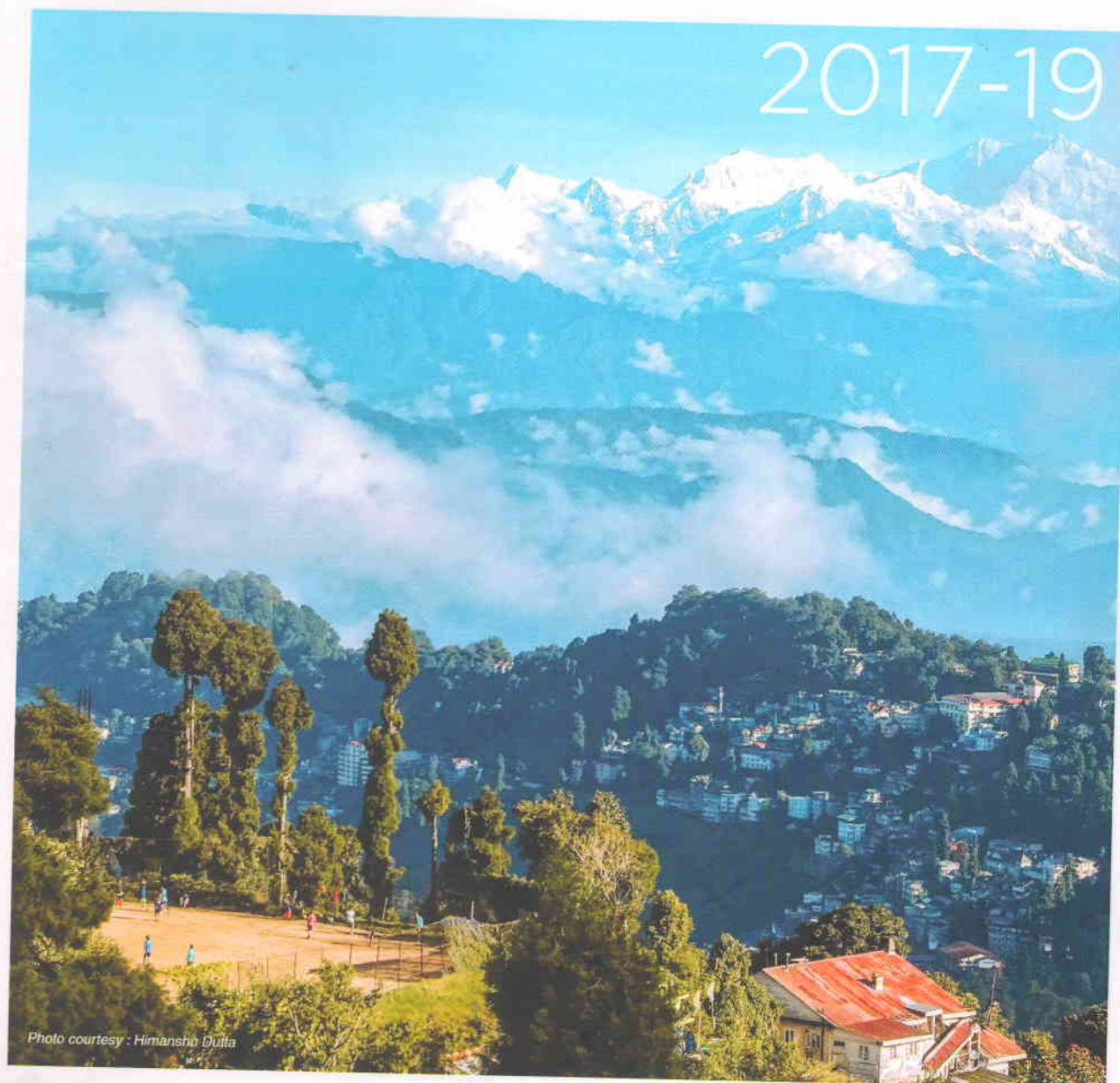


POLICY BRIEFS

These policy briefs are the output of a research project titled 'Understanding Mountain Peoples' Approach and Practices to Combating Climate Change in the Indian Himalayan Region: Research to Renewal and Reforms funded by National Mission on Himalayan Studies (NMHS) under MoEFCC led by Integrated Mountain Initiative and TERI.



Ministry of Environment,
Forest and Climate Change
Government of India





POLICY BRIEF

INTEGRATED FARMING SYSTEMS: A CASE OF PADDY CUM FISH CULTURE IN ARUNACHAL PRADESH



Ministry of Environment,
Forest and Climate Change
Government of India



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BACKGROUND:

Understanding the attributes of traditional, location specific land use system will provide insights for its improvement and wider applicability. The integrated rice cum fish culture system developed by the Apatani tribe of Ziro valley, Arunachal Pradesh is a unique system. Faced with shortages of the staple food items (rice and fish), these subsistence farmers developed this ingenious system in preference to wide spread shifting cultivation in the region, by capitalizing on the good water supply (from rainfall supplemented by natural flow from hills surrounding the valley (Dollo,M,Samal,P.K.). Two rice crops are grown annually and fish is reared in the paddy fields during the main rainy season. Crop residues and animal waste are the sources of nutrients to the crops. Based on the research it showed a great deal of interest on which this culture creates sustainable management and conservation through its mechanism and are expected to enhance both the crop and land conservation of the state as a whole. The resilience and the sustainability of the system could be attributed to efficient nutrient cycling and nutrient input through water seeping in from surrounding hills, which have not been, but deserve to be quantified.



Fig: Paddy cum fish farming field at Ziro.

APPROACH:

The study site was Lower Subansiri, Ziro. The study included intensive review of secondary literature and peer reviewed research articles. Field interviews with progressive farmers; key person interviews and focused group discussions with officials of line departments such as Agriculture, Horticulture and other experts and practitioners were undertaken. Participatory rural appraisal approach was also used to capture the timeline of planting, calendar, perception of weather change, impacts on the community, coping and adaptation practices to undertake environmentally friendly activities that can help maintain these system.

FINDINGS:

The use of pesticides, insecticides, weedicides and fungicides which even in minute quantities are highly toxic to aquatic life and have degraded both the quality of soil and fish that are reared. Lack of management, pond culture at Ziro is observed. Traditionally they use herbal poisonous plant to kill in order to catch fish. Further it causes imbalancing of ecological niche and thereby damaging the river bank. Therefore local conservation practices needs to be followed in a sustainable manner for the conservation of the biodiversity.

When agriculture's contribution to gross domestic product is declining throughout North Eastern region, large populations are still based in rural areas, depending on agriculture directly or indirectly for employment and income (ARUNACHAL-SAPCC). The Eastern Himalayan region is likely to face the highest reductions in agricultural potential due to climate change. As a result climate change will place an additional burden on efforts to meet long-term development goals in Arunachal Pradesh in particular.

RECOMMENDATIONS:

The ingenious integrated rice with fish farming system of the Apatani is in urgent need of dynamic conservation. The traditional conservational attitude of local farmers to managing the rich natural resources helps them reap economic self-sufficiency and ecosystem services in this ecologically-fragile Arunachal Himalaya, north eastern India.

To cope with current crisis, the ongoing development initiatives need to be strengthened to reduce vulnerability to climate change by adopting suitable policies and technologies. The adaptation will require improvements that take existing development policies above and beyond their current capacity that encompasses innovative policies like changing investment allocations within and cross sectors, increasing the focus on risk-sharing and risk-reducing, disaster preparedness, capacity building and proper indigenous traditional knowledge on farming to compliment the scientific recommendation for wide acceptability. Thus the agriculture and the farming system of the state must make necessary adjustment and readjustment with the changing climate to enhance the resilience of the sector.

Implementing this mechanism requires a credible institutional setup. The study recommends the local bodies along with the administrative sector could work together to manage and create a sustainable farming system. The government support in implementing the recommendations forwarded by the Arunachal Pradesh State Action Plan on Climate Change could also support the system and could finance the work needed to improve the quality and effectiveness of this system (Arunachal-Pradesh-SAPCC.)

Lack of technical knowledge of farmers, and risks associated with flood and drought is a significant challenge for the adoption of integrated rice with fish farming. Hence, proper training should be imparted that would help enriching the knowledge of rural farmers' improving productivity and reducing risks. A full recognition of its multi-ecological functions must be achieved, such as its role in preserving biological diversity, protecting food security, enriching soil and lowering the emission of greenhouse gases.

The farmers and the local people out there are willing to create a constructive and sustainable way for the farming methods and reduce the use of chemical fertilizers and pesticides in farmland if provided with proper channelized funds and proper guidance and training methods from the agricultural administration



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POLICY BRIEF

Traditional Water Harvesting Structures as an Adaptation Practice

IN THE CONTEXT OF HIMACHAL PRADESH



Ministry of Environment,
Forest and Climate Change
Government of India



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Background

The SAPCC states that **moderate to extreme drought conditions are to be expected in the state, with more than a 20% increase in places**, despite the overall increase in rainfall (*State Strategy & Action Plan on Climate Change, 2012*). Floods are set to become more common, posing a threat to human life, agriculture and the hydropower projects that form a major part of the state's economy.

At a district scale, the trends vary, but **Shimla, Sirmour** and **Solan** in particular have witnessed a decrease in rainfall of **13.3%**, **16.6%** and **8.7%** respectively in the past 25 years. In districts which will see an increase in average annual rainfall, this translates to more intense rainfall. These districts are Kangra, Kullu, Chamba and Una (*State Strategy & Action Plan on Climate Change, 2012*). Broadly, the key changes that are occurring that have been identified by the State Action Plan are an average 2-4 degree temperature increase,

snow and glacial field loss and associated events such as GLOFs and doubled frequency of extreme events. It is also projected that south-eastern parts may see drought-like conditions in coming decades.

The key changes predicted in the water sector are an increased frequency of heavy precipitation, increase in extreme rainfall intensity, increased variability in rainfall patterns, increased likelihood of water shortages/droughts, reduced levels of snow precipitation, loss of glacial volumes, premature snow melt and increased temperatures. The likelihood of these changes taking place have been rated as very high. The likely impacts on water resources that have been identified are increased runoff and higher sediment load, reduced groundwater recharge, increased flood flows, reduced dry season flows, drying up of minor tributaries and springs and loss of perennial sources.

