CASE STUDIES

CLIMATE ADAPTIVE PRACTICES GRASSROOTS INITIATIVES

Development Alternatives

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CONTENTS

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The report describes case studies on climate change adaptation from the seven states of India- Andhra Pradesh, Assam, Himachal Pradesh, Madhya Pradesh, Odhisha, Sikkim, Tripura and Uttarakhand. Development Alternatives (DA) would like to express gratitude to the various organisations and individuals who provided support and cooperation. The support and knowledge shared by the teams of these organisations helped gain a deeper understanding of climate resilience and adaptation mechanism to build resilient communities. Gratitude is also expressed to the local community members, who shared their issues and experiences especially; the impact on their livelihoods contributed to strengthening the study.

DA expresses thanks, especially to the following organisations for contributing their work for the study:

Andhra Pradesh

- LAYA, a CSO based in Visakhapatnam, Andhra Pradesh. The study explores their work on integrated farming and renewable energy models in East Godavari district of Andhra Pradesh State.

- Centre for institutions and government agencies in Humanitarian Assistance (CeFHA), an organisation based in Vishakhapatnam, Andhra Pradesh. The study explores CeFHA's work on children as ambassadors for climate change.

Assam

- Aaranyak, a premier research based organisation dedicated to nature conservation in North East India. The study documents Aranyak's work around Manas National Park on community based conservation and community based flood management systems in Brahmaputra basin.

Himachal Pradesh

- Chinmaya Organisation for Rural Development (CORD), a service arm of the Chinmaya Mission. The study explores CORD's work on organic farming for climate resilience in Kangra district of Himachal Pradesh.

- Di di Contractor, a lady of foreign origin is now residing in Sighbari village of Kangra, Himachal Pradesh. The study highlights Di di's passion for mud architecture, as an alternative disaster resistant technology from Kangra district of Himachal district.

- Jagori Rural Charitable Trust in Dharamshala committed to build a just and equitable society. The study documents its Green Leaf Project on building market connectivity for organic producers.

Madhya Pradesh

- Haritika, an organisation based in Bundelkhand region of Madhya Pradesh committed to natural resource management. The study explores Haritika's work on community based drinking water model.

- The team of Shubkal: From Information to Knowledge and Action, an initiative of Development Alternatives has been documented in this report.

Odisha

- Western Orissa Rural Livelihood Project (WORLP), a Government of Odisha initiative;

contributes to reducing poverty through promotion of livelihoods initiatives for the poorest. The study explores WORLP's sustainable livelihood approach.

- LEAD-India, an Indian chapter of LEAD (Leadership for Environment and Development) is a network committed to "development that is environmentally sustainable, socially equitable and economically viable." The study documents LEAD-India's work on adaptive agriculture and water conservation.

Sikkim

- Rural Management and Development Department (RMDD), Government of Sikkim. The study explores RMDD's work on Springshed development, lake revival and agro-horticulture model under MGNREGA (Mahatma Gandhi National Rural Employment Guarantee Scheme).

Tripura

- Uttarayan Agriculure Research Society of Tripura and ICAR's (Indian Council of Agicultural Research) work on Agro-forestry model for undulating topography has been showcased in the report.
- Forest Department, Government of Tripura's work on integrated soil and water conservation has been highlighted in the report.

Uttarakhand

- Central Himalayan Environmental Association, CHEA; a Nainital based organisation has environment and livelihoods of Himalayan people as its core concern. The study explores their work on capacity enhancement for sustainable and utilisation and management of resources.

- Chirag, a rural development organisation working in Uttarakhand. The study documents Chirag's work on Van Pachayats.

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INTRODUCTION

Climate change is likely to have varying impacts on each and every one of us. There are scientific evidences of climate change globally manifested through rise in temperature levels, increase in the incidence of extreme climatic events in the form of recurring droughts and floods, melting glaciers, sea-level rise etc. It is estimated that extreme weather events related to climate change is likely to affect 175 million children a year in the coming decade[1].

Today uncertainties associated with climate variability poses great risks to the economic development globally. The developing countries, given their disadvantageous socio-economic conditions, low adaptive capacities and inadequate disaster management planning are particularly prone to high climate change vulnerabilities. The long-term nature of climate change and the significant impact it can have on grassroots communities requires future development policy and practices to include both short-term and long-term planning incorporating climate change knowledge and understanding, in order to adequately respond to the reality of a changing climate. This entails mainstreaming climate change concerns in the current planning process, in order to address the issues of growing vulnerabilities and livelihood security of poor and vulnerable communities. Currently, decision makers need to understand the need of climate adaptive planning through the cost benefit analysis of potential losses from climate change risks and the perceived benefits of climate resilience development in the long run.

India is a fast growing middle income country with diverse geography, wide range of natural resources and different agro-climatic zones, where climate change is a particularly serious challenge that will significantly impact the Indian economy (and the livelihoods that depend on it) due to a high reliance on climate-sensitive sectors such as agriculture, forestry, and fishery. Agriculture sector, on which approximately 70% of the population is completely dependent, will be impacted by the expected change in predictability and variability in the availability of water[2]. Children are at risk due to the consequences of climate change given their direct or indirect dependence on subsistence farming and agriculture. A study on school enrolment in rural areas of India found that a 10 per cent decline in agricultural income due to heavy rainfall led to an average decline in school attendance of five days[3].

Even as scientists sharpen their understanding on the potential changes, forcing governments to respond through macro level policy and planning measures. While communities and businesses all over the world are looking for evidence based researched knowledge to support local planning and decision-making processes. This collection of case studies suggests that many of the at-risk communities are owning-up the choice to discover craft adaptation measures and practices. Knowledge on strategies for climate change adaptation and risk mitigation is being continuously generated and improved at varied levels; through inspired action on ground by communities and civil society actors, by researchers from various disciplines and by policy analysts. This knowledge generated at a smaller scale has potentiality to serve as learning for communities and others that plan to adapt to the emerging challenges from Climate Change.

[1] *UNICEF Office of Research (2014). 'The Challenges of Climate Change: Children on the front line', Innocenti Insight, Florence: UNICEF Office of Research*

[2] *Gosain, A. K., Rao, S. & Arora, A., 2011. Climate change impact assessment of water resources in India. Current Science, pp. 356-371*

[3] *UNICEF East Asia and Pacific Regional Office (2011). 'Children's Vulnerability to Climate Change and Disaster Impacts in East Asia and the Pacific": UNICEF East Asia and Pacific Regional Office*

These initiatives address vulnerability and build resilience of these climate vulnerable communities through collective and planned action.

The objective of documenting these case studies of grassroots initiatives from climate adaptive perspectives is its potentiality for replication and scalability. The document will cater to the learning needs of the various stakeholders i.e. policy makers, scientific and academic community and general public on climate change issues, share best practices and community based adaptation processes. Having said that it is important to note that adaptation work is dependent on specific judgments based on context/risk analysis and the process of engagement of various local stakeholders. While deciding on replication or scaling up, recognition of variability between one situation and the other matters. 'One-size-fit all' protocol might fail in the context of climate change adaptation.

These climate adaptive grassroots initiatives have been documented from the eight states of Andhra Pradesh, Assam, Himachal Pradesh, Madhya Pradesh, Odisha, Sikkim, Tripura and Uttarakhand, which face varied impacts due to climate change. The case studies have been analysed from the need for and context for building the adaptation strategy, the methodology adopted for facilitating change process. It builds a body of knowledge for sharing and learning and providing "process lessons" for various stakeholders including Governments to locally relevant solutions framework. The documented initiatives highlight the impact of climate change in these hot spots and how the initiative has addressed the challenge and vulnerability of the desired communities making them climate resilient.

- The initiatives highlight the need for comprehensive area development for effective resource maximisation and sustainability.

- The use of government flagship programmes like MGNREGA and IWMP have potentiality and have been leveraged most effectively for incorporating climate resilience and enhancing adaptive capacities of communities.

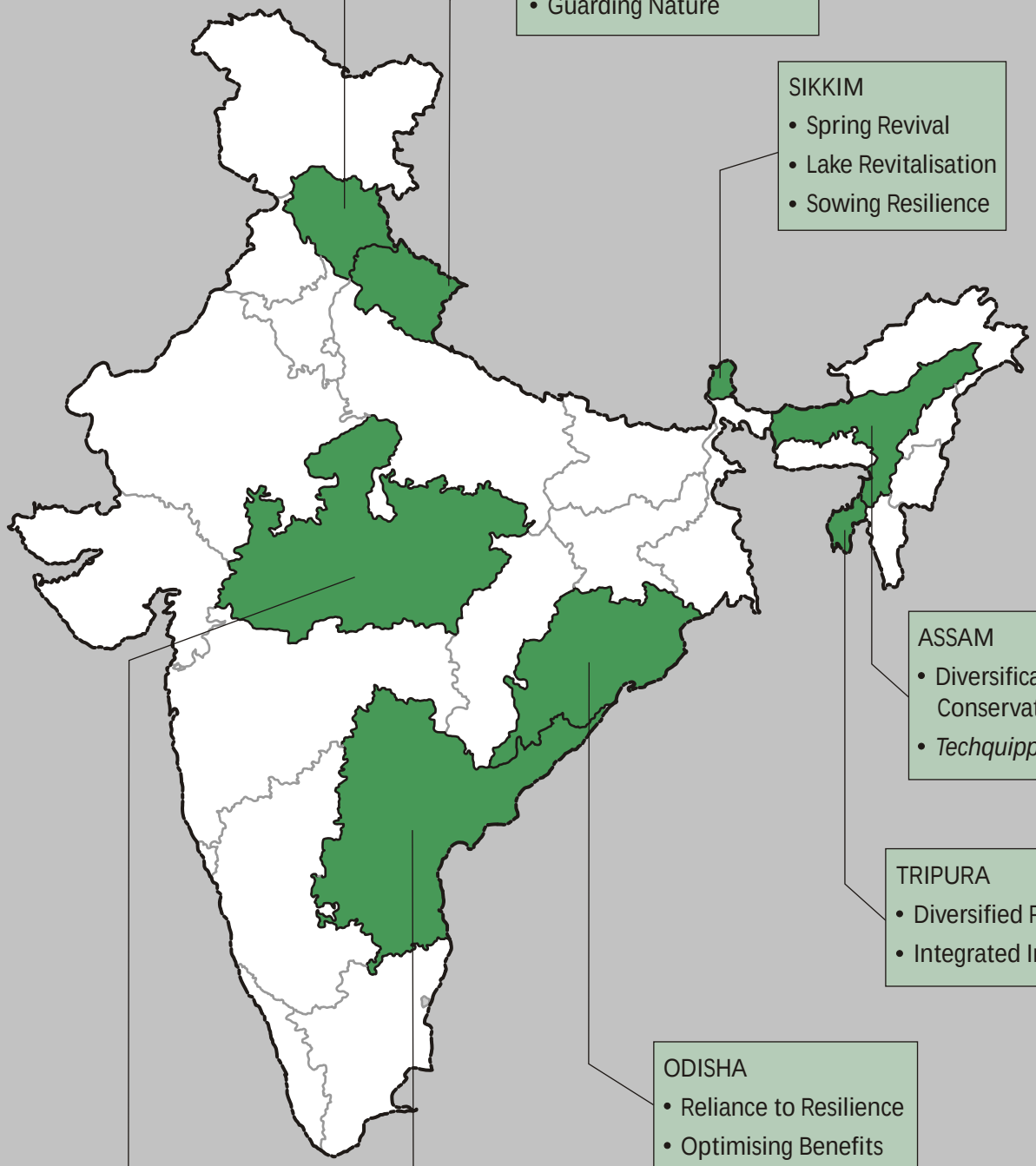
- Some initiatives also highlight data collection and its conversion into information and understanding through practices like water budgeting and flood early warning systems for taking affirmative action for CCA by communities.

- One of the important lessons emerging from the case studies is that there is strong latent capacity at local level to do range of adaption work.

HIMACHAL PRADESH
- Grow Organic: Go Resilient
- Interweaving Traditional and Modern Architecture
- Organic Market Place

UTTARAKHAND
- Committed Communities
- Guarding Nature

SIKKIM
- Spring Revival
- Lake Revitalisation
- Sowing Resilience



ASSAM
- Diversification for Conservation
- *Techquipped* for Floods

TRIPURA
- Diversified Prosperity
- Integrated Investment

ODISHA
- Reliance to Resilience
- Optimising Benefits

MADHYA PRADESH
- Community Water Budgeting
- From Information to
- Knowledge and Action

ANDHRA PRADESH
- Back to Backyard
- Powering People
- Catch them Young

Population	As of 2011 Census of India, the state had a population of 49,386,799[1]. It ranks 10th in terms of population in India.
Climate	The climate of Andhra Pradesh varies considerably, depending on the geographical region. Monsoons play a major role in determining the climate of the state. Summers last from March to June. In the coastal plain, the summer temperatures are generally higher than the rest of the state, with temperature ranging between 20 °C and 41 °C.
Climate Vulnerabilities	Changing weather patterns, rising temperatures, irregular and unpredictable rainfall patterns, high dependence on forest ecosystem
Average Annual Rainfall	1015.7 millimetre[2]
Economy	Andhra Pradesh's economy is mainly based on agriculture and livestock.

[1] *2011 Census of India*

[2] *District-wise monthly rainfall data from 2004-2010 for the whole of India by Indian Meteorological department from www.indiaportal.org*

Andhra Pradesh is situated on India's southeastern coast. The state has the second longest coastline of 972 km. The state is endowed with a variety of physiographic features ranging from Eastern Ghats, Nallamala Forest, Coastal plains to deltas of two major rivers of Krishna and Godavari. The state is the largest producer of rice in India and hence, it is nicknamed as 'the Rice Bowl of India'. The climate of Andhra Pradesh varies considerably, depending on the geographical region. Monsoons play a major role in determining the climate of the state. Major climate change issues for the State arise in the agriculture sector and for the long coastline. Agriculture is severely affected by variability in rainfall and temperature patterns, while rising sea levels and extreme events of marine origin such as cyclones pose problems for the coastal areas[1].

[1] *http://www.moef.nic.in/sites/default/files/sapcc/Andhra-pradesh.pdf*

Back to Backyard

Key Messages

- Integrated adaptation models have shown multifold benefits for increasing adaptive capacities of communities.
- Adaptation strategies such as poultry, fisheries, vegetable farming not only meet food and nutritional security of communities, but also helps them in income generation.
- Simple and innovative integrated models can go a long way in conserving natural resources.

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1. Context

1.1. Need:

Pathakota and Daragedda are two panchayats located in East Godavari district of Andhra Pradesh and comprise of 19 and 10 villages, respectively. Both these Panchayats consists of tribal communities largely dependent on forest ecosystems and agricultural activities for their sustenance. Key climate change vulnerabilities of tribal communities in this region are:

- Irregular and unpredictable rainfall patterns.
- High dependence on forest ecosystems.
- Weak socio-economic and institutional capacities of the communities.

Primary evidences from consultations highlight that over the last 17 years, the region has witnessed 7 years of major crop failures, due to excess rainfall in 3 years and deficit rainfall in 4 years.

Furthermore, remote and interior location and naxalite incidences in the past have limited the region from institutional systems of the government. Being relatively untouched by Government interventions, these villages of East Godavari district have become highly vulnerable, due to complex climatic and socio-economic dynamics. Vulnerability studies conducted for the region reveal that communities in the region with indigenous wisdom are neither adequately prepared nor have the capacities to hold to their resources; utilising them to earn livelihoods in consensus with present realities.

Other factors that accentuate the vulnerabilities of the region include:

- Soil degradation on hill lands and over

exploitation of forests due to unsustainable practices of extraction.

- Unregulated conversion of forest land into agricultural land and non-forest activities, due to insecurities in conventional livelihood activities.
- Regeneration from such slash and burn activities is not being affected by climate fluctuation and prolonged dry conditions.

1.2. Response:

To address the peculiar vulnerabilities of tribal communities in the region, LAYA- a Vishakapatman based non-government organisation implemented a set of Integrated natural resource management practices; to conserve the pristine natural resource base of the East Godavari region and minimise the impacts of climatic fluctuations in the region.

"Integrated adaptation models have shown multifold benefits for increasing adaptive capacities of communities"

2. Objectives

- Minimise the dependency of tribal communities on forest ecosystems for slash and burn agriculture.
- Increase the adaptive capacities of communities by introducing them to alternate livelihood sources.
- Introduce tribal communities to integrated and resource efficient adaptation measures.

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A farm in Daragedda

3. Approach

In response to the climate change vulnerabilities in Daragedda and Pathakota, LAYA introduced Integrated natural resource management practices; with the purview of increasing the resilience of communities by securing their livelihood. The idea was to integrate modern natural resource management techniques, with traditional resource-friendly farming practices of the tribal communities. These adaptation practices include alternate livelihoods through homestead organic farming and integrated poultry-fisheries model.

4. Key Stakeholders

LAYA adopted a participatory approach and engaged the village decision making body i.e. Panchayat and Sarpanch for engaging the villages in adaptation process. Special emphasis was given to the engagement of women and youth farmers of the two panchayats. Farmer groups (comprising of 15 farmers per group) were developed to demonstrate and disseminate the adaptation practices among other farmers in the region.

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Spices and vegetable cultivation in homestead

5. Key Components

Alternate livelihoods through homestead organic farming: This adaptation is very unique; both in terms of increasing community resilience through alternate income generation and resource utlilisation. Under this intervention, tribal farmers have utilised fallow and unused backyard lands to cultivate spices, vegetables and tubers. This system of homestead farming is completely organic based and is integrated with vermicomposting units established by the communities. It comprises of 12 varieties of home grown vegetables such as leafy vegetables, various types of gourd, beans, ladyfinger, tomato, brinjal and carrot. It comprises of tubers and spices such as turmeric and ginger have also been cultivated. Turmeric and ginger are less water intensive, and use the existing moisture. This chemical free system of utilising wasteland and resources has reduced the dependency of communities on markets. It has also assured a regular supply of nutrition and reduced at least 20% of expenditure on food.

Integrated poultry-fisheries model: This integrated model is a noteworthy example to increase adaptive capacities of communities and minimising their dependency, solely on agriculture. Small hut like structures have been created over farm ponds to complete the food cycle between poultry and fishes; and increase income generation from livestock and fishery sector, respectively. The poultry, feeds on by products of the agriculture sector, i.e. rice husks and fish feed on the feces droppings of the poultry that pass through the hut meshes to drop down to the farm ponds. This food chain cycle between poultry and fish has been set up at same piece of land; and helps the farmers to

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Tribal women working in homestead farm

reap benefits from both the sectors. This model of diversification using limited amount of land and efficient management of waste products has helped the communities to generate wealth from waste.

6. Outcomes and Impacts

Both the adaptation measures have proved to be simple yet effective in minimsing the risks of tribal communities to climate change. The homestead farming systems have got the farmers additional incomes; which has helped them to cope in situations of low farm productivity, due to unpredictable rainfall patterns. On an average, farmers have earned around INR 4000 from 200 square yards of homestead farming. Additionally, it has reduced their dependency on markets to meet food and nutrition needs. Similarly, integrated poultry-fisheries model has turned the tribals from mere farmers to develop small integrated enterprise models.

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Homestead farming field

7. Lessons Learnt

- An integrated model of agriculture provides for both short-term income generation and for long term gains for vulnerable tribal communities.
- Adaptation of traditional practices to newer contexts and threats, facilitates adoption.

Powering People

Key Messages

- Absence of grid based electricity and use of wood for meeting energy needs increases socio-economic challenges of villages and also increases the burden on women.
- A mix/combination of renewable technologies aids energy access in an efficient and sustainable manner.
- "Technology based cluster" of integrated renewable energy model comprising of micro-hydro off grid, solar powered devices and fuel efficient smokeless stoves help increase adaptive capacities of the communities.

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1. Context

1.1. Need:

Pathakota is a panchayat located in East Godavari district of Andhra Pradesh; and inhabits tribal communities largely dependent on forest ecosystems and agricultural activities for their sustenance. Key climate change vulnerabilities of tribal communities in this region are:

- Irregular and unpredictable rainfall patterns.
- High dependence on forest ecosystems.
- Weak socio-economic and institutional capacities of the communities.

Its remote and interior location and naxalite incidences in the past, have limited the region from institutional systems of the government. Being relatively untouched by Government interventions, these villages of East Godavari district have become highly vulnerable, due to complex climatic and socio-economic dynamics. Vulnerability studies conducted for the region reveal that communities in the region with indigenous wisdom are neither adequately prepared nor have the capacities to hold to their resources, as they utilised them to earn livelihoods in consensus with present realities. These vulnerabilities were further accentuated with the technological backwardness of communities. Absence of grid based electricity and age old methods of using woods for meeting energy needs; not only increased the socio-economic challenges of the villages, but also increased the burden on women. Totally cut-off from the external world; the tribal communities were living in the age of darkness and compromising on

their adaptation needs to tackle climate change. Electricity, a crucial determinant for meeting development and adaptation challenges was an important requirement; for helping communities' battle against climate change and poverty.

Absence of grid based electricity and use of wood for meeting energy needs increases socio-economic challenges of villages and also increases the burden on women.

1.2. Response:

To address the peculiar vulnerabilities of tribal communities in the region; LAYA- a Vishakapatman based non-government organisation introduced renewable and decentralised energy alternatives in Pathakota. A pico-hydel based decentralised grid provided electricity to two villages of the panchayat, and simple adaptation solutions for energy-efficient cook-stoves helped the communities deal with the issues of gender and climate change.

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Pico-hydel off grid

2. Objectives

- Meet the energy needs of tribal communities, who were completely deprived of grid-based electricity supply of Government.
- Reduce the burden on women and enhance their capacities to deal with climate change.

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Pico-hydel off grid operated by a community member

3. Approach

Using a cluster approach, this model has a group of villages powered by a mix/combination of renewable technologies for aiding energy access; in an efficient and sustainable manner. This "technology based cluster" is an integrated renewable energy model comprising of micro-hydro off grid, solar powered devices and fuel efficient smokeless stoves.

4. Key Stakeholders

Tribal communities in the intervention area were involved right from the initial assessment to the design phase. The energy intervention options were identified on the basis of local energy needs and priorities of

the communities. On the basis of feasibility; household/hamlet clusters were developed as energy hub encompassing the three technologies-solar lanterns, fuel efficient cook stoves and micro hydro. The stakeholder engagement and ownership-development process was an important aspect of LAYA's intervention to engage the community in development, and management of the energy hub model in the region. This helped to ensure sustainability and success of this community-owned and community-run renewable energy model.

5. Key Components

Pico-hydel off grid: LAYA constructed a pico-hydel off-grid on a perennial stream flowing through Pathakota. This renewable energy powered system provides electricity to two villages, with a maximum output of 6 kWh. Local ownership and management of the energy generated is the biggest reason for the sustainability of this decentralised energy system; wherein there is no alienation between the producer and consumer of energy. The community contributed labour for constructing their micro-hydro power station of 6 kWh, supplying electricity to around 85 households. Community based institutions such as user groups and micro-hydro management committees were developed.

