



**Farmer
FIRST**



Farmer FIRST: Advancing Sustainable Agriculture through Participatory Action Research

ANNUAL REPORT 2023-25



**ICAR-Agricultural Technology Application Research Institute
Zone-I, PAU Campus, Ludhiana-141004, Punjab**





Farmer FIRST: Advancing Sustainable Agriculture through Participatory Action Research

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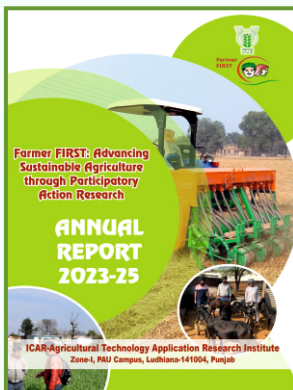
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Citation:

Murai, Ashish Santosh; Singh, Narinder; Kaur, Sharandeep; Sheoran, Parvender (2026). Farmer FIRST: Advancing Sustainable Agriculture through Participatory Action Research. ICAR-Agricultural Technology Application Research Institute, Zone-1, Ludhiana, Punjab, India. PP: 1-100

ICAR-ATARI-1 PME Ref. No.: ATARI-1/Annual Report/2026/27

Published by:

ICAR-Agricultural Technology Application Research Institute
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PREFACE

The earlier initiatives in Indian agriculture significantly enhanced production but largely centred on technology as the primary driver, often viewing farmers as passive beneficiaries. Moreover, the vital role of multi-stakeholder involvement in the processes of technology development, integration, and adoption received limited attention. In today's context-marked by the expansion of smallholder farming, increasing participation of women in agriculture, and shifting socioeconomic dynamics-there is a growing need for an inclusive and participatory approach.

Recognizing these evolving challenges, the Indian Council of Agricultural Research (ICAR) launched the Farmer FIRST Programme (Farm, Innovations, Resources, Science, and Technology) in 2016. The programme was conceived to bridge the gap between scientific research and on-farm practice by positioning farmers as active partners in innovation. Over time, it has evolved into a collaborative platform connecting farmers, researchers, and extension professionals, thereby strengthening linkages across the agricultural knowledge system. Distinct from earlier technology-led approaches, the Farmer FIRST Programme emphasizes participatory technology development, enabling farmers to contribute their indigenous knowledge while benefiting from scientific advancements. The programme also harnesses digital tools to promote precision farming and data-driven decision-making, while encouraging sustainable and eco-friendly practices that safeguard long-term food security.

At its core, the Farmer FIRST Programme institutionalizes a farmer-centric, collaborative framework where farmers are co-creators of knowledge and innovation. By integrating modern technological interventions, improved agronomic practices, and need-based capacity building, the programme has led to notable improvements in productivity, profitability, and sustainability. Its success is reflected not only in measurable outcomes but also in the strong, positive feedback from participating farmers across diverse agro-ecological settings.

It is a matter of great satisfaction to present the Report of the Farmer FIRST Programme (2023-24 & 2024-25), which documents the programme's key achievements, challenges, and the roadmap ahead. The remarkable progress of this initiative has been made possible through the unwavering support of all stakeholders. We gratefully acknowledge the leadership of Dr M.L. Jat, Secretary, DARE, and Director General, ICAR, as well as the contributions of former Director General Dr Himanshu Pathak, whose vision steered agricultural innovation. We also extend our appreciation to Dr Rajbir Singh, Deputy Director General (Agricultural Extension), ICAR, and former DDG Dr U.S. Gautam for their strategic guidance. The dedicated efforts of the Project Investigators have been instrumental in realizing the programme's objectives. This report offers an opportunity to reflect on the transformative outcomes of the Farmer FIRST Programme and to reimagine the future of Indian agriculture one driven by sustainability, inclusivity, and farmer-led innovation.

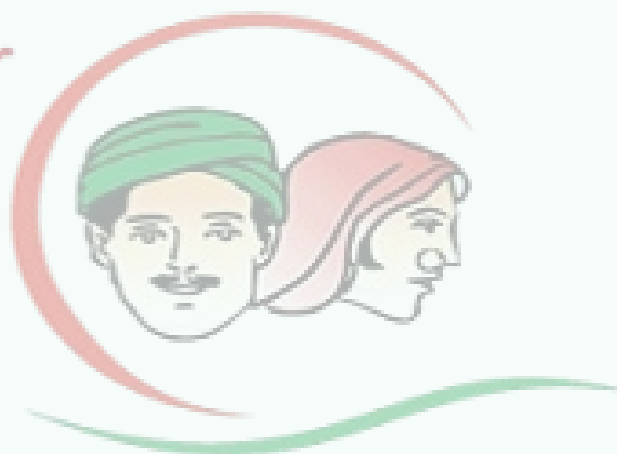
Editors



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**Farmer
FIRST**



INTRODUCTION

Indian agriculture relies on a diverse range of stakeholders to meet the food demands of a growing population, with small, marginal, and landless farmers playing a pivotal role in ensuring national food security. Women also make invaluable contributions through their active participation in cultivation, harvesting, post-harvest management, and allied sectors such as horticulture and animal husbandry, thereby strengthening the agricultural value chain. However, the sector continues to face significant challenges arising from population growth, climate change, and shifting dietary patterns. Ensuring profitability and stable incomes is therefore critical to sustaining farmers' long-term engagement in agriculture.

In this context, innovation and technology are essential tools for addressing emerging challenges. The identification, testing, and integration of innovations generated by both scientists and farmers play a central role in enhancing resilience and productivity. Innovation in agriculture encompasses problem identification, research, solution development, and the diffusion and adoption of technologies. Yet, there is growing concern that farmers' evolving technological and institutional needs are not being adequately met, leading to a persistent disconnect between field-level realities and research outcomes. To bridge this gap, the research system must adopt a proactive and participatory approach centered on direct engagement with farmers, continuous feedback, and the refinement of technologies suited to diverse farming conditions.

The Indian Council of Agricultural Research (ICAR) launched the Farmer FIRST Programme (FFP) in 2016 as a strategic initiative aimed at moving beyond mere production and productivity. The programme specifically prioritizes smallholder agriculture and seeks to address the complex, diverse, and risk-prone realities faced by the majority of farmers through active farmer-scientist interactions. It focuses on key domains such as resource management, climate-resilient agriculture, production management including storage, market and value chains, innovation systems, and information networks. The Farmer FIRST concept places farmers at the centre of research by involving them in problem identification, priority setting, experimentation, and management under real farm conditions. It focuses on farmer's farm, innovations, resources, science, and technology (FIRST). This initiative is built on two core principles: "enriching knowledge" and "integrating technology." Enriching knowledge highlights the importance of mutual learning between farmers and researchers, considering the farm environment, farmer perceptions, and interactions with surrounding agricultural systems.

Meanwhile, "Integrating Technology" highlights that, at times, recommended practices may not perform as expected in farmers' fields. To ensure successful adoption, researchers can modify and fine-tune these recommendations at the field level, making them more practical and effective. This joint effort in developing location-specific, demand-oriented, and farmer-friendly technology solutions aligns with ICAR's vision to double the farmer's income by improving farm productivity and sustainability.

Farmers frequently face challenges in production and natural resource management, but often lack effective solutions to overcome them. The Farmer FIRST Programme provides a collaborative platform where researchers, extension personnel, and farmers work together to assess and implement suitable interventions. Furthermore, as farmers generate new ideas to improve cultivation and resource management, the initiative promotes joint experimentation, enabling all stakeholders to co-design and refine innovative agricultural practices. The programme is implemented at household, village, and community levels through collective

experimentation. While most experiments are carried out by individual farmers participating in the project or selected as village representatives, some are designed to address challenges that affect entire communities. This approach ensures a wider impact by fostering community-driven solutions to agricultural problems. Farmer FIRST adopts a participatory research framework in which farmers actively engage with scientists to define research questions and monitor experiments. Whether conducted with selected farmers or across entire villages, the primary objective is to develop innovative practices by integrating the expertise of multiple stakeholders. Experiments are tailored to local farming conditions, highlighting the significance of indigenous knowledge in generating effective solutions. Extension personnel play a pivotal role in facilitating the successful implementation of these innovations, enabling researchers and extensionists to gain a deeper understanding of village-level needs. Consequently, research priorities are shaped by the farmers the end users of technological developments, rather than being solely determined by researchers.

OBJECTIVES OF THE PROJECT

The Farmer FIRST Programme seeks to reinforce the interface between farmers and scientists to facilitate the development and effective application of agricultural technologies. This goal is pursued through a focus on innovations, technological interventions, systematic feedback mechanisms, active participation of multiple stakeholders, recognition of diverse farming realities, utilization of varied methodologies, and implementation of interventions targeting vulnerability and livelihood enhancement. The programme's specific objectives are:

- ❖ To enhance the farmer-scientist interface, enrich knowledge, and facilitate continued feedback
- ❖ To identify and integrate economically viable and socially compatible technological options as adoptable models for different agro-ecological situations
- ❖ To develop modules for farm women to address drudgery reduction, income enhancement and livelihood security
- ❖ To study the performance of technologies and perception of the farmers about agriculture as a profession in the rural settings
- ❖ To build a network of linkages of organizations around the farm households for improving access to information, technology, input, and market
- ❖ To institutionalize Farmer FIRST process

COMPONENTS

The project is conceptualized to deal with the following:

I. **Enhancing Farmer- Scientist Interface**

Enabling involvement of researchers for continuous interaction with farm conditions, problem orientation, exchange of knowledge between farmers and other stakeholders, prioritization of problems, and setting up of research agenda

II. **Technology Assemblage, Application, and Feedback**

Integrating components of technology for application in different agro-ecosystems with a focus on innovations and feedback

III. **Partnership and Institution Building**

Building partnerships involving different stakeholders, development of rural based institutions, agro-ecosystem, and stakeholders analysis and impact studies

IV. Content Mobilization

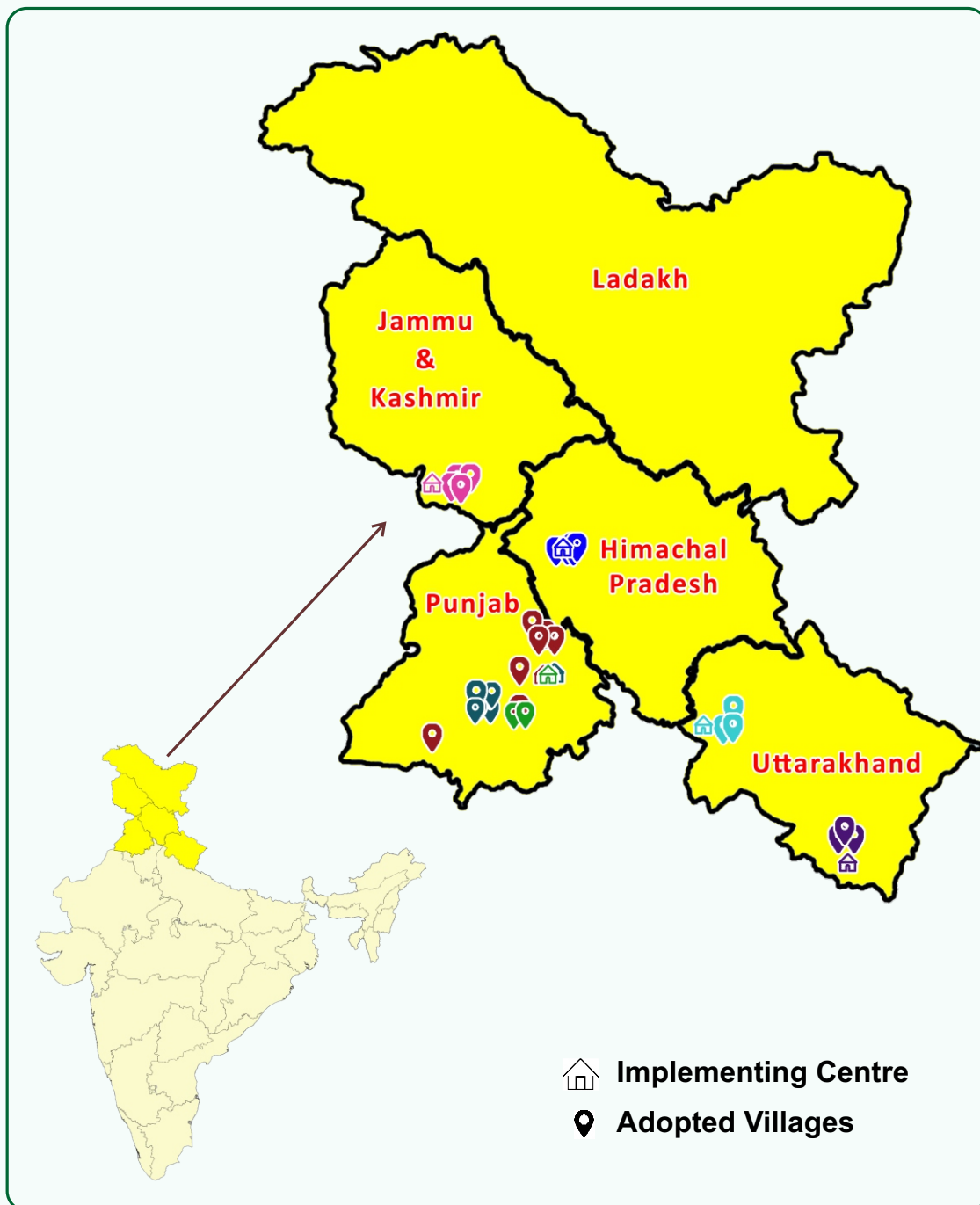
Using the platform of the project, having institutions as partners to develop specific content for e-enabled knowledge sharing

The ICAR-ATARI, Zone-I, Ludhiana, has established seven Farmer FIRST Programme (FFP) centers to empower farmers by providing real-time access to scientific technologies and expert guidance. These centers comprise two ICAR institutes and five State Agricultural/ Veterinary Universities. The initiative emphasizes enhancing farmers' decision-making capacities, strengthening resilience to climate and market uncertainties, and promoting sustainable agricultural development. During the 2023-24 and 2024-25 period, the project is being implemented across 43 villages, benefiting more than 4,965 households through seven FFP centres. In addition, one joint village has been adopted by the Ludhiana-based FFP centres, PAU, GADVASU, and ICAR-CIPHET. These centres function as knowledge hubs, facilitating the exchange of information and enabling farmers to adopt innovative practices that improve productivity. The locations of the FFP centers are illustrated in the accompanying map, while zone-wise details are presented in Table 1. This collaborative approach plays a pivotal role in bridging the gap between scientific advancements and farming communities, thereby fostering inclusive and sustainable agricultural growth.

