Sitaram Rao

LIVELIHOODS INDIA

CASE STUDY COMPENDIUM 2022

Sitaram Rao
CASE STUDY COMPETITION
documenting and disseminating knowledge

Climate Resilient Livelihood Models

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ACCESS Development Services is a national livelihoods support organisation with a focus on incubating innovations for promoting sustainable livelihoods of the poor. Set up in March 2006, as a "not for profit" organization with support from DFID (Govt. of UK), ACCESS is structured uniquely, to work at all levels of the value chain - implementing programmes on the ground, working with Government, Corporate Sector, Multilateral / Bilateral Agencies and Civil Society organisations, to improve and enhance their programme implementation and also undertaking initiatives to support, inform and influence policies. The ACCESS mandate emanates from the analysis that the poor continue to teeter on the brink of subsistence due to lack of access to resources, services, information, finance and markets and composite models will deliver durable outcomes. The lack of social capital perpetuates their vulnerability. Several inventive and integrated models in livelihoods strengthening have been developed by ACCESS which have helped the poor to overcome these impediments.

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Preface

While Climate change is one of the biggest challenges of the 21st century. It negatively impacts a wide range of livelihoods, particularly rural livelihoods as they are heavily reliant on agricultural activities and more vulnerable to climate-induced risks and shocks. Investing in adaptation interventions to widen livelihood options and develop more resilient livelihoods is therefore crucial to ensure vulnerable communities are able to cope with the impacts of climate change and the increasing frequency of extreme weather events.

For the year 2022, the Sitaram Rao Livelihoods India Case Study Competition invites cases from across the country that are built around models that are climate resilient while supporting livelihoods and showcase evidence of sustainable impact to the lives and livelihoods of the poor. The Sitaram Rao Livelihoods India Case Study Compendium 2021 has brought together ten such cases from across the country that show evidence of sustainable impact to lives and livelihoods of the farmers & rural poor through resilient agricultural value chain development, natural farming and watershed development among others.

Overall 42 cases were received. The cases were put through a rigorous evaluation process and were assessed by an expert jury composed of Meera Mishra, Dr. Madhu Sharan, Rajiv Ahuja and Suneel Padale who adjudged them and came up with the top 3 winners. On behalf of ACCESS, I express my sincere gratitude to the Jury Members for volunteering their time and efforts for deliberating upon and collating the final list. I'm sure that their critical examination and their expertise has contributed to bringing the best cases to the fore. My sincerest thanks to our Technical Partner IRMA and Prof C Shambu Prasad for helping us narrow down the best ten cases. I would also like to thank those who have shown interest in the case study competition and submitted their cases.

I'm deeply indebted to UNDP for their invaluable support to the Case Study Competition. I also express my gratitude to the Livelihoods India Advisory Group and our CEO, Vipin Sharma for their guidance in the conduct of the Competition. Last but not the least I would like to thank the Livelihoods India team of Parul and Lalitha for facilitating the process in a seamless manner. I hope this compendium will prove to be a useful resource on climate resilient livelihoods models and prove to be of value to the sector.

Puja Gour
Vice President

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Medicinal and Aromatic Plants Cultivation for Climate Change Adaptation and Value Chain Management in Chamoli District of Uttarakhand

Deepti Ameta, Manoj Karayat and Arpana Nandita Tirkey

1. Introduction

Apiculture was one of the most flourishing cottage industries in the Himalayan area until climate change, and ecological degradation started. The honeybee has proven to be a good biological indicator that is easy to use for environmental biomonitoring at any scale. When Udyogini first started its work in Uttarakhand, they observed that even though the Himalayan region is rich in floral diversity, the region exhibits a bleak picture of alternative livelihoods based on apiculture. Agriculture too did not appear profitable due to rising cultivation costs, a decrease in land productivity, reduced per capita land due to land fragmentation high transport and logistics costs, the migration of farmers to cities in search of better livelihoods, as well as changing climate patterns that lead to 50% crop failure. The situation was further aggravated by damage to the food crops caused by wild animals, which is also becoming one of the prominent reasons that cause farmers to move away from the traditional farming system. This was also the time when Chamoli faced massive flash floods and landslides due to the melting of the Chorabari glacier, which caused a deluge in the Mandakini river and resulted in deaths of residents and tourists, as well as extensive damage to property.

The tourism industry, which was the mainstay of livelihood in the vicinity, was severely affected by the calamity. Additionally, the event culminated in a catastrophe for locals as prices of all essential goods saw a steep increase in the wake of the floods, which caused landslides, roadblocks, etc. The loss of income and livelihoods, coupled with an increase in the prices of essentials, pushed more and more people to extract and harvest medicinal and aromatic plants from the wild, which put immense pressure on the ecosystem. The unsustainable harvest of MAPs from alpine meadows (locally termed 'Bugyals') and forest areas has put pressure on the natural ecosystem of the Himalayan region; consequently, today, more than 150 medicinal plant species are on the verge of extinction in the Himalayas. To further exacerbate the situation, a lack of transparency and traceability mechanisms in the trade of MAPs ensures that they are better harvested from the wild than brought under cultivation. Around 90% of medicinal plants used by industries are collected from the wild, leading to environmental degradation.

While the locals understand the impact of the unsustainable collection of MAPs (medicinal and aromatic plants) on ecology, harvesting from the wild seems easier as it has been practiced traditionally for generations. Medicinal and aromatic plants are naturally foun across the Himalayan region of Uttarakhand. Their sturdy nature, the availability of a

number of species suited to diverse climatic conditions, their ability to withstand adverse climate conditions, lower efforts required for cultivation compared to food crops, and their role in maintaining a balanced ecosystem could be utilised for cultivation, thus reducing the pressure on the ecosystem while meeting market demand and creating a sustainable source of livelihoods for the farmers. Above all, their chemical composition makes them less susceptible to damage by wild animals, and when intercropped with food crops, they help in reducing destruction to the food crops from wild animals, a common occurrence in the area that has increased manifold in the last few decades.

Udyogini's interaction with the locals of Chamoli let them to the conclusion that often males from the villages migrate for work to cities, leaving behind women, children, and old parents to look after the land and manage a living from the meagre production the women farmers are able to manage. Frequent occurrences of extreme weather events concurrent with the destruction of food crops by wild animals have resulted in 'ghost villages', where the entire village is deserted, leaving behind empty houses and fallow land where nothing edible but the weed grows. Further, the disruption of the supply chain from the plains for food and essential supplies due to frequent landslides and roadblocks makes the items expensive and unaffordable for common people who already are struggling to make a living in the harsh climatic conditions with a few livelihood options, namely agriculture, animal husbandry, and the collection of MAPs.

After considering all the circumstances, Udyogini decided in 2015 to work with farmers interested in cultivating MAPs on fallow land, as an alternative source of income on a smaller scale. The success of the production and the additional income earned by the farmers, as well as the intersection of women entrepreneurship and climate-resilient methods, encouraged them to replicate it on a larger scale.

MAP cultivation began in three development blocks of the Chamoli district and has now spread to five development blocks. Udyogini also started collectives with women who were silent workers at farms with little to no say in family income, had dual responsibility for taking care of agriculture and care work, and were time-poor and engaged in less remunerative tasks. Udyogini managed to engage 300 women by 2019 in the farmer's collective named 'Badri Kedar', a district cooperative in Chamoli district. Their objective was to include women in rural enterprises where they will engage in value addition, processing, packaging, and marketing of the produce bought locally and supplied in the local economy, thus developing a local supply chain. The cooperative engages farmers in high-value medicinal and aromatic crops as an alternate source of income utilising fallow land and overall increases the adaptive capacity of the area to deal with climate change.

Udyogini's constant endeavour in the Chamoli district has been to make the livelihoods of farmers climate resilient, and their incomes diversified, but much work remains to be done, such as making cultivation sustainable, developing capacities that ensure farmers are able to adapt to climate-related adversaries such as pest attacks, droughts, or flood-like

situations, dealing with traders who dictate prices to farmers, developing the supply chain, and replicating the model in other remote areas.

Even though the activities narrated in the case are 7-8 years old, Udyogini has reached the current stage through learning, trials on the ground, and general observation and understanding.

2. Background

2.1. Chamoli District Context and Background

Chamoli district is spread over 8,030 square kilometres (sq km), comprising high hills and mountains with very narrow valleys and deep gorges having steep gradients. The northern, north-western, and eastern parts of the Chamoli district comprise the Tethyan Himalaya, which remains snow-covered throughout the year. The high-altitude range has a unique climate and topographic conditions that support a rich biodiversity, culture, tradition, and mythology. The area's local communities depend on their immediate natural resources for their livelihood. The inhabitants of the Chamoli district are mostly familiar with the medicinal and aromatic plants of the surrounding area for their traditional uses. According to many reports, the forest provides 70–80% of the MAP demand. This has endangered the availability of the MAPs in their natural habitat and is likely to disappear in the coming years if enough initiatives are not taken to safeguard their regeneration. Studies have suggested that the cultivation and domestication of wild medicinal and aromatic plants could create a balance between using and conserving MAPs. Udyogini's current ongoing project, 'Sampada Se Samriddhi', intends to reduce pressure on the ecologically fragile system due to the unsustainable harvesting of medicinal and aromatic plants (MAPs). An estimated 30 acres of land will be brought under the cultivation of endangered MAPs in a year. The project also aligned with the local communities to promote, cultivate, and multiply the plant species on waste/fallow land.

2.2. Brief Profile of Udyogini

Udyogini was conceptualised in 1992 by the World Bank to create a movement for women's economic empowerment. It was created with the goal to provide entrepreneurial training to tribal women in order to develop their management skills as producers. For entrepreneurship and enterprise development, two interventions were launched: an 'Enterprise Management Program' and an 'Intel-Udyogini School of Entrepreneurship Training Program'. Udyogini, over the years through its interventions, also recognised that its training and support for women's microenterprise promotion would need to address life-cycle issues that cut across a spectrum of women's market engagement because they affect women's confidence and motivation, ultimately affecting the sustainability of women's empowerment through enterprise.

In 2002, it decided to transform from an advisory institution to a practitioner institution to design and develop a market-led approach to reduce poverty and bring gender equality to

tribal regions of India. Udyogini learned through years of experience and on-the-ground work that the stakeholders promoting the cause of women's economic empowerment, focused mostly on skill training programmes that impart technical skills related to a specific industry.

In 2015, Udyogini realised the need to work on the conservation of the Himalayan region's MAP flora, which is severely marred by the pharmaceutical companies' high demand and high value of medicinal species. There has been an extinction of more than 150 plant species and a ban on 34 other species due to the rise of unsustainable wild harvesting. This led to several other repercussions for the villagers. It further worsened the situation, forcing the villagers to look for another alternative for their livelihood. In 2019, Udyogini developed and integrated its work on alternate livelihoods to push conservation efforts. In 2021, Udyogini started to get recognition for its efforts in conservation from the HRDI, the rural development department, and NABARD. Today, Udyogini is not only working on the conservation of endangered medicinal and aromatic plant species in Uttarakhand but also trying to develop incentives for their efforts.

2.3. Strategy

Udyogini's strategies include reducing vulnerability and strengthening local-level adaptation through 'bottom-up' community-led processes built on local knowledge, innovations, and practices. The emphasis is on developing adaptive capacity (awareness, governance, and

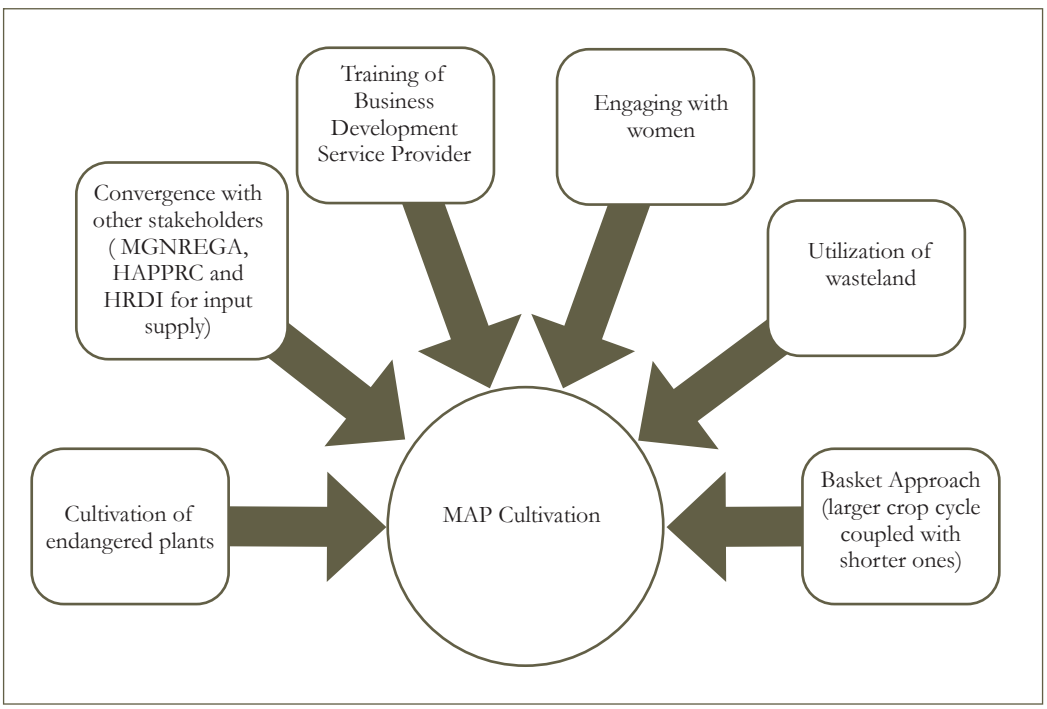


Figure 1: Strategy

knowledge) as well as adaptation itself (change of behaviour, practices, and livelihoods according to new conditions). Their approach to adaptation includes, among other things, general poverty alleviation mechanisms on existing livelihood strategies, collectivisation of farmers who are unable to deal with the situation on their own, institutionalising these collectives that work on transparency in decision-making, and empowerment of women.

Currently, Udyogini is dealing with 32 different types of medicinal and aromatic plant species. These species were selected based on the suitability of the crop to the geography, farmers' capacity to engage in the production process, and market demand. Some of the advantages of engaging in MAPs are that they are good cash crops for farmers, have better market prices compared to traditional crops, require less labour, and demand less water compared to some traditional crops. Hence farmers are less dependent on irrigation and level of rain. There are fewer crop losses and fewer animal attacks to the crop as MAPs are not a food alternative to them. They are more sustainable – it is called long life demandable crop when demands are constant and continuously growing. Besides cultivable wasteland could be reclaimed and brought under cultivation of MAPs.

The selection of MAPs depends on the overall geographical conditions. Therefore, a suitable cluster was identified first, and then villages in the cluster were identified and selected. The selection of clusters and villages is made on the basis of a set of criteria essential for the cultivation of MAPs, which include the geographical condition of the area, altitude, soil composition and texture, the direction of sun exposure, etc. To access the specific characteristics of each cluster, Udyogini team also consults its network of people, including local authorities.

Once the clusters and villages are identified, the team engages in building rapport with the people. Networking with the villagers is crucial to achieving the desired outcomes and thus becomes the most essential part of the strategy. Once the village is identified, the organisation engages in the process of social licencing among the villagers. It consists of a set of activities designed with the purpose of delivering the vision and outcomes of the activities to be carried out in the village. A village resource person is identified among the villagers called a Business Development Service Provider: (BDSP) with the capacity, an interest in MAP cultivation, and who is innovative. The BDSP person is an important link between the villagers and the executives of the organisation. Thus, the person identified should be someone trusted and respected by the villagers who could convince and motivate them to engage. The designated person becomes the liaison with the villagers and is generally referred to as a 'community resource person' or 'business development service provider'. The resource person engages with the people through meetings, trainings, awareness camps, and mobilisation drives.

Village-level meetings where farmers participate and engage in discussions with the staff as well as among are held themselves. These meetings are generally attended by the village headman, SHG members, members of Mahila Mangal Dal, and members of the Van Panchayat. Attendees of the meeting share their experiences, knowledge, and concerns

about the viability of MAP cultivation on their lands and deliberate on the suitability of MAP species to be introduced and cultivated. Individual farmers decide the land parcels they wish to dedicate under MAP cultivation. By the end of the meeting, the organisation has a list of potential farmers to work with. However, the shortlisting of farmers depends on some parameters, such as the availability of cultivable wasteland with them and their willingness and ability to invest manpower in land preparation, cultivation, weeding, mulching, harvesting, etc.

Building trust with farmers is one of the critical points of the project. Most of them are familiar with the harvesting of medicinal plants from the wild and their traditional uses, but they are generally unaware of the cultivation practises of MAPs and the marketability of the cultivated crops. Even though many of them have agreed to the cultivation of MAPs on their fallow land, they remain apprehensive due to the long gestation period of medicinal plants (generally more than two years) and their lack of knowledge of the market for cultivated crops. Thus, the exercise of building trust includes sharing the concept of a farmer's collective (Badri Kedar Self-Reliant Cooperative) for marketing MAPs, which allows for economies of scale, as well as the strategy of a compensatory livelihood approach through the cultivation of short-lived aromatic plants, which provides farmers with consistent income. The farmers get very excited with the sale of their first harvest through the collective and then start to multiply the land under MAP cultivation. This shows that the farmers see MAPs as an alternate livelihood option and have eventually started believing in the initiative.

In 2016, the organisation introduced short-term aromatic crops such as oregano, parsley, thyme, rosemary, camomile, basil, tulsi, turmeric, peppermint, kala jeera, faran, lemongrass, and stevia to guarantee an alternative source of income for farmers and to motivate them to engage in long-term medicinal plant crops. Short-term aromatic crops last from 3 to 6 months, compared to two to three years for long-term medicinal plant crops. Additionally, in 2017, the farmers' collective (Badri Kedar) procured some of the short-duration aromatic crops, initiated value addition of the crops, and developed various combinations of herbal green teas of Tulsi (Sweet Basil), Lemongrass, Chamomile, Rosemary, etc. This activity engaged village women from SHGs, and brought additional income to women engaged in tea preparation. The strategy demonstrated that the value addition of produce brings not only income to cultivators but also helps create additional employment for women.

3. Intervention

3.1. Problem and Solution Identified

The Himalayan range is an extensive mountain ecosystem highly vulnerable to climate change. This region is warming faster than the rest of the world. The Trans-Himalayan region, which lies on the southern edge of the Tibetan Plateau, in particular, is warming at a faster rate than the rest of the Himalayas. The warming in the Himalayan region has caused glacial retreat, glacial lake expansion and outburst, rapid snowmelt, more frequent

extreme events including precipitation, drought, and desertification, a transition from a snow-dominant to a rain-dominant precipitation system, a forward shift in precipitation, earlier flowering and fruiting, and an upslope treeline shift. Consequently, many lowland species are expanding their ranges to higher elevations to take advantage of warming temperatures and longer frost-free days. Moreover, the extent of grasslands and forests is receding due to climate change, which has implications for biodiversity conservation.

These changes impact important ecosystem services that support Himalayan communities. The consequences of climate change, coupled with the unsustainable harvesting of MAPs from the Alpine meadows and forest areas, have brought forth unprecedented challenges for the conservation of medicinal and aromatic plants in the wild. The area under MAPs in the wild is shrinking, and the population and species diversity of the MAPs are decreasing, resulting in the extinction of many beneficial species. Thus, it becomes imperative to bring the MAPs under cultivation so that the pressure on their collection from the wild can be controlled. The strategy should be to have both ex-situ cultivation on wasteland and in-situ conservation of MAPs to achieve overall conservation of the MAPs and to make their trade sustainable.

3.2. Producer Group Formation and Governance Structure

Udyogini's framework for 'value chain-oriented entrepreneurship promotion' consists of five stages. Udyogini follows this framework that has been developed based on years of experience in promoting micro-entrepreneurship.

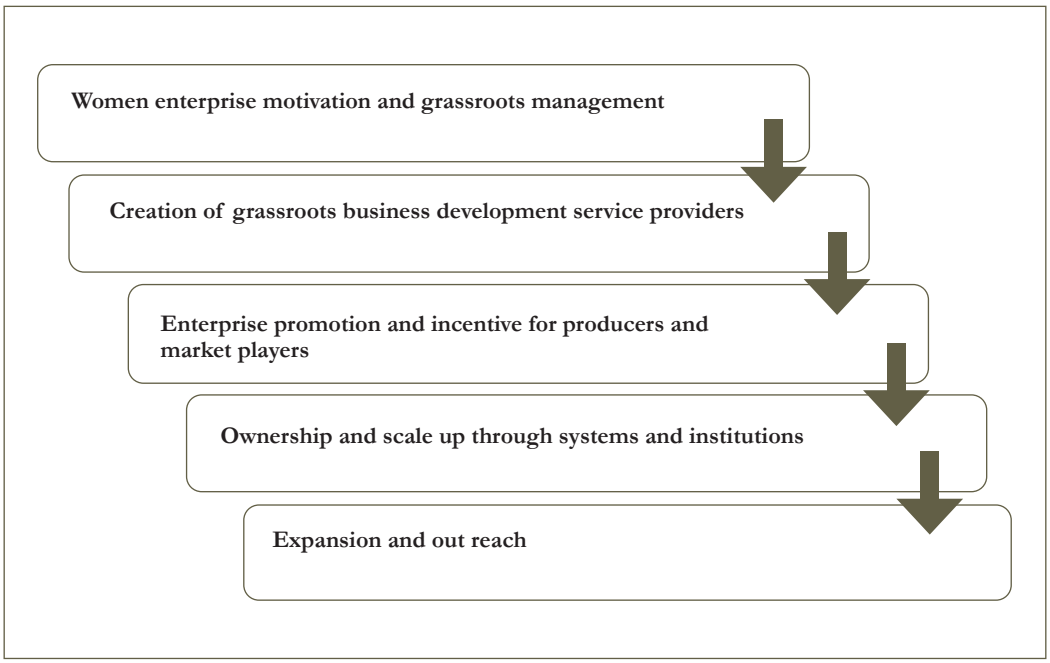


Figure 2: Approach

The first stage focuses on organising and mobilising women into organisations or institutions in order to begin working toward microenterprise. Through their groups, the institutions are aided in saving and credit operations in order to carefully address the capital requirements of the microenterprise. The second stage involves identifying and training active, interested women from the groups to serve as service providers. This cadre aids female entrepreneurs at all stages of the value chain. This covers procurement, raw material distribution, production, management of production centres, quality control, aggregation, and so on. Service providers receive specialised training in order to play the role of effective mentors. The third stage focuses on strengthening the capacity of microentrepreneurs and their institutions to form alliances for improved input access, market access, and leveraging financial services from various institutions. This is the most important step of the intervention, and its efficacy determines the organisations' ability to negotiate with better markets and mobilise resources. The fourth stage involves promoting institutions of community so that they can create their own businesses. This step is analogous to passing the torch to the community to handle the enterprise autonomously.

Udyogini emphasises reaching out to new producers through local NGOs and entrepreneurs in the fifth stage, as well as duplicate the strategy in other districts and states. According to Udyogini, a smooth transition from stage one to stage five will take six to eight years.

3.3. Functioning of Enterprise

Udyogini has always prioritised women's participation in enterprise activity and the establishment of microenterprises led by women. These enterprises create an ecosystem where women, who most often have multiple responsibilities in the household and are limited to the role of farm hand in agriculture operations without any say in the sales and marketing of the produce they have invested their time and labour in are empowered to take those decisions. This enables them to create an identity of their own and additionally invest the additional income from the enterprise on themselves. In order to achieve this outcome in Uttarakhand, women of intervention villages in Chamoli were organised into a farmers' collective that is led and owned by women. This culminated in establishing a district-level cooperative of women and registering it as Badri Kedar Swayyat Sahakarita (Badri Kedar Self Reliant Cooperative) under the Uttarakhand Swayat Sahakarita Adhiniyam 2003 in the year 2012. The cooperative runs its business from its field office in Chamoli, Uttarakhand. Currently, there are seven women on its board, and it has a membership base of around 300 women from more than 30 villages.

The cooperatives, through their business, which includes the procurement and sale of agriculture commodities grown in Uttarakhand in addition to the value addition of raw produce and the development of products such as herbal green teas, juices, squashes, pickles, etc., under the brand name 'Badri Kedar', The cooperative was created with the vision of bringing sustainable change to the lives of women in the hill district of Chamoli through their economic empowerment. To achieve this goal, the cooperative engages with

its women members and also with other women in its intervention areas through trainings, capacity-building exercises, workshops, and exposure visits. The activities of the cooperative and the benefits it has brought so far have reached thousands of women in more than fifty villages in the Chamoli district. Therefore it can be said that the outreach of the cooperative is much greater than its actual membership base. In addition to the direct outreach of the cooperative, it indirectly touches the lives of many more women through collaborations with other similar cooperatives (namely HARC Alaknanda Swayatt Sahakarita), FPOs (Himsampada Farmer Producer Company), and social enterprises such as Aarohi and local SHGs, wherein the cooperative purchases products prepared by women associated with these organisations and markets them through its own retail outlet on Badrinath Highway in Chamoli.

The crucial element in the success of the cooperative is its ground-level workforce, referred to as Business Development Service Providers (BDSPs), who provide all essential services to farmers with respect to production, management, harvest, post-harvest, value addition, etc. Additionally, they work as aggregators of the produce and products from rural areas, make necessary transport and logistics arrangements, and supply the produce and products to the cooperative. The cooperative acts as a facilitator for the forward linkages of the aggregated produce.

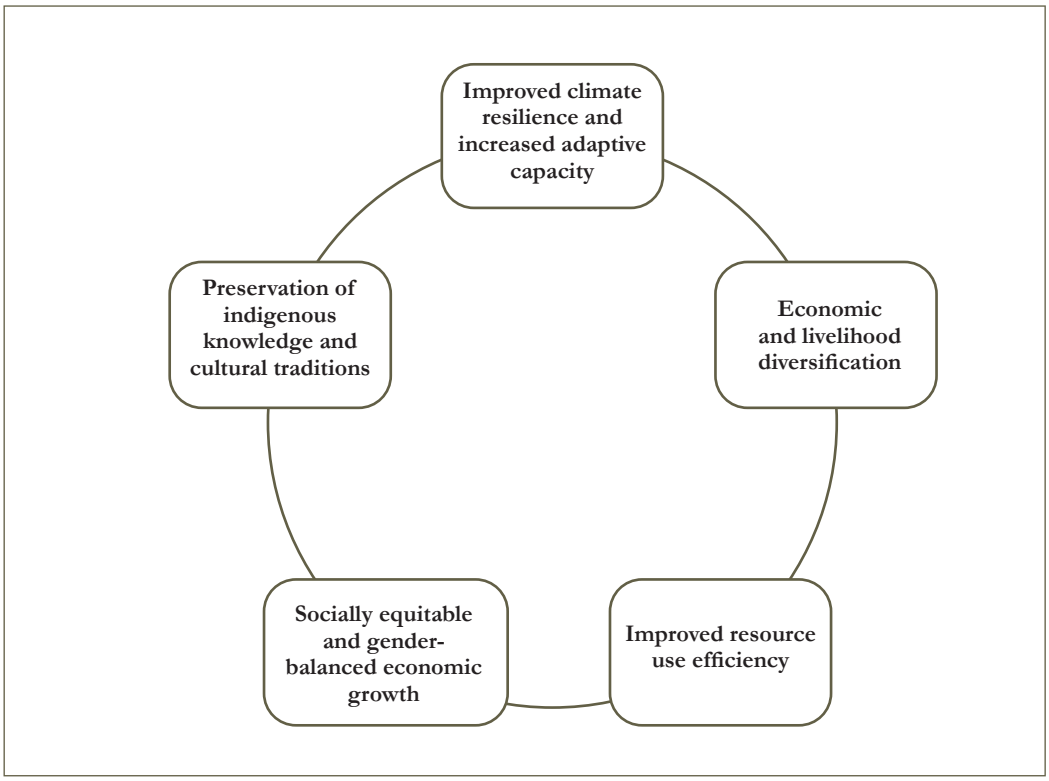


Figure 3: Impact of the MAP Cultivation Intervention on Community

4. Impact of the Interventions

4.1. Improved Climate Resilience and Increased Adaptive Capacity

The frequent change in the climatic conditions and its consequences are evident from the ever-increasing number of 'ghost villages' in hilly areas of Uttarakhand. The changing climate has compelled the residents of the district to migrate to the plains in search of better employment opportunities as agriculture became unprofitable and a major portion of the cultivated crops were damaged by wild animals, who are increasingly frequenting the farmland in search of food. The established cycle of interdependence necessitates adaptation to changes in the climate and, consequently, crop patterns. The introduction of medicinal and aromatic plants, which are sturdier than food crops, are less labour- and resource-intensive, and are not susceptible to damage by wild animals, has proved a successful strategy for building a climate-resilient livelihood model. The cultivation of MAPs, which initially started in the three development blocks of Chamoli to bring an overall balance to the ecology, has now scaled to five development blocks in the Chamoli district.

The intervention run by Udyogini, involving the cultivation of medicinal and aromatic plants on wasteland and as border crops around the fields of food crops, proved successful in reducing the damage by wild animals to food crops. In some instances, farmers cultivating MAPs have reported more than a 60% decrease in food crops due to the damage caused by wild animals. This resulted in farmers not having to stay awake at night to ward off the wild animals from their fields, getting more out of the cultivated crops for their own consumption and sale. The income from the sale of the produce and additional income from the MAPs led to the economic empowerment of farmers. Around 1000 women beneficiaries showed interest and were selected for the project. Their capacities were increased with respect to cultivation, management (weeding, hoeing, mulching), harvesting, and post-harvest activities. The 1000 beneficiaries were targeted in five development blocks (Dasholi, Dewal, Joshimath, Nandanagar Ghat, and Tharali) of Chamoli.

4.2. Economic and Livelihood Diversification

Udyogini's interventions in the Chamoli district began at a critical juncture when the disaster in the Chamoli district resulted in the loss of lives and livelihoods. The jolt to the tourism industry due to the disaster, the changing climate leading to a decrease in pollinator (bee) population, damage to crops due to wild animals, inaccessible markets due to difficult terrain, and low prices of traditional crops (millet, finger millet, barnyard millet), *amaranthus*, kidney beans, and potatoes made people wary of agriculture. During these times, the cultivation of medicinal and aromatic plants provided the community with much-needed assistance in diversifying livelihood activities. The introduction of new crops (MAPs) had multiple benefits and advantages compared to staples, as they have a constant demand in the market, very little fluctuation in prices, higher per unit prices, and are more suitable for cultivation even on wastelands without much expenditure on inputs. The economic benefits

received by farmers from the cultivation of MAPs did not remain limited to the sale of the harvested produce, but the ongoing nature of Udyogini's intervention ensured that every year new MAP cultivators would need planting material for cultivation. This was purchased from the existing farmers and distributed among the new farmers, thus opening a new avenue of livelihood for farmers through the sale of planting material for MAP crops.

Additionally, the incorporation of a farmer's cooperative shifted the onus of marketing the produce from the farmers to the collectives. The collective ensured that the produce achieved economies of scale, which is an essential requirement for selling the produce beyond local markets. The collective being purely a women-led enterprise ensured that the incomes received by the women through the sale of produce and products could empower them economically. The collective ensured that the farmers could not only have their income from MAPs but also from other food crops.

4.3. Improved Resource Use Efficiency

Medicinal and Aromatic plants found in the Himalayan region utilise different land profiles; for example, Jatamansi (Nardostachys Jatamansi) grows naturally in steep slopes and rock crevices. Similarly, Kutki (Picrorhiza Kurroa) can be found growing naturally on hilly slopes and soils devoid of rich organic matter, Thus the MAPs can be cultivated on wasteland, which is generally poor in soil nutrients. The reclaimed wasteland then receives attention, and over some time increase in the fertility of the soil is evident. The advantages of cultivating MAPs on wasteland are numerous: on the one hand, they are brought to utilisation, reducing pressure on cropland already under cultivation of food crops; on the other hand, the production of MAPs from the wasteland, which has not been cultivated in ages, provides farmers with additional income in addition to income from food crops. Since 2015 more than 40 ha. of cultivable wastelands have been reclaimed and brought under cultivation of MAPs. In addition to the utilisation of land having steep slopes which could not be used for conventional agriculture as the constant digging and ploughing makes the land more susceptible to soil erosion could be used for cultivation of Kutki *(Picrorhiza kurroa)* as the plants grow very well on sloping land and are not suitable for fields where waterlogging could happen. Thus it could be used to reclaim sloping lands, where agriculture is not suitable.

The cultivation practices adopted by farmers since the intervention, through training and handholding support, increased the productivity of the land on which the MAPs are being cultivated, as these plants require mulching during winter months to protect them from frost and snow. The mulch of leaf litter eventually decomposes and provides good manure for the plants thus increases the productivity and fertility of the wasteland. Changes in plant damage caused by white grub larvae have also been observed. The larvae generally affect fields where cattle dung has been applied directly from the cattle shed, whereas training farmers on proper decomposition of the cattle dung before its application in the fields has resulted in fewer instances of damage by white grub.

The cultivation of aromatic plants such as lemongrass as border crops (on bunds) in the fields where food crops are being cultivated helps in mitigating the adverse effects of soil erosion.

4.4. Socially Equitable and Gender-Balanced Economic Growth

Agriculture has always been a gamble for small and marginal farmers, as their livelihood is always at the mercy of suitable climatic conditions. The risk of loss of livelihood due to climatic adversities leaves them very vulnerable, but the cultivation of MAPs, which are sturdier and are suited to higher altitudes in the Himalayas, diversifies the livelihood portfolio of the smallholders. The selection of beneficiaries for the cultivation of MAPs is done only based on available wasteland and the willingness to invest manpower in production operations. As a result, it does not exclude or discriminate against smallholders or farmers who own several hectares of land. The strategy to work with women and increase their capacities has been an integral part of the intervention; thus, all the beneficiaries of the intervention are women. Additionally, women are encouraged to be members and owners of the cooperative (Badri Kedar) so that they can be empowered economically. The training, capacity-building exercises, and exposure workshops provide them with the much-needed support of an increase in skills and capacities and a broader perspective of the outside world. They were provided platforms to express themselves and to raise issues and concerns with the outside world, which empowered them and made them rise against injustices. Many community resource persons delivering the objectives of the intervention are women farmers themselves chosen from the villages. They act as the strongest pillars for the success of the intervention as they have total responsibility for its on-ground implementation.

