

CLIMATE CHANGE TREND ANALYSIS AND PARTICIPATORY MITIGATION STRATEGIES: EXPERIENCES FROM CENTRAL TRIBAL BELT OF INDIA

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ABSTRACT

Climate change is an inevitable phenomenon at global level. All micro-watersheds are facing the effect of it with various degree of severity. The severity of effect of climate change is very obvious in rain fed marginal farmer community with a low economic status.

A scientific study of climatic factors trend analysis with vulnerability assessment of community, in context to climate change done using various tools in Madhya Pradesh, Gujarat, Rajasthan and Maharashtra was carried out. The results are not so good and need to address scientifically with micro plan so that community and ecosystem will be prepared to face the 'disaster days' either in the form of drought or flood or any other natural calamities. We are doing water centric rural development in semi-arid areas inhabited by tribal or indigenous community. And the results are very optimistic. We have developed a road map for the same and it works very well.

The first step of success starts with preparedness of community after assessment of vulnerability along with trend analysis of climatic factors (comparison of past and projections using different models (at least RCP 4.5)).

A micro-plan was developed with the participation of community execution also done. First of all, rain water harvested and then the judicious use of it done for two seasons agriculture with change in cropping pattern. So up to this level, irrigation was sure followed by food and nutritional security. As a result, migration checked and because of horticulture activities and reintroduction of indigenous tree species, green cover increased as well as additional income generated. Development is a continual process and in project areas, activities like skill development, women empowerment are going on. But at this level water, food, nutrition and work security partially at village level achieved.

This model is scalable and replicable for any watershed or area of semi-arid climatic zone

Keywords: *Climate change, trend analysis, vulnerability assessment, indigenous people*

INTRODUCTION

Climate change is a very important, extensive and intensive global environmental problem. It has the number of evil consequences on the economic development along with the different productive sectors and economic development activities in the economy.

The impacts of climate change are being obvious throughout the world. It is becoming warmer, rainfall is more erratic, extreme weather events are becoming more frequent and intense, prolonged periods of drought, excessive rains and in all uncertainty of climate is most obvious. The poor and marginalized are often most affected by climate variability and change.

Still there is silver lining in the sky, if we, the community are prepared to face the problems with adequate preparations, the effect can be mitigated. There is a need of it to act at micro level and this study is a part of coping mechanism for climate change by following certain road map. The watershed is the natural unit and most important platform to work for development considering all resources with special preference to natural resources and its management.

Vulnerability assessment is a key aspect of anchoring assessments of climate change impacts to present development planning. According to the IPCC (2007)

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definition, vulnerability in the context of climate change is "the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity". Main components of the vulnerability are exposure, sensitivity and Adaptive capacity.

Trend analysis of climatic factors specifically, rainfall, maximum temperature, minimum temperature, PET etc., by observing data from history and projections for future helpful in planning and preparedness of community to mitigate the consequences of climate change.

The analysis of data shows that, there is a rise in maximum and minimum temperature and in some pockets quantum of rainfall will also more and along with this there will be increase in days of disaster. So, there is a need to develop a coping mechanism to lessen the effect of climate change in small units so that collectively major part of the big ecosystem can be ready with preventive measures.

Materials and Methods

The study area belongs to selected tribal pockets of Rajasthan, Gujarat, Madhya Pradesh, Maharashtra, Andhra Pradesh, Odisha etc., The study area belongs to different river basins viz., Sabarmati, Chambal, Mahi, Narmada, Mahanadi, Tapi etc., The study area is highly diversified in community, culture, geology, water quality and quantity, agro- climate but commonality is that all are facing consequences of climate change at different degree, unmanaged natural resources and with low to moderate