Table 1: Title of Projects in FFP centres under ICAR-ATARI, Ludhiana

S. No.	Name of Institute / University	Title of the project	No. of villages	No. of households
1	PAU, Ludhiana	Technology application and upscaling for sustaining natural resources and augmenting farm income: farmers led market linked approach	4	1430
2	GADVASU, Ludhiana	Integrated approaches for livestock development: farmer's context	7	939
3	ICAR-CIPHET, Ludhiana	Processing and value addition of agricultural produce for enhancing farmers income and employment in production catchment	9	230
4	CSKHPKV, Palampur	Transfer of improved farm production technologies for enhancement of rural livelihood security amongst the farm households of Kangra district of Himachal Pradesh	8	500
5	SKAUST, Jammu	Exploring economic opportunities for farmers of Kandi villages through the application of proven rainfed technologies	6	403
6	GBPUAT, Pantnagar	Enhancing livelihood opportunities of farming community in the mid-hills of Uttarakhand	4	210
7	ICAR-IISWC, Dehradun	Farmer participatory technology application for sustainable resource management and livelihood security in North-Western Himalaya	5	1253
Total			43	4965

ICAR-ATARI, Zone-I, Ludhiana



Section 2.1

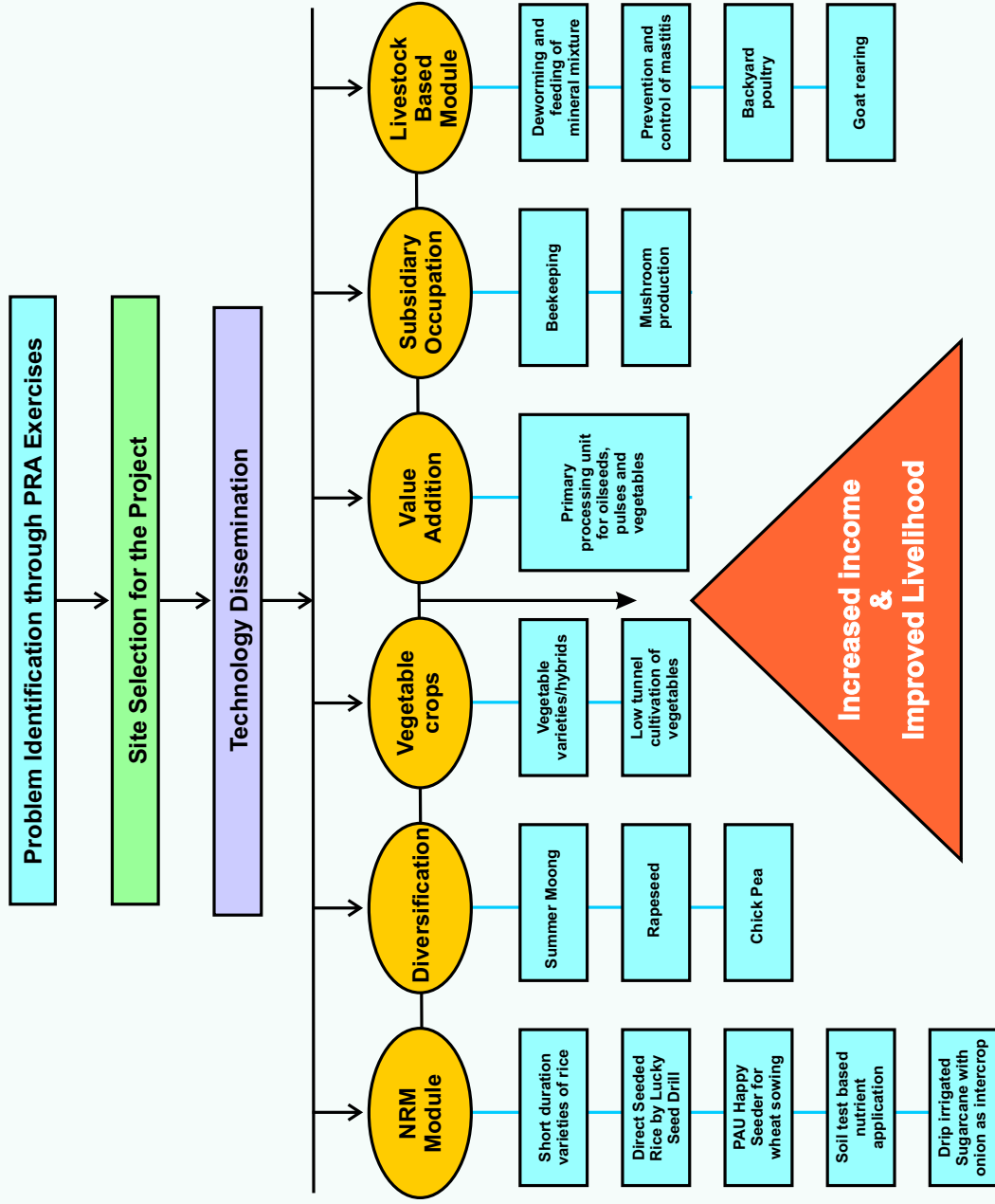
Punjab Agricultural University, Ludhiana **Technology application and upscaling for sustaining natural resources** **and augmenting farm income: Farmers led market linked approach**

The Punjab Agricultural University (PAU), Ludhiana, implemented the Farmer FIRST Programme (FFP) in selected villages of Sangrur district. In the first phase, the villages Chatha Nanhera and Taranji Khera were adopted, while in the second phase, Bhojowali and Bhadalwadh were included. About 75% of the activities are undertaken in Bhojowali and Bhadalwadh, while 25% are conducted in Chatha Nanhera and Taranji Khera. The project area falls under the Central Plain Zone of Punjab, a region known for high input use and intensive agricultural production. The paddy-wheat cropping system dominates this zone, covering more than 85% of the cultivated land. Bhojowali village has a total area of 577 ha, of which 500 ha is under agriculture. It comprises 388 households with a population of 1,732. Bhadalwadh village covers 362 ha, including 250 ha of agricultural land, and has 205 households with a population of 991. The overall literacy rate in the cluster is around 62%. Chatha Nanhera village, with a population of 6,225 and a literacy rate of 81%, comprises 796 farming families. The major crop rotation practiced is paddy-wheat, cultivated over 2,926 acres. In addition, crops such as basmati, cotton, mustard, and fodder oats are also grown in the area. In contrast, Taranji Khera village, with a smaller population of 2,180 and a literacy rate of 55.2%, has 210 farming families. Here too, paddy and wheat dominate the cropping pattern, although other crops, including cotton, maize, mustard, fodder oats, and sugarcane, are also cultivated.

Research problem identification and prioritization

The project area is facing severe groundwater depletion, largely due to the predominance of paddy-wheat monoculture and the excessive water requirement of long-duration paddy varieties, such as Pusa-44 and Dogar Pusa/Pili Pusa. Consequently, the adopted villages have been classified in the 'dark zone' where groundwater exploitation, coupled with water-saving irrigation technologies, is seldom adopted. In this context, interventions such as short-duration paddy varieties, direct-seeded rice (DSR), and alternate wetting and drying practices played a vital role in conserving water. However, farmers heavily relied on chemical fertilizers, while giving little attention to integrated nutrient management (INM) and integrated pest management (IPM). Similarly, paddy residue burning remains a major challenge, due to the very short interval available for wheat sowing after paddy harvesting. Farmers also face significant challenges in managing *Phalaris minor* in wheat, primarily due to their limited understanding of effective herbicide use.

Although pulse, fruit, and vegetable crops are cultivated, they occupy only a small area. Their potential remained underutilized due to weak value addition and an insufficient marketing network. Likewise, in livestock production, farmers express the need for improved feeding, breeding, and healthcare support to enhance overall productivity. Small-scale processing of pulses, fruits, and vegetables, along with subsidiary enterprises such as beekeeping and mushroom cultivation, offered considerable potential for increasing the incomes of small and marginal farmers. However, such initiatives are presently underdeveloped in the project area. To bridge this gap, farmers require skill-oriented training, particularly in entrepreneurship, and institutional support for processing and marketing networks. Moreover, to strengthen both sustainability and profitability, the introduction of integrated farming systems is identified as essential.

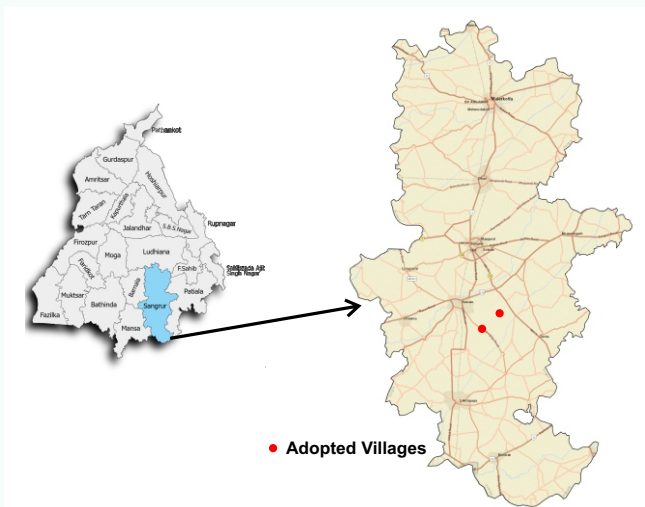


Graphical Abstract : PAU, Ludhiana

COMPONENT-I:

Enhancing Farmer-Scientist Interface

Strengthening the farmer-scientist interface requires ongoing exchange of ideas, innovations, resources, and feedback to facilitate the development of suitable technologies and support human resource development. In 2023-24, a total of 63 programs were organized, benefiting 1,721 farmers, whereas in 2024-25, a total of 62 programs reached 1,480 farmers. Technology agents were also identified for each module and assigned the responsibility of disseminating the technology. The major programs conducted include:



Farmer Awareness & Capacity Building: Scientists-Farmers Interfaces, exposure visits to Kisan Melas, and ICT-based agricultural training.

Crop Production & Resource Management: Field days were conducted on pre-rabi crops, direct seeding of rice, protected vegetable cultivation, and oilseeds/pulses. Training on resource conservation technologies, crop residue management, and efficient urea use in paddy by using LCC.

Sustainable Agriculture & Environment: Awareness and training sessions provided on paddy straw management, residue burning, soil testing, rodent control, water conservation, and sustainable agriculture.

Agro-processing & Value Addition: Training given on processing cereals, oilseeds, vegetables, honey, and turmeric. Exposure visits to food industries and craft melas.

Horticulture & Diversification: Training given on kitchen gardening, nutrition gardens, winter vegetable cultivation (chillies, onions), and mushroom farming. Exposure visits to mushroom farms and vegetable excellence centres.

Livestock & Dairy Farming: In this training, the mineral mixture used for dairy animals and improved management practices.

COMPONENT-II

Technology Assemblage, Application, and Feedback

Considering the prevailing challenges in the adopted area, the FFP Centre at PAU, Ludhiana, concentrated on interventions aimed at addressing key concerns, including groundwater depletion, crop residue burning, and the promotion of sustainable farming practices.

Crop-based modules

To promote crop diversification and increase profitability, several interventions were introduced. These included the incorporation of summer green gram into the rice-wheat system to support nitrogen fixation and generate additional income, cultivating canola rapeseed (Gobhi Sarson) for its high oil content and profitability, and encouraging efficient water utilization and providing dual income. Together, these practices contribute to

sustainability, improve resource use efficiency, and boost both farm productivity and farmers' incomes.

