DISTRICT CLIMATE RESILIENCE PLAN

KHANDWA DISTRICT

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District Climate Resilience Plan: Khandwa District

July, 2022

An initiative of CAN South Asia and EFICOR
in co-operation with
UNICEF India and Environmental Planning & Coordination Organisation (EPCO),
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 fort 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 Khandwa 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 Khandwa 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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1. District Planning Key to Address Climate Risks and Build Resilience

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

India is an important signatory and keen participant to UN Sustainable Development Goals (SDGs) and Paris Agreement on Climate Change signed by over 190 nations in 2015. Most of the SDGs and adaptation measures to changing climate submitted in India's NDC (nationally determined contribution) to UNFCCC are aimed at building resilience of Indian society, economy and ecosystem. These agreements and their goals are best implemented only as part of decentralised governance. Thus, the Government of India has constituted a federal structure to meet these international commitments while linking them to national and sub-national planning mechanisms –

- National Action Plan on Climate Change (NAPCC)
- State Action Plan on Climate Change (SAPCC)
- Central and state sponsored schemes to meet SDGs

India is a federation with extreme diversity across districts in natural resource endowments, poverty incidence, development gains and potential for growth. Accordingly, the role of district administration is to apply customised development models as per local context. Local government and decentralised planning are the avowed Indian mechanisms and strategy, respectively, as per 73rd and 74th amendment to ensure delivery of several public goods and social justice. District level planning holds a significant position in Indian governance system due to advantages of efficiency, access to local resources and knowledge as well as quick response potential. It is also the level at which planning can effectively include people's requirements and ensure real-time flexibility based on changing ground realities.

Structural inequalities on the ground matter when examining the impacts of climate change hazards to 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

- 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 policies 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.

Climate Resilience is the ability of an ecosystem or community to survive disruption to their normal ways of life and to anticipate, adapt, and flourish in the face of climate change impacts.

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.

resilience planning. As it is often noted in climate policy world, taking action on climate change is a "no regrets" approach to governance with additional benefits for the region even if climate risks did not exist or were low in intensity.

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 Khandwa district.

2. DCRP Planning Process

2.1. District Profile

Khandwa district is situated in the South-western part of Madhya Pradesh. The district is surrounded by Betul and Hoshangabad district in East, Burhanpur district in South, West Nimar district in West and Dewas district in North. Satpura and Vindyanchal mountain range runs in the district. The district falls under Narmada basin and thus Narmada and its tributaries form the main source of water for the district. The district home to electricity projects - Indira Sagar and Omkareswar dam on Narmada river.

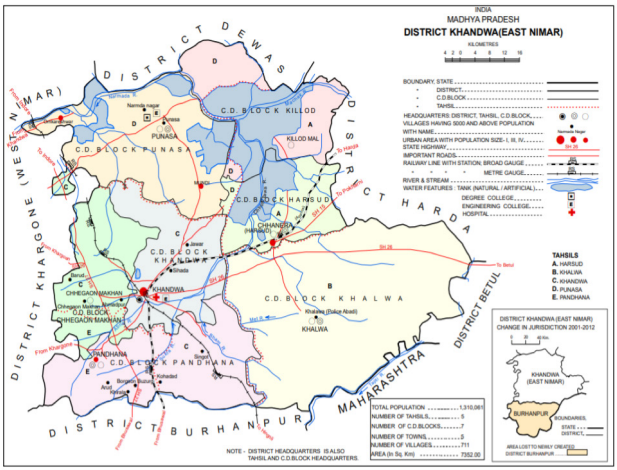


Figure 1: Location map of Khandwa district (Source: DCHB, Census of India, 2011)

As per Census 2011, total population is 1,310,061, of which males and females are 674,329 (51.47%) and 635,732 (48.53%), respectively. The population density in 2011 was 178 persons per sq. km. and the decadal growth rate between 2001 and 2011 was 21.5% (Fig. 2). More than 80% of the population belongs to rural areas. The scheduled caste and schedule tribe population are 156601 (11.95%) and 459122 (35.04%) which is 47% of the total population.

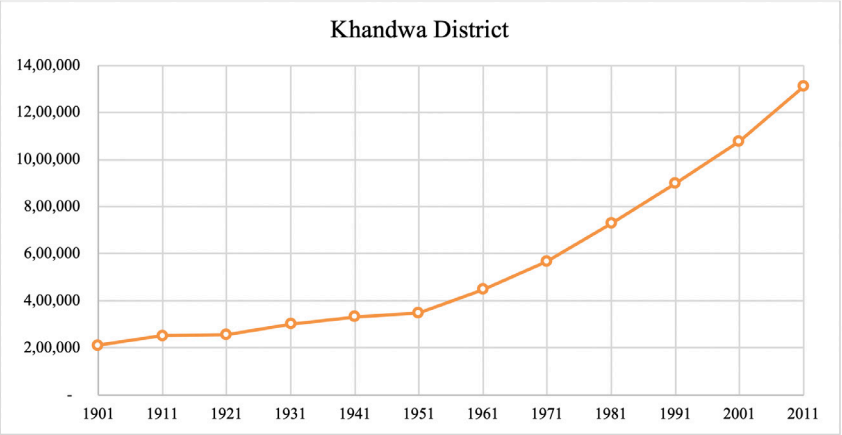


Figure 2: Decadal variation in population since 1901

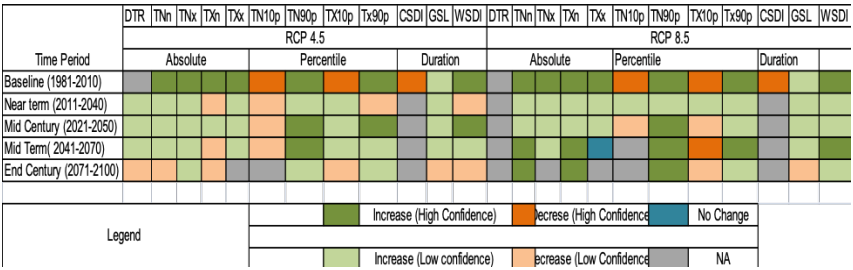
The area of the district is 7524.50 sq. km, and it has been divided into three tehsil, seven blocks, 423 panchayats and 725 villages. The geographic area of the district is 7,52,450 Ha (7524.5 Sq. Km) out of which the forest occupies an area of 309200 Ha. The district consists of 4 revenue subdivisions, 5 tehsils, 22 revenue circles, 422-gram panchayats, 710 revenue and 54 forest villages.