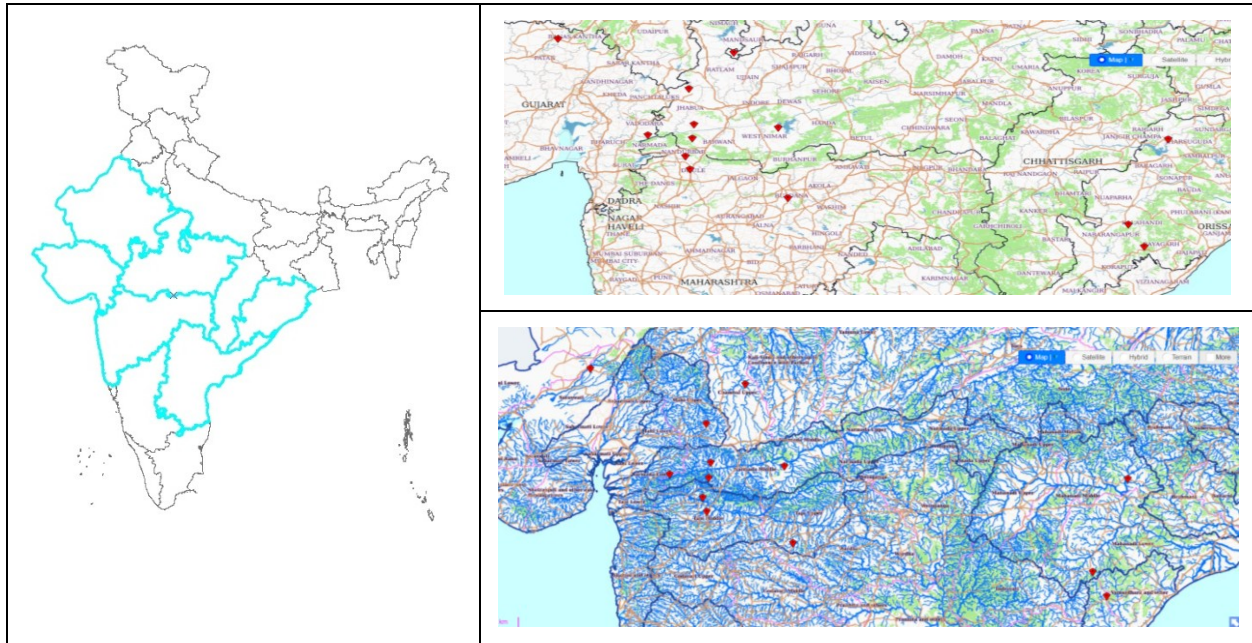


Fig 1

socio economical status but most importantly the community is well conversant with the local ecosystem and with little efforts the community will be / are prepared with coping mechanism.

The method applied is a mix bag of social, scientific and technical aspects. In general, following methods followed:

A. Trend analysis of climatic factors (rainfall, temperature, moisture etc.,)

For trend analysis of climatic factors, an in depth study of climatic factors up to 199 years (100+99 years) was undertaken using different tools and projection by different climatic models

B. Identification of climatic risk and vulnerability assessment of community in given area by stake holders and experts by

- Observation during transect walk
- Fuzzy cognitive mapping and Focus group discussions with community
- Closed ended questionnaire and Secondary data

from reliable source

C. Identification of climatic risk and adaptation strategies for climatic risk in followings:

- State of natural resources: Soil, Water (surface and ground water). Green cover
- Socio-economic dynamics: Rainfed agriculture, food security, migration
- Environmental issues: forest cover, pressure on it
- Developmental issues: Agriculture, Animal husbandry, alternate livelihood

RESULTS AND DISCUSSION

Trend analysis: Rains

The pattern of rainfall and temperature in history and projected time period was observed and analysed to find out the trend of climatic factors. The study area divided as per river basin and trend analysis done for each area individually but in want of space only one example from part of Narmada Basin is quoted below.

The comparison of rainfall in both periods shows that in

Table 1

Month		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Grand Total	Rainy days
Rainfall mm	History	8.09	6.34	9.63	17.39	72.04	127.97	273.94	243.63	131.45	30.94	19.65	13.69	954.75	64
	Projection	7.57	6.08	8.09	21.74	69.06	151.31	304.26	300.76	165.19	33.51	16.38	12.13	1096.07	65
Days of disaster	History	1	2	2	5	30	31	130	138	44	8	11	6		
	Projection	4	3	1	15	44	102	237	249	105	19	10	6		

projected period, the quantum of rainfall will be slightly more, the number of rainy days is almost same. But the number of disaster days will be more in projected period. It means, there is need of strategic plans to cope up with the disaster days.