Summer green gram in Rice-Wheat cropping system: Punjab's agriculture is largely dominated by the rice-wheat cropping system, which, being highly nutrient-exhaustive, has become increasingly unsustainable due to nutrient deficiencies, soil compaction, and structural degradation. To promote diversification, ten demonstrations of summer green gram variety SML 1827 were conducted in 2024-25. The demonstration plots yielded 9.3 q/ha compared with 8.3 q/ha in check plots. Consequently, net returns were higher at ₹37,593/ha versus ₹30,306/ha. However, in some areas, delayed wheat harvesting resulted in late sowing. Farmers highlighted the need for early-maturing wheat varieties as a potential third crop in the rice-wheat rotation to enhance sustainability.

Popularization of canola mustards (Gobhi Sarson): To promote crop diversification, strengthen nutritional security, and support sustainability, demonstrations on the cultivation of canola-quality mustard (Gobhi Sarson) variety GSC 7 were organized during 2023-24 and 2024-25 on plots of 0.2 ha each. The corresponding yield and economic performance are presented in Table 1.1. Farmers expressed satisfaction with GSC 7, noting that its returns were comparable to those of wheat. Moreover, the rising market price of sarson and sarson oil has led to a noticeable increase in the area allocated to mustard cultivation by farmers.

Table 1.1: Demonstrations on canola Gobhi sarson variety GSC 7

Year	Average yield (q/ha)		BC ratio	
	Demo plot	Local check	Demo plot	Local check
2023-24	20.6	17.2	3.51	2.93
2024-25	26.2	24.7	4.21	3.86

Adoption of Sugarcane: A spring season demonstration on sugarcane cultivation was undertaken to promote crop diversification and encourage farmers to move away from traditional mono-cropping systems towards more profitable and sustainable alternatives. A total of 12 demonstrations were conducted over an area of 2.4 ha. The demonstration plots achieved an impressive average yield of 1050 q/ha, significantly higher than competing crops in the rice-wheat rotation. Net returns amounted to ₹2,47,913/ha, clearly reflecting the high profitability of sugarcane. The BC ratio of 1.88 further indicated that every rupee invested generated ₹1.88 in return, nearly doubling the investment. Additionally, growing awareness of the processing potential of by-products such as jaggery and brown sugar has motivated farmers to explore



Demo on summer green gram



Demo on Gobhi sarson



ICAR experts' visit to vegetable demo

value addition rather than selling raw produce. Farmers welcomed the timely guidance, which strengthened their confidence in adopting sugarcane as a viable diversification option.

Horticulture-based module

Vegetable production and Kitchen gardening: Under the demonstrations, kitchen gardening was promoted to ensure a regular supply of vegetables and improve nutritional security. In addition, field demonstrations on vegetable cultivation were also carried out. During 2023-24, a total of 20 demonstrations on chilli (variety CH 27) and 24 on onion (variety PRO 7) were conducted. In 2024-25, a total of 15 demonstrations each were organized on potato (variety Kufri Pukhraj), onion (variety Pb Naroya), and pea (variety Pb 89). Farmers reported that vegetables were more profitable than cereals, however, concerns regarding price fluctuations and high labour requirements limited their large-scale adoption. Nevertheless, farmers continued cultivating vegetables on a smaller scale.

Livestock-based module

Deworming and Feeding with a Mineral Mixture: Area-specific mineral mixtures were procured from GADVASU, Ludhiana, and demonstrations were conducted by feeding them to 20 milch animals in 2023-24 and 40 milch animals in 2024-25 to enhance livestock nutrition. Furthermore, the mineral mixture was incorporated at a rate of 2 kg per quintal of concentrate feed, formulated as per recommendations. In addition, deworming practices were carried out during demonstrations to improve overall animal health. As a result, post-intervention data indicated an increase in average milk production by 0.6 L/animal/day in 2023-24 and by 0.8 L/animal/day in 2024-25 compared to unfed animals, which was attributed to improved nutrient digestion and better fodder utilization. Moreover, the economic analysis of these demonstrations revealed a net return of ₹ 29.9/litre of milk in 2023-24, whereas it increased to ₹ 31.9/litre in 2024-25.

Prevention and Control of Mastitis in Dairy Animals: Mastitis in dairy animals adversely affects milk production and significantly reduces farmer profits. To address this issue, BTB cards were employed for early detection, while farmers were simultaneously provided with guidance on treatment and preventive measures. Additionally, a post-teat dip solution was applied to minimize the risk of mastitis and ensure better udder health. A total of 10 demonstrations were conducted in 2023-24, while 20 were carried out in 2024-25. In 2023-24, the average milk production increased from 10.2 to 11.5 litres per animal per day, while in 2024-25 it rose from 11.25 to 12.55 litres per animal per day. Furthermore, the economic analysis revealed a net return of ₹ 30.9 per litre under demonstrations as compared to ₹ 28.21 per litre under local



Demo on livestock related interventions

control in 2023-24. Similarly, in 2024-25, the net return was ₹32.9 per litre under demonstrations, while it remained lower at ₹30.21 per litre under local check.

Enterprise-based module

Value Addition: In 2023-24, demonstrations on mustard oil processing and spice grinding were conducted to promote value addition. The oil expeller was utilized by 60 households, processing 6,000 kg of mustard (₹ 60/kg) into 1,860 kg of oil and 3,720 kg of oil cake. With a processing cost of ₹ 10/kg and a selling price of ₹ 220/kg, the total profit amounted to ₹1,00,800, yielding ₹16.8 profit per kg over the raw product. The oil was sold directly to consumers and also used for self-consumption, while the oil cake was marketed as cattle feed. Similarly, spice grinder demonstrations were conducted in 15 households, processing 192 kg of raw material into 165.12 kg of spice powder. With a raw material cost of ₹ 425/kg, a processing cost of ₹ 55/kg, and a selling price of ₹ 700/kg, the total profit was ₹ 24,384, resulting in ₹ 127 profit per kg over the raw product.

In 2024-25, demonstrations on oil processing were conducted, processing 6,000 kg of mustard (₹ 58/kg) into 1,920 kg of oil and 3,900 kg of oil cake. With a processing cost of ₹ 10/kg and a selling price of ₹ 200/kg, the total profit reached ₹ 93,000, giving ₹ 15.5 profit per kg over the raw product. Likewise, the spice grinder was used in 15 households, where 225 kg of raw material yielded 193.5 kg of spice powder. With a processing cost of ₹ 50/kg and a selling price of ₹ 700/kg, the total profit was ₹ 28,575, with ₹ 127 profit per kg. Both the oil and spice powder were sold directly to consumers, reflecting the profitability of small-scale processing units.

Beekeeping: Beekeeping offers significant potential as a subsidiary enterprise for small and marginal farmers, unemployed youth, and rural women since it involves low requirements of land, equipment, and capital. To support this livelihood option, farmers received training on diverse aspects such as colony management, disease and pest control, honey extraction, pollination benefits, financial assistance schemes, and techniques for colony multiplication. In 2023-24, observations from 10 beekeeping units with 100 bee boxes indicated that the production cost per colony in the demonstration plot was ₹ 1,650. Moreover, each colony yielded 33.0 kg of honey, resulting in a gross return of ₹ 5,266 per box. Consequently, after deducting the production cost, the net return stood at ₹ 3,616, and the BC ratio was 3.19. In contrast, in 2024-25, the data from 4 beekeeping units comprising 36 bee boxes showed a slightly



Beekeeping demo visited by experts



Demo on preparation of mushroom compost

higher production cost of ₹ 1,725 per colony. Nevertheless, each colony produced 32 kg of honey, generating ₹ 7,680, along with an additional ₹ 150 from wax sales. Therefore, the gross return increased to ₹ 7,830 per colony. As a result, the net return rose to ₹ 6,105, while the BC ratio improved to 3.53, highlighting better profitability in comparison to the previous year.

Mushroom: In 2023-24, a total of 20 demonstrations on *Agaricus bisporus* were conducted in the adopted villages. The yield recorded was 2.2 kg per bag, resulting in a net return of ₹ 137 per bag. Consequently, the BC ratio was 3.11, reflecting good profitability. In 2024-25, demonstrations were expanded to include both *Pleurotus florida* and *Agaricus bisporus*. The yield of *Pleurotus florida* was 3.0 kg per bag, resulting in a higher net return of ₹ 190 and a BC ratio of 4.80, thereby proving to be more profitable. On the other hand, *Agaricus bisporus* yielded 1.8 kg per bag with a net return of ₹ 117 and a BC ratio of 2.86. Overall, the results highlighted that *Pleurotus florida* offered comparatively better economic returns, encouraging farmers to adopt it as a sustainable enterprise.

NRM-based module

Short-duration varieties of rice for efficient water management:

Prior to the intervention, farmers in the adopted village mainly cultivated water-intensive, long-duration, and non-recommended paddy varieties such as Pusa 44, Dogar Pusa, and Pili Pusa. To overcome this challenge, short-duration varieties like PR 121 and PR 126 were introduced, both of which provide yields comparable to Pusa 44. These varieties also possess resistance to bacterial blight, with PR 121 maturing in about 110 days and PR 126 in just 93 days after transplanting. Since short-duration varieties are more resource-efficient,

yield alone is not a sufficient measure of performance. Although Pusa 44 produces slightly higher yields, it requires an additional 25-30 days to mature, reducing overall efficiency. Demonstrations further revealed that PR 121 often surpassed its average potential yield, showing promising results. Therefore, evaluating the BC ratio and net returns offers a more accurate assessment than evaluating only yield indicators. The

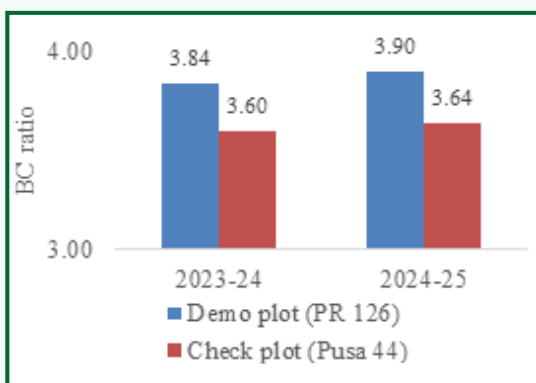


Fig 1.1: BC ratio of PR 126 (demo) and Pusa 44 (check)

comparative BC ratio of PR 126 and Pusa 44 is illustrated in Figure 1.1.

In 2023-24, a total of 300 demonstrations on the short-duration rice variety PR 126 were conducted, covering 120 ha. The average yield under demonstrations was 81.51 q/ha, which was slightly lower than the check plots (83.98 q/ha). However, despite this marginal reduction in yield, the demonstration plots achieved higher economic efficiency, recording a BC ratio of 3.84 compared to 3.60 in the checks. Net returns were Rs. 1,32,745/ha in the demonstration and ₹ 1,33,576/ha in the check. In 2024-25, a total of 110 demonstrations were conducted on 44 ha. Although the yield was slightly lower (77.55 q/ha vs. 81.51 q/ha), the demonstrations again recorded better economic efficiency with a BC ratio of 3.90 compared to 3.64 in the checks. Net returns were ₹ 1,32,616/ha in the demonstration and ₹ 1,35,985/ha in the check, reaffirming the profitability of the short-duration variety PR 126. Overall, the results highlighted that PR 126, with its short duration and reduced resource requirements, ensured timely harvesting, facilitated better crop rotation opportunities, and ensured profitability for farmers. Consequently, more farmers are shifting from long-duration to short-duration varieties like PR 126.

Direct Seeded Rice: To promote water-saving cultivation practices in project villages, demonstrations on direct-seeded rice (DSR) using PR 126 were carried out in 2023-24. A total of five demonstrations covering 2.0 ha were conducted, comparing DSR with the conventional method of transplanting. The average yield under DSR was slightly lower (77.20 q/ha) than that of transplanted rice (79.30 q/ha). However, despite this minor reduction in yield, the DSR plots recorded higher profitability, with a net return of ₹ 1,29,437/ha and a BC ratio of 4.19, compared to ₹ 1,28,323/ha and a BC ratio of 3.77 under transplanting. These results clearly highlight that DSR with PR 126 is not only resource efficient but also economically beneficial, encouraging farmers to gradually expand its adoption.

Wheat Sowing with Happy Seeder for paddy straw management: To promote sustainable wheat cultivation and reduce residue burning, demonstrations on sowing PBW 766 with Happy Seeder were conducted in project villages. In 2023-24, a total of 100 demonstrations covering 40.0 ha were conducted.