Solar lanterns: These device-based solar powered lanterns provide basic lighting in 13 villages (approximately 450 households); thereby, replacing kerosene lanterns. Communities have contributed money for the solar lanterns and have identified individuals from within, who would be trained as technicians to repair solar lanterns.

Energy efficient wood stoves: These cook stoves require less firewood; are more efficient in meeting domestic energy needs and have also been extremely helpful for women (from health perspective; as well as help them to minimise their drudgery of collecting firewood).

6. Outcomes and Impacts

This model of renewable energy cluster has:

- Helped the tribal communities of Pathakota deal with socio-economic and development issues.
- Increased tribal communities's adaptive capacities against climate change.
- The smokeless stoves have reduced the fuelwood requirement to almost half; which has greatly reduced the time spent by them on collecting fuel woods.
- Two-flame sets of the cook stoves have also saved time spent by them in household chores. As a result, their participation in village meetings and community decision making processes has increased. This is a significant example of helping woman deal with the unknown risks of climate change.
- Similarly, solar lanterns have helped the people to reduce kerosene usage, enabling them to live in a healthy environment.
- Farmers have also benefitted from the efficient light, provided for agricultural purposes. The electricity supply in the villages has turned around the development and social dynamics of the village.

7. Lessons Learnt

- It is very important to understand community energy needs; before setting up any renewable energy intervention in a remote and inaccessible area.
- It is also important to keep in mind; the changes in upcoming prospects with grid connectivity in near future. The communities are now identifying prospects to connect their de-centralised energy systems with grid systems in the near future.
- Feed-in tariffs and government regulatory systems for decentralised energy, are some of the options that will help to connect such pilot systems; to mainstream energy systems and will ensure their sustainability.

Catch them Young

Key Messages

- Generating awareness and sensitisation of children and youth on issues of environmental protection and adoption of sustainable climate adaptive practices creates young cadre of change-makers and future citizens.
- Use of mass media and new media is critical in engaging Green Ambassadors for advocating change.

© CeFHA

1. Context

1.1. Need:

Given increasing threats due to climate variability and global warming, it has become extremely important to develop simplified tools and frameworks for climate change communications. Specific initiatives have been taken by a non-government organisation, Centre for Humanitarian Assistance (CeFHA). In Kotauratla block of Vishakhapatnam district of Andhra Pradesh; to create awareness amongst young citizens on issues of climate change. CeFHA has helped school children to understand the adverse threats posed by climate change. It has sensitised them on the issues of global warming, climate change adaptation and environmental conservation. This sensitisation process has motivated the children to conserve their biodiversity and natural resource base; promote sustainable development practices for management of grasslands, forests and common property community resources. Awareness generation and capacity building of children on climate change issues has created a young cadre of change-makers; who are now working to build networks amongst other children, institutions and government agencies in the region.

2. Objectives

- Enhance capacities of children on issues of global warming, climate change resilience and biodiversity conservation.
- Disseminate knowledge and information on the benefits of protecting natural resources from over exploitation and pollution.
- Help children understand simple evaluation methods for assessing water

quality and the importance of neutralising its pollution.

- Build a cadre of Green Ambassadors for protecting and strengthening the existing fauna, flora on land as well as in water.
- Create awareness on adaptive practices such as agroforestry & agro biodiversity and sustainable management of grasslands.

"Generating awareness and sensitisation of children and youth on issues of environmental protection, and adoption of sustainable climate adaptive practices creates young cadre of change-makers and future citizens"

3. Approach

In order to sensitise children groups from different villages, local communities on the issues of climate protection and environmental conservation, CeFHA (Centre for Humanitarian Assistance) used a futuristic approach by building the capacities of future citizens (children) on research, awareness, conservation and adaptation aspects. The implementation framework adopted in the process focused on development of research and knowledge base for environmental conservation; and climate protection and use of community led communication campaigns for increased understanding of climate change issues.

To further consolidate the efforts made by these children, Green Ambassadors were institutionalised into the Green Ambassador Children Network and Eco Club. This institutionalisation process helped to streamline small efforts made by children and ensured sustainability of the initiatives.

© CeFHA

Training of children as the Green Ambassadors

4. Key Stakeholders

The initiative established the Green Ambassadors Children Network with 1324 children of Dalit and tribal communities; living in Kotauratla Mandal of Visakhapatnam district. In order to engage these stakeholders; 62 children groups were formed in 36 villages of Kotauratla and a Mandal network was established. Simultaneously, five clubs in schools of five different villages were established. These clubs were established to engage large number of students in environmental conservation and climate change awareness activities. Village resource centres were used to plan campaigns, assessment studies and awareness initiatives. Organisational and institutional capacities of the children were built to take ownership of resources and tasks. Special meetings were convened by them on Sundays and local holidays.

5. Key Components

Capacity building: CeFHA (Centre for Humanitarian Assistance) conducted a series of interactive and participatory sessions, which built the theoretical and practical knowledge of children on biodiversity and climate change related issues. Theoretical classes helped them to understand the science of climate change and biodiversity. Practical exposure activities such as transect walks, exposure visits and visits to different adaptation interventions in the region helped them to understand the related problems and solutions. Lastly, children were also capacitated to use modern media tools for awareness and campaigning.

Development of research & knowledge base: To assess the vulnerabilities arising due to climate variability and natural resource exploitation in the region; children developed tools such as herbariums, biodiversity register and sectoral maps. These sectoral maps helped them to understand adverse impacts on different sectors such as forests, agriculture, horticulture, water resources and animal husbandry. A large focus of intervention was to document the changes observed in local biodiversity. The children emphasised on the impact of seasonal variability on availability of water resources. Since a large number of children came from agricultural families, special efforts were made to help them analyse; how climate change had impacted agriculture sector in the region.

Awareness & advocacy: The most crucial element of this initiative was focussed on generating awareness and sensitisation on issues of environmental protection, and adoption of sustainable climate adaptive practices. Some of the awareness activities included climate campaigns in schools, public places and village community events. Some of the major events included:

- Rally on ecological crisis and climate justice.
- Workshop for children's voices on climate protection and biodiversity conservation.
- National awareness yatra on climate change from Odisha to Chennai.
- Cycle yatra on environment protection.
- Community climate march rally.

Besides creating awareness, these children led activities have:

- Created a large sensitisation movement in local village communities.
- Promoted afforestation and preservation of indigenous seed varieties.

Children also voiced their opinions on climate through radio and television. The children interacted with the digital media and shared their views, both in the local visual and audio media. They were covered in almost all the leading news channels and were also invited by the popular radio channels for interview.

6. Outcomes and Impacts

Development of knowledge resource base has helped to create mass awareness on environmental protection and adoption of climate adaptive practices. These interventions have helped the communities to compare the climatic impacts, which have affected their resources in past and present.

Some of the changes which have been accelerated after this movement are:

- Development of seed banks for indigenous and hardy crop varieties.
- Indulgence in afforestation activities.
- Conservation of biodiversity.
- Reduction in pollution of water sources.

© CeFHA

Green Ambassadors planting saplings

Green Ambassadors have also been successful in advocating these issues to district officials. A memorandum was submitted for pushing the issues of environmental protection. Some of the key asks included:

- Promotion of decentralised energy options.
- Inclusion of climate change subject in school syllabus.
- Increased efforts on water conservation.
- Promotion of organic culture.
- Reduction in slash and burn agriculture and protection of forest resources.

7. Lessons Learnt

- Children are good change makers and medium for climate change awareness and sustainability.
- It is important to incorporate/integrate climate change and environmental issues in school curriculum.
- Additionally, local government and decision makers should engage more with children, to get an unbiased and converned view to development.

Population	As per 2011 census, total population of Assam was 31,169,272. It Ranks 15th in terms of population in India.[1]
Climate	With the "Tropical Monsoon Rainforest Climate", Assam's temperate (summer max. at 95–100 °F or 35–38 °C and winter min. at 43–46 °F or 6–8 °C) and experiences heavy rainfall and high humidity.[2,3] The climate is characterised by heavy monsoon downpours reducing summer temperatures and affecting foggy nights and mornings in winters, frequent during the afternoons.
Climate Vulnerabilities	Changing weather pattern, rising temperature, cloud bursts, flash floods, floods.
Average Annual Rainfall	2203 millimetre[4]
Economy	Assam's economy is based on agriculture and oil. Assam produces a significant part of the total tea production of the world. Assam produces more than half of India's petroleum.

[1] *2011 Census of India.*

[2] *Singh, R. L. (1993), India, A Regional Geography, Varanasi, India: National Geographical Society of India.*

[3] *Guwahati's landscape to change with satellite towns, BRT systems". The Assam Tribune. Retrieved 4 August2013.*

[4] *District-wise monthly rainfall data from 2004-2010 for the whole of India by Indian Meteorological department from www.indiaportal.org*

Assam is a state of India in the north-eastern region. Located south of the eastern Himalayas, Assam comprises the Brahmaputra Valley and the Barak river valleys along with the Karbi Anglong and the North Cachar Hills. Like the rest of the northeast region of India, Assam is extremely vulnerable to climate change. The 20th century has observed a warming trend of 0.51°C in India with accelerated warming observed from 1970 onwards. The region has experienced increase in the annual mean maximum temperatures, with increase at the rate of +0.11°C per decade and annual mean temperatures at a rate of 0.04°C per decade in the region. Assam has a high reliance on agriculture that is likely to only increase given its growing population. Changing weather patterns and rising temperatures leave farmers vulnerable to crop losses. Additional precipitation increases the risk of crop flooding. Climate change will also negatively impact the water resources sector by increasing freshwater scarcity, which is already a problem for Assam in the summer[1].

[1] *http://www.nicra-icar.in/nicrarevised/images/State%20Action%20Plan/Assam-SAPCC.pdf*

Diversification for Conservation

Key Messages:

- Mal-adaptation to climate change is a common occurrence in forest dependent communities and leads to environmental issues like deforestation and soil erosion.
- Community based conservation can help reduce dependency on forest ecosystems for sourcing resources, while promotion of market participation can provide incentives to economic diversification, skill intensification and human capital augmentation.

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1. Context

1.1 Need:

Manas National Park is a unique and fascinating landscape in the world. Despite the ecological importance of the forests of Manas National Park, the ecosystems here have been subjected to great stress and continue to face multiple threats from human induced causes – directly through deforestation and indirectly through human induced climate change.

The southern boundary of Manas has thickly populated villages and these populations are heavily dependent on the natural resources for their livelihood. These communities in the fringe areas of the protected area are least developed and highly dependent on the forest resources for their livelihood. The adverse effects of climate change ie. cloudbursts, flash floods, crop degradation etc. affect these communities severely and limit their means of living, especially communities that are agrarian, where they either own small land holding or work in others' lands as farmers.

As a result of insufficient income from farming alone, the communities rely heavily on forest resources for sustaining themselves eg. collecting firewood for fuel sales in nearby villages. This of course, leads to environmental issues like deforestation followed by soil erosion. Soil erosion and deforestation have reduced water retention, increased flooding after rains and reduced

[1] *Choudhury, A.U.(2010)The vanishing herds : the wild water buffalo. Gibbon Books, Rhino Foundation, CEPF & COA, Taiwan, Guwahati, India*

[2] *Wikramanayake, Eric; Eric Dinerstein; Colby J. Loucks; et al. (2002). Terrestrial Ecoregions of the Indo-Pacific: a Conservation Assessment. Island Press; Washington, DC. pp. 300-301*

water flow between the rains. These environmental changes complicate living with increased climate variability in the future because a reduced natural resource base may not be able to provide the same safety net functions to these communities, as it does currently during periods of stress.

1.2. Responce:

These communities living in the Bhuyanpara, Panbari and Bansbari Range depend on the forest for a variety of forest products for food, fodder, agriculture, housing and an array of marketable minor forests produces, which can potentially degrade the forest, if harvested unsustainably. Efforts to reduce vulnerability to increased climate variability in this region would need to safeguard the natural resource base, promote market access and augment human capital. The promotion of market participation can provide incentives to economic diversification, skill intensification and help reduce dependence on forest ecosystems. Thus, the need for implementing a strategy that protected ecosystem services, as well as provided some alternative livelihood intervention was seen.

"Efforts to reduce vulnerability to increased climate variability require safeguarding the natural resource base, promoting market access and augmenting human capital"

2. Objectives

The community based conservation programme was conceptualised by Aaranyak for the fringe tribal communities of national parks. In Manas National Park (MNP), the project received funding from the Bodoland Territorial Council and the US Fish Wildlife Services.

The project targeted local stakeholders, mainly women and farmers to provide diversified and environmentally sustainable means of livelihood in the fringe areas of Manas National Park. It aimed to minimise the dependency on the park for livelihoods, to promote market participation and enhance existing skills.

Map of Manas National Park indicating forest cover and location of human habitation

Key objectives of the initiative were:

- Create baseline analysis of local skills and market linkages.
- Diversification of livelihoods of forest-dependent vulnerable communities living on the fringe areas of Manas National Park.
- Revive and strengthen the existing SHGs in villages and leverage that network for awareness building on impacts of natural resource degradation.
- Pilot alternative livelihoods in SHGs.
- Provide value addition to existing activities through market linkages, mechanisation of processes, efficient techniques and infrastructural changes.
- Educate and empower women.

3. Approach

The methodological approach for the project was based on piloting a community built sustained livelihood tool, which contained a repertoire of alternate livelihoods, leading to micro-enterprises to enhance their self-generating economy. While performing preliminary research on the sites, it was found that several women's self-help groups (SHGs) were in existence, but only for a rudimentary money lending service. The project saw an opportunity to leverage the existing SHGs to form a base upon which training and capacity building could then further transpire from.

Through consultation workshops and intense community PRAs, the requirement and type of intervention was determined. These led to alternate livelihoods being identified. Nine such livelihoods were identified following which skill development trainings and capacity building began. Till date, 116 SHGs have been selected, consulted, trained and supported through the project's activities.

Consultation workshops: Consultation workshops and one-to-one group discussions were conducted with members of all 116 SHGs under the three ranges of MNP. These were conducted at the beginning of the project in order to give the beneficiaries a clear understanding of project goals and the aim for selecting them.

Through the consultations, the group coordination and mode of operation was also determined and suggestions for alternate livelihoods were gathered .

Capacity Building: Building of capacities then leads to a livelihood strategy, which is community based and has a direct impact on existing structures and processes.

4. Key Stakeholders

In this pilot project, 116 self-help groups were involved in from 53 fringe villages around the southern boundary of Manas National Park from Panbari, Bansbari and Bhuyanpara Ranges.

In addition, the target audience also involved the farmers from these villages, who were facilitated with livelihood options that were easy and profitable.

The trainings and capacity building workshops were conducted in collaboration with several NGOs, experts and governmental agencies like:

- Assam Khadi and Village Industries Board.
- Kamdhenu Dugdha Utpdak Samabay Samity.

- Manas Agrang Society, a local NGO.
- Local fishery entrepreneur with ties to the Agricultural University.
- Local entrepreneur with food processing unit.
- Krishi Vigyan Kendra, Howli.
- Bodoland Territorial Council resource persons.
- Local forest department officials.

Other stakeholders in the project include the following, who have helped create market linkages and provide platforms for showcasing these organic products.

- Assam State Trade Fair.
- International Agri Fair.
- Manas National Park eco-shops and tourist lodges.

5. Key Components

A baseline study was conducted first to determine the skill level of the communities and their capabilities to diversify into different sectors. The baseline found that the environment and surrounding grasslands were available for grazing, indicating that livestock rearing could be an option. In addition, existing practices like pickle making, pig-rearing and fisheries were occurring on small scale. Training on optimisation and larger scale production were identified as intervention areas.

After the baseline, preliminary training sessions were conducted by Aaranyak with the relevant external resource persons for each sector:

i. Fishery

ii. Bee keeping

iii. Dairy Farming

iv. Goat farming

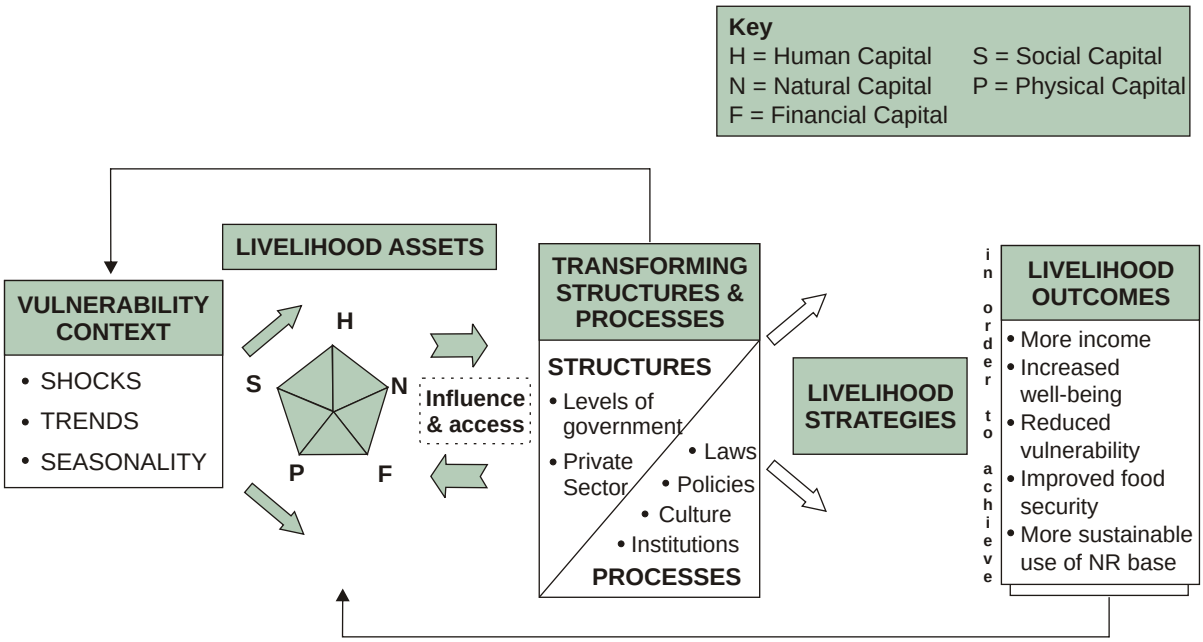
v. Vermicomposting

vi. Food processing and preservation

vii. Pig rearing

viii. Embroidery and weaving

ix. Mushroom farming



Sustainable Livelihoods Framework

Fishery: Alternate livelihood option

Dairy farming: Alternate livelihood option

6. Outcomes and Impacts

In the two years of the project running, there have been several visible linked impacts seen in the pilot areas:

i. Impacted about 5,000 people from 1,000 households living in 53 out of 62 fringe villages

ii. Increased awareness about forest degradation, direct impacts of run-off on everyday lives.

iii. Reduced dependency and pressures on the forest due to diversification of livelihoods.

a. Increased income of SHGs by targeted sales of Rs. 120/kg.

b. Increased income through sale of honey at Rs. 400/kg.

c. 50 % of distributed goats have reproduced. Shed construction was done by the SHGs themselves

d. 100kgs of vermicompost was produced, which the SHG has put back into their fields. A direct impact was that zinc deficiency was reduced in paddy fields.

e. Food products such as lemon and orange squashes, pineapple, guava jellies, pickles and sauces were produced. These have been sold at fairs, ecoshops and tourist lodges becoming one of the most visible produce outcomes of the intervention.

f. Mushroom farming brings in Rs. 400/bundle/month and is the most profitable alternative livelihood for the women.

iv. Reduced pressure on the forest for sourcing resources and increase in the number of trees surrounding intervention villages.

v. Reduced instances of communities being found inside national park boundaries by forest officials.

vi. Reduced dependency on forest for fodder for grazing animals.

vii. Greater empowerment amongst women of SHGs.

a. Exposure to financial transactions, market linkages and contribution to the family's financial security has given the women a sense of confidence and improved their status, in varying degrees within the household.

viii. Change in social fabric of communities, where menfolk are supportive of women being away from home and taking over traditionally female roles.

ix. Greater understanding about the threats of deforestation, after visits to the National Park.

7. Lessons Learnt

For larger scale implementation and replication in other areas with similar threats, a few learnings have been identified:

- Diversification of livelihoods results in reduced dependency and pressures on the forest.
- For some livelihoods, it was found that the communities were not following the designated best practices or techniques despite getting trained in them and knowing the benefits. To motivate them to follow the procedures, an incentive scheme was found to be a good option.
- Organising livelihood clusters for the farmers and SHGs to ensure that economies of scale make the production continuous.

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Mushroom farming

Techquipped for Floods

Key Messages:

- Flexible flood management planning (FFMP) is a comprehensive, participatory process preparing vulnerable communities for effective flood management saving lives and livelihoods.
- A comprehensive disaster risk reduction strategy coupling warning system with critical infrastructure and environmental buffers is important. Hence, appropriate investment in all three areas is the best approach to achieve substantial benefits.
- Flood Early Warning System (FEWS) feeding information to Disaster Response Agencies facilitate timely and effective action.

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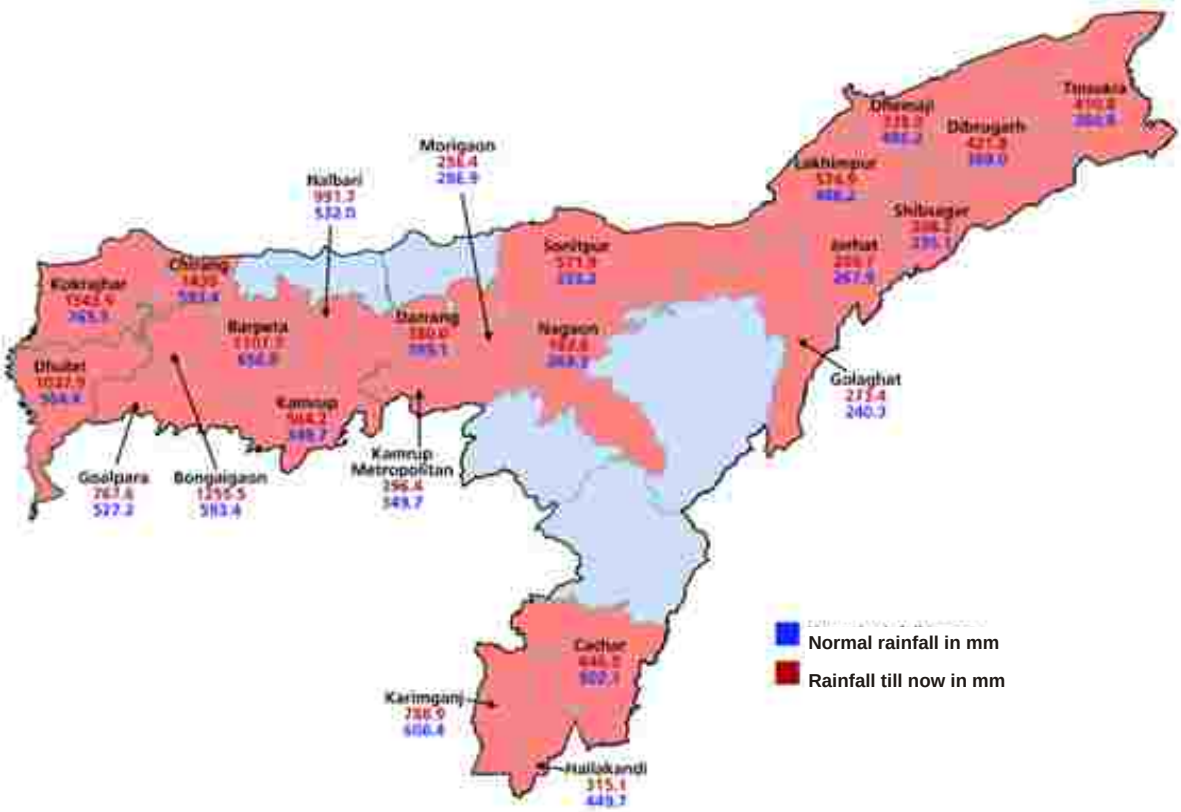
1. Context

1.1. Need:

Floods, flash floods, river-bank erosion and sand-casting (deposition of large amounts of sand by flood water) are the most frequent water-induced hazards in the eastern Brahmaputra basin in Assam. Such hazards affect all aspects of land, lives, and livelihoods of communities living in the region to a significant degree. Moreover, annual cycles of hazards cripple people's resilience and intensify the poverty spiral. Thousands of hectares of fertile land in hundreds of villages; have been lost to the river, due to frequent shifting in the river course and erosion of river banks. The impacts of climate change on the Himalayan region further increases incidences of landslides and cloudbursts, and flash floods affecting the hydrological regime of large rivers like the Brahmaputra.