This has raised question about water security in the state, especially in rural areas, which is where **nearly 90% of the state's population** resides.

2-4° C

Increased
Temperature

Traditional water harvesting structures in Himachal Pradesh, such as the **chapri**, or *kaccha ponds* for storing water for irrigation and livestock, the **baoris** for household usage, the **naun** for non-drinking household uses such as washing clothes and the **panihar** for bathing and drinking, have been in use for centuries in these areas and are community-managed structures that collect underground seepage or rainwater and store it for later use. These structures follow specific construction patterns that have been passed down over generations and all of them have a certain set of cultural practice and rituals associated with them whose intricacies are unique to every region.



This study aimed at understanding the state of traditional water resources in the state and how their usage has changed over the years.

Approach

The study involved reviewing secondary literature and conducting stakeholder interviews in Sirmour, Kangra and Kullu, and consulting the concerned departments and subject matter experts, we were able to create a picture of the state of traditional water resources in the state and to understand how their use has changed over the years. Through our findings, we were also able to **give suggestions as to how these sources can be developed** to allow this traditional adaptation technique to prevail.

Findings

These structures are a part of the rich cultural heritage of Himachal Pradesh and are already being used as supplementary sources of water during times of scarcity, but figures showing the decline of these structures are alarming. The State Action Plan also recognises the importance of these structures and admits that a startling number of them are drying up. Studies have also found that most of them, due to **poor maintenance**, supply water that is unfit for drinking purposes.

A survey conducted by the State Council for Science technology and Environment has uncovered disturbing statistics;

30.41%

In the 169 Panchayats that were surveyed across 7 districts, only 30.41% of the traditional water sources were found to be in good condition structurally and recharging water all year round. This figure was a mere 1% for Chamba district. A study conducted in Hamirpur and Bilaspur district found that 23% and 5.2% respectively of the baoris in these districts were not in use anymore. However, the results also showed that 55% of the baoris and 33% of the khatris had water that was unfit for drinking. The same study also points out, however, that many of the households in the area are forced to use water from these sources, polluted or not, during dry seasons (*Singh et al., 2010b*).

A similar, more detailed study carried out in the same area found **the pH values of 44% of the baoris were above acceptable levels and the water in 55% of them was unfit for consumption** (*Sharma, 2008*).



Recommendations

- In order to develop these structures as a viable adaptation option then, **it is necessary that the state take steps towards their revival.** Treating the catchment area of the sources housed in these structures may help revive discharge.
- **Greater scrutiny** also needs to be directed towards the activities being carried out in this catchment area, for example the construction of roads, tunnels or poorly designed and executed toilets.
- Despite the persisting belief that water from these sources is always clean, studies have unfortunately shown that this is not true for a great number of the water sources. Panchayats and local water user groups **need to be trained to be able to carry out rudimentary water quality monitoring and maintaining water quality** according to standard procedure using the equipment/chemicals provided to them by the state departments.
- Steps also need to be taken to **preserve traditional knowledge and artisanship**, such as the masonry skills required to build traditional



structures. The form of these sources follows a certain function and it may perhaps be that by **introducing modern aesthetic elements into the structures** themselves, the very function of the structures is being meddled with. Encouragement and support extended towards Panchayats to build more of these structures, especially in areas that have been identified by the State as being vulnerable to droughts in the future, could go a great length in ensuring drinking water security in these areas.

- The sustainability of traditional water harvesting structures depends heavily

on the **community's willingness to contribute to their upkeep**. It has been suggested that in order to effectively revive these structures, it would be necessary to maintain informal rules for the sustenance of these water sources. These rules ensure that **cleanliness is maintained** at and close to the source. Prayers and rituals that are offered at the sources also contribute to their cleanliness. The responsibility of maintaining the source is shared by the communities, and repair work is either funded by the Panchayat or done through contributions.



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POLICY BRIEF

**The revival of traditional system
(Chutsir) on water allocation:
A case from Ladakh.**



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Background

Ladakh region is a mountainous cold desert region, where irrigation is dependent on glacial melts and snow. More than 90% of villages are dependent on glacial melt for irrigation. Irrigation technology came to Ladakh from its neighbouring regions. Farmers have made use of the barren semi-desert conditions for cultivation through skillful irrigation. This traditional irrigation system followed by the farmers was introduced in the tenth century. Since the streams run away from cultivable land or are incised deep below to bring a long canal, it requires considerable traditional expertise.

The melted snow water from various rivulets merge at some point forming a stream, that flows through a valley touching many villages connected by a main channel. It is built along a mountainside that forms its retaining wall, and is lined with clay to hold the water. At some places rocks are broken to allow the passage of water or else where the rocks are too hard, a hollow poplar or willow trunk is cut into two equal halves to allow the water easy passage. Water from the main channel is further diverted into small canals, which irrigates the fields. The water distribution through a system of channels is quite complex with different sizes of channels. The bed of the canals is also often made of very porous material, loose stones and boulders, so there is considerable loss through seepage.

Chutsir is a traditional water distribution system in a particular order. It helps to manage and distribute water resources. The system is prevalent in many villages of Ladakh where agriculture is the primary source of livelihood. However, changes in livelihood practices have led to rural-urban migration and eroded traditional community-based systems. At the same time, villages are facing shortage of water due to receding glaciers just as traditional water management systems are being lost in these villages. Ladakh 2025 Vision Document too mentions about the current depletion of water resources, caused by decreased snow cover, glacial area and precipitation which is further intensified by inadequate conservation effort. Strengthening of the community ownership and participation through incentives along with policy intervention from local self government institutions such as LAHDC and Panchayats is urgently needed. This will require changes in manpower management, technology and implementing and encouraging innovative methods of conservation and harvesting of resources. This will help deal with issues of water scarcity caused by changes in the local climatic pattern.

Case Study and Approach

Changes in local climatic pattern in terms of rainfall, snowfall and temperature, has resulted in receding glaciers and water scarcity in the region. This research was conducted in two villages of Leh district: Saboo and Leh. The water distribution system 'Chhu tsir' in Saboo is 'without parallel' as per the Churpons (traditional head of water distribution system) of the village. While, Leh, earlier a hamlet, and now an urban hub, dotted with guesthouses and hotels, the Churpon system is no longer practiced though there are plans to revive it. It has been observed that due to water shortage, many springs in Leh as well as adjoining villages have dried up and lands are left uncultivated where villages are located at a distance from water sources and are dependent on spring water discharge such as Skara Yokma in Leh. Furthermore, migration, tourism and use of western toilets, has intensified the extraction of ground water in and around the town.

Findings

Traditional crop cultivation has reduced in both Saboo and Leh. According to informants in Saboo, it would take 10 to 12 days for a family to complete sowing, which is now completed in 5 days. Also, the current land utilization pattern data shows increase in land left fallow. In 2015-16, the area of land left uncultivated was 439 hectares as compared to 2003-2004 when it was 190 hectares and 495 hectares in 2011-12 when Ladakh was recovering from the 2010 floods. People cited shortage of water, family labour, less income from traditional crops as reason for the declining cultivation.

Through discussion with local community especially in Leh where the Churpon system no longer exists, it emerged that incentives will help revive the Chhu-tsir system from the brink of collapse. The Goba of Leh mentioned that since most families' members have government and private jobs, no one is interested in the responsibility of being a Churpon. There is a post called Mirab (water lord) in Rural Department, however, it is not clear if this post has been created in all villages. Currently there are only eleven positions and all of them are engaged in Class 4 jobs. If they were meant to serve as Churpon, then the number of posts must match the number of villages. Another important point that emerged during interviews was that there is an ab-

sence of conservation efforts by local government bodies and by villagers. There is no arrangement to store water in dZings from streams that otherwise go waste. Most of the dZings have been damaged by floods and no funds have been sanctioned to restore them.

Also, there is a need to explore new adaptation methods. For instance, In Ladakh, when the agriculture season ends, glacial melt water is not used. In Nang Phu, embankments have been constructed by NGOs with participation from community members to conserve water that would otherwise go waste. Such conservation methods can reduce the impact of climate change. However, without community participation, the sustainability of such measures is questionable. In Leh, most of the dZings lay damaged after the 2010 floods.

Various researchers and experts provided insights to the water shortage in Ladakh, especially Leh. For instance, a junior scientist at SKUAST Leh cited conjunctive use of water as an important strategy to mitigate the problem of water scarcity.

Recommendations

- Provision of incentives to Churpons will revive Chhu-tsir. There should be involvement from locals in the construction, maintenance and repair of khuls, water channels, streams, and dZings which was an obligation in the past.
- Policy has to be area-specific and village-specific. This will ensure accountability and sustainability.
- Lifting water from the Indus for irrigation and the use of renewable energy will reduce water stress in the district.
- Since dZings help ground water recharging, more dZings should be built to store water.
- Building artificial glaciers and Ice stupa will not only reduce shortage of water during sowing season, but also recharge natural springs.
- Cropping of plants that consumes less water will reduce water shortage. In addition, awareness and capacity-building for water conservation is needed.