Although women are at the center of the intervention, the collectors of MAPs from the wild are generally male. These MAPs collectors were also trained on sustainable harvesting practices, and their capacities were built so that in-situ conservation of MAPs could be achieved.

4.5. Preservation of Indigenous Knowledge and Cultural Traditions

The villagers of Chamoli are aware of the uses of MAPs in traditional medicine. During their intervention Udyogini also observed that medicinal plants collected from the wild is widely used in the treatment of common ailments in cattle as well as humans. The roots of *Kutki* are soaked in water, and the infused water is given to cows. However, it was also observed that there had been a decline in the number of traditional medicine practitioners, locally called *Vaidya*. When villagers were asked about the gradual shift over the years, they suggested that it was due to the availability of allopathic medicine and treatment in nearby cities, which had previously been limited. They further added that the younger generation has not taken much interest in learning the use of traditional medicine. However, the most significant reason for the decline they mentioned was the decreasing availability of MAPs in the wild over the years.

Villagers, as well as city folk, use some of the MAPs in the preparation of chemical-free, herbal incense sticks for use in their homes; however, the trend has seen a decline over the years, because of the scant availability of MAPs in the wild and because of the convenience of purchasing and using incense sticks in the market.

However, small-scale interventions are being promoted by Udyogini through the cooperative, which is trying to revive and popularise the use of herbal incense sticks and *dhoop* prepared from cultivated MAPs. The products have received acclaim locally, but scaling them, increasing the production capacity, and tapping a larger market share is still a faraway dream.

5. Challenges and Learning

The biggest challenge with respect to the intervention is the timing of the cultivation season of the majority of the medicinal and aromatic plants with the peak of the monsoon season, which hampers the desired progress of the intervention.

The medicinal and aromatic plant efforts have been ongoing and have encountered numerous challenges. After working on this initiative since 2018, the organisation determined that farmers were slow to adapt because of the long gestation period of MAP. As a result, maintaining an economy of scale has become extremely difficult, as production per *nali* (20 *nali*= 1 acre) is negligible. The certification procedure, in which farmers are chosen to cultivate these crops, is likewise manual and takes more than six months to complete and begin. Furthermore, the market certification and transit pass processes are also manual, which has inexplicably delayed MAP trade by almost 15 days. It has become difficult to maintain the motivation of farmers as the returns depend on market conditions, which compel them to source these crops from the wild.

Our approach has been quite successful in re-establishing people's trust in herbal and natural goods for healthcare and dietary supplements. We have learned to make links with the government department and the village Pradhan in order to take advantage of the MGNREGA initiative and leverage the cultivable wasteland for plantation and nursery development. The government recognises its importance and has promoted research on herbal plants, their care, and marketing. We recognised there is an ongoing need to motivate and encourage communities to cultivate endangered species such as Ateesh, Kutt, Jatamansi, Choru, and Salam Panja. Despite continual stage revamping, we have discovered that our intervention and strategy must be synchronised and updated as quickly as the external environment changes.

6. Conclusion

This case study details the processes, activities, and impacts that Udyogini has had in Uttarakhand thus far. The initiative is already underway, and there is still plenty of room to enhance livelihoods by preserving medicinal and aromatic plants. The capacity of MAP to

tolerate unfavourable weather conditions, resistance to wild animal attacks, cultivability on wasteland, higher returns on investment, high commercial demand, and the lack of forward market linkages made it an ideal choice.

To address the adversity of climate change, the cultivation of MAPs was aligned with the current crop patterns, as changing traditional cropping systems was difficult and ineffective. Because of its gestation duration, the project has not been taken on a large scale and so offers numerous opportunities to improve the process. To assess overall development, projects like this require collaboration at several levels with various stakeholders. Existing government policies may not be helpful to the promotion of MAPs in many regions. The potential of MAPs can be achieved when policy constraints are lifted, and attempts are made simultaneously to commercialise the goods and explore markets for lesser-known species.

Nonetheless, with their MAP cultivation programme, Udyogini was able to reintroduce honeybees to the valley, as ATI has recently established adequate technology for bee rearing near intervention villages. Udyogini has also provided alternative livelihoods to women affected by climate change, animal attacks, and low crop output. and we have been able to reproduce models with some returned adolescents from a neighbouring hamlet who perceive MAP as a profitable endeavour.

Particularly Vulnerable Tribal Group (PVTG) Women-Led Community Enterprise in Jharkhand

Suraj Kumar[1], Bishnu Charan Parida[2], Suvakanta Nayak[3]

1. Introduction

Particularly Vulnerable Tribal Groups (PVTGs) are the most marginalized of any of India's indigenous communities. Living in the tough topography, movement limitations, comparatively low income, by middlemen, inaccessibility to government entitlements, and a lack of skills are some of the factors that contribute to the extreme backwardness of PVTGs in Jharkhand.

In this situation, the Jharkhand State Livelihood Promotion Society (JSLPS), Department of Rural Development, Government of Jharkhand's initiative, i.e. Gutu Galang Kalyan Trust (GGKT) for the PVTG community in Pakur district turned out to be a successful community-based intervention for providing PVTGs with enhanced economic opportunities.

Gutu Galang Kalyan Trust (GGKT) is a PVTG-led women's enterprise. It was established in 2019. It is owned and operated by members of PVTG's Self-Help Group in the Littipara block of Pakur. At GGKT, the women manage a variety of micro-enterprises, such as a PP (polypropylene) woven sack manufacturing unit, a seed bank for the traditional lobia (black-eyed peas), a value-added marketing platform for the traditional crops lobia, millet and pulses, and a registered vendor under MGNREGA to supply various planting materials to families all across the district.

One success after another has been achieved by the PVTG women of GGKT. This microenterprise began operations three years ago with just ₹ 4.5 lakh in grant funding from JSLPS and has now grown to an annual turnover of more than ₹ 1 crore. In addition, the yearly family income has significantly grown from less than ₹ 20,000 to at least ₹ 50,000 from diverse sources of income.

2. Context

Tribal communities are considered indigenous, and their customs and agricultural methods are distinctive. In addition to these characteristics, certain tribal communities have special characteristics such as dependency on hunting and gathering for sustenance, a pre-agriculture level of technology, zero or negative population growth, forest residents, and

[1] Suraj Kumar, IAS – Chief Executive Officer, JSLPS, Rural Development Department, Government of Jharkhand
[2] Bishnu Charan Parida – Chief Operating Officer, JSLPS
[3] Suvakanta Nayak – State Lead, PVTG & Ultra Poor Development, JSLPS

extremely low literacy levels. These ethnic groups are known as PVTGs and they are the most vulnerable among India's tribal groups. The Government of India began identifying the most vulnerable tribal groups as a separate category in 1975, naming them PVTGs.

According to the Food, Public Distribution, and Consumer Affairs Department of the Government of Jharkhand, there are over 73,000 PVTG households living in the state, with a population of approximately 3.1 lakh. The state's PVTGs are divided into eight categories: *Asur, Birhor, Korwa, Birjiya, Saurya Paharia, Mal Paharia, Parahiya,* and *Sabar.* Each has its own culture and traditions, making them distinct ethnic groupings in the state. These PVTGs account for around 1% of the total population of Jharkhand, have historically been at the bottom of the development pyramid, deprived of basic services and economic possibilities. Many people living in still remote and neglected areas of the state are excluded from governmental assistance programmes and continue to struggle for basic food, water, and shelter. A PVTG family in the state has low literacy, insignificant productive assets, no market orientation, weak life skills, irregular income from forest and agriculture sources, nomadic circumstances, and distress migration. Because of the low socio-economic status, food security for a PVTG family for 365 days is still difficult.

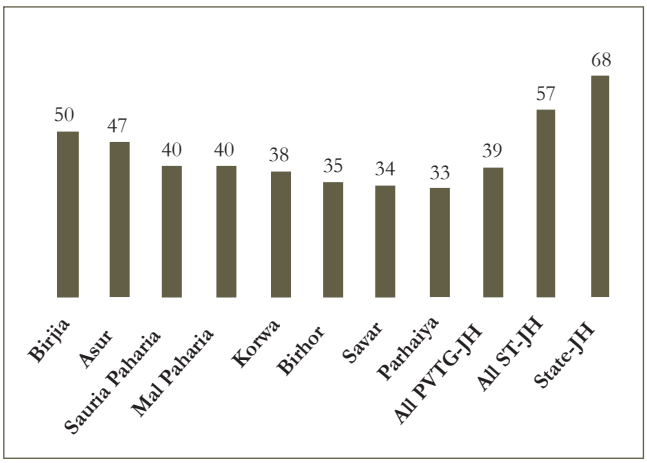


Figure 1: Status of Literacy of PVTG vis-a-vis ST and State (in %)

3. Background

In this situation, the timely distribution of food grains through the Public Distribution System (PDS) under the National Food Security Act 2013 became a lifesaver for these PVTG households. However, because of leakage, the PDS dealer's abuse, and the challenging location, these vulnerable families were not receiving the food grains on a regular basis. The state government has started a novel programme called the PVTG-Dakiya Yojana in 2017-18 to guarantee the prompt provision of food grain (rice) to the doorsteps of these families. Every PVTG family receives 35 kg of packaged rice monthly at their home as part of this Yojana. The Self-Help Group (SHG) members were given the responsibility for packaging the food grains. The Jharkhand State Livelihood Promotion Society (JSLPS) was made as the nodal organization to carry out the programme through its extensive SHG network. To support the SHG movement in the state as part of the Deendayal Antyodaya Yojana - National Rural Livelihoods Mission (DAY-NRLM), the JSLPS was a nodal organization under the Department of Rural Development,

Government of Jharkhand. JSLPS is tasked with ensuring the PVTG-Dakiya Yojana's quality and quantity requirements for food grain packing by SHG members. A group of SHG women that JSLPS taught to perform the packing task at the block level FCI (Food Corporation of India) godown.

The JSLPS found it challenging in the early stages of the Dakiya Yojana to organize in bulk and provide gunny sacks to different districts in order to pack food grain for more than 73,000 PVTG families each month. JSLPS made the decision to support a PVTG women-led enterprise to produce in-house gunny sacks in order to maintain uniformity in quality and proper packing and reduce the cost of sourcing the sacks. This decision would not only address the issue of sack availability but would also provide some means of support for these vulnerable women.

4. Journey of GGKT

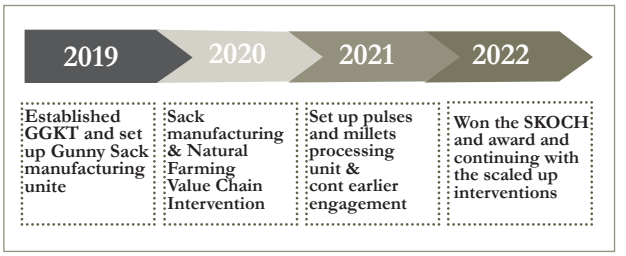


Figure 2: Journey of Gutu Galang Kalyan Trust

JSLPS promoted the Gutu Galang Kalyan Trust (GGKT) in 2019 to produce in-house gunny sacks. In a remote tribal block of the Pakur district called Littipara where the Trust maintains its registered office. Currently, it is developing a model of PVTG microenterprise for various livelihood interventions for PVTG households in addition to providing rice sacks.

The origin of the Trust was the notion of 'reducing vulnerability' among the most marginalized populations. The JSLPS team believed that if they collaborated with women living in extreme poverty who desired to break the cycle of poverty, they could create a model that would assist PVTGs in earning a living.

Six women from the PVTG community (Paharia) were eager to take on the challenge of establishing the unit, but they encountered resistance from their family. Gradually, however, additional 30 PVTG women from the villages of Gadapahadi, Kisbita, and Mukri in the Litipara block joined the programme after considerable effort and support. Their primary objective was to obtain stable employment and earn higher incomes with immediate effect. This would assist them in meeting the urgent requirements of their families and pay for the education of their children.

Now, the GGKT is first microenterprise recognized in Jharkhand that was founded by PVTG women. Currently, the GGKT functions as an autonomous entity, with its Board of Directors making independent decisions about operations, governance, and management. Using their creativity while honouring their aspirations for a living, they gave their organization the name 'Gutu-Galang', which means 'thread sewing' or 'thread stitching' in Santhali and refers to their main source of income.

The relationship was legally institutionalized in December 2019 with the establishment of GGKT in Littipara, Pakur district, pursuant to the India Trust Act of 1861. It has been supported by the JSLPS and the Pakur District Administration from its beginning. GGKT constructed a gunny sack (PP woven) production facility in Littipara, Pakur, with an initial investment of ₹ 4.5 lakhs from JSLPS. The Trust manufactures approximately 75,000 high-quality gunny sacks for packing food grain each month and assures their timely delivery to each area in the state.

Gradually, the women of the GGKT added natural farming and Farmer Producer Organization (FPO) operations to their portfolio, in addition to gunny sack manufacture. As a non-profit organization, the Trust supported traditional agricultural practices and connected farmers to formal markets through the Market System Development strategy. As a result, the GGKT was able to serve as a platform for PVTG women's social empowerment as well as economic opportunities and expansion. Women members of GGKT were able to achieve their initial objective of alleviating abject poverty in their areas through exploring traditional wisdom.

5. Livelihood Interventions by GGKT

GGKT is working to improve the economic condition of the most chronically disadvantaged women in the state by engaging in a variety of livelihood activities. Figure 3 shows the primary activities that are carried out by this microenterprise include the production of gunny sacks, natural farming, processing units, marketing and branding, and the supply of planting materials. These multiple interventions not only create a chance for these PVTG women to raise their income, but they also guide them in the direction that will lead them to financial independence. The following are the specific interventions that are being implemented by GGKT.

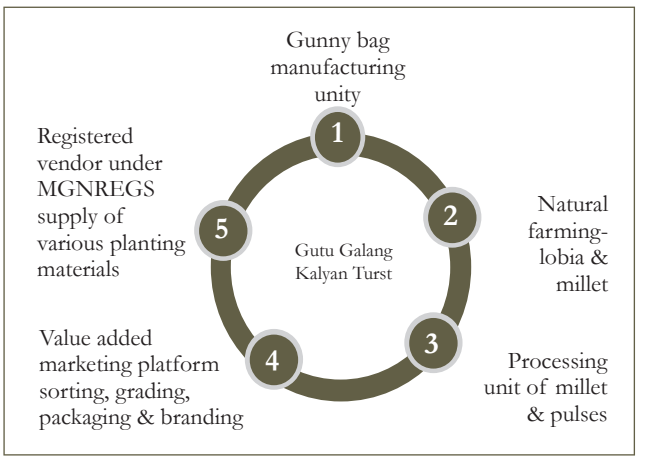


Figure 3: Primary Work Carried Out by Micro enterprise

5.1. PP Woven Sack Manufacturing Unit

Every month, the GGKT produces over 75,000 PP woven gunny sacks of high quality for packing food grains and ensures their timely distribution to all the districts for the packaging of food grains under the PVTG Dakiya Yojana. It began with a seed grant of ₹ 4.5 lakh from JSLPS to establish the unit, followed by a loan of ₹ 12 lakh from the Cluster Level Federation (CLF) as working capital. Since embarking on this journey, GGKT's average annual turnover has surpassed ₹ 100 lakh, with an annual profit of

₹ 10-12 lakh. This microenterprise employs 35 PVTG women in full-time roles who work in the production unit and also earn ₹ 4,500 per month through direct participation. More than 1000 SHG women are engaged in this entire supply chain that ensures the timely delivery of packed food grain at the doorsteps of over 73,000 PVTG families. The GGKT produces 75,000 sacks per month to meet the demand of 24 districts, earns over ₹ 75,000, and supplies approximately 900,000 gunny sacks every year under the PVTG Dakiya Yojana. The current market price of a medium-size fabric roll weighing around 3.0 quintals costs ₹ 45,600 and 4300 sacks are produced in one go. The total production cost is around ₹ 56,100, including labour, transportation, and printing; i.e., the production cost per sack is around ₹ 13 and GGKT sells it to the districts at ₹ 14 per piece. In producing gunny sacks, the GGKT makes around ₹ 4000 profit from one fabric roll.

Table 1: Production Cost of Sacks

Item Name	Cost (in ₹)
Medium-size fabric roll	45,600
Labour Cost	3000
Ink, diesel & other miscellaneous costs	1500
Transportation cost for procuring raw materials	1500
Dispatch of Sacks	4500
Total Cost of Production for 4300 sacks	**56,100**

Table 2: Selling Price of Sacks

Item Name	Cost (in ₹)
Selling price of 1 sack	14
Selling Price of 4300 sacks	60,200

Table 3: Net Profit

Item Name	Cost (in ₹)
Selling Price	60,200
Cost of Production	56,100
Net profit on one Roll	4,100

The GGKT makes about 75,000 sacks a month to meet demand and supply under the PVTG - Dakiya Yojana, about 9,000,000 gunny sacks every year.

PVTG women in the manufacturing unit work in shifts, so if one of them is sick or can't come to work, another takes her place. At first, none of these women wanted to touch or use the machines because they were scared. But with the right amount of help, experience, and regular hand-holding support, they are now confident.

5.2. Natural Farming – Reviving and Expanding the Traditional Wisdom

GGKT helped people grow lobia, which is the traditional crop of this tribal area and is very nutritious, and bajra (pearl millet) in the hilly areas. Most of the PVTG families in this area were already used to growing lobia. As the number of seeds ran out and middlemen became more powerful in the sales process, many farmers stopped growing this crop. Middlemen have always taken advantage of the fact that farmers in PVTG communities aren't very educated and bought their crops at very low prices. The Trust bought good lobia seeds in the area and gave them to PVTG farmers who needed them. With help from

the JSLPS team on the technical side and regular support from the PVTG Change Makers, the community picked up indigenous practices again. GGKT started this project in 2020 to help the PVTG communities in the Pakur and Dumka districts. In the first phase of the project, the trust gave 5 kg of lobia seeds directly to about 1000 PVTG beneficiaries and helped another 4000 PVTG families with technical knowledge in the first year of activities. In the second year, GGKT gave lobia seeds to another 4000 PVTG families, which covered almost 1000 acres of land.

Farmers who grow lobia under the GGKT umbrella received marketing support. Community institutions (SHGs and Village Organizations) collect the produce at the village level, and GGKT buys the extra seeds at a good price. The women who work at the microenterprise and have been trained to sort, grade, and package these products. The value-added products are put in packages with the brand name 'PALASH' and are ready to sell in the market and at PALASH outlets. PALASH is a brand name that the government of Jharkhand uses to promote products made by SHG women in rural areas. Now, the Trust buys these products directly from the women farmers at the market price. Because of the added value, there is now a market linkage. As a result, PVTG women farmers now get 40% more money than they used to get before.

5.3. Establishment of Seed Bank

The PVTG community in the Santhal region of Jharkhand has restored two traditional crops to its local farming - lobia and bajra. This revitalizing strategy has not only increased the earnings of the poorest women, but it has also helped to reduce the prevalence of malnutrition. The GGKT preserves these vital heritage crops and traditional farming practices by establishing a seed bank.

The GGKT seed bank saves some of each year's harvest for the next year, with a goal of reaching 10,000 tribal farmers within two years. This method prevents the seed shortages that have previously prevented the community from cultivating lobia. To withdraw seeds from GGKT, farmers don't have to pay any money, but they do need to deposit the same seed quantity they took out once they've harvested their crop.

5.4. Establishment of Processing Unit of *Lobia, Bajra* and *Arhar*

The district administration of Pakur, inspired by the achievements of the GGKT, donated value-adding machinery to the tune of ₹ 20.7 lakhs in order to support the growth of the business. This came about as a direct response to the request made by the GGKT to the administration for more value-added activities. On the same premises, GGKT is now operating a lobia sorting, grading, and packaging unit in addition to a flour mill for bajra, and a dal mill facility. With the assistance of the JSLPS, the GGKT is currently selling its finished goods under the brand name 'PALASH'.

5.5. Registered Vendor Under MGNREGS – Supply of Various Planting

GGKT is also involved in leveraging convergence mostly with MGNREGA. It has been providing timber plant seedlings to the Pakur district administration. The trust gave out more than 40,000 saplings of timber plants between 2020 and 2021. Under this programme, the GGKT sets up nurseries of different kinds of timber saplings in some of the locations and gives them to the District Administration for use in plantations. Through MGNREA, they are going to provide their own PVTG community with around 80,000 plants this year. By selling the timber saplings, GGKT makes a good amount of money. By taking part in this activity, GGKT is also making sure that the materials for this segment will be high-quality and ready on time.

5.6. Promotion of Nutri-Garden

During the Kharif season, GGKT initiated a special intervention to promote the nutritional garden, also known as the Kitchen Garden. The objective of this intervention was to ensure that adequate nutrition was available to the households in order to prevent malnutrition among the members of the family, particularly the women and children. Seed kits, including around eight different varieties of green vegetables and creepers, are supplied through GGKT to approximately 3000 PVTG households in order to encourage them to implement this model in their backyards. The on-the-ground training and mentorship that was necessary to build these models within the community were given by Change Makers.

6. Success Factors and Ripple Effect

This microenterprise's success is largely due to its ability to adapt to different ways to promote livelihoods, its efficient supply management, its focus on local demand and products, its use of traditional knowledge, and its drive to achieve a dream.

Soon after the first activity started, the JSLPS team realized that getting involved in more than one business would lower the risk of losing money. If one product doesn't sell well, the other one may still have a chance. Different government agencies and the Pakur district government agreed that diversification was a good idea. In the last two years, the GGKT has made a net profit of about ₹ 21 lakhs. In the last two years, the Trust has paid the government about ₹ 17.2 lakhs in GST (Goods and Services Tax). The trust's net income rose by 40.7% from the previous year to FY 2021–22. In the same way, the annual sales went up by 37% from the first year. The average household income of PVTG women who work directly with this trust has gone up by five times. After running the unit for three years in a row and seeing how well it did and how much

Table 4: Yearly Turnover and Profit of the Micro enterprise

Financial Year	Annual Turnover (in ₹ Lakh)	Profit Margin (in ₹ Lakh)
2019-20	24.95	-
2020-21	81.92	8.89
2021-22	112.46	12.51

business it could bring in, the State Bank of India also gave a CC loan of ₹ 20 lakh to help grow the business.

Through the lobia and millet interventions, the Trust wants to reach around 12,000 PVTG women farmers this year. It also wants to generate more revenue than it did last year.

7. Challenges

7.1 Generating Interest

Getting suitable female workers to work with PVTG community and getting PVTG women interested in regularly working in the production units proved to be difficult tasks. The local women who are members of PVTG groups are more accustomed to collecting NTFPs from the forest. As a result they are unwilling to commit themselves to any kind of regular work schedule. The JSLPS professionals and PVTG Change Makers, driven by their immense motivation and strong commitment, worked hard in trying to overcome this obstacle.

7.2 Procurement, Transportation, and Working Capital

Raw materials, like the fabric rolls used to make gunny bags, are not sold in nearby markets or the capital of the state even in Ranchi. The GGKT used to get their supplies from Gujarat, but now they can buy from Kolkata. The group still has to pay high transportation costs. GGKT keeps looking for other sellers who can offer better quality at lower prices.

For goods to get from one place to another, the GGKT depends on private facilities. As the crude oil price has gone up, transportation costs have gone up in a unexpected way. This change in prices is reflected in the final prices of the products, which affects sales.

In the beginning, the Trust has a small amount of working capital, which makes it hard to buy raw materials and keep a good buffer stock. With India's financial system changing, the JSLPS team and the GGKT want to make this better.

7.3. COVID -19 Pandemic

A disruption had occurred in the supply networks of GGKT as a result of COVID-19 pandemic. In addition, during the full lockdown, there were limits placed on female employees of the manufacturing unit who commuted long distances to their work. The most difficult obstacle was obtaining the raw supplies. On the other hand, once the severity of the situation began to improve, the GGKT was able to resume its operations.

8. GGKT: Not only a 'Trust' but the Trust of the PVTG Women

GGKT stands as a symbol of success for women in business and as a example of collective action, resilience, and efficient environment scanning for opportunity creation. In the Pakur

area of Jharkhand, a small sack stitching operation was the seed for a Trust that today provides both financial and emotional support to more than 10,000 tribal women (PVTG).

Women in the PVTG Trust are now responsible for managing hundreds of community cadre who handhold thousands of PVTG homes in the field, paying their taxes (GST) on time, keeping books of records with crores of monetary transactions, dealing with banks and government offices for finances, keeping an inventory, anchoring the state government's flagship programme connected to "food security," managing transports to provide commodities to faraway regions, and managing the whole operation

9. Conclusion

GGKT is a thriving PVTG women-owned business that operates on the concept that 'development' and 'economic growth' are intertwined.

In order to grow their business, they are also trying to get contracts from bigger companies like NTPC, cement factories, rice mills, flour mills, etc., and also convergence activities from the Government of Jharkhand which will help them eventually to expand their areas of operation.

GGKT is working with JSLPS toward a Geographic Identification (GI) label for lobia grown in the Santhal Pargana region of Jharkhand. They will do this while staying true to local farming practices and traditional ways of doing things.

Notably GGKT has won the prestigious SKOCH award in the silver category for the year 2022.

Annexure - Voices from the Field

Box 1: Story of Rubi Malto

Rubi Malto, a simple woman who hails from Mukri Pahar, a small PVTG Village located at the hilltop of the Littipara Block of Pakur district in Jharkhand, has fought against all odds to become a rural entrepreneur.

Rubi's life has been beset with problems. Alcoholism and food security are major issues in her community. She has faced domestic violence early on in her married life. Rubi was keen to earn the respect of her family members, for which she wanted to become financially independent. In search of work, in 2016, Rubi became a member of Gulab Aajeevika Self-Help Group, and took her first loan from the group to start a farm-based livelihood activity.

But her dedication and interest resulted in her being identified together with 36 PVTG women as PVTG active women to carry forward the initiation of the PVTG micro-enterprise named Gutu Galang Kalyan Trust. Soon, the Gutu Galang Kalyaan Trust started the PP Woven Sack manufacturing unit, and started supplying 70,000 sacks to the districts. Rubi Malto became the President (Trustee) of the Trust.

She, along with 10 team members have been trained in the technical aspects and leads the activity. Now, Rubi Malto is not only earning a monthly fixed amount but also looking after the entire business of the Trust. She is a PVTG Woman Leader !

Box 2: Story of Lili Malto

Lili Malto, who belongs to Shauriya Pahariya Community, lives in a small PVTG village Kisbhita of Littipara Block. She suffers from an acute poverty condition where she struggled to get two full meals per day. She got 5 kg of lobia seed from the Community Institution (Gutu Galang Kalyaan Trust) and also, she had 5 kg seed on her own. In the year 2020 due to covid 19 pandemic, all kind of economic activity was affected when Lili Malto harvested lobia and got the total production around 130 kg in December 2020. She returned back 5 kg seed to the Trust as per the norms of GGKT seed bank and also sold 100 kg lobia to Gutu Galang Kalyaan Trust at the rate of ₹ 65/ kg where the nominal market rate was ₹ 40-50 per kg. She earned ₹ 6500 from Gutu Galang Kalyan Trust with a very minimum amount of investment. Before this journey, Lili was struggling to get a quality seed and also faced market exploitation by the existing middleman.

A Silent Movement of Change in Remote Hills

Dr S. K. Upadhyaya and Deepak Shah*

This case study revolves around village Dhaspad, a typical hill village in rural Almora district in the state of Uttarakhand. Dhaspad is amongst the 87 Gram Panchayats within the boundary of the 9 micro-watersheds of the district selected for treatment. Dhaspad is nestled atop the picturesque mountain slopes at an altitude 1847 m AMSL and Latitude N - 290034.43' and Longitude E -790051.01.' It is one of 110 GPs of the Dhauladevi block of the district and situated at a distance of almost 43 km from the district headquarters. It comprises of a closely-knit village community of 57 households and a population of merely 442. It has a spread of just 251.7 ha land area segregated into two revenue villages with predominantly rainfed conditions (over 92%) coupled with tough, inaccessible terrains; this village has been facing the vagaries of climate change and shifting rainfall cycles for over a few years now, which had rendered their main livelihood option i.e. agriculture extremely unprofitable. Their relentless toils in the fields could barely fetch them enough as their crops kept failing most of the time. Besides, their land holdings were very small and fragmented, scattered throughout the village on sloped terraces, with a limited scope for mechanisation.

1. Defining the Problem

Water scarcity was a critical factor causing issues of potable drinking water, rendering them more dependable on the seasonal water sources in and around the village, in the Naulas (seeps) and Dharas (natural springs). During the lean summer months, the women had to carry head loads of water-filled cans & drums under parching heat from long distances, even from far-away water sources inside the forests or from neighbouring hamlets. Besides, water for irrigation was also very scarce and available down the slope in a small rivulet, which used to become extremely lean during summers but luckily never dried up. This was of much solace, as the nearby fields could get some water for irrigation during tough periods as well. This meant that they had some water, which if tapped and managed properly and judiciously, could be harnessed. The majority of the agriculture fields were situated up the slope in the village (80 to 100 m), and there was a dire need to provide some irrigation, especially for those lean months.

Women, besides their daily routine of traversing long distances on tough hilly terrains for fuel-wood, fodder and drinking water, also play a pivotal role in the farming activities in their fields while having to manage endless household chores. They were left with very little time to spend either with their family or for themselves. Gender issues were also prevalent in society. The village community had a typically traditional mindset with several social stigmas and taboos regarding the involvement of women in in the decision-making processes of the village.

* Watershed Management, Almora Division, Uttarakhand

The agriculture practices were subsistence in nature due to the predominance of rainfed conditions, coupled with changing rainfall cycles. Untimely and heavy rainfalls was becoming quite common, especially when they were not needed. Torrential rains kept on causing small landslides in the village, leading to the loss of arable land and washing away the rich topsoil, adding to their troubles.

Abject paucity of livelihood sources in the village was gradually leading to a rising trend of migrations in search of a better living in the metro cities or the plains downhill. This trend had left a large population of women, the old and weak or those who were physically challenged in the village to look after the ancestral assets.

2. Strategy and Planning

While carving out the road map to mitigate the issues related to the village, it was decided to take up the water management issues as the first priority, and the strategy was woven and later worked out around it. At the very onset, it was clear that the Line Department has strong technical, administrative and management aspects, but social mobilisation or marketing or market linkage was not their strength. For this they partnered with specialised NGOs having a good track record of working with people in remote hill villages of Uttarakhand. Himalayan Study Circle (HSC), Pithoragarh, got associated with the Department to work on social mobilisation and gender-related issues; and Central Himalayan Environmental Association (CHEA), Nainital, also joined hands to look after the post-production linkages, development of value chains as and where feasible and to promote the agribusiness related activities envisaged in the project plan. In this way, each put their best foot forward, and the synergy was utilised in achieving the set objectives. It was collectively decided to take up water and natural resource management issues as a first step. But at the very inception, social mobilisation, sensitisation and creating awareness was the primary agenda, and for this, the NGOs played an important role in providing skilled, experienced and knowledgeable staff who would serve as Coordinators (division level), Facilitators (at unit levels in the field) and women Motivators at (revenue village level). These Motivators were residents of the same revenue village and were educated enough to keep records of the meetings and note down the meeting agenda and proceedings, besides having the expertise to conduct women's meetings and motivate them to form their Self-help Groups. Likewise, an Account Assistant, who was a male resident of the same village beside being qualified enough to assist in bookkeeping and accounting procedures, was appointed through consensus in open General Body Meetings of the Gram Panchayat (GP).

The project was conceived, planned and executed in a decentralised mode with the stakeholders at the center. They had to plan, execute and disburse the funds for the works in their GP. Besides, provisions were made to ensure 50% participation of women in all the GP level institutions and groups. As the women of Uttarakhand are the vital to the rural hill society, they were given their due place in the project, and the entire inititive was run with women at center. A holistic farming system was promoted by carefully choosing the

initiatives for an improved production system in Dhaspad. Sustainability was brought about by bringing water security through budgeted utilisation of water-related interventions, diversifying the improved production systems, providing livelihood options to every section of society. As a second step, farming system as a whole was targeted, rather than aiming at a single production system once water security was addressed.

3. Approach

Three pronged approach was adopted while addressing the key issues which needed the utmost attention and resolution. The first was to mobilise the village masses in Dhaspad by utilising the skills and experience of the FNGO (Field NGO) team, which was based in the village have a good relationship with the village women. These were amalgamated with the technical expertise and experiences of the MDT (Multi-Disciplinary Team) to take up the task of creating awareness among the village community regarding water management issues and how climate resilience affected them, and what could be the simple ways of mitigating the rising ill-effects of Climate Change.

The second was implementing the interventions which were conceived and planned to maximise the utilisation of the limited opportunities that were available in the village to improve water security, focusing on water recharging and water harvesting interventions, ways to improve water productivity, water budgeting and increased water use efficiency.

The third was diversification of the production system to provide buffering against vagaries and to ensure the sustainability of the assets and institutions that were being created in the village.

3.1 Social Mobilization

The most essential vehicle to bring about awareness about decentralised management is social mobilisation. The women of Uttarakhand are known for their role as the linchpins of the Himalayan society. Measures such as involvement of female social mobilisation agents, holding Women Aam Sabhas, mandatory 50% participation of women in watershed committees and the disbursement of project funds ensured inclusion of women in decision-making and governance rather than their role as mere workers in its implementation. The social mobilisation was done with the help of women motivators who were from among the village families, guided by the multidisciplinary team of the project. Workshops and technical trainings were organised at the divisional as well as unit level, along with exposure-visit to a village in the treated watershed project in an adjoining district.