2.2. Climate Risk Profile of Khandwa

The climate of Khandwa district is characterized by hot summer and general dryness except during the south west monsoon season. The eco-climate of the area is semiarid, second degree mega thermal type of summer concentration with winter water deficit. A year may be divided into four distinct seasons - the cold season which lasts between December to February is followed by the hot season (March to middle of June). The monsoon season is from the middle of June to September. October and November form the post monsoon season of the district. North East monsoon has minimum contribution to ground water or to agriculture of the district. South west monsoon brings 90.5% of total rainfall in monsoon period (from June to September). Thus only 9.5% of rainfall occurs in the October to May period. Total annual rainfall is 777.6 mm.

Temperature: The district experiences hot summer days with temperature rising to 41.50C while it falls to 11.20C. The annual mean maximum and minimum temperature of Khandwa district is 340C & 19.50C respectively. The temperature indices indicate that monthly minimum (TNn) and maximum (TNx) value

of daily nighttime minimum temperature, monthly minimum (TXn) and maximum (TXx) value of daily nighttime maximum temperature is set to rise in the low emission scenario (RCP 4.5) for near term and mid-century period. Rise in temperature may result in high evapo-transpiration causing water distress for irrigation and domestic use along with rise in heat stress. Diurnal Temperature Range (DTR)[1] is set to increase in RCP 4.5 scenario. The above-mentioned indices are key for crop growth. Rise in nighttime temperature and higher DTR would have negative repercussions for growth of rabi crops (grown in the winter season) such as wheat gram and other pulses in the district.



Rainfall: There is decline in average annual rainfall by 34.1% during 1961-1990 and 1991- 2013 as shown in Fig 3. Decline in rainfall coupled with drop in number of rainy days in the district indicates erratic rainfall in the district. Very heavy rainfall (R20MM) is likely to increase in the district which could create flood like situation in the district. Most of the rainfall in the district occurs during the monsoon season. Rainfall may occur in most of the months except March-April in pre monsoon and October-December months (North East Monsoon) in post monsoon period.

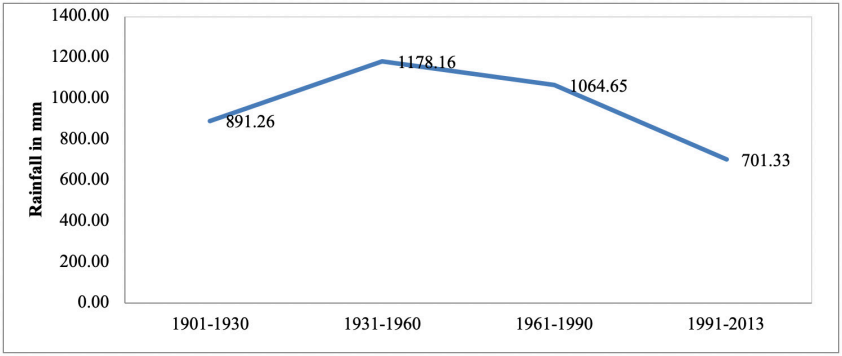
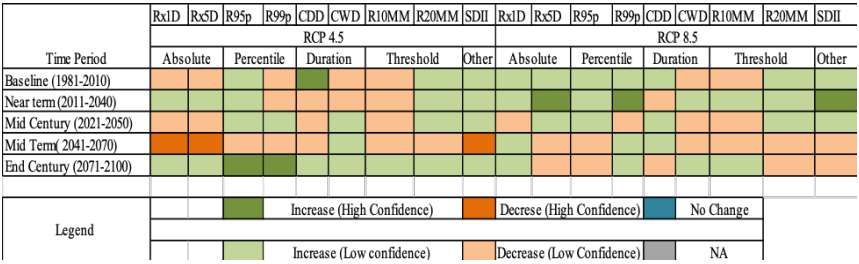


Figure 3: Average rainfall in Khandwa district

[2] DTR is the monthly mean difference between daily maximum and daily minimum temperature.



RCP	Index	Annual				Winter (JF)				Pre Monsoon (MAM)				Monsoon (JJAS)				Post Monsoon (ONI		
		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
RCP 4.5	Max Temp	1	1.3	1.6	1.9	1.2	1.6	1.9	2.2	1.2	1.7	2.4	2.8	0.6	0.7	1.1	1.4	1	1.3	1.3
RCP8.5		1.3	1.6	2.4	4.2	1.6	2	2.9	4.6	1.6	2.1	3.4	6	0.9	1.1	1.7	3.2	1.2	1.4	2.1
RCP 4.5	Min Temp	1.1	1.5	2.1	2.8	1.2	1.7	2.3	2.6	1.3	1.7	2.4	3.2	1.2	1.6	2.4	3.2	0.8	1	1.5
RCP8.5		1.4	1.9	3.4	5.7	1.1	1.7	3.1	5.1	1.8	2.4	3.8	6.2	0.3	2.1	3.8	6.7	0.9	1.4	2.5

Rainfall (Change from		Annual				Winter (J-F)				Pre Monsoon (MAM)				Monsoon (JJAS)				Post Monsoon (ONI		
		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-	NT-BL	MC-	MT-BL
RCP 4.5	Precipitation	4.6	11.5	15.2	15	0.9	1.5	2.8	2.3	-0.4	-2.9	1.2	3.6	12.5	31.2	32.2	28.2	-2.5	-3.3	2.2
RCP8.5	%	6.8	8.3	13.8	17.6	-1	-0.2	0.9	4.3	-0.2	0.8	1.3	-0.3	15.1	15.7	27.4	31.1	2.1	4.5	5.3

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

Decline in rainfall would have negative repercussions for agriculture and ground water recharge. The analysis of ground water states that in the pre-monsoon period (May 2012), water level ranges between 4.9 to 14.98 mbgl[2]. In most part of the district the water level hovers around 8 to 12 mbgl. During post monsoon period (November 2012), depth of water level is 1.45 to 7.07 mbgl. The analysis of ground water data during May 2003-May 2012 indicates both rise as well as decline in water level in the district. The rise in the water level is in the range of 2.18 to 7.09 cm/year whereas decline is in the range of 0.64 to 21.53 cm/yr. The status of ground water for 2017[3], 2013[4], 2009[5] and 2004[6] is given in the table below. The ground water extraction trend shows gradual depletion of resources up to 2013. However, there is significant drop in ground water extraction (by about 30%) need further research and analysis. Considering the rainfall and temperature trend in the district, ground water resources is a key sector and thus water management needs to be prioritized.

