a sizable woollen carpet industry in the 19th century. The coarse wool had gone down in demand though new innovative uses for it are coming up across the world which can be introduced in urban areas of Bundelkhand to generate sustainable livelihoods.

Fisheries

Fishing is the traditional occupation of Scheduled Caste groups. Fishing leases are given to fisherfolks cooperative societies but big landlords control most of these societies. The fisherfolk themselves do not own the boats or nets they use; these are owned by the well-off landlords, who pay the fisherfolk daily wages. In some cases, middlemen, who finance the business, control the fisherfolk. Nonetheless, with concerted action, some of which is already underway as evident from the MP experience, this can turn into an activity of commercial benefit. Promotional activities like providing seedlings, fish feed, guidance and extension support, equipment and subsidised inputs have helped.

Annexure 4: Institutional set-up for DCRP

1. Establish Climate Change Cell under Environment department at the district level for commissioning district-specific research on impacts of climate change on ecosystem, economy and society; ensuring dissemination of latest applicable scientific/analytical information and; providing best practice solutions to various departments, policymakers, media and public representative groups;
2. Sustainable consumption and production (SCP) principles to be promoted through nodal Climate Change and SDG officer at district level who has the mandate to integrate them in every department's or scheme's functioning.

Role of Focal point officer for DCRP

1. Update information related to climate predictions, projected impacts, vulnerabilities and progress on advance adaptation and mitigation strategies;
2. Organise meetings across departments that will provide climate-related updates and serve to advance adaptation and mitigation strategies;
3. Access to and relationship with the Municipality and Zila Panchayat leadership to be able to advise on implementation plans and budgeting resources for actions that increase local and regional resiliency;
4. Communicate about climate adaptation and community vulnerabilities to district administration and community audiences;
5. Report periodically to the DM and DPC (suggested: every 6 months).
6. Develop local or regional task forces or committees comprised of key officials and local stakeholders to address climate preparedness;
7. Use existing resources that provide guidance on how district departments can work within existing programs when planning for climate change.

Annexure 5: Images from the field visit

Figure 5 CANSA and EFICOR team members discussing with community representatives in Barwani district, February 2020

Figure 6 Meeting with Deputy Collector of Barwani district Ms. Anshu Jawla

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