Demo on short-duration varieties of rice



PR 126 in demo Plot and Pusa 44 in Check Plot



Demo on Direct Seeded Rice

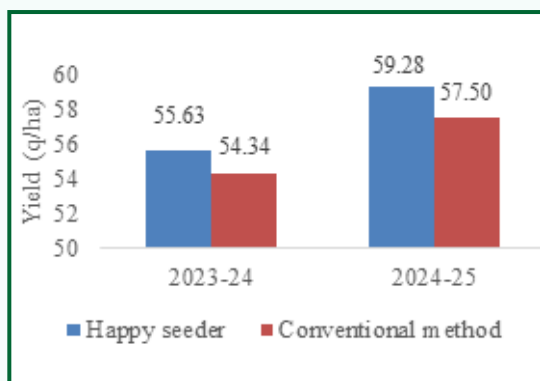


Fig 1.2: Yield performance of Happy Seeder (demo) vs. conventionally sown wheat (check)



Wheat sowing with Happy Seeder for paddy straw management

The average yield under the demonstrations was 55.63 q/ha, which was 2.4% higher than conventional planting (54.34 q/ha). Importantly, net returns from the demonstration plots were ₹ 92,974/ha with a BC ratio of 3.77, compared to ₹ 86,057/ha and a BC ratio of 3.29 under conventional methods. Encouraged by these results, more farmers participated in 2024-25, when a total of 110 demonstrations were conducted across 44.0 ha. Yields in the demonstration plots increased to 59.28 q/ha, registering a 3.1% improvement over conventional planting (57.50 q/ha) (Figure 1.2). Moreover, the demonstrations ensured higher profitability with net returns of ₹ 1,03,263/ha and a BC ratio of 3.65, compared to ₹ 97,681/ha and a BC ratio of 3.33 in check plots. These results indicate that sowing wheat with the Happy Seeder not only enhanced productivity and profitability but also supported residue management and sustainable farming practices.

IFS-based module

The Integrated Farming System (IFS) models in the project village combine multiple enterprises, including cropping, kitchen gardening, livestock, aquaculture, apiculture, mushroom production, and, in some cases, organic practices. Overall, IFS are effective in enhancing farm profitability, optimizing resource use, and improving livelihood security. In particular, farms with diversified enterprises especially those integrating livestock, aquaculture, apiculture, and mushroom production demonstrate significantly higher net returns and greater resilience against market and climatic uncertainties. The following provides a summary of the economic performance of six farms, showing gross returns, cultivation costs, and net returns for each component.

Farmer 1: S. Satwant Singh from Bhadalwadh village follows a diversified integrated model combining cropping, livestock, kitchen gardening, aquaculture, apiculture, and mushroom production. With a net sown area of 4.5 acres (1.8 ha) and a gross cropped area of 9.5 acres (3.8 ha), the farm achieves a cropping intensity of 211% using multiple cropping systems including Paddy-Wheat, Maize-Gobhi Sarson-Summer Moong, Basmati Rice-Wheat-Bajra fodder, and sugarcane, along with a 200 m² kitchen garden. The farm maintains 5 buffaloes/cattle, a 1.0 ha aquaculture pond with fruit trees on the boundary, 6 bee colonies, and a small-scale mushroom unit. Economic analysis shows a gross return of ₹ 14,43,258, cultivation cost of ₹ 5,17,957, and net return of ₹ 9,20,368, with a BC ratio of 2.78. Cropping systems are the main income source, followed by livestock and aquaculture, ensuring income stability and efficient resource use.

Farmer 2: S. Balwinder Singh from Bhadalwadh village practices mixed farming with 1.82 ha under cropping, including Paddy-Wheat, Maize-Gobhi Sarson-Summer Moong, and Basmati Rice-Wheat, and 7

kanals for fodder. A 200 m² kitchen garden, 4 buffaloes/cattle, a 1.0 ha aquaculture pond with fruit trees, and a 20 bag mushroom unit are also maintained. The farm achieves a cropping intensity of 221% with a net sown area of 3.7 acres (1.49 ha) and a gross cropped area of 8.2 acres (3.3 ha). It records a gross return of ₹ 11,81,786, cultivation cost of ₹ 3,81,777, and net return of ₹ 8,02,133, with a BC ratio of 3.19. Aquaculture and livestock are the major income sources, with aquaculture alone contributing ₹ 2.64 lakh.

Farmer 3: S. Gurpreet Singh from Bhojowali village is primarily a dairy-focused IFS with a high cropping intensity of 257%, a net sown area of 1.4 ha, and a gross cropped area of 3.6 ha, achieved through multiple cropping. The farm follows the Paddy-Wheat-Summer Moong system and allocates 1.5 acres for fodder, complemented by a 200 m² kitchen garden. It maintains 8 buffaloes/cattle and a 15 bag mushroom unit. The farm records a gross return of ₹ 10,62,013, cultivation cost of ₹ 5,47,613, and net return of ₹ 5,16,172, with a BC ratio of 1.93. Livestock contributes ₹ 2.58 lakh to the net return, highlighting the profitability of dairy even on smaller landholdings.

Farmer 4: S. Satwinder Singh from Bhojowali village integrates multiple components over a gross cropped area of 3.8 ha, including high-value crops (Paddy-Potato-Spring Maize, Paddy-Gobhi Sarson/Wheat), a 200 m² kitchen garden, 4 buffaloes, 0.2 ha fodder, a 20 bag mushroom unit, and 14 bee colonies. Flowers and fruit trees are grown to support apiculture. The farm achieves a cropping intensity of 252%, with a net sown area of 3.8 acres (1.5 ha) and a gross cropped area of 9.6 acres (3.8 ha). Economic analysis shows a gross return of ₹ 12,77,750, cultivation cost of ₹ 6,33,888, and net return of ₹ 6,62,841, with a BC ratio of 2.01. Apiculture (₹ 85,470) and livestock are key income sources, enhancing diversification and sustainability.

Farmer 5: S. Gurpreet Singh from Bhojowali village follows a vegetable based cropping system with a cropping intensity of 196%, a net sown area of 1.25 ha, and a gross cropped area of 2.46 ha. Crops include field pea (0.4 ha), bottle gourd (0.2 acre), paddy, wheat, and kharif maize, supplemented by a 200 m² kitchen garden. The farm maintains 3 buffaloes/cattle, a 20 bag mushroom unit, and 12 bee colonies. It records a gross return of ₹ 8,57,726, cultivation cost of ₹ 3,20,748, and net return of ₹ 5,36,053, with a BC ratio of 2.38. Apiculture contributes ₹ 73,260, and livestock remains a major income source, while vegetable, mushroom, and livestock integration ensures high returns per unit area.

Farmer 6: S. Malwinder Singh from Bhojowali village focuses on organic farming for home consumption and livestock, using 2.8 ha for crops including potato and spring maize (0.8 ha), sugarcane (0.4 ha), and paddy-wheat on the remaining land. A 200 m² organic kitchen garden, a 20 bag mushroom unit, 8 buffaloes/cattle, and a fruit based nutrition garden complement the system. The farm achieves a cropping intensity of 216%, with a net sown area of 2.42 ha and a gross cropped area of 5.26 ha. It records a gross return of ₹ 12,63,472, cultivation cost of ₹ 4,80,594, and net return of ₹ 7,82,878, with a BC ratio of 2.63. Field crops are the main income source, while organic practices and diversified enterprises enhance sustainability and productivity.



IFS demonstration units

Section 2.2

Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana

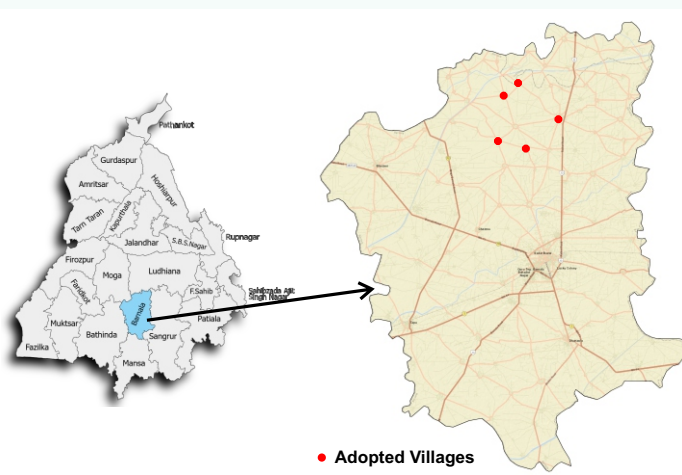
Integrated approaches for livestock development: Farmer's context

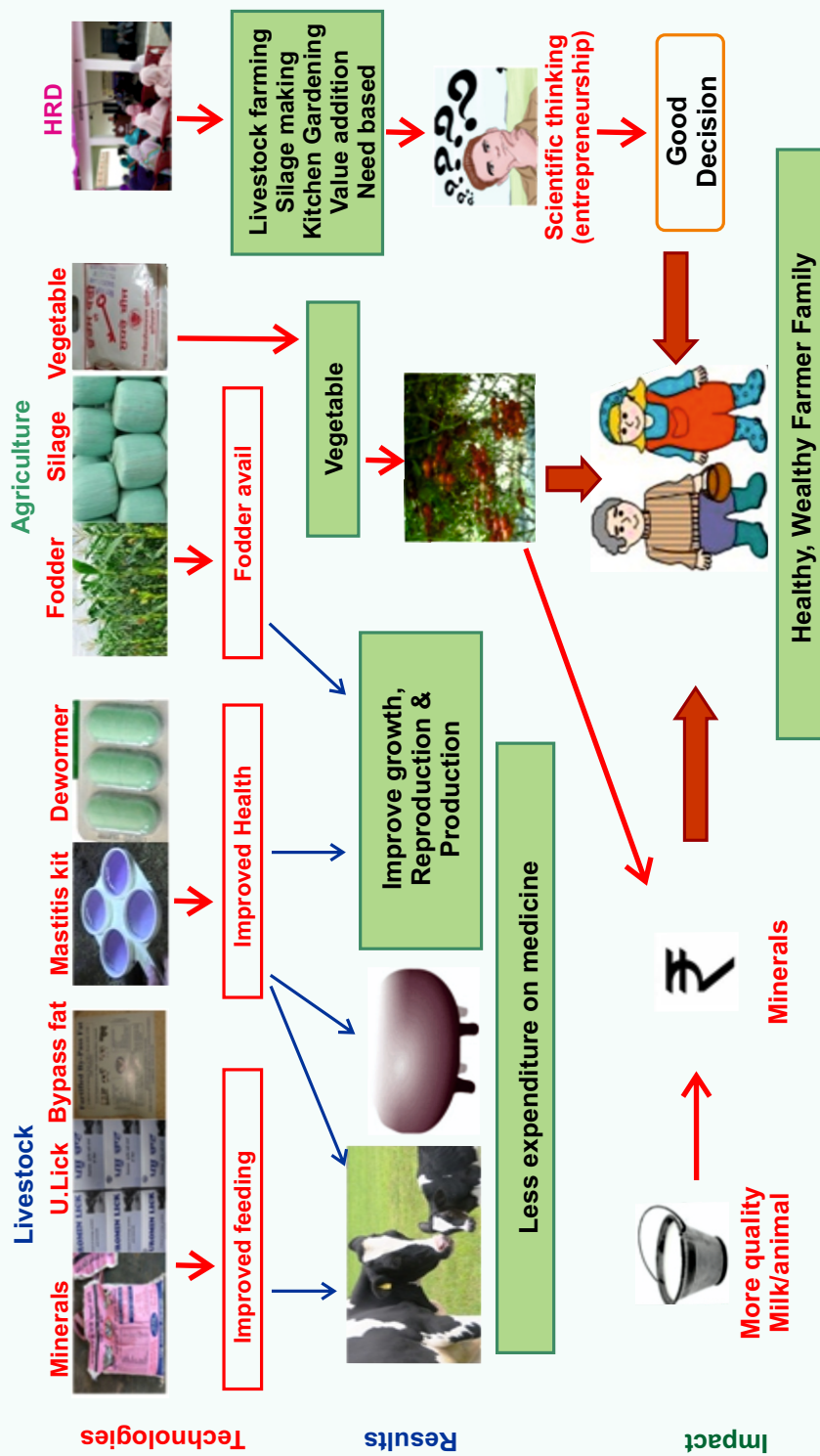
To strengthen farmers' engagement in research and the technology dissemination, Guru Angad Dev Veterinary and Animal Sciences University (GADVASU), Ludhiana, implemented the Farmer FIRST Programme (FFP) in Barnala and Ludhiana districts. The project was implemented in the Mehal Kalan block of Barnala district, covering six selected villages Dhaner, Kalala, Moom, Chananwal, Mehal Kalan, and Hamidi as well as Pamal village in Ludhiana district. A baseline survey indicated that agriculture is the predominant occupation in all villages, with the highest share of agricultural households recorded in Kalala (85.0%), and followed by Pamal (74.7%), Hamidi (70.58%), Mehal Kalan (67.46%), Moom (62.14%), Chananwal (58.43%) and Dhaner (56.6%). Animal husbandry was identified as an important supplementary source of income for several households. Livestock distribution also varied across villages, with Moom reporting the highest livestock population (1,698), followed by Mehal Kalan (1,188), Kalala (850), Chananwal (58.43%), Dhaner (577), Hamidi (446) and Pamal (346).