[1] Mbgl – Metre Below Ground Level
[2] National Compilation on Dynamic Ground Water Resources of India, 2017
[3] http://cgwb.gov.in/Documents/Dynamic%20GWRE-2013.pdf
[4] http://cgwb.gov.in/Documents/Dynamic-GW-Resources-2009.pdf
[5] http://cgwb.gov.in/Documents/Dynamic-GW-Resources-2004.pdf

Year	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											
	Recharge from Rainfall	Recharge from other sources	Recharge from Rainfall	Recharge from other sources	Total Annual GW recharge			Irrigation	Industrial	Domestic	Total			
2017	52810.08	2736.45	0	51211.66	106758.19	5962.66	101065.53	40713.2	397.56	2253.1	43364.22	3334.75	56620.06	42.91
2013	70273.8	2012.27	0	10446.48	82732.55	4136.82	78595.73	48690.4	*	2934.56	51625	4976	24629.29	73
2009	69849	1845	0	9305	80999	4050	76949	44887	*	2696	47583	4644	27417	62
2004	64001	927	0	8293	73222	3662	69560	38485	*	2391	40876	4175	26901	59

* Domestic water extraction has industrial water supply included in it

Figure 4: Average rainfall in Khandwa district

Ground water quality in Khandwa district is accessed annually by CGWB on the basis of water samples collected from hydrograph stations in the district. Groundwater in the district is generally medium to high saline as electric conductivity values varies between 539 to 2243 µs/cm at 25° C. Fluoride in the district ranges from 0.02 to 0.77 mg/l and the nitrate concentration ranges from 29 to 258 mg/l.

Hazards:

Floods: Among all the natural hazards, affecting the State of Madhya Pradesh, floods are most frequent and devastating. In other words, the state is highly prone to flood hazard. As per the data available from the Revenue Department, the state has faced severe floods in the year of 1982, 1983, 1984, 1986, 1992, 1994, 1996, 1997, 2003, 2005, 2006, 2012. It was also observed that more than 80% of the annual rainfall is concentrated over a short monsoon period of 3 months. This leads to heavy siltation, flash floods and poor discharge of flood waters, and thus sometimes even the embankments are breached due to this reason. In Khandwa district, surrounding areas of Indira Sagar Reservoir in Harsud and Khandwa tehsil are highly prone to floods.

Drought: After the flood hazard, the next severe hazard applicable to the state is Drought. On the basis of the data available of last 30 years, it was observed that the pattern of drought in the state is of a varied one, sometimes affecting the entire state, sometimes a few regions, and sometimes a few districts. The drought is a major problem for Khandwa district. In the year of 2000-01, 2002-03, 2007-08, 2008-09, 2009-10 the district has suffered drought as per agriculture department. Due to recent changes in the global climate in addition to the scarcity of water sources, dependence on rainwater fed rivers for agriculture, less no. of check dams and less percolation of water inside soil due to rocky terrain, there is an observed drought situation and affects primarily the agriculturists.

[7] http://mpsdma.mp.gov.in/uploads/media/Khandwa__DDMP_Final.pdf

Khalwa block is mainly affected from drought and only one crop is grown here.

2.2.1. Climate Change and Poverty

Apart from the hazard prone geographical conditions, the Khandwa district is also vulnerable due to the unplanned developments, growth in the population and temporary settlements in various areas. In the rural areas of the district, it's the lack of awareness among the rural communities and also their remoteness, which makes them more vulnerable to disasters. In addition to the natural causes, various manmade activities have also added the multiplier effect and created the imbalance in overall ecology of the area. All these factors have combined to turn this district into a unique region, affected by almost all the types of natural disasters.

The per capita income per annum of the district in 2012-13 was Rs. 39,726 against Rs. 13070 in 2004-05. In 2010-11, the per capita income per annum for the district was Rs. 13,070 whereas state per capita income per annum at current prices was Rs.32,453. The poverty head count ratio in Khandwa district is 41.2 in 2011-12 which means monthly per capita consumption expenditure (MPCE) of 41.2% of the population is less than the defined poverty line expenditure. It 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.

District with more than 50 % higher poverty than State Average Poverty	Central Sample	State Sample	Combined Sample
	Sagar, Jhabua, Sidhi, Raisen, Seoni, Shahdol, Khandwa, Mandla, Umaria	Katni, **Khandwa**, Chhatarpur, West Nimar, Betul, Satna, Panna, Bhopal, Harda, Shahdol, Barwani	Khandwa, Sidhi, Harda, Chhatarpur, Mandla, Betul, Panna, Umaria, Shahdo

Source: District wise Poverty Estimates for Madhya Pradesh

As per agricultural contingency plan 2012, the cultivable land area of the district is 39% of the geographical area. 11% of the land area is on non-agricultural use whereas 7% of the area is permanent pastures. Out of 300,600 Ha net area sown, 40.85% of the area (122,800 Ha) has assured irrigation sources such as canal, tube well, lake and others. 39.82% of net sown area (119,700 Ha) is dependent on rain-fed irrigation. 62.8% of the area is irrigated with open wells bore wells provide water to 13.1% of area. Apparently, without ensured irrigation, agriculture in the district may fail during erratic/unseasonal rainfall or drought conditions. The low cropping intensity

[8] Land use and land cover effect on groundwater storage
[9] Water Resources Department

The district is mainly known for cotton and vegetable cultivation. The principal kharif crops grown in the district are Paddy, Jowar, Maize, Soyabean, Split black gram (Urad) and Pigeon pea (Tur dal). Main rabi crops are wheat, gram and other pulses. The average annual rainfall of the district is 950 mm approximately. Vegetable is the major horticultural crop which is cultivated both in kharif and rabi season.

The workers of the district are divided into four broad categories i.e., cultivators, agricultural labourers, workers in household industries and other workers[8].

