DISTRICT CLIMATE RESILIENCE PLAN

DAMOH DISTRICT

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South Asia

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District Climate Resilience Plan: Damoh District

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An initiative of EFICOR and Climate Action Network South Asia
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 for water rises, the pressure for efficient use of highly scarce water resources will rise manifold. As per the international norms, a country is classified as Water Stressed and Water Scarce if per capita water availability goes below 1700 m3 and 1000 m3, respectively. With 1544 m3 per capita water availability, India is already a water-stressed country and moving towards becoming water scarce. While the stress on limited water resources in the country is rising, the scarcity is not reflected in the use of water. India uses 2-4 times water to produce one unit of major food crops as compared to other major agricultural countries like China, Brazil, USA (Hoekstra and Chapagain 2008). These variations imply that if India attains water use efficiency of those countries it can save at least half of the water presently used for irrigation purposes.

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

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

Effective policy making plays a significant role in building resilience to climate change. Policies set the tone to create enabling environment for climate action and dealing with inherent structural inequalities. Speaking of inequalities, a sizeable section of people of Damoh 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 Damoh district is an attempt to do just that. The DCRP explores the points of convergence – climate concerns into district development plans in climate sensitive sectors. It identifies policy gaps and provides practical, grounded and workable suggestion to improve the status-quo in priority sectors namely agriculture, livestock, irrigation, renewable energy, health and nutrition, forest and land use.

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

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

Yours truly,

M. Ramesh Babu
Executive Director
EFICOR

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Director
CAN South Asia

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

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

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

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

To be effective, the building of climate change resilience must entail addressing the causes underlying such structural inequalities.

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

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

1.2. District Climate Resilience Planning (DCRP)

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

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

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

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

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

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

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

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

1. Flexibility

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

2. Learning

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

3. Inclusivity

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

4. Preventive management

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

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

2. DCRP Planning Process

2.1. District Profile

District Damoh is one of the districts of the Bundelkhand region of Madhya Pradesh. The district drives its name from the headquarters town of Damoh. The town Damoh is believed to have been named after Damayanti the founder and the queen of Raja Nala of Narwar. It is located in the north-eastern part of the state and is surrounded by Sagar in the west, Narsinghpur & Jabalpur in the South, Chhatarpur in the North, Panna & Katni in the east. It is situated in a plateau region about 19 km south-east of the Sonar River. Its average elevation is 595 metres (1,952 ft) and occupies an area of 7,306 sq. Km. Byarma, Sunar, Kopra and Gourayia rivers flow through the district. These rivers are the main source of drinking and irrigational water for the district. Besides, there are 69 lakes and 28 dams in the district. Rivers, lakes and dams are used both for drinking and irrigation purposes.

In terms of population, the district occupies 31st and 15th in terms of area (7,306 sq.km) occupying 2.4% of the total area of state. The total population of the district was 1,264,219 out of which 80.1% live in rural areas.

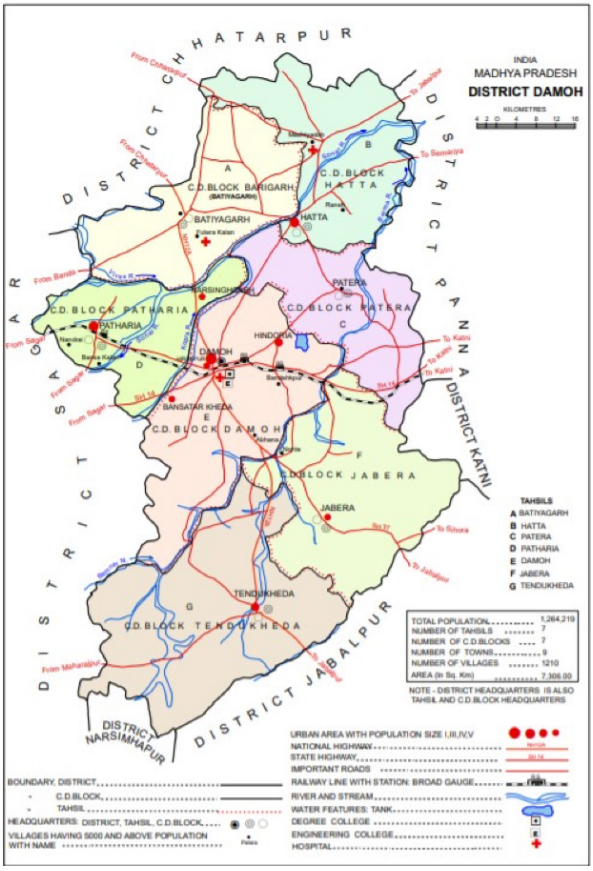

Figure 1: Location map of Damoh district (Source: DCHB, Census of India, 2011)

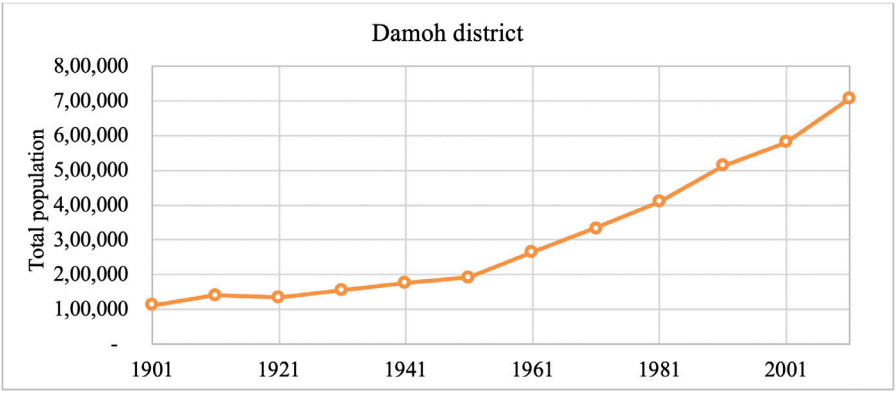

Figure 2: Decadal Variation in Population since 1901

As per Census 2011, 32.64% of the population are scheduled caste (19.49%) and scheduled tribes (13.15%). Damoh is largely inhabited by tribal communities such as Gonds, Lodhis, Karpetis and other communities (Dalits, Rajputs, Kurmis, Thakurs and Marwaris). Literacy rate of the district is 69.7% and it occupies 24th position in the state. The female literacy rate of the district is 59.2%. The economy of the district is mainly dependent on agriculture. According to Census 2011, the total number of villages in the district are 1210, out of which 1176 villages are inhabited and 34 villages are un-inhabited. The district has one parliamentary constituency i.e. Damoh and Four assembly constituencies viz. Pathariya, Damoh, Jabera and Hatta.[1]

2.2. Climate Risk Profile of Damoh

The climate of Damoh district is characterized by hot summer and general dryness except during the southwest monsoon season. The normal maximum temperature received during the month of May is 42 C and minimum during the month of December/January is 9.7 C. The normal annual means maximum and minimum temperatures of Damoh district is 32.6 Cand 18.9 C respectively. The average annual rainfall of Damoh district is 1173.0 mm. The district receives maximum rainfall (90.4% of the annual rainfall) during southwest monsoon period (from June to September). Only 9.6% of the annual rainfall takes place between October to May period, during north east monsoon. Therefore, south-west monsoon is critical for ground water recharge in the district[2].

