Global Water Partnership
South Asia
India Water Partnership

Water & Climate Resilience Programme *(WACREP), India*

Report on Creating a Knowledge Platform for Advocating and Bringing about Changes in the Reservoir Operation Schedules (ROS) and Documenting Farm level/Pond level Practices

Activity No. 3.6.1.A (Work Package-6) :

i) Creating a knowledge platform for advocating and bringing about changes in the reservoir operation schedules (ROS) of the major dams in Wainganga, namely Sanjay Sarovar & Gosikhurd Dam

ii) Documenting farm level/pond level practices which have demonstrated resilience to climate change as a reference guide used to enhance capacity,

Gomukh

Gomukh Environmental Trust for Sustainable Development
92/2, Durga, Ganagote Path, Erandwane,
Pune 411 004
Tel: + 91 20 – 25673324 / 08380003155
E-mail id - paranjpye@yahoo.co.uk / gomukh.ntrust@gmail.com

India Water Partnership (IWP)
Secretariat- WAPCOS Ltd.
76-C, Sector-18, Institutional Area, Gurgaon - 122015 (Haryana)
Tel. : (91-0124) 2348022 (D); (91-0124) 2399421, Extn : 1404
Email: iwpneer@gmail.com; veena@cwp-india.org Web: www.cwp-india.org
Facebook: India Water Partnership

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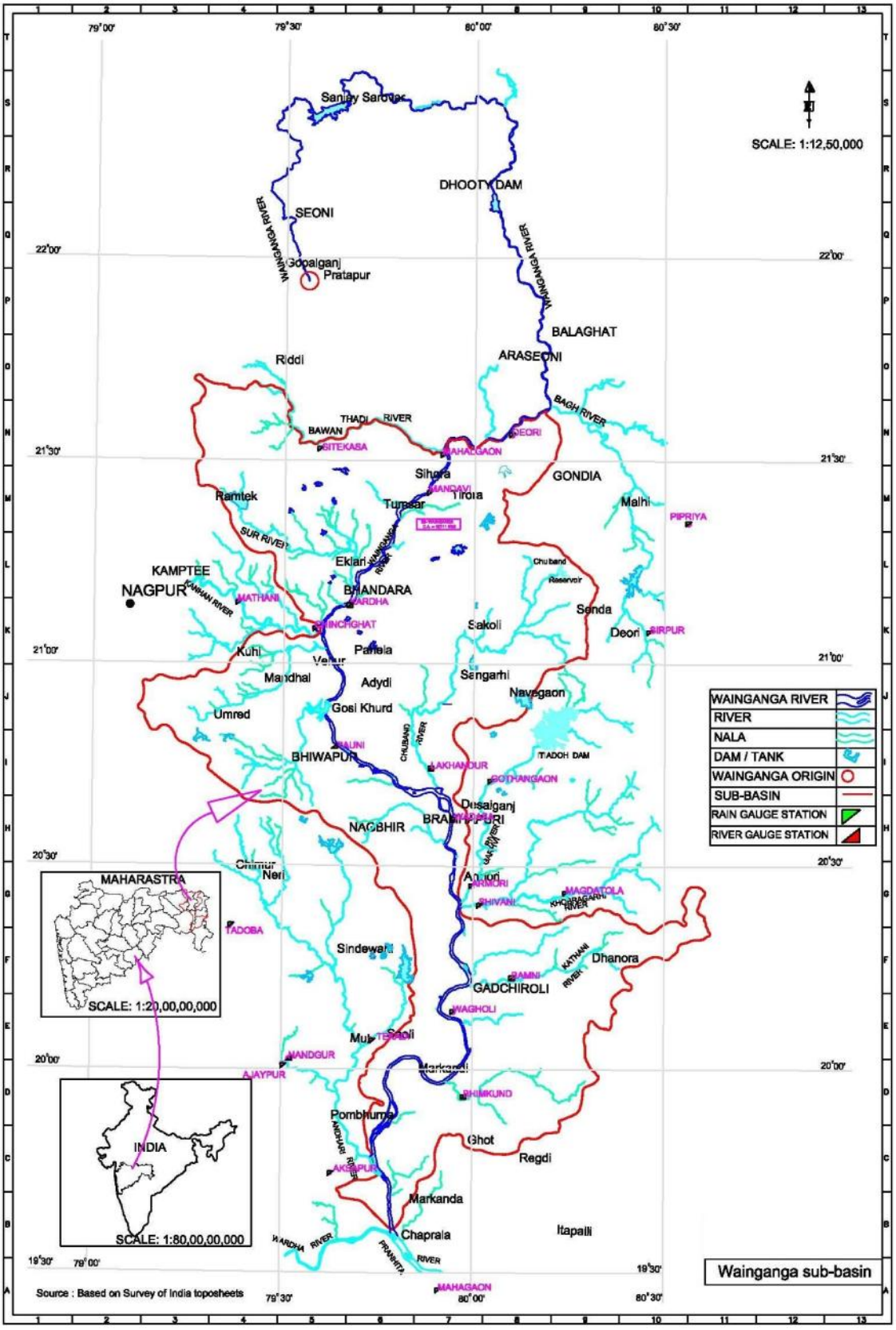
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DHOOTY DAM
SEONI
Gopalganj
Pratapur
WAINGANGA RIVER
BALAGHAT
ARASEONI
Riddi
THADI RIVER
BAWAN
BAGH RIVER
DEORI
SITEKASA
AHALGAON
Sihora
GONDIA
MANDAVI
Tiroda
Ramtek
Tumsar
Malhi
PIPRIYA
SUR RIVER
Eklari
KAMPTEE
NAGPUR
BHANDARA
WARDHA
MATHANI
PAUNI
Sakoli
Sonda
Deori
PIRPUR
Kuhi
Pauni
Mandhal
Adyoli
Sangarhi
Navegaon
Umred
Gosi Khurd
CHUBAND RIVER
BHIWAPUR
TADOH DAM
LAKHANDUR
GOTHANGAON
Dusalgaon
NAGBHIR
BRAHMAPURI
Chimur
Neri
Armori
MAGDATOLA
SHIVANI
KHOBRAGARH RIVER
TADOBA
Sindewahi
Dhanora
KATHANI RIVER
RAMNI
GADCHIROLI
WAGHOLI
Mul
TEKADI
MANDGUR
AJAYPUR
Markanar
BHIMKUND
Pombhurna
Ghot
ANDHARI RIVER
Regdi
AKSAPUR
Markanda
Chaprala
Itapalli
WARDHA RIVER
PRANHITA RIVER
MAHAGAON
MAHARASTRA
SCALE: 1:20,00,00,000
INDIA
SCALE: 1:80,00,00,000
WAINGANGA RIVER
RIVER
NALA
DAM / TANK
WAINGANGA ORIGIN
SUB-BASIN
RAIN GAUGE STATION
RIVER GAUGE STATION
Wainganga sub-basin
Source : Based on Survey of India toposheets
79°00'
79°30'
80°00'
80°30'
22°00'
21°30'
21°00'
20°30'
20°00'
19°30'