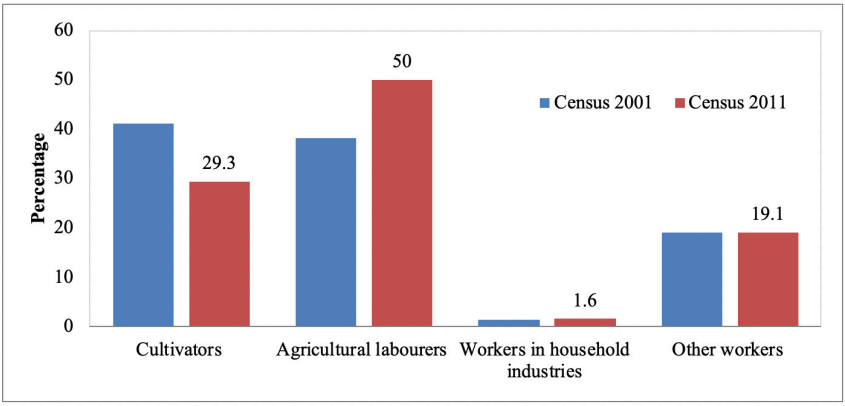


Figure 5: Categories of workers in the district (Source: Census of India, 2011)

A comparative analysis of Census 2001 and 2011 data states that the percentage of agricultural labourers has increased by 30.1% whereas percentage of cultivators has declined by 28.71%. The negative growth of cultivators shows that farmers have shifted to non-agricultural activities due to unpredictable weather parameters and inadequate farm income which is corroborated by positive growth of agricultural labourers. 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 flood situation.

2.2.2. Topography, Hydrology and Land use

Most of the district has an elevation of between 180 to 900 m above MSL. The district has an area of 7352 km^2, and it ranks 14th among all districts of state by area. Khandwa district lies in the Nimar region, which includes the lower valley of the Narmada river, Kherkhali river, Choti Tawa river, Shiva river. The

[8] 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.

Narmada forms part of the northern boundary of the district, and the Satpura range forms the southern boundary of the district. The drainage of the district falls under the Narmada and the Tapti river systems. The water-parting line between the two river-systems runs along the crest of the northern rang of the Satpura. The major portion of the district, north of this line, except the low tracts of Chandgarh and Selani, drains towards the north onto the Narmada through the Chhota Tawa and Kaveri rivers and a large number of small streams.

The nature and characteristics of soils are dependent primarily on relief of the area, which influences the variation in soil formation. The soil of Khandwa district is classified as medium black soils under the broad classification of soil of India. There are alluvial deposits constituting gravel sand, silt or clay sized unconsolidated alluvium found along the narrow strips of rivers.

Khandwa district has a forest area of 2818.42 sq. kms accounting for 33.94% of the total geographical areas of the district. Reserved forest area is 2727.24 sq. km, protected forest area is 63.69 sq. kms and unclassified forest area is 27.49 sq. kms. It is one of the most extensively forest covered district with four main types, viz., Mixed Teak, Mixed Teak and Anjan, Pure Anjan, and Salai forests. Mixed Teak and Anjan forests contain Anjan are mostly in Harsud tahsil along the south bank of Narmada. Anjan is also confined to the Narmada valley in the district. Salai forests constitute nearly half the forest area.

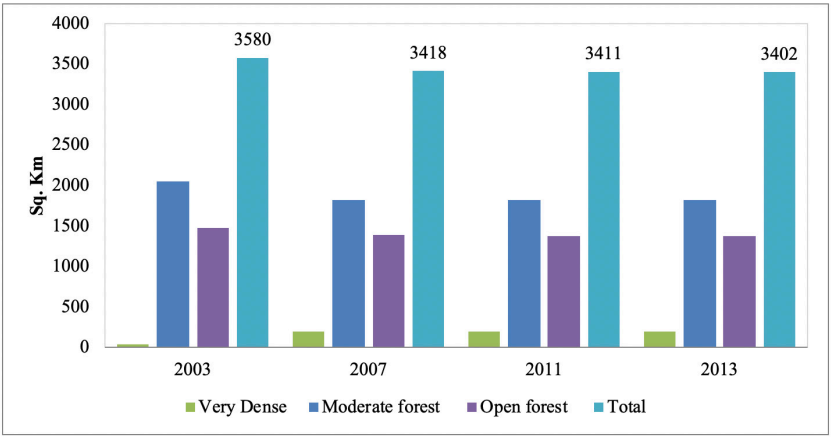


Figure 5: Categories of workers in the district (Source: Census of India, 2011)

The forest area has declined by 37%, from 50,705 Ha to 31,922.09 Ha. As per agricultural contingency plan 2012, 39.86% of the total geographical area is

under forest. However, as per India State of Forest Report 2019, forest occupies 28.42% of geographic area. The Forest Survey of India reports that the moderate and open forest area declined by 11.27% and 6.96% respectively between 2013 and 2003 whereas total forest cover decreased by 4.9%.

The forests afford shelter to numerous species of wildlife. Bison is rare in the district but found in the forests of Tapti valley and north of Narmada. Leopards or panthers locally known as Adana or Chaundaria, Cheeta or Bimat are found all over the district. Bears are found mainly in the rocky hills to the south of the district. Nilgai or Blue bull is quite common.

2.3. Adaptive Capacity and Vulnerability

Department of Science and Technology (DST, GoI) conducted the district-level climate change vulnerability assessment for Madhya Pradesh.[9] 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 ack 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. Figure 7 shows that Khandwa is highly vulnerable districts in Madhya Pradesh.