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POLICY BRIEF

Systematic and Integrated Jhumming along with Community Based Land and Ecosystem Management

IN KAMJONG DISTRICT, MANIPUR



Ministry of Environment,
Forest and Climate Change
Government of India



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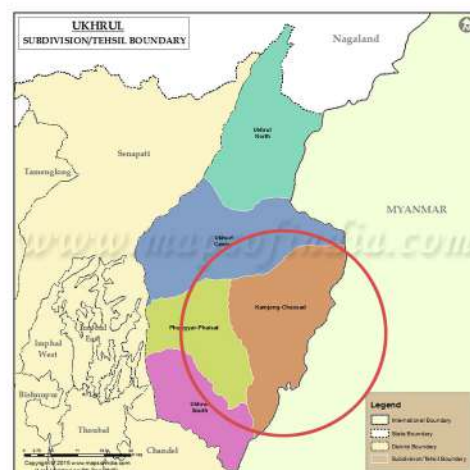
BACKGROUND



Shifting cultivation is a farming method still widely practiced in huge parts of hill districts in Manipur. Kamjong being one of the districts, six villages were taken as representative villages for the case study they are- Shungri/Sorde, East Tasom, Punge, Bungpa Khullen, Ningchou and Grihang with a total population of 5100 approximately (see Table 1). These villages are located in the eastern part of Ukhrul district in Manipur. The terrain is hilly with average height varying from 900m-3100m. Also, the villages are solely an agrarian community with majority of the families still dependent on shifting cultivation as their main source of livelihood (Marchang, 2017). Very few families are engaged in services other than agriculture in these villages. In the crucial discourse of climate change and its impacts of the recent times, the continual practice of shifting cultivation remains highly debated with divided opinions on its sustainability in long term. But it is not only a method of farming but is a way of life which deeply connects the community culturally to its ecology and nature (Sharma, 2017). Moreover there are many good traditional agricultural practices associated with shifting cultivation which can be revived or invigorated (AIPP, 2014) .

VILLAGE	POPULATION	NO.OF HOUSEHOLD
Shungri/Sorde (2018)	458	97
East Tasom (2018)	431	80
Punge (2011)	220	33
Bungpa Khullen (2011)	2716	422
Ningchou (2018)	520	91
Grihang (2018)	782	133

Table 1. Village Profile (source : Census 2011)



APPROACH

The case study was done with Integrated Mountain Initiative (IMI) under the NMHS project to identify good agricultural practices in mountainous regions through the multiple stakeholder consultation approach. The community engaged belonged to the Tangkhul Naga tribe. The study time period was from February to May, 2018 which included field visits, interviews and Focus Group Discussions (FGDs) with relevant stakeholders such as subsistence farmers, Village authority members, line departments such as the Forest Department and Directorate of Climate Change. Non-governmental organisations such as the Volunteers for Village Development (VVD) and North Eastern Region Community Resource Management Project (NERCORMP) were also involved and consulted during field work and field observation processes. The documentation is based on secondary literature review and analysis and findings of primary data collected from the field visits.



< Jhum site after slashing

Jhum site after burning >



FINDINGS

1. More than 60 crop types (foodgrains, vegetables, pulses, herbs etc.) are grown in a single farmland which provides nutritional balance and uphold food security in addition to small incentives from the surplus products. Therefore, shifting cultivation sites also serves as in-situ biodiversity bank for preserving indigenous food crops. Pest and extreme weather tolerant crops are also grown in the jhum land thus can be looked into as a good means of coping mechanism to climate change.
2. Shifting cultivation as a means of integrated ecosystem management in community level- All of the villages have community conserved area locally known as green belt around the vicinity of the village with varying sizes (1-5sqkm). These patches of conserved forest are under strict regulation of the village apex body that is the Village Authority (VA) and huge positive correlation between strong local institutions and effective resource management were observed.

3. The fallow cycle of shifting cultivation in all the six villages are still maintaining at 10 years and for villages like Shungri and East Tasom it has been increasing.

Village	Fallow Cycle (years)
East/South Tasom	12-13
Shungri/Sorde	16-18
Bungpa Khullen	15
Grihang	10-13
Ningchou	12
Punge	10

4. The population or number of families depending on shifting cultivation for livelihood has been decreasing in the last decade due to outmigration of younger generations to towns and cities for education or other alternative ways of living. The young population lack the skills required for shifting cultivation and huge gap on knowledge transmission has been visibly recorded. Therefore the sizes of land under Jhum have also been reduced.
5. Through the intervention of different government schemes and NGO initiatives, communities have tried shifting from subsistence to market-oriented farming such as agroforestry and mono-cropping as an alternative. But in many instances the non-indigenous crops have shown very poor yield and the remunerative returns from these initiatives are not sufficient to meet the ends need. The issue of market vulnerability and market uncertainty coupled with lack of skills and technological were also cited by many farmers.



RECOMMENDATIONS



- Linking shifting cultivation to the biosocial-cultural establishment of many indigenous communities, instead of explicitly targeting at measures to replace or eradicate this system of farming it would be more meaningful to focus on efficient management and improvement of traditional Jhum.
- The management and rejuvenation of fallow land and degraded forests through afforestation and reforestation programmes at the community level with the support of concerned government departments would reduce the pressure on Jhumland and increase the carbon sink.
- To ensure overall sustainability the concept of dual economy or combined means of livelihood must be encouraged where subsistence farming for meeting daily nutritional security is coupled with market oriented farming for better generation of income
- Coming to the better understanding of hill agriculture and ecosystem, separate qualitative research with subject matter specialist in agriculture, forest and allied research institutes must be taken forward to have deeper understanding for bringing sustainable agriculture in the mountains.
- Most importantly, the recognition and inclusion of traditional institution as a major stakeholder in the policy and legal regime of the State Action Plan for Climate Change (SAPCC) would lead to decentralization in policy making.



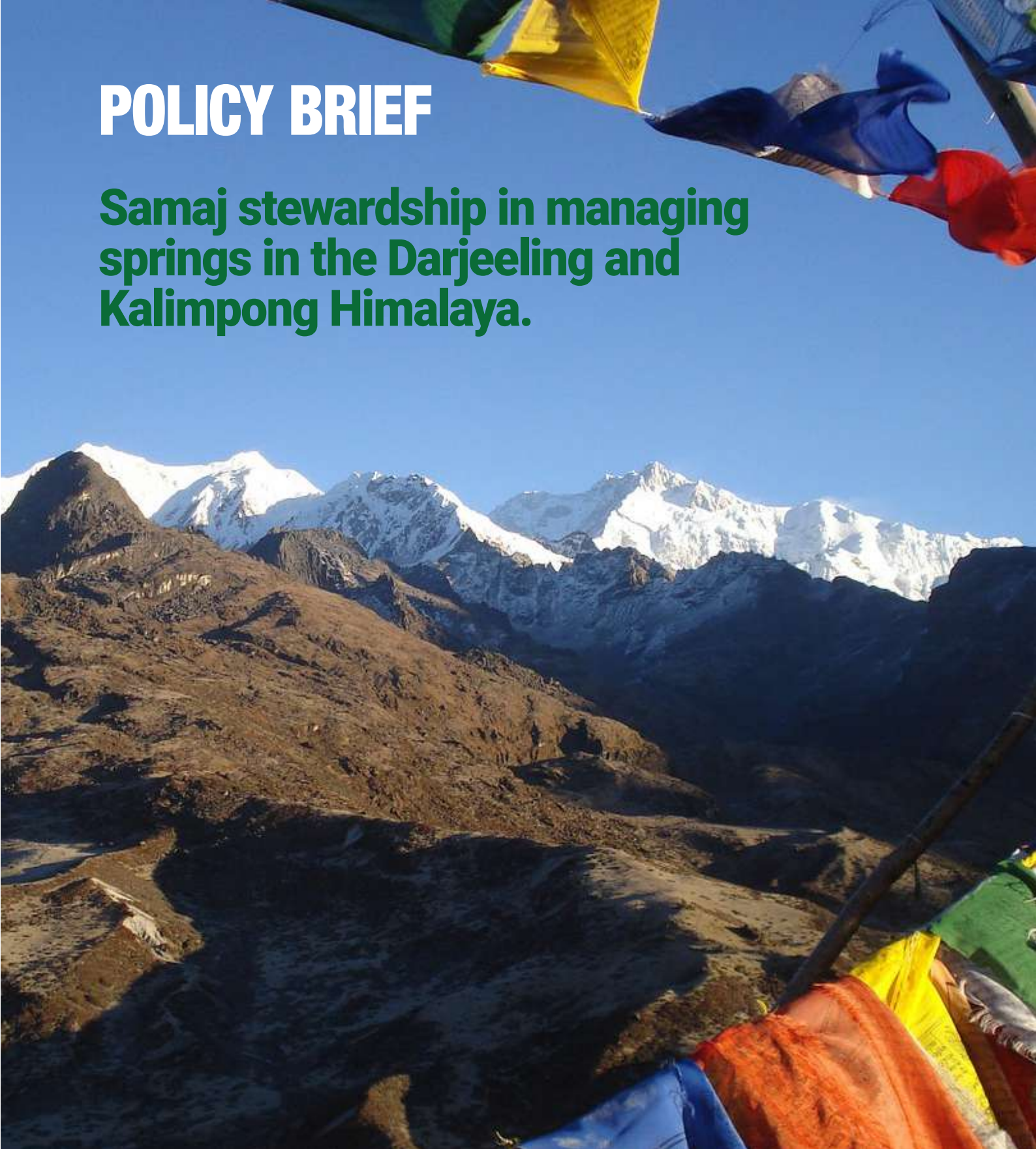
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POLICY BRIEF

Samaj stewardship in managing springs in the Darjeeling and Kalimpong Himalaya.



Ministry of Environment,
Forest and Climate Change
Government of India



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BACKGROUND

Located in the north-eastern part of the IHR are the Darjeeling and Kalimpong Districts (26.02 - 27. 13 N and 87.59 - 88.53 E; Area: 3,263 km²; Elevation: 92 m – 3539 m) occupying 3.68 % of the total area of West Bengal (Pradhan and Bhujel 2000). Darjeeling and Kalimpong Himalaya is part of a transboundary landscape adjoining Nepal in the west, Bhutan in the east, Sikkim in the north. As part of the Eastern Himalaya included among Earth's biodiversity hotspots (Myers et al. 2000) the Darjeeling and Kalimpong Himalaya is of critical ecological importance. Darjeeling Municipality was established in 1850 and is one of the oldest municipalities in India. The municipality in 2011 had a population of 120000 living in 13.81 km². Kalimpong is the district headquarter with a population size of 49,403 (Census 2011) and spread over 23 wards in 3.5 km². The town centre is located on a ridge connecting two hills, Delo and Durpin at an elevation of 1247m and 1704m. The River Teesta flows in the valley below separating Kalimpong from the state of Sikkim. The town is a major hub for the agricultural communities of the sub-division and used to be the gateway to Tibet.