Acknowledgements

This is to acknowledge the whole hearted, involvement of the fishing and forest dwelling communities and the farmers and their association, of the Wainganga sub-basin; both in Madhya Pradesh and Maharashtra. The panchayat samittee members and office bearers of the fishermen's societies were instrumental in carrying out various projects and sharing their knowledge and practices. We recognize and acknowledge that the entire knowledge base, and the physical/ structure-building-practices and traditions belong to the communities involved. Gomukh and its staff have only been responsible for documenting, collating and interpreting the traditional knowledge of the *Dhivar*, *Gond* and *Kohli* communities.

We also recognize and appreciate the efforts of the members of the Wainganga Water Partnership who contributed their valuable time and experience in all the activities carried in the Wainganga sub-basin since 2014. Further we would like to put on record the cooperation extended by Shri Vani, E.E., I.P.I. Division, Bhandara, and Shri Apte, erstwhile E.E., M.I. Division, WRD Bhandara.

The work done in the remote and Naxal affected areas of Gadchiroli and other districts of eastern Vidarbha under **Water and Climate Resilience Program (WACREP)** of **GWP-South Asia** would not have been possible without the encouragement and financial support of the IWP and GWP.

Tank restoration/part-desiltation in progress

Background

Recent findings contained in the United Nations Framework Convention on Climate Change (UNFCCC) and the Intergovernmental Panel on Climate Change (IPCC) reports indicate that these inevitable impacts would be much more pronounced in Asia, Africa, and Latin America, where agrarian livelihoods are precariously dependent on water. Several strategies are being implemented by the global community to combat these climate change impacts on water and livelihood.

According to the Central Water Commission's (CWC) preliminary report on the Effect of Climate Change in India (2008), it has been predicted that there will be a rise in rainfall intensity and extreme rainfall episodes in Central Indian river-basins like the Godavari River Basin and its tributaries. The Wainganga River basin is known as an assured rainfall zone and receives about 114 cm. of rainfall each year spread over 6 months from the South West and the North East monsoon winds. It has been predicted that there will be an increase in rainfall and its intensity and an increase in temperature by around 0.5 degrees to 2 degrees Celsius by 2030. However, today a commonly observed phenomenon in Central India is that the dry spells in the monsoons have considerably increased, despite the average rainfall values not showing appreciable change.

The Wainganga sub-basin has a tribal population of 18% wherein resides the primitive tribe namely the *Madia Gonds,* and where the total population dependent on land, forest and fishery resources is 80.37 % of the population which has a high vulnerability not only to climate changes but to all natural vagaries and market pressures.

Project Area:

Although the total area of the Wainganga River sub-basin is 74000 km^2, the area of concern is 13968.16 km^2 (approximate) i.e., the Central Wainganga sub-basin along with the main sub-streams which are directly affected by flood and unanticipated releases from large and medium dams.

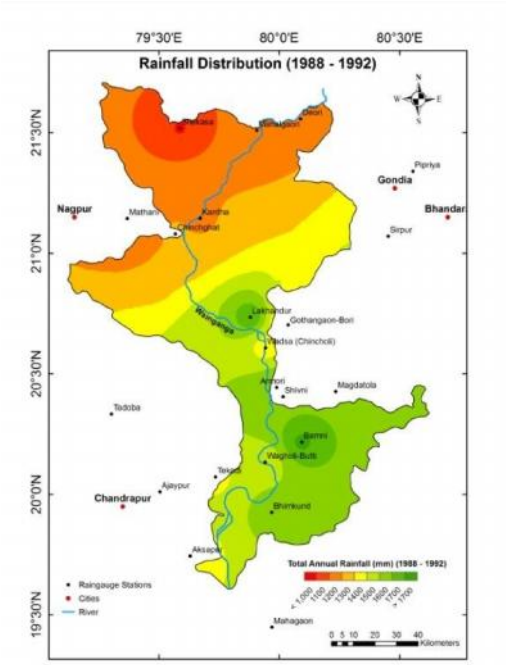
The specific, area covered by the Gomukh Trust, includes the districts of Nagpur, Chandrapur, Gondia, Gadchiroli, and Bhandara in Maharashtra.

Change in Climate Scenario:

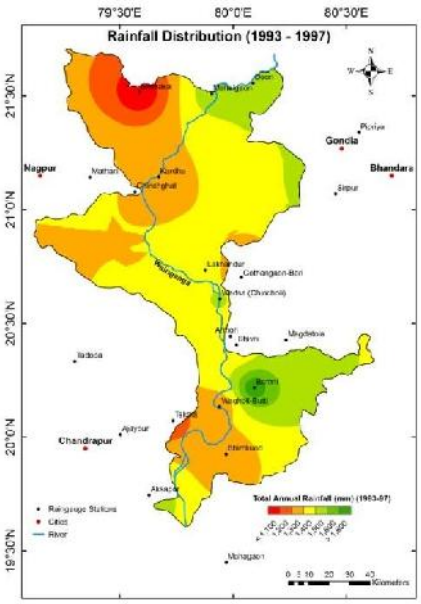
During the last two decades there has been a marked change in the rainfall pattern and variability in the river basin. Gomukh therefore conducted a detailed analysis of the meteorological data and the rainfall data collected from 22 stations established by the Central Water Commission and the Nashik hydrology project. The assessment led us to a conclusion that contrary to general belief, lowest variability in rainfall distribution was found in the north-western part of the basin which has the lowest precipitation; while the highest variability and therefore climate change impact has occurred in areas with highest precipitation, i.e. the central and south-eastern regions of the study area. This trend was derived from the moving average recorded for every five years since 1988 and right up to 2007-08. The series of maps (I to IV) which follow clearly indicate even to a lay person that there has been a reduction in the annual rainfall indicated by the larger and larger areas of yellow, brown and red and reduction in the deep green and blue areas receiving relatively high rainfall.

