Community Led Action Plan on Climate Change in Chhattisgarh

Prepared for

Action on Climate Today (ACT)

BY

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1 BACKGROUND AND APPROACH

1.1 INTRODUCTION

ACT Program has offered technical support to State's Centre on Climate Change (SCCC) in Chhattisgarh to promote the integration of climate adaptation and resilience in planning. The current project is an effort to demonstrate the climate resilience based micro-planning for the micro-watersheds to promote climate resilient infrastructure and also to insulate the implementation of NRM activities with climate change related aspects. ACT Program, in consultation with SCCC and Panchayti Raj Department has selected Mahasamund district in Chhattisgarh to demonstrate the process for community led climate resilient micro-planning.

Mahasamund, like any other districts in Chhattisgarh is a tribal dominated district and is largely rainfed and interspersed with plateau and hills. Like the other parts of the state, the livelihood options in Mahasamund are predominantly dependent on natural resources including land, water and forests and also equally on rain and weather patterns. Chhattisgarh being an agrarian state, variability in climatic conditions are adversely affecting the socio-economic and environmental conditions in most of the districts including Mahasamund.

Paddy is grown as main food crop in the Mahasamund district. In addition, Arhar, sesame, gram, alsi, mustard are mainly grown for self-consumption and income generation. Other sources of income generation include collection of Non-Timber Forest Produce (NTFP), such as Mahua flowers, goat rearing and daily wage labour.

All the farming operations in Mahasamund district are done in a set pattern and fluctuation in local weather results in loss of production and income. In June-July, the sowing of paddy takes place. Delay in sowing and transplanting due to delayed rains reduces production and hampers the timing and intensity of the second crop.

For the farmers who are able to take the Kharif crop, the months of October and November are busy time for cutting of paddy, varieties of pulses i.e. chana, alsi, peas and sowing of oil-seeds such as mustard. Rain during this period affects harvesting and also leads to delay in sowing. It results in reduced acreage as farmers refrain from sowing multi – crops.

The households who do not take the kharif crop due to not having irrigation facilities, go out for daily labour work or to collect non-timber forest produce. This continues until the month of May-June every year before the sowing season for kharif starts.

Climate Variability and Adaptation Potential

The inherent characteristics of the terrain, food and cash insecurity, unsustainable coping practices and socio-economic factors are the contributing factors for the loss of income. Women are the most affected group, who to a large extent, shoulder the farming operations such as transplanting, weeding, cutting, harvesting, storage, collection of NTFPs and taking care of children and the livestock.

To address the impact of climate variability, the farmers, those who can afford, have mostly switched to short duration crops, High Yielding Varieties (HYV) and hybrid varieties. While speaking about their experiences, the farmers shared that the hybrids are highly susceptible to insects or pests as compared to the traditional varieties and, therefore, the use of chemical fertilizers and pesticides has increased substantially. This along with the mushrooming growth of

bore wells, electric motors and setting up of diesel pumps has been spelling devastation for soil and ground water in the district.

Looking into the aspects of vulnerability of the community and ecosystem due to the factors resulting from climate change, building the resilience of both communities and the ecosystems are important. The resilience against the climate related extremes and shocks can be built through promoting mix-cropping, introduction and expansion of climate resilient crops, organic farming, promotion of horticulture activities, land development, optimum utilization of rain water, promoting rain water harvesting and promotion of drip irrigation system.

The need of the hour is to identify the livelihood resources which can withstand climate variability and can give good results in the changing situation. Last but not the least, there is also a great need to replicate already existing good practices and adaptation measures to make the community climate resilient.

1.2 APPROACH

Conventionally, in rural areas, the Gram Panchayat (GP) level/village level planning is done by different stakeholders (line departments/NGOs/PRIs, etc.) separately. Almost all of the program directs their efforts towards achieving sustainable livelihoods but emphasizing their own perspective. This approach is a delivery-based approach and does not consider the perceived and actual needs of the targeted community. The Gram Panchayat Development Plan (GPDP) based approach works towards preparing the holistic program and link it with different programs/schemes for wider implementation. Scheme like MGNREGS is also adopting the new technologies and approaches for GP level planning. MGNREGS is inducing the use of GIS and Remote Sensing (RS) and adopting a watershed-based approach in its Natural Resources Management (NRM) based works. Chhattisgarh specifically has reached to next step to become the first state in the country which has established a GIS lab for supporting the GP level planning under MGNREGS. The state is in the process of establishing more labs in different districts.

Considering the challenges posed by the climate change, the planning process needs to incorporate the climate resilience perspective in all of the interventions to be taken up. This report is an attempt to incorporate the climate resilience in the routine NRM planning process.

The approach for climate resilient based planning insulate the micro-watershed based NRM planning with climate change aspects. The approach includes the use of Remote Sensing information and GIS tools. GIS tools provide the capacity to consider multiple aspects simultaneously and help to do the spatial analysis resulting in better planning. Climate resilience is added as an aspect which focuses on strengthening the livelihood, creating versatile and less vulnerable (to climate change) livelihood options, creating more bio measures to conserve soil and water which are more sustainable as compared to engineering measures and promoting and/ or conserving native bio-species. Climate resilience aspect is basically creating an ecosystem, where multiple components are linked and support each other, are less vulnerable to external factors including climate change and, in the process, create/strengthen the livelihood opportunities.

2 ADOPTED METHODOLOGY FOR CLIMATE RESILIENT WATERSHED PLANNING

2.1 LOOKING WATERSHED MANAGEMENT THROUGH CLIMATE CHANGE LENS

Watershed based development of natural resources have been implemented in India since 1990s in rain-fed areas to mainly conserve soil and water, improve productivity of natural resources and improve the livelihoods of communities. While watershed approach lays emphasis on ecological restoration and on strengthening of rural livelihoods, the present framework has limited scope to address climate change concerns.

For improved management of watersheds, both mitigation and adaptation measures are required. Adaptation to climate change is a relatively new issue, there are some innovative practices such as Integrated Water Resources Management (IWRM), source protection, watershed management and disaster preparedness and response, which can build community resilience against the extremes and shocks of climate change. The community led micro-planning along with convergence with available Government Schemes, can facilitate in building the adaptive capacities of communities by putting systematic mechanisms in place (e.g., improved water management, adoption of climate resilient crops, communication, credit, finance, social network, alternative services livelihoods, etc.).

2.2 HOW TO BUILD ADAPTIVE CAPACITY OF COMMUNITIES

The most important aspect to be considered while conducting the micro-planning of watersheds is to build the capacity to adapt with the changing scenarios. The adaptive capacity mainly depends on socio-economic status, environmental circumstances, and available information, technology and access to finance and resources like energy. For example, an intensification of the hydrological cycle means less number of rainy days with heavy rainfall. This is exactly the problem being faced in Mahasamund district and this necessitates the implementation of measures that improve soil moisture content and harvest the runoff. It is possible to minimise the adverse impact of climate variability on crops by improving the micro climate (i.e., by conserving moisture and developing green cover).

Another action that is recommended here is to improve the access to meteorological information. There is no doubt that the communities will be in a better position to respond to climate variability if they have access to early warning systems using the historical data as well as day-to-day, reliable weather forecasts targeted to farming practices. This is the most critical aspect of climate change adaptation.

In addition, the capacity building of communities with respect to the crop, cattle and health insurance is equally important. Convergence with programs like MGNERGS for drought proofing works will also ensure community participation towards reducing adverse impacts of climate change. Table-1 presents a number of possible actions to integrate climate change concerns in micro-planning. For better understanding, the table has used the permitted works under MGNREGS and their potential contribution to climate resilience.