In Darjeeling town, the water supply system consists of tapping 26 springs from the Senchal Wildlife Sanctuary located about 15 km away from the main town into two reservoirs, from where it is distributed by gravity through a combination of pipes and tanks across the town. However, Darjeeling currently is in a state synonymous with 'water crisis'.

APPROACH

Urban springs of Darjeeling and Kalimpong municipalities were chosen to study community adaptive practices around water and climate change. Careful consideration was taken to ensure geographical representation within the municipal landscape while studying the springs. Lanku, a rural site, was chosen as it was one of the key successes in spring-shed management in the Darjeeling and Kalimpong Himalaya. An extensive review of literature on water, climate change and other relevant issues from the study sites was carried out. A workshop with stakeholders and key informants was also facilitated to give direction to the study. Subject experts were interviewed that gave insights into issues of water and climate change.

Once the study sites were identified a combination of 16 semi-structured interviews, 2 focus group discussions and transect walks were undertaken. The semi-structured interviewee selection factored in diversity of people accessing the spring water. Water flows, discharge rates of 9 key springs were also documented. A core group of members of the Darjeeling Himalaya Initiative brainstormed the processes and development of the study as well as analysing the data emerging from the study.

The study was conducted during the months of September and January so as to have better understanding of the availability and the demand of water supply. Standard data are not available as no records or tracks were kept of the springs visited so far as there has been no intervention taken. The communities interviewed are from the different part of Darjeeling and Kalimpong as shown in the table :



No	Name of spring	Location	Ownership	Possible recharge ownership	Households dependent (approx)	Status
1	Jore Dhara	Dungra Busty, Kalimpong	Private Land	Private Land	500HH	Decline in discharge
2	Park Dhara	Ward no.19 Kalimpong	Govt	Govt	150 HH	Decline in discharge
3	Sub-edarney Dhara	Damai Tar, Kalimpong	Private Land	Private Land	80 HH	Decline in discharge
4	Raja Dhara	Bhutan house area, Kalimpong	Bhutan Govt	Bhutan Govt	100 HH	Decline in discharge
5	Pari Dhara	Block C, Homes area, Kalimpong	Private Land	Private Land	80 HH	Decline in discharge
6	Hart Spring	Homes, Kalimpong	Private Land	Private Land	3000 population	Decline in discharge
7	Lal dhiki dhara	Lal dhiki, Darjeeling	Govt Land	Govt Land	25,000 population	Decline in discharge
8	Mangal Puri	Mangal Puri, Darjeeling	Govt Land	Govt Land	200 HH	Decline in discharge,
9	Giri Dhara	Below Darjeeling railway station, Darjeeling	Govt Land	Govt Land	-	Decline in discharge
10	Mul Dara	Mul Dara, below Chowrasta, Darjeeling	Govt land	Govt land	300 HH	Decline in discharge
11	Jowahar busty	Jowahar busty 2 Below tungsung, Darjeeling	Govt Land	Govt Land	300 HH	Decline in discharge
12	Birsing Dhara	Lanku Khasmahal, Sittong, Darjeeling	Private Land	Private Land	60 HH	Decline in discharge
13	Gokul Dhara	Lanku Khasmahal, Sittong, Darjeeling	Private Land	Private Land	70 HH	Decline in discharge
14	Saroj Dhara	Lanku Khasmahal, Sittong, Darjeeling	Private Land	Private Land	70 HH	Decline in discharge

COMMUNITY BASED MANAGEMENT AS ADAPTATION PRACTICE

Of the 14 springs that were surveyed as part of this study across Darjeeling and Kalimpong Himalaya, 7 were in private landholding, while the rest were located in Government owned land, mainly that of Forest Department. However irrespective of land ownership, all springs are managed to a large extent by the community in many cases the local Samaj, mainly from a distribution and access point of view.

The management of the spring discharge, Laldhiki, Mangalpuri, Muldara, Jowahar Busty and Giri Dhara, studied in Darjeeling Municipality shows the stewardship and the diversity and management systems adopted by the samaj, in managing access and distribution.

In the face of climate change and the overreaching implications it has on springs and water flow, these community-based management interventions are good examples of best practices. However, these decentralized systems of management most often go unrecognized in larger discussion spaces around water, and there is an urgent need to document, further strengthen and include them in the water discourse.

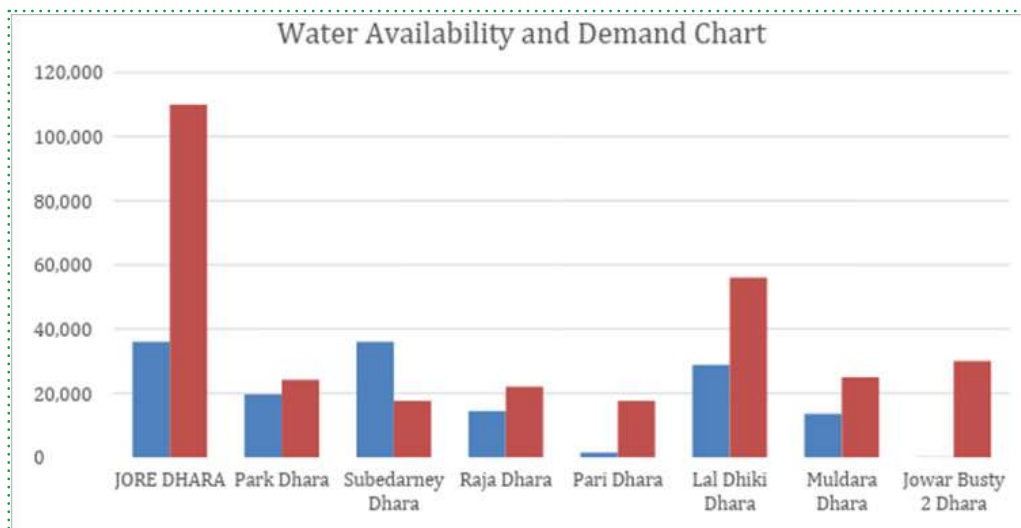
FINDINGS

A report by Kalimpong Sangrachan Samity and Gorkha Dukha Niwarak Samelan, 2012 states that water has been supplied to Kalimpong through a system from the British times. The inadequacy of water supply necessitated the Neora Khola water project. 'Kalimpong requires about 10 lakh gallons of water every day and half of the need is met by the Neora Khola scheme.' (The Telegraph 29 September 2015). This situation means that the town has a water deficit of 3,00,000 gallons per day and similar to Darjeeling does not account for the urban springs of Kalimpong.

Upper Lanku, located under Gram Panchayat Unit Sittong III of Kurseong Block District Darjeeling lying between Latitude 26°57'01.6", Longitude 088°25'09.1", Altitude- 727.5 mts above sea level. The village lies close to the NH31A above the River Teesta and the forests surrounding the village are under Kurseong Forest Division and are contiguous with Mahananda Wildlife Sanctuary. Upper Lanku has a population of around 450. Agriculture is the main source of livelihood for most of the village, with a small population engaged as labourers and in Government service as well. Erratic rainfall pattern, no irrigation facility and drying up of natural springs have perilous effect on socio-economic life status of Lanku Valley.

The community of Upper Lanku depends on three springs, Saroj Dhara, Birsing and Gokul Dhara for their water. Community narratives talk about how all three springs in the village have shown a declining trend in its discharge over the past 10 – 15 years during the winter months of November – March during which time the villagers face serious water scarcity. WWF-India and Lanku Valley Biodiversity Conservation Committee worked together to increase the discharge of two springs through groundwater recharge by reducing surface runoff thereby resulting in overall landscape level improvement in water availability in the springs as well as streams in lean seasons.

A quick analysis was also done to understand the water demand of 6 springs in Kalimpong and to match that with the water that was available from the spring flow. The water demand was calculated by the approximate population dependent on the springs and their daily requirement, while the availability was the amount of water that was flowing from the spring in 24 hours.

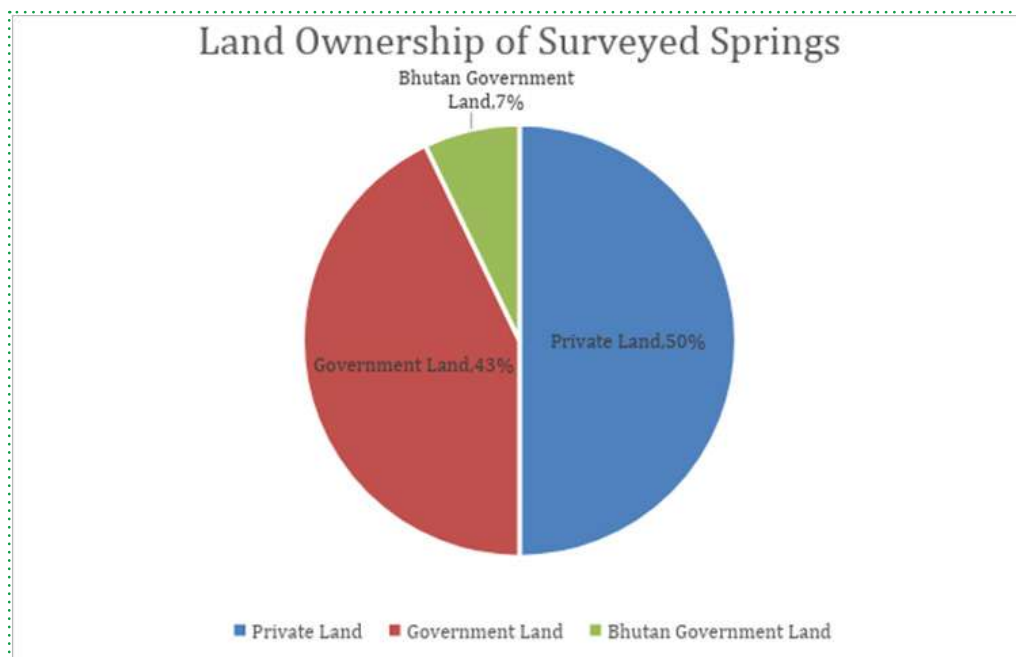


The blue bar shows the availability of water/day and the maroon bar shows the demand of water/day (source: Data collected from field visits)

As clearly seen, almost all the communities surveyed showed disparity in the water that was

available from the springs and the water that the households required for their daily needs. This does not take into account the piped water supplied by the PHE Department, which was in most cases reported to be negligible or the community did not have access to it.