A comparison of quantum receives in every month of history and projected period is given below:

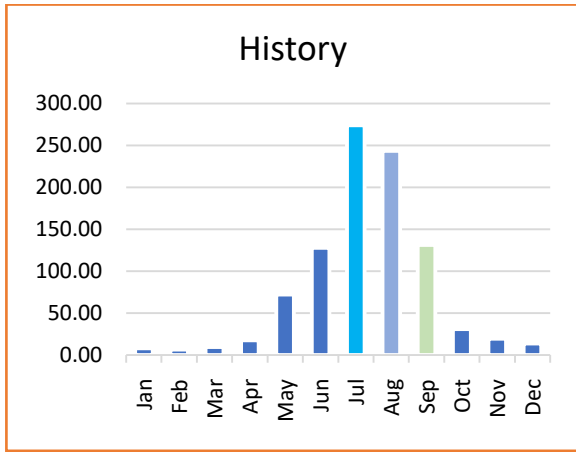


Fig. 3

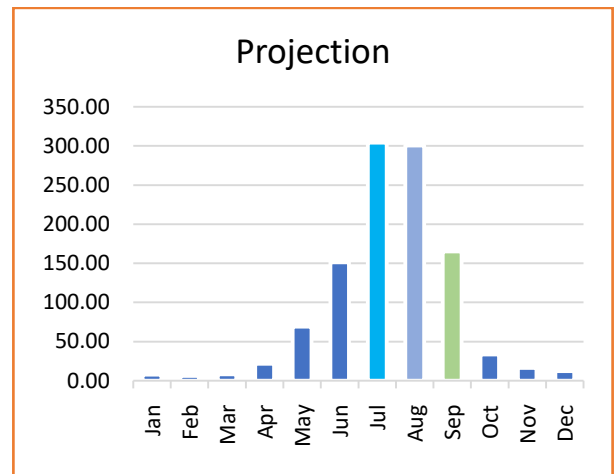


Fig. 4

Rains are the main source of water in dry lands and most of the marginal farmers are practicing rainfed agriculture. This trend analysis will help them to cope up and prepared for it and can plan accordingly to survive happily.

Trend analysis: Temperature

Temperature: Maximum

Table 2

The comparison of maximum temperature in history and projection period is given below:

Temp Max	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Overall
History	24.04	25.97	31.15	36.21	35.25	32.86	30.18	29.54	29.97	30.89	29.97	26.82	30.24
Projection	27.80	29.07	34.13	38.59	37.36	34.85	32.56	31.58	31.39	32.60	33.01	30.56	32.79
Change	3.75	3.10	2.99	2.38	2.11	1.99	2.38	2.04	1.42	1.71	3.04	3.73	2.55

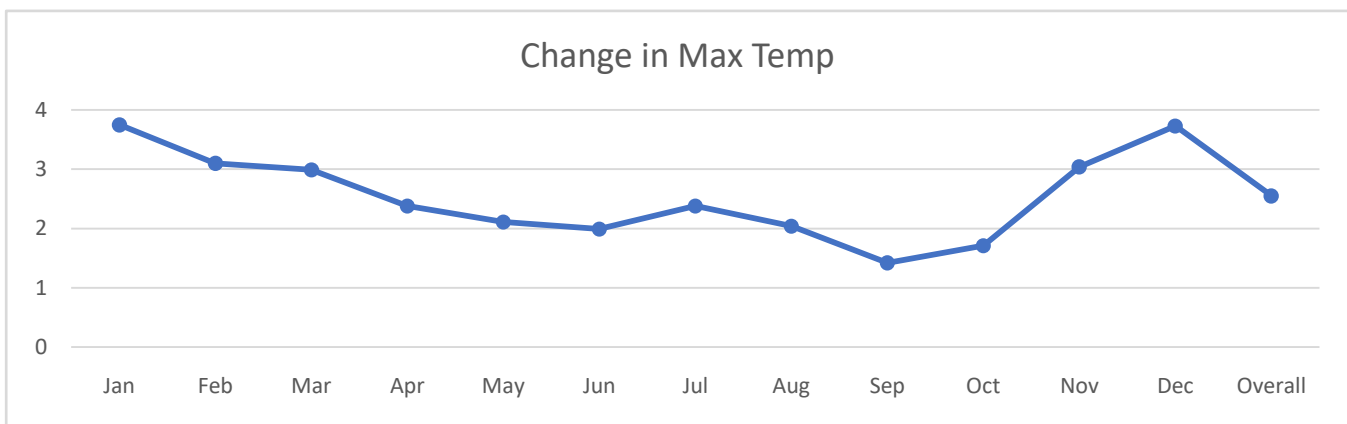


Figure 2

Table 3

Change in future in max temp	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Overall
Upper limit Temp Max	5.31	1.90	5.73	4.02	3.33	5.04	8.75	5.32	2.33	3.03	3.69	4.51	4.41
AVG Temp Max	3.75	3.10	2.99	2.38	2.11	1.99	2.38	2.04	1.42	1.71	3.04	3.73	2.55
Temp Max lower	3.56	4.36	0.59	1.10	2.34	0.65	1.20	0.83	1.48	2.16	2.47	2.69	1.95