[1] https://censusindia.gov.in/2011census/dchb/2311_PART_B_DCHB_DAMOH.pdf
[2] http://cgwb.gov.in/AQM/NAQUIM_REPORT/MP/Damoh.pdf

2.2.1. Climate Projections & Analysis from the climate portal

Temperature Indices

Time Period	DTR	TNn	TNx	TXn	TXx	TN10p	TN90p	TX10p	Tx90p	CSDI	GSL	WSDI	DTR	TNn	TNx	TXn	TXx	TN10p	TN90p	TX10p	Tx90p	CSDI	GSL	WSDI
	RCP 4.5												RCP 8.5											
	Absolute					Percentile				Duration			Absolute					Percentile				Duration		
Baseline (1981-2010)																								
Near term (2011-2040)																								
Mid Century (2021-2050)																								
Mid Term(2041-2070)																								
End Century (2071-2100)																								

Legend	Increase (High Confidence)	Decrese (High Confidence)	No Change
	Increase (Low confidence)	Decrease (Low Confidence)	NA

Rainfall Indices

Time Period	Rx1D	Rx5D	R95p	R99p	CDD	CWD	R10MM	R20MM	SDII	Rx1D	Rx5D	R95p	R99p	CDD	CWD	R10MM	R20MM	SDII
	RCP 4.5									RCP 8.5								
	Absolute		Percentile		Duration		Threshold		Other	Absolute		Percentile		Duration		Threshold		Other
Baseline (1981-2010)																		
Near term (2011-2040)																		
Mid Century (2021-2050)																		
Mid Term(2041-2070)																		
End Century (2071-2100)																		

Legend	Increase (High Confidence)	Decrese (High Confidence	No Change
	Increase (Low confidence)	Decrease (Low Confidence	NA

Multi model Ensemble Mean

RCP	Index	Annual				Winter (JF)				Pre Monsoon (MAM)				Monsoon (JJAS)				Post Monsoon (OND)			
		NT-BL	MC-BL	MT-BL	EC-BL	NT-BL	MC-BL	MT-BL	EC-BL	NT-BL	MC-BL	MT-BL	EC-BL	NT-BL	MC-BL	MT-BL	EC-BL	NT-BL	MC-BL	MT-BL	EC-BL
RCP 4.5	Max Temp	1.1	1.4	1.8	2.1	1.3	1.8	2	2.3	1.4	2	2.8	3.3	0.7	0.8	1.3	1.5	1.1	1.3	1.3	1.5
RCP 8.5		1.4	1.7	2.5	4.5	1.6	2	2.9	4.5	2	2.5	3.8	6.6	0.9	1.2	1.8	3.5	1.1	1.4	2.1	3.6
RCP 4.5	Min Temp	1	1.3	1.9	2.4	1.2	1.6	2.1	2.5	1	1.4	2	2.5	1.1	1.4	2.1	2.7	0.8	1	1.4	1.9
RCP 8.5		1.2	1.7	2.9	5	1.2	1.6	2.9	4.7	1.4	2	3.2	5.2	1.3	1.8	3.2	5.7	1	1.4	2.4	4.1

Rainfall (Change from baseline)		Annual				Winter (J-F)				Pre Monsoon (MAM)				Monsoon (JJAS)				Post Monsoon (OND)			
		NT-BL	MC-BL	MT-BL	EC-BL	NT-BL	MC-BL	MT-BL	EC-BL	NT-BL	MC-BL	MT-BL	EC-BL	NT-BL	MC-BL	MT-BL	EC-BL	NT-BL	MC-BL	MT-BL	EC-BL
RCP 4.5	%	-7	-6.5	-3.1	-4.1	8.3	21.4	28	93	-15	-58	17.4	15.3	-7	-5.6	-5	-7	-2.3	-11	11.6	15.8
RCP 8.5	Precipitation	-9	-4.9	1.2	-3.2	34.3	18.3	86	70	-21	39	49.7	13.6	-10	-5.4	0	-6	-11	-9.9	-3.3	27.9

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

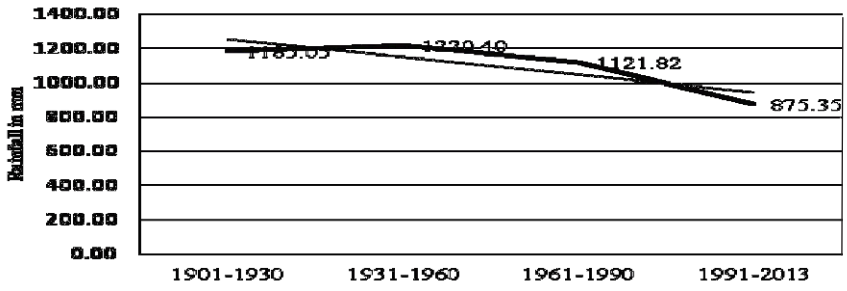

Figure 3: Average annual rainfall in Damoh district

The average annual rainfall data studied for last 62 years (1949-2010) in Damoh district indicates mean annual rainfall was 1225.1 with 30.3% variability. The district indicates significant declining trend in rainfall in the total amount of annual rainfall in the last 15 years (1996 to 2010). The annual rainfall decreased by 310.7 mm in last 15 years.[3]

In Damoh district, annual rainfall decreased by 22% during 1991-2013 from 1961-1990 (Fig 3). The rainfall indices indicate that monthly maximum 1 day (Rx1D) and consecutive 5 days (Rx5D) precipitation is set to fall in the district. Similarly very wet day precipitation (R95p - the annual precipitation higher than 95th percentile of the reference period) and extreme wet days (R99p - the annual precipitation higher than 99th percentile of the reference period) is decreasing except in mid-term (2041-2070) for both low and high emission scenario. Consecutive Dry Days (CDD – maximum number of consecutive days with precipitation below 1mm) may decrease and the increase during later part of the century in RCP 4.5 where a variable trend is observed at RCP 8.5. For consecutive wet days (CWD - maximum number of consecutive days with precipitation greater or equal to 1 mm) are set to fall in both the scenarios. All the above indices indicate drought conditions in the district. The district need to establish and practice contingency measures to support agriculture and allied activities in the area. Number of heavy (R10 mm - precipitation greater or equal to 10 mm) and very heavy precipitation days (R20mm - precipitation greater or equal to 20 mm) is likely to decrease in RCP 4.5 while the same is likely to increase in RCP 8.5 scenario. Hence flood control and management measures need to be undertaken at district level to tide over very heavy precipitation. The indices show that winter and monsoon rainfall is likely to increase and decrease respectively regardless of the emission scenario. In its recent report, Indian Meteorological Department (IMD) states that there is a significant increase in heavy rainfall days.