WHAT DO YOU MEAN BY BHUTAN GOVT LAND?



The Land ownership chart shows the ownership of the land where the springs are located.

There is no description in the findings on the “Samaj”

RECOMMENDATIONS

- The community based or Samajas water management system should be strengthened as they are the ones who uses the springs and has been looking after it for a very long period of time and who can locally monitor the discharge and the conservation part of it.
- Technical know-how of the samajas must be upgraded on the basis of both the knowledge and skill on conservation techniques as it's the primary thing for the sustenance of the intervention.
- Spring conservation activities must be taken up by the administration as it is the primary infrastructure required for the sustainability of the community development.
- Mapping of springs and the recharge area must be an important component while planning for the development of different infrastructures in the Himalayan Region.

REFERENCES

- Climate Change and water (IPCC technical Paper VI- June 2008)
- Water Management in Post-colonial Darjeeling: The Promise and Limits of Decentralised Resource Provision-Georgina (Drew & Roshan P. Rai, July,2016)
- Water Security in the Darjeeling Himalaya, unravelling the seen and unseen forces. Darjeeling Himalayan Initiative, (Roshan P. Rai¹, Priyadarshinee Shrestha², Deependra Sunar³, Praful Rao⁴, Lakpa Tamang⁵, September 2016)
- Mapping the vulnerability of mountain peoples to food insecurity (FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS-Rome, 2015)
- WBSAPCC,2012
- Report of Working Group I Inventory and Revival of Springs in the Himalayas for Water Security, August,2018.
- The perennial springs of Darjeeling, a survey to community-based conservation. Liekel Boer, February, 2011
- (Water, Crisis and Climate Change in India: A Policy Brief (Dennis Taenzler, Lukas Ruettinger, Katherina Ziegenhagen (adelphi) Gopalakrishna Murthy, Academy of Gandhian Studies) October 2011
- The Role of Local Institutions in Adaptation to Climate Change, Arun Agrawal, Minna Kononen and Nicolas Perrin, 2009.



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POLICY BRIEF

Climate proofing of spring sheds in Meghalaya



Ministry of Environment,
Forest and Climate Change
Government of India



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Background:

It has become a regular phenomenon to hear about springs drying up or incidents of reduced discharge in Meghalaya owing to anthropogenic stress and a combination of factors ranging from erratic rainfall pattern, seismic activity and ecological degradation associated with land use change for infrastructural development causing pressures on mountain aquifer systems (MBDA, 2015). Many of the springs and water sources have dried up or have become seasonal resulting into waters shortages for domestic usage (MoST, 2017). The dependency of large proportion of the population on spring water suggests that with varying climatic conditions and rainfall pattern, a large number of villages are facing potential drinking water shortage (Pandey, 2018). The ignorance of springs in the larger context of rivers, watersheds and aquifers is also a reason for great concern as such unawareness has led to gaps in practice and policy in developing any strategic national response to spring water management in India (Shrestha & Nepal, 2015). Besides, depletion, of late, there has been increasing concern about the quality of spring water. There is a crucial need to address these issues in a holistic and scientific manner given that spring water is important for people living in the mountains.



Figure 1. Mr. Bor Borshemlang Saiborne of NERCoRMP explaining how a spring tapped chamber has been constructed to tap the underground springs and help prevent sedimentation making it more hygienic for domestic use.



Figure 2. Artificial created reservoir at the lower level of Langlewvillage, Mawthaidraishan, WKH; there is a pipe connected to a generator which pumps out water from this spring tapped chamber to the elevated sections of the nearby villages.

Approach:

A case study approach was undertaken to document the climate proofing activities for spring sheds in Mawphanlur and Mawthaidraishan villages of West Khasi Hills (WKH) district, Meghalaya in August 2018 and December 2018 –January 2019. The study started off with an intensive review of secondary literature and peer reviewed research articles. Participatory rural appraisal tools like semi-structured key person interviews and focussed group discussions were undertaken with the practitioners of spring shed management i.e. farmers, cultivators, village folk and village headman (See Figure 3). Discussions were also made with relevant stakeholders at village, district and state level including subject matter



Figure 3. Conducting Focussed Group Discussions with current headman, previous headman and locals including women.

experts including officials and experts from State Soil & water conservation department, State forest department, Meghalaya Basin Development Authority (MBDA), North Eastern Region Community Resource Management Project (NERCORMP) under North Eastern Council (NEC) & International Fund for Agricultural Development (IFAD), North Eastern Hill University (NEHU), Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ).

Results:

According to discussions with various stakeholders across villages in West Khasi Hills, the water flow in a spring gradually declines after the end of the monsoon period and may completely dry up during December to March, causing drinking water scarcities and affecting livelihoods and increasing drudgery. The depletion of spring water during the lean season, has led to shift to alternatives. People resort to immediate coping mechanisms like transport water using animals and tankers especially during the lean season or during prolonged dry spells. Drudgery to women exist during the lean season when springs run dry, as manual collection of water is done.

It was been observed that impaired springs have caused widespread water stress in these regions especially during the winter seasons adversely affecting agriculture, horticulture, livestock and other allied livelihood activities of the people and causing hardship and drudgery. In spite of heavy rainfall, there are many areas which are water-stressed due to increase in demand-supply gap leading to a rise in ground water usage. So despite heavy rainfall, the state suffers from water shortages. This is mainly due to its inability to store and capture the rain water because of its location in the hilly areas, which leads to increased surface water runoff.

The site visit to Mawphanlur village and Mawthadraishan highlighted the spring shed revival programs being undertaken under the aegis of the state government. Along the slopes of the hills, construction of staggered contour trenches (Figure 4), digging of staggered pits, other methods of impounding rainwater such as water harvesting structures and ponds (Figure 5) and changing the vegetative cover through plantations are being undertaken with the primary purpose of increasing rainwater percolation and minimising run-off. Water budgeting, introduction of improved technologies and cropping strategies would be carried out for efficient utilisation of water post conservation of springs. The state government intends to develop a geographic information system (GIS) platform for information and knowledge management for better management of the project activities.



Figure 4. Staggered contoured trenches on the hill slopes of Mawthaidraishan, WKH to reduce run off and improve soil fertility.

State level stakeholders indicated that the state government is creating a large-scale, community-based initiative developed from the ground-up to protect springs for long term water security. The state has roped in volunteers from colleges and academic institutions that will visit communities and train the youths in mapping the springs. They will be called para-hydrologists who will monitor the springs and collect the data. Similarly, communities are being encouraged to create nurseries in the spring-shed area to promote sustained groundwater recharge.

Recommendations:

- 1) **Engaging with communities** to facilitate in the planning of various potential interventions to be undertaken during the spring shed rejuvenation. With the support of traditional knowledge; communities are able to understand the various aspects of spring shed management and derive a sense of ownership.
- 2) **Capacity building** through simple yet scientific practices can be imparted to the community and state line departments to aid them in measuring water discharge, rainfall and sometimes even water quality parameters such as fecal coliform using field test kits. The emphasis of training sessions is to bring about sensitization regarding springs and hydrogeology based participatory management to enable a mental shift towards community management approaches.
- 3) **Field training and site demonstration** in developing the required infrastructure for the spring shed such as contoured trenches and staggered pits etc to intensify the recharge process and source protection in accordance to the norms set out for drinking water as well as other supporting infrastructure.
- 4) A **comprehensive inventory and mapping of village-wise springs and spring fed streams** to facilitate a comprehensive treatment of the catchment should be brought within the ambit of the Community Natural Resource Management (CNRM) plan. This will also facilitate the local communities situated on the higher ridges of the catchment area of the springs towards controlling deforestation and mining activities which inevitably affect the quality and peak flows.
- 5) The CNRM plan should also take into account the **efficient practices of forest and non-forest land usage** and related water use to help sustain normal flow of springs, streams so as to not affect the vitality of ecosystems that depend on these flows downstream, including sediment transport and circulation.
- 6) **Maintaining water quality control and treatment** in cases where the spring rejuvenation and catchment conservation activities would be linked to potable water supply through convergence with drinking water schemes
- 7) In order to develop, plan and execute a successful spring shed program, **convergence of existing government schemes** including MGNREGS, National Rural Drinking Water Program, Integrated Watershed Development Program and others, as well as collaboration between responsible line departments is significant. Such programs should be able to impart sufficient resources for providing the basic infrastructure, technological support, training and capacity building at different levels. The support of the state government is important in this regard, to facilitate an enabling institutional architecture for communities to access spring recharge areas including in forest lands.



Figure 5. Formation of water bodies due to accumulation of run-off water attributed to spring shed activities in Mawthaidraishan village, WKH.



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POLICY BRIEF

Drip irrigation practice in Mizoram for combating the effect of climate change to on farmers in Mizoram.



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Background

Mizoram is blessed with a moderate climatic condition in the country. Although the state climatic condition is suitable for the growth of most of the plants, it has started experiencing the effect of climate change.

There is change in rainfall pattern with seasonal dry period and heavy rainfall that wash away soil nutrients and thus reduce annual crop production. This also leads to scarcity in freshwater. The year 2005, saw extended dry periods in Mizoram. Many springs and streams dried up accompanied by large-scale landslides (ICIMOD, 2008).

Drip irrigation known as micro irrigation can ensure equitable water distribution, save water and energy input as well as increase crop yield. Crop yields are adversely affected both in excess or deficit of water supply.