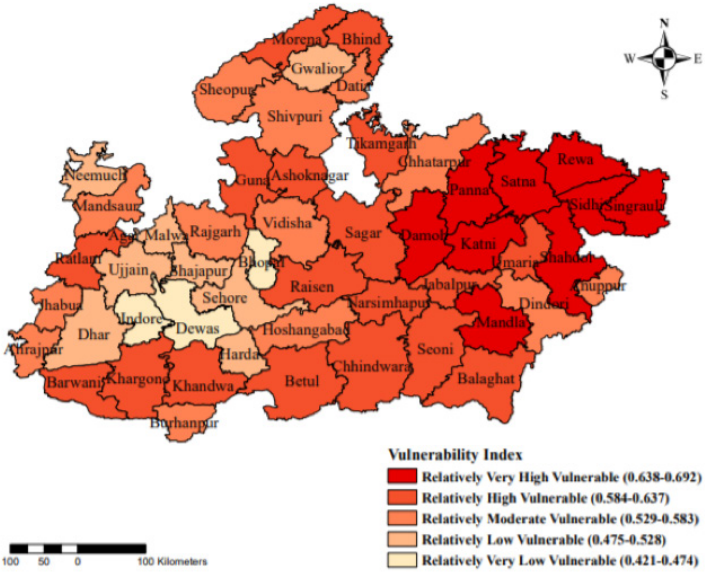


Figure 7: Map showing vulnerability Categories of Madhya Pradesh at district level (Source: DST, 2019-20)

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

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, Khandwa falls under moderate vulnerability category. The current and future vulnerabilities of the district in different sectors are as given below:

i. Current Vulnerability (1981-2010)[10]

District	Climate	Agriculture	Social	Economical	Water Resources	Forest	Composite
Khandwa	M	M	M	L	H	VL	M

ii. Future vulnerability (2021 – 2100)

The study also provided 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[11] for mid-century and end century is represented as below.

District Khandwa	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	H	VH	M	L	H	H	EH	EH	M	M
End Century	H	VH	L	L	H	H	EH	EH	M	M
	Legend		EH - Extremely High	VH - Very High	H - High	M - Moderate	L - Low			

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

About 79% of the total workforce is dependent on agriculture in Khandwa. Many farmers are small and marginal farmers, who are 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

[10] http://www.climatechange.mp.gov.in/en/vulnerability-dashboard

[11] 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.

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

assets. All of these indicate higher sensitivity and lower adaptive capacity of Khandwa.

Socio-Economic Variables	Khandwa	Madhya Pradesh
Household size - > 5 members (%)	34.4	32.7
Women headed household (%)	8.5	9.4
Population below age 15 years (%)	30.9	30.3
Scheduled Caste and Scheduled Tribe population (%)	47.0	36.7
Illiteracy rate (%)	52.5	48.2
Agricultural dependency (%)	79.3	69.8
Households with no land (%)	65.3	54.7
Households having monthly income of highest earning household member - less than Rs. 5000 (%)	83.9	83.5
Marginal worker (%)	19.7	28.1
Non-worker (%)	53.2	56.5
Households without electricity connection (%)	9.7	10.1
Households without an improved drinking-water source (%)	21.9	15.3
Households without an improved sanitation facility (%)	65.9	66.3
Households without assets (%)	43.2	32.6
Households without any usual member covered by a health scheme or health insurance (%)	89.3	82.3
Data Source: Census of India, 2011; Socio Economic Caste Census, 2011; National Family Health Survey - 4, 2015-16		

Khandwa is most vulnerable socially due to bad sanitation facilities, low literacy rate, unsafe drinking water, poor health infrastructure, higher percentage of people below poverty line and higher scheduled tribe's population.

Block Level vulnerability assessment					
Blocks	**Physical/ Infrastructural Vulnerability**	**Environmental/ Natural vulnerability**	**Social vulnerability**	**Economic vulnerability**	**Institutional vulnerability**
Khandwa	Submerged villages of block	Flooding of villages	Rehabilitation and property loss	Loss of life and property	Damage to govt. property
Pandhana	Buildings of govt. and people	Damage of ecosystem balance and species	Damage and rehabilitation of people	Loss of crop, livestock, and life	Damage to govt. property
Harsood	Submerged villages	Water fills during rains, loss of biodiversity	People resettled at evacuated villages	Loss of life and property	Damage to house and land
Punasa	Omkareswar ghats and surrounding area	Flooding, loss of biodiversity of area due to dams	Encroachment of people around ghats	Life and property loss	Damage to house and land

Source: District Disaster Management Plan - Khandwa[13]

2.4. Integrating Climate Concerns in District Development

Khandwa has featured in India's 283 most backward districts list.[14] 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 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.

[13] http://mpsdma.mp.gov.in/uploads/media/Khandwa__DDMP_Final.pdf
[14] http://acad.uohyd.ac.in/downloads/backdist.pdf

State/District	Health	Education	Standard of Living	HDI values
Madhya Pradesh	0.6225	0.6440	0.459	0.5687
Khandwa (East Nimar)	0.5881	0.5035	0.4821	0.5226

Source: Development of Human Development Index at District Level for EAG States, 2016[15]

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

are gaps, new strategies are proposed in order to integrate climate resilience in district governance through convergence, customisation and consultation. Additionally, continuous monitoring, evaluation and adjustment is essential to ensure strategies are kept relevant to the district's needs and situation.

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.

[15] https://www.ssca.org.in/media/4_2016_HDI_t1hcMZm.pdf

Considering the need for effective planning to build climate resilience at district level, the DCRP is designed to be a handbook that provides an approach to achieving resilience of district peoples, economy and ecosystem through convergence of all relevant policies, laws, schemes and planning tools while being flexible to the local context and emerging situation from climate risks.

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

3.1. Drinking Water Sufficiency

3.1.1. Lessons from the water-surplus history of Bundelkhand

The Chandela and Bundela rulers between the 10th and 18th centuries took a keen interest in conserving water as a means of supporting the livelihoods and the development of the region. They established a network of several hundred tanks to ensure a satisfactory level of groundwater. The tanks enriched the underground water levels, increased the level of water in wells and the increased soil moisture resulted in the abundant growth of vegetation. The farmers used the wells, tanks, etc. for limited irrigation.

The water tanks, lakes and surface reservoirs built by tapping many streams using the sloping topography of the region to build embankments on the downstream sides were a strategic response to the terrain and hydrology of Bundelkhand.

The British Administration, post 1860, constructed canals and linked them to the existing tanks in order to sell water to the farmers, divesting people of their control over local natural resources. Till 1970s, the state governments maintained the tanks by paying for the Chowkidars (guards) for the tanks and then stopped thereafter which led to a decline in the maintenance, which in turn led to the silting of the tank beds, etc. By the end of the 20th century, the total area irrigated by the wells, ponds, tanks etc. had considerably reduced. There is a need to bring back the mechanism of water bodies maintenance through guards paid for by Water Users Associations (WUAs), Farmers Co-operatives and State Government.