Note: For details see Annex 1

I (1988- 1992)

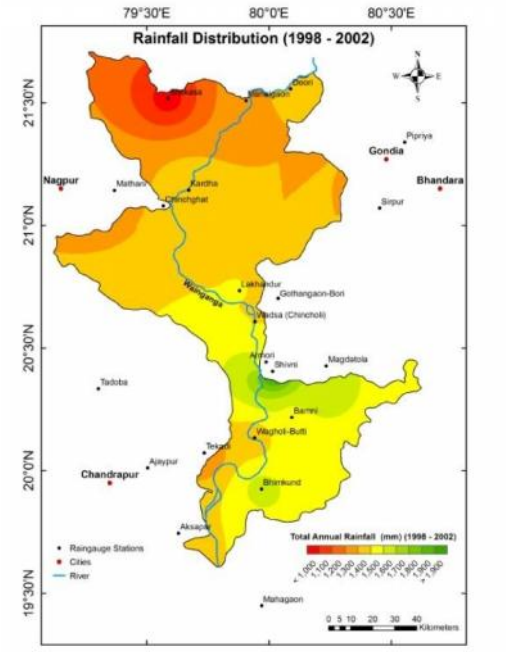


II (1993-1997)

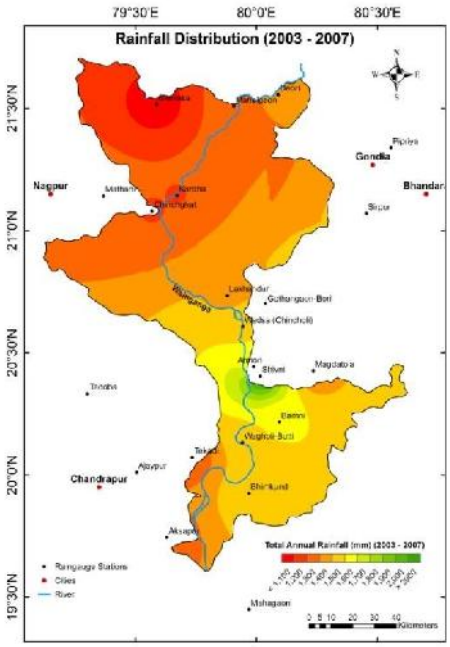


This series of maps shows the moving average of total annual precipitation calculated for every five years. Note the increasing areas under red, yellow and brown, and also the shifts in the nucleus of the highest rainfall locations indicated by the dark green and blue areas.

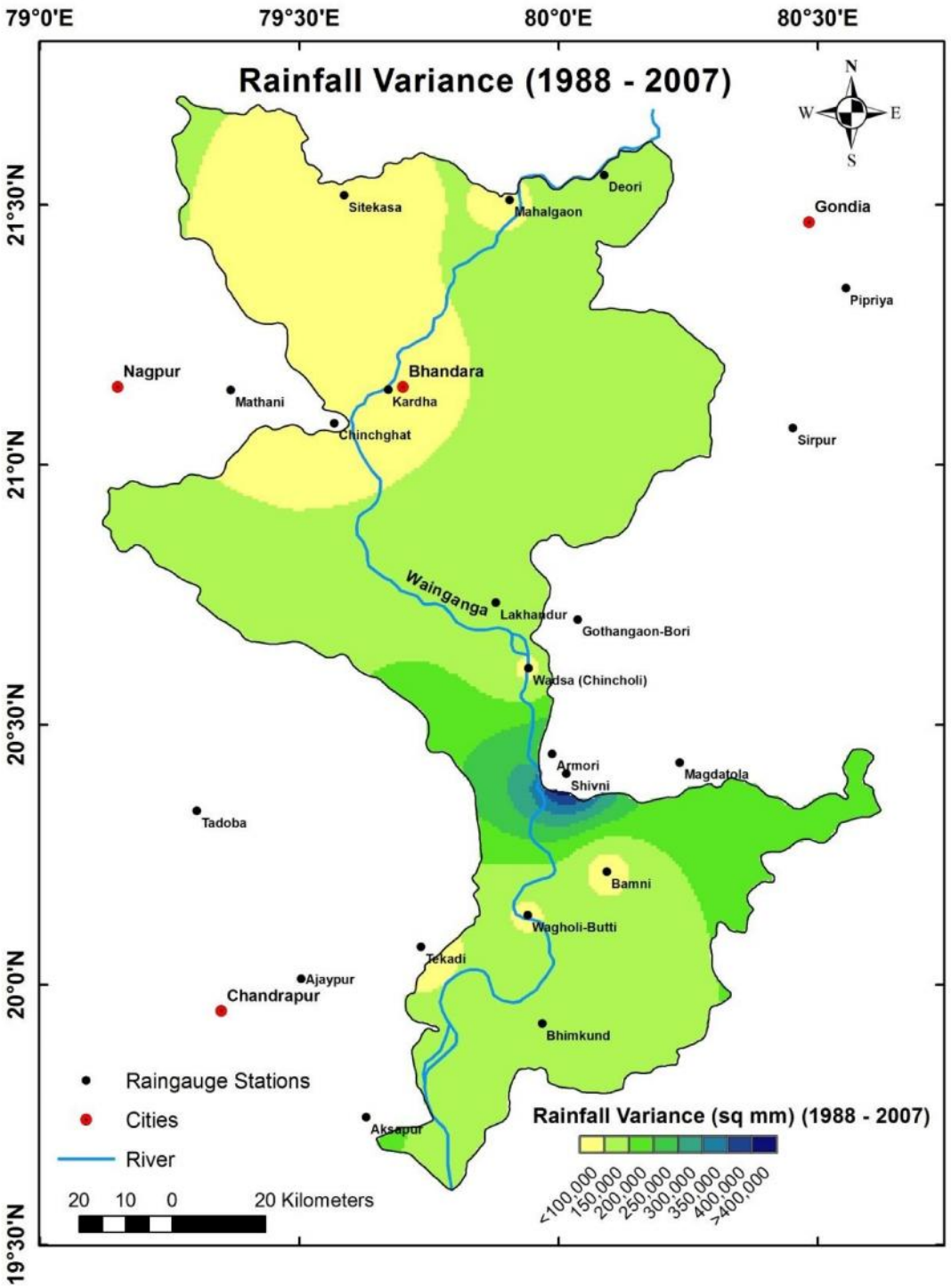
Note: When we calculate an average annual rainfall over a 100 year period the short-term variations get neutralized.