Drip irrigation is a technique in which water flows through a filter into special drip pipes, with emitters located at different spacing. Drip irrigation is adaptable to any farmable slope and is suitable for most soils. Basically, the farmer can control how much water each plant gets so that there is little water waste. This method is effective because it avoids the arbitrary placement of water over the whole expanse of a field, regardless of whether the plant is actually receiving the nourishment or not. Additionally, drip irrigation can help decrease eutrophication (which is when bodies of water receive an unhealthy dose of fertilizers such as nitrogen and phosphorus through farm runoff). Instead of excess runoff dragging harmful chemicals into rivers and streams, little to no water is wasted. Through drip irrigation only the immediate root zone of each plant is wetted. Therefore, this can be a very efficient method of irrigation.

Practising drip irrigation system is one good adaptive measure for combating the effect of climate change which is now practised in various districts of Mizoram by hundreds of farmers.

Observation and findings:

Within the study area drip irrigation system was practiced in two types of land a) slope or terrace land and b) plain area. This study illustrates that drip irrigation system is spreading in Mizoram for agriculture or farming practices due to increasing demand of water. The practice of drip irrigation could be considered as an adaptation measure for the farmer, because it required less amount of water and enable farmers to grow plants throughout the year.

1.

It was found that terrace areas required less amount of water compared to plain area because water flows at a higher rate and was distributed evenly within a shorter period of time compared to the plain area.

2.

Mulching film was used to cover the water dripping area which prevent the rapid loss of water and thus required lesser amount of water as it conserves the water longer.

Recommendations:

1.

Although drip irrigation system itself is good enough to be taken as an adaptive measure for combating the effect of climate change, use of mulching film with drip irrigation makes the system even more effective. Therefore, there is a need to increase the usage of mulching film in combination with drip irrigation among the farmers.

2.

Proper maintenance of drip pipeline is required as clogging can occur easily. Therefore, training program is necessary at the beginning of installation and at least once in a year for long term usage by the farmers.



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Agro-Biodiversity for Food, Nutrition and Ecological Security:

A Case Study on Jhum Agriculture, Nagaland



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Background:

Lives and livelihoods of the mountain people in the Himalayan region are highly dependent on climate sensitive resources like agriculture, forest biodiversity and water for sustenance (INCCA, 2010), (Niti Aayog Report, 2018). Agriculture and allied sector is the largest contributor to the economy of Nagaland and is the development priority to achieve 'Food for All' by 2025, and also envisioned as an important component in Nagaland's 'Vision 2030'. Predominantly agrarian, Jhum cultivation (rainfed) is the most common form of traditional agricultural system practiced across the State (Economic Survey 2016-2017, Government of Nagaland), (Nagaland State Human Development Report, 2016). Nagaland's topography and terrain is mountainous in nature with high hills, deep gorges and sharp crest ridges. Despite the inaccessible terrain feature, socio-economic instability or impediments, geo-ecological fragility and seismic ecosystem exposing the community to climate variability, its people have built resilience by balancing the present needs through their traditional Jhum agriculture. Jhum is widely practiced across the Himalayan mountain states of Northeast and tropical regions in South East Asia. As per the Task Force on Shifting Cultivation set up by the Government of India, an estimated 6.2 lakh families are engaged in Shifting cultivation (Report 1983) and a cumulative area of 1.73 million hectares under the practice in NE India during the period 1987-97 (Report 2003). More recent figures provided by the Indian Council of Forestry Research and Education, published in the Statistical Year Book 2014 by the Ministry of Statistics and Programme Implementation (MoSPI), suggest significant reduction in the area under shifting cultivation over the last decade (2000-2010).



Some agricultural produce harvested from Jhum field.

The UN Climate Change Annual Report 2017 strongly streamlines the magnitude of indigenous people and local communities' traditional knowledge and perspectives, their role and contribution to climate change adaptation and traditional coping mechanisms.

The bio-diverse traditional Jhum or swidden agricultural sustainable farming system is embedded in Naga's socio-economic, ecological and cultural way of life. It is a coping and adaptation mechanism to combat climate variability in rural communities. It also enhances seed sovereignty and alleviates poverty and hunger. In a Jhum field, 15-40 diverse crops are grown together and harvested on a rotational basis. Maintaining genetic diversity serve as an insurance for the farmers in the context of climate variability, because even when one crop fails, other crops thrive. It sustains their family, contributes to community's local food production and food chain. The practitioners of this system are known as swidden cultivators/ agriculturalists or Jhumia. Jhumias are typically small land holders or marginal farmers, who cultivate in privately owned and clan-owned plots of land, or community owned forests within and in adjoining village boundary. They are the custodians of agro-biodiversity in their community.

The in-depth study was undertaken in Chizami village. However, field visits to other villages like, Tsupfume, K.Basa. K.Bawe of Phek district, Salomi and Pungro village of Kiphire district and Old Pangsha, Hakchang of Tuensang and Wokha village of Wokha district were included in the study as these communities widely practice Jhum agriculture. The other stakeholders including Governmental and Non-Governmental agencies involved in the study are:

Sl.No	Stakeholders
1	Government of Nagaland
2	Nagaland Science and Technology Council (NASTEC)
3	The Energy & Resources Institute (TERI)
4	Integrated Mountain Initiative (IMI)
5	Sustainable Development Forum, Nagaland
6	Department of Forests, Environment and Climate Change, Government of Nagaland
7	Youthnet, Nagaland
8	Chakhesang Public Organisation (CPO)
9	North-east Initiative Development Agency - Tata Trusts
10	North-east Network, Nagaland
11	NEPED
12	CCA-NER, GIZ
13	Land Resources Department, Govt. of Nagaland
14	Agriculture Dept., Govt. of Nagaland
15	Horticulture Dept., Govt. of Nagaland
16	Nagaland Beekeeping & Honey Mission
17	State Agriculture Research Station (SARS), Agriculture Dept. , Govt. of Nagaland
18	IFAD - FOCUS
19	Eleutherous Christian Society (NGO), Tuensang district

Community's Approach/ Findings:

Jhum agriculture is an ecosystem based adaptation with tacit indigenous knowledge. For centuries, it has been a vastly productive form of ecological farming. Some of the major findings are:

- ▶ Traditional Jhum practice is participatory, effective, ecological and sustainable.
- ▶ The Jhum technique is local and cost-effective. Low agricultural inputs is applied through efficient use of natural resources like decomposition of biomass from fell trees, wood chips, branches, twigs, leaves, shrubs/plants, residue crop mulching to improve the process of soil macro fauna (earthworms, termites) to enhance the soil nutrients and soil structure through natural process.
- ▶ Traditional Jhum adopts good fire management, soil and water conservation measures. Mountain tops where the natural forests are, is protected by the community as it is their water resource catchment area.
- ▶ Intercropping, rotational crops and fallowing for regeneration of forest practiced in the traditional Jhum agriculture ensures year round food, nutrition and livelihood security. Thus, it generates social, economic and cultural benefits and also help maintain resilient ecosystems in the process.
- ▶ The practice is based on the community's specific adapted agro-diverse cropping patterns and use locally available natural resources. It sustains the



Jhumia's voice: It is our indigenous community's social identity, heritage, wisdom and wealth, cultural values and food and nutritional security. It is our right and collective responsibility to maintain, upholds, protect and preserve the traditional knowledge and skills and our environment'

indigenous community's wealth of knowledge, skill and innovation. Community resilience is embedded in their traditional knowledge.

- ▶ The decision-making mechanism on selection, resource management, land use and ownership practices are historically managed and governed by the social institutions through community norms, customary laws and cultural values which is tribe/ village specific. Traditional institutions play a significant role in influencing the decisions of local communities.
- ▶ Jhum agriculture is women driven as they play a significant role in selection of seeds to post-harvest management. However Women are excluded in land-holding and therefore this impacts their decision-making in management and protection of the resources at the community level.
- ▶ Poor infrastructure and market inaccessibility for their agricultural produce and therefore limiting livelihood opportunity
- ▶ Heat stress, water stress and climate variability is posing a challenge to the community's health and food security.

Recommendations:

Below are lessons learnt from Community's coping and adaptation strategies. These also provide an opportunity for other States to replicate the bio-diverse Jhum agriculture practice of Nagaland:

- ▶ Recognize traditional agricultural contribution and incorporate to State climate change policies.
- ▶ Recognize Indigenous communities' contribution to ecological food and farming systems.
- ▶ Safeguard the traditional agro biodiversity conservation and retain farmers' right to their biodiversity and traditional knowledge systems.
- ▶ Recognize and acknowledge women farmers' contribution to sustainable agriculture through conservation of genetic diversity.
- ▶ Integration of agro-forestry and improved fallow management: Improve or better land use management and longer fallow cycle, cropping and agro-forestry system based on local context-based solutions.
- ▶ Enhancement of livelihood opportunity: Facilitate marketing opportunities for Jhumias by supporting with market infrastructure, inputs and capital to enhance their livelihood opportunities.
- ▶ Identify existing traditional agriculture practices that are climate-resilient and focus on building/ improving these practices and integrate with appropriate technology.
- ▶ Ensure community's access to appropriate technology for improved production and to decrease drudgery of work, especially for women.
- ▶ Research and Documentation: Documentation of Indigenous Technical Knowledge (ITK) and practices. Traditional knowledge of the agricultural system can be a good source of information at the local ground and may provide simple and effective solutions for climate change adaptation. Use of traditional knowledge as a strategy for decision-making on climate change.
- ▶ Recognize traditional knowledge holders and acknowledge their significant role and contribution to climate resilience across the States in the Himalayan region. Their knowledge will be their contribution to climate change adaptation and mitigation.
- ▶ Develop data repository of traditional knowledge system and practices of community-based climate change adaptation and coping practices.
- ▶ Introduction and promotion of the documented traditional knowledge/repository in formal education and through public education to reach out to diverse stakeholders.
- ▶ Strengthening the existing local institutions and support them with effective and context specific policies towards a diversified and climate resilient agriculture.
- ▶ Develop an operational guideline framework based on the traditional techniques and inputs, available climate change adaptation practices from other Himalayan States and other Regions.
- ▶ The need for Shift in State policy to categorize shifting cultivation fallows as 'arable, regeneration fallows' from 'abandoned wastelands' and as 'unclassed state forests' (Report of Working Group III, NITI AYOg, 2018).