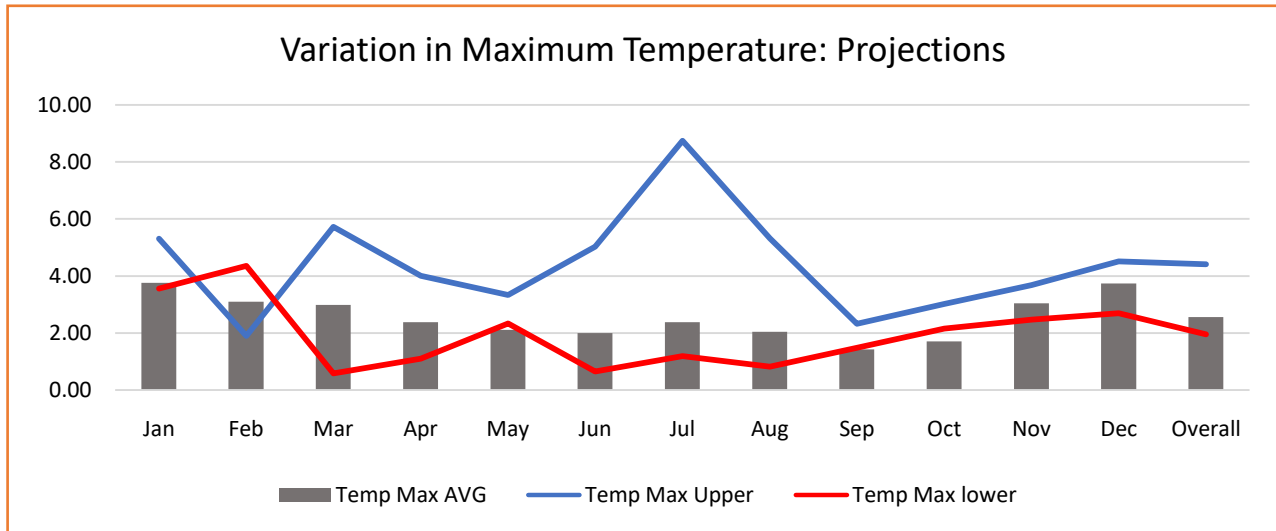


Fig. 5

Temperature Minimum:

The comparison of minimum temperature in history and projection is given below:

Table 2

Change in future in min temp	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Overall
Min Avg History	11.82	13.32	18.63	24.30	25.69	24.95	24.01	23.38	22.49	20.85	19.04	15.47	20.36
Min Avg Projection	16.26	16.95	22.30	27.32	28.29	27.46	26.61	25.94	25.19	23.76	22.57	20.13	23.60
Change	4.44	3.64	3.68	3.03	2.60	2.51	2.61	2.56	2.70	2.91	3.54	4.66	3.23

There is trend of rise in minimum temperature by 3.23 °C (on an average). The projection of minimum temperature which shows rise in the month of January and February may lead to less productivity due to early maturity. During plan this point to be considered and act

properly.

The rise in temperature will lead to retrieval of soil moisture and there will be need of water. Because of it, second crop will be in starvation and leads to loss to farmer and ultimately migration