District	June		July		August		September		Monsoon		Annualy	
	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
Damoh	145.6	98.2	354.4	50.3	344.2	45.1	170.1	81.8	1014.9.	35	1094	37.6

Decadal Variation in Population since 1901

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[3] Rai, Suchit Kumar, Sunil Kumar, Arvind Kumar Rai, and Dana Ram Palsaniya. 2014. "Climate Change , Variability and Rainfall Probability for Crop Planning in Few Districts of Central India," no. July: 394–403. https://w-w.scirp.org/pdf/ACS_2014072510280946.pdf

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The temperature indices indicate that minimum (TNn) and maximum (TNx) value of daily night time minimum temperature is set to rise in the district. TNx is likely to decrease in the near term (2011-2040) during 2011-2040. Similarly, minimum (TXn) and maximum (TXx) of day time temperature is likely to increase in both the scenarios. Cool nights[4] (TN10p) show a decreasing trend in both RCP 4.5 and RCP 8.5 scenario. Number of warm nights[5] (TN90p) shows increasing trend with high confidence for both RCP 4.5 and RCP 8.5 scenario. Similarly the trend for number of cool days[6] (TX10p) is on decline and warm

[4]% of days – number of days with minimum temperature below 10th percentile calculated for a 5 day window centred on each calendar day in the period 1981-2010.

[5] % of days - Number of days with minimum temperature above 90th percentile calculated for a 5 day window centred on each calendar day in the period 1981-2010.

[6] % of days with maximum temperature below 10th percentile calculated for a 5 day window centred on each calendar day in the period 1981-2010.

days[7] (TX90p) are on the rise except in the near term (2011-2040) in both the scenarios. Rise in temperature may reduce. The Warm Spell Duration Indicator (WSDI) shows rise in warm spell in the district for both the scenarios except in near term duration (2011-2040). In general rise in temperature in the district raises the risks of drought and heat stress in the region. The indices also indicate rise in both maximum and minimum temperatures in Damoh district regardless of the scenario. Increase in maximum temperature is likely to be in the range of 1.1 to 3.3 0C in RCP 4.5 where as the range is 0.9 to 4.50C. The range of rise in minimum temperature is likely to be 0.8 to 2.70C in RCP 4.5 and 1 to 5.70C in RCP 8.50C.

2.2.2. Hazards

Floods:

Floods occur mainly due to heavy rainfall during monsoon. Sonar river flowing in Hattaa Block is mainly responsible for the flood in the district. The main rivers flowing in the district and the blocks that they flow through are as follows:

- Sonar River–Hatta,Batiagarh,Patharia,Patera
- Kopra River- Patharia,Patera,Damoh,Jabera
- Vyarma River-Hatta, Batiagarh

Earthquake:

Damoh lies in Seismic Zone 3. Although there is no history of earthquake in the area but still possibilities of the disaster cannot be overlooked.

Drought:
Last noted drought was 10 years ago and it had its effect throughout the district.

Fire:

All the forest area is highly prone to catching fire during summers. Industrial & chemical disasters: Narsinghgarh (Diamond Cement Factory) is one of the big industries of the state. Although no major accident has been reported but it can be categorized as a hazard prone industry.

Epidemic:

There is a possibility of Dehydration and Measles in most of the areas in the district.

[7] % of days with maximum temperature below 10th percentile calculated for a 5 day window centred on each calendar day in the period 1981-2010.

Table 1: Risk Profiling

Risk profiling of the district							
Blocks	Damoh	Batiagarh	Patharia	Patera	Tendukhera	Hattaa	Jabera
Flood							
Drought							
Earthquake							
Source: District Disaster Management Plan - Damoh							

2.2.3. Climate Change and Poverty

The per capita income per annum of the district in 2012-13 was Rs. 26,199 against Rs. 13,070 in 2004-05[8] at constant process. In 2010-11, the per capita income per annum of the state Rs.32,453. The total number of families Below Poverty Line is 1,50,498 which is 68.8% of total households (DDMP 2012). This shows that a significant proportion of the population lack economic ability to deal with frequent disasters like floods and droughts that the district is prone to. As per Human Development Report 2007[9], Human Development Index of Damoh was 0.571 which indicates widespread poverty in the region. If we take into consideration the socio – economic profile of the residents of Damoh along with the number of population below poverty line and their access to and dependence on natural resources, the vulnerability of people is very high due to low on development parameters.

The size of holdings and prolong duration of high temperature or summer is also an indicator, the community is dependent on climate variables and any change is its intensity and timing or duration could increase vulnerability of its livelihood practices.

The cultivable land area of the district is 44.2% of the geographical area. Out of total area sown of 3114 sq. Km, only 37.18% land area (1158 sq Km) has assured irrigation sources such as canal, tube well, lake and others. 62.81% of net sown area is dependent on rain-fed irrigation. Apparently, without ensured irrigation, agriculture in the district may fail during erratic/unseasonal rainfall or drought conditions[10]. The low cropping intensity (130%) suggests that most of the farmland stays fallow after one major crop which is evident from the fact that only 942 sq Km is sown more than once in a year. Reservoirs are the main sources of irrigation (38.05%) whereas bore wells (25.03%) and open wells (23.7%) followed by canals (12.1%) are other sources of irrigation.

2.2.4. Topography and Hydrology

Topographically, Damoh district is divided into three physiographic sub divisions, namely, Vindhya range, Vindhya scarp-lands and Bundelkhend upland. The Vindhya scarp-lands cover the entire Sonar valley and the southern

[8] Land use and land cover effect on groundwater storage
[9] Water Resources Department
[10] National Compilation on Dynamic Ground Water Resources of India, 2017

plateau, now excluding the main line of hills belonging to the Vindhya range. Vindhyan range may be grouped with the rest of the southern hills. There are three physical divisions, viz 1) The Southern Plateau; (i) The Vindhyan Range and the Southern Precipice. (ii) The Broad Southern Plateau. 2) The Sonar Valley and 3) The North-Western Hill Range.

The Southern plateau lies at a general elevation of about 450 meters above the sea level and marked with the main line of hills more or less a continuous precipice overlooking the Narmada and the Hiran valleys. The Vindhyachal range, the long range of escarped hills, stretch from the vicinity of Mandvi to the junction of the river Hiran with the river Narmada and continues into the Bhanrer and the Kaimur ranges to the north of the Sonar valley. The escarpment is more prominently marked than the hill range, because the range is either mingled with or less distinct from the offshoot. The southern part of the Vindhya range up to Katangi is called the Bhanrer range whereas the escarpment enclosing the land locked valley of Singrampur, is called the Kaimur range.

Originally the Southern edge of the plateau and the hills scarp steeply to the south facing the Narmada & Hiran valley is extended beyond Panna in the north. With the establishment of drainage lines and the consequent erosion, now the valley of the Sonar and the Kopra lies into a broad belt of low alluvial soil between the line of dissected hills on the south east and the scarps of the north western plateau.

The Sonar valley with an elevation of 335 metres from mean sea level is about 80 km. long from south-west to north-east and 32 to 40 km. wide between the scarps of the southern and northern plateau of the Vindhyas also form the local water shed between the river Sonar and the Barana nala to the north-west composed of fertile black soil formed from the detritus of volcanic rocks which still cap the south western hills, and had extended in large area in the geological past.

Except a few small streams joining the river Hiran, a tributary of the river Narmada, the whole district is drained into Yamuna through the tributaries and feeders of the river Ken. The main local system is of the Sonar and the Bearma, which follow the general slope of the country and flow towards the northeast. These rivers are perennial in their later courses but most of the drainage lines are seasonal in their character. While the floods cause great inconvenience and loss to the region, the summers spell scarcity of water for drinking and other purposes.