III (1998-2002)



IV (2003-2007)



The available data is of 22 stations from year 1988 – 2007 in form of monthly averages. Variance has been calculated using monthly average rainfall for every station. Unit of variance in this case is mm^2.

The rainfall variability is the lowest in the yellow potions, higher in the light green sections, very high in the dark green and blue sections.

The Problem of Field Application

The problem with the studies conducted so far by the UNFCCC and the CWC is that they have given macro level assessments or at best regional or basin level assessments, which are not necessarily applicable or useful for decision making at the sub-basin level. It is therefore necessary that, within the context of the larger assessments, micro studies be carried out for identifying climate change effects/ extreme events or episodes relevant to specific sub-basins. This is important because time and location specific advice and recommendations to farmers, fisher folk , forest dwellers, who have to face such extreme events is required for increasing their resilience and avoiding losses and damage to their resources and property.

In order to peruse this objective, we adopted the method of calculating moving averages for 5 years each over the period 1988 to 2008, this study led us to an inference that location specific advice and guidelines cannot be given on macro level studies and have to be based on micro level studies.

The study showed us that global warming and climate change were having a considerable effect on rainfall. Even though from past 100 years rainfall data it is clear that the study area lies in assured rainfall area; these two decades shows decreasing rainfall trends over the area.

This GIS analysis was very handy and efficient over conventional tabular or graphical analysis as it shoes the study area in form of maps rather than figures and lines. GIS can also help in analysing complex situations in the planning stage, like suitability analysis for water conservation structures, agricultural decision making like irrigation and crop patterns etc.

The study makes it apparent that, it is necessary to plan sustainable watershed development to ensure water resource availability for future needs. Also this study of rainfall variation coupled with other data like surface runoff, agricultural parameters, irrigation network etc., has been very helpful during the planning process.

The results of the study as mentioned above, have become the scientific basis for discussing and negotiating for (a) A change in the attitude in the local community towards the ground level implications related to cropping patterns, land management practices, fishing techniques and ecosystem restoration programs.

(b) Change in the ROS with the Government officials.

When these maps where shown to villagers they were quick in associating the changes with their ground level experience over the last 20 years. Thus a link between scientific assessment and ground level experience was quickly established.

The Gosekhurd Dam in Bhandara Dist. for which, modifications in Reservoir Operation Schedules would be recommended.

A Dynamic ROS as a Resilience Response to Floods:

The Wainganga Basin has over 24 major and medium dams, the discharges from which need to be coordinated to avoid 'shock floods' due to unplanned/unexpected releases from large reservoirs, and to ensure storage of water for drinking water supply and irrigation. The Reservoir Operation Schedules (ROS) currently followed in the region are based on the 100 year (normal) time series of meteorological data collected by the Indian Meteorological Department. Since the weather patterns have changed discernibly during the last two decade and more, rapid change is predicted for the next 40 years, the ROS need to be more sensitive and dynamic to be able to respond to the impacts.

The economy of the Waingangā sub-basin is known for its near complete dependence on agriculture, forests and fisheries, with over 80.37% of the community involved in these occupations. Agriculture, forests and fisheries are an integral part of the natural agro-climatic system and extremely sensitive to climate change. Historically, it has largely been perceived that traditional practices in agriculture and fisheries were responsive to nature and had the potential and flexibility to adapt to climate change. However, the systems currently followed in the Wainganga sub-basin have considerably changed for the worse from the traditional management practices. The choice of species, time of seeding, harvesting, etc. have slowly shifted to market based management and have adopted non-sustainable practices like using dynamite or poisoning river water for harvesting fish. With the advent of Climate Change and the loss of traditional agriculture and fisheries management practices, livelihoods dependent on them have been severely affected. It is therefore necessary to document the existing strategies that could be 'climate-responsive' and, identify new techniques or management practices which have the potential to survive in the changing climate scenario thereby increasing the resilience of the community.

The Wainganga has a catchment area of 23388 km2 up to the M.P. border and another 1624 km2 in Maharashtra up to the Gosekhurd dam. Unlike other peninsular rivers, it is a relatively water abundant river, since it enjoys an assured annual rainfall of 1200-1600 mm. Over 300 traditional villages and settlements have been established along the banks of

the Waingangā, and experience some degree of inundation if not dangerous flooding every year. This is a region that has a long history of flooding and has traditional cultures that have adapted to living with these floods. In some cases villages that are situated on islands in the river bed, have established a temporary migration pattern to another village on the nearest river bank when the monsoon (flood) season begins.

In the table below, it can be observed that during seven years out of ten, the water level crossed the bridge on Waingangā at Bhandara. Since there are many areas in Bhandara city lower than 10.65 meters, especially along the *nalas* and streams, these parts had suffered from flooding. The floods of 2005 and 2006 were especially bad, when water had entered several hundred houses. The situation in the villages upstream and downstream of Bhandara was even worse, since there were a large number of '*kaccha*' houses which got either submerged or washed away.