Research problem identification and prioritization

Integrating agriculture with animal husbandry is crucial for diversifying rural income and ensuring long-term sustainability. Nevertheless, livestock farmers encounter multiple challenges that adversely affect both milk productivity and overall farm profitability. A baseline survey revealed that poor milk production (81.23%) emerged as the most widespread issue, while tick infestation (53.38%) ranked second. In addition, reproductive disorders such as anoestrous (45.41%) and repeat breeding (37.26%) further constrain dairy efficiency. Moreover, mastitis, which affects 28.66% of dairy animals, not only lowers milk yield but also compromises quality. Similarly, calf mortality (9.22%) causes considerable economic losses. Apart from these, other health problems, including retention of the placenta, stringhalt, and pica, were reported in 23.49% of livestock. To overcome these hurdles, a strategic approach is essential, emphasizing scientific management, proper nutrition, and timely veterinary interventions. In this context, scientific livestock management plays a pivotal role in modern agriculture, as it improves production efficiency, reduces resource wastage, and enhances animal welfare. Furthermore, such practices ensure a consistent supply of high-quality animal products while simultaneously boosting farm profitability by minimizing input costs and maximizing output.

Technological innovations, including precision feeding systems and data analytics, are refining feeding regimes, thereby improving both animal health and overall productivity. Furthermore,





Graphical Abstract : GADVASU, Ludhiana

the adoption of scientific livestock management practices promotes environmental sustainability by minimizing the ecological footprint through efficient resource utilization and effective waste management. By integrating these modern techniques into livestock farming, farmers not only enhance profitability but also provide consumers with safer, high-quality products, while simultaneously advancing the broader goals of sustainable agriculture and food security. In order to address existing challenges, the project emphasizes a comprehensive approach. It focuses on assessing farmers' knowledge and the extent of their adoption of scientific livestock practices, identifying training needs and operational constraints, delivering suitable technological interventions for integrated livestock development, and finally, evaluating the impact of these interventions on farm families.

COMPONENT-I:

Enhancing Farmer-Scientist Interface

The project seeks to strengthen collaboration between farmers and scientists in order to promote technological advancements in agriculture. To achieve this, a series of extension activities such as awareness camps, exposure visits, and training programs are organized with the objective of equipping farmers with the necessary knowledge, skills, and resources for improved livestock management and sustainable farming practices. Notably, during 2023-24, FFP centre GADVASU conducted 26 such activities, directly benefiting 622 farmers. In contrast, during 2024-25, a total of 16 activities were carried out, reaching 658 farmers, thereby highlighting both the continuity and expansion of farmer



Organization of *kisan gosthi*



Exposure visit of farmers in GADVASU, Ludhiana



Field visit by Dr. Ram Chand (Former ADG-ICAR)



Field visit by team from NAARM Hyderabad

participation. As part of the initiative to identify and groom farm innovators as technology agents, progressive farmers were selected from different villages under the project. These include Jaswinder Singh from Dhaner, Gurvinder Singh from Kalalan, Resham Singh from Channanwal, Jagtar Singh from Moom, Jasveer Singh from Hamidi, Harmanjeet Singh from Mehal Kalan, and Jagdish Singh from Pamal. These farmers were recognized for their innovative approaches and leadership qualities and were trained to act as technology agents to promote and disseminate improved agricultural practices within their respective villages.

COMPONENT-II:

Technology Assemblage, Application, and Feedback

Crop-based modules:

The fodder maize variety J1006 was demonstrated in the adopted villages, where it successfully replaced outdated varieties, and farmers have now begun cultivating it independently. Earlier, high-yielding fodder maize varieties for fodder were not commonly used, and the average crop yield remained unsatisfactory at only 250.0 q/ha. However, with the introduction of this improved variety, the yield increased substantially to 440.0 q/ha. In a similar manner, the Napier Bajra Hybrid PBN 233 was introduced to livestock owners as an effective solution to fodder scarcity, thereby ensuring better year-round fodder availability. Additionally, bag silage technology was promoted to help farmers address fodder shortages by preserving green fodder in durable polythene bags. Demonstrations conducted in the adopted villages enabled livestock owners to understand and practice silage making. As a result of continuous efforts by scientists, farmers adopted silage-making techniques, which not only improved livestock nutrition but also reduced fodder expenses. Collectively, these interventions provide a sustainable fodder management solution, ensuring better livestock health, financial relief for farmers, and greater resilience of the agricultural system, particularly during periods of fodder scarcity.



Scientists inspecting silage pit

Horticulture-based module:

Horticulture plays a vital role in ensuring food security, enhancing the environment, and contributing to overall human well-being. In this context, after being motivated by the demonstrations conducted in the previous years, farmers have independently initiated vegetable kitchen gardening to meet their daily nutritional needs. As a result, this practice has not only strengthened nutritional security but

also promoted self-sufficiency, making kitchen gardening a sustainable and beneficial approach in the project's operational area. In addition, farmers have also adopted low poly tunnel vegetable technology on their own, which facilitates off-season vegetable cultivation. This technology protects crops from adverse weather conditions, thereby ensuring higher yield and better quality. Moreover, by extending the growing season and improving crop resilience, low poly tunnels have emerged as a valuable intervention that promotes sustainable farming while increasing vegetable availability around the year.

Livestock-based module:

Livestock serves as a vital asset for farmers, providing multiple benefits that enhance their livelihoods and strengthen the resilience of farming communities. Accordingly, the following demonstrations were conducted to address the specific challenges identified in the operational area:

Oral magnet therapy: Oral magnet feeding in dairy animals is a preventive measure against the harmful effects of ingesting sharp metallic objects. Once administered, the magnet remains effective in the rumen for about three years. As metallic particles attach to the magnet's surface, they are prevented from piercing the reticulum and heart, thereby safeguarding the animal's health. Moreover, this initiative not only enhanced farmers' awareness but also helped them realize its practical benefits in protecting their livestock. Consequently, farmers expressed satisfaction and requested the continuation of oral magnet therapy in their area, as it promotes better animal health and reduces financial losses from such preventable conditions.

Mineral mixture feeding: Mineral mixture is a finely ground blend of essential macro- and micronutrients, and its deficiency adversely affects both milk production and reproductive performance in livestock. Since animals require an external supplementation of about 50-60 grams per day, its regular and proper use is highly important. However, in the operational area, most farmers were unaware of its benefits and consequently suffered from low milk yields, with only a few making use of mineral mixtures. To address this issue, demonstrations were conducted, wherein a total of 259 animals were supplemented with mineral mixtures in 2023-24, followed by 100 animals (HF, Murrah, and Nili Ravi breeds) in 2024-25. As a result of these interventions, the average milk yield increased from 6.0 litres to 6.8 litres per animal per day, accompanied by a noticeable rise in the fat percentage of milk in cattle.

Bypass fat: Bypass fat, a blend of calcium salts and rice bran oil, is formulated to bypass the rumen and be directly absorbed in the intestine. It acts as an immediate energy source, which is especially important during the early lactation period when animals often experience a negative energy balance. The recommended dosage is 80-100 grams per animal per day. Initially, farmers in the operational area were unaware of this technology and its benefits. To bridge this gap, demonstrations were organized, and in 2024-25, a total of 60 animals (HF, Murrah, and Nili Ravi breeds) were supplemented with bypass fat. As a result, the fat percentage in buffalo milk increased from 6.53% to 6.60%, thereby enhancing overall productivity and contributing to better animal performance.

Goat welfare camp: In the operational areas, unscientific goat-rearing practices resulted in emaciation, low body weight, and poor milk production. To overcome these challenges, goat welfare

camps were organized, where 550 Beetal breed goats were examined for their health status and potential diseases. As part of the intervention, farmers were provided with oral Ivermectin for parasite control, along with liver tonics and multivitamins to support growth and promote early puberty. Consequently, these measures led to a significant improvement in goat health and productivity. As a direct outcome of the project, milk production increased by 22.1%, thereby boosting farmers' income while also encouraging the adoption of improved management practices in goat farming.

Infertility camps: A benchmark survey conducted among farmers revealed that infertility was a major challenge for nearly 30% of dairy farmers in the project area. To tackle this issue, special infertility treatment camps were organized during 2023-24 and 2024-25 to provide scientific treatment and guidance for affected animals. The survey further indicated that repeat breeding was the predominant problem in cattle, whereas anoestrus was more common in buffaloes. Infertility in buffaloes lowered reproductive efficiency and caused significant economic losses due to reduced milk production. About 30% of the affected farmers were even considering giving up dairy farming. However, through these targeted camps, infertility issues were effectively managed, leading to improved conception rates, reduced economic losses, and enhanced livestock productivity. As a result, farmers regained confidence and showed renewed enthusiasm for dairy farming as a sustainable source of livelihood.

Ecto- and endoparasite control camp: Internal parasites adversely affect digestion and growth, weaken immunity, and ultimately reduce milk production, cutting into farm profitability. In the adopted villages,



Distribution of inputs among farmers



Demo on oral magnet therapy



Diagnosis of animals in infertility camps



Goat welfare camp

parasite infestations were widespread, mainly due to farmers' limited awareness about the importance of regular deworming. To address this challenge, a total of 485 animals were treated for both endo- and ectoparasites during 2023-24. Alongside treatment, awareness camps on deworming and tick control were conducted, which encouraged farmers to adopt these practices on a wider scale. As a result, livestock health improved noticeably, and milk production increased by 3.33%. These interventions not only enhanced animal productivity but also contributed to higher farm income, highlighting the importance of parasite control as an integral component of scientific dairy farm management.

Enterprise-based module:

Value addition of milk: Value addition of milk was promoted through 24 demonstrations on paneer and whey drink preparation conducted for women farmers in the villages. The women farmers from the project area were trained in milk value addition, learning to prepare ghee, paneer, flavoured milk, and sweets. They visited the College of Dairy Science and Technology, GADVASU, Ludhiana, where they gained practical knowledge of scientific processing and packaging methods. Following the training, many women began practicing milk value addition at home, improving household-level dairy production. The project team is further motivating them to form self-help groups to promote entrepreneurship and economic independence. This initiative is fostering sustainable livelihoods through dairy-based value-added products.

Vermicompost preparation: Vermicomposting is a natural process in which earthworms decompose organic waste into nutrient-rich manure, thereby reducing dependence on chemical fertilizers and pesticides. Under the project, village Moom was declared a 'Zero-Waste Village' to promote vermicomposting as a sustainable practice. To support this initiative, farmers were provided with vermicompost kits consisting of vermi beds and covering sheets to establish their own units. To build farmers' capacity, four training camps were organized, and a total of 75 vermi beds were distributed in 2023-24, followed by 15 in 2024-25. Encouragingly, the initiative soon expanded beyond Moom, as farmers from Dhaner, Hamidi, Mehal Kalan, and Kalala also adopted vermicomposting. Each vermi bed yielded about 200 kg of compost, which was sold at ₹ 10 per kg, thereby generating ₹ 2,000 profit per bed within two months (equivalent to ₹ 1,000 per month per bed).



Demo on value addition of milk



Demo on vermicompost

ICAR-Central Institute of Post-Harvest Engineering & Technology, Ludhiana

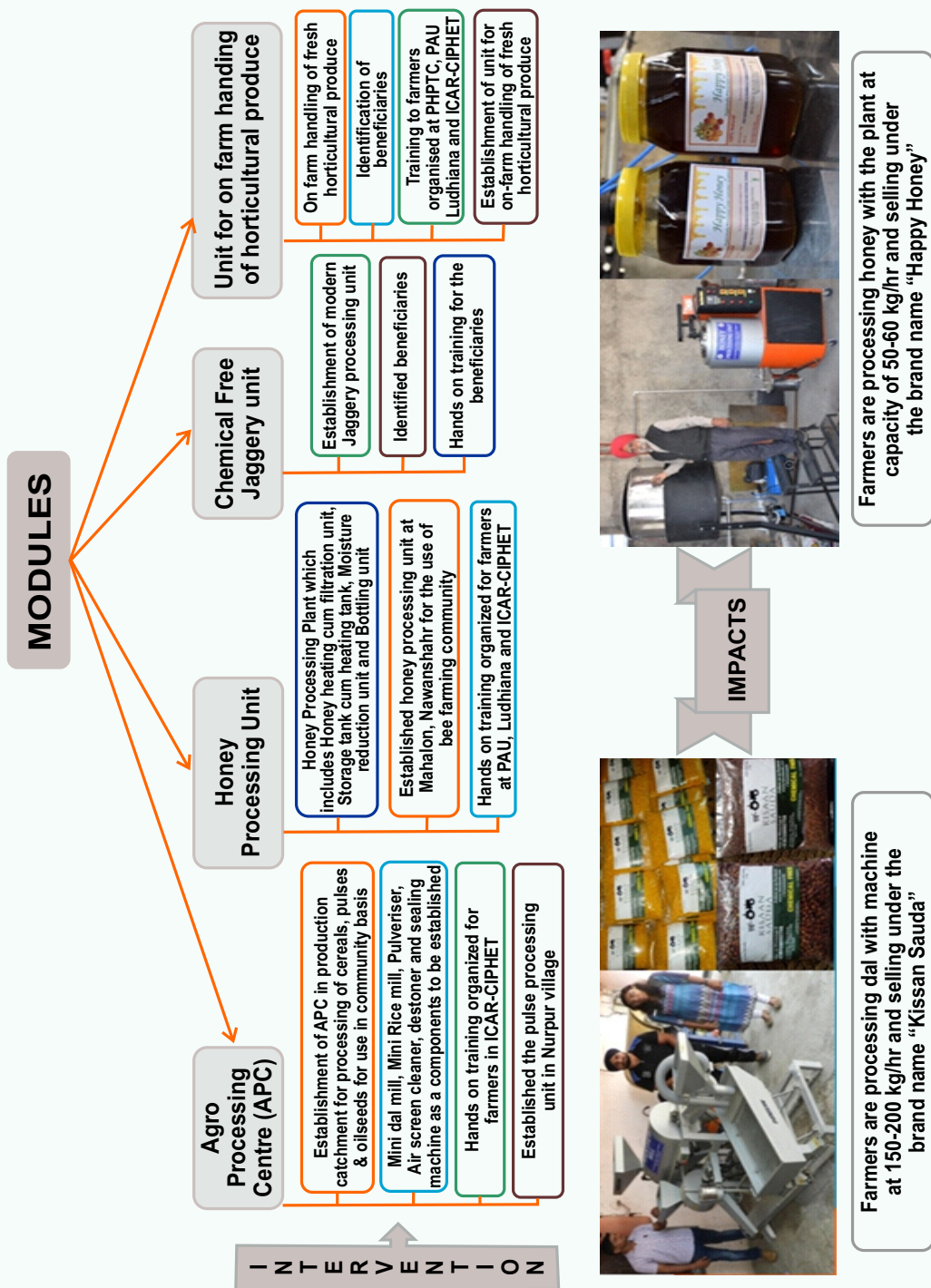
Processing and value addition of agricultural produce for enhancing farmers income and employment in production catchment