2.3. Adaptive Capacity and Vulnerability

Department of Science and Technology (DST, GoI) conducted the district-level climate change vulnerability assessment for Madhya Pradesh.[11] It was based on 18 indicators related to agriculture, biophysical, institutional infrastructure, health, and socio-economic and livelihood practices. Six indicators that emerged as the main drivers of vulnerability are lack of crop insurance in the area, lack of forest area per 1000 rural population, low road density, lack of groundwater availability, a small number of doctors per 1000 population, and lack of horticulture.

Gosain et al. 2017 assessed risks and vulnerabilities of Madhya Pradesh state in a collaborative project with the 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 the present climate, Damoh falls under high vulnerability category. As per the study, the current vulnerability of Damoh district in different sectors is as given below.

The study also provided projected future vulnerability profile of the district for mid century (2021-2050) and end century (2071-2100) in the moderate emission scenario. Vulnerability of the district in projected climatic conditions in RCP 4.5[12] for mid century and end century is represented as below.

District	Climate	Agriculture	Social	Economical	Water Resources	Forest	Composite
Damoh	L	EH	H	VH	L	M	H

Damoh	RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5
Mid Century	VH	H	H	H	M	M	VH	VH	H	H
End Century	M	VH	M	M	M	L	H	H	H	H

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

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

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

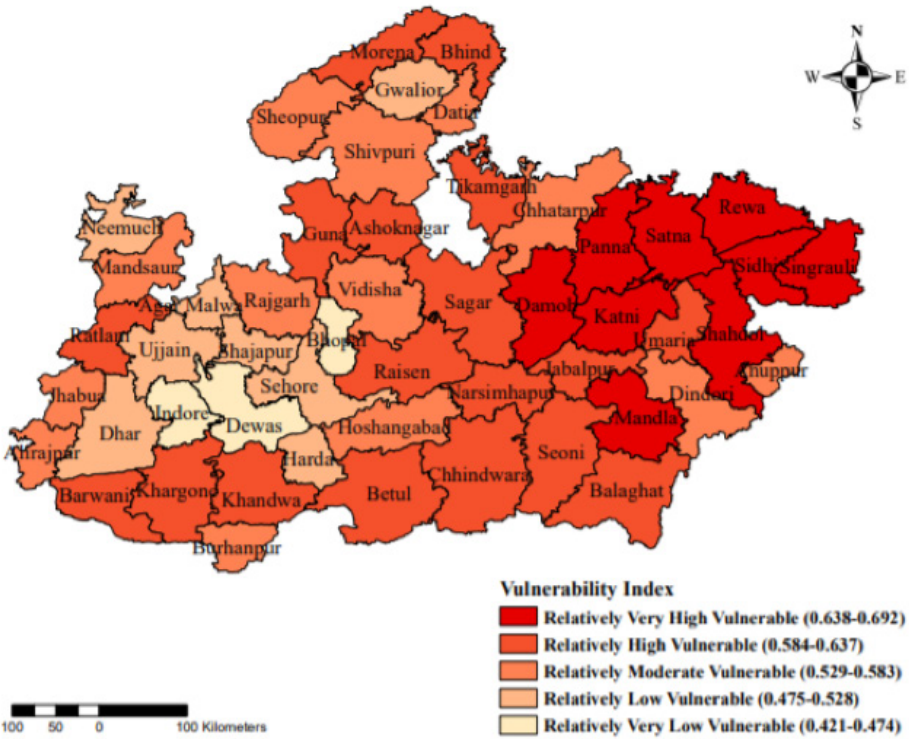


Figure 4: Map showing vulnerability Categories of Madhya Pradesh at district level (Source: DST, 2019-20)

Figure 4 shows that Damoh is very high vulnerable districts in Madhya Pradesh. Other studies also indicate that in Madhya Pradesh, Damoh is one of the districts most vulnerable to climate change.

According to the Risk and Vulnerability Assessment of Indian Agriculture to Climate Change (2019), Damoh is highly vulnerable district in Madhya Pradesh.[13] Projected rise in min temperature, high cyclone proneness, low net irrigated area, and high SC/ST population are the most important factors contributing to risk.

[13] 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

Table 2: Risk and Vulnerability Ranking

Risk		Exposure	Vulnerability	Historic Hazard	Future Hazard
Key drivers	High	High SC/ST population	Low Net Irrigated Area	High cyclone proneness	Rise in Min T
Rank (out of 573 rural districts of India)	338	396	259	280	305
Source: Risk and Vulnerability Assessment of Indian Agriculture to Climate Change, 2019					

About 63.5% of the total workforce is dependent on agriculture in Damoh. 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 assets. All of these indicate higher sensitivity and lower adaptive capacity of Damoh.

Table 3: Socio-economic Variables Comparison

Socio-Economic Variables	Damoh	Madhya Pradesh Average
Household size - > 5 members (%)	22.6	32.7
Women headed household (%)	9.9	9.4
Population below age 15 years (%)	30.0	30.3
Scheduled Caste and Scheduled Tribe population (%)	32.6	36.7
Illiteracy rate (%)	48.2	48.2
Agricultural dependency (%)	63.5	69.8
Households with no land (%)	64.2	54.7
Households having monthly income of highest earning household member - less than Rs. 5000 (%)	82.3	83.5
Marginal worker (%)	32.1	28.1
Non-worker (%)	54.5	56.5
Households without electricity connection (%)	14.3	10.1
Households without an improved drinking-water source (%)	21.7	15.3
Households without an improved sanitation facility (%)	77.8	66.3
Households without assets (%)	41.1	32.6
Households without any usual member covered by a health scheme or health insurance (%)	85.8	82.3
Data Source: Census of India, 2011; Socio Economic Caste Census, 2011; National Family Health Survey - 4, 2015-16		

Damoh is most vulnerable socially due to bad sanitation facilities, low electricity coverage, unsafe drinking water, poor health infrastructure, higher percentage of people below poverty line and no health insurance coverage.

2.4. Integrating Climate Concerns in District Development

Damoh has featured in India's 283 most backward districts list. Climate impacts put the district at further risk of loss of income, social welfare services and

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

Table 4: HDI Index

State/District	Health	Education	Standard of Living	HDI values
Madhya Pradesh	0.6225	0.6440	0.459	0.5687
Damoh	0.4908	0.6273	0.3619	0.4812

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

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

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

3. Climate Resistance Priorities

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

- Effective management of vagaries of nature and climate change impacts through convergence of inter-departmental development planning and collaborative management of natural resources;

- Make a participatory and inclusive action plan with adequate scope for traditional knowledge and practices that hold the potential to make planning by district administration durable and relevant to an area under severe stress.

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

3.1. Drinking Water Sufficiency

The Central Ground Water Board, under the Central Sector Scheme, has been extending technical and financial support to the State Government for implementing practices in rural and urban areas of the district. In Damoh district no such project has been taken up by CGWB, however technical guidance for preparing DPR and other recharging has been guided to PHED and other state departments. Major part of the district shows seasonal fluctuation in groundwater rise more from 3-10m and in small parts of block Hatta, Patera Cetral part of Damoh, Jabera & Tendukeda blocks shows fluctuation fall from >3to >10m.[14]

In the last two decades Damoh district has shown growth in Industry as well as in Agriculture sector, resultant is pressure came on ground water utilization, Groundwater is the only source of irrigation in 90 % of the part of Jabera, Patera and Tendukheda blocks, where canal irrigation exists. Farmers solely depend on groundwater for irrigation. Every year number and depth of bore wells are increasing. The yield of the dug wells in shallow aquifer (0-30 mbgl) is reduced due to over development of deep fractured aquifer by bore wells. The phreatic aquifer is recharged during monsoon and the dug wells sustain for 3 to 4 months only. The dug wells sustain only for 2 to 3 hours of pumping with a drawdown of 2 to 5 m. Decline in groundwater level is observed in the last decade is 0.05m in Batiyagarh to maximum 2.26m in Pathariya block and overall decline in the last ten years in Damoh district is about 0.98m.