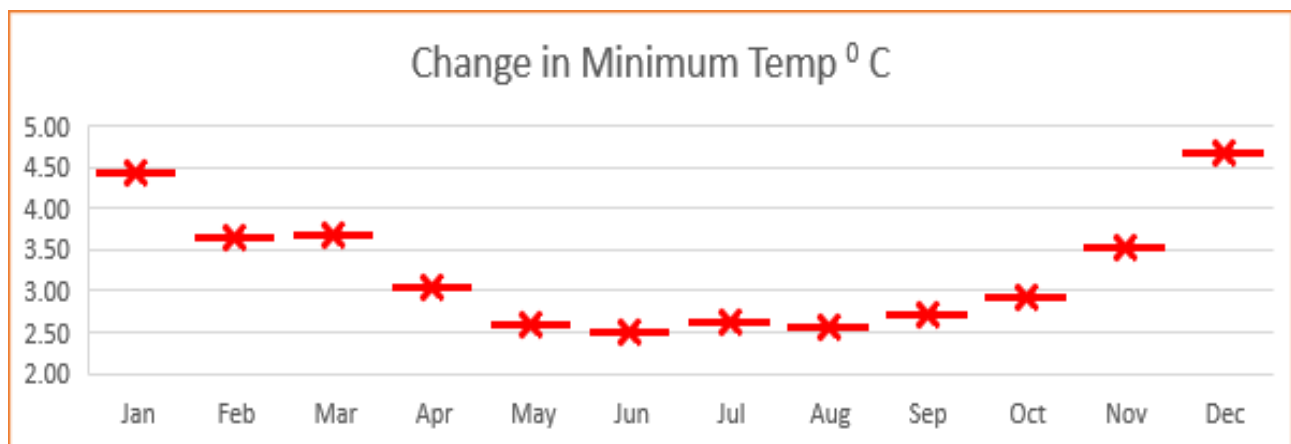


Fig. 6

Identification of climatic risk and vulnerability assessment of community in given area by

- Observation during transect walk

As land is undulating and soil is without moisture and organic carbon, dried river stream, such observation kept in mind during the planning so that ecosystem can function optimal.

- Fuzzy cognitive mapping and Focus group discussions with community

These are the instrument used to collect the data which become helpful in planning and execution. Most of the

senior villagers explained in depth about the natural resources and its status and local geology and flora and fauna. This kind of participation is the main key of success in mitigation of effects of climate change. As per Weljibhai: “30 years back, the rivulet was full of water but now it dried up in December only.”

- Closed ended questionnaire and Secondary data from reliable source: The outcome of this questionnaire helped in planning as it indicates the present scenario and potential for future. We developed many formats to get the desired data and it is dynamic as per location and situation.



Fig. 7



Fig. 8

Identification of climatic risk and adaptation strategies for climatic risk in followings:

- State of natural resources: Soil, Water (surface and ground water). Green cover
- Socio-economic dynamics: Rainfed agriculture, food security, migration
- Environmental issues: forest cover, pressure on it
- Developmental issues: Agriculture, Animal husbandry, alternate livelihood

Vulnerability assessment for a given watershed. This belongs to the given watershed but such assessment can be done for any area.

After analysis of data collected by each instrument, planning done with the help of community followed by the execution again with support of community. In our model, community and transparency of work done, are two main key items and it leads to ownership of community for work and quality work with sustainability.

Some recommendations and working areas are as follows which after proper execution leads to “prepared community to mitigate the effect of climate change at micro level”:

Agriculture

- Awareness for soil testing practices and according to results follow of input protocol.
- Awareness for less chemical to organic farming and development and demonstrations of organic inputs
- Reintroduction of biological and mechanical means for plant protection and productivity enhancement
- Introduction of precision farming
- Demonstration of some new high yielding crop variety’s
- Demonstration of Closed Cultivation methods like Net house, Ventilated Poly house, Low Hight Tunnel,
- Development Seed Bank of Village or Watershed level
- Introduction of collective marketing of Agriculture, Horticulture, floriculture produce
- Introduction of collective procurement of Agri Inputs through CBO, / SHG’s
- Demonstration plots for crop rotation and mixed cropping looking to the local varieties of crops with some green manuring plantations
- Awareness and demonstration for drought tolerant crops