In the project, a number of women facilitators were inducted for a cluster of GPs and women village motivators for the revenue villages were engaged through the FNGO (Field NGO). These women motivators and facilitators frequently visited the village households, assisted the women of the village in PRA and organised them into various group activities along with other stakeholders. They also assisted them in their need assessment, capacity

building and initiation of Income Generating Activities (IGAs), exposure visits, and trainings, besides motivating them also to join the user group communities of the village. These women motivators and facilitators played an important role in motivating and mobilising the village community by acting as an important interface between the members of the village community and the project staff. Their role was a vital factor in the formation and continued functioning of the SHGs and other women groups. Community members also conceded that once the women facilitators had developed individual bonding with the young and old of the village, their incessant persuasion and back-to-back meetings involving the women from the village were quite impactful and had a lasting effect on the masses. As they were sources of recreation and intermingling amidst their otherwise harsh, laborious and stereotypical life, these meetings were like gusts of fresh air for these women.

Earlier women-related issues were generally sidelined or dusted under the carpets by the male counterparts in the Gram Sabha meetings. The concept of Mahila Aam Sabhas was conceived with the objective of addressing women-specific issues and concerns regarding the formulation of the Gram Panchayat Watershed Development Plan (GPWDP). These Mahila Aam Sabhas were invariably held prior to the finalisation of the annual GPWDP to identify and prioritise the issues impacting the women locally. It was ensured that the women-related priorities and issues were discussed prior to the finalisation of the GPWDP and included in the annual plan. Due to the positive impacts of these meetings, the Mahila Aam Sabhas were regularised and were mandatory before the finalisation of the annual work plans. These Sabhas served as a platform for the women to bring forth their issues of major concern, identification of their needs and redressal of their grievances with transparency. The proceedings of these meetings were thoroughly recorded, and the proposals put before these Sabhas were reviewed from time to time by the women members themselves.

An elected woman ward member of the village Panchayat, who was also a member of the Water and Watershed Committee (WWMC) of that village headed by the male Gram Pradhan, was appointed as a co-signatory for operating the dedicated watershed bank account in joint operation mode. Earlier, the Gram Panchayat officers used to be the co-signatories in such accounts. This change provided the much-needed impetus to the involvement of women. The capacity-building measures enhanced the administrative capacity of the local people who were associated with the initiative in one way or the other.

3.2 Interventions to Enhance Water Security

The prioritisation of the major problems and collectively finding ways to mitigate them through PRA was the initial step in the management of the natural resources, with water security and budgeting as focus. The community sensitisation by the MDT staffs and the village women motivators was helpful in creating awareness about the necessity of serious thought and action towards water management.

3.3 Planning

A spring shed map was generated (superimposing a digital elevation model on a contour drainage map), and the recharge zone was geographically identified; treatments were undertaken scientifically following the spring shed approach.

In the recharge zone, dug out ponds with diversion drains (on upper sides, to trap the runoff and guide it into the ponds), and staggered contour trenches (with filter strip of fodder grass in the nether side) were constructed by villagers. Plantation of forest/fodder plants on either side below the trench, promotion of vegetative cover by plantation of fodder grasses by van panchayat, construction of check dams (brushwood, drystone and gabion) and small dug-out ponds behind stone check dams in stream course were undertaken to arrest silt and promote recharge.

4. Interventions Related to Water and its Storage Capacity in Village Dhaspad

- Water Recharge: 11 medium size ponds (810m^3), 43 small dug-out ponds (398m^3), 2540 trenches (1905m^3)
- Water Harvesting: 46 roof water harvesting tanks (119.6m^3), 5 common irrigation tanks (75m^3), 1 geo membrane tank (20m^3), 18 LDPE tanks (216m^3)
- Water Conveyance: 16 Solar Panels with 5.0 HP / 3.2 KV submersible solar pump installed, 1800 m length of HDPE pipeline installed (vertical 500m, Lateral300, Distribution 1000m), drip irrigation (4polyhouses), sprinklers (0.4ha), rain hosepipes (220m).
- Soil and Water conservation structures: 13 Brushwood check-dams, 21 Drystone check-dam, 27 Gabion check dams.
- Vegetative Work: Plantation of forest and fodder plants on either side below the trench, promotion of vegetative cover by plantation of fodder grasses by Van Panchayat, contour bunding with 8.4 lakh running meters of Napier plantation on terraced fields. 8.38 ha under homestead plantation of fruit trees (peach, pear, apricot, walnut, pomegranate, citrus) and 1.20 ha plantation of forest species (Oak, Rhododendron, Uteesh).

5. Impact

5.1 Water Bodies Revived Through Community Participation

- The two seeps (Naulas) viz. Dharatok and Naudhar, which had depleted to mere sustenance levels during the summers, have been rejuvenated to 80 to 85% of the optimum capacity during rough summers. In Lwaranaula, water availability has been stretched to 10 months which was merely for 4 months prior to the inception of the project.

- Out of seven springs (dhara) in the village, four had turned seasonal. Two of them (viz. Kotila and Chapardhara) have now regained their perennial status. In Kafligair dhara water is now available for nine month's contrary to just three months initially. Water discharge during summers in perennial Bhadyo, Bagad and Rubidhara (1.9, 2.6 and 3.2 lpm respectively) and 32 to 47% more discharge has been recorded as compared to that initially.
- For a total of fourteen streams tracked in the village, five are now perennial against two. Kavidhar, Sheem and Karoudigadhera have changed from seasonal (7 to 9 month water availability) to perennial streams. Water discharge in two perennial streams (Dadav and Bagad) has increased by 27 and 43% respectively during summers. For the rest of the nine seasonal streams, the surface flow periods have increased by 46 days to 183 days.
- Additional 1905 m3 of water recharge and 236 m3 of water harvesting capacity was generated.
- Solar pump intervention has bought 6 ha additional area of 30 households under assured irrigation.
- Use of solar energy for irrigation saved ₹ 2.58 lakhs annually, incurred otherwise on diesel-run pump reducing carbon emission of 6174.4 kgs annually or ₹ 0.36 lakhs on electricity annually if the electric pump of the same capacity would have been used. (Report by Sutra Consultancy, 2020)
- Reduction in women's drudgery through saving of at least 3 hours which otherwise would have been used in fetching water and fodder.

6. Sustainability Through Users Group and Farmer Interest Groups (FIGs)

Water Security was ensured by installing solar submersible water lifting pump (3HP) in the sedimentation chamber constructed beside the check-dam. This was built on the rivulet flowing down the hill, to slow down its flow and gather the water in the chamber for the solar operated 3 HP submersible water lift pump to lift water to the Geo Membrane Tank (118m above), which in turn would feed 18 LDPE tanks in its command area for irrigating 6ha land of 30 households. The constant availability of water for irrigation resulted in a cropping pattern change with an increase in the area under vegetables, spices, floriculture and medicinal plants, fetching more income from the same fields, which earlier was unthinkable for the villagers.

After ensuring water security, the farmers were introduced to the cultivation of cash crops in the form of off-season vegetables, profitability of growing flowers like Lilium, Gladiolus etc., based on the market needs under protected conditions. Now the farmers started venturing into the cultivation of crops in polyhouses and the use of polytunnels for raising their nurseries. As the water was utilised turn-by-turn by the families, who were equipped

with LDPE tanks in the fields near to their dwellings, the trends in open-field cultivation also started to shift. People started cultivation of capsicum, cauliflower, cabbage, brinjal, pea, cucumber, bottle gourd, chilli etc. and also ventured into medicinal and aromatic plants to cover those areas where they did not have the LDPE tanks. These areas were dedicated to long duration crops like the Pink Cone Flower *(Echinacea purpurea)* which had immense medicinal values and ready money in markets like Dehradun and Delhi. Another drastic change to which the farmers seemed more open now was production of certified and foundation seeds of nutri-cereal crops or the traditional crops which they had been growing for ages, but only for self-consumption, from which could hardly muster any profits when sold as grains. With motivation, education and encouragement, the project and NGO staff were able to orient them towards the economic value of selling the same produce as quality seeds. For this, the high-yielding and improved variety Breeder Seeds developed for these hill regions by national level research institutes like the VPKAS, Hawalbagh, and Almora were procured for the farmers, and they were provided with technical and moral support throughout the first sowings. The scientists and experts from the Uttarakhand State Seed Certification Agency, Pirumadara (Ramnagar), kept on visiting at all the vital crop stages and assessed the quantity and quality of the seed being produced in their fields. The Mobile Seed Processing Unit from the Tarai Seed & Development Corporation Ltd (TDC) was hired to process their seeds at Dhauladevi Block. After their seeds passed through the laboratory tests and were tagged by USSCA, they now earned much more than they had expected; they were convinced of the profitability of this venture and soon formed their farmers' federation.

Besides the changes in the agriculture production systems, production of climate-smart cash crops, targeting to cash the early season harvests which were becoming normal for the farmers of this village, the poor, the landless and the single women were provided financial grants to venture into goat rearing as an alternate source of livelihood. They were also given an improved breed 'Sirohi' buck for Natural Breeding Centres; these bucks not only improved the local progeny of goats but also enabled them to earn much more by selling them for meat purposes; besides, they also proved to be a good source of earning as breeding centres; earning through coverings by these bucks as well. For single and poor women, these proved to be a good source of livelihood.

7. Vulnerable Group Fund for Livelihood Interventions

The project mandate included outreach to the last person of the village society keeping in view the social lacunae which needed plugging through provisions of livelihood opportunities for starting micro-enterprises or any livelihood activity that could provide them with some source of sustenance and support. The landless, the women and those who were the poorest of the poor were included. To ensure this, during the Participatory Rural Appraisal (PRA) process, the village community had identified such people as 'C – Category Households' through a wealth ranking exercise done with the help of social mobilisation team at the time of preparing the Watershed Development Plans for the GP. The vulnerable households (C – Category) were identified by the community, and

provision was made for a monetary grant for vulnerable group individuals as well as groups after imparting them mandatory training under the Entrepreneur Development Program (EDP).

The result of including these non-farm-based activities was that 3 persons were given a sum of ₹ 30,000 each as a grant to start goat rearing as a livelihood option. One was a young widow who had no other sources of income and no one to look after her and the two children. By rearing goats, she started earning and could sustain her family. One such vulnerable individual was funded for backyard poultry which he started with 1000 nos. of 3-day old chicks from Pant Nagar University, earning a supplementary income from the small portion of land, which he had in the village. Similarly, another person was funded ₹ 30,000 for starting his tailor shop at home in the village itself and supporting his family besides some small earnings from the field. Thus in Dhaspad alone, vulnerable individuals were given a grant of ₹ 1,60,000 (Rupees one lakh and sixty thousand) to support their livelihoods. A beneficiary share was mandatory to inculcate a sense of ownership and as a mechanism for the operation and maintenance of assets created. For every asset created, the beneficiary share ranged from 5 to 20 percent of the total cost, which had to be contributed in cash or in the form of labour. Further formation of a user's group for every community asset created and their mandatory contribution in corpus funds ensured its operation and maintenance. It was ensured that all the households of the village were included in this either through Users' Groups or through FIGs (Farmers Interest Group).

- The villagers of Dhaspad also formed FIGs (Farmers' Interest Groups) which were involved in the Certified Seed Production Programme of high-yielding traditional coarse cereals (Nutri-cereals), varieties of finger millets, amaranthus and barnyard millet which are rich sources of fiber and nutrients like iron and calcium. This quadrupled their profitability by fetching better price for the same crop not as grain but quality seed and contributed to self-sufficiency in improved resilient seeds:
- Inclusion of poly mulch in plantation and vegetable cultivation, sprinklers, rain hosepipes, protected cultivation of off-season vegetables and floriculture (Lilium) in poly houses ensured the conservation of soil moisture and judicious water use
- Geo-tagging all works using the latest GIS technology
- Formation of user's group, corpus for O&M of assets created

8. AP for Animal v/s Man

The project was open and inclusive for all the members of the village society. Thee high rate of migration from the village had left behind a population of only the aged and those who were not able to do physical labour in the fields. Besides, toiling hard in the fields did not give good returns and farming was limited to subsistence level only. So, Pink Coneflower *(Echinacea Purpurea)* production was introduced. The advantage of this crop is that once sown in the fields, this crop remains there for three years. Whole plants

are cut and dried, and all the plant parts are used medicinally, fetching good prices in the market. One youth from the village came forward for the initiative. He learnt the basics of marketing and was successful in establishing links with the market in Dehradun. He collected all the material from the village and sell it in Dehradun. He distributed the money among all the stakeholders in the village at a nominal commission. Gradually, after the residents gradually developed their own marketing intelligence, other youth from the village also started following suite and were able to bargain for better returns. In this way, the production of MAPs (Medicinal and Aromatic plants) also picked up in the village. Now the farmers started to grow Basil (Tulsi) in their fields in lesser quantities as compared with *Echinacea purpurea.*

9. Scale of Work

The scalability of the approach and the success of the experiments in Dhaspad is huge. To sum up, 6690 agriculture mini-kits were distributed in the villages; The soil and moisture conservation works for increasing the biomass and to help in groundwater recharging included the construction of 1111 vegetative check dams, coupled with 250 cu m of vegetative treatment measures, 940.25 cu m. Dry Stone Check Dams, 1,17,211.07 cu m Gabion Check Dams, 174.88 cu m Spurs were constructed on the rivers to train the water current and reduce erosion at the river banks. Besides 19210.08 cu m, of river bank protection structures, which were also constructed for protecting the river banks in the area. 386 water sources were thus recharged through planned and concerted efforts by the villagers with the knowledge and technical guidance of the project staff.

So far, 5199 number of Water Harvesting Tanks (2.59 m^3) have been constructed in the various GPs with 51.99 ha. additional irrigation potential was created for every structure, with a gross area of 77.99 ha of Gross Area brought under irrigation. As far as the construction of Irrigation Tanks (15.0 m^3) is concerned, 217.80 ha of additional irrigation potential was created by the construction of 363 assets. Likewise, the construction of 45.50 km of Irrigation Channel for water conveyance was instrumental in creating 182.35 ha of additional irrigation potential in the area, and it brought 273.65 ha of gross area under irrigation by irrigation channels alone. Water recharge was another priority of water management activities which was addressed through the digging of 112 Earthen Village Ponds (200 m^3); these ponds were dug in combination with 1,47,001 Staggered Contour Trenches in the vicinity of these ponds. Only through water harvesting and recharge interventions in the 87 Gram Panchayats, an additional irrigation potential of 452.14 ha was created in the project area, due to which 678.34 ha of gross area was brought under irrigation. The agricultural crop demonstrations also had a positive impact on the rainfed farmers, as 72% of such farmers of the area adopted and sustained the efficient irrigated crop production technologies as compared to a mere 24% adoption by the irrigated area farmers. Adoption rates to the tune of 80% to 85% were recorded throughout the project area. This had a positive impact on the cropping intensity, which could be increased up to the tune of 135% to 160%. As far as the production of climate-resilient cash crops and vegetable crop production of cauliflower, cabbage, capsicum, french bean and tomato was

concerned, it was found that 84% of the vegetable growers adopted and sustained the efficient irrigated crop production technologies with an adoption rate of 80 to 85%. Similarly, 777.60 ha fruit tree plantation was carried out in homestead plantation in the kitchen gardens of each household; 617.35 ha was brought under Orchard Plantations, and 1233.50 ha area was brought under the forestry species plantation in the Van Panchayat areas of the villages under the project. The animal husbandry sector was aided by the provision of 3014 animal shelters provided to the inhabitants of the area for their cattle, similarly, 610 animal mangers, 524 animal water *charis* were constructed on the roadside or in open areas near the forests for the animals to drink water.

Landslides were a major cause of loss of agricultural land of the villagers, so to check the losses due to erosion, landslides etc., 9602.22 cu. m. of roadside erosion control works were carried out in the village. Another 300.93 cu. m. area was brought under the landslide treatment measures. To protect the fields below, 6.313 km of diversion drains were also constructed above the villages to protect the agricultural as well as the residential lands from the corrosions due to water flow during the heavy rain falls. To harness the rainwater, 5199 roof rainwater harvesting tanks were constructed, along with 363 irrigation tanks and 431 LDPE tanks were constructed in the project area for providing irrigation where it was direly needed. 5.61 kms of HDPE pipelines were also provided in villages to provide water for drinking as well as for irrigation, when needs and demands came up. With groundwater augmentation works being meticulously planned and implemented in some villages for this combination of 43 Nos. of dug-out ponds (*kutcha* ponds) and 1,47,001 staggered contour trenches were dug for recharging the underlying groundwater aquifers.

For natural springs of the village which are predominantly used for drinking purposes; rejuvenation work was carried out in 131 *naulas* of the project area. Water mills have long been in use for cold milling of wheat, rice and pulses etc. 3 such water mills or *gharats* were rejuvenated under the project.

Special emphasis was laid on improving livelihood conditions by providing them options to stay on in their villages instead of migrating to the plains or metros. Funds were disbursed as Grants (Vulnerable Group Fund) confined only to the persons belonging to the vulnerable sections, landless or marginal farmers, single women, differently abled people and the poorest of the poor. Youth of the project area who wanted to adopt technical works for livelihood were compulsorily given EDP (Entrepreneurship Development Programme) Trainings at the Extension Training Centre (ETC) at Hawalbagh, Kosi (Almora), before providing the grant to the individuals or groups according to their activity. Month-long residential trainings were given on trades such as blacksmith, carpentry, plumbing, electrician, mobile repairing and beautician (for young girls and women). Besides this, the trainings for vocations such as pickle making, tailoring, weaving, candle making, artificial jewelry and traditional art 'Aipan' were given at village level. Girls and young women who wanted to learn more and could come to Almora were given a month-long residential training on 'Aipan' designing for caps, waist coats, sarees, cushion covers, file covers, diaries and many other objects of domestic use like coasters etc. Over the project

period of 7 years, a grant of ₹ 2.11 Crore was disbursed among 839 different individuals after providing them training. Similarly, the inhabitants of the 87 GPs were motivated to start many group activities like Tent House, D J Musicians, organic plates & bowl manufacturers, noodle manufacturers, music groups, catering businesses etc. Vulnerable Group grant to the tune of ₹ 1,77,66,643 was disbursed for 213 Group activities in the project area over the period from 2016-17 to 2021-22.

The majority of the project area was under rainfed conditions, with barely 9% area under irrigation. The project's main concern was to provide alternate sources of earning to the farming community in the project area. It was therefore decided that the farmers should be encouraged and educated in commercial seed production of nutri-cereals in their fields. This on one hand, would cater to the needs of providing nutritional security to the project area villages, and on the other, the same crops with climate resilient, high-yielding varieties would fetch higher prices as seeds instead of grains, providing quadruple income from agriculture. This also contributed towards sufficiency in quality seeds and improving seed replacement rates.

Several meetings were organised in the project area to educate, motivate and encourage the farmers to grow Breeder Seeds developed by the ICAR- *Vivekanand Parvatiya Krishi Anusandhanshala*, Hawalbagh (Almora) and adopt Climate Smart Agriculture and paved way to get more income from the same crop with value addition as Certified and Foundation seeds. They were shown the value of seed as compared with the value of grain, as the seeds would fetch double to quadruple prices. The idea resonated with the farmers, and they willingly joined the Farmers' Interest Groups (FIGs) in the villages, which eventually turned into a Farmers' Federation named the *Jagnath Krishi Beej Utpadak Sangh, Aartola (Almora)*. This Federation was registered under the Cooperative Societies Act, and also was given a license for selling the seeds produced in their own fields by the State Agriculture Department, Almora. This is the first Federation to get a license for selling seed as a business enterprise. Agribusiness Support Organisation which was hired for marketing of the produce played an instrumental role as its dedicated field staff and managers took to the task of getting all the farmers, their field areas registered with the Uttarakhand State Seed Certification Agency (USSCA), Dehradun at its regional office at Pirumadara (Ram Nagar). The Federation bore all the registration, transportation, processing and laboratory expenses and also curtailed the handling charges, to return good amounts for the seeds purchased as Certified or Foundation seeds. This venture began in 2015-16, and the earnings started in 2016-17. In 2016-17 the gross value of seeds produced in Kharif and Rabi seasons were ₹ 85.01 against gross production of 24.99 qunitals; in 2017-18 it was ₹ 861.87 from 151.84 quintal production; in 2018-19 the earnings reached to a new high of ₹ 1038.09 against 173.42 quintal gross produce. Similarly in 2019-20 the gross earnings rose to ₹ 1821.39 against a gross production of 267.22 qunitals, while an earning of ₹ 1812.78 was recorded in 2020-21 from the gross production of 265.16 qunitals. In the final year 2021-22 the gross earnings were ₹ 1407.321 from the gross production of 203.66 qunitals, even though COVID 19had devastated the earnings from all the other sectors evenly

during this period. The coarse cereals of which certified seeds were being produced were on one hand, nutria-cereals (being rich in nutrients) and also C4 plants that contributed to carbon sink).

Animal husbandry has always been an integral part of the rural economy. So emphasis was laid on genetic improvement of the indigenous progeny of the local cows and buffalos through the Natural Breeding Centre programme (NBC) of the project. Farming as a profession was gradually becoming less profitable and strenuous for the farmers on the hills, who were getting even more discouraged by the growing instances of crop damage by the wild animals (like boars, porcupines, stags and deer etc.) and monkeys in the region. It was thought that improving the existing stock of large local ruminants could be helpful in improving the livelihood status of the local farmers in addition to the small pieces of land which were in the vicinity of their dwelling and which they could themselves protect. The idea of introducing natural breeding through genetically improved and acclimatised cattle progeny in the area by the project was considered and discussed thoroughly before it was implemented in the field.

Fifty-seven healthy buffalo bulls of 2 to 3 years old, suitable for breeding purposes who were descendants of robust breeding lines of the famous *Murrah* breed of Haryana, were bought from the Central Institute of Research on Buffalo (ICAR-CIRB) at Hissar (Haryana) and From Lala Lajpat Rai University of Animal Sciences (LUVAS) and were given to selected animal rearers in the village. This has been quite successful as the animal rearers are also earning at least ₹ 1000 per covering. These coverings have been instrumental in breed improvement in the villages, which in turn will have a positive effect on the dairy industry of the district. Likewise, a convergence plan was devised with the State Animal Husbandry department in which about 107 local cows were artificially inseminated with sex sorted semen. The promotion of A2 milk production in the project area was also included in this breed improvement venture by the project. These efforts are resulting in progeny with increased fodder efficiency and better milk production.

For AI, the services of the local youth who had been provided Para Veterinarian trainings by this project at the AI Training Centre by the experts of Uttarakhand Livestock Development Board (ULDB) at *Pashulok (Rishikesh)* were utilised. Such trained Paravet youths are helping hands for the veterinarians who are working in the remote villages of Uttarakhand.

Youth in the village were provided technical guidance and infrastructure assistance by the project staff and the veterinary officer to establish 4 brooder units of Broiler and Kroiler chicken in the project area and are successfully sustaining with several batches of chicks sold to local and outside poultry farmers. Besides this, 54 backyard poultry activities were also promoted through the project, which is sustaining well and providing supplementary income to the stakeholders in the region. These poultry farmers are also rearing Uttara fowl and Kadaknath as per the demands of the local market and are fetching good money. Since

the advent of Covid 19, these backyard poultries and goat-rearing units have thrived well in the region, second best only after the vegetable-growing business in the area.

The same idea was implemented on small ruminants, also known as 'the poor man's cow,' to develop improved progeny of small ruminants in Uttarakhand, which were indigenized and acclimatised to the conditions. 105 female and 86 male goats of improved, *Sirohi* breed was bought from Jodhpur in Rajasthan during the project period. The breeder also came with the stock, and a set of 4 females and 1 buck were given to women who evinced keen interest in rearing, and stall feeding these animals. Each woman was provided with an animal shelter for constructing the goat stands for proper rearing and mangers for stall feeding. Continuous medical supervision was provided to these animals after due quarantine, and acclimatisation procedures were completed before handing over the animals to the goat-rearing women. Their progeny has flourished and is being used in improving indigenous breed and fetches ₹ 500 to 700 per covering. Thus, these goats are proving to be sources of livelihood for the rural women and fetch them much more as the Animal Husbandry Department also purchases acclimatised Sirohi bucks and goats from them.

Diversified farming enterprises were beneficial as the ventures complemented each other, proving to be supplementary sources of livelihood for the stakeholders of the project area minimising the losses and maximising their profits.

Community-based participatory approach with the same set of interventions has been successfully replicated in villages *Dansili* and *Taank* of Dhauladevi Block, Almora. In *Dansili*, two-stage pumping (with the use of two solar submersible pumps, 5.0 hp each) has resulted in lifting water to the vertical height of 289m, with a discharge of 22 kl per day, bringing arable land of 8.76 ha. under assured irrigation by 17 LDPE tanks in the catchment of two cemented feeder tanks benefiting 39 households. Recently, in *Taank* village, an area of 8.0 ha covering 34 households has been bought under assured irrigation, pumping water to a vertical height of 108m using a solar submersible pump of 5.0 HP and its distribution in 9 LDPE tanks in its catchment.

It has been institutionalised by the Gramya (watershed) project to make it sustainable and replicable. The project was planned on the basis of a community-based participatory approach to turn it into a community movement by making them stakeholders in the project. The works have been carried out under the watershed projects in convergence with the schemes of the line department, making it cost-effective. These practices are simple and require relatively low technical skills. By way of interdepartmental convergence through funds of MNREGA and other schemes of agriculture, horticulture and Irrigation Department readily available in the district, decentralised planning and implementation, the impact can be replicated elsewhere.

10. Intangible Impacts

- Vegetative cover and water recharge structures are contributing to Gross Environmental Benefits (GEB) like increased soil moisture regime and reduction in soil erosion
- Mobilised and motivated community with increased awareness towards water management
- Active inclusion of women in decision-making and governance redefined their role in society
- Recognition of Dhaspad as a farmer's school to showcase efficient water management practices in the hills will be helpful to the communities visiting it for learning
- Availability of water source database on GIS portal, spring shed maps for future use

11. Learnings from the Project

- Female staff for social mobilisation proves to be more effective in sensitisation in places like the Himalayan region, where women are the linchpin of society
- Appointment of youth from the same village as a female motivator and account assistant leads to acceptance from community members
- Provision of Mahila Aam Sabha and inclusion of women as co-signatory in project fund account ensures gender equity and inclusion of women in decision-making
- Process of PME (Participatory Monitoring and Evaluation) is an effective method to ensure transparency, accountability and grievance redressal in society
- Focusing on the farming system rather than orienting on a particular production system brings multiple income avenues resulting in more resilience against vagaries
- Breed improvement in small ruminants using improved male breeds can bring noticeable change in earnings in pockets with large rain-fed areas where agriculture is relatively non-profitable
- Certified seed production of high-yielding indigenous crop varieties through farmer's federation is an effective way to increase agriculture income manifold on one hand and self-sufficiency in resilient climate seed on other
- Water management has a vital role in the mitigation of climate change. In hilly areas, water recharge interventions in upstream and solar submersible pump downstream coupled with an effective conveyance system can sustainably increase the income from the farming system manifold.

This silent revolution which embarked on its seven-year journey in the mid-Himalayan village of Dhaspad had sustainable and long-lasting impressions in the hearts and minds of the simple villagers. It paved the way for a long and successful journey in time and provided them with a special place in the history of watershed projects in the area, which is worth recognition.

Safe Agri Value Chain Strengthening Rural Resilience to Climate Impacts in Uttar Pradesh

Neelmani Gupta

1. Background

By 2022, India was seeking to double the farmer's income; an ambitious and worthy goal. Despite being the first link to settled civilisation's prosperity, farmers have become the poster child of poverty as is evident from the low (15- 40%) share of farmers in consumer's price of food items. IndiaSpend report reveals alarming statistics that indicate 70% of India's 90 million agricultural households spend more than they earn on average each month, pushing them towards debt, which is now the primary reason for more than half of all suicides by farmers nationwide. The main reason for this is that use of external inputs in present agriculture has made the farm economy unviable. Most of the small and marginal farmers sell their produce from the field to intermediaries and traders. They neither have the capacity to store their produce nor do they engage in any processing activity. As a result, they do not get remunerative prices. Moreover, the food produced is not safe for human consumption.

'*Climate change has severely affected the livelihoods of farming communities which were already on the verge of marginalisation due to high input cost and other ill impacts of chemical farming. Our Annadata is doomed. Today, farming has become a loss-making occupation. It neither provides good income nor respect and social recognition. Farmers do not want their children to practice farming*'

Rakesh Pandey, CEO of Shramik Bharti

Shramik Bharti, grassroots development organisation based in Uttar Pradesh has been working among the small and marginal farming community for the last 35 years with a mission to ensure sustainable livelihood and living for our *Annadata*, by engaging them in natural resource-based livelihoods.

The livelihood development initiatives at Shramik Bharti encompass the interconnectedness of social and ecological systems, and it promotes and strengthens natural resource-based livelihoods that are economically rewarding and ecologically sound.

The year 2015 marked the beginning of the initiative 'The Safe Agri Value Chain for Strengthening Rural Resilience to Climate Change' when a small group of rural women who were members of Self-help groups, promoted by Shramik Bharti in villages of Kanpur Nagar and Kanpur Dehat districts of Uttar Pradesh, were introduced to the concept of natural farming during Self-help group meetings. A seed sown seven years ago in the form

of skilling a few women members of Self-help groups in natural farming has now grown into a giant tree having multiple branches, which embrace the entire Safe Agri Value Chain in the form of a complete Package of Practices (PoP).

2. Context

Uttar Pradesh is the most populous state of India, having more than 199 million populace, as per the 2011 census. Agriculture forms an integral part of Uttar Pradesh's economy and the lives of its people. The state has more than 18 million agricultural households, and approximately 59% of its workforce was dependent on agriculture for livelihood in 2011 (as per NSS 2012-13; and Census 2011).

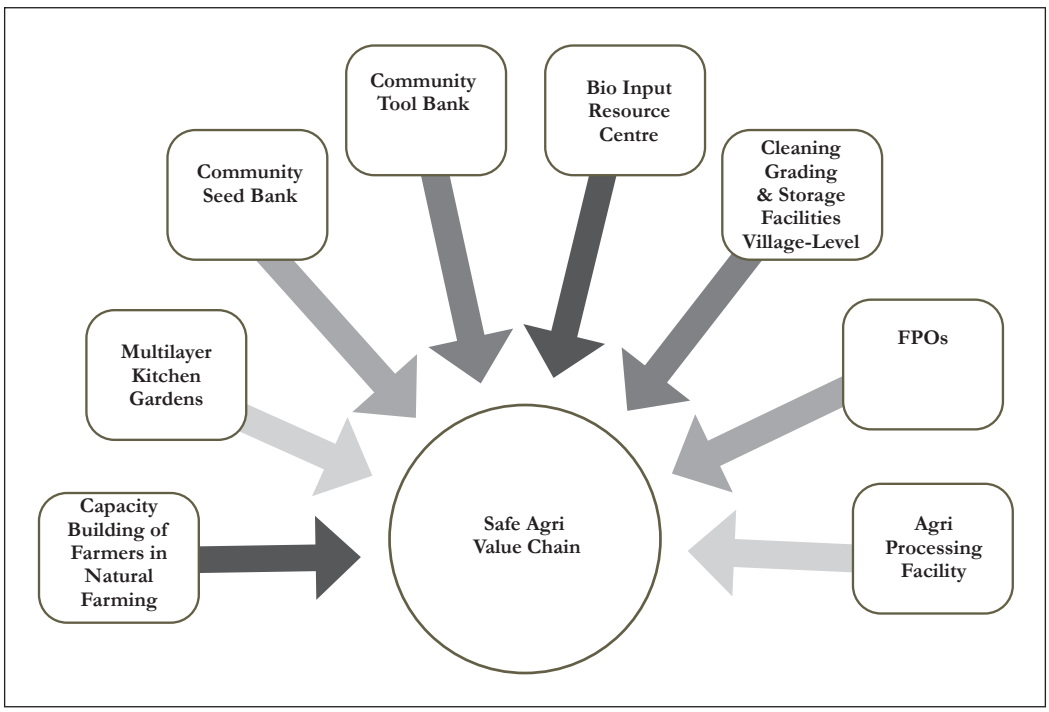


Figure 1: Components of a Safe Agri Value Chain

Marginal (< 1 ha) and small (1 – 2 ha) farmers cultivate 92.5% of all landholdings in Uttar Pradesh, which accounts for 64.8 % of the total area cultivated in the State. The average monthly income of an agricultural household in Uttar Pradesh is the third lowest (₹ 4701) in the country and the state also accounts for the largest share (16.9 %) of all indebted agricultural households in India – 90.4% of these being marginal and small agricultural households (Agricultural Statistics at a Glance, 2015).

The technology promoted in the last few decades moved farmers from local resource-based, labour-intensive agriculture to market-dependent, high-investment, machine and chemical-based agriculture. This high external input-based and mechanised farming does not augur well for our small & marginal farmers.

The farmer is economically doomed because, with soil fatigue and the rise in input costs, they are unable to grow the proportionate produce which leads to unviable farm income and finally to migration in order to sustain their living. The food they grow is chemically polluted with pesticides which compound the problems of nutritional diseases. The farmer is driven to haplessly grow according to the needs of the market, which is centred on the practices of mono-cropping that affects the diet diversity, deteriorates the soil quality and further leads to environmental degradation.

3. Natural Farming as Climate Resilient Farm Livelihoods: Why & How

The impact of climate change is directly or indirectly related to crops, water and soil. Extreme weather events due to climate change, such as high temperatures reduce crop duration, speed up nutrient mineralisation, influence pest population and escalate the evapotranspiration in soil.

"Natural Farming, which follows the ideology of '*Avartansheelta*' (means maintaining water, air, temperature, fertility, energy and societal equilibrium), is the essence of farming. It holds the answer to most of the pressing issues threatening humanity and our ecological sustainability", shared Rana Singh, the agriculturist and natural farming expert at Shramik Bharti.