3.1.1. Current situation and challenges

The District Damoh is one of the water stress regions of the state. Rapid exploitation of ground water resources in the district led to the water stress situation. Thus, there is urgent need for taking up suitable water management interventions based on integrated approach, which on one hand includes augmentation of ground water resources through appropriate techniques,

[14] http://cgwb.gov.in/AQM/NAQUIM_REPORT/MP/Damoh.pdf

and on the other hand requires the adoption of suitable water conservation measures, such as ensuring water use efficiency through creation of additional water storage facility, maintenance/ renovation of existing water bodies etc.

Drought: natural and human-induced causes

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

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

3.1.2. Relevant and timely scientific information at the district level

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

3.1.3. Way Forward

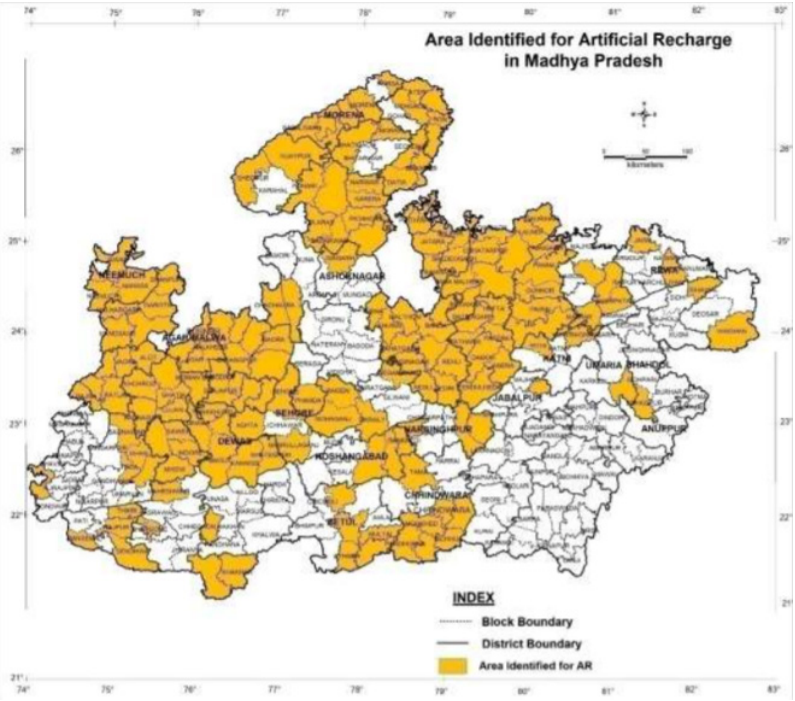
The Public Health Engineering Department (PHED) in Madhya Pradesh has historically had project-oriented approach concerned with physical progress of water supply projects and financial disbursement, instead of programmatic approach required for long-term water availability. There has been little interaction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

Bringing accountability and programmatic approach in the system to ensure water availability will be instrumental to ensure results. Decentralisation puts planning, implementation, operation and maintenance in the hands of beneficiaries. This creates ownership and commitment to action. Through programmes such as NRDWP, District Administration should access and extend continuous support including training, technical support, access to professional services and financing to GPs to supplement their own resources. Results-based financing schemes for drinking water security such as the new Atal Bhujal Yojana (ABHY) will strengthen decentralised governance.

As per the provisions of the National Water Policy, drinking water has the first priority in allocation, of all available water. The District Administration should prepare through public consultation a district water conservation and usage guidance document to map water sources and accordingly 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.



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

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

An integrated drought monitoring and communications plan that uses early warning system to enable proper planning of adaptation strategies for the district needs to be developed. In normal conditions also, there needs to be

systematic monitoring and recording of groundwater levels and rainfall at sub-block or GP level.

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

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

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

3.2. Agriculture Productivity & Livestock Resilience

In all, 28% of the total workers are cultivators and 29.7% are agriculture labourers who will be worst affected by changing climate impacts on crop productivity. Damoh district comprises of a primarily agrarian economy. A major segment of the working population is involved in agriculture. wheat, rice, jowar, maize and soyabean are the major crops sown in the district. Around 42.91% of the land is under cultivation, with 2% land area under cultivable waste land. Around 13% of the land is not available for cultivation and 2% constitutes fallow land. The percentage of area under cultivation is 42.91% and has witnessed a miniscule increase of 0.34% during the period 2005-09. There has been a significant increase in dual cropped land as it has increased from 28.17% in 2005-06 to 45.07% in 2008-09. Forest and logging activities in the district are also alternate sources of livelihood in the district. Additionally, export of betel leaf and livestock rearing support the rural communities of Damoh. In the horticulture sector, Damoh district's rainfall and soil type are favourable for cultivation of mandarin, acid lime, mosambi, aonla, pomegranate, mango, ber, chiku, papaya, turmeric, chillies, coriander, ajwain and all seasonal vegetables. It also has a considerable cattle-market as well as several home grown small industries such as weaving, dyeing and pottery making are also present in the district.[15]

[15] http://www.madhyapradesh.co.in/damoh-district/

3.2.1. Vulnerability from Climate Change Impacts and Farm Practices

Underground water has an important role for irrigation in this district due to lack of perennial rivers. The percentage irrigated area of the land under cultivation is 37.58%, which increased by 1.69% 39 during the period 2005-09. The net irrigated area is 115.6 thousand Ha as compared to 195.6 thousand Ha that is rainfed.[16]

Irrigation and Water-use Efficiency

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

1.6	**Irrigation**	**Area ('000 ha)**		
	Net irrigated area	115.8		
	Gross irrigated area	118.6		
	Rainfed area	195.6		
	Sources of Irrigation	Number	Area ('000 ha)	Percentage of total irrigated area
	Canals	139	14.4	12.1
	Tanks	47	0.8	0.6
	Open wells	15540	28.3	23.7
	Bore wells	7372	29.8	25.03
	Lift irrigation schemes	NA		
	Micro-irrigation	NA		
	Other sources (reservoirs)	476	45.3	38.05
	Total Irrigated Area	-NA	118.6	
	Pump sets (Diesel + Electric)	25,947		
	No. of Tractors	4083		
	Groundwater availability and use* (Data source: State/Central Ground water Department /Board)	No. of blocks/ Tehsils 07	Area ('000 ha)	Quality of water (specify the problem such as high levels of arsenic, fluoride, saline etc)
	Over exploited	-		
	Critical	-		
	Semi- critical	-		
	Safe	07	19.163	
	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.