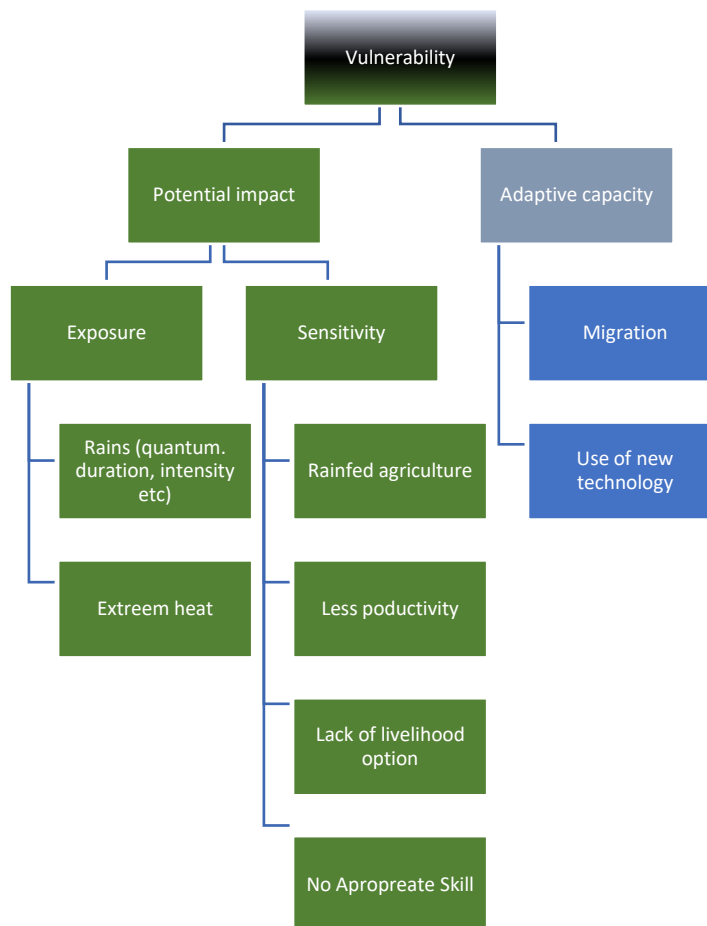


Fig. 9

- Awareness and demonstration for underutilized crops
- Water
- Development of water budget and make aware community about it; awareness for conservation of water
- Awareness of community for development of rain water harvesting structure at individual and community level; execution of rain water harvesting structures;
- Fixing of nonfunctional water harvesting structures; repair and de-silting work
- Awareness for use of micro irrigation system to the community; exposure visit to nearby farm using micro irrigation systems
- Awareness for well recharge techniques
- Use of drudgery reducing implements (Water Wheel) for carrying water from source to user location
- Use of low-cost water purification techniques for domestic consumption

Soil

- Awareness for soil conservation measures at individual and community level.
- Awareness for usefulness of FYM after proper treatment
- Awareness for usefulness of biomass to maintain the fertility through different composting techniques
- Awareness for no tillage or less tillage
- Soil conservation measures by biological means needed as erosion is heavy

Animal Husbandry

- Awareness for cultivation of multi cut good quality green fodder; Awareness through training on hydroponics technique for green fodder cultivation for lactating large and small ruminants
- Awareness for use of cow dung for manure and generating the biogas as energy source and use of digested slurry in the farm field as manure
- Introduction of indigenous improved breed of Large and small ruminants with scientific rearing practices as livelihood option with collective marketing of its produce
- Demonstration of Stall-feeding unit of Small and large ruminants with
Livelihood and Food Security
- Introduction of new technologies where less water per crop is used
- Awareness for collective farming so that market will approach to village

- Introduction of small trade as skill components
- Introduction of horticulture crop as additional income with economic technologies
- Integrated approach for production enhancement
- Introduction of small trade as skill components as income generation activities as well as parallel livelihood options
- Skill education is must
- Migration with siblings and other villagers so that collectively they can face the problem

Green Cover:

- protection and rejuvenation by means of reintroduction of indigenous species using three tier model.
- The tribal belt is full of indigenous knowledge and which is vanishing drastically so rejuvenation of indigenous knowledge
Along with these, different matrix developed as blue print to prepared the community ecosystem to mitigate the adverse effect of climate change and these are:
- Livelihood and resources of the community as per season
- Livelihood mapping and priority ranking
- Hazard analysis with the severity (of natural resources, livelihood and assests)
- Priority of hazard and its impact on resources
- Vulnerability assessment of community
- Vulnerability assessment of critical sectors
- Assessment of resilience capacity of vulnerable community and critical sectors
- Assessment of coping and adaptation strategies
- Identification of partners
- Selection of activities for CC adaptation
- Climate risk mapping of different sectors
- Climate proofing of different sectors
- Identification of activities to be undertaken
- Analysis of climate risk and adaptation strategies in watershed/given area
- Integrated Adaptation Strategies identified based on analysis of Stakeholders Feedback and Vulnerability assessment by Climate Change Experts

CONCLUSION

Climate change is a global problem but solution is at micro level. This is not an quote but it is doable and it is replicable also. But to achieve this we have to consider all aspects viz., social, scientific, technical, ecological and financial also

with a micro-plan and active participation of all stakeholders.

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