Table 1: Natural Resource Management Works under MGNREGS and Climate Resilient Infrastructure Planning

Climate Vulnerable Areas	Output based MGNREGA Works	Potential Contribution to Climate Resilience
WATER	▪ Water conservation, water harvesting, recharging of ground water resources and water management ▪ Watershed management ▪ Micro and minor irrigation ▪ Renovation of traditional water bodies and flood control works	▪ Erosion control ▪ Ground water recharge ▪ Soil moisture retention ▪ Improved availability of water for irrigation ▪ Improved availability of drinking water ▪ Improvement in soil fertility and quality ▪ Improved vegetative growth and crop production
LAND	▪ Land development (both common and private lands) ▪ Land levelling, field bunding, contour bunding, terracing, graded bunding, field bunding, pasture development, ▪ Flood control measures ▪ Application of silt in farm fields coming from the desilting of water bodies and farm ponds ▪ Drought proofing ▪ Soil improvement	▪ Improvement in soil fertility and quality ▪ Productive use of degraded lands including reclamation ▪ Erosion control ▪ Improvement in soil moisture ▪ Improved production from trees, crops and other vegetation ▪ Improved quality of cultivation fields leading to increased crop yields
AGRICULTURE	▪ Water conservation, water harvesting, recharging of ground water resources and water management ▪ Watershed management ▪ Micro and minor irrigation ▪ Renovation of traditional water bodies and flood control works	▪ Improvement in soil fertility and quality ▪ Productive use of degraded lands including reclamation ▪ Erosion control ▪ Flood control for crop protection, etc. ▪ Ground water recharge ▪ Soil moisture retention ▪ Improved availability of water for irrigation ▪ Improvement in soil fertility and quality ▪ Improved quality of cultivation fields leading to increased crop yields
FORESTS	▪ Afforestation ▪ Timber, fruit, fodder, fiber varieties of tree plantations ▪ Boundary and block plantation ▪ Agro-forestry, silvi-pasture, horticulture ▪ Pasture development ▪ Wasteland development	▪ Conservation of forests ▪ Natural regeneration of trees, shrubs and perennial grasses ▪ Improved carbon sink ▪ Improved soil moisture retention and protection ▪ Improves soil quality ▪ Improved income from non-timber forest products ▪ Improved micro-climate ▪ Ground water recharge ▪ Improved availability of water in surface water bodies

While conducting the micro-planning, three guiding principles should be adopted to overcome climate related vulnerabilities and to build resilience against the changing climate.

- Put the adaptive Integrated Natural Resources Management at the centre of planning and investment for climate change adaptation in order to promote the durability and effectiveness of assets. For example, a check dam may be implemented in isolation as a water harvesting structure, but its value can be increased by planting its catchment area with perennial grasses, shrubs and multipurpose trees to increase vegetative cover, increase groundwater recharge, minimize erosion and siltation of the storage area, and limit evaporation losses.
- Promote investment in management, restoration and sustainability of 'natural infrastructure' – the ecosystem services provided by healthy micro-watersheds, forests and agriculture lands.
- Support actions at scale by combining watershed management, sustainable infrastructure, empowerment and learning through adaptive institutions.

2.3 ADOPTED STEPS FOR MICRO-PLANNING IN MAHASAMUND DISTRICT

As mentioned in Chapter-1, the Mahasamund District was identified for selection of a village for demonstration of community led micro-planning process. The ACT project team collected and analysed the primary and secondary data of Mahasamund District and Block and discussed the requirements for selection of a villages with local Government officials. After a detailed analysis of data and higher amount of interest shown by the village community, Chuhari village of Chuhari Panchayat was selected for conducting the micro-planning exercise. The key steps taken for the micro-planning are listed below:

- The first step was to collect the secondary data and the metrological data. The analysis of this data helped in identification of areas with water stress, low groundwater tables, areas producing only one crop a year, low productivity, low income and areas with difficult terrain.
- The second step was to visit few selected villages to collect primary data and get the buy in from communities.
- Considering that the ACT program has identified a 5,500-ha watershed in the Mahanadi river basin (which includes Mahasamund area) for the planning process, a recce was conducted in 5-6 villages to assess the feasibility of the project. During the visits to the villages, Chuhari village was identified for demonstrating the climate resilient planning. Chuhari being a Panchayat consisting of three villages which are not contiguous, thus, only Chuhari village was identified for the intervention planning, as it's village boundaries are almost matching with the hydrological boundaries.
- After the selection of village Chuhari, GIS and remote sensing data along with the collection of revenue map and other related information was collected.
- The next step was to prepare digitised maps for the village area and mark the micro-watershed boundaries on the map. Three micro-watersheds, CH-1, CH-2 and CH-3 were marked on the village map for effective planning.
- A detailed water budgeting exercise was conducted to estimate the availability of water resources for future use. The current cropping pattern, water use, irrigation pumping, crop productivity, available water harvesting structures, large water bodies near to the village and metrological data was also analysed to understand the overall requirement of water in the village and the possible sources of water.
- The profile of the village was prepared along with the GIS based technical maps.

- A rapid vulnerability assessment of available natural resources, crop productivity and the socio-economic status of communities was conducted to understand the extent of resilience to be built against the changing climate.
- The next step was to conduct the micro-planning exercise with the help of village community. Based upon the requirements of communities and with the use of GIS data, measures to improve the condition of natural resources, community livelihoods and crop productivity have been recommended.
- While recommending the conservation measures, the efforts were also made to identify the available Government Schemes to fund the implementation.
- Once the planning and design of soil and water conservation structures is complete, from a climate resilience perspective, it was important to plan required vegetative cover (trees, shrubs, grass, crops, fruits, etc) both upstream and downstream of the mechanical structures. Without the plantation of trees, grasses, fruits, etc, the mechanical measures will have a limited role to play. Thus, it is suggested to use the presence of soil and water conservation structures (mechanical measures) for creating climate resilient infrastructures by introducing initiatives like agro-forestry, horticulture, bund plantation, fodder development, etc for ensuring not only additional livelihood resources but also the longer life of the soil and water conservation structures.
- The recommendations have been made for creating climate resilient infrastructure around the soil and water conservation structures with the help of introduction of permanent measures (vegetative cover) and multi-purpose varieties of trees, shrubs, grasses, fruit trees, etc. In addition, recommendations are also made for slight shift in cropping patterns to suit the availability of resources like water, and infrastructure like market, roads, storage facilities, processing facilities to increase the value of produce, economic value and local consumption.

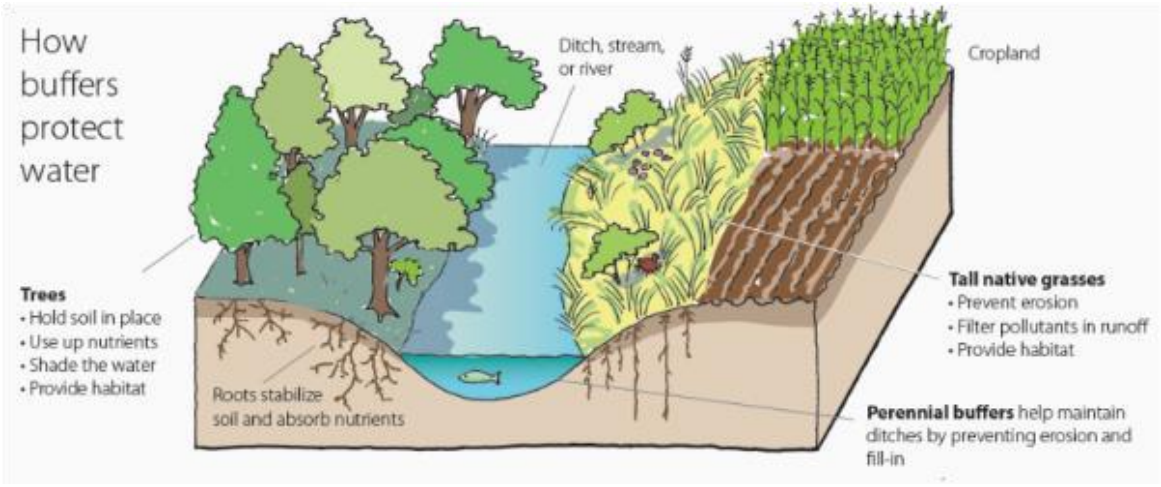


Figure 1: Climate Resilient Infrastructure in a Watershed.

3 PROJECT AREA PROFILE AND DATA ANALYSIS

3.1 IDENTIFICATION OF PROJECT AREA AND LOCATION

The project area is located in the Eastern district of the Chhattisgarh, Mahasamund. The location map of the area is provided in Figure 2.