Natural Farming is a technology that includes the adoption of an area-specific combination of farming principles and practices that aims to improve soil health, agrobiodiversity, climate resilience, carbon sequestration, water resilience, productivity, habitat restoration, and food security & enhance ecosystem services. Thus, it maximises conservation benefits while achieving productivity.

4. The Beginning

While working with the farming community, Shramik Bharti experienced that men farmers are more concerned about the quantity of production so that they can bring in more cash income in the family. However, women farmers are concerned more about the quality of food they get from their farm for their families to take care of nutrition and health. But women are not recognised as farmers and do not control the farm decisions in a family.

When Shramik Bharti raised the issue of increasing malnutrition and increasing illness in the society, and if the farming families adopt natural farming, at least their families can get better nutrition and health, women came forward, but farms decisions were not in their control. So it was decided to start small Kitchen Gardens with natural farming practices. The success of kitchen gardens worked as a 'learning school for natural farming,' and paved the way for both women and men farmers to gradually shift from high external input-based chemical agriculture and unsafe food production to a local resource-based natural farming practice for safe food production.

5. The Rise

After some initial success, in the year 2015, Shramik Bharti, through its Women Self-help groups (WSHGs) which were associated with two federations promoted by Shramik Bharti namely Ekta Mahila Samiti (in Shiavarajpur block of Kanpur Nagar, Uttar Pradesh) and Chetna Mahila Samiti (in Akbarpur Block of Kanpur Dehat, Uttar Pradesh), which comprised women members from farming families, started engaging interested women members of SHGs more systematically in Natural Farming activities.

This also proved to be a turning point in the lives of women from agrarian families who were struggling to manifest their role in farming as a farmer rather than as mere agricultural labour.

Soon, the idea of forming Farmer Producer Organisations from Women Self Help Groups was floated among group members for collective production, aggregation, processing, storage and marketing of safe agri produce and was well accepted. Thus, two FPOs named Ekta Nature Farming Producer Company Ltd., in Shivrajpur Block of Kanpur Nagar and Chetna Nature Farming Producer Company Ltd., in Akbarpur, Block of Kanpur Dehat got registered in the year 2016.

6. Journey from Natural Farming to Safe Agri Value Chain

Natural farming has been able to improve natural resource use efficiency and economic opportunities for more than 3000 rural households engaged in agriculture and allied sector by ensuring their participation in a bouquet of activities that finally contributed towards developing a safe agri value chain in Uttar Pradesh.

Owing to the concerted efforts of Shramik Bharti, today 1500+ small and marginal farmers in Uttar Pradesh have been shifted to natural farming on their 1000 acres land. They are engaged in collective aggregation, storage, processing and marketing of safe food through their 4 Farmer Producer Organisations (FPOs) for improved lives and livelihoods. More than 600 natural farmers have received organic certification for their agri produce/products that provided them with a distinct identity in the market. Nearly 2500 farmers are engaging in natural farming on trial basis by developing organic Kitchen Gardens and will soon join the cadre of natural farmers. The journey of Safe Food is on to embrace more and more farmers for ethical food production, ecological sustainability and enhancing rural resilience to climate impacts.

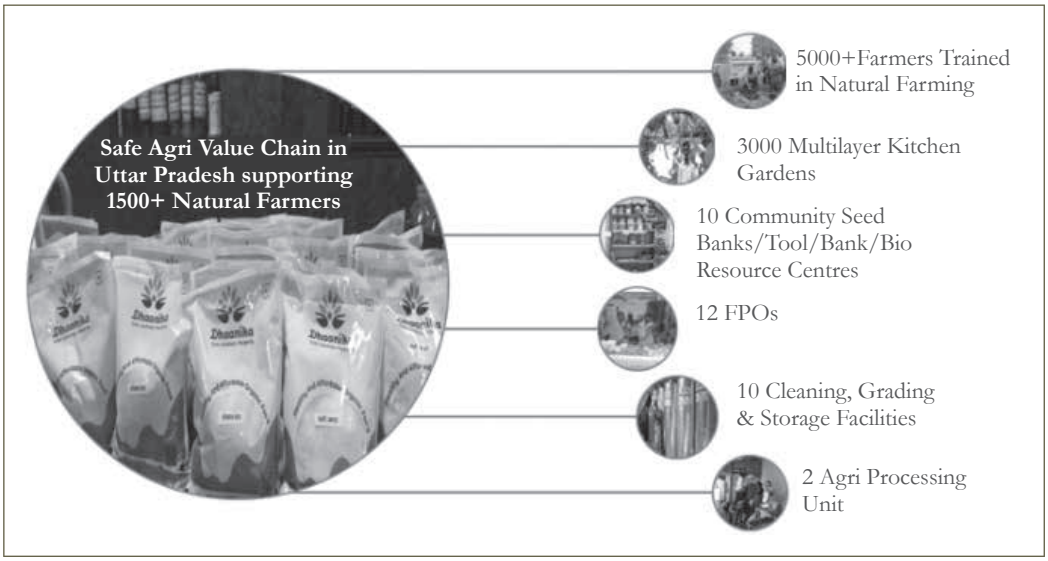


Figure 2: Components Contributing to Development of a Safe Agri Value Chain in Uttar Pradesh

7. The Impact: Safe Food Production

A pre and post intervention Benchmark Study of its Natural Farming Intervention among 250 small and marginal farmers in Rasoolabad Block of Kanpur Dehat district in Uttar Pradesh was conducted by Shramik Bharti in September 2022. Two major crops of the area, wheat and paddy, were selected for cost-benefit analysis. This study aimed to assess the impact of a NABARD-supported two years project on natural farming.

8. Key Outcomes: Wheat

8.1 Net Farm Income

It is evident from the graphical presentation above that there was a 90% increase in the Net Farm Income of natural farmers. The income of farmers who adopted natural farming increased from ₹ 12,655 pre-intervention to ₹ 23,983 post-intervention. It is important to note that the net farm income of farmers increased to 90% even after a 32% reduction in crop yield (as traditional and local varieties of paddy were introduced among farmers while promoting natural farming intervention, which provides less yield as compared to hybrid varieties).

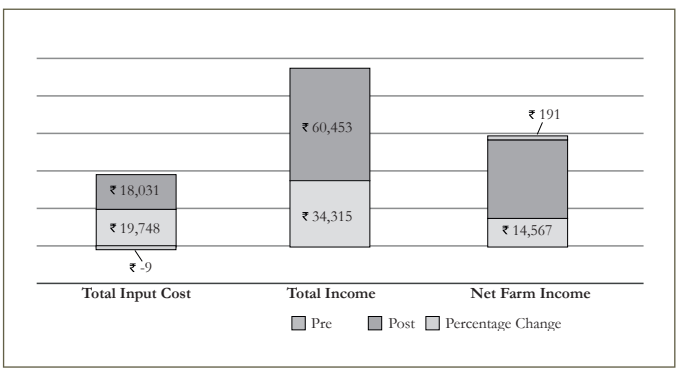


Figure 3: Cost Benefit Analysis of Wheat Crop

8.2 Input Cost

It is also evident from picture 1 that the total average input cost of farming was reduced by 9%. The total farm input expenses were reduced from ₹ 19,748 to ₹ 18,031 after the adoption of natural farming intervention. Here it is important to mention that natural farmers witnessed reduced input cost even after the hike in the average cost of major farm inputs (due to inflation).

8.3 Crop Yield

The above graph shows a 5% increase in the yield of Dana (grain) from 18.5 quintals to 19.35 quintals and an 11% increase in the yield of *Bhoosa* (Straw) from 18.5 quintals to 20.6 quintals per acre land after the adoption of natural farming practices by the farmers.

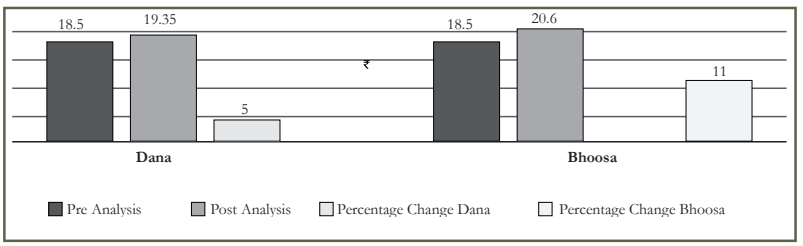


Figure 4: Percentage Change in Pre and Post Yield Wheat Crop (in Quintal)

Table 1: Pre & Post Total Average Cost Benefit Analysis of Wheat

Wheat										
Average Input Cost									Cost Benefit %	
Farming Input	Pre Intervention				Post Intervention				% Change (in Unit Rate)	% Change (in average total input cost)
Input Cost(₹) (Per Acre)	No.	Unit	Rate (₹)	Average Total Cost (₹)	No.	Unit	Rate (₹)	Average Total Cost (₹)		
Ploughing	3	No.	706	2,168	3	No.	800	2,400	13	11
Paleva (Field Preparation)	16	hour	100	1,560	13	hour	120	1,512	20	-3
Seed	69	Kg	31	2,120	54	Kg	0	-	-100	-100
Sowing	2	No.	200	380	2	No.	220	418	10	10
Urea/ Tonic/ Jeevamrunt	4		320	1,152	0		0	-	-100	-100

Wheat										
Average Input Cost									Cost Benefit %	
Farming Input	Pre Intervention				Post Intervention				% Change (in Unit Rate)	% Change (in average total input cost)
DAP/Organic Manure	2		1230	2,335	0		0	-	-100	-100
Input Cost(₹) (Per Acre)	No.	Unit	Rate (₹)	Average Total Cost (₹)	No.	Unit	Rate (₹)	Average Total Cost (₹)		
Zinc/Butter milk /Cow dung cake liquid	9		52	484	1		0	-	-100	-100
Weedicide	1	No.	655	655	0	No.	0	-	-100	-100
Pesticides	0	-	0	-	0	-	0	-		
Fungicide	0	-	0	-	0	-	0	-		
Irrigation	34	hour	100	3,360	31	hour	121	3,798	21	13
Nikai (weeding & Hoeing)	0	-	0	-	0	-	0	-		
Harvesting	1	No.	1200	1,200	1	No.	1600	1,600	33	33
Threshing (Madai)	3	Quintal	1560	4,334	3	Quintal	2295	6,658	47	54
Storage	0	Quintal	0	-	16	Quintal	100	1,645		100
Total Input Cost				19,748				18,031		-9
Yield										
Dana (Wheat Grain)	19	Quintal	1560	28,915	19	Quintal	2295	44,388	47	54
Bhoosa (Straw)	19	Quintal	290	5,490	21	Quintal	780	16,065	169	193
Total Income				34,315				60,453		76
Net Farm Income				14,567				42,422		191

Table 1 clearly reflects the percentage change, between pre-intervention and post-intervention, in the Average Unit Rate (in ₹) of major farm inputs in wheat crop and in Average Input Cost (in ₹).

- There is a 13% increase in the Average Unit Rate of farm inputs between pre-intervention and post-intervention (due to inflation), whereas the total average cost of ploughing increased by only 11 %. This is due to decreased ploughing time in a few project villages. Few early adopters followed the natural farming practices thoroughly, and they used natural decoctions on their farms that made the soil porous enough and reduced the number of ploughings from 4 to 3. Thus we witness a fall of 2% in ploughing cost in a natural farming intervention that would otherwise be 13 % if farmers were doing chemical farming.
- The table shows a 20% increase in the total average unit cost of *paleva* as the unit cost became ₹ 120 (at the time of the post-intervention study) from ₹ 100 (at the time of the pre-intervention study). Yet we see a 3% decline in the total average cost of paleva as the number of hours invested in *paleva* reduced from an average of 16 hours to 13 hours after adopting natural farming intervention.
- The input cost on the purchase of seeds became zero. This is a 100% decrease in the cost of procuring seeds. Natural farming is based on traditional and local varieties of seeds. During the project, farmers learnt to store and conserve traditional seeds by setting up community seeds banks. They were also trained in seed production by selection method technique. Farmers borrowed seeds from the community seed bank, and after harvesting, they returned the seeds to the seed bank after adding 50% to it. Thus ensuring the sustainability of the community seed bank.
- The quantity of seeds used for sowing also reduced, from a total average quantity of 69 kg, to a total average quantity of 54 kg, as we promoted line sowing and raised bed system. Mixed cropping was also introduced, where farmers sowed mustard, cumin and flex seeds along with wheat.
- The above table shows a 100% decrease in the input cost incurred on the purchase of chemical fertilisers, weedicides, pesticides, fungicides etc., during the post-intervention study. Under Natural Farming Intervention, farmers learnt to prepare and use natural decoctions such as Jeevamrut, Ghanamrut, Beejamrut, Bramhastra Neemastra and natural farming practices like Green Manure, mix cropping, mulching etc., that zeroed down the input cost under the said head.
- The table reflects a 21% increase in the average unit cost of irrigation; still, the average total cost of irrigation increased by just 13%. The key reason was a 7% decrease in hours of irrigation after the adoption of natural farming intervention. The table shows that during the pre-intervention study, the total average hours of irrigation required for wheat crops were 34, while after the natural farming intervention, the number of hours for irrigation reduced to 31. This also saved the amount of water used in irrigation.

- As it is evident from the table, the average unit cost of Madai (threshing) increased by 47%, while we see a 54% increase in the total average cost of threshing post-intervention. It is clear from the table that the yield of Dana (wheat grain) and Bhoosa (straw), both increased. 5% increase in Dana and an 11% increase in Bhoosa after the adoption of natural farming intervention since the quantity of the produce was increased, so thus the cost of threshing also increased.
- The cost of threshing depends on the amount of grain obtained after threshing from the harvested crop. Since farmers lack money to pay for the cost of threshing, so they give 15% of the total amount of grain (obtained after threshing) as the cost of threshing.
- The table shows an additional cost involved in natural farming for the storage of agri produce. This is for better price realisation. The farmers were trained in basic processing like cleaning, grading and storage of agri produce. This process will enable them to fetch a better price in the market for their agri produce, especially during the off-season. We are also planning to connect them to urban consumers directly, so the storage will help them maintain the supply throughout the year.

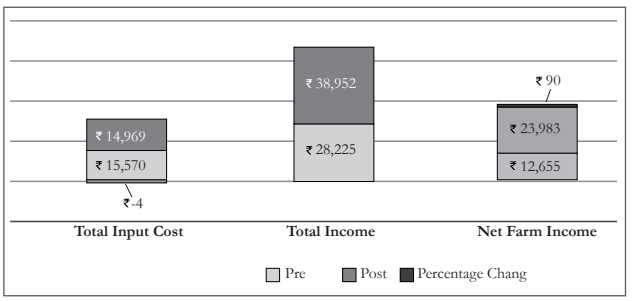


Figure 5: Cost Benefit Analysis of Paddy Crop

- The average unit cost of Dana increased by 47%, yet the farmers who adopted natural farming witnessed a 54% increase in the average total cost of Dana. This happened due to increased yield and better quality of agri produce.
- Add to this, we promoted *Bansi* and *Lokman* varieties of wheat with a good market value. So the better price realisation to farmers.
- The table reflects a 169% increase in the unit cost of Bhoosa (straw), while the total average cost of Bhoosa per acre increased to 193% as we promoted the Bansi variety of wheat among natural farmers. Bansi is a tall variety of wheat, so it provided 11% more straw.

9. Key Outcomes: Paddy

9.1 Net Farm Income

It is evident from the graphical presentation above that there was a 90% increase in the Net Farm Income of natural farmers who adopted natural farming intervention. The income of farmers who adopted natural farming increased from ₹ 12,655 pre-intervention to ₹ 23,983 post-intervention. It is important to note that the net farm income of farmers increased to 90% even after a 32% reduction in crop yield (as traditional and local varieties of paddy were introduced among farmers while promoting natural farming intervention, which provides less yield as compared to hybrid varieties).

9.2 Input Cost

It is also evident from picture 3 that the total average input cost of farming was reduced by up to 4%. The total farm input expenses were reduced from ₹ 15,570 to ₹ 14,969 after the adoption of natural farming intervention. Similar to the wheat crop, natural farmers witnessed reduced input cost even after the hike in the average cost of major farm inputs (due to inflation).

9.3 Crop Yield

The above graph shows a 32% reduction in yield of Dana (rice grain) from 24 quintals to 16.3 quintals. In natural farming intervention, the traditional and local varieties of Paddy like *Rambhog, Samalei,* and *Katani* were promoted. These varieties provide less yield as compared to hybrid seeds. Yet the market value of traditional varieties of rice is much better due to their rich taste and aroma. Moreover, the Paddy straw of traditional and local varieties is used as good cattle feed.

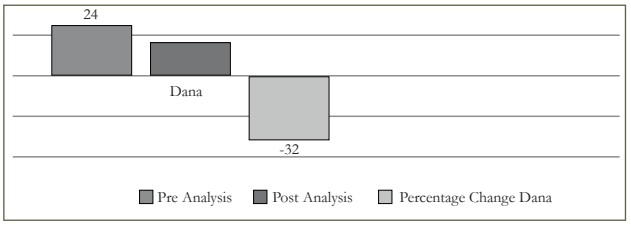


Figure 6: Percentage Change in Pre and Post Yield Paddy Crop (in Quintal)

Table 2 explains the percentage change in Average Unit Rate (in ₹) of major farm inputs in paddy crop, and in Average Input Cost (in ₹) per acre of land, between pre and post-intervention.

Table 2: Pre & Post Total Average Cost Benefit Analysis of Paddy

Paddy										
Average Input Cost									Cost Benefit %	
Farming Input	Pre Intervention				Post Intervention				% Change (in Unit Rate)	% Change (in average total input cost)
Input Cost (₹) (Per Acre)	No.	Unit	Rate (₹)	Average Total Cost (₹)	No.	Unit	Rate (₹)	Average Total Cost (₹)		
Ploughing	3	No.	741	2,090	3	No.	812	2,190	10	5
Paleva (Field Preparation)	15	hour	100	1,475	13	hour	124	1,612	24	9
Seed	6	Kg	314	1,851	6	Kg	0	-	-100	-100
Sowing	13	No.	200	2,560	12	No.	220	2,574	10	0.5
Urea/ Tonic/ Jeevamrunt	3		323	1,030	0		0	-	-100	-100

Paddy										
Average Input Cost									Cost Benefit %	
Farming Input	Pre Intervention				Post Intervention				% Change (in Unit Rate)	% Change (in average total input cost)
DAP/Organic Manure/ Ghanamrut	1		1215	1,215	0		0	-	-100	-100
Zinc/Butter milk /Cow dung cake liquid	8		81	534	0		0	-	-100	-100
Weedicide	1	No.	640	640	0	No.	0	-	-100	-100
Pesticides	0	-	35	35	0	-	0	-		
Fungicide	0	-	0	-	0	-	0	-		
Irrigation	38	hour	100	2,800	25	hour	124	3,040	24	9
Input Cost (₹) (Per Acre)	No.	Unit	Rate (₹)	Average Total Cost (₹)	No.	Unit	Rate (₹)	Average Total Cost (₹)		
Nikai (weeding & Hoeing)	0	-	0	-	2	-	965	1,930	100	100
Harvesting	1	No.	1635	1,635	1	No.	2000	2,000	22	22
Threshing (Madai)	0	Quintal	0	-	0	Quintal	0	-		
Storage	0	Quintal	0		16	Quintal	100	1,623		100
Total Input Cost				15,570				14,969		-4
Yield				-				0		
Dana (Grain)	24	Quintal	1180	28,225	16	Quintal	2400	38,952	103	38
Bhoosa (Straw)	19	Quintal	0	-	0	Quintal	780	-		
Total Income				28,225				38,952		38
Net Farm Income				12,655				23,983		90

- There was a 10% increase in the Average Unit Rate of farm inputs used in paddy crops between pre and post-intervention due to inflation, whereas the total average cost of ploughing increased by only 5%. This is due to decreased ploughing time in a few project villages. Few early adopters followed the natural farming practices thoroughly, and they used natural decoctions on their farms that made the soil porous enough and reduced the number of ploughings from 3 to 2. Thus we witness a fall of 5% in ploughing cost in a natural farming intervention that could otherwise be 10% if farmers were doing chemical farming.
- The table shows a 24% increase in the total average unit cost of *paleva* or field preparation. Yet we see only a 9% increase in the total average cost of *paleva* as the number of hours invested in *paleva* has been reduced from an average of 15 hours to 13 hours after adopting natural farming intervention.
- The input cost on the purchase of seeds became Zero. This means a 100% decrease in the cost of procuring seeds. Natural farming is based on traditional and local varieties of seeds. During the project, farmers learnt to store and conserve traditional seeds by setting up community seeds banks. They were also trained in seed production by selection method technique. Farmers borrowed seeds from the community seed bank, and after harvesting, they returned the seeds to the seed bank after adding 50% to it. Thus ensuring the sustainability of the community seed bank. Here it is important to mention that we promoted traditional varieties of paddy among natural farmers.
- The table reflects a 100% decrease in the input cost incurred on the purchase of chemical fertilisers, weedicides, pesticides, fungicides etc., during the post-intervention study. Under Natural Farming Intervention, farmers learnt to prepare and use natural decoctions such as Jeevamrut, Ghanamrut, Beejamrut, Bramhastra Neemastra and natural farming practices like Green Manure, mix cropping, mulching etc. that zeroed down the input cost incurred on chemical fertilizers
- There was a 24% increase in the average unit cost of irrigation, still, the average total cost of irrigation increased by 9%. The key reason remained around a 13% decrease in hours of irrigation after the adoption of natural farming intervention. The table shows that during the pre-intervention study, the total average hours of irrigation required for paddy crops were 28 while after the natural farming intervention, the number of hours for irrigation was reduced to 25. This also saved the amount of water used in irrigation.
- The table shows an additional cost involved in natural farming for the storage of agri produce. This is for better price realisation. The farmers were trained in basic processing like cleaning, grading and storage of agri produce. This process will enable them to fetch better prices in the market for their agri produce, especially during the off-season. It is also planned to connect them to urban consumers directly, so the storage will help them maintain the supply throughout the year.
- Here we see an additional expenditure on weeding and hoeing (Niakai) during post-intervention. Instead of using weedicide, farmers used manual tools for the management of weeds. They also performed hoeing (Nikai) on their farm. Hoeing or Nikai also contributes to improved yield as it opens the root zone.

- The average unit cost of *Dana* (rice) increased by 103%, yet the natural farmers witnessed a 38% increase in the Average Total Cost of rice. This is due to reduced production. As we stated earlier, we have promoted traditional and local varieties of paddy among natural farmers where the production is low (farmers witnessed 32% decrease in production) compared to hybrid varieties. But traditional varieties of paddy provided better price in the market due to its rich taste and aroma. So the farmers were able to fetch profits.
- The paddy straw of traditional paddy varieties is used as cattle feed.

In a nutshell, it is evident that Natural farming contributed towards a reduction in the input cost of farming and increased net farm income of farmers.

10. The Challenges

- The major challenge was (or still persists) to convince farmers to learn and shift to natural farming from chemical farming as it was deeply embedded in their minds during the last few decades (post green revolution) that farming is not possible without the use of chemicals.
- The farmers have become accustomed to using readymade chemical fertilisers, pesticides etc., available in the market. While natural farming is a system of food production by using natural processes and natural home-made decoctions using cow dung and urine, and other locally available materials, which is though cost-effective yet requires manual labour.
- Shifting farmers from mono-cropping to multi-cropping was really difficult. Post-green revolution farmers were consistently told by market players (of chemical fertilisers, pesticides etc.) and even by the government to grow wheat and paddy to feed the growing population. Farmers who were traditionally engaged in multi-cropping and were undertaking farming for their kitchen shifted to farming for the market for the past few decades. Bringing change in their mindset and behaviour is still a tough terrain.
- Small and marginal farmers were following the practice of selling their agri produce right from their farm, even at low prices, to get cash income. Preparing them to aggregate and store their agri produce and selling it later when the rates are better in the market and engaging them in basic processing like cleaning, sorting and grading for a better price was another big challenge.

11. Learnings

Rakesh Pandey, CEO of Shramik Bharti, shared that the 'the seven years journey was encouraging and full of learnings that contributed to shaping the program as it looks today. A small idea of promoting natural farming among members of women's Self-help groups evolved as a focused program in these years to solve the most urgent and pressing issue of the current time, that is climate resilient farm livelihoods. Shramik Bharti learnt from

its criticism, appreciation, success and failures. The current Package of Practices to build a Safe Agri Value Chain is the result of the challenges and learnings in this entire safe food journey'.

12. The Scaling Up and Sustainability

The Indian Government has been promoting Natural Farming and the formation of 10,000 FPOs as a means to double farmers' income. Shramik Bharti, with the support of NABARD, has scaled up its FPO promotion programme and today, with its 12 Registered Farmer Producer Organisations, the organisation is working among 5000+ small and marginal farmers in 6 districts (Kanpur Nagar, Kanpur Dehat, Fatehpur, Unnao, Etawah & Chandauli) of Uttar Pradesh, for Safe Food Production, Processing and Marketing.

The process for the formation and registration of 17 more FPOs in 4 districts, namely Kanpur Dehat, Bhadohi, Kannauj and Banda is ongoing with the support of NABARD. Though natural farming is not mandated by NABARD, yet Shramik Bharti is committed to promoting natural farming as an essential component of its FPO program and has been successful in mainstreaming its agenda of Safe Food Production in NABARD-supported FPO Formation Program. Thus, around 10,000 new small and marginal farmers will begin the journey of safe food production from next year with Shramik Bharti to strengthen their resilience to climate impacts in the year to come, by becoming part of the Safe Agri Value Chain in Uttar Pradesh.

Contribution Towards SDGs

Table 3: Contribution to SDGs

No Poverty, Gender Equality Responsible Production and Consumption	SDG 1, 5 & 12	By reducing input costs, natural farming has ensured better income and financial stability, which would in turn help alleviate poverty, bring in gender equality and ensure sustainable production and consumption patterns. participation of women in farming in decisions making role is establishing their role as. farmers and helping to reduce inequality.
Zero Hunger, Good Health & Wellbeing	SDG 2, & 3	Natural farming is ensuring food security and zero hunger through better yield, diversity in cropping and access to a suite of nutritional sources and income generating crops through out the year. natural farming is contributing towards good health of farmers, consumers and can contribute to the reduction of various diseases in the community in long run.
Quality Education, Clean Water & Sanitation	SDG 4 & 6	Improved livelihood is enabling communities to access to quality education and safe water and sanitation facilities.
Climate Action	SDG 13	The water-conserving and ecological preservation aspects of natural farming contribute to the availability and sustainable management of water, the zero use of chemical inputs in agriculture in turn resulting in improved soil health, curbing leaching of harmful chemical in ground water and flowing to our rivers as well.

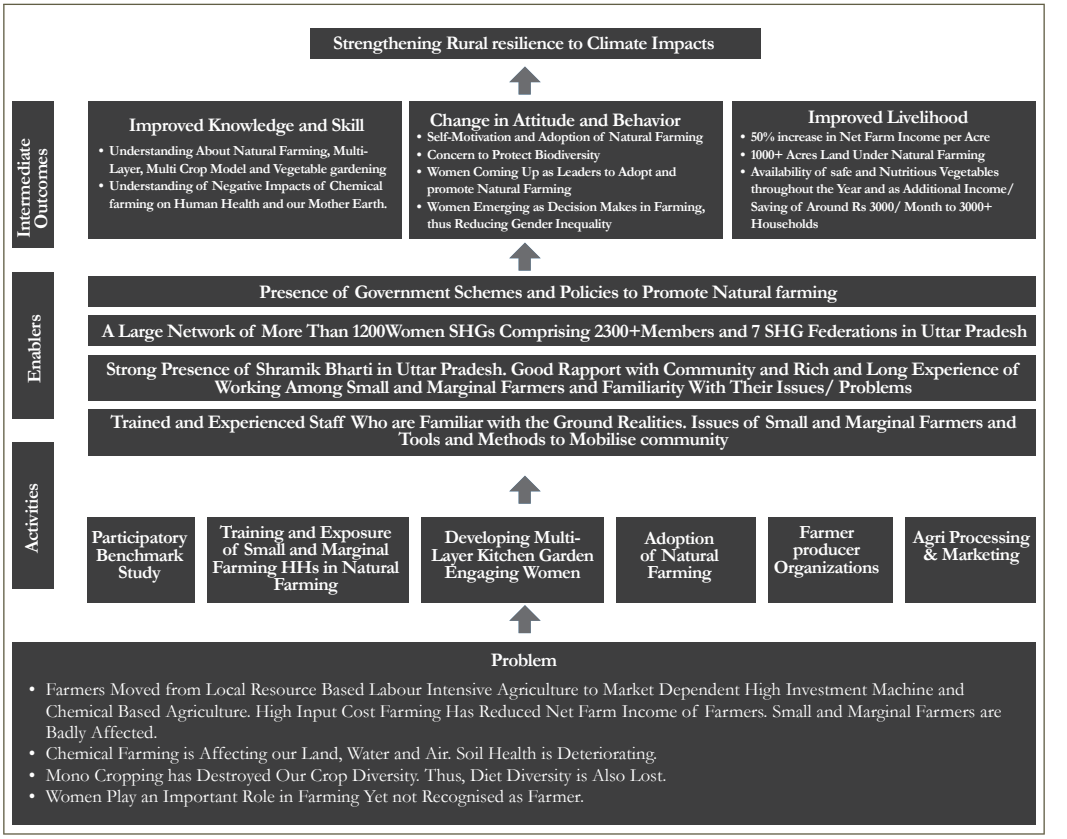


Figure 7: Theory of Change

13. Inspiring Stories From the Ground

Box 1: Story of a Woman Natural Farmer Krishnawati

Krishnawati resides in Kamahariya village in Chandauli district of Uttar Pradesh. She has developed multilayer organic vegetable garden with the support of Shramik Bharti. Her family owns a small piece of 10 Biswa land, and they used to grow wheat, paddy and a few vegetables for family consumption. After learning Natural Farming, they took the land of others for shared cropping and started growing vegetables for sale.

Before the unprecedented COVID-19 epidemic and lockdown, she used to sell vegetable produce from her Vegetable Garden in the nearby market. But during the lockdown, all economic activities were shut down including the market where she used to go to sell her vegetables. There was a bumper production of organic vegetables in her vegetable garden. Vegetables, being perishable in nature, cannot be stored for a long time. There emerged a need to create a market within the village for sustaining the livelihood of Krishnawati and her family.

On the other hand, there were many families in the village whose earnings were stopped due to the lockdown, and it was difficult for them to spend money on the purchase of vegetables for family consumption. In this challenging time, team members of Shramik Bharti maintained regular contact with Krishnwati and supported her in developing a market within her village. Families who were able to purchase vegetables were provided safe, fresh and nutritious vegetables at lower rates by Krishnawati. This enabled Krishnawati to earn a regular income for the family during the lockdown, and people got safe and fresh vegetables at reasonable rates at their doorstep as well.

During the lockdown, Krishnawati earned ₹ 28,000 from the sale of vegetables from her multilayer vegetable garden. Moreover, seven families in the village who were not able to purchase vegetables; they were provided fresh and nutritious vegetables free of cost by Krishnawati.

Box 2: Sushila Devi-A Leader Among Natural Farmers

Sushila Devi is a resident of village Korsam, Fatehpur, Uttar Pradesh. She owns one bigha of land, and farming is the main source of livelihood for Sushila's family. It was in the year 2016 when Shramik Bharti started promoting natural farming in her village. Sushila got influenced by the idea and attended training programmes on natural farming. She learnt to prepare natural fertilizers (Jeevamrut & Ghanamrut prepared using cow dung and cow urine and other locally available material), Shivansh Khad, Growth Promoters, Pesticides etc.

Sushila started by developing a Kitchen Garden on a small piece of land and grew Sharbati paddy and mustard on the remaining land using natural farming processes. She got a very good yield, and the produce was safe for consumption and rich in taste.

Sushila decided to motivate other women in her vicinity for natural farming. She trained women in natural farming and further organized them into Farmer-Producer Groups. With her dedication and consistent efforts, today more than 50 farmers have convected to natural farming in the village Korsam. There were 30 women farmers who became a member of the Farmer Producer Company 'Srishti Nature Farming Producer Company' for collective processing and marketing of their produce. This has ensured sustainable livelihood for these women farmers by enabling them to have *'Apna Beej, Apna Khad Aur Apna Bazaar'*.

Women Empowerment through Revival of Traditional Industries

Raman Thapar, Smriti Ahuja, Rashika Sharma, Prachi Gupta
Co-author-Mangal Swami

1. Introduction

Babui grass grows naturally in the eastern state of West Bengal in India. Women in households have been utilising this naturally grown grass to make multi-utility products like baskets and decorative items. The products are sustainable and environmentally friendly. The handloom mat weaving in the Pashchim Medinipur district of West Bengal holds a rich cultural heritage. For hundreds of years, the local people used to weave mats on a bamboo structured loom fixed on the floor, which were used as floor mats or bed mats. Earlier, these products were utilised only at the household level, but the women-led Mat & Babui (Sabai)[1] Grass Craft Cluster in the Markandachak village of Pashchim Medinipur district, located 150 km away from Kolkata has provided livelihood opportunities, especially to the women artisans. The grass is listed as a cash crop. The Indian Micro Enterprises Development Foundation (IMEDF) and Child and Social Welfare Society (CSWS) identified the opportunity to set up a cluster through the Scheme "Fund for the Regeneration of Traditional Industries (SFURTI)" under the Ministry of Micro, Small, and Medium Enterprises (MSME) that promotes the revival of such traditional cottage industries. IMEDF is a Nodal Agency with the Ministry of MSME. Its primary line of business is cluster development.