The Farmer FIRST project was implemented across nine villages in six districts of Punjab, including Shahid Bhagat Singh Nagar (Bharta Khurd, Dharamkot, Balachour, and Rahon), Ludhiana (Jalaldiwal), Sangrur (Kandhargarh), Bathinda (Bandi), Fazilka (Abohar), and Patiala (Gagga). Under the theme "Processing and value addition of agricultural produce for enhancing farmers income and employment in production catchment," the project aims to promote agricultural sustainability and profitability. The selected districts are primarily known for cereal crops such as paddy and wheat. However, other important crops include maize, gram, lentil, green gram, mustard, sunflower, onion, okra, chilli, tomato, and mentha. In addition, sugarcane cultivation is prominent in certain pockets of the districts, further enriching the region's crop diversity. Approximately 10% of the cultivated area is under fruits and vegetables, while pulses and oilseeds also occupy a considerable share of farmland. Furthermore, beekeeping is widely practiced, offering farmers supplementary income and contributing to improved crop productivity through pollination.

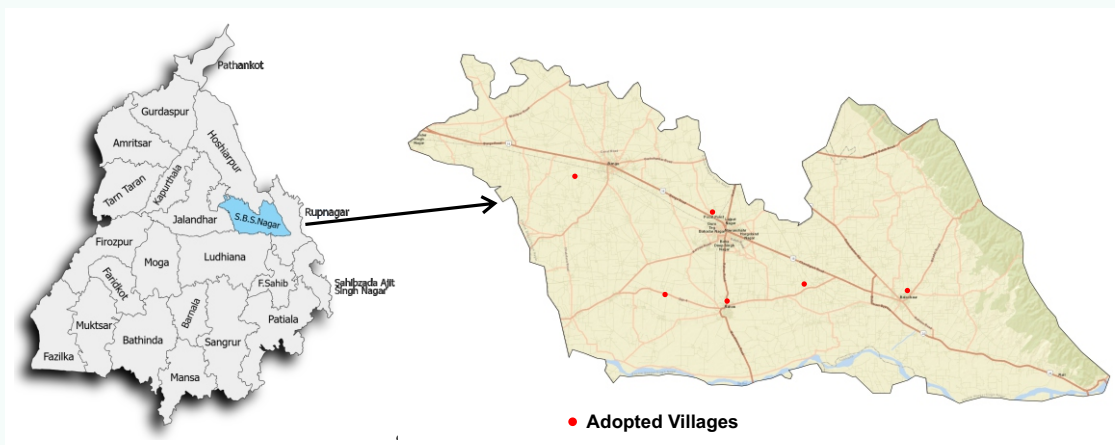
Research problem identification and prioritization

During the Farmer-Scientist Interface meeting at ICAR-CIPHET, Ludhiana, the project team interacted with farmers to identify the major challenges associated with food processing in their region. A significant concern was the lack of awareness regarding the benefits of processing, which prevented farmers from adding value to their crops and enhancing profitability. Furthermore, reliance on traditional and inefficient processing methods often compromises product quality, thereby restricting innovation and reducing competitiveness in the market. In addition, although modern techniques offer considerable advantages, farmers were unable to maximize their profits due to the limited adoption of advanced processing practices. Another pressing issue was poor market access, as farmers largely depended on middlemen, which not only resulted in low selling prices but also weakened their bargaining power. This overdependence increased their economic vulnerability and left them exposed to exploitation.

To improve the profitability of farmers in the adopted area, post-harvest processing plays a pivotal role by enabling conversion, value addition, and loss reduction of agricultural produce. In this regard, the Farmer FIRST project of ICAR-CIPHET, Ludhiana, has undertaken several initiatives, such as establishing agro-processing centres, introducing a chemical-free jaggery production unit, promoting quality honey processing, and strengthening on-farm handling of horticultural produce. Through these interventions, farmers are not only gaining practical knowledge of processing techniques but also reaping the benefits of value addition, which in turn enhances their economic well-being. Moreover, these efforts are in line with the country's agricultural policy, formulated by the Government to boost production and productivity while simultaneously increasing farmers' income and improving their standard of living within a specified timeframe.



Graphical Abstract : ICAR-CIPHET, Ludhiana



The establishment of the Agro-Processing Centre (APC) has significantly facilitated food commodity processing and value addition at the village level. This initiative not only helps reduce post-harvest losses but also creates additional employment opportunities for farmers as well as local communities. Furthermore, the promotion of honey processing techniques equips farmers with essential knowledge and skills to extract, filter, and package honey more efficiently, thereby improving its marketability and ensuring higher economic returns for beekeepers. Similarly, the introduction of a chemical-free jaggery unit has empowered farmers by lessening their dependence on sugar mills for marketing sugarcane. In addition, it has enabled them to process sugarcane hygienically into different forms of jaggery, which further enhances the value of their produce. Overall, these interventions under the project provide farmers with the necessary facilities, resources, skills, and technical know-how to actively participate in agro-processing and value addition, ultimately strengthening their livelihoods and economic resilience.

COMPONENT-I:

Enhancing Farmer-Scientist Interface

A series of training programs on post-harvest management, value addition, and marketing of fruits and vegetables was organized to build the capacity of farmers. During these sessions, participants were guided on methods to minimize losses during handling and to deliver superior quality produce to consumers, thereby enhancing profitability. Moreover, they were sensitized to the fact that post-harvest losses and marketing constraints remain critical challenges, which necessitate interventions such as scientific packaging and efficient storage practices. In addition to training, an exposure visit was arranged to ICAR-CIPHET, Ludhiana, where farmers were introduced to diverse opportunities for on-farm handling and processing of horticultural produce. This practical experience helped them to better understand approaches for reducing losses and improving marketability. Furthermore, a specialized training program on honey processing was conducted at the Department of Processing and Food Engineering, PAU, Ludhiana. Here, farmers received hands-on training in honey extraction, filtration, and packaging techniques, enabling them to enhance product quality and secure higher returns. Taken together, these initiatives not only provided farmers with essential skills and practical knowledge in post-harvest management but also empowered them to reduce losses, improve value addition, and create new income opportunities.



Training on honey processing



Exposure visit to a jaggery processing unit

COMPONENT-II:

Technology Assemblage, Application, and Feedback

Enterprise-based module:

The project is being carried out in the designated adopted area to strengthen agricultural processing and allied activities. To achieve this, a range of enterprise-based interventions has been introduced, aimed at both income generation and efficient resource utilization. Moreover, the project emphasizes the promotion of sustainable practices, the enhancement of farmers' skills, and the creation of effective market linkages. In this context, the following section highlights the key activities undertaken under each intervention along with their significant outcomes.

Agro-processing centre (APC):

APC-I: The Agro-Processing Centre established at Khalsa Farm, Balachour, Nawanshahr, under the ICAR-CIPHET, Ludhiana, has continued to demonstrate remarkable outcomes in food processing and value addition. In 2023-24, demonstrations on processing were conducted, covering 50 households. By processing wheat along with maize, pulses, spices, and turmeric, the unit not only reduced post-harvest losses but also diversified the product portfolio to cater to consumer demand. As a result, the unit generated a substantial profit of ₹ 27,19,757, selling directly to consumers as well as through dealers. Building on this success, the year 2024-25 witnessed further expansion, with demonstrations covering 60 households. The consistent processing of wheat and other commodities, coupled with the utilization of by-products, helped the unit achieve even higher profits, reaching ₹ 30,55,650. This growth highlights the increasing efficiency and profitability of farmer-led processing initiatives. Moreover, the combined approach of direct-to-consumer and dealer-based sales enhanced market outreach, ensuring better price realization. Overall, Khalsa Farm has emerged as a model of successful agro-processing, contributing to rural employment, improved income, and greater farmer confidence in adopting modern processing technologies.

APC-II: The agro-processing centre established by the Pabla Brothers at Bharta Khurd, Rahon, Nawanshahr, under the guidance of ICAR-CIPHET, Ludhiana, has emerged as a promising model for value addition and income enhancement. In 2023-24, the unit conducted demonstrations on processing, covering 50 households. Alongside wheat, crops such as chana dal, turmeric, red chilli, and coriander were also processed, helping farmers reduce post-harvest losses and diversify their product portfolio. With direct-to-consumer sales as well as dealer-based marketing, the initiative generated a profit of ₹ 9,41,585 during the year. Building on this progress, the centre further expanded its reach in 2024-25 and conducted demonstrations that covered 60

households. As a result of efficient processing and better market linkages, the profit increased to ₹ 9,84,015. This consistent growth not only highlights the economic viability of agro-processing but also demonstrates how farmer-led enterprises can enhance profitability and strengthen rural livelihoods.

APC-III: Mr. Tarsem Lal, an innovative agro-processor from Rahon, Nawanshahr, has successfully expanded his enterprise, *Padan Atta Chakki*, under the project of ICAR-CIPHET, Ludhiana. Initially engaged in milling wheat and maize to cater to local household needs, he gradually diversified into processing pulses, mustard, and spices such as turmeric. In 2023-24, his unit conducted demonstrations on processing, covering 50 households. By offering both direct-to-consumer sales and dealer-based marketing, the enterprise generated an impressive profit of ₹ 12,47,260. Encouraged by this success, the unit expanded further in 2024-25, covering more households through demonstrations. With improved processing efficiency, diversified product offerings, and better packaging strategies, profits rose to ₹ 14,86,550. This steady growth underscores the economic viability of farmer-led processing enterprises. Moreover, Mr. Tarsem Lal's initiative demonstrates how small-scale processors can leverage modern techniques and institutional support to increase profitability, reduce dependence on middlemen, and build consumer trust. His achievements continue to motivate other agro-processors in the region to adopt agro-processing as a means of sustainable income generation and rural development.

APC-IV: Under the project, a cattle feed production unit was established at Jalaldiwal, Raikot (Ludhiana), to promote value addition in agricultural by-products and ensure better livestock nutrition. The unit processes wheat, maize, and soybean to prepare balanced feed for dairy and livestock farmers. In 2023-24,



Khalsa Farm APC unit Balachour (SBS Nagar)



Pabla Brothers APC unit Bharta Khurd (SBS Nagar)



Cattle feed production unit, Jalaldiwal (Ludhiana)

demonstrations were conducted, which highlighted the feed preparation process and its benefits for animal health and productivity. With direct-to-consumer sales as well as dealer-based distribution, the enterprise generated a profit of ₹ 16,28,350 during the year. Building on this foundation, the unit continued its operations in 2024-25 and conducted demonstrations to expand its outreach. As a result of improved efficiency and growing demand, the profit rose further to ₹ 19,57,500. The consistent growth of this enterprise underscores its role in providing quality cattle feed, reducing farmers' dependency on external markets, and strengthening the livestock sector. Moreover, by linking nearby farmers with the unit, this initiative has created a reliable supply chain for nutritious feed, thereby improving both farm income and livestock productivity in the region.

Honey processing module

As part of the project, concerted efforts were undertaken to promote scientific honey processing and the utilization of by-products among beekeepers. Accordingly, ICAR-CIPHET, Ludhiana, organized demonstrations and encouraged beekeepers to adopt newly developed technologies, enabling them to process honey scientifically and sell it directly in the market. For instance, farmers like Sh. Lakhbir Singh witnessed a remarkable transformation through the project, as the installation of a modern honey processing plant allowed him to maintain quality standards and market value, thereby producing high-quality honey under hygienic conditions. Similarly, Sh. Deepak Sunda, a 22-year-old beekeeper, initially relied on traditional methods, heating honey over a wood fire. This practice compromised quality, resulting in darker honey with a smoky taste, which fetched only ₹ 120-140 per kg in bulk sales to traders. However, after receiving training from ICAR experts, he adopted an advanced honey processing unit and registered his FSSAI-certified brand, *Hive Honey*. Consequently, he now produces premium-quality honey, successfully selling it at better prices.