Climate change is considered a major driving force, triggering alternation in the regional and local weather and climate systems. The impacts of climate change on the Himalayan region are rising temperatures, recession of glaciers, extreme rain events, increased incidences of landslides and cloudbursts, and flash floods triggered by landslide which affect the hydrological regime of large rivers like the Brahmaputra. The gargantuan river sustains millions of people, scores of ethnic cultures and supports diverse ecosystems in the eastern Himalayan region.

Flash floods have been causing considerable loss of life and property in lowland communities, particularly during the monsoon season. Although floods in small



Flood affected districts of Assam

rivers and tributaries can be extremely disastrous, they do not receive enough attention from government and other concerned agencies. Two districts that are the areas of intervention – Lakhimpur and Dhemaji are notorious for being flood-prone, as they lie in the river basins of Jiadhal and Singora.

The communities living in these areas have developed mechanisms over time that have become ingrained in their lifestyles and traditions – for example, housing, agriculture, livestock rearing, food storage, and weather and flood predictions. These mechanisms had helped them cope with and adapt to the immediate and long-term impacts of such hazards for quite some time. But as climate scientists are observing rising temperatures in the region, decreasing rainfall and recent drought-like situations in the past two decades, it is evident that the climate of the region is changing faster than the communities can adapt. The traditional coping and adaptation practices of the riparian communities living in these areas and practices that had developed in response to normal climatic variations have been rendered less effective against the increasing scale and intensity of the changing hazards.

2. Objectives

ICIMOD and Aaranyak have together piloted this project to use community-based *flood early warning systems* (FEWS) and *flexible flood management planning* (FFMP) to help manage flood risk and uncertainty as part of the Himalayan Climate Change Adaptation Programme (HICAP). These tools for flood risk management have been piloted in the Jiadhal and Singora river basins of the eastern Brahmaputra in Assam. The objectives of the project were to:

- Manage flood or flash flood risk by providing early warning to downstream communities.

- Enhance cooperation between upstream and downstream communities through flood information sharing.
- Enhance adaptive capacities and resilience of communities to withstand adverse effects of floods and flash floods.
- Form a local institutional arrangement to increase effectiveness of community-based FEWS *(flood early warning systems).*

"Flexible flood management planning (FFMP) is a comprehensive, participatory process preparing vulnerable communities for effective flood management saving lives and livelihoods"

3. Approach

Flexible flood management planning (FFMP) is a comprehensive, participatory process used to prepare a flood management plan for vulnerable communities. The process also explores uncertainties as a co-learning experience between communities, researchers, policy makers and institutions on the ground in the context of social and environmental change including climate change.

The FFMP was piloted in four villages: Dihiri and KechhuKhana Koch Gaon in the Jiadhal river basin; and Soroni and Borsola in Singora river basin. The four main steps performed under the FFMP were:

- Participatory flood mapping (also known as social flood hazard mapping); participants prepared a flood hazard map with the help of a trained facilitator.
- Community driven monitoring: A six month long activity in which local community members regularly monitored and recorded flood events and weather conditions, particularly temperature and rainfall. Participants received training on how to monitor and record flood and weather conditions in advance.
- Participatory envisioning: An exercise in which local communities anticipate plausible future environmental scenarios based on their own experiences. Using these scenarios, participants identify major drivers of change. Community perceptions identified upstream deforestation and population pressures on food security, lack of good governance as major drivers of change increasing flood risk. After identifying the drivers, participants are given future climate projections, which they use to envision how climate change will affect major drivers of change and prepare two future scenarios. Well-trained facilitators, including individuals to take notes are required to perform this exercise.
- Preparation of a flood management plan: The final step in the FFMP and is prepared on the basis of the data and information obtained from the previous three steps. This activity enables local community members to learn how to plan; as a key step in building their adaptive capacity. Facilitators and note takers play a vital role in this step.

4. Key Stakeholders

In this pilot project, the vulnerable communities from all four villages were the main stakeholders The nature of the project was such that the role of communities was

vital in the planning process, operations and execution of the warning systems. The real time data logging and information dissemination system was heavily dependent on villagers, nodal point people and the project operators communicating with each other.

Aaranyak's network and the district government's networks were engaged for the process of participatory mapping, including the following key stakeholders:

- Local governance and district administration.
- District Disaster Management Authority, Lakhimpur.
- District Disaster Management Authority, Dhemaji.
- University of Pennsylvania, USA.

5. Key Components

Flexible Flood Management Planning (FFMP)

To perform the FFMP, training on participatory flood mapping and community based monitoring was conducted for field facilitators followed by envisioning training, field exercises and a flexible flood management planning exercise.

As a result of the participatory envisioning, several factors contributing to loss of life and property due to floods were identified. The community was aware of several flood mitigation systems that could be useful in their situations. In infrastructural developments, suggestion were made for embankments, sluice gates, high structures etc. In pre-flood systems, early warnings system was a suggestion.

Following that suggestion, the team saw an opportunity to test out FEWS in some sites in the area of intervention.

Flood Early Warning System (FEWS)

The Wireless flood early warning system (FEWS) is a low-tech, cost-effective and user friendly system. It consists of two units: a transmitter and a receiver – both of which were installed upstream. The transmitter was installed along the riverbank and the receiver was installed at a house near the river.

Technology of FEWS

A flood sensor attached to the transmitter detects rising water levels. Critical floods levels are set with the help of the local community. When the water reaches a critical level, a signal is wirelessly transmitted to the receiver. The flood warning is then, disseminated via mobile phones to vulnerable communities and concerned agencies. The flow of information then proceeds simultaneously in two parallel chains to reach both the village and the nearby government officials.

The effectiveness of wireless FEWS is dependent on the selection of proper sites for the installation of both the units. It is necessary to provide training to local community members on the installation and operation of the system, as well as troubleshooting.

Five sets of early warning systems were installed in Jiadhal and Singora rivers in 2013. The first set was installed at Sagarpur village in Lakhimpur district in June 2013. Two days later, the system provided a flood warning system that was successfully communicated to communities downstream. All the equipment performed well during the 2013 flood season. The system is such that the village electrician can also run the technology. Moreover, it is crucial to institutionalise the roles and responsibilities of different stakeholders and develop an efficient communication and dissemination mechanism between upstream and downstream operators.

6. Outcomes and Impacts

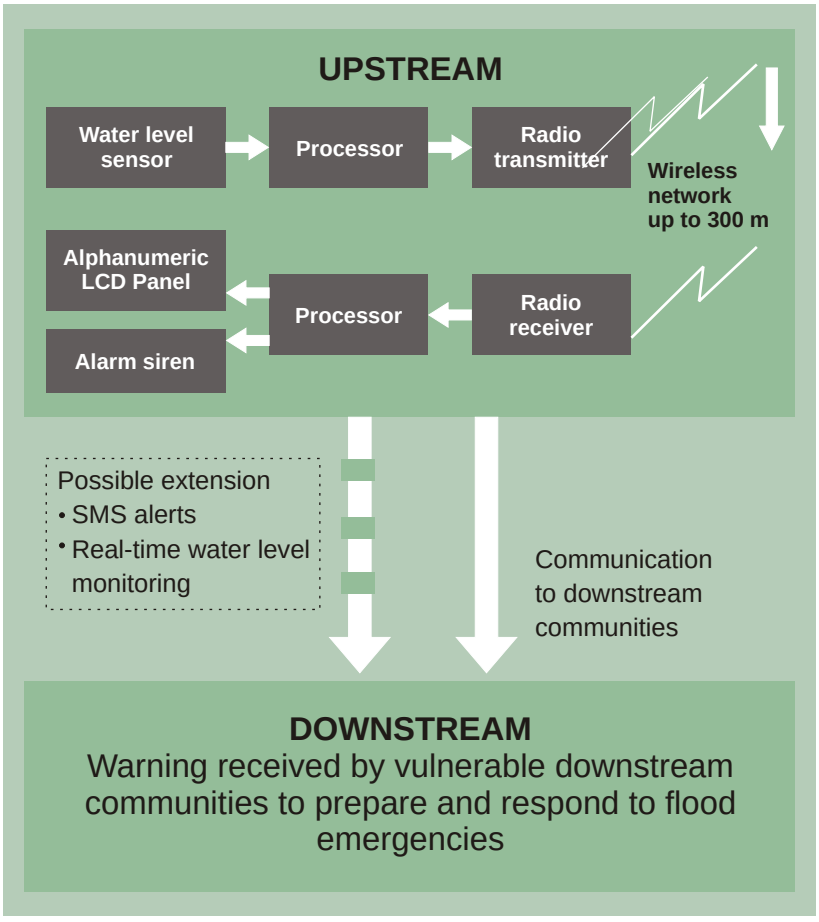
The direct impact of this pilot project has been on 20-25,000 people living downstream in 40 villages. They now have a lead time of 1.5-2 hours to prepare for the impending floods, and evacuate, if necessary. In Dihiri in the Jiadhal river basin, assets including livestock worth approximately 3,300 USD were saved during the flood season of 2013. With a lead time of 2 hours, simultaneous measures were taken, where some community members were plugging in breaches, reinforcing the embankments etc., and other members were moving people and livestock to higher ground.

In addition, local authorities have knowledge of the impending floods and can facilitate faster response to the problems of food and water. Local authorities can position equipment for emergency response and aid agencies can mobilise sooner.

Priority given to planning and management: During this process, lives of women, children and elderly people were saved. They were sent to safe zones – higher road, railroad, higher building, school buildings etc. Livestock were also taken to safe places next. Reactions to the information were based on what kind of warning was received.

The information transfer systems have been streamlined and made more efficient promoting upstream and downstream cooperation. FEWS installed in one village upstream has the capacity to save thousands of lives in 20 villages downstream.

Spatial planning was done for these structures and the map created in conjunction with the community was handed over the district level planners.



Flow of information in FEWS

Public Platform to highlight broad-ranging climate change actions are achieving heavy results on the ground. Strengthened motivation, spurred innovation; catalysed further change towards a low emission high resilience future.

7. Lessons Learnt

- Methodology and instrumentation of FEWS have been improved every season with learning from the previous season. Currently, information is disseminated through voice calls from one operator to several nodal people in each village, to project operators and district administrators. The technology developers are working now to have a built in system to send an sms warning at Levels 1, 2 and 3.
- Dissemination of the information, either through voice calls or sms, is dependent on a functional telecommunications network. This may create problems in events of freak cloudbursts, as networks are often down. An alternate is to have access to radio frequencies used by the military to increase the reliability of the information communication system.
- Greater involvement of various stakeholders in an overall disaster risk reduction strategy such as local CSO, NGO and district officials.

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FEWS Transmitter

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Community involvement plays a key factor in FEWS

Population	As per 2011 census, Himachal Pradesh has a total population of 6,856,509.[1] It ranks 21st in terms of population in India.
Climate	The state experiences three seasons: Summer, Winter and rainy season.[2]
Climate Vulnerabilities	Changing weather pattern, rising temperature, recession of glaciers, extreme rain events, landslides, cloudbursts, flash floods
Average Annual Rainfall	1142.1 millimetre[3]
Economy	Agriculture is the main source of income and employment in Himachal. Over 93% of the population in Himachal depends directly upon agriculture which provides direct employment to 71% of its people.

[1] *2011 Census of India.*

[2] *"Climate of Himachal Pradesh". himachalpradesh.us.*

[3] *District-wise monthly rainfall data from 2004-2010 for the whole of India by Indian Meteorological department from www.indiaportal.org*

Himachal Pradesh, situated in the western Himalayas, is a state in Northern India. Himachal Pradesh is famous for its abundant natural beauty; a land of hill stations, dense forest ranges, deep valleys, snow - capped mountain ranges, serene and cool environment. Agriculture contributes nearly 45% to the net state domestic product. It is the main source of income as well as employment in Himachal. About 93% of the state population depends directly upon agriculture. The Himalayan ecosystem is fragile and diverse. It includes over 51 million people who practice hill agriculture and remains vulnerable. The Himalayan eco system is vulnerable and susceptible to the impacts and consequences of a) changes on account of natural causes, b) climate change and c) developmental paradigms of the modern society[1].

[1] *http://dst.gov.in/scientific-programme/NMSHE_June_2010.pdf*

Grow Organic: Go Resilient

Key Messages

- Organic ways of agriculture are beneficial for farmer's personal well-being, as well as for planetary well-being and are more climate resilient.
- To make farmers self-reliant; it is important to strengthen community institutions for enhancing their decision making ability and introducing new techniques of production systems.

© DA

1. Context

1.1. Need:

The Kangra district of Himachal Pradesh lies on the southern spur of Dauladhar Range of the Himalayas. This region, like many other regions of the world has witnessed significant changes in the incidence of variations in seasons and temperature. In the last one decade, Himachal Pradesh has been a witness to the most drastic impacts of global warming. The changing climate has affected people's lives and livelihood in various aspects. Agriculture has also suffered great amounts because of the same cause. Cropping pattern and choices have altered over the time. Cash crops like apple, potatoes that were grown extensively in this region earlier, had shown continuous fluctuation in the production in Himachal Pradesh. The production of fruits in Himachal Pradesh has witnessed a decline of 96.3 % from 1027820 tonnes in 2010-11 to 37820 tonnes in 2011-12 (Economic Survey of Himachal Pradesh, 2013-14). This increased the vulnerability of the population largely dependent on agriculture. These factors forced farmers to use chemical fertilisers for higher and constant production.

The small and marginal holding farmers in the Kangra district have shifted from small scale commercial agriculture to subsistence agriculture, over the past decade and a half. This shift has been on account of lower yield of regular crops in the region. This region, like many other regions in the country started using chemical pesticides and fertilisers during the mid-19th century. These were used with a goal of increasing the production and income from crop production. The high yielding varieties and new seed varieties in the market, were also tested by farmers; over the same period of time. They had potentially

decent results in the production of the region initially. However, the inputs kept increasing and so did the costs of fertilisers and pesticides, thereby reducing substantial profits from the final produce.

1.2. Response:

Chinmaya Organisation for Rural Development (CORD) has been interacting with villages in the Kangra district to build a knowledge base for using organic substances as agriculture inputs. These organic practices are spread across for their benefits in production, but also because of its environment friendly and climate resilient nature, which makes agricultural practices positively related to farmer's and environmental gains.

Organic ways of agriculture are beneficial for farmer's personal well-being, as well as for planetary well-being and are more climate resilient

2. Objectives

- Discover and scale up the use of organic materials and suitable seed variety available within households as agricultural inputs in congruence to the region.
- Motivate farmers to turn towards organic materials, using local farmers as agents of change.
- Enable scale and scope of green learnings from other regions to be adapted for use in Kangra District.

3. Approach

CORD uses volunteer base as an approach for engagement with community members. They also form community based institutions viz. farmers groups, women groups, youth groups etc. These community institutions are where engagement and discussion are carried out on issues of sustainable management of natural resources for increased livelihoods. CORD's approach to agriculture is to create an integrated, humane, environmentally and economically sustainable agricultural production system, which meet on regular basis to discuss concerned agriculture issues.

4. Key Stakeholders

- Local farmers: The people who practice organic agriculture, gain personally in terms of their personal health and quality production of the crops.
- Local customers: The consumers receive a better quality of product, healthier and more nutritious as organic.
- CORD: CORD facilitates the process and ensures that they are fruitful for people and in harmony with nature.

5. Key Components

Volunteers regularly visit and interact with the villagers, they build village groups, which meet monthly for discussing their concerned issues of agriculture. The volunteers share their experiences, try to mobilise few volunteers in the village; to start seed selection and organic practices of manure,

pest control. All the villagers, who volunteer for starting organic practices, are then assisted with popular successful organic practices by the CORD volunteers. A village resource person is also appointed in all the village groups, who can facilitate and mobilise the group towards transitioning to organic practices. Thus, a chain of farmers is made within the village; which keeps growing as more villagers get influenced and join the circle of organic practices. Various farmer groups; women groups, youth mandals, children groups are also formed for effective engagement.

There are various natural pest-control and manure generating techniques initiated by CORD across the region.

CORD has introduced Azolla as a bio-fertiliser and cattle feed. It is a water fern and increases milk and calcium content in milk. This provides farmers with better quality milk and supports good health of the cattle.

Another introduction is "*Panchagavya*", a bio-pest control measure produced by mixing cow-dung, cow urine (*Gomutra*), milk, ghee and curd along with banana, vinegar and coconut in a fixed proportion.

Another practice that CORD volunteers have successfully initiated and spread across scale is seed testing practice. Taking a part of field on volunteer basis from a farmer, all kind of varieties of grains that are available in the market are sowed in small number. Regular meeting on the field are organised for farmer to check the status of the crop. In this way, farmers are able to decide the best variety of seeds for their soil, based on climatic conditions that they should sow in their own villages. This practice is done with an aim to bring the element of self-reliance, where farmers can evaluate on their own, which seed variety is best suitable in the present conditions.

The overall approach that CORD follows, is of innovating new ways of enhancing agricultural productivity and building resilience of communities.

Azolla: a bio-fertiliser and cattle feed

Panchgavya for pest control in the field

Six varieties of seeds of the same grain in a farm plot to assess the best variety

6. Outcomes and Impacts

CORD has been working on climate resilient agricultural practices; with around 200 families in 48 villages for past 3 years. They have significantly impacted farming practices and resulted in :

- Increased use of organic pest control techniques, organic based agricultural practice.
- Farmers have been trained to use the best suitable seed in the market.
- Reduced impact of rains on the crops by increasing their resilience; by feeding organic manure to crops, instead of pesticides.
- Reduced health issues in this region, related to skin and lungs, which fertilisers and pesticides had potential to aggravate.

7. Lessons Learnt

- Farmers , if guided and showcased by example of innovative profitable organic practices prefer organic over inorganic; keeping in mind social, economic and environmental benefits of organic farming.
- Backward and forward linkage in building organic practices is crucial.
- Moreover, the choice of agriculture practices should be made by farmers through informed decision making process.

Interweaving Traditional and Modern Architecture

Key Messages:

- Construction activities in disaster prone area need to follow precautionary pathways.
- Local wisdom and locally available material can be used for building modern and yet environmental friendly houses.
- Mud architecture provide enhanced value to local resources for climate mitigation, if taken to scale and talent promoting differentiated value of asset.

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1. Context

1.1. Need:

The Kangra district of Himachal Pradesh lies on the southern spur of Dauladhar Range of the Himalayas.

Deforestation, unscientific road construction, terracing, water intensive agricultural practices, and encroachment on steep hill slopes are some of the anthropogenic factors that have contributed towards increased intensity and frequency of landslides. Experts point out that unscientific land use and unplanned expansion of urban areas is also overloading and destabilising the slopes in the towns and cities such as Shimla, Kangra. Overloaded slopes may initially cause only minor landslides, but at later stage could trigger larger landslides.

Construction activities in such disaster prone area need to follow some precautionary pathways. However, the recent trends in the construction industry have resulted in massive construction of concrete infrastructure in the Himalayan region. These concrete buildings are not in terms with nature's law. Such excessive cement burdens on the soft and susceptible nature of the Himalayan mountains can be dangerous and have chances to lead to man-made catastrophes. Also, the present design and planning of concrete structures are usually hazardous with respect to its utility of natural light, energy and insulation available.

1.2. Response:

Di Di, a lady of foreign origin in her eighties, has been residing in Sidhbari village of Kangra district for over 20 years. She has built a number of beautiful and practical mud brick houses and structures. Her approach to construction involves utilisation of locally available materials to reduce carbon footprint. She also seeks to learn from vernacular architecture and improve on it, by incorporating some improved design features and materials that are appropriate. For example as Dharamsala is in an earthquake zone, she includes vertical steel reinforcing rods in the structure and these are connected to a

reinforced concrete beam at lintel level. She assesses the details in terms of selecting the materials, house plan, etc. to optimise the use of nature's resources in a non-exploitative manner. She has also built a hospital and a couple of schools, all of them in the local Kangra style. Di Di believes that a building designed with due consideration towards climate, topography, standards and adequate details outlives any other building designed casually with just other building material. She incorporates concerns towards the issues of climate change, sustainability, and carbon foot prints; her methods of cycling and reusing her knowledge of traditional, local crafts and earth buildings all form an integral part in her design ideology. After decades of practicing in Himachal, her projects have become inspiring examples of mud and earth construction in contemporary architecture.[1]

Building and designing materials using local wisdom and locally available material for building modern and yet environmental friendly houses

2. Objectives

- Optimise use of easily available, local resources, materials and skills to design houses with natural temperature moderation to reduce the usage of air conditioners and heater.
- Integrate disaster management perspective in construction practices.
- Ensure involvement of local stakeholders rather than promoting commercial gains from the construction practices.

3. Approach

Primary design principles include response to climate as contextual to every project. Houses constructed with such mud architecture are custom based. The projects are chosen on the basis of value by the customer. Mud architecture practiced by Di Di Contractor is not easy on pockets. Mud architecture amounts to one-third of the cost of conventional concrete architecture, but the labour costs of building mud houses is higher than conventional buildings; not only because it needs specific skills, but primarily as an acknowledgement to the value of labour. The choice of material for house is basically done keeping in mind the question of 'who's going to benefit' and the carbon costs of the material. The mud available on site is used for the construction of walls. Mud, which is a material with less carbon footprint and its potential of going back as nutrients, makes it a good choice for sustainable building practices. The stones used for construction are gathered from the nearby available water source 'khud', which has deposits of stones required for construction. The mud house with modern amenities is constructed with local material and local labourers; after analysing the following factors:

- carbon costs of material.
- energy saving design of the house.