3.1.2. Current situation and challenges

The key challenge in climate-constrained district of Khandwa is the sustainability of water sources to meet the current and projected consumption levels. The multiple drought spells have led to severe drinking water crisis in Khandwa. Most of the tanks and ponds as well as traditional and masonry wells used for drinking water purposes have dried up. Despite their usefulness, the traditional

tanks stand neglected and fell into disuse or encroached. In the villages, these common resources have been privatised for development of fisheries. Many tanks were flattened to raise paddy crops or for the expansion of village settlements. In urban areas, large-scale shopping and residential complexes were raised closed to the tanks filling them up with filth and drain/sewer disposals.

Madhya Pradesh is staring at an acute water shortage as 65 dams, out of 164 important reservoirs in the state, have almost dried up. The Indira Sagar Dam, built over the Narmada river in MP's Khandwa district, has around 2,104 million cubic metres (MCM) of water as against a total capacity of 9,750 MCM.

Many rivers have gone dry, many shrunk to a dangerous level and there is a drastic fall in water table, due to which people in more than half of the state are not getting daily water supply. The situation is such in some parts that there is no water supply and the precious commodity is being transported by tankers. The situation is even worse in the Bundelkhand and Chambal region. Reeling from severe water crisis, people have to walk 1km to 5km in search of water. More than 30 per cent of the hand pumps and tube wells are not functioning due to mechanical glitch or a steep dip in underground water level. Many risk their lives to fetch water from old dug wells.

Issues in Water as a Resource in Madhya Pradesh

- Variability in rainfall necessitates region-specific water use policy
- Despite being richly endowed with surface water there is too much reliance on groundwater
- Evidence of conjunctive exploitation of ground water and surface water not found
- Presence of fluoride, salinity and iron will lead to adverse and irreversible health problems
- Lack of data on different demands for water, their quantum, and how they are currently being fulfilled

Inadequate groundwater recharge in this region due to rocky terrain, high runoff of rainwater and over-exploitation resulted into depletion of groundwater leaving thousands of hand pumps defunct. Water scarcity also triggered caste conflicts over access to water.

The quality of ground water has also progressively deteriorated. Tremendous use of ground water has brought adverse changes in the geochemistry of water. Climate change will further increase ground water extraction due to less

availability of surface water and rising demand which could further deteriorate ground water quality and have serious effects on health of people. Greater variability in rainfall could result in frequent and prolonged periods of high or low groundwater levels, and saline intrusion in aquifers.

While industrialisation is promoted as a means to address unemployment and distress migration, it will put pressure on limited water availability, as comparable share of water consumption by industry in rich industrialised countries is more than 50%. Water consumption and wastage in urban and peri-urban areas needs to be monitored and managed.

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.

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, 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 rebuild the schemes.

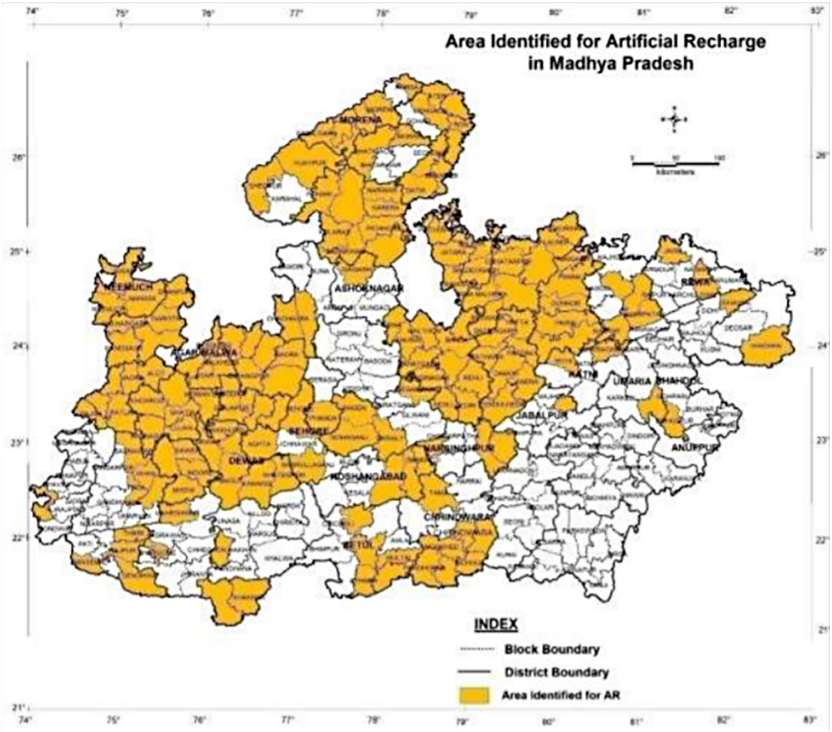
Bringing accountability and programmatic approach in the system to ensure water availability will be instrumental to ensure results. Decentralisation puts planning, implementation, operation and maintenance in the hands of beneficiaries. This creates ownership and commitment to action. Through programmes 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 suggesting 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. 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 retrofitting 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.

3.2. Agriculture Productivity & Livestock Resilience

3.2.1. Vulnerability from Climate Change Impacts and Farm Practices

The general lack of water for irrigation and recent droughts have affected the farm productivity, allied livelihoods, agricultural practices and the livestock leading to various social vulnerabilities in this region. Climate change enhances these vulnerabilities. In a drought year, the area under cultivation drops by half. They stand at risk of no food and income in event of drought or heat wave or untimely rainfall, thus, depends on other livelihoods such as daily wage labour.

Food security is the primary objective of cultivation by the small holding farmers and in the event of that at risk along with net loss on investment, many young farmers are looking to give it up leading to mass migration.

Irrigation and Water-use Efficiency

Agriculture practiced today in Khandwa is largely rain-fed as dug wells and

borewells either doesn't hold groundwater through the year and/or are costly 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.