In addition, the FFP team engaged with beekeepers in Kandhargarh village (Tehsil Dhuri, Sangrur), where honey was being sold at low prices directly to traders. Recognizing this gap, the team introduced the beekeepers to the benefits of processing and value addition. Similarly, S. Mangal Singh from Nawanshahr formed a commodity interest group and established a modern processing unit in Rahon, Punjab, under the FSSAI-certified brand Mangal Honey Bee Farm. Likewise, S. Avtar Singh from Bandi, Bathinda (Pure honey brand name), who managed 250 bee boxes, upgraded his marketing approach. Similarly, Sh. Mohinder Singh from Nawanshahr launched his FSSAI-certified brand Happy Honey after setting up a processing plant. Furthermore, more and more farmers are showing keen interest in this entrepreneurship, and they are also actively participating in training programs to acquire the necessary skills and knowledge. To strengthen these initiatives, the FFP team conducted hands-on training sessions covering modern honey processing, hygienic packaging, branding, labeling, and FSSAI registration. These interventions empowered the beekeepers to process and market premium honey under their own brands. As a result, they are now selling honey at ₹ 500-600 per kg, significantly enhancing both income and profitability.



Brand Name "Pure Honey" with FSSAI Reg. No.: 22123008000182



**Visit to honey processing unit by
Dr Ram Chand (Former ADG-ICAR)**



Honey processing unit at Bandi, Bathinda

In 2023-24, these farmers collectively generated a substantial profit of ₹ 1,01,66,240 from processed honey and ₹ 4,56,250 from wax, resulting in a total income of ₹ 1,06,22,490. Building on this success, the initiative was further expanded in 2024-25. As a result of adopting improved practices and strengthening market linkages, farmers achieved profits of ₹ 1,20,41,700 from processed honey and ₹ 4,28,800 from wax, which together raised their overall earnings to ₹ 1,24,70,500. These consistent achievements clearly highlight the immense potential of honey processing and by-product utilization in enhancing rural incomes. Moreover, through direct sales to consumers, complemented by marketing via dealers and ICAR-CIPHET, farmers ensured better price realization as well as wider outreach. Consequently, this intervention not only boosted profitability but also strengthened farmers' confidence in beekeeping as a sustainable enterprise.

Chemical-free jaggery production:

The chemical-free jaggery production unit consists of a sugarcane crusher and a three-pan heating system for juice concentration, ensuring efficient and hygienic processing. The setup includes a crusher with a capacity of 1 ton per hour, a 750-litre collection tank, jaggery moulding frames, a mould tray (1" × 1" × 1"), and an open-pan system with three pans. To strengthen market prospects, farmers associated with Plant Farm Nation, Uppal Farm, Bharta Khurd, Rahon were registered with FSSAI, with guidance from the ICAR-CIPHET project team to ensure compliance with food safety standards. The introduction of moulding frames enabled the production of uniform cube-shaped jaggery blocks, enhancing both market appeal and consumer trust. Furthermore, the combination of a high-capacity crusher and an efficient concentration system facilitated higher output and superior-quality jaggery. Overall, this initiative not only promoted chemical-free jaggery production but also provided farmers with a sustainable, profitable, and market-oriented processing solution.

The production of jaggery under hygienic conditions significantly enhanced its quality, thereby making it more attractive to consumers. Furthermore, the introduction of uniform cube-shaped jaggery improved its marketability, enabling farmers to command better prices and secure higher profits. This intervention not only generated substantial income but also created new employment opportunities for local farmers. In 2023-24, for instance, a total of 625 tonnes of sugarcane was processed into solid jaggery and 450 tonnes into granular jaggery. With processing costs of ₹ 15/kg and ₹ 18/kg, the products were sold at ₹ 75/kg (solid) and ₹ 85/kg (granular). Consequently, the farmers earned profits of ₹ 12,50,000 from solid jaggery and ₹ 9,13,500 from granular jaggery, culminating in a total profit of ₹ 21,63,500. On average, this translated into additional gains of ₹ 20-22.5 per kg over the raw product.

Building on this success, the initiative expanded further in 2024-25. During this period, 630 tonnes of sugarcane were processed into solid jaggery and 500 tonnes into granular jaggery. With improved selling prices of ₹ 80/kg and ₹ 90/kg, the profits rose to ₹ 12,60,000 and ₹ 9,90,000 respectively, thereby increasing the overall earnings to ₹ 22,50,000. Moreover, the dual marketing approach, direct sales to consumers along with distribution through dealers and ICAR-CIPHET, ensured better price realization and wider market outreach. As a result, jaggery processing has emerged as a highly profitable and sustainable agro-enterprise, guaranteeing assured income while also opening new avenues for value addition. Shortly after the unit's establishment, around 40-50 sugarcane farmers visited the facility to observe the processing methods. Inspired by the efficiency of cube-shaped jaggery production, many expressed interest in replicating similar units on their own farms. According to S. Sohan Singh Uppal, if more farmers adopt this scientific approach to jaggery processing, they can substantially increase their profits and make sugarcane farming far more lucrative than before.



Chemical free jaggery production unit



Visit by Dr Ram Chand (Former ADG-ICAR) to the jaggery production unit

On-farm handling of horticultural produce module

The project emphasized building farmers' capacity in post-harvest handling and value addition of horticultural crops. Interested farmers first received training in sorting, grading, and packaging. Following this, four cling-wrapping machines were introduced. Subsequently, an on-farm cold room and a processing unit design were developed, with technical guidance provided for their installation in the Nawanshahr district. Among the beneficiaries, S. Paramjit Singh Khalsa, who cultivates vegetables on two acres, was encouraged to diversify into pickle making. Acting on this advice, he processed nearly 120 quintals of pickles from six varieties: galgal, lemon, amla, mango, chilli, cauliflower, and carrot. This initiative not only added value to his produce but also substantially boosted his income and profit margins.



Training for farmers for on-farm handling of horticultural produce

Jointly adopted village Kila Raipur

Technology Application and Upscaling for Sustaining Natural Resources and Augmenting Farm Income: Farmers Led Market Linked Approach

PAU, GADVASU, and ICAR-CIPHET, Ludhiana

Under this project, for the holistic development of the region, one common village, Kila Raipur, was jointly adopted by the Ludhiana-based FFP centers, namely PAU, GADVASU, and ICAR-CIPHET. These centres collaboratively implemented various modules. The project area, Kila Raipur village in Dehlon block, Ludhiana district, lies in the Central Plain Zone and is known for its high input use and production intensity. Kila Raipur village has a total population of 6,205, comprising 3,250 males and 2,955 females. The village includes 805 farming families and 313 agricultural labourers. Among the farming households, 210 are marginal (below 1.0 ha), 400 are small (1.0-2.0 ha), 161 are semi-medium (2.0-4.0 ha), 26 are medium (4.0-10.0 ha), and 8 are large (above 10.0 ha). Additionally, there are 501 non-farming families in the village. The literacy rate stands at 72 per cent. In Kila Raipur, paddy (1,012 ha) and basmati (112 ha) are the major Kharif crops, followed by moong (22 ha), sugarcane (15 ha), and fodder (96 ha). During the Rabi season, wheat dominates with 961 ha, while maize (148 ha), mustard (32 ha), sugarcane (15 ha), and fodder (98 ha) are also grown. Vegetable cultivation is minimal, covering only small areas under chilli (1.5 ha), bottle gourd (1.2 ha), pea (0.8 ha), and brinjal (0.6 ha).

Research problem identification and prioritization

Farmers in Kila Raipur primarily practice a paddy-wheat mono-cropping system that focuses on maximizing yield rather than profitability, resulting in long-term environmental and sustainability challenges. Thus, the adopted village faces major agricultural challenges, primarily due to the over-exploitation of groundwater. In the district, ten out of eleven blocks are severely affected by groundwater depletion, while the remaining block is classified as critical. The main source of irrigation in the adopted village is tube wells, with only 27% of irrigated land having access to canal water. Consequently, limited access to sustainable irrigation sources places immense pressure on groundwater reserves, posing serious threats to long-term environmental and agricultural sustainability. To address these, there is a need introduction of short-duration paddy varieties, Happy Seeder, Super Seeder, Smart Seeder, and Surface Seeder for efficient straw management and sustainable farming. However, crop diversification remains minimal, with pulses covering only 2.65% and oilseeds 1.42% of the cropped area. Despite proximity to major cities, vegetable cultivation is limited due to small landholdings, high input costs, costly seeds, and marketing challenges. Moreover, high land lease rates (₹ 65,000-70,000 per acre) intensify financial pressure, as 90% of farmers report monetary strain, alongside issues like costly agrochemicals (85%), machinery delays (83%), fertilizer shortages (81%), seed unavailability (73%), and labour scarcity (62%). Beyond dairying, farmers in Kila Raipur have few subsidiary occupations, such as beekeeping or mushroom cultivation, due to limited skills and knowledge. Dependence on the paddy-wheat system restricts income diversification, while marketing challenges discourage crop diversification. Value addition and processing are minimal, forcing most families to purchase essentials like honey, oil, jaggery, and pulses from the market. All farmers

reported the absence of agro-processing units and storage facilities 87% cited storage shortages, 75% lacked marketing guidance, and 43% faced price fluctuations. The absence of a local sugar mill further hampers sugarcane processing. Credit access is also inadequate, though banks and moneylenders are primary sources, over half of farmers struggle to secure loans. Moreover, most are unaware of schemes beyond PM-KISAN, limiting investment in modern technologies. Consequently, poor infrastructure, limited finance, and low awareness continue to impede income diversification, technology adoption, and sustainable agricultural growth.

To achieve sustainability and enhance farmers' profitability, various activities were planned in the adopted village, Kila Raipur, under the joint efforts of PAU, GADVASU, and ICAR-CIPHET, Ludhiana. PAU, Ludhiana, focused on improving crop productivity and sustainability through multiple interventions. These included the promotion of short-duration rice varieties, the use of Happy Seeder/Super Seeder/Smart Seeder/Surface Seeder for sowing and in-situ paddy straw management in wheat, and soil test-based nutrient application. Efforts were also made to promote crop diversification by introducing rapeseed (Gobhi sarson) and intercropping sugarcane with oilseeds and pulses. Additionally, an Integrated Farming System for livelihood security was implemented to ensure resource optimization and income stability.

GADVASU, Ludhiana, undertook activities related to precision livestock farming, emphasizing better nutrition, healthcare, welfare, and waste management. The interventions included balanced feed formulation with trace minerals and silage production under the nutrition component, deworming and infertility camps, along with oral magnet therapy under healthcare, and precision housing management using digital tools for animal welfare. ICAR-CIPHET, Ludhiana, focused on value addition and agro-processing initiatives across Kila



FFP joint team conducting a survey in Kila Raipur

Raipur. The major activities included promoting chemical-free jaggery production among sugarcane farmers, including the making of jaggery candy and square-shaped jaggery. The institute also worked to integrate sugarcane farmers with existing jaggery units, providing training, technological support, and market linkage for niche, health-oriented products. Furthermore, ICAR-CIPHET promoted processing and value addition of oilseeds by offering skill development training and technical guidance to aspiring entrepreneurs for establishing Agro-Processing Centres (APCs).

PAU, Ludhiana

COMPONENT-I:

Enhancing Farmer-Scientist Interface

PAU, Ludhiana, organized 52 programs in the commonly adopted village, Kila Raipur, to strengthen interaction between farmers and scientists. Innovative and progressive farmers were identified and trained as "technology agents" in various modules to promote the adoption of scientific practices and facilitate technology transfer at the village level.

COMPONENT-II:

Technology Assemblage, Application, and Feedback

Short-duration varieties of rice for efficient water management: To evaluate the efficiency of short-duration varieties (SDVs) in terms of water conservation and economic performance compared to long-duration varieties (LDVs), a total of 10 demonstrations, each covering 0.4 ha, were conducted in the project villages. Farmers were provided with PR 126 seeds and technical guidance. The PR 126 variety matured in just 93 days after transplanting, nearly 2-3 weeks earlier than LDVs. Although it recorded a slightly lower yield, the gross return from the demonstration plot was ₹ 1,73,834/ha, compared to ₹ 1,84,621/ha in the check plot. The net return was ₹ 1,28,574/ha in the demonstration and ₹ 1,33,443/ha in the check plot. Notably, the BC of 2.84 for the demonstration plot exceeded the 2.60 observed in the check plot, indicating better economic efficiency and resource optimization with PR 126.