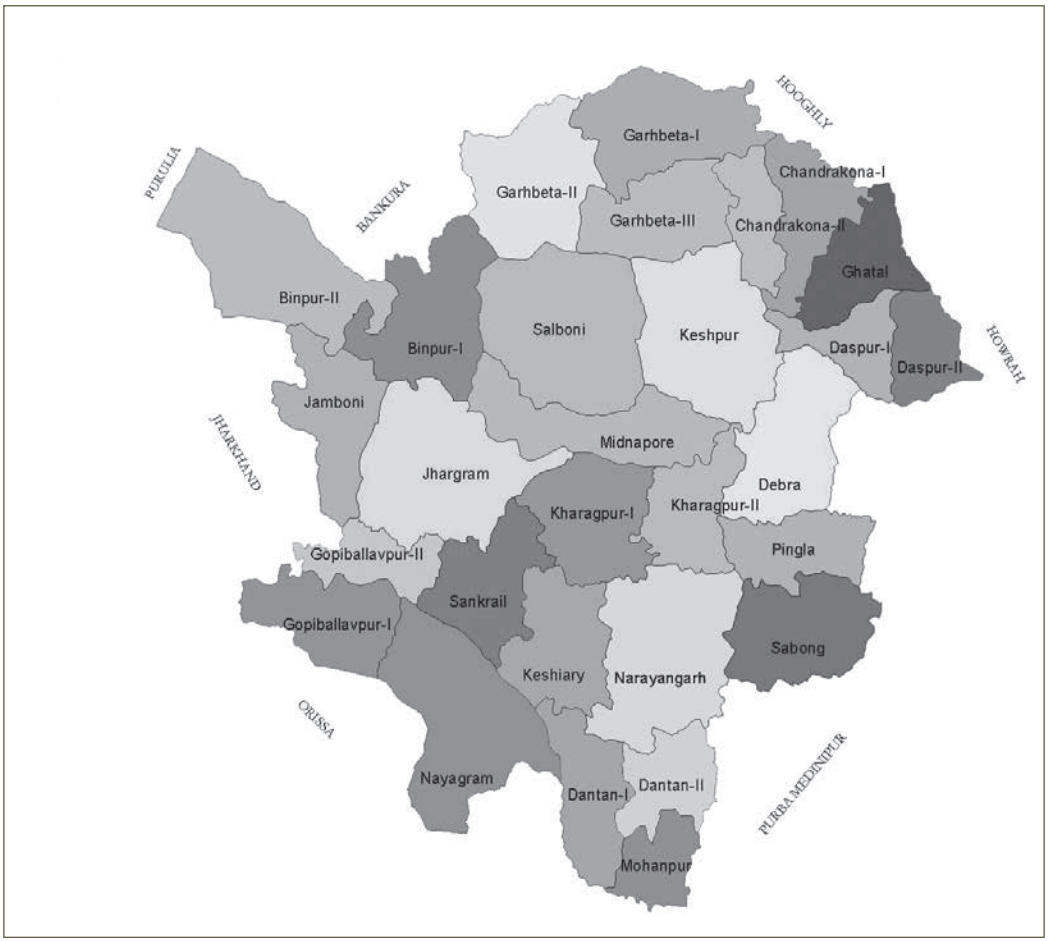
The cluster has 500 artisans, of which 420 are women. With the change in market needs, the artisans required better technologies to improve production processes and product designs that would attract urban customers. High-end machinery like loom sets and sewing machines have been installed at the Common Facility Centre (CFC) to help the artisans manufacture such market-ready products at scale. Technological upgradation has helped in the diversification of the product profile. The cluster has developed its Medini Crafts brand, which is run by a Governing Body and a Working Committee. The artisans have been trained in product quality development. They make yoga mats, handbags, and ladies' purses in the established product line and are exporting them. They have established backward and forward market linkages. Thus, they are sustaining the craft and ensuring the community's social and economic development. They promote rural handicrafts with a contemporary aesthetic appeal by producing a lifestyle line of products and accessories for home and office. Natural dyeing is practised in the cluster.

Babui grass is sabai grass. Its botanical name is Eulaliapsos Binata and it belongs to family Poaceae (grass family). It is a tufted perennial grass with basal sheaths and is wolly with whitish hair. Locally the fiber oof the grassis called babui ghash.

'Medini Crafts Brand' has been set up to sell curated products to a customer base across India through e-commerce platforms to establish a more substantial market for local products. The cluster now has an average annual turnover of ₹ 66,93,000.

2. Context of the Intervention

Handloom mat weaving is flourishing gradually with modern technologies and key organisational skills. During surveys and discussions with the stakeholders, it was established that the mat products have a good market. Thus, the cluster was set up by the Implementing Agency - Child and Social Welfare Society to engage 3000 self-help groups with 10-15 artisans in each group to increase their income through this activity. –



Map 1: District Map of Pashchim Medinipur, West Bengal

The cluster is located at Markandachak village of Sabang block, which is 75 kms away from the district headquarters and 150 kms from the state capital Kolkata. As per the 2011 Census of India, Sabang Block had a total rural population of 2,70,492 having 1,38,924 (51%) males and 1,31,568 (49%) females.

The Madur grass-based production units in Paschim Medinipur district are spread over the Sabang, Narayangarh, Pingla, and Keshiyari blocks. In West Bengal, it is cultivated in wasteland areas and grows naturally in hilly and rolling tracts, encroached land inside coppice forests, and plantation areas. Around 42% of households have an average of 0.16 h a land under Sabai grass. Out of these households, around 83% belong to the ST community, 7% belong to the SC community, and 10% belong to other social groups. About 15% of the households grow Sabai grass in encroached forest areas with the average area under cultivation being around 0.14 Ha. The average annual gross income per family is ₹ 12,000 to ₹ 15,000. It is a long-term crop, so the cost of cultivation, yield, and post-harvest expenses vary over different crop years. The plants yield till 16 to 17 years, but for better economic viability, new planting is encouraged after the 12th crop year. With the availability of raw materials and skilled women artisans, diversified Mat industries are flourishing in this geographical part of the district.

It is well-known that women are not given equal opportunities and proper education facilities in rural India. Most families in rural areas feel that female education is an economic burden for the family. Empowerment through working opportunities provides women with a source of livelihood and confidence.

The cluster has provided diversified work opportunities to the women artisans, empowering them and enhancing their decision-making power. Now, most of them are sending their children to school and college. In West Bengal, a systemic attempt has been made to enable landless tribes to have self-sustaining employment all year round.

3. Positive Transformation Witnessed at Artisans and Enterprise Level

3.1 Artisans Level

Local women artisans have executed the entire work related to the mat industry despite belonging to a low-income level community. Earlier, the artisans were earning less from the activity due to a lack of collective bargaining power for purchasing raw materials, higher wastage in the processing of raw materials due to the use of obsolete technologies, lack of proper marketing skills and limited direct marketing. The formation of Cluster has brought in the opportunity to upgrade and diversify the product range to meet the needs of contemporary market tastes through design development and quality control. Highly labour-intensive technology, tools and equipment have also been replaced, impacting artisans' lives by easing their workload.

More than 10,000 artisans are currently associated with training, production, and marketing-related activities with this cluster. IMEDF, along with CSWS, also extends its technical expertise to enhance the knowledge & skills of local artisans in and around the area. Now the artisans can secure their livelihood through enhanced income.

3.2 Enterprise Level

IMEDF's role as a nodal agency has been to design quality interventions with a focus on providing sustained employment to artisans and farmers, upgrading technology and enhancing the marketability of new products. Sanctioned with a grant of ₹ 264.33 lakhs, the cluster covers the Sabang, Narayangarh, Pingla, and Keshiary blocks of the Pashchim Medinipur district. Green energy sources such as solar and rainwater harvesting models have been adopted.

4. Key Challenges

4.1 Individual, Family & Community Related Challenges

The artisans' group belongs to the indigenous communities of Rajbanshi, categorised as Scheduled Castes in the Indian Constitution.

4.2 Systemic & Scale of Operations Related Challenges

The Project helps to build access to skilled labour and entrepreneurship development. The interventions also allowed specialisation, built technological capabilities and innovation, and facilitated knowledge development and learning through interaction. In the joint efforts in poverty alleviation, the cluster also works towards green and innovative solutions for cluster development. Rural areas often need help accessing markets and achieving scale. The cluster mobilisation has encouraged more than 10,000 artisans to harvest the mat grass twice a year, which ultimately helps to reduce the price of raw materials. Modernisation and upgradation of tools and machinery, processing, and other manufacturing methods have been conducted to assist entrepreneurs & exporters in setting up world-class facilities with the latest technology, which helps to compete in the growing competitive world market. Earlier, monthly production was 2000 pieces of mat costing ₹ 5,00,000. Post the intervention, 11,200 pieces of mat are made, costing ₹ 28,00,000.

5. Impact

5.1 Sustainable Innovation & Social Development

A positive transformation has been witnessed at the community level as more women artisans are engaged in mat weaving. Women run the operations at the Common Facility Centre. They have found an alternative livelihood and means to upgrade their skills. With the involvement of the community, the institutional linkages have strengthened. The profit distribution is in the hands of the Special Purpose Vehicle (SPV), which is a separate legal

entity created by the organisation where a portion of the profit from the project is utilised in community development work in the cluster area by providing facilities such as better health, education, water, sanitation, and community development programs.

5.2 Economic Status

Table 1: Financial Details

Total Turnover (till 30th June 2022)	Average Annual Turnover	Average Annual Surplus/Deficit (till 30th June 2022)	Average Monthly Income of Artisans (Pre-Intervention)	Average Monthly Income of Artisans (Post-Intervention)
₹ 83,67,000	₹ 66,93,600	₹ 26,77,440 (Surplus)	₹ 6,500	₹ 10,000

Innovative high technology has created sustainable impacts on the lives and livelihoods of 580 farmers, particularly women and the marginalised. The Business to Business (B2B) channel has also been worked out by registering through trade portals like Trade India and India Mart. The plan is to explore the export potential of the products. Supply channels for national markets have been worked out, and bulk selling has been initiated by partnering with agencies like GeM (Government e-MarketPlace) and KVIC with their Khadi India/ Khadi Natural brand.

6. Key Learnings

6.1 Establishing an Ecosystem

On the market linkages front, how to promote the value-added products was the biggest learning from the project. Another key learning was how to handle a project/intervention that involves multiple stakeholders like government, NGO, and community using an integrated approach. On the whole, the key learning was planning and forward-thinking. The cluster got a considerable order to make yoga mats for International Yoga Day 2022 for TRIFED.

6.2 Limitations

The artisans faced many challenges and difficulties that needed to be addressed to keep this heritage of crafts alive. The methods of production right from start to finish were old, traditional, and even archaic. The tools and implements were very crude and indigenous. Pre-intervention financial paucity prevented artisans from regularly purchasing and storing raw materials. The price of mat sticks and grass was also high because of limited cultivation. Sabai grass is second only to bamboo in importance as raw material for paper mill manufacturers. In recent years attempts have been made in the grass and mat industry to increase its use. It is cultivated mainly in Tamil Nadu, West Bengal, and Andhra Pradesh. Lack of bargaining power also disabled the artisans from having any effective say in the market or determining the sale price to their advantage. The crafts centres were not directly connected by either a motorable road or even an all-weather road, as a result, the artisans

faced immense difficulty and hardships in taking their finished product to the 'haats' and 'markets' and purchasing raw materials in the rainy season. The market was also limited to West Bengal and Orissa states only. Even though there was a huge demand for these crafts all over India and outside India, the same is not known to the artisans.

7. Way Forward

The vision is to have the impact of such clusters at scale, deep, inclusive, and enduring to provide sustainable livelihoods to rural communities and build an ecosystem that responds to such initiatives.

Box 1: Case Study of Rupali Hembram

Ms Rupali Hembram, 26 years old, is a soft-spoken and determined woman who works with the Mat and Babui Grass Cluster in West Bengal. Rupali enhanced her Babui grass or Sabai grass weaving skills by learning how to operate the modern apparatus of Juki tailoring and stitching machines which helped increase her productivity. Babui grass is grown widely in eastern districts of India and is mainly used for making Babui Rope. These ropes are mostly sold for use in weaving Charpai (Cots), sofa sets, Chairs, Small Baskets, Tea Poy, etc.

Rupali was a landless daily wage worker at a paddy farm earning ₹ 150 a day before joining the cluster. Today she earns a salary of ₹ 6,000 per month with better working conditions and social security. Rupali looks forward to creating beautiful designs and hopes that her handmade products find their way to a loving home!

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Climate Smart Village
A Case of Climate Resilient Livelihood Model in Flood Affected Ecosystem of West Bengal

Sujit Sarkar, R.N.Padaria, Sanjib Das, Biplab Das, Ganesh Biswas, Dinabondhu Roy and Ajit Sarkar

1. Introduction

Climate change has undoubtedly emerged as the gravest challenge across the globe, and the search for appropriate adaptation mechanisms has become an arduous task for policymakers. In India, the rural people of flood-affected ecosystems are considered to be the major victims of climate change because of their high dependence on climate-sensitive farming sectors. In the Sub-Himalayan foothills region of eastern India, floods are considered as the most powerful annually occurring natural disaster, which causes severe losses to the socio-economic life of the inhabitants (Mitra and Das, 2022). The downstream floodplains of Teesta in North Bengal suffer from too much water in monsoon, and huge losses are experienced in agricultural production each year. This crisis has escalated in the recent past due to climate change.

The local people in the region reported that there was a change in temperature and rainfall that had severely affected their local water sources, cropping calendars, patterns of cultivation, and ultimately their livelihood security. There was hardly any institutional support for adaptation to these changes. They lack information and skill regarding different climate-resilient agricultural technologies and practices needed for adaptation. They do not have any information about climate-smart varieties of different crops or skills for climate-smart practices like DSR, zero tillage, IPM, INM etc. The farmers expressed their helplessness in terms of adaptation to this crisis. In this situation, a farmer namely Dinabondhu Roy from Singimari said, 'With increasing climatic risk, many people are migrating to other states in India, especially Kerala, where the agricultural wages are higher. Now many villages are inhabited by only aged family members as the young generation is migrating to other cities, thus creating a social vacuum within the society'.

Though the different government bodies and agencies have diverse schemes for climate change adaptation, their field-level presence is very minimum. The state department also tried to reduce their vulnerability through the distribution of different inputs but with minimum success. Unfortunately, the conventional institutional approach and technology delivery model was not effective in the Teesta River basin, which was more vulnerable to climatic extremes. As a result, devising a more effective institutional approach with a bunch of tested & proven climate-smart technologies was felt as the most urgent need by different policymakers to reduce the vulnerability of the region towards climate change. Despite the plethora of literature on climate change, adaptation and migration, gaps remain

in identifying and designing an effective institutional approach for delivering climate-smart technologies more effectively among farming communities (Ghimire et al. 2022). Keeping this gap in mind, the Indian Agricultural Research Institute, Regional Station, Kalimpong established a 'Climate Smart Village (CSV)' in 2016 to promote different climate resilient technologies for better adaptation to climate change in Singimari and Bangkandi Village cluster of Teesta River basin in West Bengal.

2. Problems Faced by the Farming Communities

Most of the area near the Teesta River valley of North Bengal belongs to the flood ecosystem. Recently the farmers reported a huge loss in agricultural production due to current climatic variability. The majority of the area belongs to a low-land area with high sensitivity to rainfall and flooding. Farmers' living and working conditions are becoming extremely harsh, as they are under constant threat of erosion and flooding. Due to farmers' low socio-economic profile, their adaptation capacity is very poor. Most farmers do not have the investment capacity to adopt different climate-smart technologies and practices. Further, they lack information and knowledge about possible adaptation initiatives towards climate change in flood ecosystems. Lack of access to climate-smart technologies, absence of rural institutions, non-existence of weather forecasting systems, and lack of location-specific technological innovation make the farmers of the region highly vulnerable to climate change. The farmers reported that the change in climate had caused a decrease in agricultural and livestock production and productivity. Increased incidence of pests and disease infestation, presence of invasive species, frequent crop failure due to flood, exodus of labour force from villages, and market volatility have put serious challenges on the agricultural systems in the region. Hence, higher-level research for innovation in the area of adaptation options, new tools and technologies, and improvement and promotion of tested practices, creation of village-level institutions for minimising climatic risk has become the need of the hour.

Ajit Sarkar, a progressive farmer, said, 'Rainfall has become highly uncertain for the last five years. On many occasions, farmers cannot sow the paddy due to lack of rainfall; then suddenly, they face heavy unseasonal rainfall during harvesting causing total crop failure. There is a change in nature, time and frequency of rainfall as well as flood. Many lowlands now remain uncultivated either due to heavy floods or lack of rainfall during sowing time, especially near the *char* (sand bed). On the other hand, farmers faced the problem of low groundwater in the winter season due to increasing temperatures under changing climates. All these climatic stresses make the farming communities of the Teesta River basin highly vulnerable, and now they are thinking whether they can sustain their family and livelihood through farming with this pace of climatic change'

3. Establishment of Climate Smart Village

The policymakers were continuously striving to find the solution to the current crisis and devise an alternate institutional arrangement specifically for adaptation to climate change.

Then the scientists from IARI tried a new institutional arrangement named 'Climate Smart Village (CSV)' involving all the related stakeholders in a participatory approach integrating technology and social dimension for adaptation to climate changes. A climate-smart village has been conceptualised as a village where all the villagers contribute to climate change adaptation by adopting the required climate resilient technologies, following the mitigation measures for reducing greenhouse gas emissions, bringing positive behavioural change and devising local solutions to reduce vulnerability towards future climate change impacts keeping the region's socio-economic, gender and bio-physical constraints in mind through participatory community approach (Sarkar *et al.* 2022). The major criteria for a climate-smart village are as below-

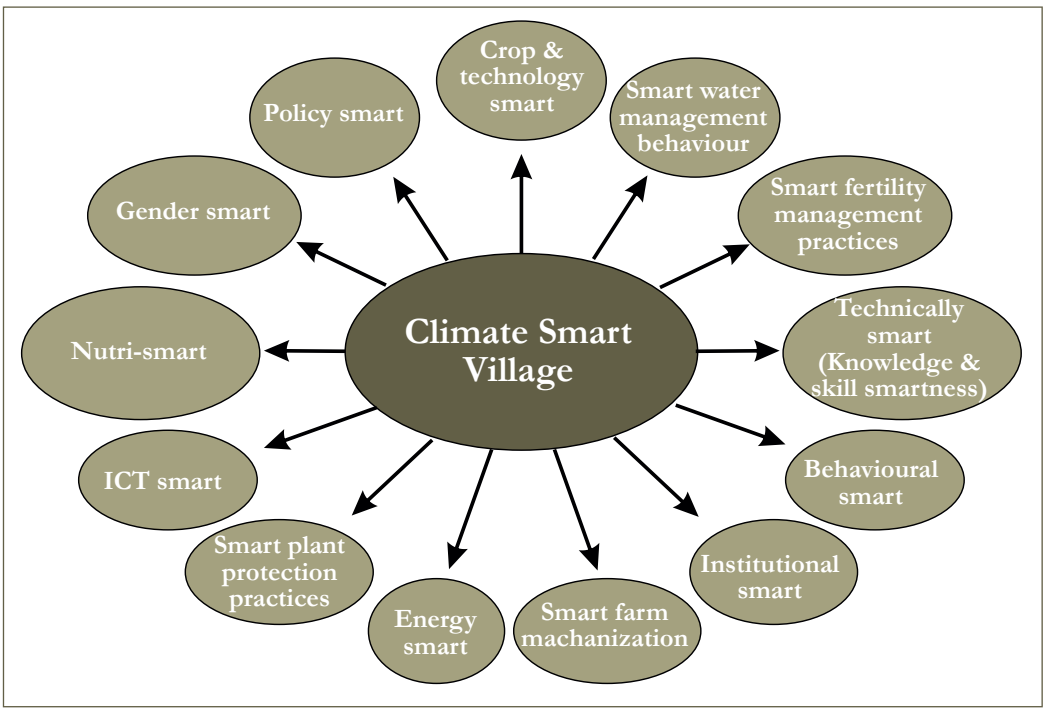

Figure 1: Conceptual Framework of Climate-Smart Village (CSV)

Keeping the above criteria in mind, a climate-smart village was established in the Singimari and Bangkandi village cluster of Maynaguri, Jalpaiguri district in West Bengal, in 2016. All the villages within a radius of nearly 15 kms were selected for the intervention under climate-smart village (CSV). Initially, participatory climatic risk analysis using PRA tools like climate calendar, climate disaster history, matrix ranking, Venn diagram, and vulnerability profiling was done involving the affected communities especially vulnerable and female farming communities. This helped to understand the vulnerability of the region, identification and prioritisation of risk, and the most relevant adaptation policy that need to be incorporated to make the village climate smart. Thereafter, a farmer's interest group was formed to work as a community and to exert group pressure as a social strategy. In this stage, the project team also identified the various service providers and their activities in the

district and divisions. These include government organisations, NGOs and private-sector players. The present project tied up with Krishi Vigyan Kendra, Jalpaiguri, NABARD, State Agricultural Department, Insurance company, Bagjan Progotishil Sangha. This activity aims to encourage all lower-level stakeholders to be part of the solution against climate change.

Finally, a formal inauguration programme was organised in the presence of all the stakeholders and villagers in September 2016. This set the tone for future operations and activities for adaptation to climate change. Thereafter, diverse climate resilient adaptation activities like the promotion of flood-tolerant rice varieties, HYV of vegetables, introduction of zero tillage, DSR, IPM, INM, organic farming, weather-based advisory services, regular training on climate-smart technologies & practices etc., were conducted in the climate-smart village. The officials from the State Agriculture Department visited the climate-smart village, and they assessed the impact of different interventions at the field level. Seeing the impressive result, the State Agricultural Department certified the village as a 'Climate Smart Village' in 2017.

4. Interventions to Make the Village Climate Smart

Since 2016, farmers have been introduced to diverse climate-smart technologies and practices. Besides introducing new technologies, they were advised to adopt different climate-smart behavioural practices like subscribing to weather updates, weather-based insurance, market intelligence etc. This helped to create evidence of climate-smart intervention at the field level. A different capacity-building programme was conducted to raise their knowledge and skill level on climate-smart technologies and practices. The major interventions made according to the different criteria of climate-smart village are presented in the Table 1

Table 1: Interventions Made in Climate-Smart Village

Sr. No.	Climate-Smart Parameter	Interventions	Number of Farmers Benefitted
1.	Crop & technology smart	Different climate-resilient technologies like climate-resilient rice varieties (PS-5, P 1612), flood-resistant rice varieties (Swarna -sub I), DSR, green gram (Pusa bishal), and mustard (PM-26, PM-28, Pusa Vijay) varieties, cultivation of pulses (arhar, moong), intercropping of jute and moong, SRI, mulching techniques, raised bed panting, line sowing, shifting planting dates and techniques, switching and diversifying crops and varieties, crop rotation, etc. were promoted in adopted villages.	5000
2	Smart water management behaviour	Drip irrigation, sprinkler irrigation, mulching, water harvesting were promoted	1450

Sr. No.	Climate-Smart Parameter	Interventions	Number of Farmers Benefitted
3	Smart fertility management practices	Soil testing, INM, uses of micro-nutrient, vermicompost, liquid fertiliser etc., were encouraged.	3200
4	Technically smart (Knowledge & skill smartness)	Conducted training on knowledge of different climate resilient technologies like DSR, zero tillage, SRI, IPM, INM etc., of different crops	5600
5	Behavioural smart (having favourable attitude, value system and perception towards climate change and climate-resilient technologies)	Awareness programme to create favourable attitude and value system towards climate-smart technologies and adoption of climate-resilient farming as well as living style. They were encouraged to subscribe to weather forecasting platforms, climate-informed agro-advisories, and weather insurance as a tool for forward planning. Tree planting was highly encouraged among the villagers.	2125
6	Institutional smart	Mobilising the communities for the formation of community-level institutions like producer companies, water user groups, custom hiring centres, seed villages and linkage with different government as well as private agencies related to climate change.	2654
7	Energy smart	Promoted solar technologies for irrigation and spray.	431
8	Smart plant protection practices	Promoted INM practices, pheromone trap, yellow sticky trap, ITKs etc.	3450
9	ICT smart	The farmers were trained to use the mobile phone to access different meteorological services from websites and apps.	1525
10	Policy smart	Having an awareness of different policies related to climate change like Pradhan Mantri Fasal Bima Yojana, Jaldoot, Paramparagat Krishi Vikas Yojana etc. and registering under those schemes for adapting to climatic risk.	1678
11	Gender smart	Involving male as well as female members in each programme and intervention	1420
12	Nutritional smart	Promoted Nutri-crops and varieties like black rice, PM-30 and PM-31 of mustard variety, iron-rich leafy vegetables, Nutri vegetables like moringa, broccoli, capsicum, red cabbage, summer squash, yellow cauliflower, anti-oxidant rich carrot etc.	3460

Sr. No.	Climate-Smart Parameter	Interventions	Number of Farmers Benefitted
13	ITK smart	Different indigenous climate resilient technologies and practices like the application of casuarina equisetifolia leave to counteract soil alkalinity, Neem plant extract as an insecticide for sucking pests and different fungal diseases, growing black gram on the bund of rice fields, etc., were documented and promoted.	675
14	Smart farm mechanisation	Different farm machineries like zero tiller, paddy trans-planter, paddy seeder, drum seeder etc., were promoted for the adoption of climate-smart practices.	2680

5. Sampling Plan and Methodology

In the present study, the villages near the Teesta River of Jalpaiguri district, West Bengal, were selected for intervention as these regions are highly vulnerable to flood ecosystem. Most of the land belongs to the low-land area with high sensitivity to rainfall and flood. The majority of the households in the Teesta floodplains in West Bengal are primarily engaged in farming; the majority of these are marginal farmers with less than 1 ha of cultivable land. Apart from rice, other important crops grown are jute, maize, potato, cabbage, cauliflower, chilli, brinjal, tomato and mustard among other . All the areas under the climate-smart village are covered for survey under the present case study to trace the impact of the intervention. The selected villages are Kathal Bari, Marich Bari, Domohani I, Chatrapar, Mouamari, and Bolbari from Singimari, whereas Petkati, Kalakhawa, Teli para, Sardar Khan, Amguri, and Domukha Danga para from Bangkandi were selected for the present case study. A total of 500 farmers were randomly selected for the survey to find the impact of climate-smart villages. The before-after approach of impact assessment was used for the case study. Statistical tools like mean, frequency and percentage were used to analyse the data.

6. Impact of Climate-Smart Village

Though it is very early to assess the impact of climate-smart villages as many impacts are long-term oriented and yet to follow. However, a trend of impact and field level changes due to the 'climate-smart village' can be observed if we compare it to the previous scenario. Hence, a survey was conducted in 2022 to find the impact of a climate-smart village among the beneficiaries. The present study documented the changes in the different farming scenarios, technology adoption status, production scenario and changes in the socio-economic scenario as an indicator of the impact of the present technology delivery model, i.e., climate-smart village. The major impact and changes witnessed at the field level and reported by farmers are presented one by one in the following sections.

6.1 Change in Land Use Pattern

It was found (Figure 2) that due to the intervention under climate-smart village significant increase in the area under pulse and oilseed (70.73%) has been observed, followed by the area under fruit, orchard and plantation crops (45.57%), land under forest (44.44%), irrigated area (42%), water bodies (43.87%), area under vegetables (29.58%), area under cereals (17.95%). The decline of fallow land by 52.63 per cent indicates that unproductive or unused land was converted into farming land under the project. The introduction of pules like red gram, green gram into the cropping pattern ensured the soil health and sustainable production system in a climate-smart village.

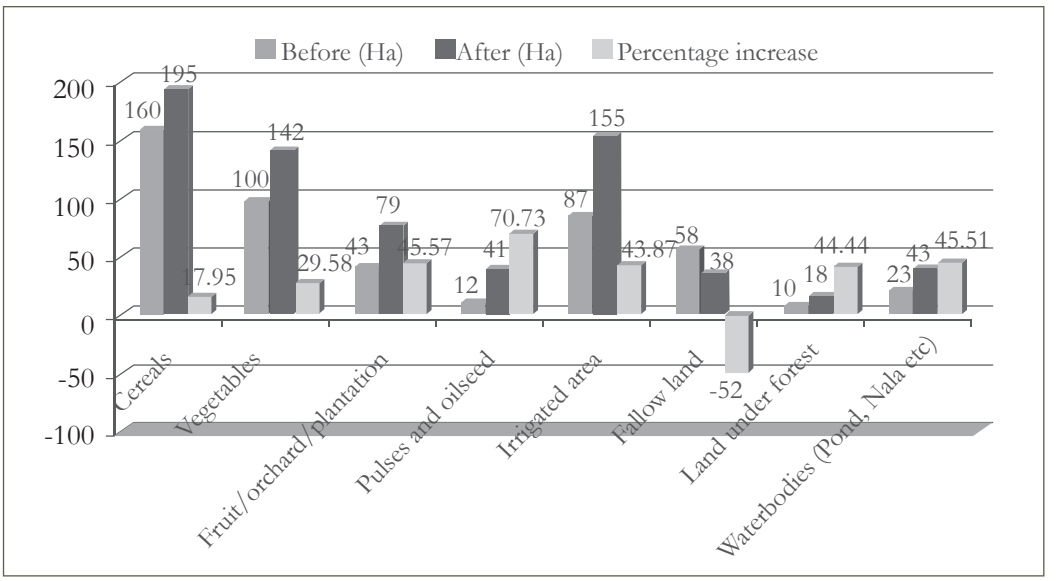

Figure 2: Before-After Land Use Pattern

6.2 Increase in Crop Yield

To unveil the impact of improved varieties and other climate-resilient technologies on the yield of major crops, the yield data of respective crops before the project intervention (2016) and at the time of the study (2022) were compared. An increase in average yield for all the major crops in the project villages was reported by the beneficiaries (Figure 3). The increase in yield could be attributed to the intensive demonstration of different climate-resilient varieties and practices for all the crops during the last five years in the climate-smart village. Maximum yield improvement (33.33%) was witnessed in the case of red gram from 5 q/ha to 7 q/ha. This is due to introducing the new high-yielding varieties like Pusa Arhar 16. In the case of rice, the yield enhancement of 21.05% was recorded due to the adoption of climate-resilient varieties like PS-5 and Swarna sub I. Adopting climate-smart paddy cultivation methods like DSR and SRI with quality seeds and adequate fertiliser helped realise this enhancement in rice yield. Demonstrations of improved varieties of off-season vegetables showed an increase in yield of Beans (Summer 26.23%), Peas (22.73%), Ladies finger (winter 20.99%), Cabbage (15.98%), Cauliflower (16.59%), Tomato (21.37%),

Brinjal (summer 15.12%). Besides the role of improved varieties, a multitude of other factors, including the adoption of conservation technologies, flood tolerant varieties, timely sowing, planting and transplanting, maintaining high moisture content in the soil, increased frequency of irrigations, improved soil and water management practices would have dovetailed in the realisation of better yields.

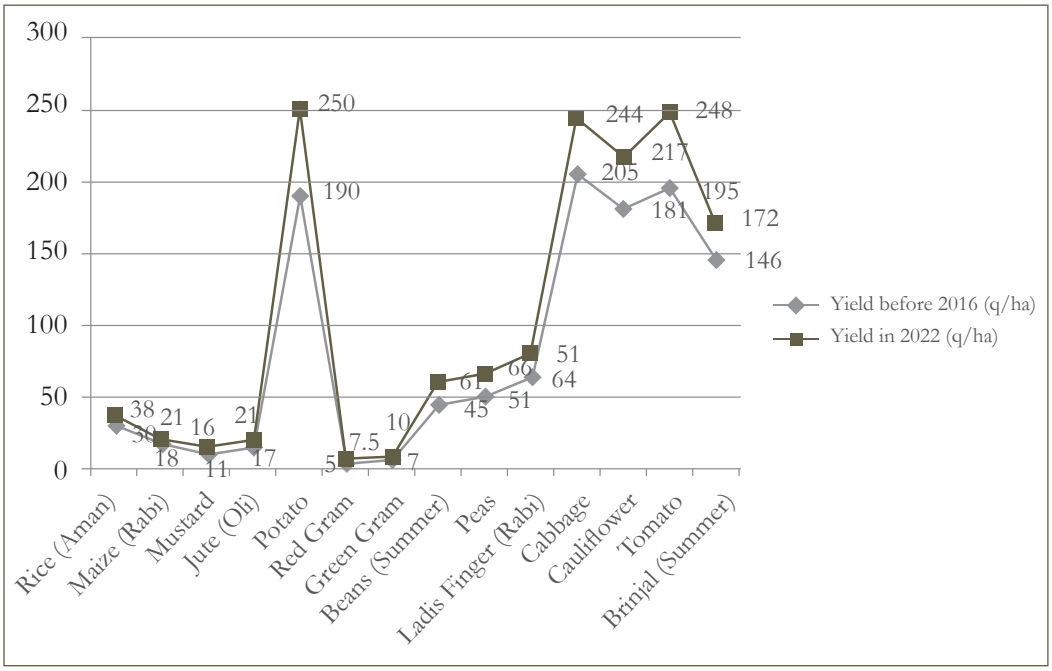

Figure. 3: Increase in Yield Level of Major Crops

6.3 Increased Adoption of Climate-Resilient Technologies

The adoption of different climate-smart technologies and the incorporation of those technologies into the local farming system is the starting point for building up adaptation against climate-change-induced impact (Nguyen HA et al. 2021). Hence, the project promoted diverse climate-smart technologies, practices and services in the climate-smart village over a period of 5 years. The findings show that a significant improvement in the adoption of different climate-resilient technologies, practices and services were observed in the climate-smart village (Table 2). The most effective and popular climate resilient technologies which were adopted by more than 50% of respondents were line sowing (50.80%), intercropping (55.60%), micro irrigation system (53.60%), water harvesting (50.60%), subscription to weather advisory services (55.40%), and subscribing crop insurance (51.80%). Other important adaptation initiatives, which were adopted by just less than 50% of respondents, were the adoption of climate-smart varieties (47%), a new cropping system (42.60%), change in planting time (43.60%), zero tillage (41.60%), mulching (48.60%), IPM (47.80%), regular vaccination and deworming of animals (49.40%).