The total irrigation potential created (IPC) from major, medium and minor irrigation schemes have reached 81% of India's ultimate irrigation potential, so the scope for further expansion of irrigation infrastructure on a large scale is limited. Therefore, priority must be given to improving the utilisation of irrigation potential (IPU) of the existing irrigation potential. The National Water Mission (NWM) Comprehensive Mission Document states that there is a need to increase water use efficiency by 20%, whilst it also advocates a policy of "more crop per drop".

NITI Aayog suggests that area under irrigation can be doubled in the country without requiring extra water through efficient management of water resources, such as those practiced in China and Brazil. The relatively lower double cropping in Damoh has to do with both the local practice of 'anna pratha' as well as insufficient/ineffective irrigation facilities when rain is less than needed.

3.2.2. Relevant Information and Scientific Advice

Downscaled temperature-rise projections and accordingly mid-to-long-term forecast of climate change impacts on agriculture are not available at the district level. Adaptation strategies such as altering the sowing dates or the choice of crops 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 generalise climatic observations and adaptation solutions. Additionally, the reach of communications and regular interface with farmers in each Gram Panchayat is still a challenge.

3.2.3. Way Forward

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

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

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

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

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

Irrigation

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

In addition to minor irrigation projects and schemes, it is necessary to re-generate old ponds and conserve catchment area to ensure water availability at every farm. These interventions need to be aided with effective and planned control over activities like sand mining, encroachment of water bodies, and urban expansion (including new construction) to correct the imbalance. Flood water management in surrounding flood-prone areas can help bring surplus water from there to water-scarce Damoh.

Farm inputs quality, availability and cost

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

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

Organic, diversity-based and dryland farming reduce input costs and healthcare expenses substantially in rain-fed and small-holding agriculture areas while enhancing soil health and fetching higher price for the produce. The district administration should set target of at least 10% per year of cultivable land to be converted to ecologically sustainable, climate-resilient, organic farming. This

will also reduce pollution of groundwater and surface water bodies from agro-chemicals thereby reducing pressure on district administration for clean water supply.

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

Livestock

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

Market-and-farmer-oriented agriculture policies

Changing incentives for the market through policy will lead to behaviour shift at the farmer level – for example, Soil Health Card listing soil carbon, organic matter and moisture to be considered when deciding sale value of a piece of agricultural land, thus, sustainable and organic practices become essential; the dedicated supply chains for organic products 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 supplying these directly to retailers including e-retailers in towns and cities will help the farmers achieve suitable prices and encourage efficient water management.

Disaster compensation and crop insurance

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

Knowledge creation and dissemination

Local and national agriculture institutions should collaborate with farmer producer 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 Damoh. Farmer needs on media used for information dissemination are varied based on their literacy and gadget-friendliness implying need for a robust public information team at the block level.

The mutually symbiotic connection between smallholding farmers, ecological agriculture, farm input elements sovereignty, climate resilience and SDGs needs policy, schemes and budget recognition through special incentives and support for smallholder farmers. Economies of scale can be achieved through collectivisation of organic farmers for production and sale.

At the district level, it is possible to bring convergence and customisation amongst various policies and schemes in consultation with the local stakeholders, especially the vulnerable faming households. Several potential issues could be avoided through free, prior and informed consent from citizens in the district. Refer to Chapter 4 for relevant schemes and Annexure 2 for specific climate-resilience solutions to irrigation challenges in Damoh district.

3.3 Livelihood Options and Income Security

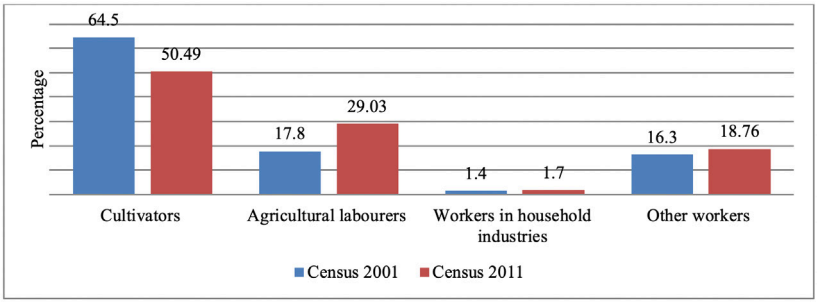


Figure 5: Livelihood Options Damoh

The workers of the district are divided into four broad categories i.e. cultivators, agricultural labourers, workers in household industries and other workers[17]. A comparative analysis of Census 2001 and 2011 data states that cultivators declined by 14% where as agricultural labourers increased by 11.23%. The negative growth of cultivators and positive growth of agricultural labourers show that farmers have shifted to non agricultural activities due to unpredictable weather parameters and inadequate farm income. The overall high percentage of agricultural labourers is an indicator of poor state of agriculture in the district.

3.3.1. Way Forward

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

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

[17] 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.

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

3.4. Nutrition Security & Access to Healthcare

Households in the district are becoming vulnerable as more and more youngsters are migrating, leaving elderly relatives on their own and sometimes leaving young children also to their care. The children are in need of proper parental care, apart from clearly needing more and better food, which under climate impacts is at risk. The infant mortality rate is already quite high in the state while women work in a weakened physical state much beyond their capacity. As per National Family Health Survey (NFHS) 2015-16,[18] only 6.8% children under 2 years (6-23 months) in Damoh are receiving an adequate diet while out of all children under 5 years, approximately 43.2% are stunted (height-for-age), 21% wasted (weight-for-height), 38% underweight (weight-for-age), and a massive 75% anemic. Women and men whose Body Mass Index (BMI) is below normal are 27.1% and 35.4%, respectively, while 45% women were found anemic.[19]

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

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

3.4.1. Way Forward

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

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

[18] http://rchiips.org/nfhs/FCTS/MP/MP_FactSheet_428_Damoh.pdf
[19] http://rchiips.org/nfhs/FCTS/MP/MP_FactSheet_428_Damoh.pdf

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

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

3.5. Ecological Balance

About half of the area of the district was covered with thick forests, scrubs and grasslands a century ago. The forests of the district are classified as tropical dry deciduous forests. A good number of deciduous, a few evergreens or semi-evergreen and a few xerophytic to semi-xerophytic types of species are found in the district, mostly mixed up in various proportions. In certain localities, one or the other species seems to have monopolized the area. The over-wood and under-wood are at most places indistinguishable and only single tree canopy is met. The soil is not well drained and the proportion of clay is higher than required for favorable growth of teak. The most common species are teak, saja, bija, dhaora, tendu, tinsa, jamun, baher and mahua. The major teak forest belts are along the western and eastern boundaries and on the hills south of Tejgarh and south-west of Tendukhera upto the southern boundary

As per Forest Survey of India Report[20], 35.41% of geographical area in 2019 of the district is forest. This is a decrease of -6.82% from 2017. However, it is clear that the quality of forest is poor. More than 67% and 32% of the forest is open and moderate respectively. About 22.53% of the Bundelkhand region consists of forest cover and scrubs. Additionally, population growth, increase in cultivable land, increased extraction of fuel wood, anthropogenic pressures and climatic changes have, all-in-all, affected the quality of forests in the region. Losses in the agricultural produce due to variable climate have also increased people's dependence on forests for other livelihood options.