The project area was studied properly to identify the area of intervention. This was done based on the following factors:

1. Area must have habitation for ensuring better utilization of the resources.
2. Area must be near to the ridge line so that it has minimum dependency on the upper catchment areas.
3. In addition, expected community/ institutional support also an important parameter to identify the area.

Among all the habitation areas within the project area, Chuhari was observed to be the only village, which is near to the ridge line and have minimum channels in south of the village (small section of a channel). On this basis, the village Chuhari was zeroed down for planning process.

Figure 2: Project Area Location Map

Name of Gram Panchayat	Chuhari
Block, District & State	District & Block – Mahasamund State - Chhattisgarh
The Geographical Area of Village	125 Ha (215 ha through GIS)
Latitude and Longitude of GP/Village	21.40 N, 82.25 E
Numbers of Revenue Villages/Habitations in GP	3
Average Rainfall	1373 mm (Mahasamund)

3.2 COLLECTION OF REVENUE MAP AND PREPARATION OF PROFILE MAPS

The village revenue map was collected to obtain the deeper details about the area. The micro-watersheds are marked over the village map for better planning. The intervention can be marked over the village map for better presentation of planning. The revenue maps can be downloaded from the website http://bhunaksha.cg.nic.in/. The map of Chuhari Panchayat, which comes under Patewa RI and in Mahasamund Tehsil of Mahasamund District, was downloaded from this website.

The figure-3 presents the revenue map of Chuhari village.

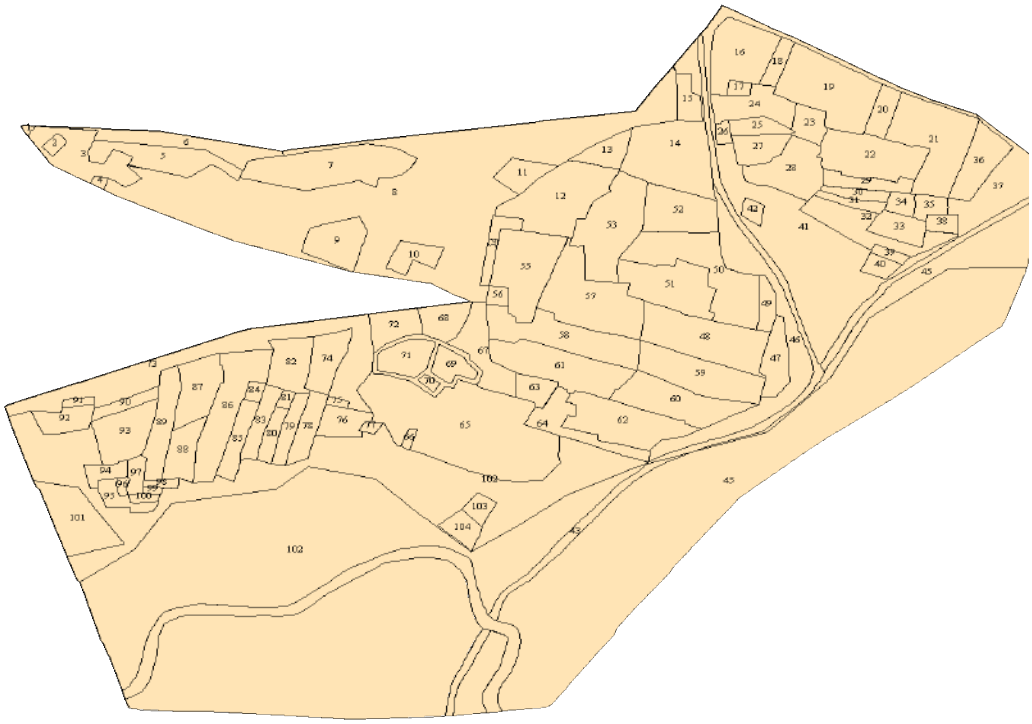


Figure 3: Map of Chuhari Village

3.3 DIGITIZATION OF REVENUE MAP

The map of Chuhari village was digitized using the QGIS software and overlaid on the georeferenced project area maps and images on the GIS. In addition, other information like land ownership was also digitized to support the analysis. Digitization of map for using it on GIS, give the flexibility of working and to understand The map was digitized using the QGIS software, which is an open source software.

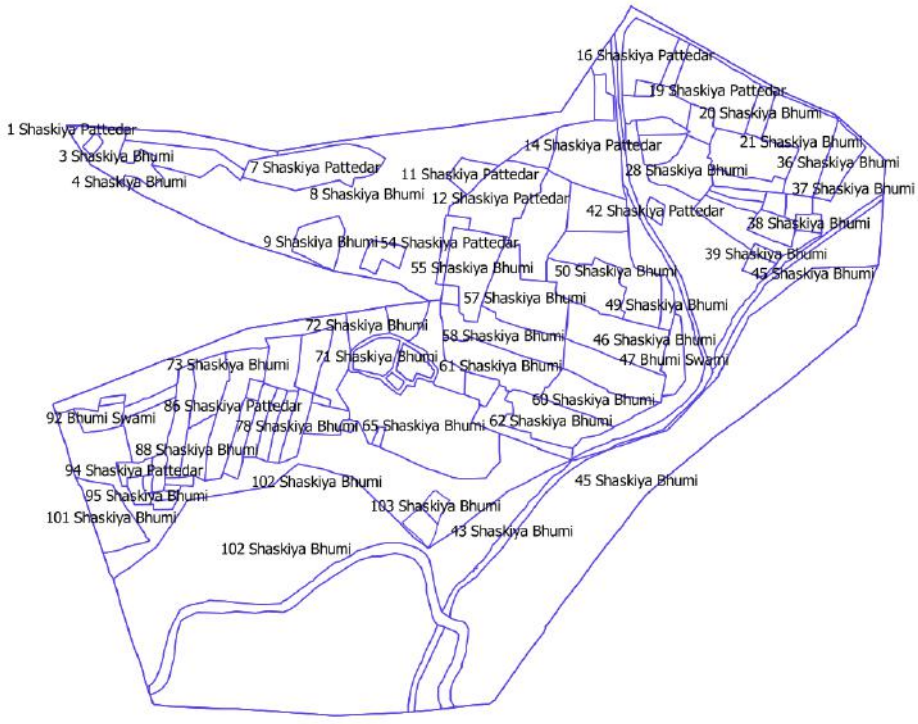


Figure 4: Digitized Map of Chuhari Village along With Land Ownership Details

The digitization helped in making the information understandable and easy to analyze along with the other digitized information. Digitization also helped in keeping the information in different layers and integrate the same for spatial analysis.

3.4 PREPARATION OF THEMATIC MAPS FOR THE PROJECT AREA

The thematic maps presenting different scenarios for the Chuhari village micro-watersheds were prepared. The Information for the preparation of thematic maps was collected from different sources. The thematic maps, their importance and the sources for procurement are provided below. These maps are important for the micro-planning purpose.

Land use Land Cover Map: This information was generated using the satellite imageries and then processing them using the image processing software. Similar information is also available on 'Bhuvan' but at a lower resolution. This information was required to understand the land use and land covers like forest cover/degraded forest cover, agriculture land or the barren land, etc. This helps in identifying the location of different kind of activities.

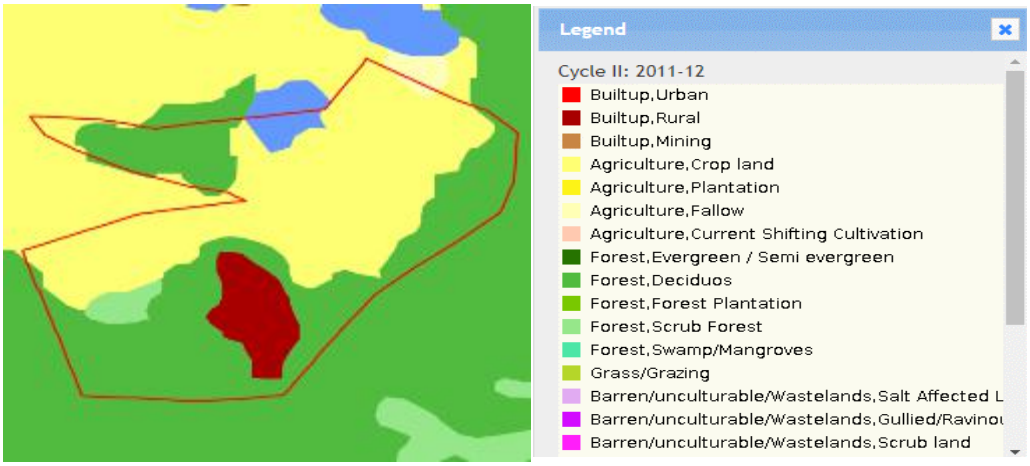


Figure 5: Landuse Map of the Village

The land use map reflects that the forest area is covering the southern portion of the village and there is only one waterbody in north-eastern portion of the village, which is of significant size.