4. Key Stakeholders

- Local people: Customers who prefer a mud house because of its environmental friendly nature and also locals, who are involved in buying and transporting local materials like slate- stone used for roofs of the houses, extensively available in Dharamshala.
- Labourers: The labour cost of the mud architecture is much higher than concrete

[1] *http://www.osdesign.org/uploads/2/1/4/5/21456262/osdg.a.o.traditional_manifestations_-_didi_contractor.pdf*

architecture. The materials used for construction does not include chemicals like cement and thereby, reduces any risk to health of the labourers.

- Di Di Contractor and her team: The Contractor, along with a foreman and an intern support and learn from Di Di's planning, design and construction of mud houses.

5. Key Components

Mud architecture cannot be constructed throughout the year, it is aligned with the seasonal cycle. The house is designed in a manner to maximise the use of natural light and heat. Emphasis is laid to save energy by utilising natural forms of energy and for this a detailed analysis is carried out for every attribute of the house; right from the placement of windows, and corners of the house. Paper and plastic materials like chips wrappers are used in partition walls as they are non-bio-degradable and help in insulation. The life span of the house is increased by placing earthquake bands at various levels. Research is still envisioned to use wood from trees like Pine tree, which have limited other uses. Di Di Contractor builds houses with a support of one to two interns usually, and everyone who comes to work under Di Di, then leverages these mud architecture movements ahead individually. However, because of the long periods involved in the entire process and lack of infrastructure; these trainings are usually few in numbers. She hopes to have a set-up, where she can train more people in mud architecture.

6. Outcomes and Impacts

There are many mud architecture constructions that one can see in the Kangra District at present. Di Di contractor has personally completed around 15 projects of mud construction. However, the number is still very less compared to the concrete construction in this area. The mud architecture showcases one of the best practices for climate resilient construction in the Himalayan region. Some significant impacts of mud architecture are:

An Institute built by Di Di contractor

- Use of natural based local materials for instance bricks, which are 'home' cooked than baked in industry and hence, reduce carbon costs to the environment.
- Ensures energy saving mechanisms, while designing and planning such houses.
- Reduces the impact of construction activities.
- Beneficial to the local labourers because of the recognised higher value of their work.

7. Lessons Learnt

- Construction in eco-fragile and disaster prone region requires following precautionary pathways for development which are in tune with local ecology.
- Building locally appropriate housing requires integration of traditional knowledge with new approaches to building.
- Translating this project to scale will require trained and skilled manpower and incorporation in change in mainstream thinking of development.

Organic Market Place

Key Messages:

- Knowledge and capacity training on climate resilient practices facilitates informed decisions making by farmers; as farmers prefer organic agriculture when provided guidance, support and appropriate market linkages.
- The adoption of organic farming is equally profitable when facilitated with market linkages and facilitates building resilience of communities to climatic variabilities.

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1. Context

1.1. Need:

The Kangra district of Himachal Pradesh lies on the southern spur of Dauladhar Range of the Himalayas.

At present, farmers of this region are practicing subsistence farming in comparison to commercial farming. Commercial farming in the region has been on a decline because of the relative reduction in production, triggerred due to climate change over the past few decades. Meagre connectivity with markets because of the hilly terrain is also a factor that influences the farming decisions of the individual.

1.2. Response:

Jagori Grameen collaborated with 40 farmers collectively and developed a network to connect farmers with consumers, who demand organic products and are ready to recognise the added value of such production. Knowledge mechanisms and connectivity to market catalysed feasible economic incentives; thereby, reducing farmers' vulnerability to market prices. This promoted climate resilient practices based on organic farming in the region.

2. Objectives

- Promote climate resilient agricultural practices and provide farmers substantial income by connecting them directly to consumer base.
- Build a market base that farmers can utilise to understand their customers, as well as strengthen their relationships.
- Reduce the adverse impact of climate change on agriculture, by increasing

[1] *http://dst.gov.in/scientific-programme/NMSHE_June_2010.pdf*

resilience through organic pesticides and manure.

"Knowledge and capacity training on climate resilient practices facilitates informed decisions making of farmers, as farmers prefer organic agriculture when provided guidance, support and appropriate market linkages"

3. Approach

Jagori Grameen works with farmer communities to support them in climate resilient agriculture practices, organic agriculture is not only friendly to the environment, but also promotes better soil health and lesser pollution of soil and air). Organic production also yields positive impact on health of the farmers and the quality of crop production.

They facilitated a transition from inorganic to organic means of production, but most importantly Jagori established green leaf shops, where farmers can sell their organic produce at a relatively higher price than inorganic production. This local market linkage, where customers of organic products are directly linked to the farmer producers is successfully functional on the trust that Jagori has built with customers and farmers. This support for organic transition to farmer has helped them to shift to organic agriculture, despite low yield during the buffer period.

Unavailability of organic manure also hindered the farmers from shifting to organic. To address this, Jagori Grameen through the Green Leaf Project helped farmers to set up vermi-compost pits and other techniques to get substantial amount of organic manure and pesticide. They also conducted workshops to help farmers understand the buffer period when production would be lower.

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A woman selling vegetables from organic farming

4. Key Stakeholders

- Farmers: They produce organic agricultural products, which are then sold by Green Leaf Centres.
- Customers: The buyers of organic product in the market.
- Jagori Grameen: They bridge the gap between demand and supply of organic products, facilitating climate resilient agricultural production.

5. Key Components

Every week, a group of 15-25 farmers from a village collect their yields. Every Monday, the Green Leaf Coordinator calls the farmers to know what products are available. By early afternoon, all customers are informed about

the available products, via text messages. During the same time; yields reach the distribution centres, where measurement and packaging is done by local volunteers. Some customers visit and collect products directly from the centres, while others call for home delivery. Jagori has created space for farmers to interact with the customers for their product and gradually, move towards direct customer-farmer relationship.

There is a reduction in the yield, during the buffer period of 2-3 years, when a farmer switches from inorganic to organic farming. Also the yield in the initial phase is not purely organic because of chemical content in the soil. Jagori Grameen also widened their options by sharing knowledge about crops that have higher market value for instance, broccoli and lettuce. The idea of selling their products directly empowered the farmers to reach the market on their own rather than through middle men.

6. Outcomes and Impacts

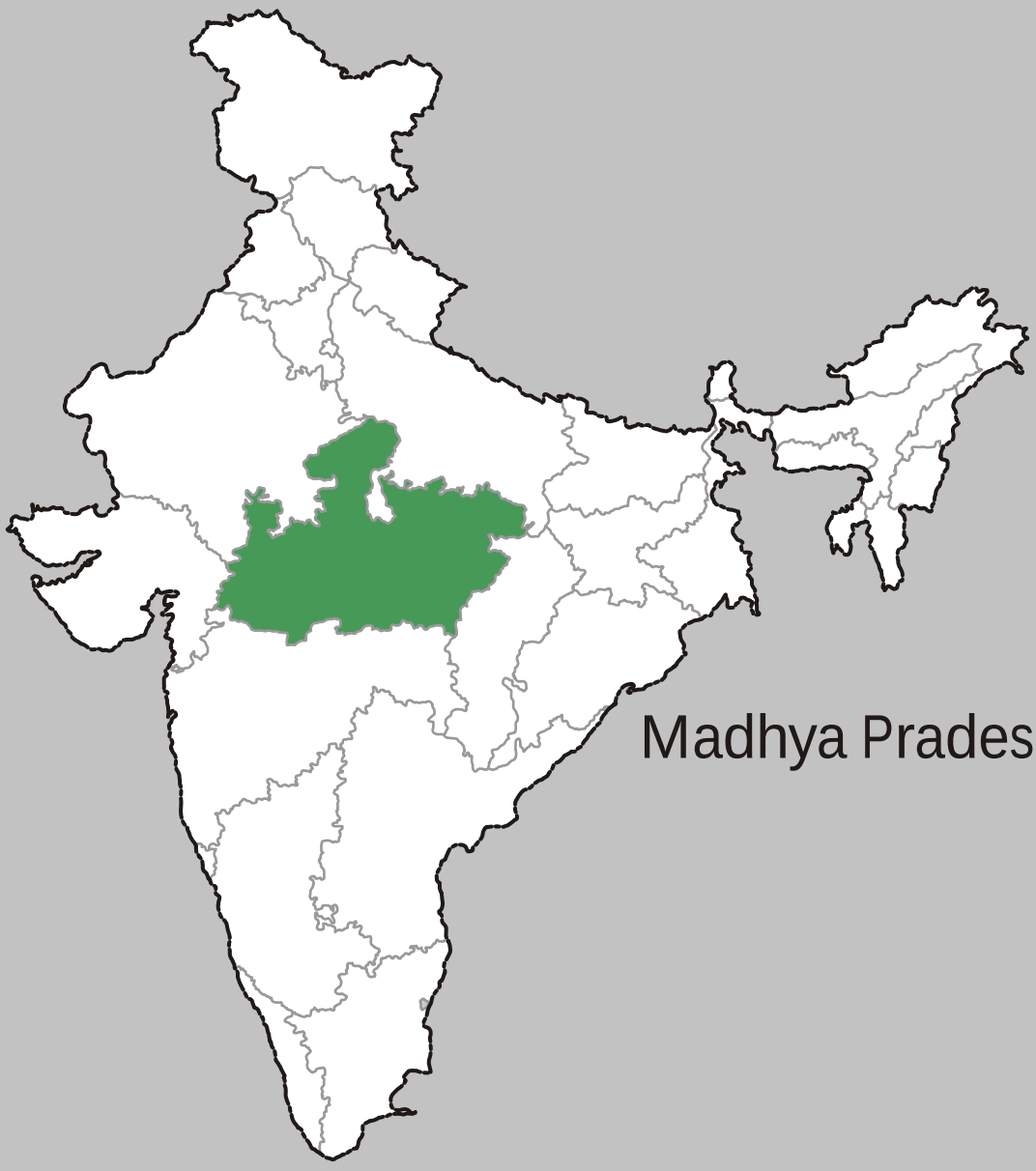
The Green Leaf Project has:

- Reached around 40 different farming groups in 3 years.
- Significantly impacted the agro-climatic concerns of the region.
- Created a better link between farmers, customers and the market.
- Increased overall income of farmers, due to higher prices of the organic produce in the area due to efforts of green leaf project.
- Reduced the spread of diseases in plants due to resilient nature of organic pesticides.
- Prevented degradation of crops and hence resulted in better quality of agricultural production.
- The crops have shown more resilience to weather extremes.
- Lesser trend of respiratory and skin diseases in the people practicing organic agriculture can be evidently seen on the ground.

An ensured income opportunity by practicing climate resilient agriculture has attracted farmers to practice organic farming, which is mutually beneficial to the farmers and the consumers.

7. Lessons Learnt

- Market based approach to promoting organic farming facilitates transition to organic means of production resulting in a co-benefit approach.
- Guidance and continuous engagement with farmers during the buffer period of transition from inorganic to organic agriculture facilitates in scaling up organic agriculture practice. Trust of the promoter is a key factor facilitating systemic changes.
- Market linkages of producers helps them to understand and utilise the demands of customers into customisation of their products.



Madhya Pradesh

Population	As per 2011 census, Madhya Pradesh has a total population of 72,597,565.[1] It ranks 5th in terms of population in India.
Climate	The state has a subtropical climate. Like most of north India, it has a hot dry summer (April–June), followed by monsoon rains (July–September) and a cool and relatively dry winter.
Climate Vulnerabilities	Changing weather pattern, rising temperature, inadequate and erratic rainfall, high run-off rates and poor water retention capacity of soil, droughts.
Average Annual Rainfall	919.4 millimetre[2]
Economy	Madhya Pradesh has an agrarian economy[3].

[1] *2011 Census of India*

[2] *District-wise monthly rainfall data from 2004-2010 for the whole of India by Indian Meteorological department from www.indiaportal.org*

[3] *Lemuel Lall (29 June 2012). "Madhya Pradesh's GDP goes up to 12 per cent". The Times of India.*

Madhya Pradesh is India's second largest state by area and sixth largest state by population. The state has a complex social structure, a predominantly agrarian economy, undulating terrain, scattered settlements over a vast area, and a large population below poverty line. The State of MP has reasons to be concerned about adverse impact of climate change. It is facing twin challenge of maintaining and enhancing economic growth at the same time prevent deterioration and degradation of its natural resources on which large section of the population depends for their livelihoods. With an agrarian economy and natural resources dependent livelihoods of majority of its population, Madhya Pradesh tend to be vulnerable to the vagaries of climate change. Natural calamities like drought, floods and hailstorms are common features for the state. Almost every year one or the other part of the state is affected by drought like conditions enhancing distress migration[1].

[1] *http://www.moef.nic.in/sites/default/files/sapcc/Madhya-Pradesh.pdf*

Community Water Budgeting

Key Messages:

- A decentralised development intervention focusing on participatory approaches to formulate action for development, enhances community engagement in the process.
- Integrated approach to development of water resource structure and simultaneous management by the communities' viz. community need analysis; participatory water budget survey, and collective planning for utilisation of water builds ownership and the intervention becomes sustainable.

© Haritika

1. Context

1.1. Need: `

Bundelkhand, a notable example of semi-arid regions in Central India, is highly prone to impacts of climatic variabilities. It is also one of the most underdeveloped regions of the country with poor human development indices. Administratively, the region comprises of thirteen districts – seven districts of Uttar Pradesh and six districts of Madhya Pradesh. It consists of 7.08 million hectares of ravines and undulating terrain, making the region prone to high run-off rates and loss of soil fertility.

Sensitivities in Bundelkhand are also aggravated by water stress in the region, due to inadequate and erratic rainfall, high run-off rates and poor water retention capacity of the soil. Furthermore, recurrent droughts are frequent to the region. The region witnessed continuous meteorological, hydrological and agricultural drought for six years in the period 2003-2009. The situation is likely to worsen further in the future, with climate forecasts for the region indicating a projected rise in annual average surface temperatures by 1-2°C in 2020s, and shooting up to 3°C and even up to 5°C towards 2050s and 2080s respectively.

Agriculture forms the backbone of the rural economy in the region with almost 75% of the people dependent on agriculture and animal husbandry for their livelihoods. Out of the total number of land holdings, 68% belong to small and marginal farmers who have less than two hectares of land. Majority of these farmers are highly dependent on the monsoon rains and modern agricultural practices for efficient water use have not been adopted. The magnitude of the problem

has increased manifold, due to erratic rainfall patterns and with the increasing demand for the use of water due to population growth; both for domestic and irrigation needs, leading to over-extraction of ground water.

While regeneration of the natural resource base needs immediate attention, communities will need to adapt to the inevitable changes in monsoon patterns; and temperature regimes that will affect agriculture, fodder and livelihoods. Addressing the potential impacts of climate change in the Bundelkhand region requires increased attention on improving the area's ability to adapt to a changing climate; while simultaneously ensuring climate resilient development.

1.2. Response:

Recognising the severity of this problem Haritika, a not-for-profit organisation working in Bundelkhand region for last 20 years, has been working on Integrated Water Resource Management Programme. The innovation in this initiative is the decentralised model designed with community-based approach and uses participatory methods like water budgeting and well-monitoring to formulate action for development.

The initiative of Haritika with the support from Water Aid, is working on improving village level water security. In this intervention, Haritika followed a stepwise process starting from community need analysis; through participatory water budget survey, then moving towards a collective planning for utilisation of water.

Geographically, this project is focused on Mahoba district of Uttar Pradesh and Chhattarpur district of Madhya Pradesh.

2. Objectives

The key objective of this initiative is to demonstrate a community based model for improving water security in Bundelkhand region with a sustainable approach. Through this model Haritika aims to strengthen watershed management in the region and build capacities of local community to utilise water resources efficiently.

"A decentralised development intervention focusing on participatory approaches to formulate action for development enhance community engagement in the process"

3. Approach

Haritika's programme followed a community based model for ensuring sustainable access of drinking water facilities; in water stressed Bundelkhand region. The diagram explains the framework of intervention, carried out by Haritika for Integrated Watershed Management.

4. Key Components and Key Stakeholders

The key components of this watershed programme included the following key aspects:

A hydrogeological survey was undertaken to identify best locations for drinking water extraction, where there would be minimal interference from agricultural wells. Drinking water is pumped to storage in the villages for

Catchment/village level water security framework

distribution to tap stands and household connections. Groundwater levels are continuously monitored in the areas, where drinking water supply extraction takes place, to assess the impact of the recharged dams. The ongoing component of this initiative involved water budgeting after the monsoon rains have fallen. This will give the villagers a rough estimate of how much water is available, by using a visual grade scale in dug wells indicating the height of water column in the well.

Sub-catchment based activities: This included integrating physical watershed and administrative boundaries. Under this, only a part of catchment is taken to ensure sustainability of drinking water sources. Drainage line treatment within a hydrological boundary has helped to maximise the impact of recharge.

Institutional capacity building: The programme has ensured that the community is aware of the quantity and quality of available water in their villages and understands why water security is critical for drinking water and livelihood. Capacity to manage water resources, and operate and manage the water services was also enhanced by working with

Village Water and Sanitation Committee (VWSC). The former includes monitoring of rainfall and water budgeting, aided by results of technical studies in geology and geo-morphology.

5. Outcomes and Impacts

The major outcomes and impacts observed after this programme, were clearly indicative of progress towards improving water security. Some of impacts observed post-implementation of the project explain how grassroots activities led to a larger change at the community level.

- Since the meagre supply of water through annual rainfall is insufficient to meet the irrigation, domestic and drinking water needs; construction of check dams becomes very important to encourage infiltration of surface run-off. Construction of check dams on course of Bharad River reduced the flow velocity and augmented soil water and ground water recharge. The drainage line treatment carried out on three secondary streams has led to sustain 8 water supply schemes in the area. This decentralised network of water harvesting structures has proved to be more effective than a single large structure, in augmenting ground water recharge.
- The present programme created a transparent system of financial transaction where bank accounts are opened at local level and operated by the Village Water and Sanitation Committee (VWSCs). The cost and contributions are shared in the village meetings. Haritika also ensured that a community based procurement process is followed in all villages. Efforts were also made to make water supply a low cost investment so that community can afford its maintenance.
- Earlier, the 14 project villages had acute water scarcity, and women and children often spent considerable time fetching water. Now, a projected population of 13,000 people is assured of water supply to meet their drinking and domestic needs. A convergence of water conservation measures and community participation has been the key success of this project and is an answer to the drought prone and water stressed Bundelkhand region.

© Haritika

Measuring water levels in a dug well

There are some examples of how this IWRM programme has impacted soil water conservation, groundwater augmentation and artificial storage interventions aimed at addressing water stress. Communication and

awareness raising techniques have a good influence on people. Due to the uncertain and different pressures on their water resources and their potential impact on household incomes and food security; communities have an interest in the availability and management of the water resources.

6. Lessons Learnt

Some of the key components of this programme like water budgeting, setting up of observation wells, construction of water recharge structures etc. helped the communities to plan, build, monitor and maintain systems for effective water usage. This is a significant move towards building climate resilient communities; where they are aware, incapacitated and enabled to handle climate change impacts. This programme by Haritika has yielded some very important learnings for watershed management such as:

- Improved irrigation efficiency and self-regulatory norms for water utilisation is important to achieve water security as a whole.
- The training of Village Water and Sanitation Committee (VWSCs) helps in proper implementation of the programme, and sustainable operation and maintenance of water supply schemes. Community contribution plays an important role in ensuring participation and ownership among the community members.
- The present programme approach also indicates that the drinking water crisis cannot be addressed in isolation. Broader issues of source sustainability, water quality and sanitation must be taken into account. The present project reaffirms the belief that assured water supply can lead towards better usage and coverage of sanitation and improved hygiene behavior.
- The assured water supply at household level indicates that giving communities a reliable source of water; frees women for participation in other productive activities. Adequate quantity of sustainable and safe water supply also ensures personal hygiene and improved maternal and child health.
- One of the major challenges in the area is to bring in self-regulatory norms at farmers' level, to opt for lower water use crops in low rainfall years as part of the system. Therefore, introduction of tools like water budgeting and monitoring of wells facilitate community to understand the demand and supply side management of water resources, and accordingly adopt self-regulation.

From Information to Knowledge and Action

Key Messages:

- Community radios are an effective mechanism to build climate resilience of the community.
- Community radio reporters trained in climate change journalism can be a strong interface medium between communities, scientists and government officials.

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1. Context

1.1. Need:

With illiteracy being rampant, rural communities in Bundelkhand have an extremely low climate change risk perception and are also quite resistant to change. Research shows that simple adaptation actions such as watershed management, changing planting dates and crop varieties could greatly reduce the climate change impacts. However, communities being poorly linked to scientists and policy makers lack information about climate change adaptation options and government schemes related to the same. There are also challenges of communicating scientific research in simplified ways that are appropriate to local stakeholder needs.

1.2. Response:

Development Alternatives initiated a pilot project, named Shubh Kal (a better future) - From Information to Knowledge and Action. This project was implemented in the drought prone, climate sensitive region of Bundelkhand in Central India in 2012 -2013. Supported by Climate and Development Knowledge Network (CDKN), this initiative aimed to test a communication model on the ground, to see if community radio reporters can be an effective link to bridge the knowledge gap on climate change adaptation between the farming community, scientists and policy makers. In June 2012, this initiative was formally launched with four community radio stations (Lalit Lokwani, Radio Dadhkan, Chanderi Ki Awaaz and Radio Bundelkhand) in and around the Bundelkhand region.

2. Objectives

The key objective of Shubhkal project was to pilot a participatory engagement methodology for supporting the convergence

of radio with climate change science; to strengthen communication and community voices in knowledge sharing for climate change adaptation. It included the following aspects:

- Built capacities of local community radio journalists in climate change reporting .
- Trained community radio reporters to bridge the climate change knowledge gap between communities, scientists, local government officials and policy makers.
- Strengthened community knowledge and voice on climate change impacts and adaptation by enabling communities to share their experiences in coping with and adapting to climate change.
- Increased awareness of the scientific community, local government authorities and policy makers on how climate change is impacting local development.

"Community radios are an effective mechanism for building climate resilience of the community"

3. Approach

The methodological framework was based on testing a pilot model for climate change communication between communities, scientists and local government officials at the grassroots level.

This figure describes the ecosystem for climate change communication at the state and district level in India. Nodal scientific agencies, government planning departments and district planning committees are expected to work together, to integrate climate change concerns in the development planning process of the state. This is facilitated by state level nodal agencies for climate change adaptation such as the State Action Plan on Climate Change (SAPCC); which devise appropriate adaptation guidelines for the various states.