Though the findings of the present study contradict many previous findings; for example, Khati, K. (2020) reported about the low adoption level of climate-resilient technologies. Similarly, in 2019 Anseera T.P. too has mentioned that the results of the adoption of climate-resilient practices are not very encouraging. The low adoption scenario in past studies may be due to the fact that in all the past studies, there was no focused institutional approach, unlike the present study where a specific institutional approach, i.e. 'Climate Smart Village (CSV)', was followed.

Table 2: Interventions Made in Climate-Smart Village

Sr. No.	Climate-Smart Technologies, Practices and Services	No. of Respondents(%)	
		Before Adoption	After Adoption
1	New cropping system	48 (9.60)	213 (42.60)
2	Change in planting time	58 (11.60)	218 (43.60)
3	Adoption of climate-smart crops	69 (13.80)	176 (35.20)
4	Adoption of climate-smart varieties	74 (14.80)	235 (47.00)
5	Line sowing	90 (18.00)	254 (50.80)
6	Raised bed planting	46 (9.20)	151 (30.20)
7	Crop rotation	78 (15.60)	195 (39.00)
8	Zero tillage	15 (3.00)	208 (41.60)
9	Direct seeded rice	25 (5.00)	181 (36.20)
10	Intercropping	85 (17)	278 (55.60)
11	Mulching	67 (13.40)	243 (48.60)
12	IPM	56 (11.20)	239(47.80)
13	INM	49 (9.80)	194 (38.89)
14	Micro irrigation system	50 (1.00)	268 (53.60)
15	Water harvesting	78 (15.60)	253 (50.60)
16	Solar pump	0 (0)	82 (16.40)
17	Subscribe to weather advisory	20 (4.00)	277 (55.40)
18	Registration in crop insurance	30 (6.00)	259 (51.80)
19	Organic farming	35 (7.00)	85 (17)
20	Adoption of pulse-based cropping pattern	78 (15.60)	177(35.40)
21	Improved fodder management practices	52 (10.40)	155 (31.00)
22	Regular vaccination and deforming of animals	87 (17.40)	247 (49.40)
23	Adoption of fishery	93 (18.60)	195 (39.00)
24	Adoption of poultry	84 (16.80)	147 (29.40)
25	Adoption of goatery	64 (12.80)	109 (21.80)

6.4 Increase in Income

The major objective of establishing a climate-smart village was to increase the income of farmers and ensure their livelihood security in a sustainable way. Different technological interventions through the climate-smart village (CSV) not only restore the natural ecological

balance but also enhance the income of farmers from agriculture and allied sectors. The case study found that in 2016 majority of the farmers (50%) belonged to low-income categories (<₹ 100000 lakh/year), and only fifty farmers (10%) belonged to the very high-income category (> ₹ 500000/year). Whereas in 2022, there was a decline of 177.78% in low-income categories (<₹ 100000/year), and a majority of the farmers (33.33%) had a medium level of income (₹ 1-3 lakh/year) followed by high level of income of ₹ 300001-500000/year (30%) and very high income of greater than ₹ 500000/year (20% of farmers). Hence, it can be concluded that the introduction of different improved climate resilient varieties like PS-5, Swarna sub I of paddy; PM 26, PM28 of mustard, HYV of different vegetables, new commercial crops like dragon fruits, off-farm income from poultry, goat rearing and dairy helped the farmers to pocket more money from agriculture.

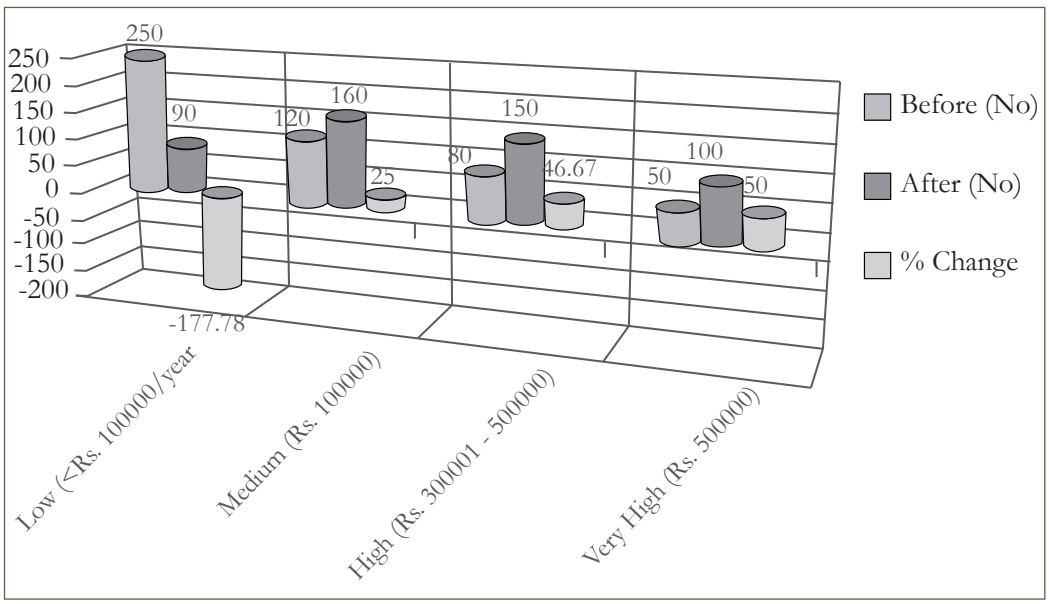

Figure 4: Before-After Income Categories of Farmers

A farmer, Ajay Sarkar, aged 35, from Bangkandi, reported that cultivation of new varieties of paddy, vegetables with climate-smart practices helped to raise his production and income significantly. Now he cultivates commercially important crops like dragon fruit which minimises his vulnerability to climatic change and ensures his monetary income. Earlier he could hardly earn ₹ 4,31,000 from his 5-acre area, which surged up to ₹ 9,26,000.

6.5 Increased Access to Production Resources and Services

It is an ironic fact that the majority of farmers in the Teesta river basin live in rural areas under extreme climatic threat with limited access to climate-resilient technology, inputs, extension service, weather advisory services, and financial services, which was highly needed for their adaptation to climate change. Hence, rural institutions like 'Bagjan Pragatishil FPO' and 'Krishak Bandhu Farmers Club' was established, which acted as service-providing platforms to vulnerable farmers. Now farmers receive all types of technological, financial and extension advisory services from this centre.

The household survey found that access to different production resources and services significantly increased in the climate-smart village (Figure 5&6). The access to different extension services like (awareness, training, sanitation, vaccination, farm pasteurisation, crop protection etc.) has raised to 79% from 16% in 2016. The access to financial services (loans, insurance, marketing, registration for Krishi Sanman Nidhi and other programmes etc.) has raised to 65% from 10% within these 5 years in the climate-smart village. Most importantly, access to climatic services (weather forecast, capacity building on climate-smart practices, SHC, etc.) has risen to 73% from a meagre 5%. The access to technological services (new varieties, crops, new machinery, new practices from training etc.) has gone up to 85% from 21% in the climate-smart village. Now, 90% of the farmers in the climate-smart village have access to different input services (fertiliser, pesticide, seed etc.) in the climate-smart village, which was earlier only 26%. Similarly, the access to marketing services (purchase of inputs, sale of farm produce, market intelligence etc.) has climbed up to 87% from 13% in 2016.

A farmer Yogesh Nandi commented 'Now farmers can come to the FPO, discuss with fellow farmers, can see the different climate-smart products and services, and can avail or purchase the need-based technologies or services at the doorstep. It is a win-win situation for all of us.'

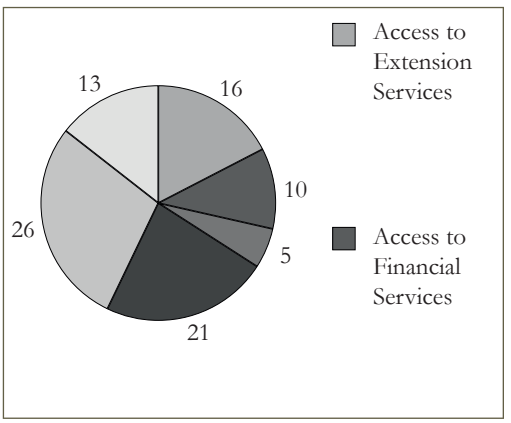

Figure 5: Access to Production Input & Services in 2016

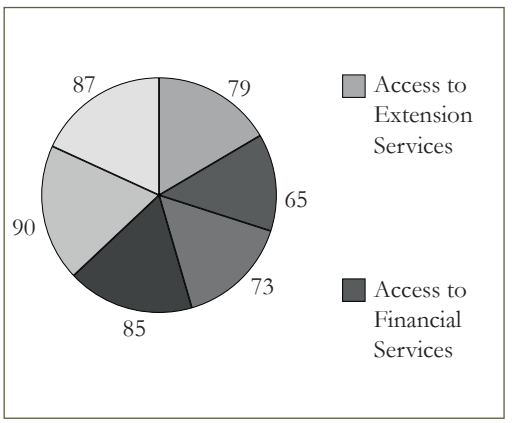

Figure 6: Access to Production Input & Services in 2022

6.6 Increased Mobile Usage Among the Farming Communities

All the farmers with mobile phones are linked with Gramin Krishi Mausam Seva (GKMS), and training was provided on using mobile to access different weather advisory services. Now they are getting regular weather updates through messages from Gramin Krishi Mausam Seva and local KVKs. As a result, farmers have now become experts in using mobile phones for getting not only weather updates but also price updates, marketing intelligence and other agriculture services. They also started using YouTube, android apps on farming & specific crops, social sites and websites on agriculture for different purposes. Farmers in the climate-smart village (CSV) are regularly using climate information through

the GKMS platform to make critical farm decisions such as choice of crops, when to plant, and when to apply fertilisers & pesticides. The survey among beneficiaries showed that there had been a consistent increase in farm productivity for 94% of farmers even after climatic hazards because of taking timely adaptation initiatives through GKMS.

6.7 Enhanced Social Networking

The farmers in CSV now frequently visit the FPO and Farmers club, where they interact with farmers of other villages, officials from government and private organisations, input providers and other stakeholders. As a result, the interaction and information exchange among the farmers has increased significantly in the climate-smart village. The survey during the case study found that farmers now regularly exchange information and knowledge on pest and disease management (89%), technical use of fertiliser (76%), new crops & varieties (80), water management (68%) and risk management (65%). All these activities helped them to strengthen their social network and establish good relations with progressive farmers, input dealers, extension officials and other stakeholders. Thus, the farmers in the climate-smart village are now enjoying high social status with a sense of strong social security and social empowerment.

6.8 Convergence Among Different Institutions

The different organisations provide different types of climate-related services. For synergistic output, a convergence among all these institutions is compulsory for the successful realisation of the benefit of current interventions on climate-resilient technologies. Hence, the project tied up with Krishi Vigyan Kendra, Jalpaiguri (for technology, training and monitoring), NABARD (Jaldyoot scheme, financial aid, consultancy etc.), State Agricultural Department (for technology, extension service, training

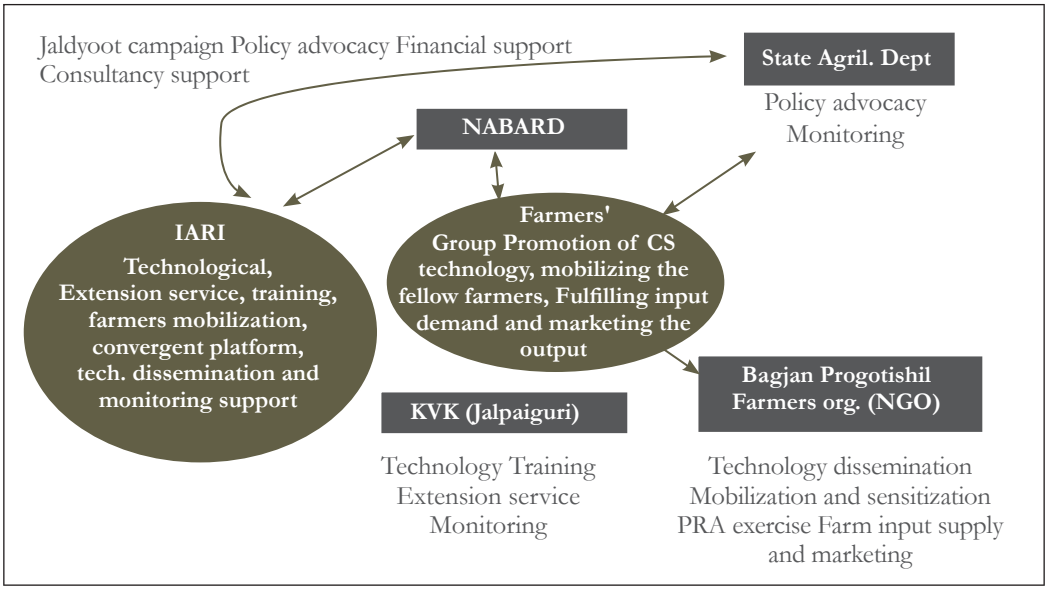

Figure 7: Institutional Mechanism for Establishing Climate-Smart Village

and monitoring), NGO & FPO (farmers mobilisation, technology dissemination, marketing support etc.) for delivering different climate-related products and services to the farmers of climate-smart village (Figure 7).

This helped to achieve convergence and coordination among all the stakeholders in delivering climate-smart products and services, which maximises the effectiveness and efficiency of all the partners both at the field and institutional levels. The case of the CSV initiative in the region demonstrates an institutional mechanism for strong cooperation between civil, public, and private sectors in implementing CSA for better adaptation to climatic risk. This case study on collaboration between central & state government bodies, NGOs, think tanks, local government, and farmers' organisations illustrate an example of how different institutions operating at multiple levels can work together in delivering climate-related technologies & services for the betterment of the farming community in a vulnerable region.

6.9 Diffusion of Climate-Smart Technologies to Nearby Villages

The diverse technologies and practices introduced in the climate-smart village (CSV) not only help the villagers but also help the farmers of nearby villagers. The case study found that the technologies which were introduced in CSV were adopted by the farmers of nearby villages. The secretary of FPO Ajit Sarkar said that farmers from different blocks and districts now approach them for different climate-smart technologies. The FPO from other blocks visited their demonstrated field and took necessary information and training on climate-smart technologies and practices. Thus farmer-to-farmer diffusion of technology accelerated the pace of adaptation of the whole ecosystem in the region.

6.10 A Decline in Migration of Youth

Human displacement in response to environmental shocks is not a new phenomenon. The climate-induced livelihood risk factor was perceived as one of the major drivers of farmers' migration (Jha C.K. et al. 2018). The case study found that in 2016, 29 % of rural youth migrated from the region, and a total of 35% of males migrated from the same area. The majority of them migrated to Kerala (73%), followed by Delhi (10%), Bangalore (7%), Kolkata (6%) and Rajasthan (4%). However, seeing the success of a few farmers in CSV on agriculture with new technologies & practices, many farmers expressed their interest in farming. Gradually, the young generation showed their discontent with working in other states, leaving their family and starting to engage in farming activities. Now only 11% of rural youth are reported as a migrant. This was possible due to high-income generation from farming, dairy, poultry and fishery through FPO under the climate-smart village.

6.11 Gender Equality

Traditionally, women's role in the region was limited to agricultural activities, mostly as daily wage earners, and few were landless casual workers. The baseline survey in 2016 showed that most of the women were involved in diverse agricultural operations. Still, their involvement in decision-making for different farm operations and marketing was

very limited. After establishing a climate-smart village, the women were encouraged to take membership in FPOs and took part in all farm operations, including its marketing.

From group discussions and in-depth interviews, it was found that women identified a range of personal development outcomes like starting poultry, goat rearing, fishery, non-farm business, building a range of production skills, and awareness about key issues on climate change adaption. The women were educated about productivity enhancement activities such as better feeding, timely vaccination, de-worming, improved castration methods, and formal marketing channels. As a result, the boundary of the tasks commonly assigned strictly to one gender has faded in their social life. Now women are handling tasks that earlier commonly were done by men, like running machines, purchasing inputs, selling the produce etc. One woman said that 'it is only since CSV came here that we women can sit together with men and discuss collectively. Moreover, a women's Climate-Smart Agriculture (CSA) group was formed in the village, which contributed to empowering the rest women of the village in agricultural activities and nutritional security'.

6.12 Increased Awareness and Knowledge About Climate Change

Extensive awareness and training programme was conducted among the farmers in the climate-smart village. As a result, the awareness and knowledge about different climate-smart technologies have increased. Farmers can now name the different climate-resilient varieties, they can sow the crop in line sowing, use zero tiller, follow the SRI, DSR method for paddy cultivation, practice IPM, INM, and started organic farming as an adaptive measure towards climate change. 'The transforming voice and agency among the CSA-adopters attracted a large number of other farmers to join and created a favourable atmosphere in the community, which contributed to enhancing their adaptive capacities and resilience to climate change impacts', said Mr Dinabondhu Roy, Singimari village, from focus group discussion.

6.13 Better Environmental Management and Ensuring Sustainable Earth

The ultimate goal of a climate-smart village (CSV) was to ensure a better earth for the next generation. The project team in CSV was able to create a better environmental management system involving local people. With the guidance and support from CSV scientists, the farmers now practised DSR, zero tillage, line sowing, IPM, INM, worm farming (vermicomposting), chicken raising with biological cushion, etc. This farming model not only reduces greenhouse gas emissions and protects the environment but also guarantees household income security and improves the standard of living. In terms of environmental benefits, the farmers reported 'decreasing environmental pollution' as a major advantage (85%), followed by a decline in overuse of pesticides and fertiliser (81%), increased bio-diversity in agriculture (80%), improved soil quality(75%), improved water quality (73%), less incidence of insect and diseases (70%), better water use management(67%). Now the farmers in the village have understood that the 'Climate Smart Village' model is a solution

that combines all eco-friendly techniques and practices for building a better earth with a healthy environment for the present as well as future generations.

7. Conclusion

The present case study proved that the promotion of climate-smart technology needs a focused institutional approach at the grassroots level involving local farmers. A significant increase in the adoption rate of diverse climate-smart technologies and practices is possible if the farmers are convinced about its potential. The climate-smart village approach was able to bring the following changes within five year period- change in land use pattern, yield increase, increased adoption of climate-smart technologies, increased income, increased access to production inputs, enhanced social networking, increased convergence among the stakeholders, a decline in migration of youth, gender equality, increased awareness and knowledge about climate change, diffusion of climate-smart technologies to nearby villages, and ensuring better environmental management. Thus, climate-smart village (CSV) has become a typical example of the CSV approach that proposed several technological, institutional, and policy interventions to help farmers adapt to current and future weather variability and to mitigate the climate change impacts. The initial successes have proven that the CSV model can help to prioritise technologies and practices that not only leverage household income while also improve climate adaptive capacity. The CSV approach showed the pathway of convergent institutional mechanisms for promoting climate-smart technology and services with maximum effectiveness. Finally, it can be concluded that through the case study of the climate-smart village, the policy makers find out the pathways of increasing productivity, enhancing resiliency, and reducing emissions towards climate change.

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Impact of Climate Change Adaptation Program Interventions on the Lives and Livelihoods of Hill Women of the Indian Himalayas

Seema Ravandale, Santarpana Choudhury, Dr Rajashree Joshi and Dr Dinesh Prasad

BAIF Development Research Foundation

1. Introduction

As the effects of climate change take root, the patterns of lives and livelihoods of agrarian communities in different parts of the globe are getting altered. This is even more evident in cases of smallholder farming communities situated in areas particularly vulnerable to climate risks, like the Indian Himalayan Region (IHR).

In such fragile ecosystems, the effects of climate change tend to get magnified owing to the complex socio-economic-ecological patterns of life. The state of Uttarakhand displays features characteristically associated with climate change in the IHR and its spillover on the socio-economic life of the people. Driven by a money-order economy wherein men migrate outwards in search of better livelihood opportunities, women play a central role in their families and fields. But degrading natural resources imply growing drudgery and hardship for these women.

Taking cognizance of the vulnerabilities of these hill communities, the Adaptation Fund Board launched a project in 2015-16 for five years in ten villages of Champawat district, Uttarakhand. Named 'Climate Smart Actions and Strategies for Sustainable Livelihood of Agriculture Dependent Hill Communities', the project was implemented in the target region by BAIF Development Research Foundation, reaching up to 800 vulnerable households, among which 500 were women-headed households.

The Hill Climate Change Adaptation model included multi-sectoral interventions and a gender-sensitive approach for increasing the productivity of natural resources and creating new livelihood avenues.

2. Background

Climate change has led to an increase in the number of extreme weather events like cyclones, heatwaves, floods, droughts, wildfires and even rising numbers of insect-borne diseases. Besides endangering natural and physical infrastructure and taking a toll on life, there are additional secondary and tertiary effects: forced displacement and migration, psychological distress, loss of traditional knowledge, and diminished social capital.

These effects are, however, not distributed equally, and there are differential effects based on gender, geography and social status. According to the report on Global Climate Risk Index 2020, presented by Germanwatch Institute during COP25 in Madrid, India is the 5th most affected country based on the impacts of extreme weather events and the socio-economic losses they cause (Germanwatch, 2020). With billion-plus mouths to feed, climate change is emerging as the biggest threat to the Indian economy.

The IHR is amongst the most fragile and vulnerable ecosystems that are highly exposed to climate change. The region is also facing increased frequency and duration of extreme weather events and natural hazards (IHCAP, 2020). The region is experiencing several challenges in the form of – altered precipitation, reduced snowfall; increased incidence of extreme weather events like cloud bursts, flash floods; and change in the vegetative zone due to temperature change, longer dry spells, land and soil degradation. The climate change vulnerability of the region is also increased because of cascading effects of changes in the composition and distribution of natural resources – water, forest and agro-biodiversity (IHCAP, 2020). As studies have shown, 'Climate change is perceived to threaten livelihoods of the people, particularly where they are dependent upon natural resources that are particularly vulnerable to changes in climatic conditions' (Rautela & Karki, 2015). The impacts have been further exacerbated due to anthropological factors within case-specific socio-economic factors like gender inequalities.

A report by the WHO finds that 'the effects of climate on human society, and our ability to mitigate and adapt to them, are mediated by social factors, including gender' (WHO, 2014). This is due to the fact that resources, attitudes and strategies to respond to weather-related hazards often differ between women and men. It is seldom acknowledged that women are more vulnerable to the indirect and longer-term effects of climate-related hazards. For example, droughts in developing countries bring health hazards through reduced availability of water for drinking, cooking and hygiene and through food insecurity, all of which tend to affect women disproportionately.

This is due to the fact that in most developing countries, women are intrinsically tied to water. They are responsible for collecting, storing, protecting and distributing water. As climate uncertainty renders water more scarce, women are forced to undertake long journeys to the nearest wells in search of water encumbered with heavy vessels. This not only causes exhaustion and damage to bones but is also accompanied by opportunity costs, such as the time that could be spent productively going to school or working.

In addition to these health hazards, 'Feminisation of agriculture' in the Indian Himalayan region is well established by numerous literatures in the recent decade (Resurrección, 2019). The burden of carrying agricultural activities along with household chores and the highly strenuous task of fodder collection and water fetching fall on the women's shoulders who are left behind in the villages. With climate change causing steady degradation of natural resources, women are encumbered with increasing drudgery while fetching fodder and water from long distances.

Due to the closely intertwined nature of the problem at hand, the case study has been studied through a lens that studies the system as a whole. This includes trying to identify, correlate and study as many aspects of the problem as possible, along with the impacts of the targeted intervention.

3. Intervention

To address these vulnerabilities of hill communities and women, Adaptation Fund Board (AFB) under United Nations Framework Convention on Climate Change (UNFCCC) came forward with financial support for a project named 'Climate Smart Actions and Strategies for Sustainable Livelihood of Agriculture Dependent Hill Communities'. The project was launched in 2015-2016 for five years in the Champawat district of Uttarakhand in the Northwest Himalayan region of India. National Bank for Agriculture and Rural Development (NABARD) is a National Implementing Entity (NIE), and BAIF Development Research Foundation (hereafter referred to as BAIF) is an Executing Entity (EE) for the project.

Under the project, many multi-sectoral climate smart interventions, technologies and services have been introduced in ten villages of Champawat district, reaching up to 800 vulnerable households, among which 500 are women-headed households. The hill climate change adaptation model introduced includes– water resource management, climate resilient farming practices, scientific management of livestock resources, weather forecasting, market linkages and strengthening community-based organisations. The project incorporates a gender-sensitive approach along with increasing the productivity of natural resources and creating new livelihood avenues.

The project was implemented in a cluster of ten villages/Gram Panchayats, which are mainly administrative parts of three blocks (Champawat, Pati, Lohaghat) of Champawat district, Uttarakhand. The area is representative of the Western Himalayan agro-climatic zone of India[Ministry of Agriculture, Government of India have divided the country into 15 agroclimatic zones] and Zone B (1000–1500 m elevation) of Uttarakhand state, which is marked by mid-hill Himalayan terrain, sandy loamy soil and rainfall of 1200-1500 mm and traditionally known for production of millet (Manduwa), apple, pear and milk.

Figure 1: Intervention Design

A comprehensive Vulnerability Assessment was carried out for these areas prior to the initiation of the project. The Assessment was conducted using different Participatory Rural Appraisal (PRA) tools, including a Historical Timeline, Resource Mapping, Venn Diagram, Problem Solving Matrix, and Transect Walk, among others. The PRA tools, along with focus group discussions and semi-structured interviews, were pivotal to providing a thorough bottom-up picture of the ground reality and situation analysis.

Based on the findings from the Vulnerability Assessment, the interventions were designed specifically to meet the needs of the region and to minimize the risks associated with climate change. The following interventions took place in the last five years (Source: Primary data collected by BAIF):

- 252 families have been engaged in gainful employment and sustained income through Polyhouse farming.
- All the beneficiary families were covered through the livestock improvement programme, which mainly includes the improvement of the local breed by hybrid artificial insemination and improved fodder and feed practices.
- 136 ha area was developed with Silvi-Pasture interventions (also known as forest rejuvenation) on Van Panchayat Van Panchayat is community based joint forest management program in Uttarakhand, India. Van Panchayat or Village Forest Council is an autonomous local institution having legally demarcated village forests land.
- 120000 trees have been planted in the region under agroforestry and horticulture.
- 10 Village Forest Councils (Van Panchayats) restored community pasture lands in an ecologically sound manner.
- 1500 million litre water capacity was created through the rejuvenation of 15 natural springs.
- 650 Families have been associated with crop and weather advisory services.
- 25 Landraces of native indigenous food crops are being conserved by the community, and local seed banks have been established.
- Strong community-based organisations in the form of Self-help groups, User interest groups (e.g., polyhouse farmers group, executive committee called *Peyjal Samiti* associated with each drinking water scheme), etc., have been established in all 10 villages
- The average additional income that families involved in polyhouses have earned is up to ₹ 25,000 to 35,000 in a year; the income ranges from ₹ 25,000 to ₹ 1 lakh.

4. Beneficiary and Area Profile

The criterion was set to identify the project villages and potential beneficiaries depending upon the socio-economic profile of the region. The basic profile of the study area is as follows:

- The total number of households in the 10 villages is 1357, out of which 556 (41%) are women-headed households, and 1276 (94%) are small and marginal farming families.
- The average landholding size is 1.3 ha, while 1276 families have landholding below 2 ha. 70% population is dependent primarily on agriculture and livestock for livelihood. Of the total geographical area of 3543 sq.km, 30% of the area is forest, 10% is pastureland, and 51% of the area is cultivable land. Out of the total cultivable land, only 28% of the area is net sown area.
- 5% of the net sown area has irrigation facilities.
- 800 beneficiary families were selected, out of which 500 were women-headed families. The criterion for the selection of beneficiary families was based on small and marginal farmers, women-headed families, families with sole dependence on agriculture/ primary sector for their livelihood, families staying in remote locations and other poor households (including Scheduled Caste households) jointly identified by villagers using participatory processes, considering poverty and marginalisation.
- Traditionally major crops in the region were cereal, pulses, millets, vegetables like potatoes, and fruits like apples and pears. Due to climate change, the cropping pattern has changed drastically in the recent past, majorly impacting cereal, millets, potato, apple and pear cultivation.
- The average annual income per household is ₹ 28,000

5. Analysis

Since this was an action-research project, a mix of both quantitative and qualitative data was collected routinely on a timely basis from 2016-2021. The tools used for data collection are participatory methods like Participatory Rural Appraisal (PRA), Focus Group Discussions (FGDs), structured and semi-structured interviews, questionnaire-based surveys, etc. Primary and secondary data were collected for pre-project situation analysis, which was followed by a questionnaire-based survey from 100% of the participants for a baseline survey. During the project period from 2016-2021 and for post-project impact assessment, structured questionnaires, case studies and testimonials were used with a sample from the ten project villages.

6. Sampling Criterion

Stratified sampling of 150 families (18%) out of 800 beneficiary families was conducted, with the sampled households being equally distributed among the 10 villages, i.e. 15

families per village. The families were chosen to be representative of – women-headed families, small and marginal families and with the implementation of various combinations of the interventions. The sample covers a population of 837 among these families, with 448 males and 389 females. The average land holding size is 1.25 ha. All the families have implemented one or more interventions, as mentioned in the Table 1.

Table 1: Number of Families Adopting Each Intervention

Interventions	No. of Families Adopting Each Interventions (year-wise)		
	2016	2019	2021
Polyhouse for Vegetable Cultivation	128	149	150
Drip Irrigation (Along With Polyhouse)	67	97	100
Rainwater Harvesting	39	62	62
Improved Horticulture and Agroforestry	113	146	147
Improved Livestock Programme	136	146	146
All Above Interventions	25	39	40

The springshed development to improve water availability and Silvi-Pasture for forest rejuvenation took place in all the villages. Hence, the responses from women of the same sampled families have been recorded to analyse the impact of these two interventions on beneficiary women.

7. Results

Since most of the participants were small and marginal farmers, a multi-sectoral approach was adopted which would improve their income, lead to better nutritional outcomes and provide better resilience against climate change.

From the initial FGDs, it was learnt that the villagers had a variety of cereals, pulses, vegetables, forest food etc., on their platters prior to 2005. However, in the recent past, their agriculture and, consequently, diet have undergone major changes. Due to climate change vagaries and wildlife attacks, many farmers have stopped cultivating cereals, millets, and potato farming, and 70% of cultivable land is now lying fallow. The cultivation of apple and pear have also been impacted due to changes in the vegetation zone. Hence, new crops were introduced by BAIF in newly developed climatic conditions. Vegetable cultivation has been promoted with the help of polyhouse; major crops cultivated are tomato and capsicum, and minor crops include cabbage, cauliflower, chilli pepper, etc. However, potato cultivation could not be revived due to frequent wildlife attacks.

Likewise, production of cereal and millets have gone down and could not be revived. Nonetheless, some new fruit varieties, like malta, lemon, apricot, plum, peach, etc., are being promoted, which have better chances of survival in these altered climatic conditions. The comprehensive livestock program introduced artificial insemination, fodder development, better feed practices etc., which have ensured increased milk production.

Regular data has been collected to study how these interventions affect income and whether this increase in disposable income has resulted in achieving better food security by ensuring the availability, accessibility and affordability of food. The findings are discussed below.

7.1 Food Production and Income

Vegetables

From figures (2.a) and (2.b), it can be observed that the overall production of vegetables has gone down as compared to the production in 2005[Primary data has been collected mainly for potato, tomato and capsicum as these are the major crops]. The main contribution in the production is potato as this was the only traditionally grown vegetable. Though the production of potatoes has seen a steady decline, other crops have been introduced through polyhouses. The diversity in vegetable production has increased from 2016 to 2021, with tomato and capsicum contributing to 47% and 27% respectively in the total production in 2021. The economic returns on these crops are higher than potatoes, which can lead to higher income for the household.

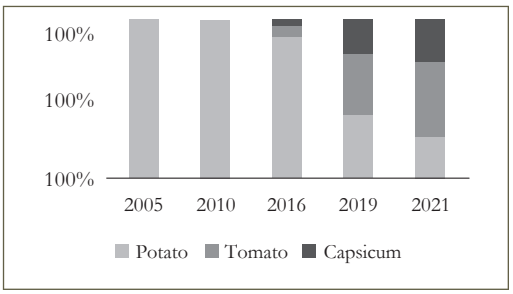

Figure 2.a: Year-wise Percentage Share of Production of Major Vegetables in Total Production of Vegetable

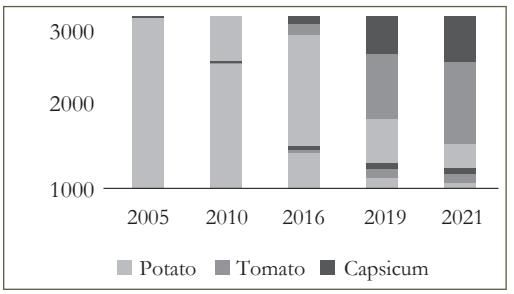

Figure 2.b: Average Production of Vegetables per Family

Fruits

Likewise, it can be observed from figure (3.a) and figure (3.b) that in spite of a decrease in pear production, diversity in fruit production has increased in recent years as a result of introduction of new fruit crops during the project period.