Lineaments Map: These maps were obtained using Bhuvan site and Global Mapper. This provides the information about the lineaments, which can help in identifying the exact location of structures dealing with aquifers/groundwater.

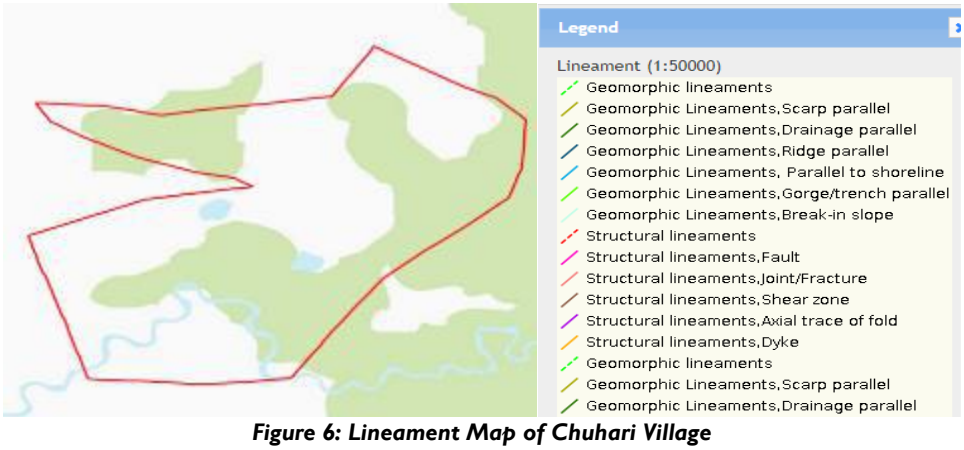


Figure 6: Lineament Map of Chuhari Village

The Map reflects that there are no lineaments in the area of interventions.

Soil Erosion Map: The soil erosion information was collected from Bhuvan and plotted on the Chuhari village map. This helped in understanding the status of erosion in the area. In the context of climate, this information is very critical, as high-intensity rainfall may increase the erosion and strategies to establish the soils helps to sustain the productivity and resilience.

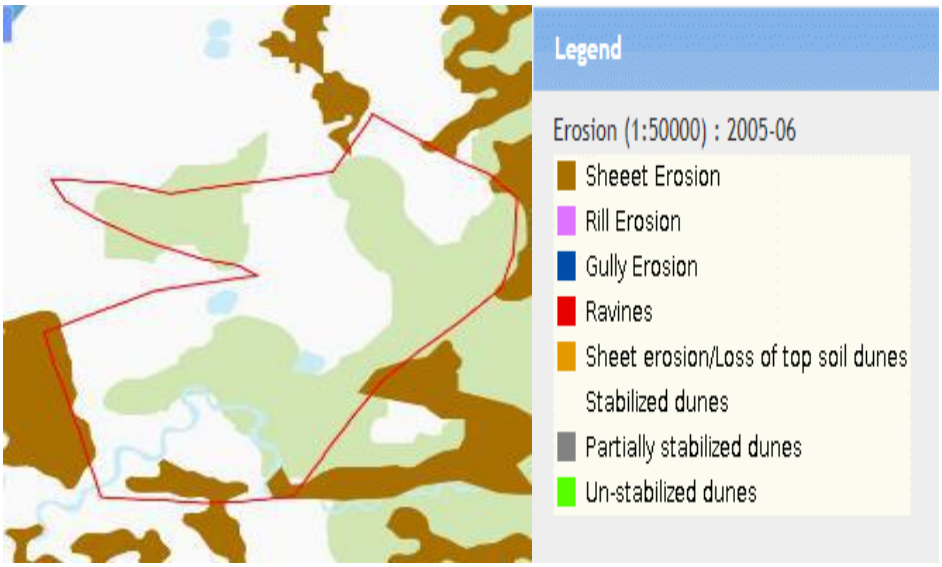


Figure 7: Soil Erosion Map of the Area

The map reflects that the soil erosion in the village and in its surroundings is not much of concern, except for some patches in the southern parts, which are affected by the sheet erosion. This area can be treated with plantation activity to control any further damage to the land resources.

Groundwater Prospect Map: Again, the remote sensing data and Bhuvav was used for the preparation of groundwater prospects map. This map helped in understanding the groundwater status in the micro-watershed area and the location for any possible groundwater structures for improved charging or replenishment.

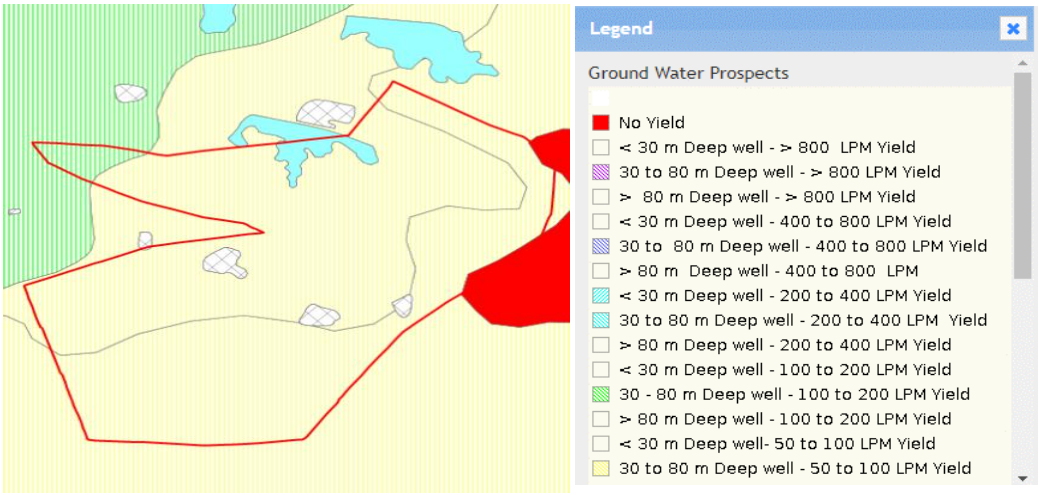


Figure 8: Groundwater Status Map of the Village Area

The groundwater status map is showing that there is not much variation in groundwater levels in the micro-watershed areas. The village has low to medium discharge. This was also confirmed by the villagers at the time of visit to the village.

Elevation Map: Elevation map was generated through DEM, which can be downloaded from different free sources. DEM also important to generate contours doe the area using GIS software.

3.5 POPULATION

The village has approximately 68 households and its total population is 338. The total population of the Panchayat is 1012. Demography of Chuhari is presented below:

Total Population			Category wise Population		
Female	Male	Total	SCs	STs	Total
165	173	338	0	248	248

BPL Families	Landless Farmers	Small Farmers	Marginal Farmers	Total Families	SCs Families	STs Families
NA	25	15	0	68	0	23

3.6 VILLAGE AREA DETAILS

As per the information received from the agriculture department, the total area of the Village is 125 ha. Total geographical area of the Panchayat is 752.04 Ha. Gross cropped area of the village is 105.29 ha. and that of the Panchayat 299.64 ha. More than 97% (102 ha) of the gross cropped area is the net sown area. The village was a forest village until 2016. As per the information provided by the Agriculture Department, the land use of the village does not include any forest land. Due to the recent transfer from Forest village to Revenue village, the detailed historical information about the village is not available. But from the planning point of view, it is good that the village has no prior planning and the micro-planning exercise conducted. The village panchayat and the local authorities need a detailed micro-plan for Chuhari village.