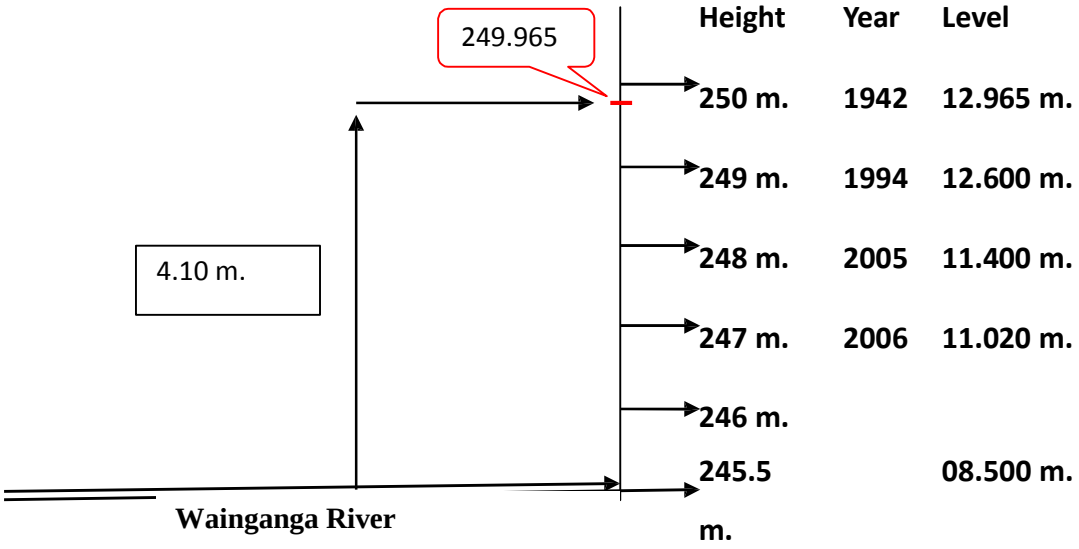
Highest Water Level from 1998-2007 (at Wainganga Bridge, Bhandara)

Name of the River	**Water Limit**	**Warning Level: 9.000 Mt ; Water Level Parallel to Bridge Level: 10.250 Mt Risk Level: 9.500 Mt; Water Flowing Over the Bridge: 10.650 Mt**										
	Blue Line	Red Line	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Waingangā	13 Mt.	17 Mt.	11.62	13.05	9.50	10.3	13.5	11.3	5.30	15.9	15.2	7.00
Source : Bhandara Minor Irrigation Project Circle 2013-14												

If the extreme flood event that took place in 2006 is taken as a basis for calculating how much the dams on the Waingangā contribute to the flood situation, it can be calculated that these dams contribute approximately 10-15% of the total natural discharge during floods. This means that these dams are contributing a significant extent towards the flood situation that develops in these parts every monsoon season. Sanjay Sarovar and Gosekhurd between them have a storage capacity of 1653 Million Cubic Meters, and can therefore holdback large floods during the month of June and July, so long as they release water as per the reservoir operation schedule. However sometimes the precipitation is unexpected high and the water wells keep on building up. In such cases, the dam authorities have to

anticipate the possibility of floods and release large quantities of water. Such shock releases to the water already being carried by the river, leading to inundation and flooding of fields and habitations.

Major Floods on the Wainganga River



The time taken for the flood water to travel from the upstream dam to the downstream dam is a critical parameter which helps the planners in effectively warning the downstream population in case of unanticipated floods. In the table below we have therefore given the number of hours required for flood waters to travel between key locations. It is obvious that this time is too short for any systematic evacuation. Therefore the dam authorities have to warn the downstream settlements at least 48 hours before releasing the water. In case of dams located in the lower reaches, the warning time gets longer and longer since the subsequent dams also retain their respective “flood-cushions”.

Table showing distance and Flow per hour of Wainganga River from Sirpur to Pujari Tola, Kalisarar to Pujari Tola, and Pujaritola to Bagh River, till Rajegaon (Maharashtra) and from Sanjay Sarovar Dam (M.P) to Gosekhurd Dam (Maharashtra)

Distance and travel time of floods discharged (2013-2014)

Sr. No.	Name of Village (River/Dam)	Distance (Km)	Discharge (Hour)
1	Sirpur to Pujaritola	20	07
2	Kalisarar to Pujaritola	07	02
3	Pujaritola Dam to Aamgaon to Salekasa road till Sakharitola point - Bagh River	20	07
4	Aamgaon Sakharitola point to Bagh River (Rajegaon, Maharashtra)	35	11

Source: Data received from Executive Engineer WRD M.I. Division, Bhandara and Gondia

Distance and travel time of floods discharged from

Sanjay Sarovar Dam to Gosekhurd Dam (2013-2014)

Sanjay Sarovar Dam (M.P)			
Sr. No.	**Name of Village (River/Dam)**	**Distance (Km)**	**Discharge (Hour)**
1	Sanjay Sarovar Dam to Dhuti Weir Balaghat (M.P)	104	15
2	Dhuti Weir to Balaghat Birsola Kati(M.P)	66	10
3	Birsola (Kati to Devari)	17	03
4	Devari to Kardha (Bhandara)	75	11
5	Kardha (Bhandara) to Gosekhurd	40	06
	Total	**302**	**45**

Source: Data received from Executive Engineer, M.I. Division, Bhandara.