4. Key Stakeholders

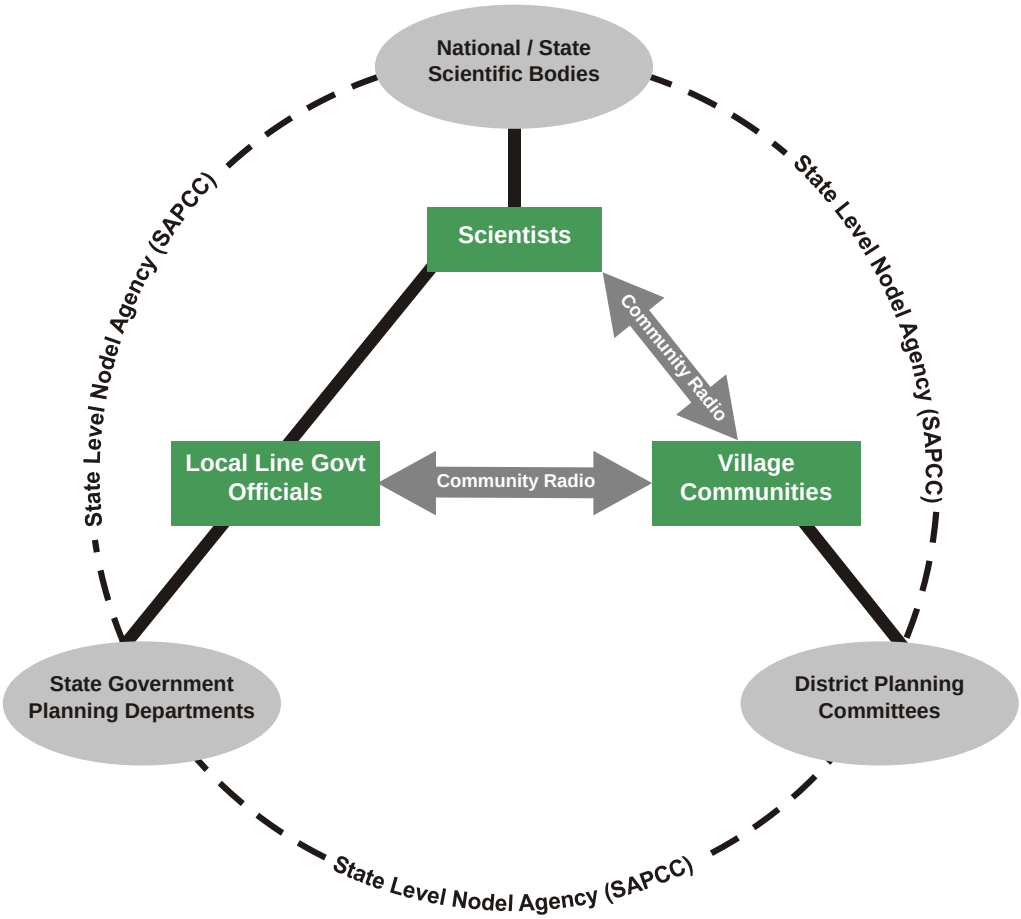
In this pilot project, four community radios (Radio Bundelkhand, Lalit Lokwani, Chanderi Ki Awaaz and Radio Dhadkan) from four different districts in the Bundelkhand region; partnered to link key stakeholders and bring local experiences and priorities on climate change and development to the forefront of the community-science-policy dialogue.

5. Key Components

A baseline research on climate change communication covering the main stakeholders (scientists, policymakers, farmers and local community radios) was conducted.

Capacity building of 35 radio reporters in climate change journalism through a series of training workshops was done to:

- Familiarise reporters with the fundamentals of climate change causes and impacts at the global, national and local levels.
- Improve their journalistic skills through creative tasks such as conducting mock interviews, producing radio plays and short radio stories .
- Teach them how to make interesting and informative climate change radio programmes.



Climate change communication ecosystem

Facilitation of stakeholder engage-ment at the grassroots by creating dialogue between local communities, scientists and local line department officials on climate change issues; through the process of developing radio programmes, in which all stakeholders were interviewed and their views and concerns communicated to each other.

Production of radio programme: Each of the four participating radio stations produced 12 radio programmes on climate change issues. This process included identification of topics and themes for the radio shows, depending on the issues facing their communities; interviews of scientists and government officials and converting this scientific information into simple and easily comprehensible messages using an edutainment approach and local dialects.

Broadcast of 12 radio programmes on climate change issues in their respective districts (reaching out to about 100 villages per district. All the 12 radio programmes were narrow-casted in 30 villages each of all the 4 districts i.e. total of 360 narrowcasting sessions were carried out to increase listenership and get direct feedback).

It communicated voices of the vulnerable communities and findings of the pilot study to the state and national level policy makers and scientists; through the participation of radio reporters in 3 multi- stakeholder regional workshops and 1 national workshop.

6. Outcomes and Impacts

i. Strengthened community knowledge and voice on climate change impacts and adaptation by enabling communities to share their experiences in coping with and adapting to climate change: The pilot project 'Shubh Kal – From Information to Knowledge and Action' sensitised the farming communities of Bundelkhand regarding the need to adapt to the changing climate. The listener groups found that the information provided in the radio programmes was valuable to them and such shows should be encouraged in the future.

Community members became familiar with new options and government schemes related to climate change adaptation such as line sowing, drip irrigation techniques, water harvesting measures, soil testing, organic composting methods, drought resistant seed varieties, subsidies on constructing farm ponds, subsidies on bio gas plants etc. The project reached out to more than 400 villages bringing awareness on climate change issues amongst more than 4 lakh villagers within Bundelkhand region.

ii. Capacity building of community radio reporters' climate change reporting and advocating on climate issues: The Shubh Kal initiative was fairly successful in building capacities of radio reporters from the four participating community radio stations in climate change journalism. The findings clearly indicated that designing capacity modules; which impart both practical and theoretical experience to the reporters are effective in building their capacities and enhancing their knowledge and skills with respect to climate change communication.The climate change reporting capacity building workshops held at the beginning of the pilot project proved to be very useful as it:

- Provided them with an understanding of climate change issues that were affecting the rural communities in Bundelkhand.
- Improved their technical skills such as how to conduct interviews, the kind of questions to ask etc.
- Enhanced their journalistic skills and teaching them how to make interesting climate change stories and programmes.
- Introduced the radio reporters to new methods of group learning.

© DA

Community radio reporters presenting show on climate change

iii. Bridged climate change knowledge gap between farming communities, scientists, local government officials and policy makers.

7. Lessons Learnt

- This pilot project created a new space for dialogue between communities, scientists and local government authorities; to exchange information about climate change impacts and advocated responses which address local communities' needs.
- Community radio reporters trained in climate change journalism have proved to be a strong interface medium between communities, scientists and government officials. Since the radio reporters belong to the community, farmers found it easy to communicate their concerns and queries to them. The scientists and government officials found interacting with the radio reporters useful; as they receive an improved understanding of the communities' perceptions, information needs on climate change issues and how climate change impacted local development. In future, this information will help them design more locally relevant adaptation strategies.
- The involvement of community radios in sensitisation of climate change concerns and adoption of adaptation measures can be scaled up in different climate sensitive regions to bridge the knowledge gap between communities, scientific organisations and decision makers to achieve climate resilient development.

A farmer sharing his concerns with community radio reporters

Population	As per 2011 census, Odisha has a population of 41,947,358. It ranks 11th in terms of population in India[1].
Climate	The state experiences three meteorological seasons: winter (January to February), pre-monsoon season (March to May),south-west monsoon season (June to September) and north east monsoon season (October-December).[2]
Climate Vulnerabilities	Changing weather pattern, rising temperature, high variability of rainfall, drought and dry spells, flash floods
Average Annual Rainfall	1521.6 millimetre[3]
Economy	Odisha 's economy is mainly based on agriculture and livestock.

[1] *2011 Census of India*

[2] *"Geography of Odisha".Know India. Government of India.*

[3] *District-wise monthly rainfall data from 2004-2010 for the whole of India by Indian Meteorological department from www.indiaportal.org*

Odisha is an Indian state, lying on the subcontinent's eastern part. It also has approximately 480 km of coastline stretched across Bay of Bengal on its East. The state varies in climate vulnerability from moderate to highest levels in pockets. It is a multi-hazard disaster state impacting lives and livelihoods of the population. The agriculture sector is particularly vulnerable to the vagaries of climate induced weather changes. Odisha remains one of India's poorest states and it is tied to low agricultural productivity. Climate change is predicted to impede poverty alleviation. The direct impacts could include loss of life, livelihoods, assets, infrastructure etc. from extreme events[1].

[1] *http://www.moef.nic.in/sites/default/files/sapcc/Odhisa.pdf*

Reliance to Resilience

Key Messages

- Diversification of livelihoods to less climate sensitive sectors facilitate building resilience of the community to climatic impacts.
- Participatory approach to development facilitates to build relationships between the key stakeholders for sustaining development interventions.

© WORLP

1. Context

1.1. Need:

Western Odisha is home to some of the poorest communities in India. The habitat of the region is fragile with erratic rainfall causing crop failures. The communities are highly vulnerable to climate change and entangled by issues of inequitable social structures, land distribution, access to resources and indebtedness. The geographically high-risk location and poverty hamper the capacity of the locals to cope and recover from stresses and shocks.

50 years of meteorological data was analysed and illustrated a number of climate risks associated with the region:

- High variability of rainfall, leaving people with two peak periods of food shortage in the region.
- Drought and dry spells at an interval of every 2 years, with a major drought every 5-6 years.
- Flash floods during the rainy season.

A rise in mean temperatures has been recorded in the areas of intervention, and has been recognised as one of the areas of highest risk and vulnerability in the country.

1.2. Response:

To help overcome these dreadful circumstances, the Western Orissa Rural Livelihoods Project (WORLP) was introduced in the Bargarh, Bolangir, Kalahandi and Nuapara districts of Odisha. The intervention strived to address the issues of abject poverty and the adverse impacts of climate change, to strengthen peoples' existing capacities by introducing a variety of livelihoods initiatives and enhanced the access to resources to help diversify the asset base (including financial, human, physical, social and natural) of the villages.

The project was mainly targeted at empowering the poor. It aspired to make long - term investment to help change the way local government tackles development; make processes more participatory in nature and build partnerships between Government and NGOs.

"Diversification of livelihoods to less climate sensitive sectors facilitate building resilience of the community to climatic impacts"

2. Objectives

The overall aim of WORLP is to alleviate poverty and reduce vulnerability. The main objectives are:

- Build structures and processes that develop community skills and confidence, enabling them to articulate their needs and demand improved services.
- Enable the poor and marginalised to become actively and effectively involved in planning and development.
- Promote equity between socio-cultural groups and empower rural women.
- Promote farm and non-farm enterprises that improve income, employment and nutritional security, relieve the debt burden, and encourage savings.
- Improve management of common property and the fair distribution of its benefits.
- Promote local technology that responds to specific needs, including the particular needs of women.
- Help communities and local service providers – government or non-government - to use modern participatory methods for planning, implementation, monitoring and evaluation.
- Help create an environment that promotes pro-poor policy change.

3. Approach

The Western Orissa Rural Livelihoods Project was conceived using the Sustainable Livelihoods Approach (SLA). This approach provided a framework that helped understanding the complexities of poverty and a basic set of principles to guide action, to address and overcome poverty. SLA also sets people at the centre of any intervention designed.

Therefore, the basis of this project was not climate change adaptation or improvement of environmental conditions, but it was based on providing opportunities and support the communities, to overcome their constraints.

However, this does not imply that the outcomes of the initiative do not cover these issues. Despite this approach, the asset levels of the poor and their ability to cope with hazards have improved.

4. Key Stakeholders

WORLP (The Western Orissa Rural Livelihoods Project) is funded by the Government of United Kingdom (DFID), given technical support by NR International and implemented by the Orissa Watershed Development Mission. It was a multi stakeholder initiative and had the following

organisations on board for their specific expertise:

- Central Tuber Crop Research Institute and International Potato Centre: provided on-farm trials and extension of tuber crops and training of farmers.
- Indo-Swiss Natural Resources Management Programme - Odisha and the Animal Husbandry Department: helped build local level technical skills of selected villagers as community link workers in emphasis on local poultry and small ruminants.
- United Nations Development Programme guided the intensive soil and water works using mechanical measures and training village level 'volunteers'.
- Gramin Vikas Trust and Xavier Institute of Management, Bhubaneshwar supported the management of the Livelihoods Support Teams.
- International Development Enterprises conducted trials and on-farm demonstrations of water management technologies.
- MART provided its expertise in identifying market opportunities for small-scale, low technology, off-farm enterprises and advice on other ways of improving marketing and access to market information.
- BASIX developed micro – finance skills amongst WORLP PIAs, in order to strengthen their support for SHGs.
- Network of Aquaculture centres in Asia - Pacific: Support to Regional Aquatic Resource Management evolved a relevant and poverty – focused aquaculture programme.

© WORLP

Women making homemade artifacts

5. Key Components

- Participatory approach to development: As the problems faced by people is the central focus of SLA (Sustainable Livelihoods Approach), participatory micro planning process were planned between the community, government staff and the implementing team from the project. This was an essential component of the project, as it helped identify the difficulties and obstacles faced by the community. It further facilitated in building relationships between the key stakeholders of the project.
- Diversification of livelihoods: Women and men in the intervention villages were introduced to cultivation of new commodities like mushrooms, onions, fish, silk worms and honeybees. Support was also provided to set up small enterprises for local artisans, especially those without land for agriculture. Furthermore, guidance was provided for

collection and processing of NTFPs (Non Timber Forest Products) and medicinal plants; value addition; and marketing of homemade products.

- Build human capacity: Farmers have been given training to enhance or increase their skillset in a variety of cropping methods, aquaculture, vegetable gardens, agricultural diversification and other income generating activities. This has helped increase resilience of the community to change. Additionally, the increase in livelihood options is a factor that demotivates people to migrate out of the villages.
- Formation of Self Help Groups: Over 4000 Self Help Groups (SHGs) for women have been established during the project to increase social cohesion; collective action and collaboration for creating new livelihood opportunities. The members of the SHGs have been trained with suitable responses for adverse climatic conditions and to manage common property resources. This has also empowered the women and made them more independent.
- Water conservation: With the support of the project stakeholders; extensive soil and water conservation measures were made through community participatory micro planning. Water storage structures were created under this activity to decrease dependence of farmers on unreliable monsoon rainfall for irrigation of crops and cope with drought periods better. Additionally, these structures helped recharge ground water; improve soil moisture; reduce water table fluctuations; check run-off and allowed villagers to initiate pisciculture.

© WORLP

Water harvesting structure

© WORLP

SHG members meeting in a village of Nuapada districts

6. Outcomes and Impacts

The project had multiple impacts on the communities belonging to the four districts. Below are some of the outcomes of the initiative:

- Reduction in the total number of people living below the poverty line and more than 15,000 households were driven out of poverty.
- Community members are now less vulnerable to climate change, as

agriculture is no longer the sole livelihood fetching income. Daily wagers have been given support to enhance their skills. They have improved access to information and are trained to take appropriate action in case of a calamity.

- The communities are participants in the micro planning and decision making of the region, along with relevant authorities. This includes women, people from all castes and the most vulnerable families as well. They are also responsible for managing their local resources and common pool resources. SHGs too have empowered the women.
- Water and soil conservation have reduced sedimentation of water bodies through management of run-off. Groundwater table has risen by nearly 6 metres.
- Migration in the region has decreased by manifolds.
- A variety of crops can be cultivated due to the availability of water for irrigation. Productivity of land too has risen. Farmers can now grow crop for a second time in the 'winter season'.
- Food security in the families increased tremendously and food intake is more holistic and nutritious, as a result of the vegetable gardens.

7. Lessons Learnt

- The SLA (Sustainable Livelihoods Approach) helped improve people's livelihoods, as well as trained them to manage resources better and increase resilience to climate change.
- A project of this nature requires support from government and other agencies.
- Transfer of new technologies to build capacities and strengthen institutions; requires long-term investment in terms of money and time.
- Development of strategies for communities to be self – sufficient and be able to sustain the intervention after the project period is essential.

Optimising Benefits

Key Messages

- Combination of adaptation activities in agriculture, health and water conservation: facilitate reduction of community vulnerability to climate change.
- "One size fits all" is not an appropriate approach to address climate impacts and building resilience of communities.

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1. Context

1.1. Need:

Odisha's population is said to be one of the most poor, possibly a state with nearly equal percentage of families living above and below the poverty line. Odhisa is vulnerable to floods, drought, irregular rainfall, cyclones and other climatic events and it has been noted that poverty is particularly high in the rural areas, where the only means of livelihood is agriculture; an activity that is heavily dependent on the climate.

LEAD-India: A study was carried out in the Rayagada and Gajapati districts of Odisha, to assess the impact of climate change on communities. The research focused to:

- Identify current and future risks to livelihood and health in these areas.
- Assess the impact of climate variability and climate change on community livelihoods and health.

The study concluded that climate variability over time has impacted negatively on the life of poor communities in the area. It highlighted the importance of practicing adaptation activities in agriculture, health and water conservation to reduce community vulnerability.

Tribal communities in Odisha have little knowledge of climate change adaptation, sustainable land and forest use, or new agricultural techniques. Most of those without land are either unemployed or receive low wages from seasonal agricultural work. Nutrition rates are poor and the area is a high-risk malaria zone.

1.2. Response:

Two Districts (Rayagada and Gajapati) from Odhisa were chosen; which had vulnerable, poor and underprivileged communities. The focus was to enhance the livelihood opportunities.

The project aimed to improve food security and incomes of households, through the delivery of a combination of interventions to enhance the capacity of communities in farm and non-farm based livelihood options.

Families, who own farming land, but live below the poverty line were trained in good agricultural practices; while those without any land were given access to training for alternative livelihoods. Information regarding government schemes was provided at regular intervals to communities, so that these can be utilised in an optimum manner. Farmers' Groups and Self-Help Groups (SHGs) were set-up or strengthened, where already existing. This was done to expand the outreach and participation for the project, especially the training and capacity building activities. These activities equip households, groups, communities and local leaders to utilise various Government schemes and build resilience for disasters.

2. Objectives

The initiative aimed at making communities more adaptive to Climate change and sensitive to their impacts on the surrounding ecosystems. The main objectives of the initiative were to:

- Help diversify livelihoods options for the rural tribal communities.
- Try and eliminate the forest slash and burn culture, a tradition in such communities.
- Build resilience in the communities and combat any negative effects of climate change and improve disaster risk mitigation planning.
- Enable tribal households to increase their income and nutritional intake, by increasing their crop yields.
- Build capacities of families to reclaim barren land.
- Strengthen Farmers' Groups and cooperative activities to establish sustainable livelihoods, encourage better natural resource management, enhance their skills base, and foster local market linkages.

© LEAD- India

Damaged maize in a farm post cyclone Hudhud

3. Approach

The approach adopted by LEAD – India was to set up and work through Farmers' Groups and Self Help Groups (SHGs). The idea was not to impose new methods of farming and alternative livelihood option, but to let the groups decide for themselves. Similarly, an attempt was made to get groups, the community or families to pay for purchases (seeds, equipment, etc) made under the project, when possible. This helped communities to value investments made and the sustainability of the initiative, post-project.

Therefore, several of the methods being promoted in these villages were first demonstrated on a smaller patch of land, so that the farmers can witness and be

convinced of the technique or inputs being used.

For non-farm activities too, families were given options to determine what tasks they can undertake, given the locally available resources.

"Combination of adaptation activities in agriculture, health and water conservation facilitate reduction of community vulnerability to climate change"

4. Key Stakeholders

- BIG Lottery Fund: The Big Lottery Fund, under its International Strategic fund, supported the 'Securing Tribal Livelihoods' project to help disadvantaged communities overseas; to tackle the causes of poverty and deprivation and brought about a long-term difference to the lives of the most disadvantaged people.
- LEAD – India: LEAD – India is spearheading the project in Odisha. They implemented the strategies with a local NGO partner, Ekjut. Together, this team has mobilised the communities and sown the seeds of change.
- Community: The communities were the main stakeholders involved. It is for them and only with them that the initiative can get implemented successfully. As mentioned previously, within the communities, Farmers' Groups and SHGs have been formed. Additionally, there is one 'village volunteer' from the community, for a cluster of villages, who is the direct link between the NGOs and the community. They were the source to relay updates and any urgent information between these two stakeholders. The volunteers are also trained to troubleshoot to a certain extent. Having this volunteer also helps build the sustainability of the initiative, once the project period is terminated.
- Government Bodies: The State Horticulture Department provides technical support to LEAD – India, in seed testing and the selection of seeds. Other relevant bodies have also been approached to subsidise technologies; being provided to communities through the project.

5. Key Components

- New Agricultural Practices: Efforts were made to get farmers to adopt organic agricultural practices. It was also noticed with this variety of the maize crop; that it could not withstand the impacts of cyclone Hudhud. Conversely, families that had planted the traditional maize seeds, had healthy maize growing even after the cyclone. Families were encouraged to make compost for the farms from the organic waste produced in houses, such as cow dung and urine, and any destroyed harvest. Farmers were also trained in different agricultural techniques like spiral farming and drip irrigation to use efficiently and conserve natural resources. Farmers that previously had fallow or undulated land were supported to reclaim this land and make it productive. Yam bin was introduced in the region, which does not

require any irrigation once sowed. The produce is sold for approximately Rs. 40/kg, however the seeds are sold for almost Rs. 300/kg, fetching the farmers large margins.

- Non-farm income generation activities: Families, mostly women were trained in income generation activities that do not depend on agriculture or the climate such as like stitching and sewing, hill – broom production, duckery, poultry, mushroom cultivable and pisciculture. Ducks eggs are mainly sold to restaurants in the nearby small towns. Brooms, fish, chicken and chicken eggs are sold within the surrounding villages itself. Women groups have also been given ownership of small shops that store daily essentials like shampoo sachets, soaps, candles, brooms, biscuits and other amenities.
- Seed and grain banks: Community members and groups were mobilised to create grain banks and traditional seed banks in villages to ensure the availability of grain in adverse condition and conservation of traditional seed varieties in community seed banks. A total of 50 grain banks and 29 seed banks were created and are maintained by community members.
- Kitchen gardens: Kitchen gardens were established across all intervention villages to increase vegetable consumption; to ensure nutritional security, especially amongst children and women. Households were supported through the provision of various varieties of vegetable seedlings and seeds, concentrating on indigenous varieties so that farmers can preserve the seed in the seed banks for the next planting season. Farmers have cultivated egg plant, tomato, beans, chilli, cauliflower, leafy vegetables, papaya, drumsticks etc. This intervention has helped families to produce vegetable for their consumption and also earning from sale of excess produce.

© LEAD- India

Duckery: a non-farm livelihood option

6. Outcomes and Impacts

The impacts of the project are positive and visible:

- Increased intake of vegetables in every household.
- Provided women and men with a means of livelihood.
- Increased household income and purchasing power of the family. While, cyclones continue to cause devastation in the region, these events no longer paralyse families.
- Provided secondary sources of income, through the introduction of alternative livelihoods, sustain the family. While efforts are being made to revive agriculture.