3.7 CROPPING PATTERN

The only major and important crop in the village is paddy in Kharif season. During the years of good rainfall, the farmers those who have irrigation facilities, also go for the cultivation of rabi season paddy. Most farmers take only one crop in the year. The chunk of 10-15 villages including the Chuhari village get canal irrigation once in three years. This helps the farmers to grow the paddy in rabi season also. Only 5-10 farmers grow wheat and mustard during the rabi season.

Other crops like groundnut and maize are also grown during kharif season by some of the farmers. Most of the farmers avoid growing horticulture crops because of the perceived risk of animals from the nearby forest area. However, it is possible to grow citrus or other kinds of horticulture crops which are safe from the animal attacks.

Rainy Season (Kharif) Crop Areas			
S. N.	Name of Crop	Area (Hectare)	Productivity (Quintal/Ha)
1.	Maize	1.12	18.10

2.	Groundnuts	1.08	12.63
3.	Paddy	102	45.00
Total	**-**	**104.2**	**-**

Winter Season (Rabi) Crop Areas			
S. N.	**Name of Crop**	**Area (Ha.)**	**Productivity (Quintal/Ha)**
1.	Paddy	10.10	55.0
2.	Wheat	2.48	11.74
3.	Mustard	1.37	4.14
Total	-	**13.95**	**-**

3.8 LIVESTOCK

Livestock is an important resource for farmers in Chuhari village. The agriculture operations are dependent on the cattle. Cows are being used for the mulching purpose and its dung is used in several ways including as fuel, as manure or to clean the floor etc. Livestock in Chuhari village are helpful in reducing the vulnerability of farmers through providing diversified livelihood options. As per the latest livestock census, the status of the livestock population Chuhari village is presented in the table below.

Large Ruminant	**Small Ruminant/animals**	**Poultry**	**Total**
282	62	122	466

Fodder Demands Animal Husbandry					
S. N.	**Category**	**Number**	**Daily Food/Fodder Need (KG)**	**Annual Need (M.T)**	**Deficit /Surplus**
1.	Buffaloes	5	9.2	17	5
2.	Cow	277	6.85	693	208
3.	Goat	55	1.5	30	9
4.	Dogs	7	1.5	4	1

3.9 WATER RESOURCES

Rainfall:

The average rain fall of Mahasamund Block is 1175 mm. The average rainfall of Mahasamund District is 1180 mm. The table below presents the rainfall data for last 20-years as collected from the "Bhu-Abhilekh Department" of Mahasamund District.

S. N.	**Year**	**Annual Rainfall mm Mahasamund Block**	**Annual Rainfall mm Mahasamund Distt.**	**% of rainfall in Block as Compared to the District**
1.	1997	625.1	1127.9	55.42%
2.	1998	472.9	853.5	55.41%

3.	1999	656.6	949.9	69.12%
4.	2000	473.0	600.0	78.83%
5.	2001	821.3	1118.1	73.45%
6.	2002	860.7	1160.2	74.19%
7.	2003	986.8	895.3	110.22%
8.	2004	2256.5	2150.5	104.93%
9.	2005	1440.5	1179.7	122.11%
10.	2006	1219.9	1280.2	95.29%
11.	2007	1810.4	1353.9	133.72%
12.	2008	1000.2	1005.9	99.43%
13.	2009	1563.4	1305.1	119.79%
14.	2010	1303.6	1084.8	120.17%
15.	2011	1424.7	1381.0	103.16%
16.	2012	1215.0	1331.6	91.24%
17.	2013	1493.3	1378.4	108.34%
18.	2014	1207.7	1445.0	83.58%
19.	2015	1290.5	940.2	137.26%
20.	2016	1359.6	1031.0	131.87%

The monthly distribution of average rainfall in Mahasamund Block is provided in the table below. The maximum rainfall is received during the monsoon months. There is uncertainty about receiving winter rainfall to support the cultivation of rabi crops.

Months	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sept	Oct	Nov	Dec
Precipitation / Rainfall (mm)	4.0	11.0	26.0	11.0	11.0	205.0	430.0	378.0	228.0	62.0	3.0	4.0

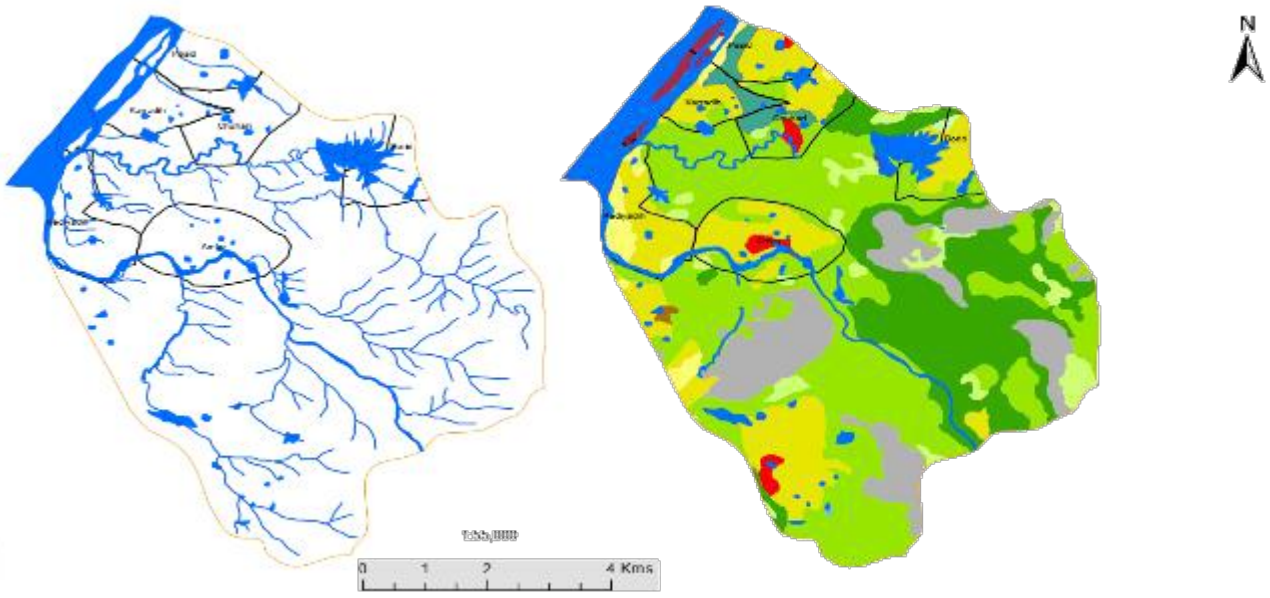


Figure 9: Map Showing the Topography and Drainage Pattern of the Area

Estimation of Runoff:

Out of 125 ha area of village, approximately 60 ha allows goof runoff. The runoff is average from the remaining 65 ha area. The area for good, average and bad runoff can be calculated using GIS

data. The near to actual runoff can be estimated using Strange's table method. Once the available runoff data is available, the plan for water harvesting structures can be prepared.

Runoff as Estimated using Strange's Table Method				**Rainfall:1180 mm**
Types of Run-Off	**Area (Ha.)**	**% of Runoff**	**Runoff (Cum)**	**Runoff (Ha.M)**
Good Run-off Area	60	25.1	2961.80	17.80
Average Run-off Area	65	18.8	2218.40	14.40
Bad Run-off Area	-	12.5	1475.00	00.00
Total	125	-	-	32.20

Surface Water Resources:
Despite the fact, the district receives good average annual rainfall. The Chuhari village and the surrounding area are facing water shortages, especially for the irrigation purpose. Farmers in Chuhari village are depending on only kharif crops. This is because uncertain or negligible winter rainfall and absence of provisions for harvesting the rainwater for life saving irrigation during the stress periods.