1.6	**Irrigation**	Area ('000 ha)		
	Net irrigated area	1.7		
	Gross irrigated area	1.7		
	Rainfed area	202.0		
	Sources of Irrigation	Number	Area ('000 ha)	Percentage of total irrigated area
	Canals	38	1.1	64.7
	Tanks	0	0	0
	Open wells	397	0.2	11.7
	Bore wells	0	0	0
	Lift irrigation schemes	NA	NA	
	Micro-irrigation	NA		
	Other sources (reservoir)	697	0.4	23.5
	Total Irrigated Area		1.7	
	Pump sets	765		
	No. of Tractors	703		
	Groundwater availability and use* (Data source: State/Central Ground water Department /Board)	No. of blocks/ Tehsils 07	(%) area	Quality of water (specify the problem such as high levels of arsenic, fluoride, saline etc)
	Over exploited	-		
	Critical	-		
	Semi- critical	-		
	Safe	07		
	Wastewater availability and use	-		
	Ground water quality	-		
*over-exploited: groundwater utilization > 100%; critical: 90-100%; semi-critical: 70-90%; safe: <70%				

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.

Money invested in irrigation canals does not come with assurance and predictability of water leading to losses to farmers growing crops dependent on canal water.

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 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.

Economies of Scale and Risk-bearing Capacity

Nearly 80% of the farming households in the district cultivate less than 2 hectares

and at times their fields are scattered so economies of scale are not achieved as well as net income is quite low. They are highly vulnerable to long delays in subsidies transfer or crop losses. This need for food security and low risk bearing capacity are the reasons behind the lack of favour from most farmers to crop diversification towards high value horticulture and other products. Challenges in land leasing at scale deter move towards consolidation of land holdings by interested farmers.

Livestock Selection and Care

Cows and goats play a very important role in the rural economy, although farmers are getting very low output from these animals. Now, resourceful farmers are replacing cows with buffaloes. Crossbreeding native species with the foreign breeds is not finding favour by the people as they are not accustomed to the heat of Bundelkhand. The veterinary clinics are insufficient in number and staff to provide regular care to all the livestock; the camps also have not been able to reach all villages since the farmers cannot afford the transportation for their livestock. For pastoralists and agro-pastoralists whose livelihoods and food security depend on livestock, drought conditions can cause malnutrition or disease in livestock because of insufficient fodder and deterioration in pastoral lands. The relatively lower double cropping in Khandwa has to do with both the local practice of 'anna pratha' as well as insufficient/ineffective irrigation facilities when rain is less than needed.

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 district level. Adaptation strategies such as altering the sowing dates or the choice of crops 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 pace can be given 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 generalize climatic observations and adaptation solutions. Additionally, the reach of communications and regular interface with farmers in each Gram Panchayat is still a challenge.

Policy Gaps

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. accountability for all 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.

The experience of various initiatives in Bundelkhand has shown that it is the combination of efficient water management/ harvesting techniques together with farmer-level interventions to make informed crop and seed choices as well as cropping practices supplemented with effective customization of and coordination amongst State Government programmes to support pre- and post-harvest farmer needs that will address agriculture issues.

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 Khandwa.

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 groundwater and surface water bodies pollution 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 livestock or breeds that can sustain in heat and drought should be promoted as well as measures are 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 supply these directly to retailers including e-retailers in towns and cities will help farmers achieve suitable prices and encourage efficient water management.

Disaster compensation and crop insurance
Minimum 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 landholdings farmers, and ensure assessment is made accurately and comprehensively. This requires capacity building at PRI and district administration level for credible assessment.

Knowledge creation and dissemination
Local and national agriculture institutions should collaborate with farmer producer 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 Khandwa. 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.

Convergence, customisation and consultation
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.

3.3. Livelihood Options & Income Security

In Bundelkhand, migration has been a socio-economic norm, with generations upon generations of families opting for it in order to survive. Lack of livelihood, food and water insecurity, and rural health system are the leading causes of migration from Bundelkhand.

A special relief package was announced for the region, under which BPL cardholders are to get rice, wheat, sacks of potato, oil, and pulses although most of the eligible people had failed to register their names due to various reasons besides lack of awareness about the scheme.

Given the very high vulnerability of the district to climate change impacts, incomes need to be diversified beyond small holding agriculture and MGNREGS. Excessive 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 were 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;
5. Other enabling conditions that sustainably support growth.

Instead of large infrastructure projects that usually remain out of reach for farmers, a long-term livelihood option would be complementary micro-enterprises that are linked to markets.

The district railway stations, bus stands and towns could set up "migration helpdesk" for support to prepare for life in a new place. The helpdesk could be linked with similar helpdesks in major towns receiving migrants for dignified temporary resettlement in the form of skills training, jobs, housing, healthcare and education. This will enable the migrating population to be empowered if and when they return as well as boot local economy with higher monetary remittances.

Tourism for pilgrimage spaces and ecological tourism offers alternate livelihood opportunities and District Administration can support through suitable infrastructure and services. Sustainable and reliable multi-modal transport ensuring full connectivity between various tourism spots and transport hubs will enhance tourism.

Mission Antyodaya recognises the multi-dimensional aspects of poverty, thus, has made Gram Panchayat and its Development Plan (GPDP) as the centrepiece where all development programmes and information will be converged.

3.4. Nutrition Security & Access to Healthcare

3.4.1 Challenges

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 at much beyond their capacity. As per National Family Health Survey (NFHS) 2015-16, approximately 46% children in the district are either stunted (height-to-age), or underweight.

Women and men whose Body Mass Index (BMI) is below normal were 33% and 38%, respectively. The malnutrition cases are higher than ever. According to a test conducted in 6 locations of Bundelkhand region in the year 2016, 17 undernourished children and 35 severely malnourished children were recorded at an average of about 9 per hamlet. In 65% cases informants, mostly mothers, stated that their milk was insufficient to meet the demand of the infant and they resorted to buying expensive commercial products from the market. According to another study, in 40% cases people have reported to go to bed hungry because of insufficiency of food. The pregnant and post-partum mothers of Bundelkhand are manifestly malnourished. The lack of water and food today could impact tomorrow's generation implying weaker workforce and undeveloped talent.