With the shift to organic agriculture, the expenditures incurred by farmers for inputs

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Kitchen garden

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Left: Barren land made productive; Right Fallow land being plowed

have decreased tremendously. Although, the modified seeds along with chemicals had a higher productivity, farmers felt the organic harvest was of a higher quality and healthier. Furthermore, several farmers can now harvest crops from previously barren land.

© LEAD- India

Excess beans from a family farm for sale in the market

7. Lessons Learnt

- Through the implementation of this project it was established that multiple types of interventions are required.
- A 'one-size- fits-all' approach is not a good technique. Different individuals have different abilities and it is important to cater to these needs. While some families were very responsive to possessing poultry, others did not want to get into the complication of keeping them. Therefore, it was important to provide them with an alternative. This also increased the diversity in livelihoods, not flooding the market with one kind of product or service.
- To share the learning's and work together on climate change issues a network forum including local NGOs, CBOs, Government department representatives will be established in Rayagada and Gajapati districts. This climate change network will work to create awareness on climate change issues and promote appropriate adaptation practices to reduce communities vulnerability in their area.

Population	As per 2011 census, Sikkim has a population of 610,577, and Ranks 29th in India in terms of population.[1]
Climate	The state has five seasons: winter, summer, spring, autumn, and a monsoon season between June and September. Sikkim's climate ranges from sub-tropical in the south to tundra in the north.season (June to September) and north east monsoon season (October-December).
Climate Vulnerabilities	Changing weather patterns and rising temperatures, water scarcity, spatial variation in rain fall, increase intensity of extreme rain fall.
Average Annual Rainfall	2756.3 millimetre[2]
Economy	Sikkim's economy is largely agrarian, based on the terraced farming of rice and the cultivation of crops such as maize, millet, wheat, barley, oranges, tea andcardamom.[3,4]

[1] *2011 Census of India.*

[2] *District-wise monthly rainfall data from 2004-2010 for the whole of India by Indian Meteorological department from www.indiaportal.org*

[3] *Dutt, Ashok K.; Baleshwar Thakur (2007). City, Society and Planning: Society. Concept Publishing. p. 501. ISBN 81-8069-460-7.*

[4] *Bareh 2001, pp. 20–21.*

Sikkim is a northeastern state of India landlocked in the Himalayan range. It is home to one of the world's highest peaks, Kanchenjunga. Like most of the Himalayan region, Sikkim is rich in beautiful springs, lakes, mountains, deep valleys and biodiversity; making it a sought after tourist destination. Water is one of the most important sectors on which climate change (increase in temperatures, evapo-transpiration, spatial variation in rain fall, increase intensity of extreme rain fall and drought events) can have a profound impact, which in turn can have cascading impacts on other sectors. The agricultural sector is highly dependent on the climate, and given the low productivity increase of the last few years compared to population growth, climate change is likely to have serious consequences for Sikkim's agriculture[1].

[1] *http://www.moef.nic.in/sites/default/files/sapcc/Sikkim.pdf*

Spring Revival

Key Messages

- Springshed development under MGNREGA revived the drying spring facilitated co-benefit for communities dependent on springs and streams for domestic and cultivation purposes.
- An innovative mechanisms of using scientific methodology (geohydrology) with decentralised decision making facilitated in success and sustainability of the initiative.

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1. Context

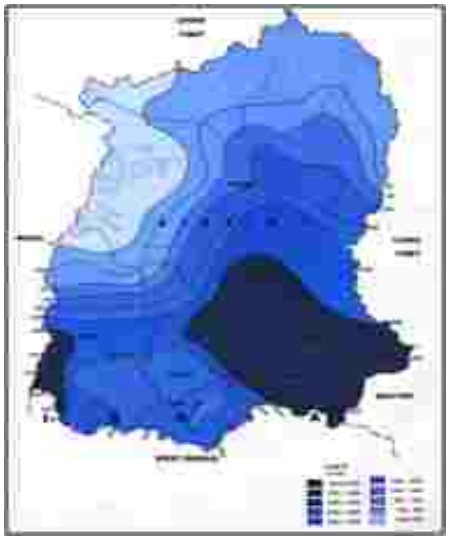
1.1. Need:

Long-term reliable data from Gangtok indicates that the temperature in Gangtok has been rising at the rate of 0.2^0 Celsius every year, with the annual rainfall increasing at the rate of nearly 50mm per decade. Due to climate change, the monsoon rains are erratic coming in at shorter bursts and the winters are becoming longer, warmer and drier. Over the decade, increasing instances of springs drying up or becoming seasonal, with reduction in lean periods have been reported.

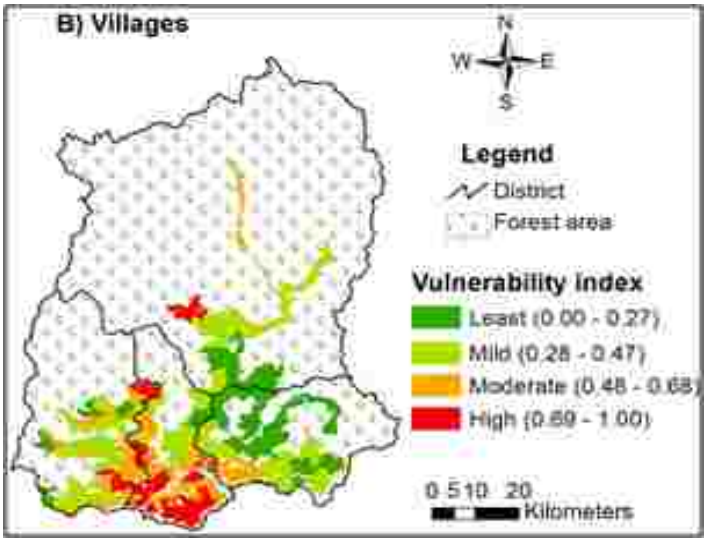
With the growing population and increasing temperatures; issues of top soil erosion, sporadic rainfall patterns, deforestation, development activities, etc. springsheds which used to comprise of well-forested catchments are being reduced to few trees or bamboo clumps. Even though the rainfall during monsoons is essentially adequate, the high surface run-off causes hindrance in the natural ground water recharging. Less than 15% of the rainwater percolates down to recharge the springs, while the remaining just flows down as run-offs. Further, in South Sikkim most of the villages are situated in the upper catchments, while the reserve forests are situated in the valley along the riverbank; thereby, reducing their rainwater harvesting potential. Access to rivers, Teesta and Rangeet is difficult due to steepness of the slopes. Thus, the rural people are almost entirely dependent on springs for their livelihood.

With winters being drier than usual, little or no rainfall occurs during the lean period of

[1] *http://sikkimforest.gov.in/climate-change-in-sikkim/1-chapter-Climate%20Change%20Synthetic%20Scenario%20over%20Gangtok.pdf*



Rainfall Variation



Vulnerability Index

November to April causing severe water shortage. The springs are drying up as their aquifers are not getting adequately recharged and consistent winter droughts are further affecting the soil moisture retention. Being located in the rain-shadow of the Darjeeling Himalayas, it receives only 150cm of annual rainfall, which is much less than the 250cm or more received in east and North Sikkim. Increasing studies have indicated that spring discharge shows strong response to rainfall patterns, while a healthy catchment is vital for a good discharge of the springs. South Sikkim suffers from various vulnerabilities, which adversely impact the groundwater recharge of the region.

Considering that agricultural and horticultural activities is the main source of livelihood for the rural population of Sikkim and the quality of the spring water is at acceptable standards for drinking water; there is a desperate need to revive the perishing springs of South Sikkim.

1.2. Response:

To address the scarcity and vulnerability of the people of Sadam block, South Sikkim, Rural Management and Development Department (RMDD) with funding support from MGNREGA initiated the Dhara Vikas Programme (Spring-shed Development). It is modelled with idea of reviving and protecting the spring's catchment area and essentially recharging its aquifer.

2. Objectives

- Recharge the ground water to increase the discharge of springs in Sadam block.
- Tackle the problems of water scarcity faced in the region.
- Empower and protect the livelihood of the beneficiaries.

3. Approach

The initiative started with collecting data regarding the number of springs that had dried up or were drying up. Analysing the gravity of the issue, the new scientifically proven artificial method of ground water

recharging was coined and implemented in a decentralised manner through the Gram Panchayat Units. The project was conceptualised in 2008, when the drastic effects of climate change were in the forefront. 2009 was dedicated to capacity building and 2010, the first project was implemented and monitored.

"Springshed development under MGNREGA to revive the drying spring facilitated co-benefit for communities dependent on springs and streams for domestic and cultivation purposes"

4. Key Stakeholders

Government:

- Rural Management and Development Department: Facilitated and guided the initiative.
- MGNREGA: Provided support for funding and labourer to work on the initiative.
- Department of Forest, Environment, and Wildlife Management: Granted permission to carry out the task of digging trenches/ponds in the hilltop forests.
- Department of Science and Technology, and Climate Change: Studied the climate change in the state.
- ISRO, Department of Space: Installed Automatic Weather Stations (AWS) to record the weather parameters, like temperature, rainfall, etc.

NGOs/Institutions:

- ACWADAM, Pune: Supported in knowledge sharing, technical guidance, and research
- Arghyam, Bangalore: Supported in knowledge sharing, technical guidance, and research
- WWF India: Provided capacity building opportunities

Communities:

- Locals: The beneficiaries of the initiative, who got access to water through gravity pipelines.

5. Key Components

The technology behind the Dhara Vikas Programme is to slow down the movement of water down the slope adequately, in order to ensure water percolation into the soil, as well as recharge of spring aquifers. The construction of the artificial recharge structures is essentially easy. The technical challenge lies in the accurate identification of the spring recharge area, while taking into account the type, structure, and orientation of the rocks. For this entire process the geohydrology technique is adopted, that takes into account the type and structure of the rocks along with the nature and geometry of the underlying aquifers. This method provides high levels of accuracy, as it deals with the distribution and movement of groundwater in the soils and rocks mainly in the aquifers. Artificial recharge methods were taken up on the sloping lands, comprising mostly of rows of staggered contour trenches and ponds.

The installation of trenches and ponds in

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Water harvesting structures

barren lands of the forest hilltops, gives rainwater a place to stagnate and percolate down into the ground. The trenches were dug 6 feet by 3 feet, with a depth of 2.5 feet along the contour lines. The trenches are staggered between contours to ensure maximum collection of runoff water. Similarly, ponds are dug 10 feet by 10 feet, with a depth of 2.5 feet. The vertical gap between trenches and ponds were kept according to the degree of the slope. Furthermore, a critical criterion is that if the slope was greater than 50 degrees, no trenches or ponds are dug. On the other hand, plants were planted in hedgerows to slow down the flow of water. Mechanical and vegetative measures were taken along with social measures such as bans on grazing, firewood cutting, and fencing of the recharge area.

6. Outcomes and Impacts

Impacts in South Sikkim – Sikkim's Dhara Vikas programme has:

- Covered 7 hill top forests in South Sikkim (namely: Simkharka, Sadam, Tendong, Maenam, Gerethang, Chakung, and Sudunglakaha.
- Revived 55 springs in Kaluk, Rhenock, Ravangla, Sumbuk, Jorethang, and Namthang areas.
- Recharged 1,035 million litres of ground water annually in the last 4 years.
- A total investment of Rs.250 lakhs was made in the last 4 years.

Impacts in Sadam Block – The Dhara Vikas programme in Sadam block of Sikkim has:

- Recharged 150 million litres of ground water.
- A total of 10,000 trenches and 2500 ponds dug in the 100-hectare hilltop forest land of Sadam Block.
- A total investment of Rs.20.88 lakh were made in the last 4 years.

Name of spring	Spring discharge, May 2011 (LPM)	Spring discharge, May 2013 (LPM)	Increase in discharge (LPM)	Number of dependent households
Nagal Dhara	8	13	5	98
Aiman Dhara	3	5.9	2.9	17
Dewarey Dhara	13	23.1	10.1	199
Lungaley Dhara	7	7.9	0.9	30

Table shows the impact of springshed development

- Benefitted nearly 500 households in the three GPUs in Sadam.
- Revived a total of 21 springs.
- The water from the springs is now directly connected households through gravity based piped systems.

7. Lessons Learnt

- Buoyed with the success of this new water conservation programme, this initiative has been initiated in other regions of South Sikkim, as well as West and East Sikkim.
- This initiative showcases how local communities can be empowered to take decisions locally and subsequently; enable decentralised way of execution, best suited for sustaining rural livelihoods.
- Based on the success of the pilots, spring shed development was added to the list permissible works of MGNREGA, the national flagship programme in 2012.
- Sikkim's Dhara Vikas programme has not only been successful in reviving the rain-fed springs and streams, but has also set an example for teams from WWF Nepal, Bhutan Government, Arunachal Pradesh Government are looking at this approach for revival of springs.

Sources:

http://www.sikenvis.nic.in/writereaddata/web-Sikkim%20Census%202011%20Data.pdf

http://www.sikkimsprings.org/dv/Educational%20research/South_sikkim.pdf

Lake Revitalisation

Key Messages

- Lake revitalisation, a successful initiative recharged the ground water along with promoting eco-tourism.
- Convergence with a national flagship programme, MGNREGA revitalised local water resources and facilitated building resilience of local communities.

1. Context

1.1. Need:

Amidst the high mountains of the Himalayas and picturesque rivers and streams, the North-Eastern state of Sikkim is rich in flora and fauna. With only around 10-15% land available for cultivation; the main source of livelihood in Sikkim is agriculture, horticulture, and animal husbandry. Lakes, streams, and springs essentially form the main source of water for rural households.

However, drastic changes in climate with it have brought about a change to all the natural resources. Due to increasing temperature over the years, the already drought prone area of south Sikkim has become more averse to water scarcity. With the temperatures rising at the rate of around 0.2^{0} Celsius per year, the monsoon rains have become sporadic, while the winter rains have become scanty. The springs and lakes while decreasing in their discharge over the years have in many places dwindled away. Lake Doling, which used to be full of water a few decades back, had turned into a marshy land. This severely affected the natural ground water recharge of the region and further, reduced the flow to the aquifers of the springs in the peripheral areas.

Apart from the climatic changes affecting the flow of springs; the 2011 earthquake in Sikkim caused the spring sources to change its location, as a result they got blocked. Since 100% of the rural population was dependent on spring water for their day-to-day and

[1] *Cheerapunji is credited as being the wettest place on Earth*

[2] *http://www.ehsst.org/PL00702-376.pdf*

[3] *http://sikkimforest.gov.in/climate-change-in-sikkim/1-chapter-Climate%20Change%20Synthetic%20Scenario%20over%20Gangtok.pdf*

cultivation purposes, lack of access to spring water were causing grave hindrance in their lives. Women had to walk for 2-3 km to collect water from neighbouring sources; especially, during the lean period of November to April.

1.2. Response:

The resurrection of Lake Doling was made possible by a unique attempt of the government of Sikkim, to ensure that this once seasonal lake now has water throughout the year. In order to provide a solution to the problem of water scarcity while sustaining livelihoods, Rural Management and Development Department (RMDD) with funding support from MGNREGA initiated the revival of Lake Doling. In 2008, Block Administrative Centre (BAC), Ravangla with the help of Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), diverted a nearby stream located in the middle of a forest, through a pipe into lake Doling. It is modelled on the concept of increasing infiltration of water to enhance recharging of ground water, essentially recharging the aquifers that feed of the springs.

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Women carrying water during lean period

2. Objectives

- Recharge the ground water to increase the discharge of springs in Ravangla.

© DA

Pipeline used to revive lake Doling

- Promote the lake as an eco-tourism site.

3. Approach

In 2008, an initiative was made to revive the marshy land lying between Kewzing and Barfung, Gram Panchayat Unit of Ravangla. Under the technical advisory of the Rural Management and Development Department, water was diverted from a stream around 300m above the lake through a pipeline into Lake Doling, to replenish water in the lake throughout the year. This stream was not being used by people due to difficulty in accessing it.

4. Key Stakeholders

The initiative was driven at a local level with the following key stakeholders:

- Rural Management and Development Department: Facilitated and guided the initiative.
- Block Administrative Centre, Ravangla: Implemented the initiative on the ground.
- MGNREGA: provided support for funds and labourer to work on the initiative.
- Locals: The beneficiaries of the initiative, who got access to water.

- Department of Forest, Environment, and Wildlife Management: Granted permission to carry out the task of digging the lake.
- Gram Panchayat: Implemented the initiative on the ground.

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Lake Doling, 2008: Pre-revival

5. Key Components

The entire process of resurrection took approximately two years for completion, from 2009 to 2011. Given that the work was carried out by MGNREGA stakeholders, on the technical side the task was not very intense. The initial steps of the resurrection involved digging of the marshy land up to 40 feet deep to the centre. A pavement was constructed around the dug land. The water was replenished by diverting the water from an upstream into the man-made lake, through pipeline.

6. Outcomes and Impacts

The interaction with local communities of Barfung Gram Panchayat Unit indicated that the revival of the lake has:

- Directly benefitted approximately 80-100 households by a connecting pipeline for drinking and cultivation purposes.
- Recharged ground water of peripheral area of about 5-8 km, essentially the gram panchayat units of Kewzing, Barfung, Bakhim, Kyongsha, Banyakhol and Sangmoo.
- Improved livelihoods of the local people, as now they have the opportunity to cultivate various kinds of vegetable like cabbage, beans, spinach, cardamom, etc. and they are able to sell them in the rural product market of their gram.
- In the Banyakhol ward, the National Hydroelectric Power Corporation has access to the continuous flow of water due to increased spring water discharge.
- The cardamom field located in the area of Barfung is now flourishing due to the ground water recharge of the vicinity.
- The project was completed within an amount of Rs. 1,68,264 the sanctioned amount for the project was Rs. 2,88,232.

© DA

Lake Doling, 2011: Post-revival

Since the water of the stream never dries up, Lake Doling today, has become perennial and

lasts throughout the year. Lake Doling has emerged as an added retreat to those visiting the nearby monastery. The concept of resurrecting Lake Doling has been seen in the revitalisation of four other lakes in Deythang (2010), Nagi (2011), Karthok, and Datum.

"Lake revitalisation was seen as a successful initiative to recharge the ground water along with promoting eco-tourism"

7. Lessons Learnt

- The presence of the monastery near the lake was initially seen as a bottleneck to the project. The cultural barrier within the locals, and the mind-set that the lake is holy, caused problems for initiating the process of renovating the lake. To tackle this barrier, a Monk was called to preach the locals regarding the benefits of the lake. However, the potential of converting the lake into a fisheries business is on a standstill.
- Revitalisation of the Lake Doling is an excellent example to ensure resilient and replicable methods for controlling the adverse impacts of climate change.
- Introducing methods of lake revitalisation in other states, through a flagship programme under MGNREGA is an aspect that can be promoted.

Source:
http://www.indiawaterportal.org/articles/springs-hope-film-revival-dying-springs-sikkim

Sowing Resilience

Key Messages

- Traditional adaptive management system combined with new scientific approaches have potential for improved ecological health, and socio-economic well-being of vulnerable communities.
- Convergence of different departments facilitated improvement of livelihoods of climate vulnerable societies.

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1. Context

1.1. Need:

Around 57% of the total cultivated land in Sikkim is covered by horticulture crops and about 70 % of the horticulture farmers are marginal and small. With the temperatures rising at around 0.2°C[1] per year, the monsoon rains have become sporadic, winters have become warmer and the winter rains have become scanty. This has affected the year-long availability of water for agriculture and horticulture. The impact has been worse in the drought prone areas of South and West Sikkim. Unseasonal climate occurrences have caused serious depletion in ground water and this has affected the flow of water from the basic sources, i.e., springs, streams, etc. Furthermore, rapid spread of various fungal and bacterial diseases affecting cash crops has become more prominent since the onset of climate change.

Large-scale production of paddy crops has seen a reduction in production, due to water scarcity in the region coupled with increasing climatic changes. The lack of constant flow of water has affected the sowing period of rice; thereby, taking a toll on the yield period of the crop. Similarly, the production of water intensive crops like maize and wheat has witnessed a reduction in production, due to increasing water scarcity[2]. Large cardamom locally called *alainchii* is believed to be one of the oldest spices known[3]. A large section of farmers in North Sikkim and most parts of Sikkim are engaged in large cardamom cultivation. This traditional adaptive

[1] *http://sikkimforest.gov.in/climate-change-in-sikkim/1-chapter-Climate%20Change%20Synthetic%20Scenario%20over%20Gangtok.pdf*
[2] *http://www.fao.org/fileadmin/templates/giahs/PDF/Himalayan_System_india.pdf*
[3] *http://nopr.niscair.res.in/bitstream/123456789/2967/1/IJTK%208(1)%2017-22.pdf*

management system has been a potential livelihood support to the farmers; a means to conserve biodiversity, environmental services and ecological health, and social and economic well-being of the people. For years cardamom has been the single most crucial cash crop in Sikkim. Cardamom is a shade-loving plant and the hills of Sikkim provide an ideal environment. Frost and hail-storms are injurious to plants during flowering. Cardamom thrives in moist soil.

"Traditional, adaptive, management system combined with new scientific approaches have potential for improved ecological health, and socio-economic well-being of vulnerable communities"

Over the years, there has been a decline in the large cardamom production due to various factors such as diseases incidence, methods of agricultural practices, lack of quality planting material, socio-economic conditions; absence of proper shade management, lack of irrigation facilities and lack of scientific methods of cultivation. It is probably one of the few crops which is perennial, low-volume, high-value, non-perishable.

The cardamom plantation area in Sikkim has reduced to 12,000 hectares from 24,000 hectares in the last five years due to climate change. Maneybong Sophaka Gram Panchayat in the Dentam Block of West District used to once be a large cardamom growing village. All seven wards under the Gram Panchayat used to cultivate large cardamom as the primary cash crop, which was the main source of livelihood for the rural households. The changing climate with it brought a rapid spread of fungal diseases like colletotrycum that destroyed the entire belt of the cash crop, especially in the Maneybong Sophaka Gram Panchayat in Dentam Block of West Sikkim. The rapid spread of fungal and bacterial diseases destroyed the large cardamom crop in the entire belt and its revival did not succeed for several years. Cardamom though, a less water intensive crop, thrives in moist soil. The ground water, in West Sikkim has reduced over the years, due to lesser rainfall; thus, the soil moisture levels have declined.

The change in the weather is also affecting the production of mandarin oranges and banana; especially, the plantations in South Sikkim between 2000-3000 feet altitude, primarily due to increasing cases of water scarcity.

1.2. Response

Unlike the traditional practice of growing cardamom as an agro-forestry crop under the shade of trees, the villager adopted the new practice of growing cardamom in dry fields, which were more accessible for tending, applying manure and winter irrigation. In order to promote growth of orange and banana cultivation in south Sikkim, seedlings were distributed to the farmers along with providing them access to water storage tanks.