There is an existing water distribution system through canals carrying the water from nearby 'Pasid Reservoir'. The reservoir having limited capacity, is unable to supply the water to all the nearby villages for supporting the rabi crops. The Irrigation Department manages the reservoir and they have worked out a system to supply the water in every three years to a cluster of 5-6 villages. Thus, Chuhari village gets its quota of water after a gap of three years to support the cultivation of rabi crop.

There are four community ponds in the village. However, only two ponds are able to provide some water during the dry months. These ponds serve multiple purposes including providing irrigation water to few nearby fields, drinking water for animals and for bathing the animals and sometime for house and other construction purposes. The main sources for drinking water in the village are handpumps. The substrata being hard, the yields from handpumps are low. At the moment, only two handpumps are functional during summer months. There is no open well in the village but there are 8 private borewells for irrigation purposes.

Groundwater Resources:
It has been observed that the groundwater depth is about 40-50 ft. The substrata being hard, the recharging of ground water is limited. As per the data available from MGNREGS division, the Mahasamund block does not fall under the category of groundwater stressed area.

A detailed analysis was conducted to map the borewells and pumps under use in the village. The Primary Survey helped in listing down the pumps under operation. The table below provides the details of pumps along with their capacities. The locations of pumps have been marked on the village map for improved planning purposes. There are 17 operational pumps in the village. The usage dta for each pump has been collected. The table below presents the size of the pumps along with the name of farmer who owns the pumps. Out of all, one pump is solar operated.

S. N.	**Name of the Farmer**	**Capacity of Pumps in HP**
1.	Dukalu/Ramu	3.0
2.	Dasru/Ramnath	3.0
3.	Bishat/Mansingh	3.0 and 1.5
4.	Deendayal/Sanat	3.0 and 1.5

5.	Gopal/Vishwanath	3.0
6.	Jagadeesh/Indal	3.0 (Solar Panel Operated)
7.	Tiharu/Anandi	3.0, 3.0 and 1.5
8.	Shyamdas/Arti	3.0
9.	Chaitram/Jethram	3.0
10.	Arjun/Theluram	3.0
11.	Bhagwan Singh/Sahas	3.0
12.	Gaindu/Sahikram	3.0
13.	Shyamlal/Udairam	3.0
14.	Manohar/Vishvnath	1.5
15.	Manharan/Vishvnath	1.5
16.	Lakhan/Nagu	1.5
17.	Rajkumar/Santram	1.5

Water Budgeting for the Village:

A detailed water budgeting exercise has been conducted for all the three micro-waterseds in the village. The entire village has been divided in to three micro-watersheds called CH-1, CH-2 and CH-3. The analysis has been conducted to calculate the requirement of water for agriculture, human consumption and for cattle.

Figure 10: Location of Chuhari Village & Micro-Watersheds

This exercise is one of the most important exercise to budget the water or to understand the balance of water for different purposes. The planning for the required number and the types of soil and water conservation structure depends upon the available water for harvesting after deducting the losses from runoff, evapotranspiration, seepage and flowing out of the village and micro-watershed boundaries.

Description	Number	Daily (Litres)	Water Required Daily (Litres)
Human	338	70	23,660
Large Ruminant (Animals)	282	35	9,870
Small Ruminant	62	8	496
Poultry-Birds	122	0.25	30.5
Total	**-**	**-**	**34,056.50**

Water Requirement for Crops (all Seasons)						
	Crops	**Are Ha**	**Required Per Ha-M**	**Present Water Requirement Ha-M**	**Supply from Groundwater / Canal**	**Additional Requirement Ha-M**
Kharif	Maize	0.66	0.2	0.1	0.1	0.0

	Groundnuts	6.39	0.2	1.3	1.0	0.3
	Paddy	102	1.125	114.8	86.1	28.7
	Millet		0.2	0.0	0.0	0.0
Rabi	Wheat	4.46	0.45	2.0	1.6	0.4
	Chickpea	0.57	0.45	0.3	0.2	0.1
	Mustard	1.37	0.25	0.3	0.3	0.1
						29.5

One can use water to the extent it is available. Total available water and the total requirement is being given below in a consolidated manner:

S. N.	Description	Water (Ha- m)
1.	Water for Agriculture	29.5
2.	Water for Animal & Human	1.24
3.	Village water required (1+2)	30.7
4.	Available run-off from rainwater	37.5
5.	Harvested Runoff from Water Harvesting Activities	5.6
6.	Water deficiency/Surplus (5-3)	-25.2

The above table reflects that there is enough water, within village boundaries, however, the village is facing the water-related issues, as most of the water is being drained out of the village. Thus, the focus should be on harvesting the runoff at places to stop the water going out of the village boundary.

3.10 TEMPERATURE PATTERN

There is a big variation in the temperature in the district. It varies from 13° in December to 42° in May. In general, April to June are the hottest months and December and January is the coldest months.

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
Avg. Temp. in °C	20.5	23.4	27.6	32.1	35.3	32.1	27.3	27.1	27.5	26.2	22.3	20.2
Min. Temp. in °C	13.3	16.1	20.2	25	28.6	26.9	24.3	24.2	24.1	21.5	15.8	13
Max. Temp. in °C	27.8	30.7	35	39.2	42	37.3	30.3	30	30.9	31	28.9	27.5

The micro-planning results are presented in the following chapter. The Chapter-4 also presents the recommended conservation measures.

4 CLIMATE RESILIENT MICRO PLANNING

The climate resilient micro-planning presented in this chapter is participatory in nature and involves the recommendations which are the combination of top-down and bottom-up approaches. The following key steps were kept in mind while making the recommendations for management of natural resources in the village.

Baseline Data Collection and Analysis: The baseline data for the micro-watershed area was collected and the analysis is presented in Chapter-3. The changes in community livelihoods, ecosystem and in agriculture production can be measured against the baseline information over a period of time.

Vulnerability Assessment: Detailed vulnerability assessment was conducted to understand about the extent of resilience to be built to prepare the village community for facing any future climate related shocks.

Climate Analysis: Based on the climate data, actual or potential bio-physical and socio-economic impacts of climate change on the chosen unit of measurement (in this case the natural system of the watersheds and communities living within the watershed), has been analysed.

Identification and Prioritization of Adaptation Options: Based on baseline climate conditions and projected climate scenarios, prioritized treatment measures and adaptation options are recommended for implementation.

Integration: With the involvement of community members from the watershed, the selected options were integrated into the planning.

4.1 VULNERABILITY ASSESSMENT

The vulnerability assessment was conducted to understand about climate sensitivities and the adaptive capacities of the villages community. Climate sensitivities were identified through using biophysical parameters. Similarly, adaptive capacities were identified through using socioeconomic parameters.

Biophysical and socioeconomic parameters were selected that reflect the potential contribution of conservation measures in reducing climate sensitivities or increasing adaptive capacities, i.e. their ability to address climate vulnerabilities and thereby increase resilience.

Table 2. Biophysical Parameters to Address Climate Sensitivities

Biophysical Parameters	Potential Contribution of the Project for Reducing Climate Sensitivity
Net Irrigated Area (%)	Increasing net irrigated area will: • Help better manage rainwater • Allow farmers to grow Rabi crop • Be achieved if heavy rainfall can be kept for future use.
Groundwater availability (BCM)	Groundwater availability will be improved if the amount of rainfall that is absorbed by the ground can be increased.
Forest cover (%)	Increasing forest cover will help by: • Increasing how much water the soil absorbs, if local species are chosen that do not use much water

	• Increasing how quickly soil absorbs water • Reducing run-off • Slowing and reducing the flow of water • Reducing erosion

Table 3. Socioeconomic Parameters to Address Adaptive Capacities

Parameters	Possible Contributions of the Project for Improving Adaptive Capacities
Poverty	• Diversification of livelihoods for the poor and landless • Income generation and savings potential for the houseless who could invest in a safe shelter • Improved ability of the poorest families to access healthcare, education, skills and employment opportunities for themselves and their children • Individuals, households and communities who are able to escape the vicious cycle of poverty
Marginalization	• Improved gender parity and resilient outcomes for women and girls • Improved livelihoods, participation and empowerment of marginalized disabled and indigenous tribal groups • Improved productivity of marginalized individuals, households and communities and contribution to local economies

The text box below provides the details about additional parameters that were kept in mind for the selection and recommendation of conservation measures.