Disaster management plan when goes into action, the distance

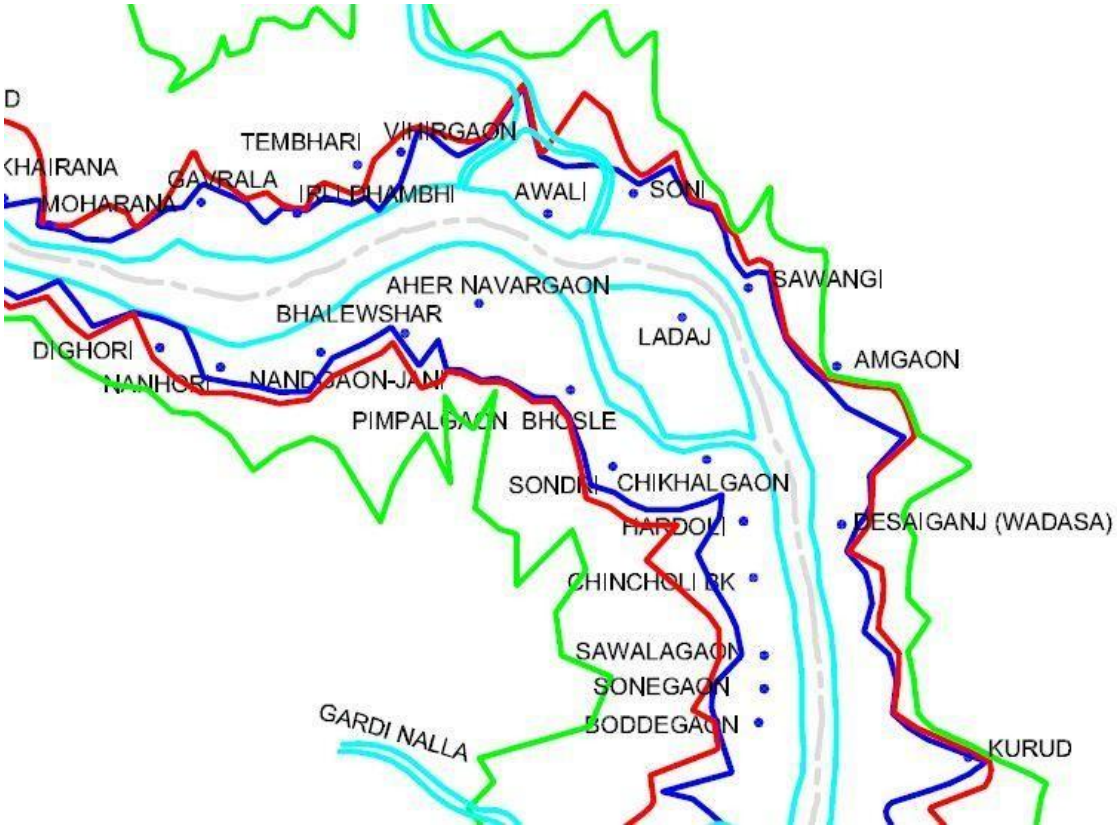
The yearly migration of Ladaj and other riverine islands

During the post monsoon period as the river bed areas are exposed, several islands are created within the Wainganga river bed. It is currently estimated that about five islands are observed during the summer months **as well as during the rainy seasons,** namely Kultha, Jungaon, Ladaj, Awali, Pandharipande *bet*. There are several other small islands which are inconsequential. Cultivation is in practice on all these islands, during the rabi and kharif season, and such areas are recorded by the revenue department. Due to annual

inundation, they all have high micro nutrients and fertilizer content and the productivity is high. Four of these islands had village settlements, two of which have now been relocated elsewhere.

The produce from these islands carries higher values since the vegetables etc. have special characters and appearance, e.g. Brinjal from Ladaj Island. Ladaj is a village panchayat located in the Chandrapur district of Maharashtra state, India. The latitude 20.65 and longitude 79.92 are the geocoordinates of Ladaj.

Ladaj and Awali islands as shown in the flood zoning map of the Wainganga



SOURCE: Flood Map prepared by Gomukh in 2013-14

The houses on these islands have been built in a particular manner, i.e. with wooden or metal stilts, so that during normal annual floods, the villages can use boats to enter their houses on the island even though the land area is submerged. On a few occasions as it happened in 2006, 2010-11 etc., the water levels can rise up to the floor of the houses. During such years the entire population has to move out and stay in adjoining villages.

Recognising the dangers of living on these islands especially after construction of major dams i.e. Sanjay Sagar and Gosekhurd, the government decided to relocate them on the mainland, which the villagers initially accepted. However over time the villagers in Ladaj realized that there was no need to abandon the original village since it contained some of the fertile soils in the entire Waingangā river basin. They had also developed an interesting way of constructing *Machaans* on the taller trees in the Ladaj village where they could live for up to a week till the flood waters receded. Historically they were aware that the floods on the Waingangā don't last beyond a few days, and that this technique of living on treetop *Machaans* would enable them to look after their critical or important belongings and houses. The village panchayat is now demanding electricity connections and a road.

Constructing houses which can withstand normal floods is a traditional building technology which has been developed by these settlers. On the one hand they get the full benefits of the silt which is brought down by the river, which has created the island, and on the other hand, they have developed fishing techniques and settlement patterns which remain unaffected by floods. This is a coping mechanism which has been developed over centuries in the deltaic areas of the Ganga-Brahmaputra in Bangladesh and West Bengal. In smaller deltas like the Godavari, Krishna and Cauvery etc. a similar technology has evolved.

Google Earth view of Ladaj Island

Source: Accessed from Google in December 2014

Outcome of the Negotiated approach

What we learnt from the meetings held with both the villagers as well as the engineers is that flood management has a much larger objective i.e. disaster management. However, in order to avoid disasters, the technology and systems of information and communication are not in place. A way to effectively share relevant information related to flooding can be developed so that the authorities and decision makers can coordinate with each other and effective dissemination of information can take place.

Currently there are enormous delays in receiving up to date data at different stations at the reservoir sites. In order to avoid this, a Real Time Streamflow Forecasting System (RTSF) should be put in place, so that data is transmitted automatically from the different sites to a central server. The dam authorities, preferably of the rank of Executive Engineer or Superintending Engineer can then take the responsibility of communicating the decision to the Apex Body mentioned above which will further communicate with the relevant Panchayats, Taluka and district authorities and other line-agencies.

Traditional Techniques of Resilience

Resilience to climate change impact can be effectively achieved only through integrating traditional techniques with the needs of today. The people living in a particular area have developed certain strategies to cope with the environmental conditions around them. In the Wainganga basin, the locals have certain traditional agriculture techniques that help them survive in the lean summer months when water for crops are scarce; they have also modified some tribal practices like gathering silkworms from the forest, into full-fledged sericulture that survives on hardy trees that grow in the forest. Thus resilience is seen here as an ability to be able to make a living that will not be adversely affected by climate change.

Gal-per Agriculture

Sand bed or river bed agriculture and pond bed fisheries are great traditional techniques for increasing systemic resilience to climate change impact. The area exposed during the lean season i.e. the area between the contour of the reservoir being full and the

contour indicating lowest drawdown level, is potentially suited for a combination of sand bed farming and freshwater prawn and fish harvesting.