2. Objectives

- Revive and enhance horticulture in South and West Sikkim through adoption of low

water intensive form of cultivation.

- Empower and protect the livelihoods of small and marginal farmers.

3. Approach

Given that more than half of the rural population depends on horticulture for their livelihood security, the Government of Sikkim along with other departments envisaged to help the marginalised and small farmers cope better with the changing climate and simultaneously, adapt to it. A convergence between Department of Horticulture and MGNREGA was formed, where the Department of Horticulture distributed seedlings/saplings of mandarin orange, banana, and cardamom to the local farmers.

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Cardomom field, Dentam

© DA

Pipeline for irrigation

While MGNREGA provided funding and labour to carry out the task.

© DA

Water storage tank

4. Key Stakeholders

- Rural Management and Development Department: Facilitated and guided the initiative.
- MGNREGA: Supported with the funding and labour to work on the initiative.
- Department of Horticulture: Provided the seedlings of orange, banana, and cardamom, along with organic manure.
- Local Farmers: The lands of the local farmers were used.

5. Key Components

- Cardamom plantation

The replantation of cardamom across various lands of the farmers was taken up by MGNREGA in convergence with the Department of Horticulture. In 2011, the Gram Sabha passed a resolution to take up large cardamom plantations in all seven Gram Panchayat Wards of Maneybong Sophaka, with funding support from MGNREGA. Accordingly in June 2011, large cardamom


© DA

Orange field, Melli-Dara


© DA

Banana field, Melli-Dara

plantation was taken up in all the 7 villages, covering 77 hectare on an investment of about Rs. 24 lakh.

Unlike the traditional practice of growing cardamom as an agro-forest crop, the villagers adopted the practice in dry fields that were more accessible to tending, applying manure and winter irrigation. The cultivation of this crop is less labour intensive and involves ploughing (June-July) and plucking (October-November). Essentially, this requires around 120 labour days, per annum per hectare of land. While it is a less water intensive crop, access to water still remains a problem. Water is accessed through springs or streams and via personal pipes. Organic manure is used to strengthen the seedlings, within 2-3 months of planting them.

- Mandarin Orange and Banana

In order to protect and promote livelihood security amongst the farmers in Melli-Dara Gram of South Sikkim, MGNREGA and Department of Horticulture distributed seedlings/saplings of orange and banana to the local farmers. Each household in this gram was provided with a water storage tank, through which the farmers had access to water for irrigation and domestic purposes. The water tanker were refilled through water trucks and it essentially lasted for a week. The bio-manure was also provided by the Department of Horticulture.

6. Outcomes and Impacts

Cardamom plantation all over Sikkim:

- Covered 77 hectare of land with an investment of about Rs. 24 Lakh in 2010.
- Planted 3.50 lakh cardamom seedlings
- Covered 120 farmers.
- The cardamom plants started bearing suckers after two years of plantation, with maximum yield after 3 years.
- By 2013, on an average; a household sold 40kgs of large cardamom at the average market price of Rs. 1100/kg.
- Provided an additional income of Rs. 44,000, per annum per household of the 120 families in the Maneybong Sophaka Gram Panchayat.

Mandarin orange was cultivated in an area of about 6,300 hectares, with a total average annual production of about 17,190 tonnes. While exact data for the Melli-dara gram isn't available, as mandarin orange produce will come only after 4-5 years, the local farmers

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Mr. Buddhiman Limboo

I planted 10,000 cardamom plants in the 2-hectare of land in 2011. The harvest produced about 50 kg of dry cardamom, sold at Rs. 1500/kg helping me earn a profit of Rs. 50,000 this year. I also sold around 14,000 cardamom seedlings at Rs.4/sapling and earned Rs. 56,000.

are motivated and confident about the move from rice paddy to less water intensive farming. One of the banana farmer mentioned that he has made a profit of Rs. 10,000 on the 1 hectare of banana field he owns.

7. Lessons Learnt

- Impact of climate change forced farmers to rethink their livelihood strategy and enabled them to move towards climate resilient agricultural practices. The farmers, who earlier practiced farming of water intensive crops like maize, millet and vegetables; have now changed their cropping pattern over the last two years to cardamom, orange etc.
- Changing to less water intensive cropping has helped communities cope with the problem of water scarcity.
- Introduction to horticultural crops has also helped to increase the production outcomes of the farmers enhancing their economic security.

Population	As per 2011 census, Tripura has a population of 3,671,032, and Ranks 22nd in India in terms of population.[1]
Climate	The state has a tropical savanna climate, designated Aw under the Köppen climate classification. The undulating topography leads to local variations, particularly in the hill ranges.[2] The four main seasons are winter, from December to February; pre-monsoon or summer, from March to April; monsoon, from May to September; and post-monsoon, from October to November.[3]
Climate Vulnerabilities	Changing weather patterns and rising temperatures, cropping patter (. Jhum cultivation can affect forestry). According to a United Nations Development Programme report, the state lies in "very high damage risk" zone from wind and cyclones.[4]
Average Annual Rainfall	2336.7 millimetre[5]
Economy	Tripura is an agrarian state with more than half of the population dependent on agriculture and allied activities. However, due to hilly terrain and forest cover, only 27 per cent of the land is available for cultivation.[6]

[1] *2011 Census of India.*
[2] *"Land, soil and climate". Department of Agriculture, Government of Tripura. Archived from the original on 20 April 2012.*
[3] *"Annual plan 2011–12" (PDF). Department of Agriculture, Government of Tripura.*
[4] *"Hazard profiles of Indian districts" (PDF). National capacity building project in disaster management. UNDP.*
[5] *District-wise monthly rainfall data from 2004-2010 for the whole of India by Indian Meteorological department from www.indiaportal.org*
[6] *"Economic review of Tripura 2010–11" (PDF). Directorate of Economics and Statistics, Planning (Statistics) Department, Government of Tripura. pp. 8–10.*

Tripura is a state in Northeast India. Its capital is Agartala and it is the third-smallest state in the country. Due to its geographical isolation, economic progress in the state is hindered. Poverty and unemployment continue to plague Tripura, which has a limited infrastructure. Most residents are involved in agriculture and allied activities, although the service sector is the largest contributor to the state's gross domestic product. Vulnerabilities arising out of climate change are multidimensional in nature. One sector can compound the vulnerability in the other (e.g. Jhum cultivation can affect forestry). Changes in Tripura's biophysical environment due to the Climatic variability can alter the stable dynamic equilibrium[1].

[1] *http://www.moef.nic.in/sites/default/files/sapcc/TRIPURA.pdf*

Diversified Prosperity

Key Messages

- Agro forestry has the potential to contribute to both climate change mitigation and adaptation by enhancing resilience and reducing threats
- Economic diversification facilitates building resilience of communities

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1. Context

1.1. Need:

In the state of Tripura, 60% of the state is under forest cover and indigenous forest dependent communities comprise 25% of the total population. These tribal communities depend heavily on the forest for their daily living and income generation. Due to pressures on these forestlands and shifting (*Jhum*) cultivation cycles has led to depletion of soil fertility and reduction in crop yield.

In addition, errtic rainfall, deforestation and depletion of topsoil are stressors getting serious by the season due to climate change. Producers are also already experiencing noticeable weather patterns outside of climate norms ie. floods in northern Tripura, scanty rainfall in east Tripura district and early onset of winter frost.

Prediction of future climate conditions for the North East include higher summer temperatures, unreliable rainfalls which could lead to heat waves, greater incidences of flash floods and droughts, and onset of insects and weeds earlier not seen in the area. Climate change drives many stressors and interacts with many non-climatic stressors, which make it difficult to forecast the outcomes in one particular direction. There is consensus however, that existing threats like erosion, water availability and pest control are problems that will be exacerbated under shifting climate.

1.2. Response:

There are several methods to bring together a climate change integrated conservation toolbox for these lands and agro-forestry is one such method. Agro-forestry is a scientific system of growing agriculture, horticulture and forest crops on the same piece of land for optimum utilisation of the land. The topography of Tripura is that of undulating lands with hills and valleys that are under forest cover. Agro-forestry is highly suitable

for such lands and for raising crops on the less productive hilly slopes of Tripura and on the lands on which heavy shifting cultivation was practiced.

Agro forestry has the potential to contribute to both climate change mitigation and adaptation by sequestering carbon, reducing greenhouse gas emissions, enhancing resilience and reducing threats, while facilitating migration to more favorable condition in the highly fragmented agriculture landscape. Agriculture is a sector that is most vulnerable to climate change.

"Agro forestry has the potential to contribute to both climate change mitigation and adaptation by enhancing resilience and reducing threats"

2. Objectives

This pilot is a joint initiative of the Uttarayan Agriculure Research Society of Tripura and ICAR (Indian council of Agicultural Research) complex for North-East Hill region, Tripura centre. Some financial assistance has been provided by NICRA. The specific objectives of this joint initiative were:

- Demonstrate an agro-forestry model to the local farmers.
- Conversion of waste land into fertile land.
- Demonstrate sustainability of the model and profitability per hectare.
- Act as a catalyst between research organisations and farmers.

3. Approach

The land upon which this pilot has been initiated is approximately 5 hectares and contains uplands, medium lands and lowlands. This plot perfectly replicates the conditions for Tripura state as a whole and thus forms a demonstrable site for small farmers.

The land was first bought, leveled and tilled with nearby community members under the guidance of Uttarayan and ICAR. These two organisations were also responsible for conceptualising and implementing the project. The planting of the saplings was assisted through by ICAR.

Plowing, maintenance and harvesting of the plants, crops and produce have been done by the community members. Their ownership of the plot of land and its products has been a key component of the approach.

4. Key Stakeholders

Tribal communities living around the area of Nepali Basti, just outside of Agartala were the direct beneficiaries of this pilot project. In addition, the following organisations were the stakeholders in developing and executing the initiative:

- ICAR, Tripura.
- Uttarayan Agricultural Research Center.
- Centre for Forest based Livelihood and Training (CFLE).
- Department of Biotechnology, Tripura State Government.

5. Key Components

The organisation has implemented this pilot to cover approximately 2.5 hectares of land.

Process

The works in the plantation were started in late 2012 all through to mid 2013. In that time duration, most of the input into the plot of land was performed along with the heavy manual labour. The crops were planted, and large pond for water supply was also created.

There was an issue after the first season of planting, where water scarcity was observed during important growing months for Maize. In 2013, the rain was very scanty and the crops suffered. As a direct response to that learning experience, a simple bore well was dug where water was found at 12ft and a lowland pond was created. The gullies and small trenches from around the plot lead to this pond to collect any extra run-off and rain water. At the same time, bamboo was planted in these gullies to break the fast flow of water. Though the maize crop suffered, the pineapple crop which requires little water, grew well during that season.

The lowland plant now contains fish, fed by oil cakes made from leftover crops. The fish are slated to be another source of income by the next season.

Multiple row farming is seen on these hills where high density plantation of pineapples, bananas, maize, lemons, organges, kinnows and mangoes were taken up. This agro technique allows for greater resource efficiency, while in growth phase.

Alley cropping is a technique where widely spaced rows of high-value trees create alleyways for crops. The crop strips alternate between rows. In this case, it is pineapple, ginger, paddy, maize, watermelons, cherra (aram) that are intercropped between main trees of bananas, bamboo, orange, lemon, mango and kinnows. The main crops are planted in strips of two rows, which concentrate the nutrients and intensify the yield. In any vacant gap, dry straw had been

Agricultural land with various techniques visible

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Agricultural land with boundary systems visible

put over the ground to retain moisture and also form a cover over the topsoil.

Another key component of protecting the slope from soil erosion is the practice of contour farming, where the farming and planting of major crops is across a slope, following the elevation contour lines ie. The ruts and plow lines are made perpendicular to the slope rather than parallel, resulting in furrows that curve around the land. These create water breaks that reduce formation of rills and gullies during times of heavy water run-off.

Boundary systems like windbreaks and riparian buffers are seen:

- Windbreaks are rows of trees and shrubs that reduce wind speed. They improve crop yields, reduce soil erosion, improve water-efficiency and protect livestock. Large strip crops of Bamboo and bananas have been planted in gulleys and downstream areas to reduce soil erosion and form the barrier from strong winds and water movement.
- Riparian buffers are strips of permanent vegetation location along or near active water collecting ponds/ditches, where run-off water concentrates. Plantings help stabilise stream banks around the small pond that has been built in the area. Around the pond are gulleys, which leads left over run-off water into the pond, and surrounding the pond are large bamboo plants that hold the soil on the edge.

The goatery made in the same area is an example of Silvopasture system, where the trees benefit the fauna. In this case, upon a slopey upland, a goat shed has been situated, which is in use for 4 months and in the remaining 8 months there are crops on that slope. The trees in use are mango and bamboo and they benefit the goats, as they browse and graze under the trees. In hotter climates, the animals can graze in a cooler shadier environment, and/or also direct eat the lower leaves.

Finances:

- Initial investment:
  - Rs. 25,000 – well
  - Rs. 5,000 – pipes

- Rs. 5,000 – motor
- Rs. 10,000 – pond
- = Total Rs. 50,000 investment for one hectare of land

Active technical support was provided by ICAR Tripura Centre and CFLE. This has helped to prepare bamboo nursery and bamboo plant suckers

6. Outcomes and Impacts

The benefits from agro-forestry models are some which are well studied and completely match the requirements of the topography of Tripura. Since it is a sustainable practice, agro-forestry achieves both mitigation and adaptation objectives, while remaining relevant to the livelihoods of the poor small farmers and also addresses various on-farm adaption needs.

Agro-forestry shows promise for co-delivery of adaptation to and mitigation of climate change through the direct impacts outlined below:

- Improved soil structure and organic matter content.
- Improved soil fertility.
- Economic diversification of farming produce.

Some planted crops were as follows:

- 20,000 pineapples
- 2,000 bananas
- 1,000 lemons
- 400 mangoes
- 200 Oranges
- 50 Kinnows
- 1,000 arecanuts
- 45 papayas

Fishery

- 2.5 mt X 200 mt X 100 mt fishery

Product / Activity	Total Expense (Rs.)	Assistance	Income in FY2014 (Rs.)	Proposed Income in FY 2015 (Rs.)
Infrastructure Creation	6,80,000	1,10,000	NA	NA
Banana Cultivation (Sucker & Fruits)	1,50,000	25,000	70,000 + 5,000	80,000+25,000
Pineapple	50,000	25,000	4,000	1,50,000
Bamboo	20,000	Nil	Nil	25,000 anticipated to be Rs.1,50,000 during FY 2016
Misc Plantations like Orange, Lemon, Mango, Kinnowetc	80,000	30,000	Nil	Production in FY2017
Short term crops like Paddy, Maize, Ginger, Cherra (Aram), Water melon etc	80,000	35,000	30,000	50,000
Goatary	30,000	15,000	10,000 + 14,000 (to be realized)	50,000
Fishery	3,50,000	2,70,000	Nil	1,50,000
Total	14,40,000	5,10,000	1,33,000	5,05,000

The table shows expenses made and income earned from various agro-forestry activities

Goatery

- 1 Ha goat fodder area
- 5 goats with goat house

In addition, it has led to an increased resource efficiency and reduced nutrient run-off on this plot of land following the initiative.

7. Lessons Learnt

- While the farm area does not use fertilisers or pesticides, the project is considering trials with bio-fertilisers and bio-pesticides. To take that thought forward, a nursery of neem plants will be set up in collaboration with the Department of Biotechnology, to study their utility as bio-pesticides and bio-fertilisers.
- Institutional support systems can be of assistance for scalability of the Agro-Forestry model to a larger land area and replicability of the model to other parts of the state.
- Usage of mechanised tools could enhance productivity per person, and allow for expansion to larger tracts of land.

Integrated Investment

Key Messages

- Integrated intervention approach prevents erosion from upstream catchment slopes at the same time preventing sedimentation in downstream water bodies.
- Combining livelihood approach to soil and moisture conservation measures facilitates in better ownership and sustainability of the initiative.


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1. Context

1.1. Need:

The topography of Tripura sees undulating lands with a lot of hilly areas. The rivers that flow from these hills make it downstream with a lot of sediment; river beds have been rising due to continuous siltation. As a result, floods become furious and cause wide disruption to the people and property. Tripura is known to be prone to various natural and human induced disasters, both in recurrent and non-recurrent features. The geographic area is surrounded by Bangladesh and 100 kms from the Bay of Bengal and is prone to high winds and cyclones. Tripura faces recurrent floods during monsoons and flash floods in hilly areas.

The likely consequences of climate change on the soil-water front in Tripura are I) change in rainfall patterns that affect the soil erosion and ii) sudden bursts of rain over small periods of time causing floods. A standard characteristic of climate change is too much water in some places and too little in others. This is seen in Tripura as well; where some locations are prone to flash floods and dry spells also occur during the summer season. Crop cover and forest cover gets affected by intermittent rainfall, which in turn affects the ability of top soil to hold together. This leads to more erosion. There is consensus that existing threats like top soil erosion and water availability are problems that will be exacerbated under shifting climate. In fact, the frequencies of these climate disparities are increasing.

The issues of vulnerability of Tripura to climate change are inexorably linked to the state's location and affect the large indigenous population. 25% of the state's population primarily depends on natural

resources for their livelihoods. The need for a climate mitigation strategy is necessary and there are several ways to bring together a climate change integrated conservation toolbox for these lands. Soil and water management is one of them.

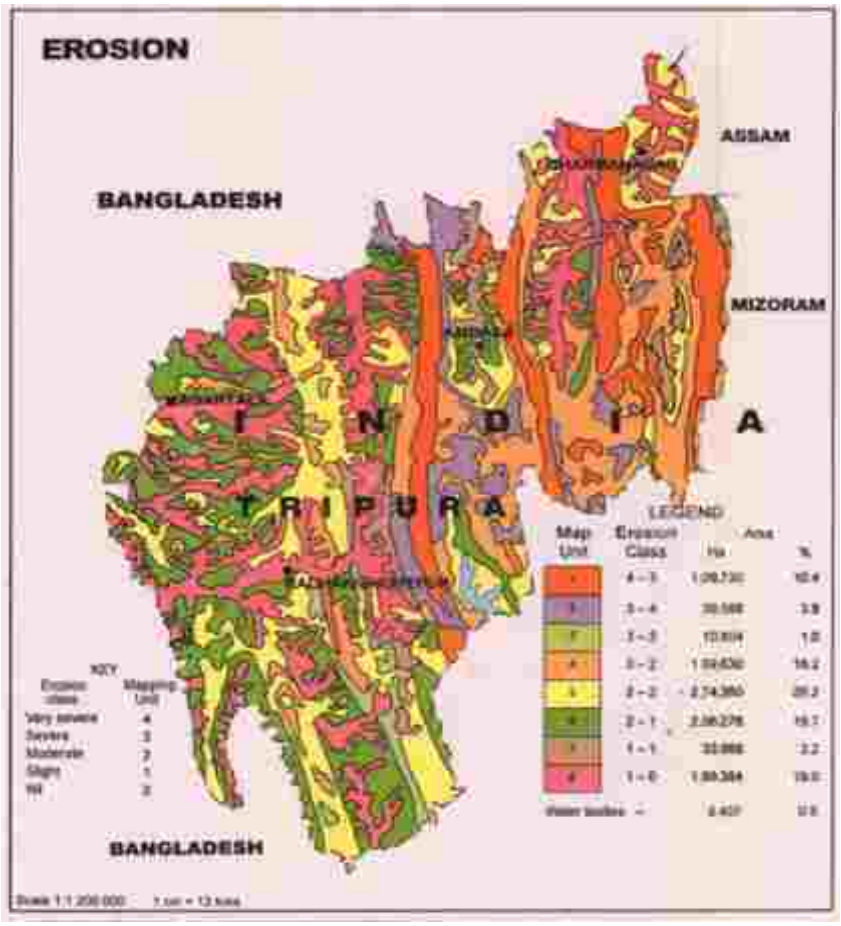
Soil and water conservation is a set of control measures which include managerial, vegetative and structural practices to reduce the loss of soil and better maintenance of natural water sources. Reduction in surface run off by structure or by changes in land management will also help to reduce erosion. Similarly, reducing erosion will usually involve preventing fast flow of water to increase infiltration and so ultimately helps to conserve water.

2. Objectives

The Forest Department, Government of Tripura has entered into an agreement with the Japan International Cooperation Agency (JICA) for a project called the Tripura Forest Environment Improvement and Poverty Alleviation Project. There are several project components under this project, of which soil and water conservation is one.

This soil and water conservation component of the project was started to achieve the following objectives:

- Maintain water regime and soil fertility of the target areas.
- Improve water table levels.
- Prevent negative impacts of natural disasters.



Soil Erosion in Tripura. Source: EU Soils, JRC

"Integrated intervention approach prevents erosion from upstream catchment slopes at the same time preventing sedimentation in downstream water bodies"

3. Approach

The soil and water conservation work adopted an integrated intervention, which targeted the whole area from up-stream catchment to downstream command within the same micro-watershed. This is an integrated approach, as it focuses on the watershed as a whole as opposed to catchment areas. The strategies and techniques required for upstream vary from those required for downstream eg. prevention of top soil erosion is the main concern upstream, whereas sedimentation becomes the main concern downstream.

This same integrated approach was applied in around 100 villages in 7 districts of Tripura, over a period of 6 years. Joint Forest Management Committees (JFMC) and cluster approach were at the core of implementation. Involvement of around 450 JFMCs and 1400 SHGs has occurred this far for implementation of the initiative.

There has been fund convergence between this project and MNREGA. MNREGA funds have been used to pay wages, whereas infrastructure and capacity building costs have been paid for through the project. For the construction of one checkdam built in 2013, Rs. 1,85,740 were paid to 135 people. This accounted for a total of 1,375 man days.

4. Key Stakeholders

Scheduled Tribes and Other Traditional Forest dwellers were the main stakeholders and beneficiaries in this initiative. They were organised into self-help groups and self-governing management committees (eg. JFMCs) to build and maintain the soil and water conservation measures that were undertaken within this project.

In addition, there were project field facilitators, who helped set up the project initially and helped later with regular maintenance of the structures and finances (bank loans or project loans). The Gram *Panchayat* was also involved in recommending land area to the project officers and tribal communities. The state government was involved in the implementation of projects and monitoring:

- Divisional Forest Officers (DFO), Forest Department.
- Chief Project Officer (CPO), Forest Department.
- Department of Agriculture, Tripura.
- Department of Fisheries, Tripura.

Activity	Output
Survey and mapping of project area	7,023 km2covered
Demarcation of JFMC area	400 hamlets/groups of hamlets
Soil and water conservation works	80 checkdams constructed

Table shows the activity and output of the integrated soil and water conservation

5. Key Components

Process

The first stage of the initiative was preparatory work done to identify areas that required intervention. This was done on the basis of a large number of indicators that included soil depth, slope, rainfall, soil texture, severity of erosion, soil degradation, infiltration rate, sediment load etc. Since community participation was of utmost importance, willingness of the JFMC for utilisation of the resources was also considered, while construction of the water harvesting structures.