Criteria used to Prioritise the Recommended Measures

Efficacy – The extent to which the works are relevant to annual variations in rainfall.

Urgency – How urgent it is to undertake the works, i.e. whether they should be implemented now to address existing variations in rainfall.

Durability – The length of time that the recommended measure is likely to last and deliver the benefits.

Acceptance – The extent to which the village community is likely to support.

Knowledge and Skills – The likelihood that village communities will have the skills and knowledge to implement the recommended measure.

Time – How many man days it is likely to take to complete the work. Works that take less time are more important.

Co-benefits – The extent to which the work will provide benefits not just for the climate sensitivities to which they have been related.

4.2 RECOMMENDED MEASURES

The section below presents the recommended measures as a result of the micro-planning. The Figure-11 presents the recommended measures and their locations.

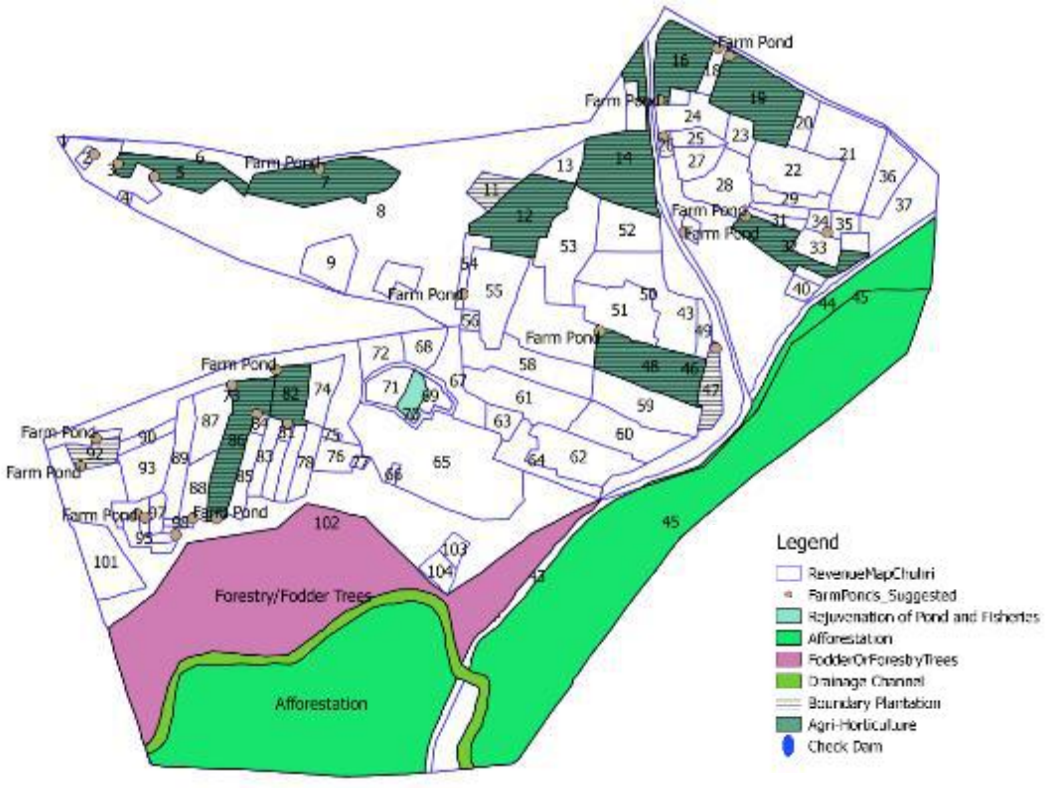


Figure 11: Map showing the Recommended Measures for Chuhari Micro-Watershed

The following natural resources management and climate resilient infrastructure measure are recommended for micro-watersheds in Chuhari village.

Farm Ponds

Private farm ponds have been recommended for 25 agricultural fields. Farm ponds are excellent vulnerability reduction tool for agriculture. These ponds are capable of absorbing shock of unexpected long dry spells during monsoon. It has been observed that due to climate change, number and length of dry spells are being increased. In such situations, farm ponds can be of great use for farmers by providing lifesaving irrigation to the crop. While constructing the farm ponds, care must be taken to not to lose topsoil, the topsoil must be spread over the rest of the field as it is the most fertile part of the soil profile.

As the farm ponds occupy the land, all farmers initially do not take interest in taking up this activity. However, it needs to be communicated that the benefits of farm pond are higher as compared to the losing a portion of land. The moisture and water of farm pond may also be used for horticulture plantation (vegetable and/or fruit production) on the bund/surrounding farm pond (see the picture).

The farm ponds can be implemented using the following arrangement.

- Project Implementation Agency (PIA): **Village Panchayat**
- To be Implemented under the Program: **MGNREGA**

- Total number of farm ponds: **25**
- Approximate cost of 25 Farm Ponds: **INR 33,75,000** (@ INR1,35,00/farm pond)

Figure 12: Farm Pond just after Construction and in use

To insulate the farm ponds with climate resilient infrastructure, the following activities are required to be taken up.

- Include the design and recommendations for mandatory plantation of local multi-purpose varieties of perennial grasses, shrubs and tree species, as protection against any kind of soil erosion on both upstream and downstream areas, banks of the pond and alongside downstream drainage areas. This will ensure minimal erosion and availability of grass, fodder, fruits, fire wood or other benefits to the communities in addition to the increased availability of water and protection of the farm pond.
- The availability of fodder from grasses and the produce from trees can provide additional sources of income for the villagers and help in protecting them against the complete failure of crops during the periods of droughts, floods or during any crisis due to natural disasters.
- The grass species should also be planted in the bed of farm pond to protect the bed and the walls from soil erosion. The carpet of planted grass varieties will contribute to increased percentage of soil moisture in and around the pond. This will ensure speedy growth of vegetative cover and support the cultivation of vegetables and horticulture crops for ensuring additional livelihood resources.
- The construction of farm ponds along with proper treatment and vegetative cover in the form of trees and grasses will ensure the longer life of the ponds.

Renovation of Dried up Village Pond

Out of the 4 water bodies in the village, one is almost completely gone out of use due to the silting and water hyacinth. This pond needs to be revived. The revival of the pond can result in the following benefits.

- Size of the Village Pond: **0.4 ha / 1.0 Ha-M**
- Project Implementation Agency (PIA): **Village Panchayat**
- To be Implemented under the Program: **MGNREGA**
- Approximate cost of renovation is: **INR 2,25,000**

- The pond will be able to provide water to all the households in the village and an additional water body can be added to the water resources in the village.
- The silt taken out from this pond can be used for improved cultivation of fruits and vegetables in the village.

- The rejuvenated pond may also be used for rearing the fish with support from the fisheries department. The village Panchayat can earn extra revenue from the sale of fish.

Afforestation

About 40 Ha land area in the village can be categorised as waste under different categories. This land can be put under plantations of mixed variety. The soil erosion map also indicated that the entire 40 Ha land is prone to sheet erosion. At the moment, villagers go far away forest lands for the collection of NTFPs. The improved afforestation within village boundaries will provide improved livelihood to the villagers.

- Total Area to be Planted: **40 ha**
- Area marked on village map (Figure-11) with: **Green**
- Project Implementation Agency (PIA): **Village Panchayat**
- To be Implemented under the Program: **MGNREGA**
- Estimated cost of plantation: **INR 8,00,000** (@ INR 20,000/Ha.)

Fodder Trees

Plant fodder trees on 19 Ha area marked with red colour on the treatment map (Figure-11). Livestock normally dependent on the grazing lands, which are not available in the village. The improved availability of good quality fodder will improve the health and milk production in the village. The soil erosion will also be stopped.

- Total Area to be Planted: **19 ha**
- Area marked on village map (Figure-11) with: **Red**
- Project Implementation Agency (PIA): **Village Panchayat**
- To be Implemented under the Program: **MGNREGA**
- Estimated cost of plantation: **INR 3,80,000** (@ INR 20,000/Ha.)