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

3.5.1. Way Forward

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

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 Damoh 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 the District Level

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

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

4.2. Planning & Implementation with Indicators for Climate Resilience

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

4.2.1. Resilience Planning Framework for Damoh District

S.No.	Climate Resilience Priority	Programmatic Approach to Building District Climate Resilience	Indicators of Climate Resilience
1.	Drinking Water Sufficiency	(i) Assessment of existing and future water requirements in the district along with mapping of water sources for existing and projected deficit; (ii) Participatory development of a district water conservation and usage guidance document "Jila Jal Sanrakshan Aevam Upyog Niti (JJSUN)" for community participation and inter-departmental convergence in planning, implementation and monitoring of water-works; (iii) Setting goals, targets, indicators of progress, transparency, user responsiveness and accountability mechanism applicable to Jal Sansthan and Gram Panchayats within the implementation framework of JJSUN; (iv) Making adequate provision for technical capacity, results-based financing, and professional advisory support to Jal Sansthan and Gram Panchayats for them to meet their goals set as per JJSUN; (v) Enhancing water availability through holistic interventions combining – • topology of the district • green cover requirement • traditional and modern methods with low infrastructure costs for decentralised groundwater recharge, drought-proof supply system, and waste/ contaminated water treatment; (vi) Integrated monitoring and communications plan to keep track of groundwater and surface water availability during normal and drought conditions at block and GP levels; (vii) Engaging stakeholders from private sector philanthropy and NGOs for coordinated planning and investment of resources to enhance water availability at the district level.	(i) water availability for priority uses exceeds usage and increasing trend in population receiving safe and adequate water for drinking and sanitation; (ii) increasing trend in ratio of water treated, recycled and reused with water available to the district and decreasing trend in expenditure per litre of water made available; (iii) increasing trend in proportion of existing water bodies rejuvenated, new construction of traditional water storage structures, and population supported by each water source; iv) Participation and adoption of JJSUN by district departments and WUAs as well as ratio of functional WUAs at municipal ward and GP levels; (v) public disclosure of annual action plan and performance report by Jal Sansthan and GPs as per JJSUN; (vi) amount invested in district-specific R&D as well as status of implementation of recommendations for enhancing water availability; (vii) performance of monitoring and communications plan to support timely response to falling water availability levels; (viii) amount invested from government, private and NGO sources in water availability under the JJSUN guidance framework.
2.	Agriculture Productivity and Livestock Resilience	(i) Focus needs to be on climate suitability, efficient use and quality of farm input elements and livestock including native resilient seeds, fertilisers and livestock breeds to meet farmer nutrition needs and target income; (ii) Ensuring water to each farm through regular, rigorous and participatory evaluation of all options such as watershed development, canals and minor irrigation projects or traditional water tanks rejuvenation; (iii) Ensuring real access to cost-effective, innovative farm equipment and farming methods suitable to the district's average farm size and inputs availability, respectively; (iv) Ensuring access to locally-relevant knowledge of value-added, arid zone agri-pastoral farm forestry options in the form of organic fruit trees, high-value crops, climate-resilient indigenous seeds, horticulture, animal husbandry, poultry, fisheries, et al that would thrive in changing climate conditions; (v) Making provision for required extension and financial services as well as subsidised/ low-cost RE-powered storage infrastructure; (vi) Participatory and customised implementation of C-DAP, SAPCC and JJSUN through convergence amongst various schemes related to agriculture, irrigation and livestock; (vii) Risk response measures for reducing risks from climate impacts as well as for comprehensive compensation/ quick relief to affected farmers; (viii) Encouraging clustering of small plots and farmer cooperatives/SHGs for achieving economies of scale through integrated dryland agriculture, seed banks and livestock rearing; (ix) Reforming land leasing laws, pricing policies, and market access rules to increase returns on investment to farmers while addressing excessive presence of supply chain intermediaries; (x) Promoting local agro-economy based small and medium enterprises for quick, low-cost and customised supply of organic farm inputs as well as marketing of organic farm products.	(i) Average monthly income increased to level of national average income of workforce employed in manufacturing and skilled jobs; (ii) Proportion of farms consuming water at par with agriculture producing countries of OECD, China, etc; (iii) Proportion of farmers diversifying crops and agriculture systems, adopting organic and dryland farming; (iv) Proportion of farmers reporting crop loss from climate impacts; (v) Proportion of farmers benefitted from one or more schemes as well as average time taken to receive benefit per scheme; (vi) Proportion of smallholding farmers active in producer cooperatives as well as proportion of SMEs in local agro-economy; (vii) Adequate nutrition levels measured periodically (vii) Efficiency of irrigation projects for water supplied and utilised per unit of rupee spent as well as area covered; (viii) Livestock coverage by health camps and hospitals as well as ratio of resilient native to hybrid breeds with farmers; (ix) Average time taken to disseminate, accuracy of forecast, and relevance of information on weather for farming as well as design of schemes;

3.	Livelihood Options and Income Security	(i) Livelihood, access to food and water, and rural healthcare need coordinated, complementary and mutually informed interventions to address distress migration. Additionally, district priority livelihood development planning required in participatory and exhaustive evaluation of options; (ii) All registered farmers to get minimum days of employment every crop season at skilled workforce rate per day if their farm income projection is going to be lower than national average income of skilled workforce; (iii) Survey required of villages prone to migration every cropping season for urgent interventions regarding food and water security, healthcare as well as interim livelihoods/ unemployment benefit. This includes support to ensure eligibility for livelihood oriented schemes such as MGNREGS; (iv) District-level livelihood transition planning is needed till local economy with secondary livelihoods and SMEs picks up as well as agriculture becomes climate-resilient. This includes interim jobs/ seasonal livelihoods, daily wage labour, migration helpdesk and unemployment benefit; (v) Promotion of local enterprises at micro and small scale through required infrastructure, financial services, market access and skills training. This will enable successful implementation of schemes in sectors identified as priority, viz. agriculture and allied livelihoods, marketing of agro produce, solar panels and irrigation systems; (vi) Resilient breeds of livestock to be promoted for enterprise and nutrition; (vii) Encourage competition in purchase of farmers produce, especially vegetables, fruits and flowers to end consumers for higher returns and livelihood creation; (viii) Banks in the district to be sensitised for benefits to their business from inclusion and nurturing of financial finesse in local population. Preferred status in banking and financial services to be given to ventures involving local farmers.	(i) Average monthly income of farmers increased to level of national average income of workforce employed in manufacturing and skilled jobs; (ii) Average monthly income in the district increased to level of national average; (iii) Migration in absolute numbers and percentage as well as temporary vs permanent form declines year on year; (iv) Increase in proportion of MSMEs for identified priority sectors in local economy; (v) Increase in sale options for farmers keen to sell their produce; (vi) Proportion of farmers and their enterprises accessing financial services.
4.	Nutrition and Access to Healthcare	(i) Focus of nutrition and food security programs to be on locally diverse food systems and native foods for resilience and health as well as streamlining of government processes to ensure timely and adequate access to nutritious food by seeking families across the district; (ii) Mechanism to disseminate information, including in interiors, at every seasonal change regarding projected weather and vector issues along with remedies and preventive measures; (iii) Healthcare facilities, including traditional medicines and systems, of a wide variety to be made available to complement government health schemes in a cost-effective way covering 100% of the population; (iv) Preferred status to organic farmers and consumers through social welfare, free education to children, healthcare, market access and retirement income incentives to promote organic farming; (v) Encouraging optimal use of space and time through women SHGs growing nutritious foods and cooking in schools, anganwadis, offices, and other public spaces; (vi) Forest produce with nutritious value and availability in drought periods to be preserved.	(i) Number of schools with mid-day meal, health-check ups and other incentives such as free uniforms and books for higher attendance enhancing the BMI of children; (ii) Number of villages covered by information dissemination mechanism (iii) Coverage ratio of population by healthcare facilities for all medicine systems and government schemes; (iv) Proportion of organic farmers and women SHGs producing organic food in the district; (v) Proportion of forest dependent communities benefitting from government providing monitored access to nutritious foods (vi) Year-on-year improvement in BMI average for various age groups and gender categories of the district population, with special focus on malnutrition and stunting.
5.	Ecological Balance	(i) Development and land use plans to be integrated with sustainable development goals (SDGs) through participatory processes for restoring balance; (ii) Open, inclusive, transparent and recurring consultations in regional language to ensure public concerns to land use change and natural resource exploitation are incorporated in district policy; (iii) Livelihood development investments to be informed by local preferences and skills with preference to sustainable micro and small enterprises over large-scale industrialisation; (iv) Population management and community engagement to reduce pressure on natural resources.	(i) Year-on-year targets to enhance forestland area and wildlife count are being achieved; (ii) Relevant SDG indicators are being achieved; (iii) Every major infrastructure and industrial project is backed by public consent; (iv) Natural resources key to protect farm productivity; nutrition and health impacts of climate change are proportionate to population requirements.