Integrated Intervention

Three models have been implemented over target areas, depending on their placement relative to the micro-watershed. The models, their terrain conditions and detailing are given in the Table below.

Check dams were constructed to harvest water and cut peak flows; in order to moderate floods, meet critical irrigation needs, provide sediment storage and store water for livestock use, fisheries and environmental improvement through on-site and off-site effects. The two types seen were:

- Brushwood check dams: Constructed using locally available bamboo posts supported by bamboo/wooden stakes.
- Small earthen check dams: Constructed with local soil across the stream.

Catchment Conservation was required to prolong life span of check dams. It minimised

Model	Terrain Conditions	Major Installation Structures
Model 1 (Upstream)	• Narrow Valley • Steep slope (>20%) • Small catchment area (<5 Ha) • 2 Ha water spread area	• Embankment ie. Small earthen check dam • Gully Plugging ▸ 5 avenues ▸ 3 pallasiding work ▸ Brush wood check dam • Catchment Conservation ▸ Staggered contour trench ▸ Half-moon terrace Mulching
Model 2 (Middle part of micro-watershed)	• Narrow Valley • Steep to Moderate slope (10 - 20%) • Small catchment area (<10Ha)	• Embankment ▸ Cement Core embankment ▸ Mud core embankment ▸ Submerged spillway ▸ Partially submerged spillway • Gully Plugging ▸ Same as Model 1 • Catchment Conservation ▸ Same as model 1 ▸ Bench terracing
Model 3 (Downstream areas)	• Wide valley • Gentle slope (<10%) • Small catchment area (<20Ha) • Water spread area (around 2 Ha)	• Embankment ▸ Same as Model 2 • Gully Plugging ▸ Same as Model 1 and 2 • Catchment Conservation ▸ Same as Model 2 ▸ Contour bunding for 1000m ▸ Plantation along water body

Table shows various model and their terrain conditions

Brushwood Check Dams

Small Earthen Check Dams

the soil erosion around the structure and contributed to regeneration of vegetation around the water body.

Vegetative materials like bamboo plantations were used to line the embankment surfaces to reduce the amount of soil flowing from the slopes into the water and to prevent sedimentation. Vegetative stabilisation was also used on gully banks. Gully plugging work was required for reduction in run-off velocities and to control gully erosion of micro-watersheds. Locally available bamboo posts were used for gully plugging.

Fisheries

In conjunction with the local SHGs, an alternative income source was started at the reservoirs or small ponds that were made through this initiative. The fishlings were provided to the SHGs by the Department of Fisheries. The feed and oil cakes were made by the SHGs/villages themselves from leftover crops. Financial assistance was provided by access to loans by banks and some starter money through the project itself. The SHGs have been able to successfully sell the fish in nearby markets and recover their investments.

6. Outcomes and Impacts

Demonstrated replicability and scalability has been visible in sites across the state. So far, the project has succeeded in making 1,995 ponds. Currently, the soil and water conservation parts of the overall project are active in the following 8 Forest divisions in 7 districts:

- Kanchanpur, North Tripura District
- Kailshahar, Unakoti District
- Teliamura, Khowai District
- Sadar, West Tripura and Sepahijala
- Udaipur, Gomati District
- Bagafa, South Tripura
- Gumti, Gomati District
- Trishna Wild Life Sanctuary, South Tripura

Increased the ground water level and well water levels after the construction of check dams. The villagers living around those areas have mentioned that simple bore wells would get water after 12-15m of digging, but now

water is found at 8-10m. Water table levels in existing wells were found to have moved up by 20% after a good rain season in 2012. This indicates that check dams have helped in recharging wells.

The integrated intervention approach succeeded in preventing erosion from upstream catchment slopes and preventing sedimentation in downstream water bodies. The velocity of the stream has reduced in all the implementation areas, resulting in reduced soil erosion.

Income through fisheries has increased for the tribal communities. In one village area, Rs. 30,000 profit was earned in 2013. Another village SHG managed to pay back a loan of Rs. 60,000 solely through earnings made by sale of fish from a check dam. Overall, 495 SHGs are actively involved in fisheries and have made 61% profit so far.

The water from the check dam reservoir has been able to supplement everyday activity in the villages nearby. Earlier water for washing and cooking would be drawn from wells, but now that same water can come from the check dam. This has also helped the women of the villages, as water for household activities and for animals is available near the house.

7. Lessons Learnt

- Increase in water conservation and water-use efficiency has had noticeable effect on yield improvement and production stability in agriculture in the surrounding areas.
- An observable change in the farmer's behavior towards investment in water harvesting structures has been noticed vis-à-vis return on that investment via increased yield and ground water replenishment.

© DA

Checkdam reservoir also used for fishery

Population	As per 2011 census, Uttarakhand has a population of 10,116,752, and Ranks 20th in India in terms of population.[1]
Climate	The state has five seasons: winter, summer, spring, autumn, and a monsoon season.
Climate Vulnerabilities	Changing weather patterns and rising temperatures, flash floods, increase intensity of extreme rain fall, recession of glaciers, extreme rain events, landslides, cloudbursts.
Average Annual Rainfall	1645.6 millimetre[2]
Economy	Economy of the state is mainly based on agriculture and livestock.

[1] *2011 Census of India.*

[2] *District-wise monthly rainfall data from 2004-2010 for the whole of India by Indian Meteorological department from www.indiaportal.org*

Uttarakhand is a state in the northern part of India. It is often referred to as the Devbhumi due to the many Hindu temples and pilgrimage centres found throughout the state. Uttarakhand is most vulnerable to climate-mediated risks. Mountainous regions are vulnerable to climate change and have shown "above average warming" in the 20th century. The livelihoods of communities are almost primarily based on natural resources - water, forest, agriculture, etc. About three-fourth of state's population is rural and virtually everyone depends on agriculture. Climate change will have direct impacts on livelihoods as most of the economic and livelihood sectors are vulnerable to the impacts of climate change[1].

[1] *www.indiaenvironmentportal.org.in/files/file/uttarakhand%20state%20action%20plan%20on%20climate%20change%202012_0.pdf*

Committed Communities

Key Messages

- Capacity building of rural community institutions on management and sustainable utilisation of resources helps in sustainable development.
- Simple interventions like introduction of climate resilient crops; helped in improving agriculture, as well as helped in maintaining environmental sustainability.
- Market systems also need to be sensitised on climate resilience and environmental sustainability as farmers depend on market for inputs and suggestions influencing their behviour patterns.

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1. Context

1.1. Need:

Uttarakhand has been impacted the most due to climatic events and disasters in Himalayan region. Ranging from disastrous events like floods and landslides; to an ecological shift in the region; there have been many climatic changes, which are impacting communities in Uttarakhand today. On one hand, it becomes important to conserve and further sustain the natural resources and on the other, basic needs of community people like food and fodder need attention for fulfillment.

In this kind of a sensitive ecological system the major problems that village communities are facing are lack of livelihood opportunities and a degrading agriculture. The temperature belts of Himalayan region have changed and warmed up in last few years. This has led to a degradation of the traditionally grown fruits and crops in this area, and major shifts in agricultural practices. With a low quality produce, agriculture does not yield much income for the farmers and thus, they look for small jobs in towns, leaving their farmlands barren or sell their farms. The other side of the picture shows that this trend is also affecting the local vegetation, as many of the species are becoming rare in the region. This clearly shows a need to work with local communities to build their capacities for adapting to this climatic change and move towards a more climate resilient agricultural approach.

1.2. Response:

CHEA (Central Himalayan Environment Association) initiated a project for improving climate resilient farming through strengthening of rural community institutions. This project has been supported by Sir Dorabji Tata Trust (SDTT). CHEA has been working in Almora District of Uttarakhand; covering 15 *Van Panchayats* to work on natural resource management.

"Capacity building of rural community institutions on management and sustainable utilisation of resources helps in sustainable development"

2. Objectives

The main purpose of CHEA's project on natural resource management with rural communities is to develop replicable models at village level that advocate for a clear linkage between rural livelihood and management of natural resources and capacity building. This larger objective thus, includes the key sub-objectives:

- Capacity building of community institutions like Van Panchayats for effective forest resource management.
- Introduction and implementation of adaptive solutions for agriculture at community level.

These objectives provide a direction to build community institution base for adaptation of practices; suitable for local environmental context and a sustainable model of environment conservation.

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Capacity building of community

3. Approach

CHEA uses participatory approach organising community based institutions "*Van Panchayats*" for engaging with community and strengthening them for effective management. The *Van Panchayats* are also used for providing support for climate agriculture practices to farmers through formation of farmers cluster. This facilitates in effective implementation and sustainability of the initiatives.

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Participatory planning for environment conservation and livelihood enhancement

4. Key stakeholders

The key stakeholders in CHEA's project were:

- Van Panchayats of the selected 15 villages in Almora District,
- Market associations of Haldwani and Nainital markets
- Farmers and women from the same villages.

The financial support was provided by Sir Dorabji Tata Trust (SDTTT).

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Farmers with their produced at a market

5. Key Components

CHEA follows a participatory process for forest management and strengthening local agriculture, organising community based institutions like *Van Panchayats* at a grass root level. As villages in Uttarakhand are further divided into areas termed as 'Toks'; CHEA organises trainings with Van Panchayats to work with them on forest management. CHEA team members use interesting tools to communicate with Van Panchayats in trainings like wall posters, group exercises etc.

They work closely with each *Van Panchayat* after trainings; to track how these *Van Panchayats* are working further in their respective villages. This tracking involves looking at present natural resources in the village like forest area, number of animals, number of trees of different varieties etc. It also maintains a regular record about functioning of the *Van Panchayats* in terms of meetings held, actions taken, record maintenance and community grievances, if any.

The other part of the project is on working with community members on climate resilient agriculture, CHEA works directly with farmers. Their methodology includes initial research and understanding of the issue with scientific experts, forming farmer clusters at *Van Panchayat* level, demonstration of new techniques and practices and developing market linkages for farmers. This approach provides support and assistance to farmers at every step of agricultural process. Some of the practices adopted are cultivation of tuberous spices like ginger, turmeric and garlic and herb cultivation as these are the safest crops from wild animal infestation.

6. Outcomes and Impacts

The area of intervention for CHEA was Almora district; directly reaching out to 15 *Van Panchayats*. During the first phase of the project in 2006-2008 the activities were undertaken in 7 *Van Panchayats* in Lamgarh block; benefitting approximately 400 families through project intervention; either in form of inputs or through strengthening their capacities.

In the second phase during 2008-2013; the project was extended to 15 Van Panchayats of Almora district. During this time, the project

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CHEA members in field with Van Panchayat member for demarcation of forest area

activities reached out to about 8,117 population (including 4000 women). In terms of land about 1124 ha land was covered in this intervention, through 15 *Van Panchayats*.

The major outcomes of this intervention could be seen as:

i. Adoption of new agricultural practices like ginger and herb cultivation provided good market value to the farmers, as well as saved crops from wild animal infestation. Thus, providing a secure option of farming. A village named Dholigaon in Nainital District has shown the highest rate of adoption by farmers.

ii. Use of wasteland, surrounding houses for growing green fodder for animals: This has shown a major result in reducing land grazing inside forest lands. Adoption of this simple practice has also improved women's life by saving their time and energy from going to far away areas for collecting fodder.

iii. Active role of *Van Panchayats* in taking lead in forest resource management: New mechanisms have been developed by *Van Panchayats* for utilising and maintaining their forest resources; after understanding and deeply analysing the utilisation and replenishment patterns.

iv. Market linkages developed by farmers have benefitted them in two major ways: better return value for agricultural produce and access to new seed varieties. This has also rebuilt the interest of farmers in agriculture as an option for livelihood; who earlier despised this, and left their lands unattended.

All these changes indicate that there has been:

- An improvement in the way natural resources are managed by communities.
- Understanding and participation has grown from beneficiaries to change makers.
- Livelihood options have been secured as compared to earlier.

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Farmers produce in a market

The key underlining factor in all these changes is that this work is happening inside the natural eco system of Uttarakhand region with sustainable development as the centre approach in all activities. There has been a simultaneous focus on conservation of resources and their judicial utilisation for better standard of living for village communities.

7. Lessons Learnt

Some of the key learnings drawn during the intervention phases by CHEA were:

- While building market linkages for farmers; a traditional relationship of exchange exists between farmers and the market buyers. This relationship influences the farmers very much for adoption of new behaviours. It included practices from use of new seeds to following different cycles of production. Thus, it became important to also work with members of market associations to bring out a holistic change.
- Each community practice has a cultural notion associated with it. And it is very important to ensure that the new practice advocated; does not violate their cultural values. However gradual and subtle changes in socio-cultural environment are not resisted.
- One of the important learning has been that *Van Panchayats* promoted by different agencies, follow different models of resource management. Although all of them follow rules and guidelines given by Forest department; few *Van Panchayats* follow money-for-fuel system; whereas, few others follow a system similar to barter system; where community member need to contribute with saplings or his/her time as guard for maintenance of forest; in return of fuel wood. They need basic capacity building and strengthening in terms of processes; but also need their own space to evolve a community specific mechanism for functioning.
- Components of CHEA's initiative have the potential of being replicated to other parts of Uttarakhand. The organisation has already started work on replicating some models like ginger and herb cultivation with other village communities. A successfully demonstrated model within the same ecological system helps communities to see, learn and adopt easily without the first level resistance.

Guarding Nature

Key Messages

- *Van Panchayats* (Community based institutions) are key institutions to manage forest/natural resources efficiently to build a sense of ownership and social authority over their natural resources.
- Regeneration of forests provides co-benefits for environment, climate and livelihood security.

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1. Context

1.1 Need:

Climate change could cause irreversible damage to forest ecosystems. Moreover, there has been an increasing extraction from forests, largely due to increase in population and thus, increase in per person requirement. The rate of use of natural resources has been more than the rate of replenishment; as visible clearly in case of trees. To tackle this issue of deforestation; pine trees were grown which have exacerbated the problem due to their harmful impact on environment. Communities living in the Himalayan region are dependent on forest for their fuel and fodder requirement. The village communities in Uttarakhand comprising small land holders depend critically on community forests for their subsistence living. However, loss of forests is impacting livelihoods of these marginal communities.

In this scenario, it becomes a difficult challenge to sustain the existing resources; as well as improve community's access to natural resources to fulfill their basic needs. For maintaining this balance Van Panchayats came into existence in 1930s in India to work from a participatory approach for management of forest resources, but due to lack of active leadership these Van Panchayats were unable to function effectively.

1.2 Response:

Chirag, a not-for profit organisation is working in Central Himalayan region since 1986, with a mission to improve lives of rural people in this region. Chirag has been working with interventions on health, education and natural resource management. It is presently working in 174 villages across 7 blocks in 3 Districts – Nainital, Bageshwar and Almora.

Chirag studied and designed a systemised response to the challenges through strengthening of *Van Panchayats*; to support communities for natural resource management. It includes capacity building of *Van Panchayats* on their rights and responsibilities, and also various models which they adopt for managing their forests. Chirag also supports *Van Panchayats* with scientific data, related to forests and spring recharge.

"*Van Panchayats* (Community based institutions) are key institutions for managing forest/natural resources efficiently building a sense of ownership and social authority over their natural resources"

2. Objectives

The key objective of Chirag's programme on natural resource management is to build capacities of local *Van Panchayat* bodies for effective management of resources like springs, forests and fodder with involvement of other community members. The emphasis of their work is on the following three aspects to:

- Increase access to leaf litter, fodder and fuel wood production through plantation on common and private lands.
- Increase the number of months, when green fodder is available for livestock, which are important sources of income for communities.
- Build a scientific understanding about the process of spring recharge mechanisms in hills among village level institutions to enable them in spring recharge management.

3. Approach

To achieve the above mentioned objectives, Chirag follows the approach of strengthening community based institutions like Van Panchayats, building their capacities to help build their systems and manage resources more efficiently.

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Demarcated Forest area of Van Panchayats

4. Key Components and Key Stakeholders

The key components of Chirag's interventions on natural resource management are:

- Introducing new varieties of fodder grasses: Through community extension workers, Chirag has introduced new fodder grasses, which would remain green for longer periods and regenerate faster. This is to improve availability of green fodder for livestock owned by rural families. Also fodder plantation is done along the contour trenches and on terraces, which encourages growth of rootstock, enabling soil moisture levels to go up and ensuring the survival of sapling broad-leaf trees.

  The fodder programme has been implemented across 38 villages and has

included setting up of nurseries; for root stock production (63 Quintals), plantation of fodder grass (1000 Quintals) - this has been achieved on both, private and *Van Panchayat* land. The fodder grass production; resulting from the above (5000 Quintals) has benefited close to 900 households.

- Forest management for fuel, fodder and leaf litter: Chirag organises regular training sessions with selected Van Panchayats. With the support from Chirag, *Van Panchayats* have developed mechanisms for appropriate utilisation of forest resources without depleting the forests completely. The system includes rules for entering the forests. The forest area under each Tok (a sub-area of village) is demarcated with wires and is open for general community members, for only two months in a year. This gives time for forest replenishment throughout the year and also maintains the level of extraction. Some other rules like one bundle of fodder grass per person also help in maintaining the ecological balance in the region. The long term sustainability of a community's forest depends on how the community maintains and protects it. Community people in a village Budibana in Kasiyalekh block, have reported a major change in their forest area in past 8 years.
- Forestry and plantation: Two major aspects of this activity have been plantation of approximately 96,244 saplings across 51 villages, covering approximately 155 Hectares of *Van Panchayat* land. This activity has been augmented by support for protection and maintenance work; which has included supporting *Van Panchayats* in appointment of forest guards and also in construction/repair of approximately 5000 Running Metres of fencing, both wire and wall. Additionally a fire line of approximately, 3000 metres has also been made with the support of *Van Panchayats*. As part of soil conservation measures, Chirag has worked in 51 villages, covering approximately 155 Hectares in construction of approximately 76252 running metres of contour terraces and also khaals, gabion check dams, gully plugs and approximately 166 Cubic Metres of percolation pits for water conservation.
- Scientific assistance in improving forestry efforts of *Van Panchayats*: Chirag has specified quadrate plots (10 m X 10 m) inside the forests to monitor the growth and survival rate of different species of fodder and trees. GPS mapping of forest area is also done to track physical growth and changes. All these systems provide data and information for continuous refining of plantation strategies and to account for local variations in geography and climatic conditions.
- Spring recharge: Chirag has worked to collect spring recharge data from about 46 springs and conducted treatment activity on them. It also worked with Jal Samitis at village level, to make them understand geographical system of spring recharge and how they can recharge their springs. Apart from this a detailed study and treatment of 70 other springs across 33 villages is being done.

5. Outcomes and Impacts

This approach of natural resource management has shown visible impacts in the forest area of the intervention area. Some of the clear outcomes of Chirag's long term intervention are -

i. Increased beneficial varieties of trees and plants in forest areas under intervention: There has been a remarkable increase in number of oak trees in place of pine trees, which has a large impact on overall ecological system. Pine trees degrade the quality of soil by making it acidic, they are more prone to forest fires, do not produce fodder and are not considered good by community members. Pine being a dominating species also does not allow other vegetation to flourish. Therefore, replacing pine with oaks in forests is a major achievement for communities.

ii. Increased spring water levels: With scientific data and detailed studies Jal Samitis were better able to understand; how to utilise their funds and efforts in the right direction for spring recharge. They worked on well-identified geographical regions and developed catchment areas. This has resulted in form of rejuvenation of springs which were once dried up. There are almost 30 springs which were recharged through this method.

iii. Reduced work load on women for gathering fuel, fodder and water as they do not require traveling long distances now.

iv. Increased awareness and understanding among community members about environmental changes take place around them. The village members are well aware of the various changes in hill temperature, plantation varieties and the need and importance to conserve our natural resources. The community members have a very clear understanding of the relationship between forests, rains and natural disasters and their impact on human existence.

6. Lessons Learnt

- Active participation and ownership in the process of forest management and conservation has shown a pathway for community based processes, which can be built effectively for sustaining development interventions. Such an intervention demonstrates a very important lesson to work on community driven natural resource management; that it is a gradual and relatively longer process.
- If community institutions like *Van Panchayats* or *Jal Samitis* are strengthened and motivated to lead; the impact derived is more sustainable. Communities continue to exist in generations and once the communities are themselves involved in their management; the development efforts get engrained within their system.
- The model can be replicated, not only in similar areas in Himalayan region, but also other regions.

CONCLUSION

The climate adaptive grassroots initiatives documented from the eight states facing diverse climatic impacts have highlighted important lessons which facilitate adaptation. The initiatives documented contribute to building adaptive capacities and resilience in communities that are highly vulnerable to climate change. The cases documented illustrate the catalytic role that different stakeholders can play in incentivising, facilitating and supporting climate adaptation. Addressing the impacts of climate change and building resilience of communities for adapting to climate change will require engagement of these key stakeholders, provide options/alternatives, establish market linkages and enhance capacities of communities to adapt. Some of the drivers and key take aways for mainstreaming adaptation are:

- "One size fits all" approach does not lead to large scale adaptation. The initiatives require a broader approach providing flexibility to address specific needs and concerns of communities.

- Diversification of agriculture to integrated farming and organic farming systems facilitate in reducing pressure on natural resource base and build resilience of farmers.

- Organise clusters ensure economies of scale enable continuous production cycles and facilitate backward forward linkages. Market based approaches promote transitions leading to co-benefit approach. Adaptation strategies enhancing economic security facilitate integration and sustenance of adaptation.

- Community based risk strategies facilitate reliability of information communication systems and greater involvement of stakeholders. Improving efficiency and setting up self-regulatory norms facilitate communities to adopt, leading to sustainability of initiatives.

- Linking traditional approaches to new and scientific knowledge have better adoption rate. Moreover, cultural contexts can be capitalised for easier adoption.

- Translating project to scale will require capacity enhancement and incorporation of change in mainstreaming while thinking of development. Building capacities of communities for informed decision making results in sustained efforts.

- Increased dialogue between different stakeholders facilitates exchange of information, integration and common understanding of adaptation strategies. Integrating institutional support systems facilitate scalability and replicability of models of adaptation.

- Climate proofing flagship programmes like MGNREGA enable financing and facilitate large scale impactful adaptation efforts.

Hence, addressing adaptation for large scale replication and adoption requires purposeful departure from business as usual approach. Government, civil society and community groups are indispensible allies for applying effective solutions to address the challenges posed by climate risks and making adaptation a key driver for climate resilient development pathways.

Development Alternatives (DA), a not-for-profit action research and development organisation, innovates and disseminates sustainable solutions aimed at reducing poverty and regenerating natural ecosystems and services. Established in 1982, its ecosolutions deliver basic needs products through the small, local enterprises that generate green jobs and sustainable incomes. Based on its innovative environment-friendly technologies and market principles, these enterprises help build local economies and communities while maintaining a minimum ecological footprint.

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