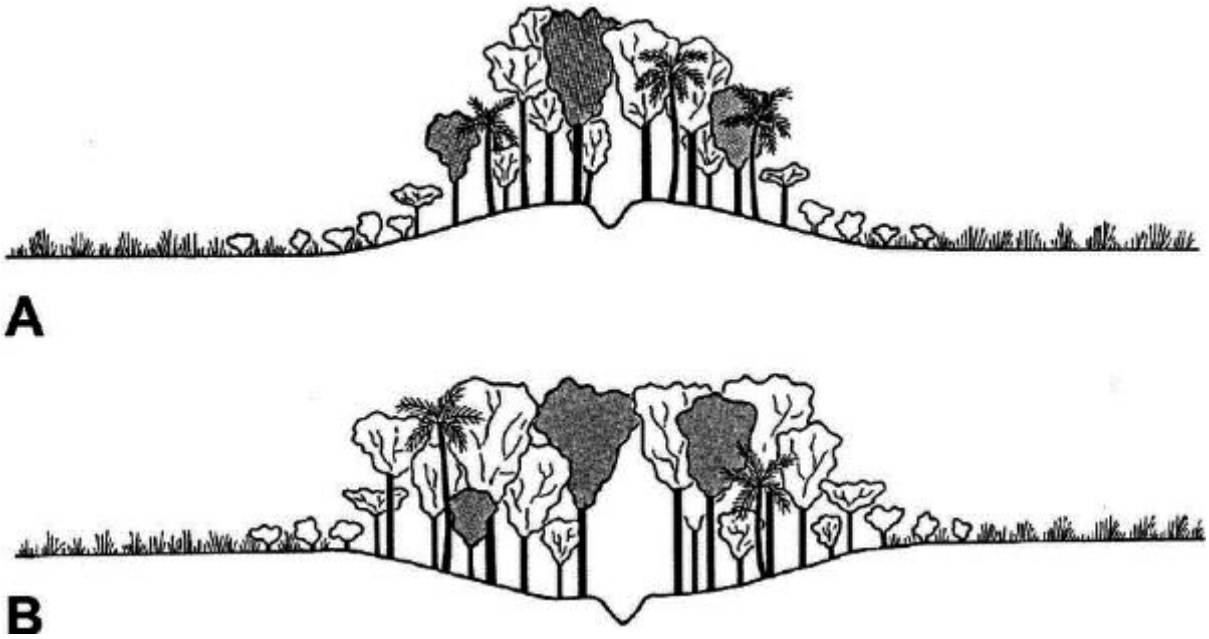
Drainage Channel Rejuvenation

A drainage channel in the southwestern part of the village is silted up. High flow in the channel cause the flooding of the nearby areas. It is suggested to go for a desilting/ repair of channel work to restore the flow in the channel. A stop dam may also be built in this channel, which will give the water storage and moisture in the surrounding areas and will support afforestation and fodder tree plantation. The location of the check dam is marked on the village map (Figure-11). This will help in harvesting the water for lean periods and also in recharging of groundwater.

- Approximate length of the channel to be rejuvenated: **500 m**
- Marked on village map (Figure-11) with: **Blue**
- Project Implementation Agency (PIA): **Village Panchayat**
- To be Implemented under the Program: **MGNREGA**
- Estimated cost for rejuvenation: **INR 33,75,000**

To insulate the drainage line with climate resilient infrastructure, the following additional activities should be implemented.

- Planning should include dense vegetative cover with a mix of grass, shrubs and trees depending upon the land use of the area for which the revetments are being constructed. The use of dense vegetative cover is a must.
- Include the design and recommendations for growing vegetation on both upstream and downstream sides of the structures. The banks of drains should be covered with perennial grass species for fodder and binding of soils. The planting of multi-purpose tree species will ensure permanent vegetative cover and additional income during periods of drought, floods or other stresses in seasons when agriculture incomes are low.
- The grass species should also be planted in drainage areas to control erosion and flow during the rains.
- Emphasis should also be given to allowing naturally regenerated tree, shrub and grass species to grow around the structures. The naturally grown vegetation will have strong root stock that will sustain it in harsh climatic conditions. Hence, planted trees or other vegetation may have a higher mortality rate



The **check dam** will also be constructed under MGNREGS. To ensure the long life, the following resilient planning is also important along with the check dam.

- Once the planning and design of check dam is complete, from the climate resilience perspective, it is important to plan required vegetative cover (trees, shrubs, grass, crops, fruits, etc) both upstream and downstream of the mechanical structures. Without the plantation of trees, grasses, fruits, etc, the check dam will have a limited role to play. Thus, it is suggested to use the presence of check dam for creating climate resilient infrastructure by introducing initiatives like agro-forestry, horticulture, bund plantation, fodder development, etc for ensuring not only additional livelihood resources but also the longer life of the check dam.
- The climate resilient infrastructure is created around the check dam with the help of introduction of permanent measures (vegetative cover) and multi-purpose varieties of trees, shrubs, grasses, fruit trees, etc. In addition, cropping patterns should be based on the

availability of resources like water, and infrastructure like market, roads, storage facilities, processing facilities to increase the value of produce, economic value and local consumption.

- Number of Check Dam: **One**
- Marked on village map (Figure-11) with: **Blue**
- Project Implementation Agency (PIA): **Village Panchayat**
- To be Implemented under the Program: **MGNREGA**
- Estimated cost for rejuvenation: **INR 10,00,000 (@ INR 90-100/CuM of storage)**

Vermi-Composting Construction

To enhance the productivity and to maintain the soil fertility in long-term, vermicompost is a viable solution. This not only provides a good quality bio manure but also help in growing healthy crops. The agri waste and the cattle dung can be converted in compost manure. Minimum 20 units of Vermicompost units should be provided to the village.

- Number of Vermi-Compost: **20**
- Project Implementation Agency (PIA): **Village Panchayat**
- To be Implemented under the Program: **MGNREGA**
- Estimated cost: **INR 2,40,000 (@ INR 12,000/pit)**

Agri-Horticulture:

In Chuhari, the villagers normally avoid the horticulture trees due to the apprehension of attack of animals on the fruits. However, citric fruits like pomegranate, gooseberry, etc can be taken up to reduce the vulnerability of the farmers significantly. Intercropping with such trees not only provide the nutritional support to the family but also ensure distributed income and reduced vulnerability to climatic conditions. Approximately 25 ha area can be planted with different kinds of fruit trees. The horticulture trees can be planted on the farm bunds, along the streams, private waste lands, common lands and near the farm ponds.

- Total Area to be Planted: **25 ha**
- Area marked on village map (Figure-11) with: **Dark Green**
- Project Implementation Agency (PIA): **Village Panchayat**
- To be Implemented under the Program: **MGNREGA**
- Estimated cost of plantation: **INR 5,00,000** (@ INR 20,000/Ha.)

4.3 EXPECTED OUTCOME FROM THE IMPLEMENTATION OF SUGGESTED WORKS IN CHUHARI VILLAGE

S. N.	Name of Work	Number	Expected Outcome
1.	Farm Pond along with horticulture plantation on the surrounding bunds	25	• Enhanced productivity of the agriculture fields • Higher returns from the agri field as well as from trees/vegetation on the bunds
2.	Renovation of old pond along with promotion of agri / horti production using its silt	1	• Extra livelihood options available • Increased revenue for the Panchayat • Increased employment generation
3.	Fisheries in the renovated pond	1	• Extra livelihood options • Increased revenue for the village • Increased employment opportunities
4.	Afforestation	40 Ha	• Increased availability and easy access to NTFP products • Reduced soil erosion • Increased natural capital • Increased overall incomes for the farmers
5.	Fodder/Fodder plantation	19 Ha	• Increased and ensured availability of fodder for livestock • Increased milk yield
6.	Drainage Channel renovation	1	• Less damage and lesser soil loss due to heavy flow in flatter lands, after completion of the work
7.	Vermi Composting	20 No.	• Increased bio manute • Increased production • Higher rates of the producs (organic products)
8.	Agri-horticulture	25 Ha	Fields with more than 1.5 ha land have been identified suitable for initiating the agri-horti practices. • Increased returns per unit land • Increased nutrient security • Less vulnerability to climate change