Currently about 90,000 people, living in 180 villages with an average population of about 500 each are benefitting from the different interventions (registered societies of fisher folk, agriculturalists practicing conjunctive use of ground water and surface water, villagers using micro irrigation systems of drips and sprinklers villagers benefitting from de-siltation and repair of traditional Malguzari tanks etc. households benefitting from the use of ***(Gal per)*** during the dry season.

There is a serious and scientific causal relationship, between unscientific riverbed abstraction and climate change impact.

Unlike agriculture that is conventionally practiced on farmlands during the conventional Kharif & Rabbi season, the practice of sand bed agriculture is predominantly observed during the months of March, April, May, June (summer months). These are also the months when the effects of climate change are the most telling/challenging, e.g. there has been a general trend towards delay in the commencement of monsoon and unseasonal pre-monsoon storms during summer. *Gal per* and sand bed agricultures take advantage of both, the unseasonal rain, which cannot be anticipated hence there is no way of planning conventional crops around it. However a part of the unseasonal rain ends up in tanks, river beds, *dohas*[1] and ponds. Till the last decade, *Gal per* agriculture was not encouraged by the irrigation department, since it was presumed that it would hamper storage capacity and/or increase siltation in the large dams. However the government has since come to realise the benefits of letting farmers practice this type of agriculture. The irrigation department, has regularised such farming/ agriculture practices, and has even started collecting land revenue on it.

[1] When a river flow starts receding during the lean period, and especially when the continuous flow ceases during summer say between February and May, little ponds get left behind in natural depressions within the river bed, practically all along the river course. The ones on the larger meander sections, known as ox bow lakes, when the two ends of the bow get dried up leaving behind a hump or bow shaped lake such lakes as well keep shrinking during summer these are called '*dohas*' and may disappear from the surface. Areas exposed by the shrinking ponds and lakes are called '*Doha*' in Gondi and Marathi language. They are an ideal measure of last resort for humans as well as natural/wild species. The gentle sand slopes and beds thus exposed are ideal for gal per cropping as well as harvesting of aquatic flora like lotus roots, singhada and other minor products and fish as well.

Sand bed or *Gal per* agriculture is an example of how an intuitive understanding that farmers have, gets converted into an agricultural practice and can take care of untimely rains and the delayed monsoons. While experts and scientists get perturbed by the climate changes, the communities at ground level develop or modify already existing techniques and practices in order to develop coping mechanisms which can see them through periods of stress. Stress, in most cases, translates to water stress or water shortage.

1. This type of agricultural knowhow is entirely indigenous and can be replicated only in similar agro-climatic and morphological conditions. The location of such land cannot be demarcated since the location shifts over time and hence these lands cannot be owned, leased, bought or sold. In this sense the gal per lands are a classical example of common pool resources, which are protected conserved and used wisely and sustainably for coping with the natural vagaries of monsoons, which are being further aggravated by climate change.
2. It can adapt and thrive in changing circumstances
3. Its ability to snap back causes it to be climate change resilient and allows the

community to build upon it

4. Such livelihoods are currently not treated as mainstream techniques for using natural resources as a coping mechanism to counter the negative impacts of climate change.

Unfortunately, we (the Gomukh Trust) have not seen any traditional techniques that can help them cope with sudden and unexpected flooding, hail and cold fronts.

Tassar Silk Rearing

Agriculture has traditionally been the main livelihood activity for most people in the Wainganga region, but it is supplemented in varying degrees by dependence on forests, small livestock rearing, handicrafts, wages, and hunting and gathering. Improving productivity of agriculture is essential to enhance rural livelihoods but agriculture has inherent limits as a livelihood option for landless families as well as families that have very small land-holdings. The challenge therefore lies in developing livelihood opportunities based on other occupations that supplement agricultural income, offset its uncertainty and exploit the growing demand for niche products, especially in urban centres. It is in this context 'Tassar-Sericulture' becomes important, since it has the potential of providing a stable sustainable income.

During the dry months in the future, it is expected that there will be an acute shortage of water and this will affect areas that grow plants that are water intensive. Areas where there is extensive silk production will greatly enhance resilience since the forest species on which Tassar silk depends do not require irrigation. In the future, when degraded areas are to be forested, if the Ain species is planted, it can work in the favour of both the environment and the people who inhabit that land. Ain is a very important hardwood species and its timber is valued both in the local as well as international market. Areas that use ain for rearing silkworms can be used as a mixed-use land with some trees being grown as timber where as others would function as food for the tassar silkworm.

The variety of tassar that can be reared on Mulberry trees can also prove sustainable because Mulberry trees can be used to provide an alternative source of income

by gathering the mulberries and selling it as is or by processing the berries and selling them as either jam or frozen.

Women constitute over 60 % of those employed in post-harvest value-addition activities of sericulture in the country. This is possible because sericulture activities starting from garden management and silkworm rearing is more effectively taken up by the women folk. The silk reeling industry including weaving is largely supported by them.

Tassar silk rearing has the following eco-friendly attributes:

- Waste from silkworm rearing can be recycled as inputs to the silk farm.
- Being a labour intensive and predominantly agro-based activity, involvement of smoke-emitting machinery is minimal.
- The pre-plantation activities like the growing of Mulberry saplings for tassar plantation are mainly in upland areas where un-used cultivable land is made productive.

Satisfies equity concerns

- Benefits of sectoral value-addition primarily accrue to rural households. As the end-product users are mostly from the higher economic groups, the money flows from high end groups to low end groups.

Malguzari Tanks; Their Restoration and Maintenance

Biological eradication of Zoonotic disease

Fish shoals in many *Malguzari* tanks were experiencing a contiguous disease due to bacterial infection which caused mass death of fish, and practically every day dead fish had to be removed. The Fisheries department did not appear to have any answers / solutions to these problems.