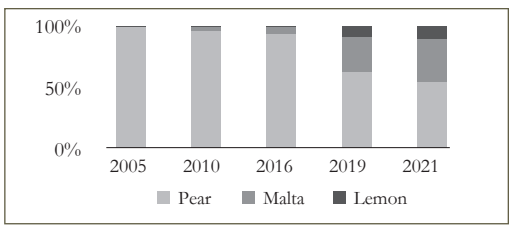

Figure 3.a: Year-wise Percent Share of Production of Major Fruits in Total Production of Fruits

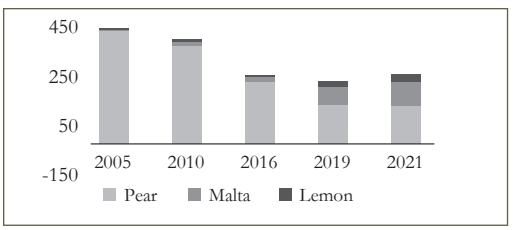

Figure 3.b: Year-wise Average Production of Each Fruit per Family (kg/annum)

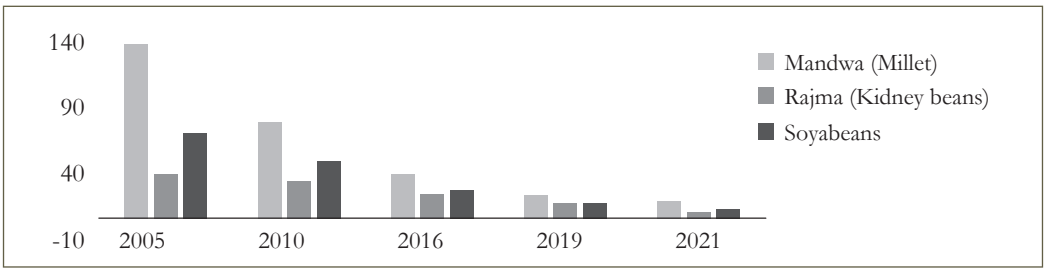

Figure 4: Year-wise Average Production of Agriculture Crop per Family (kg/annum)

Cereals, Millets and Pulses

From Figure 4, it can be observed that the productions of cereal/millets and pulses have been reducing every year. The trend is discouraging as communities are not willing to shift to cereal/millet and pulse production, as 75-80% of crops are damaged each year due to climatic events as well as wildlife attacks. The project interventions did not focus on increasing the production of cereal/millets and pulses as communities were not ready to adopt any intervention, as per the PRA during the project planning phase.

Milk Production

Due to the livestock program, the milk production per cattle and milk production per family has increased by 1.3 and 1.5 times compared to the baseline year of 2016. The hybrid breed is an improved variety of local breeds, which is produced using techniques of mix breeding, artificial insemination, selection of better semen, etc. The hybrid cattle thus produced are more suitable for climatic conditions and produce more milk. From figure 5.a, it can be observed that many more families adopted hybrid cattle over the local breed. The same families have been provided support for better feed practices and fodder development on private as well as public lands.

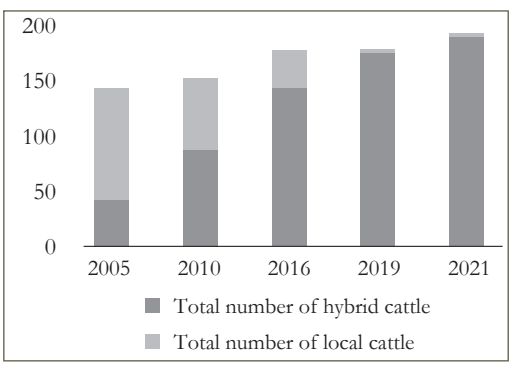

Figure 5.a: Total Number of Milk Producing Cattle in Sampled Families

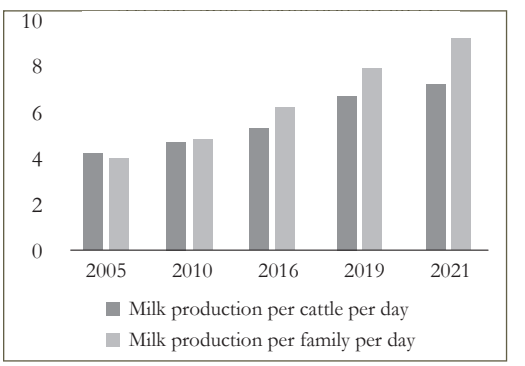

Figure 5.b: Year wise Average Production of Milk (liters/day) per Cattle As Well As Per Family

7.2 Income Analysis

Because of the above improvements, the average net income of a family has increased almost twice, from ₹ 23,500 to ₹ 46,000 in the last five years. The share of milk production

to household income has increased from 60% to 76% in the same period. The increased income ensures better purchasing power and market accessibility to achieve food availability, accessibility and affordability, as discussed in the next section.

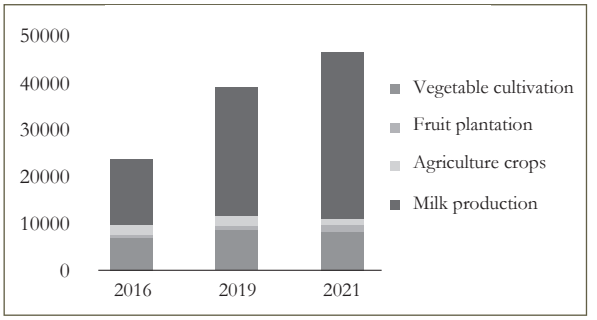

Figure 6: Average Net Income per Family with the Share of Various Livelihood Activities

7.3 Food Availability, Accessibility and Affordability

Although it appears that the overall production of cereals/millets, pulses, vegetables and fruits has decreased from 2010 to 2021, but as explained above, the diversity in diet (mainly in vegetables and fruits) has increased. This leads to better nutrition security, as per 93% of respondents from the villages. The overall consumption of various food items has increased from 2010 to 2021 due to increased food production, increased purchasing power, better accessibility and affordability, which can be attributed to the combined effect of production, income and strong community-based organisations.

From the qualitative survey, 78% (117) women respondents have said that they consume the vegetables grown in their own polyhouses daily (42% of respondents) or on alternate days (35%). 100% of respondents have recorded that fruit consumption has increased from negligible to significant levels. They further added that there is diversity in both vegetable and fruit consumption as compared to 2005 and 2010. These agriculture-based interventions and the mobilisation of women into community-based organisations have equipped women with more disposable income and agency. This ensures the nutritional security of their households as 54% of women claim to purchase good quality food from local or nearby markets. Further, 95% of respondents reported an overall improvement in the health of their family members and a reduction in health expenses in the last two years.

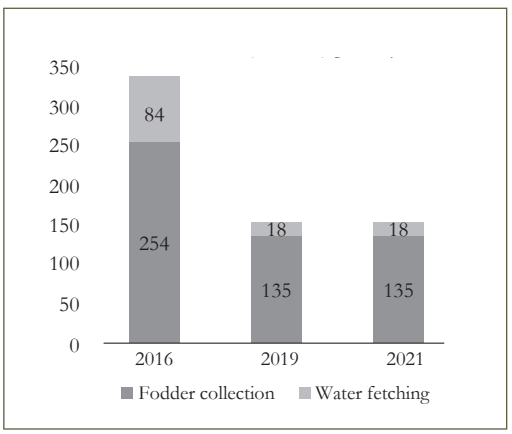

Figure 7.a: Average Time Spent by a Woman in Fodder and Water Collection (minutes per day)

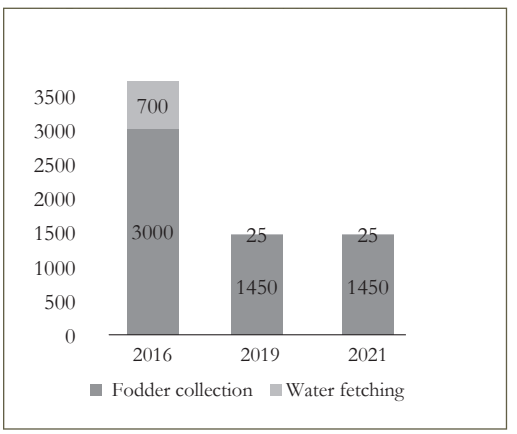

Figure 7.b: Average Distance Travelled by a Woman in Fodder and Water Collection (meter per day)

7.4 Impact on Women's Drudgery

Due to feminisation of agriculture in mountainous regions and depleting natural resources, increased drudgery of women is well reported in the literature. Hence, BAIF incorporated a gender-sensitive approach in all the interventions. Spring-shed development and forest rejuvenation on Van Panchayat land have reduced the drudgery of women by almost 50% in terms of reduction in time spent, and distance travelled to fetch water and fodder/ fuelwood as shown in figures (7.a) and (7.b).

Compared to fodder development, springshed development along with the solar lift scheme for drinking water, have significantly reduced the distance travelled and time spent on water collection. A woman now spends only 25-30 minutes daily on average as against 84 minutes (1 hour 24 minutes) earlier in water collection. This near-doorstep availability of water had a significant impact on these women's lives, according to all 150 women interviewees.

99% of respondent women have reported a significant reduction in their drudgery due to these two interventions, as collecting fodder and water have traditionally been a woman's responsibility. Apart from springshed development and forest rejuvenation, other interventions causing a notable reduction in hard labour are polyhouse and drip irrigation (78%) and rainwater harvesting for polyhouse (41%), according to women farmers.

These women are able to utilise the saved time and efforts towards leading more productive and balanced lives. Income generation activities (78% of respondents), maintaining better health and lifestyle at the household level (63%), spending more time with children and family (60%), engaging in social activities or increased engagement in the community (53%), and leisure activities like knitting, sewing and art (47%) are some of the major activities the women are now engaging in. These responses are clearly indicative of better social life and mental health for women.

Box 1: Success Story

Deepa is a resident of Banj Gaon in the Lohaghat block of Champawat district, Uttarakhand. A seasoned farmer, Deepa has been farming for around two decades now. Agriculture is the primary source of livelihood for her family. Earlier she could grow enough on her land to sustain her family and even sell the small surplus in the market.

However, in the recent past, the climate has changed so drastically that agriculture is hardly sufficient for subsistence, let alone remunerative. Deepa asserts, "The weather has been extreme; there is no rain which has led to famine or heavy storms which spoils our produce". Coupled with wild animal attacks, her family was in dire straits.

As part of 'Climate Smart Actions and Strategies for Sustainable Livelihood of Agriculture Dependent Hill Communities,' Deepa adopted Polyhouse farming in 2017-18. She got several trainings on – technicalities of the polyhouse, pesticide management, organic manuring etc., from BAIF. She is now able to grow at least 4-6 crops in the course of a year. This has raised her net income to 15,000-20,000 per season. Along with 12 other women from her village, she has formed a Self-help group (SHG) to save a share of their income and to collectively start marketing their produce.

8. Conclusion and Way Forward

Climate change does not affect only one aspect of the traditional hill dwellers' lives. This necessitates studying these effects in an interconnected manner and not in silos, and designing interventions accordingly. For instance, with agriculture becoming non-remunerative, younger men tend to migrate outwards, while women are left behind to fend for their families with increasingly unproductive assets. The growing drudgery hampers their productive capacity resulting in even lower incomes for the families. Thus, climate change can potentially have sweeping effects on the lives and livelihoods of the traditional hill communities of the IHR.

The above analysis provides empirical as well as qualitative evidence to establish that the multi-sectoral approach adopted by BAIF in Champawat, Uttarakhand, could achieve a higher income for the household by increasing the productivity of natural resources, creating new livelihood avenues, and essentially diversifying means of earning one's living. This increase in income has translated to 'food and nutritional security' for a family as a unit, with special improvement in women's physical as well as mental health.

There is a significant reduction in women's drudgery, and time and efforts saved on water and fodder collection are utilised in more productive ways, mainly in income generation activities and ensuring family nutrition and overall well-being. This has the potential to generate a virtuous cycle of prosperity within the household and then the community. From a gender perspective, springshed development and forest rejuvenation have contributed more towards the reduction of their drudgery as compared to other interventions. The agriculture and livestock-based interventions ensure the availability of food at the household level, whereas enhanced income and institutional arrangements have provided for better food accessibility and affordability.

This program has also demonstrated that a multi-sectoral approach, community-based organisation, proper technical inputs, and the creation of knowledge systems can help in achieving the climate change resilience of the communities. While adopting appropriate interventions and technologies is pivotal in achieving a higher income trajectory, it is even more so in areas prone to the effects of climate change.

As marked by specific climatic conditions, socio-economic profiles and vulnerabilities, each region requires differential strategies, which is demonstrated under this action-research program. The unique context of the Northwestern Himalayas due to their agro-climatic zone and socio-economic settings requires such dedicated efforts to enhance resilience by diversifying livelihoods. The learnings drawn from this action research can be leveraged in policy dialogues at regional and national levels for enhanced adaptation and mitigation of climate change among agrarian communities, with a particular focus on Northwestern Himalayas.

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11. Van Panchayat is community based joint forest management program in Uttarakhand, India. Van panchayat or Village Forest Council is an autonomous local institution having legally demarcated village forests.
12. Primary data has been collected mainly for Potato, Tomato and Capsicum as these are the major crops

Upaya Social Ventures' Innovative Finance Creating Dignified Jobs for the Extremely Poor - A Case Study of Tamul Plates Leveraging Arecanut Value Chain

Shruti Goel, Shrishti Puri, Sneh Bhardwaj

1. Context

At Upaya Social Ventures, we envision a world where everyone has the opportunity to earn a dignified living and pursue their dreams. We work at the forefront of fighting poverty by funding and supporting scalable businesses that create jobs for the extremely poor. Tamul Plates is a partner company (for-profit social enterprise) in Upaya's portfolio that has now raised follow-on funding to scale up its business and associated livelihoods generated. This case study highlights the story of Tamul Plates in successfully creating 3000+ jobs in North-East India for the extremely poor by leveraging local natural resources and overcoming its own challenges to survive as an early-stage social enterprise in the times of Covid-19.

2. The Challenge

Adverse climate change impact, laggard economic growth and skewed development trends have been creating a dangerous socio-cultural division in the North-East region (NER) of India, which threatened over time to devolve into rising crime, heightened suicide rates and separatist movements. For example, farmers in Assam have been experiencing a 15-20% reduction in rice production every year. With the majority of the population being dependent on agriculture, adverse impact of climate change and food price inflation push people below the poverty line, or force them to migrate in search of alternate income opportunities value of 36.21 to Assam, indicating a high presence of people living in poverty. One of the most promising solutions is to curate alternate livelihood opportunities for the communities to make them resilient to climate change and tropical turbulence.

3. The Solution

Recognising these macro-economic issues, the founders of Tamul Plates Marketing Private Limited (Tamul Plates) decided to promote non-farm employment opportunities for the rural youth, ensuring steady incomes from credible alternatives to agricultural employment. impacted by economic, environment and social unrest. Tamul Plates is a producers' initiative, generating livelihoods in rural parts of North-East India by producing and marketing biodegradable areca nut leaf dinnerware. Tamul Plates empowers village-level entrepreneurs with technological support to develop high-quality disposable plates and ensures strong market access for sustainable incomes.

The areca nut palm, also known as betelnut locally, is one of the important commercial crops of NER (North-East Region). Though the betelnut is used widely in various forms, the sheath attached to the leaf is considered as a waste, primarily used for temporary boundary walls in homes. However, disposable dinner wares made out of areca nut sheaths have better dimensional stability besides being hygienic, biodegradable and microwave safe. Due to its qualities, it has a huge market in India and internationally. There are more than 100,000 hectares of areca nut plantation in NER, and more than 5000 areca nut plate micro-enterprises can be promoted if only 30% of the available resources can be tapped. Each unit generates additional livelihood for around 30 people. Tamul Plates has emerged as a company jointly promoted by the areca nut leaf plate producers of Assam, with the objective of generating employment for thousands of rural youth.

Tamul Plates' micro-enterprise creation model has four categories of jobholders: affiliate unit owner, leaf plate producer, Tamul factory worker, and raw material collector/agent.

- Affiliate Unit Owners are village-level entrepreneurs who own small production units at the village level to manufacture areca nut leaf tableware marketed by Tamul Plates.
- Leaf Plate Producers are workers employed in individual village production units to handle the cleaning and drying of leaves and to operate the plate-making machines.
- Tamul Factory Workers are individuals employed at the Tamul Plates central production facility of leaf plates, based in Barpeta.
- Raw Material Collectors or Agents are individuals and agents supplying raw materials, such as areca nut leaf sheaths, to production units.

4. The Journey of a Social Enterprise

Tamul Plates originated as a livelihood programme under Dhriiti, a non-profit based in Barpeta, Assam, which promoted arecanut leaf plate making in the poorest districts of Assam: Baksa, Bongaigaon, Barpeta, and Chirang (collectively referred to as 'Lower Assam'). The model leveraged grant funding to provide indirect credit support and technical knowledge to low-income households, helping the first few village-level entrepreneurs for leaf plate manufacturing in the region. Beneficiaries recruited during this period were from extremely poor households.

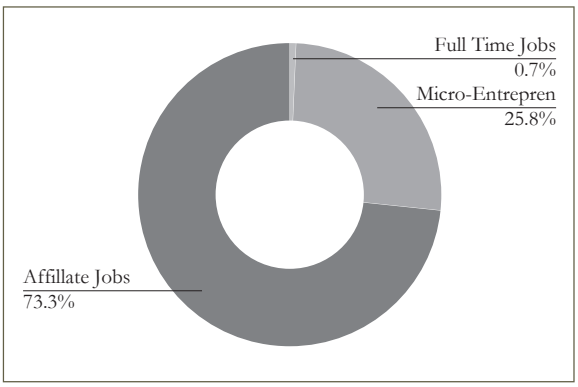

Figure 1: Categories of jobholders

Over time, the organisation's founders recognised that a for-profit model would enable sustainable operations, and so established Tamul Plates in August 2009. This move brought three significant changes in organisation strategy:

- Better Market Access: A greater focus on creating a strong end-market through coordinated marketing of the disposable areca nut tableware.
- Expansion of Manufacturing Operations: Simultaneous expansion of manufacturing operations, encouraging village-level entrepreneurs in other districts of Assam such as Tinsukia, Lakhimpur, and Cachar (commonly referred to as 'Upper Assam'[Upper Assam is considered to be the most productive region in the state, boasting an abundance of natural resources like oil and gas, as well as a fledging tea plantation economy.]), and expanding to districts in other states such as Meghalaya (West Garo Hills and Ribhoi Meghalaya districts) and West Bengal (Jalpaiguri district).
- Better Capital Access: A transition from indirect credit support for households to facilitating loans through established banks. This shift resulted in the enrolment of less indigent households, given the need for a relatively higher appetite for risk.

These steps not only streamlined operations from a business perspective but also enabled Tamul Plates to create a bigger geographical impact. By providing manufacturing technology and market linkages, Tamul Plates has supported village-level entrepreneurs across three states in the region and created alternative employment.

Box 1: Testimonial of Pranjit Das, a Microentrepreneur With Tamul Plates

'I started producing areca nut plates and bowls when areca nut sheaths were considered a waste. But 10 years later, it is generating an additional income for many and primary income for some. I think I will be able to change the economic demography of my village and want to be remembered as a pioneer in it.'

5. COVID-19 Effect-The Challenge to Stay Afloat and Sustain Livelihoods

For Tamul, like any other social enterprise, working capital is a constant struggle and often inaccessible. They have easier access to philanthropic capital and grants meant for skilling, training and rehabilitation but being based in a remote area cut off from metros and an established network, accessing even these types of funding becomes a challenge. Government relief schemes are often too time-consuming and complicated to be a viable option.

In March 2020, Tamul was on the verge of closing a follow-on equity round, which would have more than met their need for ₹ 50 lakhs ($62,500) of liquidity. But with India's COVID-19 lockdowns, the deal was cancelled. Overnight, Tamul went from planning business expansion to a fight for survival.

A crowdfunding campaign to help save their employees' jobs successfully raised ₹ 28 lakhs ($35,000) and helped 1800 households stay afloat. But they still needed working capital to continue production and keep the business afloat. Upaya, whose mission is to create dignified and lasting jobs for the poorest of the poor, stepped in and offered Tamul a loan with repayment in terms of a revenue-based investment. Upaya's timely loan during the height of COVID-19 gave Tamul the shot of liquidity it needed to meet its working capital requirements, pay its vendors, and pay its 3000 women and rural youth suppliers.

Upaya extended Tamul a revenue-based loan of ₹ 20 lakhs ($ 25,000) with a 6-month grace period, taking a 5% share of monthly revenue across a 36-month period. Upaya proposed a 1.1x multiplier, meaning that the total amount repaid would be capped at ₹ 22 lakhs ($ 27,500).

6. The Impact

As of September 30, 2022, Tamul Plates reported 3000 jobholders generating income and livelihoods by association with Tamul — a nearly tenfold increase — as well as a threefold jump in revenue and a quadruple increase in production since Upaya's investment in 2015. In addition to India, Tamul Plates' products are now being exported internationally to Australia, the US, Europe, and more. Out of the 3000 jobholders, 2200 (~73% of total) are the affiliate unit owners who either belong to agricultural communities or are non-farm jobholders and are severely impacted by deteriorating and unstable incomes amidst rising climate change impact. A secondary source of income from Tamul Plates has emerged as a stable and resilient source of livelihoods for these 2200 jobholders.

Over the course of the last eight years, several quantitative and qualitative impact studies have been conducted by Upaya and Tamul Plates to measure the performance of key indicators against the defined outputs. Over the next section, we have summarised the impact Tamul Plates has been able to achieve over the years for the communities' livelihoods and betterment in terms of their income, asset allocation and their income reliability and stability.

1. Baseline Impact Survey by Upaya in 2014
2. Midline Impact Survey by Upaya in 2018
3. Baseline Impact Survey by Dhriiti and Tamul Plates in 2018
4. Midline Impact Survey by Dhriiti and Tamul Plates in 2020

6.1 Methodology

Upaya conducted the Baseline survey in 2014 and a midline survey in 2018 and produced the results in order to assess the socio-economic background of beneficiary households across various metrics. The intent was to achieve two primary objectives: to ensure Tamul

Plates reach out to the targeted beneficiary groups and to serve as a base to measure future impact through periodic surveys. Tamul Plates conducted similar surveys in 2018 and 2020.

6.2 Data Collection

Upaya's Baseline and Midline Impact studies were sourced through detailed surveys of the beneficiary households associated with Tamul Plates and collected using the 'Social Performance Measurement Schedule' developed by Upaya. The questionnaire was designed to capture a range of socio-economic and situational parameters at the household level, including demographics, income and employment, family expenditure, housing status and access to amenities, and ownership of assets, such as land and livestock. The baseline survey for this report was undertaken between July 2014 and September 2014, while the midline survey was conducted in 2018. Surveyors interviewed 194 respondents from ~100 households covering 20 districts in the states of Assam, Meghalaya, and West Bengal. End line survey post Upaya's exit from the Tamul Plates will commence in December 2022.

6.3 Impact on Income Levels

Jobholders from all categories experienced an average income increase from 47% in 2014 at the time of the baseline survey to 155% at the end of the midline survey in 2018. Between 2018 to 2021, the percentage of the population engaged in Agriculture fell from 30% to 21%, whereas those involved in non-farm activities, especially areca leaf plate collection and production, increased from 1% to 25%. Alongside, the jobholders also experienced an increase in the number of months with a reliable source of income. In 2014, jobholders worked for 7.13 months on an average, which increased to 11.8 months of 'stable income' months in 2018. This also contributed to the annual income increase. While the agricultural farmers experienced an income increase of 51%, the sheath collectors and producers who shifted the majority of their livelihoods to sustainable income from areca leaf plantation and production experienced an income increase of 3732% after engaging with Tamul Plates.

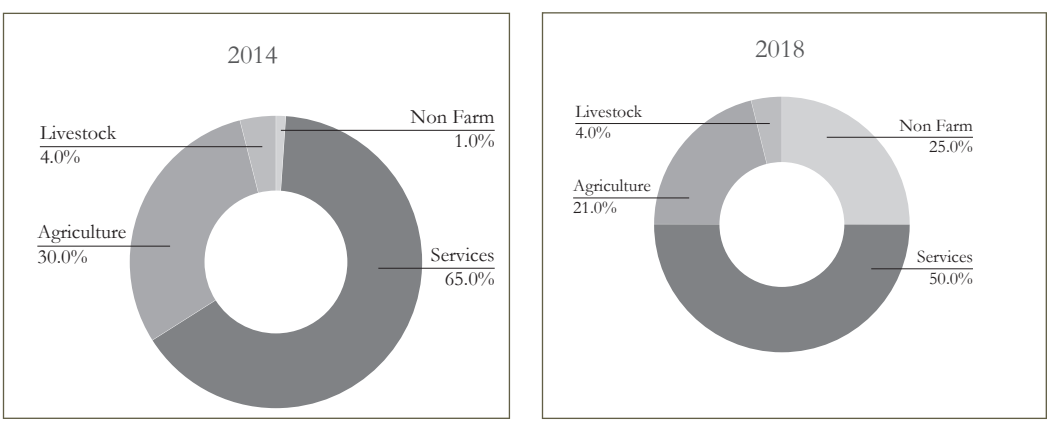

Figure 1: Changing Scenario of Categories of Job holders 2014-2018

Table 1: Income Details from Different Activities

Sources of Income	2014 (₹)	2018 (₹)	Percentage Increase
Agriculture	96,8025	14,66,000	51%
Livestock	1,09,500	2,52,800	131%
Services	21,17,600	33,63,600	59%
Non-Farm	44,000	16,86,200	3732%
TOTAL	3,23,9125	67,68,600	109%

Tamul Plate's journey - has been a journey of innumerable opportunities. Opportunities are given to individuals or regions which have been ignored and neglected by one and all. And these individuals have stood the test of time. Some have failed, yet some have become success stories worth sharing. The graph below shows changes experienced by jobholders as reported by them after being associated with Tamul Plates. A stable and better income was reported most highly.

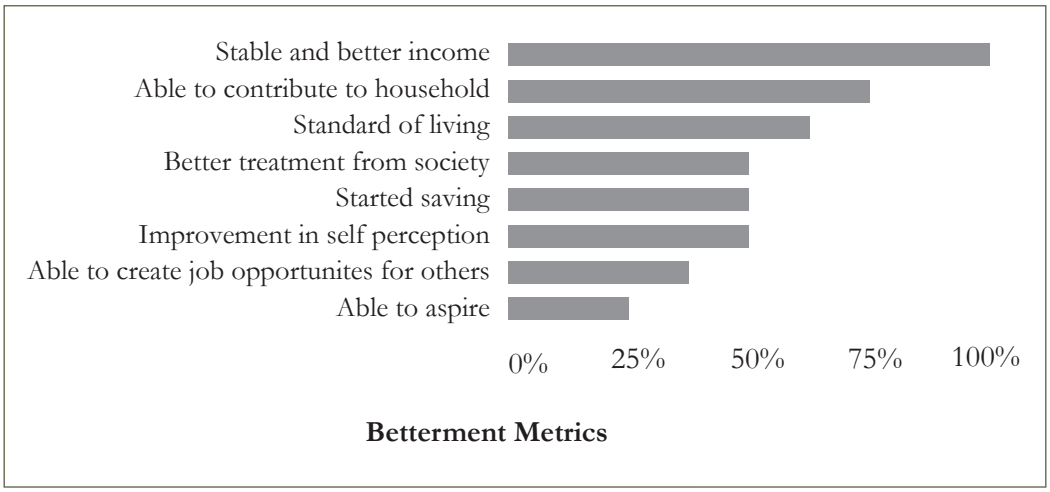

Figure 3: Changes experienced by Jobholders

Box 2: Case Study of 4 Long-Term Jobholders

Out of the total sample, 4 jobholders were common during Baseline and Midline surveys. Tamul's contribution to their income increased substantially from 45% to 65%. These were the affiliate jobholders, with income from Tamul being the secondary source of income. Over time, as their income from other sources, primarily agricultural, became more unstable and unpredictable given frequent floods and droughts, there has been an increased transition to the income earned from Tamul Plates.

6.4 Impact on Asset Ownership

Household assets can be broadly categorised into three types:

- Utility assets: These assets are the most basic necessities for all households, signifying a minimum level of quality of life. Examples include beds, chairs, and water purifiers.
- Productive assets: These assets can be used for productive purposes to derive economic benefits. Examples include mobile phones, handlooms, two-wheelers, and tractors.
- Lifestyle assets: These assets are typically purchased either as status symbols or as luxury items, and tend to be the most expensive among all assets. Examples include radios, televisions, and expensive metal utensils.
- Utility assets are the most popular asset type. Items of everyday use, like beds and chairs, have near-universal ownership.
- Cookstoves as a utility asset do not seem to have high acceptance in this region. Households tend to prefer traditional firewood cookstoves. This is primarily due to the high cost of clean fuel sources and a proximity to forests that provides an abundance of firewood.
- Among productive assets, inexpensive assets such as mobiles and bicycles have more than 85 per cent ownership. However, the more expensive productive assets such as inverters, tractors, and two-wheelers are less common.
- Expectedly, lifestyle assets have the lowest percentage of ownership among the surveyed group.
- Medium-cost assets like televisions, bell metal utensils, and silk clothes are among the few assets with high ownership, as they are seen as status symbols in this area.
- There is negligible ownership of high-cost lifestyle assets such as three- or four-wheelers.

Table 2: Percentage of Different Utility Assets

Utility Assets	
Bed	100%
Chair	95%
Water Drum	9%
Water Purifier	15%
CookStove	33%
Almirah/Dressing Unit	36%

Table 3: Percentage of Different Productive Assets

Productive Assets	
Mobile	85%
Cycle	82%
Sewing Machine	7%
2-Wheeler	9%
Handloom	24%
Inverter	6%
Plough	25%
Tractor	2%

Table 4: Percentage of Different Lifestyle Assets

Lifestyle Assets	
Casserole/Thermos	4%
Radio	15%
Television	36%
Bell Metal Utensils	43%
3/4 Wheelers	12%
DTH	26%
Silk Clothes	31%
Tractor	2%

Table 5: Percentage of Respondents were Able to Purchase Assets After Hire

Assets - 15% of Respondents were Able to Purchase Assets After Hire	
Mobile Phone	13%
Almirah	6%
Electric Fan	6%
Stove	6%
Table, Chairs	6%
Bicycle	4%
Television	4%
Pressure Cooker	3%
Motorcycle / Scooter / Car or Jeep	2%
Refrigerator	1%
Livestock- 7% of Respondents Purchased Livestock After Hire	
Cow	6%
Chicken	3%
Goat	2%

In 2018, the asset and livestock ownership was determined with the following results: While Mobile phones remain amongst the highest purchases, all other assets showed a low allocation across the respondents.

Box 4: Access to Flexible Capital Facilitates the Survival of Early-Stage Social Enterprises

The intent of catalytic capital provided by Upaya was to support the enterprise during the pandemic, and as such, Upaya considered entrepreneur-friendly, flexible terms and timeline and return expectations were based on the context, capacity, and time Tamul would take to return to normalcy.
By the end of 2020, orders were picking up again, though not quite to pre-pandemic levels. They negotiated a 6-month extension on the grace period — that Upaya granted — a move that paid off when the second, more brutal, COVID-19 wave swept through India in April 2021 and brought business to a standstill again.

Tamul used this capital to pay their vendors for raw materials, pay salaries, continue production, and stabilise and sustain operations. Today, their revenue stands at ₹ 1.89 crores ($232,331), they export to five countries, and they have managed to retain most of the jobs that existed pre-COVID.

6.5 Impact on Environment

Committed to having an impact beyond livelihood generation, Tamul Plates has been encouraging the adoption of environmentally friendly tableware. Products manufactured by Tamul Plates are 100 per cent biodegradable, reducing potential CO2 production upon discard by 6 kilograms per kilogram of the product (the amount of CO2 produced upon the destruction of Thermacol and Styrofoam).

7. Learning

Households with limited livelihood assets are more vulnerable to the impacts of climate change and food insecurity. Supporting and nurturing high-impact social enterprises that create livelihoods locally for the most vulnerable is a powerful climate adaptation strategy to ensure sustained livelihoods in a changing climate and decreasing reliance on agriculture.

Upaya has exited as Tamul Plate's investor in 2022, and this successful exit shows that social enterprises like Tamul Plates are not only impactful — they are investible. Many investors overlook 'missing middle' companies like Tamul Plates, which are too large for microfinance and too small for traditional banks. But not only are companies like this vital to the economic well-being of their communities, they can produce investor returns and significant impact. There is a need for a robust ecosystem to create a cushion for failure for social entrepreneurs who venture into high-risk businesses. Entrepreneurs are more inclined to take risks if they know they will not be penalised for failure.

Box 5: Testimonial by Arindam Dasgupta, Co-Founder & CEO, Tamul

"Investors looking to invest in the artisan sector need to be in it for the long haul and need to understand impact better. The impact must be primary. They need to factor in geography, product, sector, and have a clear understanding of rural marketing to help communities break the poverty cycle and access opportunities for sustained, dignified livelihoods."

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1. Khanum, F. (2021, September). Northeast India in the Midst of Climate Change. International Journal of Agriculture, Environment and Biotechnology, IJAEB(14(03)), 447-452. 10.30954/0974-1712.03.2021.21]. Recent report on the Multiple Poverty Index (MPI) released by NITI Aayog assigned a MPI[https://www.niti.gov.in/sites/default/files/2021-11/National_MPI_India-11242021.pdf

SDG 7 Driven Technologies for Community Oriented Post Harvest Processing in Millets A Success Story of Taptapani Farmer Producer Organisation from an Off Grid Area of Odisha

Shruti Gowda and Ishita Roy

1. Background

SELCO Foundation works towards creating a holistic ecosystem to provide reliable energy access for livelihoods to underserved communities. SELCO Foundation works towards developing sustainable energy-driven solutions across diverse portfolios-Agriculture, Animal Husbandry, Resilient Micro Businesses, Health, and Built Environment.