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POLICY BRIEF

DHARA VIKAS – Reviving the springs of Sikkim



Ministry of Environment,
Forest and Climate Change
Government of India



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Background:

Springs have been the main source of water for communities living in the Himalayan landscape of Sikkim. However, with the ever-increasing effect of climate change on rainfall pattern, there has been increasing instances of springs drying or becoming seasonal. The South and West part of Sikkim have been in the rain-shadow area and as such the villagers suffer from water scarcity during the dry season. However, this problem has reduced after the implementation of the Dhara Vikas programme. Implemented in 2008 by the Rural Management and Development Department (RMDD), Dhara Vikas in Sikkim was launched with an objective to revive critical springs, streams, and lakes. For the entire project, the geo-hydrology technique was carried out which included the mapping of springsheds, monitoring of spring discharge and quality. The spring revival technique was implemented on the sloping lands which comprised mostly of staggered rows of contour trenches.

The objective of this programme was to empower and protect the livelihood of the local beneficiaries dependent on springs and streams for domestic and agricultural purposes. The programme has succeeded in reviving 55 springs in Kaluk, Rhenock, Ravangla, Sumbuk, Jorethang, Namthang and has recharged 1,035 million liters of groundwater annually in the last 4 years.

Approach:

The study included extensive review of available literature including published journals, news articles, and grey literature. To get first-hand data, field surveys were undertaken in three villages of West and South Sikkim (Deythang, West Sikkim and Bikmat, Sumbuk in South Sikkim). Information was gathered using semi-structured formats, interviews and group discussions with key stakeholders including officials from line departments such as Rural Management and Development Department and Department of Science & technology. 25 household surveys were conducted in each village and an FGD was conducted in Sumbuk with the water users to understand the demand and trend in water availability after the implementation. A discussion was carried out with the Panchayat members and Field Facilitators to analyze the gaps and challenges towards ensuring water security in Sikkim.



Fig 1: Focus Group Discussion in Sumbuk



Fig 2: Increasing number of water harvesting structures below the spring sources



Fig 3: Spring Discharge Measurement in Bikmat

Findings:

The impact-assessment study of the programme provides evidence that spring discharge has increased over the years. The following table shows how Dhara Vikas has proved to be beneficial in the studied villages.

Pre-Implementation	Post-Implementation
Drying of springs during the lean season/reduced flow	Increased flow of springs/dharas
Reduced crop production during the dry season	Increased irrigation – Beneficial to agriculture and farming
Dry forest cover	Increased Forest Cover
Water disputes	No water disputes
	Reduced landslides, flood control and downstream field damage due to controlled run-off

Recommendations:

Niti Ayog report of Working Group I, “Inventory and Revival of Springs in the Himalayas for Water Security” stated that some of the success stories led by few State government agencies can play in effective mobilization of resources and implementation of springshed management programmes and must be replicated by other states too. The Dhara Vikas Programme initiated in Sikkim suggests that this approach has potential in enhancing rural water security in mountain states.

Our study recommends the following:

1. Need for data inventory and sharing:

- Since trends in the low flow of springs and rainfall share common correlation it is important to have a rainfall and temperature database. Hence, the State should have a data repository with rainfall and temperature data as well as water resources data.
- The capacities of Gram Panchayat Unit needs to be built by providing equipment and training to measure rainfall and temperature. Discharge of springs should be done in an institutionalized way to enable the comparison of data.
- Several agencies have rainfall data but it is not shared. Therefore, data sharing through the public domain is equally important.

2. Community ownership through funding and knowledge sharing:

- Our collection of spring discharge data shows a decline in the discharge of the spring sources of the studied villages. This has been attributed due to the lack of desilting. This would require community ownership and awareness within the villages where the programme is or will be implemented. Therefore, there is a need for an institutionalised mechanism for funding and for community ownership, both required for the desilting of the trenches.
- Decrease in the spring discharge of the studied villages post implementation of the programme has been observed. The discharge data of April 2015 was received from the Rural Management and Development Department, Sikkim and the data of April 2018 was compiled during our field study. The reason could also be if the trenches are not being desilted from time to time and the uncontrolled manner in which tapping is being done which can lead to serious water disputes in the future. Therefore, the issue of sustainable water management will also have to be addressed deeply as the number of poly pipes being tapped with the source is ever increasing. Thus, public awareness of water conservation and management is an urgent need to manage the springs of Sikkim.

3. Strengthening of laws related to water:

- a) Groundwater policy regarding deep bore wells and water tankers needs to be studied. Village water resources should be mapped and updated periodically.
- b) It is vital to build a connection between project stakeholders, policy makers, and the community. There is also an urgent need to have Underground Water Policy in the State.
- c) It is also important to monitor whether the Village Water Security Plan is being implemented in an institutionalized way.



Fig 4: Overtapping around the spring source as seen in Deythang, West Sikkim



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POLICY BRIEF

IMPACT OF CLIMATE CHANGE IN ORANGES AND SUCCESSFUL ADAPTATION STRATEGY OF ARECANUT PLANTATIONS

IN JAMPUII AND SAKHAN HILLS OF TRIPURA



Ministry of Environment,
Forest and Climate Change
Government of India



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This policy brief is the output of a research project titled 'Understanding Mountain Peoples' Approach and Practices to Combating Climate Change in the Indian Himalayan Region: Research to Renewal and Reforms' funded by National Mission on Himalayan Studies (NMHS) under MoEFCC led by Integrated Mountain Initiative and TERI.

BACKGROUND

Orange cultivation in Jampui and Sakhan is the economy backbone since 1960s. Due to sudden outbreak of disease and rapid yield decline in the last 10-16 years, a large area of orange cultivation is replaced by arecanut cultivation. In concern of the cause, a case was studied with the objective to understand the impact of changing climate and its role in orange mortality at the hilly area of Tripura. It also studies the alternate measures and adaptive strategies adopted by the same to combat climate change in two different locations i.e. Sakhan hills and Jampui hills. The field interviews, survey & group discussion were carried out among 100 respondents.

JAMPUI shares a boundary with Mizoram and Bangladesh. As per the census, 2011, Jampui has a total population of 12,311 (including institution and houseless population) living in a rural area of 343.74 sq. Km. Out of the total population, 11,391 ST (Schedule tribe) population, whereas negligible SC population of 26 person is recorded in the area of Jampui. The major communities of the area are Mizo and Reang. Four villages, namely Hmunpuui, Vanghmun, Phuldungsei and Sabual are selected for the study as most of the communities of the site were orange growers who turned into arecanut cultivators.

SAKHAN SERHMUN (S.K Serhmun) is located at latitude 23°08' and longitude 92°16' sharing a close boundary with Dhalai hills. As per the Habitation survey of Dasda Sub-Zone under North zone, TTAADC (Tripura Tribal Areas Autonomous District Council), Sakhan Serhmun hills has a total population of 3173 person in six villages out of which 50 cultivators are selected randomly from Serhmun-I, Serhmun-II, Sollung para and S.K Tlamsang for field interview and discussion. The main occupation of these hill communities is jhumming. Most of the farmers depend on the orange (*Citrus reticulata* Blanco) and arecanut (*Areca catechu*) cultivation for their livelihood.

FINDINGS

Reason Behind the decline of oranges:

The study indicates that the initial stages of disease are powdery mildew which is followed by little leaf disease, citrus greening and die back of citrus. The stem pitting like peeling of bark on orange trees is also observed on the standing few orange trees in *Sakhan hills*. It is found that the initial disease, (powdery mildew) occurred in the villages that has maximum deforestation activities (*Hmunpui, Vanghmun*) while the villages area that has less disturbance in the forest stands (*Tlangsang, Sabual, S.K Serhmun*) showed delayed occurring of the same disease by 2-5 year for the same disease. Therefore forest cover and deforestation plays a major role in alteration of the microclimate of the orange fruit trees in the hilly area of Tripura. Lack of biodiversity and cultivars of mandarin in the plantation site poses a threat against attack of pests and diseases. Therefore loss of biodiversity in the studied site is another cause of mass orange mortality. The study further found a large gap of technological, industrial and socio-economic development in the vision of sustainable development and climate resilient initiatives.



ARECANUT CULTIVATION

The horticulture department of the state has explored the possibility of arecanut cultivation in hill areas in the last few years. With the collective effort from Horticulture department and hill community, the orange growers shifted to arecanut cultivation as an adaptive strategy against the disease attack of orange plantations. Due to favorable climatic requirements in Jampui and S.K Serhmun, the arecanut cultivation is massively adopted in the studied site as a means of livelihood and stable farming. However, monocropping may lead to unsustainable practice in the long run, the example being mono-cropping of Orange in Jampui and Sakhan which led to widespread of disease at a faster rate.

As per survey, Beetle nut could be sold as high as 2-3 rupees per nut in the market. It is sold at a wholesale rate @ 1500-2000/sack. A sack full of beetlenut (arecanut) contains 2000-2500 nuts in fresh form. Most of the respondents have 5000-10,000 plant populations depending on their landholding. Although the standard spacing is suggested as 2.5-3 m X 2.5-3 metre, the spacing are not maintained by the growers. These communities are fetching good income from the cultivation earned upto 5-10 lakhs per year.

Range of Annual Income (in Rupees)	Number of Respondent (In respect to their Income) before the year 2010		Number of Respondent (In respect to their income) in the year 2017	
	Orange	Arecanut	Orange	Arecanut
10000-20000	5	10	58	14
20000-400000	8	NA	38	19
40,000-80000	40	NA	4	25
80000-1.5 lac	31	NA	NA	20
1.5-3 lac	7	NA	NA	16
> 3 lac	9	NA	NA	6
Total	100	100	100	100

Table : Annual Income of the Respondents (Prange & Arecanut growers)

Source: Saniel T Reang, Field interview, IMI-NMHS, 2018

The arecanut also hold many advantages over the fruit in terms of market demand, post harvest management and preservation. It can be sold in fresh form or dried form. The nut sizes are large compared to the nut obtained from lowland and plain area. The climatic requirements seem to be favorable in the hills of Jampui and Sakhan. As a result, arecanut growers have found their ultimate strategy to bring stable economy to their social life.