During a meeting conducted by Mr. Manish Rajankar the villagers came up with a suggestion that they should use a combination of 1 Kg of milk and 1 Kg of curds/acre should be spread / sprinkled by using Neem leaves (Margosa). The villagers stated that this

technique was by them in case of human skin ailment showing similar symptoms. Without fully understanding the scientific logic of such a procedure Mr. Rajankar agreed to try the technique in one tank which was badly affected. The mixture was sprinkled on a particular day, to everybody surprise and amazement. The fish stopped dying the very next day. And the ulcerative red colour patches gradually disappeared. Water samples of these tanks have been tested prior to this experiment and the pH levels has been recorded as 6.2. Fisheries expert had described this contiguous disease as Epizootic-Ulcerative-Syndrome. When samples of the same tank were tested later the pH level had improved gradually from 6.2 to 8.0. One conjecture was that the milk and curd as mixture had led to a spread of biological culture which has in turn reduced the incidence of the disease which were unable to thrive in at pH levels which were greater than 7.

Our field staves has now decided to verify and validate this phenomenon and check out the sequence of changes in order to establish a scientific causal relationship. Once this is done this simple technology could be used effectively in situation where a similar problem exists.

The self-esteem of the *Dhiwar* community in their traditional wisdom has been restored to the biological health of these three tanks has being restored and the fish production and income level has improved considerably.

The cases mentioned above are excellent examples of people initiated and government initiated adaptive practices / techniques which can effectively increase the resilience of the local community to Climate Change impacts by improving their coping strategies.

Restoration of Traditional Water System in Vidarbha

A *"Malguzari* tank is a traditional term for "pond water harvesting" done by a community called; *Malguzars,* who were the *Zamindars* of Eastern Vidarbha. The water was used for irrigation and providing habitat for fish so that they could be harvested for local consumption or sale. Prior to the 1950s, they were owned and maintained by the *Malguzars.* The whole scenario changed after 1960 as the State Government took over the ownership and started collecting water tax for irrigation. The *Malguzars* filed a case against the State Government and claimed their ownership on

the *Malguzari* tanks in the Supreme Court. The Supreme Court gave a judgment in favor of *Malguzars,* but did not make any provision for tanks' maintenance. Since then thousands of tanks in Vidarbha region have suffered from neglect and damage.

Over the last few centuries some of the *Malguzari* tanks had been silted up. As a consequence of the loss in storage capacity the downstream areas had seized to get water for irrigation, causing a loss in agricultural output during *Kharif* as well as *Rabi*.

It needs to be mentioned that till recently the Water Resources Department and other Government Agencies were not very enthusiastic about de-siltation of tanks, if not completely averse to it. During the current crisis however the de-siltation of reservoirs and tanks of all scales and sizes may prove to be a boon in case of drought as well as flood, the two key phenomena which have been accentuated in recent years by climate change.

In 1983, an independent committee appointed by Govt. of Maharashtra ruled that the maintenance of these *Malguzari* tank was the undeniable responsibility of the government. But since then no one has taken this responsibility and the tanks remained in their miserable condition till 2008. The Zilla Parishad of Bhandara, Gondia, Chandrapur and Gadchiroli, who were statutorily responsible for the upkeep of these tanks were unable to do so stating lack of funds as the excuse.

An Executive engineer of Minor Irrigation Division of the Bhandara district, who traditionally belongs to a *Malguzar* family, took an initiative and started the process of rejuvenating these tanks with governmental financial support. The first tank which got rejuvenated was the *Janbhora Malguzari* tank located 35 kms from Bhandara.

Outcomes & Benefits:

In our inception report, we pointed out that according to the IPCCs 5th Assessment report (2014), rainfall is supposed to increase in Central India. However, after generating a rainfall **trend line from 1988 to 2008, we have found that rainfall has in fact steadily decreased in the Wainganga basin, and continues to do so during the last six years as well, i.e. from 2009 -2014**. The obvious inference is that, while the report may be correct for

central India as a whole, it cannot and has not reflected the reality at the river basin or sub-basin level, where there is a considerable amount of variability in rainfall. It is for this reason that the sub-basin level studies which show changes in rainfall patterns or/ and short term/medium term variability become crucial for policy application. It is cannot be used by locals or managers of large infrastructure projects like dams. Location specific and updated information should be used so that it can be of use to the stakeholders in the area. The cases given above which demonstrate the context in which local communities understand resilience to climate change.

It needs to be kept in mind that at the ground level, the **climate change impact is only one of the variables, and that the and what the community has to face, is the composite impact of all the other socio-economic and political changes that take place irrespective of climate change.** For example, the sudden and massive increase in sand mining in river beds, the construction of a large dam, the establishment of a mega thermal power plant, etc., may either aggravate the climate change impact or may be instrumental in ameliorating it. Therefore the coping mechanism or resilience techniques have to consciously respond to such a complex ground reality.

We further observed that **if civil society organisations come together and engage in continuous dialogue and negotiations with the government officials, that the authorities will usually take such consultation or meetings seriously and will be amenable to making changes.** During the WACREP project period, the Gomukh Trust acted as the negotiator and arbiter for three different fronts i.e. the government, local communities and the academia.

Taking up a negotiated approach has helped us open a path of communication between the Wainganga Area Water Partnership (WGAWP), the locals and the Dam authorities that has led to documentation of the aforementioned case studies as well as a **review and change in the ROS of three out of the five gated dams in the area, namely Sirpur, Kalisarar and Pujaritola dams**.

The cases also demonstrate that **the conclusions and inferences derived from the larger macro level climate change studies, need to be appropriately changed or modified through 'ground-trothing' studies, in order to arrive at sector specific recommendations** e.g. conventional and modern inland fisheries, cropping patterns/ agriculture, sand-mining policy, groundwater use, restoration and citing of traditional tanks etc.

An important outcome of this project has been the opportunity for organising and

bringing together communities and CSOs on a common platform, and **setting up procedures for engagement with government authorities from various development sectors**. Since such engagement has sustained over the last few years, it had led to the empowerment of communities. In this context as well, **resilience or adaptation techniques to climate change cannot be seen as a one-off activity, but need to be continuously reviewed and refined in order to respond to risks and uncertainties in the future**.

During the project period, when the cases were being developed and documented, it gave us an opportunity to make the communities realise the value of our traditional technologies in addition the community leaders also realised how they could be related wit or made relevant to modern science and technology (ROS).

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