As one of the priority sectors, SELCO Foundation is actively integrating sustainable energy-driven solutions to meet the challenges in the agriculture sector for commodity-driven value chains such as rice, millet, spices, tomato, potato and other horticultural produce. The goal is to develop sustainable energy solutions across these agricultural value chains to ensure food security, diversify farmer incomes and reduce drudgery across on-farm technology, post-harvest processing & value addition. Decentralised renewable

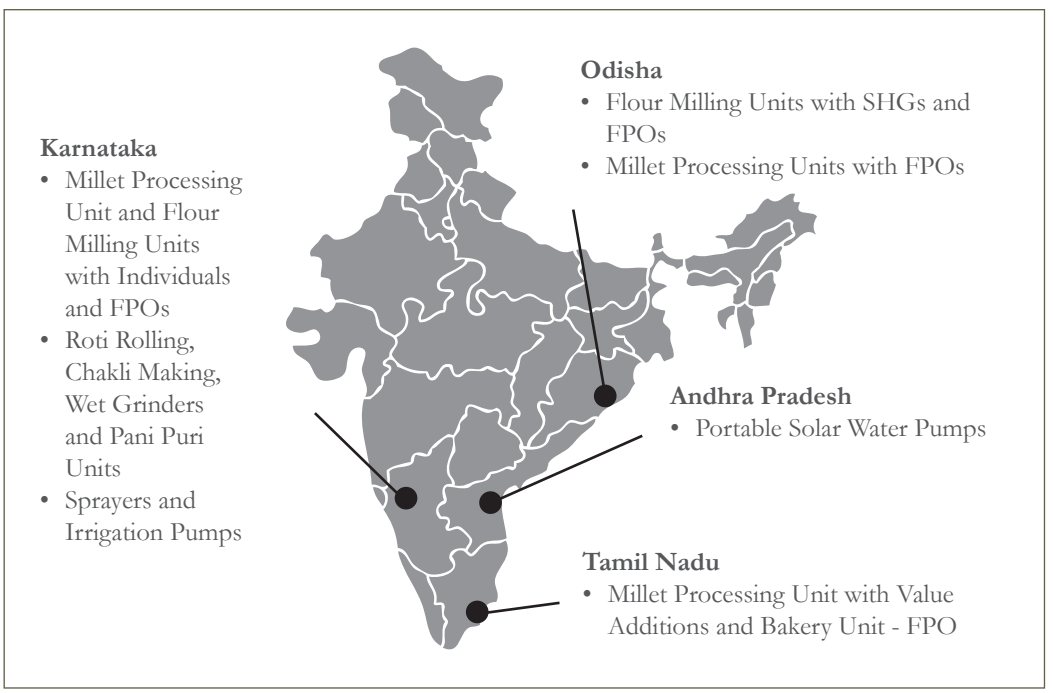

Figure 1: Selco Foundation's Implementation Map for Millet Value Chain Interventions

energy-driven technologies bring great value among small and marginal farmers and entrepreneurs, FPOs, FPCs, SHGs and other stakeholders.

The 'International Year of Millets 2023', as declared by the United Nations General Assembly (UNGA), is an opportunity to represent the extensive scope within the millet value chain at a global level. SELCO Foundation strives to build a holistic and robust ecosystem around every nodal point within millets, which can cater to the needs of small and marginalised farming communities within India and set a precedent for growers globally. Govt. initiatives to revive millets in Odisha have motivated and encouraged farmers to cultivate more millets across several geographies with quality inputs. This has shifted from millets being subsistence crops to a commodity.

Millets are resilient crops of varying types based on geographies. They have high nutritional value and are less water-intensive compared to paddy. They are hyperlocal and have historically been a traditional food for many indigenous communities.

Despite increased area under cultivation and production, farmers still struggle to market their produce due to the lack of access to modern processing technologies. This resulted in increased farmer drudgery and compromised quality of output grain, eventually forcing them to sell it at reduced prices, often through an intermediary. This leads to a steady decline in productivity, processing, consumption and income within the community, often discouraging cultivation over a period of time. Access to reliable energy in pre-production, production and post-production processes boosts production, brings efficiency across the value chain, and also reduces the detrimental economic and climatic effects of fossil fuels. Such challenges are best addressed by local stakeholders like Farmer Cooperatives, ensuring the sustainability to the interventions. Agricultural cooperatives unite single growers to boost their business productivity and increase yields.

Aggregated produce can enter a bigger market to sell their goods at a premium price and buy input supplies at lower prices, thus reducing the risk of distress sales. Additionally, it opens up opportunities for value addition, leading to better economic development and overall welfare. FPOs can be enabled to empower farmers to achieve their economic scale by enhancing backward and forward linkages to facilitate market-driven production and diversify business models.

2. The Need

Extreme climatic events such as erratic rain causing dry spells and unseasonal rains causing flooding, and intermittent drought disrupt the livelihoods of small and marginal farmers. Their risk capacities are affected directly, and they are often plunged into poverty.

Markets are presently dominated by large-scale, ill-fitted and inefficient agricultural machines powered by fossil fuels and are unaffordable for small and marginal farmers. Agricultural innovation must reorient its focus towards community-owned small processing units.

Despite its many benefits, the green revolution ignored dry land and rainfed crops such as millets and promoted rice and wheat production. It created a lot of infrastructure around growing these two crops, and many subsidies were rolled out for the same. Therefore, the main challenge of cultivating millets is the established preference for wheat and rice—by the grower and the consumer.

Over decades, a decline in millet production and consumption and an overt reliance on commercial crops have led to nutritional deficiencies, adversely affecting the traditional cropping system. Raw grains of little millets and Kodo millets produced in Dharmapuri (Tamil Nadu), Koraput (Odisha) or Dindori and Mandla districts (Madhya Pradesh) need to be transported as far as Nasik (Maharashtra) for processing. This causes an increase in price across the value chain, including for consumers, who have to pay higher amounts for millet foods compared to paddy and wheat products. Farmers also have little opportunity to increase their incomes by processing their produce.

While acknowledging the important contributions made by the ICAR and Indian National Agricultural Research System (ARS) in crop improvement, there is a need to further focus on production aspects of both improved varieties and landraces to increase the scope of suitable and financially viable technology. These researches should be aligned with the need to assess their performance under conditions of climate change as it affects crop production directly. Opportunities to deliver high-quality inputs and processing through enhancing the capacities of farmers and community-based institutions are also a very promising avenues to look into. Further, attention is required to make better links to community-based institutes for creating public seed markets and processing systems.

Economically poor communities use not just poor inputs but also inefficient and misinformed solutions to bridge the energy gap. Research has clearly established that the poorest pay 'three times more for energy than the richest'. The widening access gap to essential services related to livelihoods and well-being leads to basic needs becoming burdensome, resulting in loss of life, income, critical assets and debt.

There is a critical need to optimise technology for dehulling of different small millet species, which have different seed sizes. More research is needed to improve the separation mechanism in hullers to reduce the removal of grits and other usable materials along with the husk. Improving the sieving efficiency of graders is also needed. Large-scale equipment is available for this operation but equipment tailored for the community level and the small and medium enterprise level is needed. It would be most relevant for supporting the development of farmer enterprises.

3. Problems Specific to Odisha

Chandiput, a small village in Mohana Block of Gajapati district of Odisha, is predominantly inhabited by tribal communities majorly dependent on NTFPs as a source of income. In the race to meet the needs of a growing population and eradicate hunger, a

leap towards the green revolution promoted commercial crops, which sidelined millets and other minor crops. This shaped the diet of the local population by making Maize, paddy and other crops as the major staple leading to the scarce cultivation of minor millets and the eventual eradication of some landraces.

Millets, as climate-resilient crops, have lower irrigation-water requirements and higher nutrition quotient as compared to paddy and maize, thus simultaneously restoring the depleting groundwater table levels to secure soil and water conservation.

With this backdrop, key stakeholders have come forward to take collective action towards mitigating climatic hazards and providing climate-resilient options to farmers as an adaptive strategy. Currently, government initiatives such as OMM, OLM are striving to enhance production and boost productivity with their decentralised approach to project implementation, where NGOs are chosen as implementing partners to ensure the seamless working of supply-chain processes from farm to plate across administrative blocks. Moreover, the government of Odisha has a robust decentralised approach to PDS wherein grains are procured, processed and distributed within the district.

However, there is less or no effort to provide solutions that cater to the post-harvest management of millets, an efficient market-driven approach to sales. There are several other problems that could be quoted,

- Lack of an integrated approach to the supply chain
- Lack of communication and community awareness
- Challenges in promoting entrepreneurship and decentralised agri-tech businesses
- Lack of time-sensitive efficient channels to secure the required government approval for technical specifications of machineries
- Low remuneration compared to other competing crops such as soyabean, maize, cotton, sugarcane and sunflower, as millets are often branded as an 'elite superfood', making it expensive and urban consumer-centric

Increased demand for ultra-processed and ready-to-eat foods, high in sodium content, sugar, and trans-fats, have increased in India, resulting in less interest towards millet and allied food grains.

4. Taptapani FPCL and the Challenges Faced by the Member Farmers

Taptapani Farmers Producer Company Limited (TFPCL) was established in 2016 by organising primary producers from the Mohana area of the Gajapati district in Odisha. The area is covered by forest and is home to tribes and other communities.

Studies revealed that these parts of Odisha have high variability of rainfall, flash floods during monsoon season, heat waves during summer and intense impact of cyclonic storms. In order to tackle the issues and support farmers and other vulnerable communities, govt and non-govt organisations have initiated several approaches to overcome the issues pertaining to agriculture and livelihoods.

NABARD is one such entity actively providing technical, managerial and financial support for hand-holding, capacity building and market intervention efforts of the FPC. Such support is available in the form of a grant, loans, or a combination of the two based on the need of the situation. Capacity-building support is given only along with credit from NABARD. The inception of the FPC was actively guided by Sahabhagi Vikash Abhiyan (SVA) and SACAL- Berhampur and is supported by the NABARD. With over 700 active members, the FPC is spread across 75 villages in the Mohana area as of 2021.

The TFPCL was formed with the aim to evolve as a center of excellence in service of its vulnerable farmer members who are deprived of quality inputs (seeds, fertilizers etc.), knowledge and networking for remunerative agriculture. TFPCL is all about taking true heroes, their very own small farmers, to the limelight and ensuring that their visibility enables dialogue too. All the products and services of the TFPCL are focused on bridging identified gaps and bringing curated services to connect farmers to end consumers. TFPCL works on the entire value chain and ecosystem of support of its farmer members. Starting from providing the member farmers with high-quality agri-inputs to bringing out handcrafted products and identifying clients and customers to sell them to ensure the sale of manufactured products, TFPCL strives hard to create a footprint of its own.

They supply high-quality seeds and fertilizers to the member farmers as well as other local farmers at a more affordable price than the market. The approach to various input suppliers as bulk buyers has significantly increased the bargaining power to get inputs at much cheaper rates benefiting thousands of farmers. TFPCL is involved in producing high-quality packaged products starting from millets, rice, fruits & vegetables, and spices & condiments. They supply food products in bulk, as well as in retail. The food products are available under various leading brands like Tiril & others.

From the learning over the last five years as a collective institution, they offer training and capacity-building services to fellow collectives. They facilitate training on lessons learnt, best practices, exposure visits etc. They also organise workshops & capacity building sessions for the member farmers at a regular frequency to keep them updated with recent trends.

Buying farm equipment and machinery is a difficult investment for the majority of farmers with small landholdings. To cater to them, TFPCL has established a custom hiring center for the member farmers to rent various farm equipment at a nominal rate. Grain threshers, Solar powered millet cleaners, tillers, pump sets etc., are currently being rented to the member farmers encouraging production and productivity at the farm level.

5. Challenges Specific to Post-Harvest Processing

TFPCL is situated in an isolated and completely off-grid area with no power supply and, from the looks of it, will remain so for the next few years. There are several smallholders who depend on rain-fed cultivation of minor millets for subsistence farming.

- **Lack of Better Inputs and Post-Harvest Technologies:** Lack of better inputs and post-harvest technologies discouraging farmers from taking up millet cultivation.
- **Primary and Post-Harvest Processing:** Centralised processing units are high emitters of carbon and have lengthened supply chains, forcing farmers to travel long distances, which causes high transport emissions and costs. Such units dominate markets and leave farmers with no profit or bargaining power.
- **Climate Variability:** Climate variability demands emergency food storage and value addition at the farm level, which farmers currently do not have access to.
- **Processing and Storage:** Climate variability causes higher food spoilage and wastage and calls for more upgraded and more decentralised storage to help farming communities help store perishable, processed or value-added products.

6. Decentralised Solution

SELCO Foundation conjugated with Taptapani Farmers Producer Company Limited to illustrate possible implementable millet processing solutions and showcase benchmark technology for further replication and scaling. Through this collaboration, it is intended to promote millet processing enterprises at Panchayat/Block level to ease processing at the households and for value-added markets with an energy-efficient processing unit in the rural areas of Odisha.

In 2019, with local NGO partners, the FPO started to support farmers to undertake millet processing and value addition through decentralised clean energy-driven technologies. The FPO is also necessitating women groups called 'miller sisters' to produce value-added products and encouraging them to be self-reliant through training & capacity building.

- **Encourage Locally Owned Solutions**
  Encouraging and promoting solutions to be locally owned creates space for context-specific and socially relevant innovations in technologies, delivery models, financing and community-based institutions. It also ensures communities take ownership of their problems and solutions, creating leadership and entrepreneurial spirit.
- **Addressing Poverty, and Climate Change**
  Decentralised solutions encourage balanced adaptation without contributing further to emissions which is very critical.

- **Addressing the Technology Gap**
  Customises energy-related equipment for Indian small land-holding farmers who are a majority but don't have access to necessary efficient technologies

A typical millet post-harvest processing unit consists of a grader, destoner, huller, polisher and flour mill. The unit hugely benefits farmers by enhancing the quality of the output with efficiency up to 70%, which was otherwise 55 to 60% before. The processed produce fetches a better price in the market as well as encouraging consumption which in turn provides nutritional security. The processing setup also encourages farmers to take up value addition. Value-added products are also being made locally through collectivisation and fetch higher returns for producers.

Efficient millet processing machinery is critical to reduce drudgery and increase the uptake of millet production & consumption, as millets do not provide good returns at the farm gate and have a much higher value after processing. Decentralising those technologies are the first step towards democratising their returns.

The processing unit established at Taptapani FPO has encouraged farmers to take up post-harvest processing as the FPO provides the services at nominal charges for nearly 150 households. Through this, farmers are now able to process, sell and consume locally. It is simultaneously encouraging Millet sisters, preparing value-added products, and now earning a profit of ₹ 15,000 to 20,000/- per month. This is a phenomenal feat in terms of local employment and encourages the youth of the area to see value in their land, produce and nutrition.

7. Impact

A decentralised millet processing unit equipped with a grader, destone, dehuller, polisher and flour milling machines can serve as farmers' all-purpose post-harvest processing solution.
Farmers can consume their own produce, sell it for a higher value and also use every part of the crop within their farms itself, as the processed waste (20% of the crop) can also be turned into animal feed. Moreover, high-value-added products can be made locally through farmer cooperatives.

Table 1: Business Model*

Sr. No.	Particular	Units	Numbers	Remarks
1	Total Husked Millets processed	kg/day	150	Total capacity to process millets is 250 kg/day.
2	Total Naked Millets processed	kg/day	100	We are assuming that 150 kg of Husked millets and 100 kg of Naked millets is the demand/day
3	Selling Price of processed/Hulled Millets	Rs./kg	90	
4	Service charge of flour milling for Naked Millets	Rs./kg	5	Data provided by field staff
5	Total Turnover from Husked Millets processed	Rs./day	14000	Data provided by field staff
6	Total Turnover from Milled Millets	Rs./day	500	Total production (kg) X Selling price (Rs.)
7	Net profit for Husked millets (Approx)	Rs./kg	24	Total processing (kg) X Service charge (Rs.)
8	Net profit for Naked Millets (Approx)	Rs./kg	2	Considering all other expenses like Labour, raw materials, rent, packaging, etc.
9	Total Net Profit	Rs./day	3800	Considering labour charges
10	Total Net Profit	Rs./ month	57000	Total production (kg) X Net Profit of hulling/kg (Rs.) + Total processing (kg) X Net Profit of flouring/kg (Rs.)
11	Recommended EMI	Rs./ month	22800	Total Net Profit/day (Rs.) X Month (15 days) (as they operate the machines only for 15 days/month)
12	Total Investment (Machine + Solar)	Rs./ Unit	950000	EMI ~40% of Net Profit
13	Simple Breakeven Tenure	Months	42	
14	Simple Breakeven Tenure	Year	3.5	

*Assumption-250 kgs/day (150 kg Husked Millets in entrepreneurship & 100 kg Naked Millets in service model) with a selling price of ₹ 90 and a purchase price of ₹ 22 for Husked millets.

Table 2: Cost Analysis

Considering 250 kg/day(5 hrs) Millets Processing Unit	
Total Investment	
(Machines + Solar 5 hrs backup)	₹ 9,50,000/-
Income	₹ 57,000/month
Breakeven	~ 3.5 years*

- Taptapani FPO caters to 712 households across 20 villages, who also are millet-cultivating communities
- Average production of 300 kgs of ragi per household
- Average consumption of 15kgs/month of ragi for household consumption.
- The region is entirely off the grid.
- The millets undergo primary processing, and these grains are sold at ` 60 per kg, and the flour milling service is charged at ` 5 per/kg.

Solar-Powered Milling Reduces Reliance on Electricity and Dirty Fuels Like Diesel

- Increases income and business for both individual farmers (service model) and for SHGs and FPOs (trader models)
- Farmers are offered better price realisation at markets with processed millet
- Eased access to milling for women who perform the post-harvest activities manually and face high levels of drudgery for processing
- Women no longer lose wages or incur transport costs in day-long travel to central processing units.
- Decentralised mills do not harm the bran layer of the millets (the most nutritious and protein-rich part), thereby increasing nutrition content.
- Farm-level milling enhances round-the-year fodder availability for livestock, allowing animal feed to be locally produced with lowered emissions

8. Conclusion

Decentralised millet processing machines are designed differently in more ways than one. They are designed keeping the needs and requirements of communities in localised geography, which are starkly different in the ways larger machines and their business models function. While both have economic gains, decentralised models keep social benefits for people and the planet at the center, while centralised models keep capital gains as the focal point. With an increase in millet production, the need for processing units locally for farmers is bound to grow. Hence, it is critical to consider decentralised efficient milling units to reduce emissions and increase sustainability.

Our learnings from working with TFPCL have been multifold, and we have seen a greater community-driven interest in millet production.

To conclude, TPFCL:

- Enables sustainable practices by providing affordable climate-friendly inputs to farmers locally
- Enhances sustainability at every point of the agri-value chain
- Reduces transaction costs for end users, brings inputs and outputs closer
- Alleviates on and off-farm impacts caused by heat stress and variable precipitation.

BambusaTulda: SeSTA's Climate Sustainable Livelihood Model Leveraging Smart Agriculture in NE India

Asmita Sethi, Kalyani Kholia and Shankar Keshav Prasad

1. Overview

Bamboo is a traditional household item in the north-eastern part of India (which accounts for 67% of the country's bamboo resource). It is estimated that there are ~20 lakh traditional artisans in India that rely on bamboo harvesting, processing, and selling (along with handcrafted bamboo products) to support their livelihood. It is also one of the fastest growing plants — up to 1.2 metres per day — with its roots having properties that reduce soil erosion by 75% and generate exponentially more amounts of oxygen than comparable varieties of trees; it offers protection from ultraviolet rays by lowering the intensity of light and plays an active role in combating toxicity of the soil and air. It grows in the temperature range of 18 - 38°C, with annual rainfall between 1200 - 4000 mm. With over 1000 different species and 91 genera, 64% of the naturally occurring bamboo varieties are found in South East Asia, out of which 41 species are endemic to the north-eastern region of India.

1.1 The Problem

Climate change refers to significant changes in global temperature, precipitation, and wind patterns over a large period. It occurs due to man--made activities like burning fossil fuels, deforestation, excessive cultivation, etc., which have a ripple effect on the environment. Today, climate change is one of the most challenging battles the world is fighting. Climate change has severe effects on not just human life but wildlife and agriculture as well. This is particularly an unpleasant situation for a country like ours because agriculture in India is a major contributor to the growth of our economy. The agriculture and allied sectors contributed to ~20.2% of our Gross Domestic Product in the year 2021-22. However, traditional agricultural practices like stubble burning that continue to be in action, along with the use of nitrogen-based chemical fertilisers, contribute extensively to air pollution, water pollution, and soil degradation affecting the quality and yield of the crops.

1.2 Key Drivers

Founded in 2011, Seven Sisters Development Assistance (SeSTA) is a grassroots organisation which was conceived to catalyse activities through the process of *'Nirmaan'* or constructive development in the social and economic aspects, for rural Northeast India. It is working towards developing a vibrant and democratic society which lives by sustainable practices that enhance the capabilities of rural communities. Their interventions include community mobilisation, facilitating livelihood planning, technical training along with handholding support, and finally reviewing the activities of the Self-help Groups (SHGs) created within the community.

2. BambusaTulda Initiative

One of SeSTAs major projects, the BambusaTulda plantation initiative, which was started in 2019, is an excellent example of a climate-resilient livelihood model that can be easily scaled up to other parts of the country. Bamboo, also known as poor man's timber to many, is a hidden treasure (environmentally and commercially). This vastly popular, climate-agnostic alternative crop is a feeder for multiple industries like handicrafts, paper, building materials, kitchen utensils, clothing, etc. With this BambusaTulda's increasing popularity in the global market, it is now referred to as 'green gold'. Besides, but bamboo's fast growth without a lot of human intervention is one of its many attributes which make it a valuable resource for mankind. It is also known to have a high ability to capture and sequester atmospheric carbon and consequently help mitigate climate change, like the benefits provided by trees and forest covers.

Under the aegis of the BambusaTulda initiative, with the aid of subject-matter specialists, SeSTA is identifying blocks of land in regions with potential for bamboo plantation (in block plantation style) by conducting a scoping study of villages in areas under SeSTA's purview and orchestrating a concept-seeding phase. It is then collaborating with women farmers belonging to a network of SHGs and inducting them into the program with the help of crop development trainings, field demonstrations,

2.1 The Geography

Seven Sisters Development Assistance's project on BambusaTulda or Indian timber is currently operational in the districts of Hezamara and Jampuijala in Tripura, Darrang district covering Pachim Mangaldoi, and Kamrup Rural covering Boko in Assam. These areas were chosen strategically as the production of bamboo has been going down vis-a-vis the rise in demand. Also, this region had immense potential for the growth and promotion of bamboo cultivation, making it a lucrative option.

3. Strategic Modelling

3.1 The Livelihood Model

- **People:** Providing empowerment and building capabilities through training and capacity-building workshops
- **Resource:** Using bamboo as a source to provide sustainable additional livelihood incomes to women farmers in the Northeast region of India.
- **Institution:** Strengthening women's collectives and Self-help Groups (SHGs)

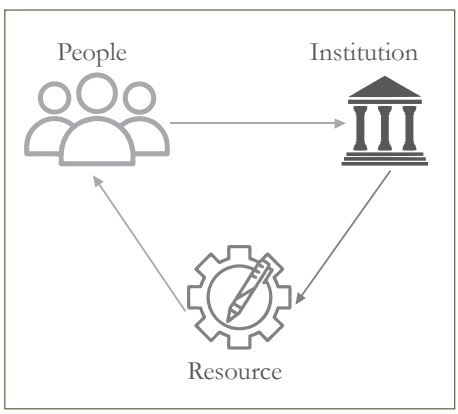

Figure 1: The 3 Pillars of SeSTA's Livelihood Model

SeSTA ensures that their livelihood strategy is a combination of goals and values that is directly mapped to socio-economic and cultural components in the Northeast region of India. This strategy aims at fulfilling the needs of every family by providing necessary resources and strategising activities to enhance the income levels of families. These activities include technical training and capacity building.

3. 2 The Intervention Model

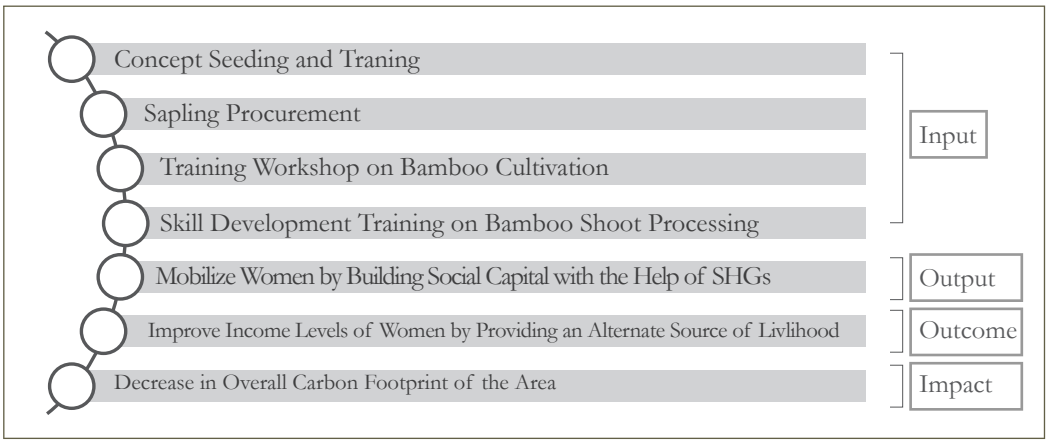

Figure 2: BambusaTulda's Intervention Model

The BambusaTulda intervention model hinges on keeping women as the key stakeholders in building strong village institutions by giving them access to (a) necessary resources and (b) support. The model accomplishes this by collaborating with self-help groups (SHGs) to build social capital to provide every household with an intervention that, on a macro level, improves soil fertility or creates an irrigation infrastructure and, at an individual level, improves their livelihood through increased income levels.

Additionally, the cultivation of bamboo leads to an overall decrease in the carbon footprint of the area, thus proving to be a climate-resilient livelihood model. This intervention model is closely monitored and evaluated on a quarterly basis, and appropriate measures are taken for course correction in case anything goes wrong. The merit of this intervention model lies in its ability to leverage the land's immense bamboo farming potential. It not only helps women farmers maintain an additional source of income but also helps promote a year-long agricultural cover. As a result, this reduces farmers' dependency on chemical fertilisers that are harmful to the soil and degrades the land.

3.3 The Implementation Model

SeSTA, through their BambusaTulda initiative, has a unique implementation model:
It begins with a needs assessment to understand if there is a need for bamboo cultivation in the village or district. After that, the women in the village/district are assessed on

income levels, and the percentage of women who need additional income support are identified. Consequently, the quality of land is examined to check if bamboo can be cultivated. This step opens the way for SeSTA to conduct various training and activities, such as collaborating with the SHGs and allocating small loans to these families. Additional knowledge and awareness training on bamboo cultivation are also conducted. Finally, this entire process is regularly monitored to understand the progress and to identify if any course corrections are required.

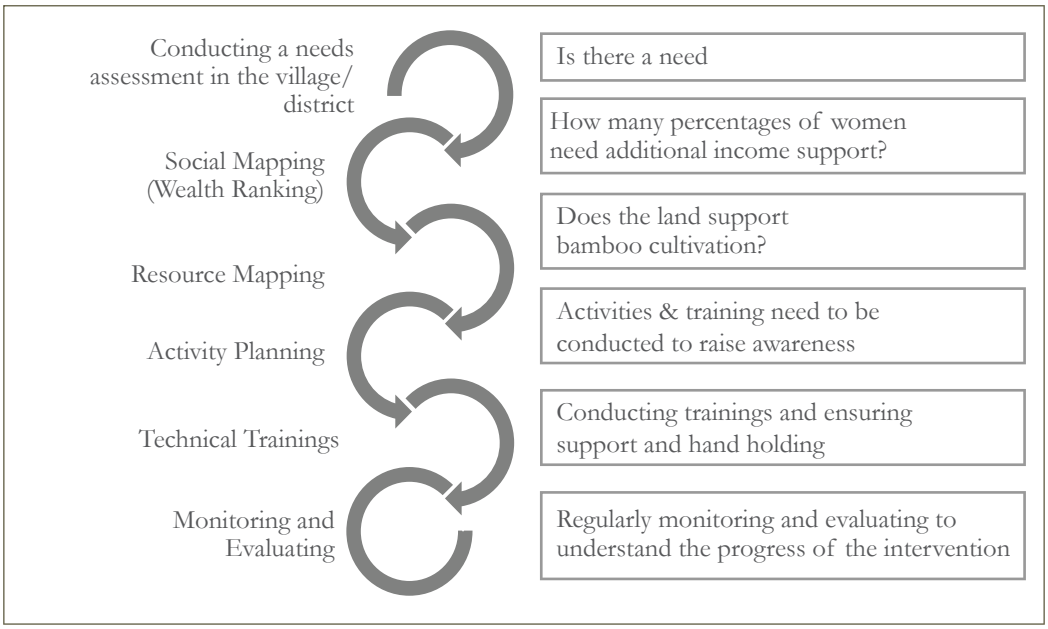

Figure 3: BambusaTulda's Intervention Model

4. Impact

The impact of the BambusaTulda Initiative extends to (a) creating awareness about facilities like crop insurance to safeguard farmers from natural adversities in lieu of climate change, (b) organising and empowering women into self-help groups as a safety net for getting a consultation, short-term loan, etc., (c) exposure to other cultivation techniques (SCI, SRI, etc.), and more. It's a holistic livelihood model that nurtures the farmers subscribed to it by preparing them to be independent while being able to access the community's resources. Till date, a total of 350 women farmers enrolled in the BambusaTulda project have seen an income level rise in the range of 30-40% and a reduction in the carbon footprint of ~10% (slated to go up to 30%).

While it lays the foundation for the livelihood of many farmers like Savita, it also makes a measurable environmental impact. The 418 hectares of land planted with the BambusaTulda bamboo variety till date under SeSTA's initiative are expected to store 1.27 lakh tonnes of carbon over a 60-year period. Studies estimate that bamboo covers ~2.2 crore hectares of land today and are expected to sequester 727.08 tera-grammes of carbon.

Moreover, bamboo has the potential to grow in many more hectares of land (in tropical and subtropical climates) and provide immense benefits to farmers without affecting their existing yields.

4.1 Rationale

Carbon sequestration is the process of capturing carbon from the atmosphere and storing it. In comparison to other forest trees, bamboos sequester a significantly greater amount of carbon in its early plantation years. However, the catch is that managed bamboo plantations (much like SeSTA's Bambusa Tulda) store a much higher level of carbon than unmanaged bamboo due to low productivity. Moreover, any carbon captured by the unmanaged bamboo returns to the atmosphere just as quickly once the culms decompose.

4.2 Way Forward for SeSTA

The versatility of bamboo, its ability to not only grow on uneven terrain and poor-quality soil but to repair the soil quality and support infrastructure in sloping regions, and its quick harvest cycle add to its appeal as a viable and valuable income stream. One of the major products with growing demand for bamboo is incense sticks (an industry with an estimated ~3244.7 Cr ₹ market cap). Even major FMCG players in the market, like the ITC – which owns the incense stick brand 'Mangaldeep', have given a boost to the production of the BambusaTulda in the Northeastern states, commensurate to the growing popularity of its own commercial products. As an additional benefit, this led to ITC choosing to partner with SeSTA under the aegis of corporate social responsibility.

SeSTA has ambitious plans for its future. It intends to make a bigger impact on the community as well as the environment. Once a pre-set percentage of bamboo saplings are of harvestable age, SeSTA envisions to set up a Farmer Producer Company (FPC) while taking these women farmers in stride.

4.3 Future of Bamboo

Production of bamboo products requires (typically) less energy than comparable fossil-fuel products. Bamboo charcoal, traditionally used as a substitute for wood/mineral charcoal, is used as a fuel, conductor and absorbent. It is also an energy source; by utilising processing operations' related waste, it can substitute the usage of fossil fuels and lower operating costs which can then also be used for thermal applications in a furnace. Activated carbon manufacturing is another process which is required in different industries like pharmaceutical, vegetable oil, et c., wherein bamboo charcoal can be used as the raw material. More recently, technological advancement has shown that bamboo can be utilised to manufacture yarn, and different kinds of textiles. Some of the other avenues where bamboo has great potential for sustainable usage are:

- Bamboo Flooring: It is another quality product that displays immense market potential. It has certain advantages over traditional wooden flooring owing to its: smoothness, stability, insulation quality, etc.

- **Matchsticks:** Muli Bamboo, a variety of bamboo that grows in abundance in northeast India, is an excellent raw material for making matchsticks. One kilogram of Muli splints can make ~8000 matchsticks.
- **Nutrition:** Fresh bamboo shoots have thiamine, niacin, vitamin A, vitamin B6 and vitamin E in balanced quantities. They are also a good source of dietary fiber and phytosterols, which makes them a popular choice of healthy foods.
- **Medicine:** High potassium content of bamboo has been proven to reduce the risk of cardiovascular disease, cancer and improves the digestive function of the body.

Box 1: Interesting Cases

Assam, India: Mr Dodhi Pathak of Nalbari district of Assam was felicitated by the National Innovation Foundation, Ahmedabad, for his innovation of making teeth out of bamboo. He had lost his own front teeth in a road accident and lacked the funds to afford a polymer-based denture. He had then set out to make his own denture from the Mokal variety of bamboo. Many patients line up outside his practice to get dentures made from him till date. It costs him just ₹ 30 and 50 to craft incisors and molars (respectively) out of bamboo, using crude tools like a knife and file in under half an hour. According to him, an estimated 4,320 people in Nalbari and Guwahati are using these bamboo teeth.

Japan: Ground bamboo bark is used to naturally preserve food by leveraging its antioxidant properties, which inhibit bacterial growth.

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Dedicated to the Late Sitaram Rao, mentor and guru of Indian microfinance and livelihoods movements, the Sitaram Rao Livelihoods India Case Study Competition aims at bringing together the collective intellect of the sector and assimilating innovative solutions, breakthroughs, good experiences and best practices that help in learning from diverse sector experience and impact poverty reduction. The competition was instituted as a pioneering initiative by ACCESS in 2009 as a tool to identify and collate models and practices that have significantly contributed to the livelihoods promotion of the poor in India.

The theme for Sitaram Rao Livelihoods India Competition 2022 was Climate Resilient Livelihood Models. The compendium covers 10 best case entries to the competition from across the country that showcase evidence of sustainable impact to the lives and livelihoods of vulnerable communities.

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