RECOMMENDATIONS

- In Tripura, SAPCC may include the **action plan focusing on the hill resident's development** particularly in terms of environment friendly agriculture and sustainable forest.
- In order to bridge the technological gaps, **establishment of a research hub** like Krishi Vigyan Kendra, Van Vigyan Kendra in the hills to impart sustainable development education and research in the hilly areas of Tripura is essential.
- Beside sole cultivation of orange and arecanut, **capacity building to maintain the ecological diversity** of many indigenous fruit trees growing naturally (such as Ber, Mango, Jackfruit, Papaya, wild Plum, Bael, Amla, Banana, Tamarind, Langsat (*Lanisum parasiticum*) locally known as Ksamai in S. K serhmum can be promoted, and provided market linkage.
- There is an urgent need to tap the genetic biodiversity of crops which is depleting in many places due to replacement of jhumming practice by stable economic practice such as arecanut, and orange plantations. This kind of practice must be re-evaluated by the policy makers for sustainable future in terms of seed storage and tapping indigenous landraces/ cultivars of many crop species. The **climate resilient steps and approach** is necessary in terms of planning for livelihood generation.





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POLICY BRIEF

Barah Anaṛa

TRADITIONAL SYSTEMS FOR RESILIENCE BUILDING: A CASE IN UTTARAKHAND



Ministry of Environment,
Forest and Climate Change
Government of India



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Background

Uttarakhand is the newest Indian Himalayan state where demography and environment are largely governed by altitudinal variation. Geographically it has been divided into five zones tarai, *the doons*, *the middle Himalaya*, *the great Himalaya* and *the trance Himalaya*, which are characterized by diverse climatic zones. A critical problem of the region is loss of forest cover, increased soil erosion, reduced runoff in rivers and spring discharge. Glacier and snowmelt also provide good flows in summer season. Currently, forest cover is 65% of the area (SAPCC, 2012). Average rainfall of the state is 1550 mm. 70% of the population is engaged in Agriculture, but 92% of them are marginal cultivators. Only 10% of the agricultural area is irrigated. The state rivers have enormous cultural and religious significance with for major shrine located near origins of Alakhnanda, Mandakini, Bhagirathi and Yamuna rivers. Livelihoods are also derived from religious as well as recreational tourism (Chopra et al. 2014).

Climate change impacts include excessive spells of rain and increase in mean intensity of monsoons (Ashrit, Kumar, & Krishna, 2001; Chung & Ramanathan, 2006). Agriculture in Uttarakhand is likely to be affected due to increase in temperatures, farmers are experiencing change in peak rainfall and winter precipitation with increased incidences of cloudbursts (GOU, 2015). Agriculture and allied activities contribute to 27.71% (during 2015) to state gross domestic product, where as 70% of the population is dependent on it.



THE TRADITIONAL AGRICULTURAL SYSTEM OF *Barah Anaja*

Barah refers to “12” **Anaja** or **grains** which includes, millets, legumes, vegetables and spices (Jardari 2010). This is a mixed inter cropping system prevalent in IHR, where 12 crops are **sown** in a piece of land **simultaneously**. Around 20-22 variety of crops are said to be a part of this mixed cropping system which varies according to climatic and geographical conditions in the region. The 21 crops are: Mandua, Ramdana, Kuttu, Jowar, Corn, Rajma, Kulath, Bhatt, Reyans, Gurunsh, Tur, Urad, Lobia, Ragadvaans, Gurunsh, Moong, Bhangjeer, Til, Jakhya, Bhang, San, Kheera. (Jardari 2010).



Barah Anaja system not only caters to the food security and nutrition of people in this region but also good for soil fertility and animal husbandry. This traditional system has also been highlighted by historians, who have documented the living standard of traditional farmers in Garhwal and Kumaon regions, stating that their cropping pattern catered to all the needs they had like, food, cloth and shelter for the domestic animals (Jadari 2010).

This system is a rain fed agricultural system, which does not require any chemical fertilizer, putting it in the category of sustainable agriculture. This system can be seen as a good practice and potential to contribute as climatic adaptation due to inherent characteristics of the system, and builds resilience to climatic variability and change in the long run.

Study area

For this study **Kimkhola village**, Block Dev Prayag, at the confluence of Bhagirathi and Alaknanda rivers was taken up. Kimkhola, has approximately 150 households mainly inhabited by Rajput community, is the farthest from the motorable road and is located atop a hill and spread out on slopes on both sides. It is a 3 km trek away from the road. Agriculture and allied activities is the mainstay of the economy. Total main workers in Tehri Garhwal comprised of 62.93%cultivators, 0.83 per cent agricultural labors and remaining 36.24%non-agricultural workers. The district also has high proportion of marginal workers - 31.55% as compared to the state average of 25.9%. Other sources of livelihood include household industry, casual employment, and tourism related income generating activities like shop-keeping, running eateries, providing accommodation etc. Only a minority of them work as government employees and army personnel (WSMD, 2009).



Methodology

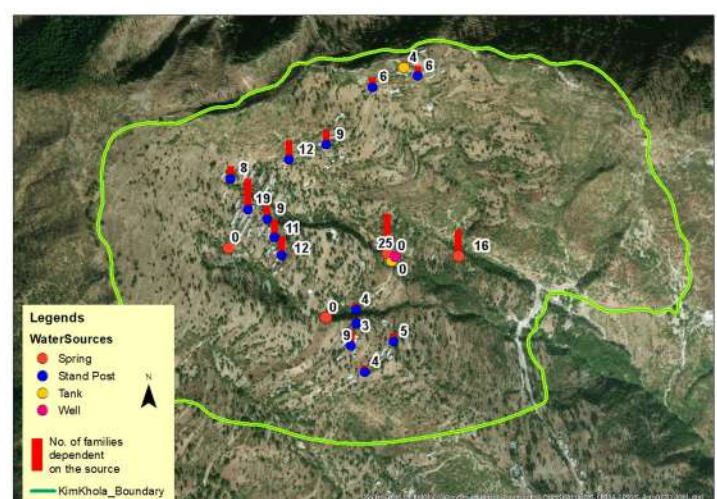
Participatory resource mapping was conducted on cadastral maps in some cases, which were made available from revenue officer (Patwari) at the village office. This map was taken to the community to identify their natural resources and initiate a discussion on them (Sharma et al. 2019). Participatory resource mapping helps in understanding the status, scale and area under cultivation for different barah anaj crops. Check list was prepared beforehand and discussions were carried out revolving around a range of topics like identifying area under irrigated/ unirrigated land, sources of irrigation, sources of drinking water, crop pattern and crop productivity, area under settlements, road network and village infrastructure etc.



Organizations Visited		Type	
TERI Delhi	NGO	Sector Expert	Mr. Vijay Jaydhari
TERI Dehradun	NGO	Communities Interviewed	ST & SC(Rajput)
CEDAR	NGO	FGDs	3
Watershed Management Directorate, Uttrakhand	Government	KII	3
		Oral History	1
Land Revenue Department, Devprayag (Patwari)	Government	Resource Map	1
		Crop Calendar	1

Analysis

- In the study area, soybean, potato, turmeric, paddy, mandua, maize and rajma are grown in kharif season. Whereas, wheat, ginger and onion are grown in rabi season. Majority of farmers are small and marginal. Agriculture is mostly **non-mechanized**, rainfed and is done for subsistence purposes.



MONTHS ► CROPS ▼	ASOOJ (SEP)	KARTIK (OCT)	FAGUN (FEB)	BAISAAKH (APR)	JETH (MAY)	ASHADH (JUN)	BHADO (AUG)
Madua	Harvesting				Sowing		
Bhatt	Harvesting					Sowing	
Urad	Harvesting					Sowing	
Moong	Harvesting					Sowing	
Raamdana/ Chowlai,maarsu		Harvesting			Sowing		
Lobia/Sungta	Harvesting					Sowing	
Jhangora			Sowing				Harvesting
Wheat	Sowing		Harvesting				
Gahat		Harvesting				Sowing	
Rajma	Harvesting					Sowing	
Kheera,Loki,Petha						Sowing	Harvesting

(Source : Field work)

- There has been a shift in cropping pattern, as cultivation has shifted to soyabean and vegetables to increase the household income. Also, few farmers have started growing wheat instead of Mandua.
- The widely practiced crop diversifying system of ‘Barah anaja’ in the mid hills where more than 12 varieties of crops are cultivated together is prevalent in the study village. Although it has been modified to cater to the needs of the present situation of farming community.
- Discussion with stakeholders also revealed that due to non-availability of credit support and inputs and poor irrigation facility and either diversification or intensification has become difficult but agro-ecological conditions favor diversification of crops.
- Further, events of attacks by monkeys and wild pigs on crops is on a rise and is leading to decrease interest in farming. Also, almost every household in the study village had one family member who has migrated to nearby town/city in search of employment.



Recommendations



- Replication at newer sites will be ensured by **enhanced awareness towards the concept itself**, ease of access to funds, and involving multiple stakeholders at various levels, especially organisations present at grassroots levels for facilitating implementation.
- **Collaboration with organisations** at community level for ease of implementation owing to existing rapport.
- **Capacity building of potential implementers** (government officials and planners) in order to ensure involvement at various levels and raise awareness regarding climate change adaptation and concept “**barah anaja**” system, to promote ‘soft measures’ along with ‘hard’ in existing policies.
- **Ensure finance mechanisms** for supporting implementation of various activities. There is budget allotted within existing programs prioritising implementation of ‘hard measures’. Such measure needs to be converged within the same ‘more crop per drop’.
- Conducting **timely monitoring and evaluation** of adaptation measures in order to avoid maladaptation and being mindful of selection of climate appropriate strategies.



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