Child Feeding Practices and Nutritional Status of Children	
62. Children under age 3 years breastfed within one hour of birth[9] (%)	30.6
63. Children under age 6 months exclusively breastfed[10] (%)	(46.1)
64. Children age 6-8 months receiving solid or semi-solid food and breastmilk[10] (%)	(36.0)
65. Breastfeeding children age 6-23 months receiving an adequate diet[10,11] (%)	3.0
66. Non-breastfeeding children age 6-23 months receiving an adequate diet[10,11] (%)	*
67. Total children age 6-23 months receiving an adequate diet[10,11] (%)	2.7
68. Children under 5 years who are stunted (height-for-age)[12] (%)	43.6
69. Children under 5 years who are wasted (weight-for-height)[12] (%)	21.5
70. Children under 5 years who are severely wasted (weight-for-height)[13] (%)	6.6
71. Children under 5 years who are underweight (weight-for-age)[12] (%)	46.8

As per National Family Health Survey (NFHS) 2015-16, approximately 46% children in the district are either stunted (height-to-age), or underweight. Women and men whose Body Mass Index (BMI) is below normal were 33% and 38%, respectively. The malnutrition cases are higher than ever. According to a test conducted in 6 locations of Bundelkhand region in the year 2016, 17 undernourished children and 35 severely malnourished children were recorded at an average of about 9 per hamlet. In 65% cases informants, mostly mothers, stated that their milk was insufficient to meet the demand of the infant and they resorted to buying expensive commercial products from the market. According to another study, in 40% cases people have reported to go to bed hungry because of insufficiency of food. The pregnant and post-partum mothers of Bundelkhand are manifestly malnourished. The lack of water and food today could impact tomorrow's generation implying weaker workforce and undeveloped talent.

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

3.4.2 Requirements

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 community to manage health impacts need 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, et al need to be based on decentralised systems of food choices, production and procurement feasibility, storage, processing and distribution. This implies locally sustainable, diverse and nutritious foods such as local green vegetables, fruits, millets, pulses, oilseeds et al 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 grow through dryland agriculture, agro-forestry and low input costs. Women self-help groups should be encouraged and supported to grow nutritious foods in public spaces such as schools, anganwadis, hospitals and parks. Forest produce as uncultivated foods is 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

Forests play a major role in maintaining ecological balance, in bringing rainfall and in countering heat waves, which is a priority for Khandwa. Deforestation in the region has impacted rainfall, groundwater and soil conservation adversely. At present, the biodiversity of Khandwa is declining fast due to the degradation of habitats by heckles and indiscriminate cutting of forests for timber, fuel wood, land use change through expansion of agriculture and construction, quarrying of stones, grazing, invasion of alien weeds, overexploitation of plants for medicines, etc.

Increasing heat as well as human interference has caused loss of wildlife, which is also essential to maintain basic ecosystem services.

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.

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 Khandwa 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 level, 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.

See Annexure 4.1 for institutional set-up required in district planning.

The DCRP will need to build on the State Action Plan on Climate Change (SAPCC) of U.P. as well as integrate any special initiatives launched for the district such as drought relief package and NITI Aayog's TAD 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.

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's 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 Khandwa 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 waterworks; (iii) Setting goals, targets, indicators of progress, transparency, user responsiveness and accountability mechanism applicable to Khandwa 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	(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

		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.	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 & 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;	(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;

		(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.	
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;	(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.

		(vi) Resilient breeds of livestock to be promoted for enterprise and nutrition as well as animals let loose under anna pratha be utilised for marketable products by dairy and manure entrepreneurs; (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.	
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-checkups 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

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
Priority 4: Nutrition and Access to Healthcare	i) Primacy to nutrition security and healthcare under direct supervision by head of district administration to ensure convergence in schemes and budgets; (ii) Mobile health vans and camps for BMI & health surveys to focus government interventions on nutrition and treatment for remote villages; (iii) Data uploaded on mission websites monthly on water quality and availability, malnutrition, and BMI levels in every village/town with next steps planned;	Departments - (i) Health (ii) Informatics (iii) Education Schemes/ Missions - (i) National Nutrition Mission (ii) National Health Mission

	(iv) Training to Anganwadi Workers and Teachers on primary steps for nutrition and healthcare along with formation of women SHGs to produce nutrition foods in the available premises.	(iii) ICDS, Mid- Day Meal, PDS (iv) Bundelkhand package
Priority 5: Ecological Balance	(i) Demarcate critical habitats for local ecology as no-go zones with any amendment after comprehensive stakeholder consultation; (ii) Develop district plan in sync with SDGs and TAD initiatives; (iii) Initiate a culture of consultative and inclusive governance in the district by all entities and governing bodies; (iv) Engage thematic/sectoral experts from academics and field practitioners for advice on convergence and coherence in schemes implementation and investment planning after the district plan is made.	Departments - (i) Environment (ii) Forests (iii) DPC (iv) Jal Sansthan (v) Revenue Schemes/ Missions - (i) Green India Mission (ii) Sustainable Habitat Mission

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 water wastage 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 geo morphological 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 et al 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 58HUs 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 incomes 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, farmers were distributed goats 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 of Field Visit

Figure 8 CANSA and EFICOR team visiting farm interventions in Khandwa

Figure 9 Interaction with Women Self Help Groups in Khandwa district

References

- 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
- 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
- https://censusindia.gov.in/2011census/dchb/2324_PART_B_DCHB_BARWANI.pdf
- 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
- 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
- Agriculture Contingency Plan, 2012
- http://cgwb.gov.in/District_Profile/MP/Barwani.pdf
- Land use and land cover effect on groundwater storage
- Water Resources Department
- National Compilation on Dynamic Ground Water Resources of India, 2017
- Water Conservation in Madhya Pradesh
- DST (2019-20). Climate Vulnerability Assessment for Adaptation Planning in India. https://dst.gov.in/sites/default/files/Full%20Report%20%281%29.pdf
- 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.
- 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
- https://censusindia.gov.in/2011census/dchb/DCHB_A/23/2324_PART_A_DCHB_BARWANI.pdf
- Agriculture Contingency Plan, 2012
- http://www.mpsdma.mp.gov.in/uploads/media/Barwani_DDMP_final.pdf
- Assessment report: Primary survey on household cooking fuel usage and willingness to convert to LPG
- https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/3934.pdf
- http://www.nicra-icar.in/nicrarevised/images/statewiseplans/madhya%20pradesh/MP1-Badwani-26.6.2012.pdf
- 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.
- http://censusmp.nic.in/censusmp/Data/PCA_DATA/006%20-%20Chapter%20-%204%20-%20WPR%2pdf
- http://rchiips.org/nfhs/FCTS/MP/MP_FactSheet_441_Barwani.pdf
- http://fsi.nic.in/isfr19/vol2/isfr-2019-vol-ii-madhya-pradesh.pdf