4.2.2. Resilience Plan Implementation by District Departments & Officials

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

Climate Resilience Priority	Actions Needed to Build Resilience	Implementing Departments & Schemes Applicable
Priority 1: **Drinking Water Sufficiency**	(i) Facilitate creation of "JJSUN" and WUAs at ward/block levels after assessment of existing and projected water requirements as well as available quantity; (ii) Establish MoUs with agencies of expertise and financial institutions (FIs) for provision of technical, financial and advisory support to Jal Sansthan and Zila Parishad; (iii) Apply Water Conservation Fee on industries and households with ceiling on extraction, requiring NOC from affected WUAs and Jal Sansthan; (iv) Build traditional water tanks, ponds, sub-surface dykes/ check dams as well as ensure maintenance and anti-encroachment drives; (v) Promote rain-water harvesting (RWH) and groundwater recharge through incentives and laws in old and new construction; (vi) Monthly monitoring of groundwater levels with real time communication to WUAs and Jal Sansthan; (vii) Organise events inviting NGOs and companies to learn about JJSUN and district challenges to coordinate research, projects and interventions for enhancing water availability;	Departments - (i) District Planning Committee (ii) Jal Sansthan Schemes/ Missions - (i) NRDWP & IWMP (ii) NURM (iii) District Water & Sanitation Mission

Priority 2: **Agriculture Productivity and Livestock Resilience**	(i) Establish District Agriculture Income Task-force for convergence between various policies and schemes by relevant departments connected to agriculture and allied sectors performance and climate resilience; (ii) Facilitate creation of "JJSUN" and WUAs including GPs/elected village leaders at block levels for assessment of existing and projected water requirements as well as available quantity to plan suitable irrigation and watershed development projects as well as inform schemes design and implementation suited to local context; (iii) Facilitate creation of farm cooperatives for clustering of farms, develop efficient farming methods and farm input supplies, achieving economies of scale with equipment and marketing to end consumers, and incentivise district and block-specific research and training on risks and climate-resilient solutions; (iv) Organise block level fairs and camps on climate-resilient solutions for farm inputs, livestock, horticulture and other allied activities, as well as financial services for agro-economy based micros, small and medium enterprises (MSMEs); (v) Regular training for officers and elected leaders on risks, solutions, schemes, participatory decision-making and tools, as well as approach to ensure convergence for efficient use of resources.	Departments - (i) Agriculture (ii) Horticulture (iii) Irrigation (iv) Animal Husbandry Schemes/ Missions - (i) National Mission for Sustainable Agriculture (ii) National Program on Organic Farming (iii) KUSUM, PMKSY (iii) C-DAP and SAPCC
Priority 3: **Livelihood Options and Income Security**	(i) Develop district priority livelihood development plan including transition from singular livelihood to secondary choices in public consultation to inform schemes, incentives and projects; (ii) Establish process for survey of projected farm incomes per cropping season and distress migration prone villages in collaboration with KVK and technical institutions as well as set up helpdesks at various public spaces in the affected season; (iii) Establish livelihood schemes awareness, credit and eligibility documentation camps in every village; (iv) Establish 'Gram Innovation' festivals to promote breakthroughs in rural economy in all forms and stages of the supply chain with credit, market access and technical expertise support; (v) Skill training institutes to be set up for affordable and/or free of cost training;	Departments - (i) Agriculture (ii) Horticulture (iii) Animal Husbandry (iv) Skill development Schemes/ Missions - (i) Mission Antyodaya (ii) MGNREGS
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; (iv) Strengthening community-based systems and mechanisms ensuring active participation of women as more and more women are joining the agricultural work force. Investing in knowledge development of community action groups ensuring active participation of women and encouraging them to grow nutritious foods in public places such as schools, anganwadis, hospitals and parks can be an effective step towards ensuring food security.	Departments - (i) Health (ii) Informatics (iii) Education Schemes/ Missions - (i) National Nutrition Mission (ii) National Health Mission (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 Smart City 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 wastage of water and the need to plan for balancing availability and consumption) and infrastructure-oriented tasks (building physical structures which can capture rainwater and surface water runoff, and/or help recharge ground water like ooranis, check dams, sub-surface dykes, etc.). The following steps are suggested for the preparation of a Sustainability Plan with a view to appropriately locating sustainability structures to sustain drinking water sources -

1. All habitations should move from dependence on a single source to conjunctive use of rainwater, groundwater and surface water sources;
2. Prioritising difficult areas - Identification of over-exploited, critical and semi-critical blocks, areas with water stress in the whole or part of the year and quality affected areas, identification and testing of all sources there;
3. Identifying the respective micro watershed/aquifer/hydrological unit - hydro 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. Monitoring of canal water discharge, silt management, timely repairs etc. need 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 3year period from 2005 to 2008. Out of 53 Hydrological Units (HUs) the groundwater balance has increased in 57% HUs, remained constant in 34% HUs and decreased only in 9% HUs. Similarly, out of 58 HUs the groundwater pumping has reduced in 55% HUs, remained constant in 31% HUs and increased only in 14% HUs. About 4800 farmers in the 638 habitations have voluntarily adopted water saving methods in one form or the other without losing the income from agriculture. This project demonstrates the power of building capacity of local organisations to collect real time data, process it and make local decisions and regulate water use.

Annexure 3: Livelihood Options

Goatery

Goatery is quite popular in rural households and most households keep a few goats for milk and sell them, when required, providing them relatively quick and assured income with relatively low investment. Large sized goatery is not common though it is extremely suitable to the undulating terrain of Bundelkhand, with a large variety and growth of bushes and shrubs. Profits from local mixed breeds have been better,

since they survive better. Local breeds are easily fed in the open jungle, while it is expensive to feed foreign breeds. In 2011-12, through the Bundelkhand Package, 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.

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