The overall emission pattern clearly highlights the environmental benefits of adopting the short-duration variety. Particulate emissions, represented by PM, PM₁₀, PM_{2.5}, organic carbon (OC), and black carbon (BC), showed probable reductions ranging from 0.35 to 5.31 kg/ha. These declines reflect a substantial decrease in suspended particulate matter released into the atmosphere, thereby improving local air quality. Similarly, gaseous emissions exhibited significant reductions. Carbon dioxide (CO₂) emissions are estimated to decrease by about 672.31 kg/ha, carbon monoxide (CO) by 55.81 kg/ha, and methane (CH₄) by 5.29 kg/ha. Other gases, including volatile organic compounds (VOC), ammonia (NH₃), nitrogen oxides (NO_x), and sulphur dioxide (SO₂), also showed probable reductions of 3.86, 2.26, 1.07, and 0.16 kg/ha, respectively. Overall, these findings indicate that cultivating PR 126 can substantially reduce both particulate and gaseous emissions compared to the conventional long-duration Pusa 44 variety, offering a more environmentally sustainable option for paddy production.

PAU Happy Seeder/Super Seeder/Smart Seeder for wheat sowing for in situ paddy straw management: The project emphasized the use of *in-situ* paddy residue management technologies for effective handling of paddy straw. A total of ten demonstrations were conducted using newly released PAU wheat varieties, PBW 766 and PBW 826. The average wheat yield in the demonstration plots was 61.25 qt/ha, compared to 58.78 qt/ha in the check plots, reflecting an increase of about 4.2% in yield. Consequently, the net return from the demonstration plots was ₹ 1,07,250/ha, compared to ₹ 99,193/ha from the check plots, indicating an increase of about 8.1%. The BC ratio was also higher in the demonstration plots (2.69) than in the check plots (2.36). These results convinced farmers of the effectiveness of in-situ crop residue management technologies. While the introduction of these technologies brought certain challenges, such as rodent attacks and pink stem borer infestations, the newly introduced Smart Seeder technology is rapidly gaining popularity among farmers due to its superior performance and operational convenience.

Diversification through Rapeseed (Gobhi sarson): A total of 20 demonstrations on the rapeseed variety GSC 7 were conducted in Kila Raipur. The average yield obtained from the demonstration plots was 24.2 qt/ha, compared to 25.2 qt/ha in the check plots. The gross return from the demonstration plots was ₹ 1,40,360/ha, while the check plots recorded a slightly higher gross return of ₹ 1,41,120/ha. However, the net return from the demonstration plots was ₹ 1,05,694/ha, which was marginally higher than that of the check plots (₹ 1,04,786/ha). The BC ratio was 3.04

for the demonstration plots, compared to 2.88 for the check plots, indicating better profitability under the demonstration conditions. Overall, the findings suggest that the rapeseed variety GSC 7 proved to be more cost-effective and profitable than the check variety (PA 5210), despite a slightly lower yield, primarily due to reduced seed and cultivation costs and higher economic efficiency.

Adoption of Sugarcane: A demonstration on sugarcane cultivation was conducted during the spring season with the objective of promoting crop diversification in the region and encouraging farmers to shift from traditional mono-cropping systems to more profitable and sustainable alternatives. Farmers were provided with method demonstrations on the scientific planting of cane sets. The demonstration was carried out on a 0.4 ha plot on variety CoPb 95, where sugarcane was planted at a row spacing of 120 cm. The demonstration plots recorded an impressive average yield of 1082 q/ha, significantly higher than most competing crops in the rice-wheat system. This high productivity resulted in a gross return of Rs 4,32,744/ha. After deducting the cost of cultivation, the net return was ₹ 2,83,788/ha, demonstrating the strong profitability of sugarcane cultivation. The BC ratio was 2.90 for the demonstration plot. These results highlight the economic and environmental sustainability of sugarcane as a diversification crop, offering farmers higher income, improved soil health, and opportunities for value addition while reducing dependence on the rice-wheat system.

Vegetable Crops

High-Yielding Vegetable Varieties/ Hybrids: To promote diversified farming and enhance agricultural income, vegetable cultivation was encouraged in the project area. A total of 15 demonstrations of high-yielding varieties of potato, pea, and onion were conducted. For potato, the average yield in the demonstration plots was 406 qt/ha, compared to 347 qt/ha in the check plots. The net return from the demonstration plots was ₹ 1,09,722 /ha, while the check plots recorded ₹ 93,263/ha. The BC ratio was 1.69 for the demonstration plots and 1.62 for the check plots. For onion, the demonstration plots yielded 353.21 qt/ha, with a net return of ₹ 3,30,284 /ha and a BC ratio of 3.52, indicating excellent profitability. For pea, the demonstration plots produced 129.6 qt/ha, generating a net return of ₹ 2,41,689 /ha and a BC ratio of 2.92, showing strong economic viability. Overall, the economic analysis of demonstrations on high-yielding vegetable varieties revealed substantial profitability, particularly for onion and pea, compared to conventional varieties.

Low tunnel cultivation of vegetables: Two demonstrations on low tunnel cultivation of cucumber were conducted in the project area. The low tunnel technology allows early sowing, enabling farmers to fetch



Demonstration on potato



Demonstration on onion

premium prices in the market. This intervention was initiated in August, with the produce ready for harvest from November onwards. In contrast, cucumber grown without low tunnel technology is exposed to harsh weather conditions during this period, leading farmers to delay sowing and consequently miss the early market advantage. As a result, farmers adopting low tunnel cultivation achieved higher productivity and profitability. The average yield in the demonstration plots was 326 qt/ha, compared to 234 qt./ha in the check plots. The net return per hectare was ₹ 4,21,460 in the demonstration plots, significantly higher than ₹ 1,55,156 in the check plots. The BC ratio was 3.17 for the demonstration plots, indicating a return of ₹ 3.17 for every rupee invested, while the check plots recorded a lower ratio of 1.46.

Subsidiary Enterprises

Beekeeping: One beekeeper was selected in the project village and provided with practical training and technical support. The beekeeper initially received six *Apis mellifera* colonies, which were successfully multiplied to ten, reflecting a 70% increase in colony numbers. The four additional colonies generated through multiplication were valued at ₹ 24,420, demonstrating the profitability and scalability of beekeeping as a viable supplementary livelihood activity.

Mushroom production: Three farmers initiated mushroom cultivation of temperate species such as *Agaricus bisporus* (Button mushroom) and *Pleurotus* spp. (Oyster mushroom). Awareness lectures on summer mushrooms, including Milky mushroom (*Calocybe indica*) and Paddy straw mushroom (*Volvariella volvacea*), were also delivered, encouraging some farmers to begin small-scale summer mushroom production. For Button mushroom, the total cost of production per 5 kg bag in the demonstration plot was ₹ 63. The average yield per bag was 1.5 kg, with a gross return of ₹ 150 and a net return of ₹ 87 per bag. The BC ratio was 2.38, indicating a return of ₹ 2.38 for every rupee invested. Similarly, the economic analysis of the demonstrations on the Dhingri (Oyster) mushroom revealed high profitability. The total cost of producing an 8 kg bag was ₹ 50, with an average yield of 2.6 kg and gross returns of ₹ 208. The net return per bag was ₹ 158, resulting in a BC ratio of 4.16, demonstrating that for every rupee invested, the return was ₹ 4.16. These results highlight that Dhingri mushroom cultivation under demonstration is a highly profitable and sustainable enterprise for farmers.

Integrated Farming System (IFS)

The IFS models implemented in the project village encompass a diverse range of farming activities across multiple farms. Each farm integrates various enterprises such as cropping systems, kitchen gardening, livestock rearing, apiculture, mushroom cultivation, and, in some cases, organic farming practices. The table below presents the economic analysis of the different IFS models adopted by two farms, detailing the gross returns, cost of cultivation, and net returns from each component.

Farmer 1: S. Sukhvir Singh has adopted a comprehensive integrated farming system combining cropping, livestock, kitchen gardening, apiculture, and mushroom production. The farm has a net sown area of 2.02 ha and a gross cropped area of 4.65 ha, achieving 230% cropping intensity through efficient land use. The cropping pattern includes sugarcane (0.61 ha), paddy-potato-spring maize (0.81 ha), paddy-wheat-summer moong (0.40 ha), mustard-summer moong (0.20 ha), and 0.20 ha for year-round fodder. The farm also maintains a 200 m² kitchen garden, 5 buffaloes/cattle, 6 bee colonies, and a 20-bag mushroom unit. The gross return is ₹ 14,56,110 with a total cost of ₹ 6,32,521, resulting in a net return of ₹ 8,24,481 and a

BC ratio of 2.30. Cropping is the primary income source, followed by livestock and apiculture. This integrated model ensures income stability, efficient resource recycling, employment generation, and resilience to market and climatic risks.

Farm 2: S. Gyan Singh represents an integrated, organic-oriented farming system focused on profitability and household sustainability. The farm covers a net sown area of 1.50 ha and a gross cropped area of 3.68 ha, achieving a high cropping intensity of 246% through efficient land use and multiple cropping. The farmer cultivates organic wheat (0.4 ha), conventional wheat (0.4 ha), paddy (1.0 ha), Kharif maize (0.5 ha), mustard (0.7 ha), and summer moong (0.7 ha), ensuring soil health, reduced pest pressure, and steady seasonal income. The 200 m² organic kitchen garden supplies vegetables for household and local sale, while a 20-bag mushroom unit provides off-season earnings. The livestock unit with four buffaloes contributes milk income and organic manure, enhancing soil fertility and reducing input costs. Overall, the farm achieved a gross return of ₹ 9,00,633, with a cultivation cost of ₹ 3,43,853 and a net return of ₹ 5,58,478. The BC ratio of 2.62 demonstrates strong economic efficiency and sustainability, making it a model of diversified and organic-integrated farming.

GADVASU, Ludhiana

COMPONENT-I:

Enhancing Farmer-Scientist Interface

The team members visited the operational area and interacted with progressive dairy farmers of the village, providing training and hands-on exposure to the latest technologies aimed at enhancing their knowledge, productivity, and overall livelihoods.

COMPONENT-II:

Technology Assemblage, Application, and Feedback

Silage making demonstration: A total of 16 demonstration on silage preparation were conducted for 16 farmers. They were guided through the entire process of controlled fermentation of chopped crop residues or high-moisture forages under anaerobic conditions. The participants were informed about the key dos and don'ts of this fodder preservation technique and encouraged to adopt it for maintaining a steady supply of nutritious feed for dairy animals throughout the year. This practice helps ensure the nutritional security of livestock and contributes to the economic stability of the farmers involved in dairy farming.

Infertility camps: A total of three infertility camps were organized based on farmers' demand to address the increasing cases of infertility in the area. The common reproductive disorders identified included anestrus, follicular cysts, and silent heat, for which appropriate treatments were provided. Farmers were advised on improved reproductive management practices, with special emphasis on mitigating heat stress during the summer months to prevent infertility issues. The camps also served as educational platforms, providing farmers with literature on reproductive health management and raising awareness about the causes and prevention of infertility in dairy animals.

Mineral mixture camp: Most farmers in the operational area were unaware of the importance of feeding mineral mixtures to dairy animals and were facing issues of low milk yield. To address this, mineral mixtures were distributed among 21 dairy farmers, emphasizing their role in daily feeding to enhance overall productivity and reproductive health.

Oral magnet therapy camp: This camp featured live demonstrations of oral magnet administration in 14 dairy animals and provided valuable insights into its benefits. Farmers were educated about how this method helps prevent traumatic reticuloperitonitis, a condition that can lead to diaphragmatic hernia. They were informed that when an animal ingests metallic foreign objects, these are attracted to the oral magnet placed in the reticulum, preventing their migration toward the diaphragm and thereby safeguarding the animal's health.

Value addition and packaging machinery: A total of 14 beneficiary farmers were trained in the scientific methods of preparing paneer and other milk-based products such as flavoured milk, khoa, mozzarella cheese, and ghee. The training aimed to enhance the value of milk and provide additional economic benefits to farmers. Participants were also guided on product marketing through the proper packaging of value-added dairy products. Hands-on training was provided on the use of cup sealer, hand sealer, and pedal sealer machines. Farmers learned how to use the cup/glass sealer for packing items like kheer, lassi, whey drinks, and flavoured milk, and the hand sealer for packing paneer, chhana, and sweets.



Mineral mixture distribution



Demo on processing of milk

ICAR-CIPHET, Ludhiana

The survey revealed that most farmers in the village practiced traditional crop cultivation with minimal processing activities. A few had started small ventures like jaggery and flour milling using outdated methods lacking hygiene, technology, and marketing knowledge. Limited awareness and access to modern equipment restricted product quality and market reach. Based on the findings, ICAR-CIPHET, Ludhiana, identified progressive farmers interested in adopting modern, hygienic processing and packaging techniques for better profitability. To assess existing setups, the FFP team visited farmers' processing units and identified key gaps such as poor hygiene, inefficient boiling and filtration, use of chemical additives in jaggery making, and weak packaging and storage. Farmers also lacked awareness of market linkages, product diversification, and quality control. The team guided them on establishing year-round agro-processing centres and encouraged setting up flour mills for processing pulses, besan, and spices. This approach aims to utilize local produce efficiently, ensure steady income, and create year-round employment through diversified value addition.

To address these challenges, ICAR-CIPHET had conducted hands-on training on chemical-free jaggery processing for interested farmers of Kila Raipur. The programme will demonstrate the use of natural

clarifying agents like okra extract and lime, along with techniques for maintaining hygiene, temperature control, and achieving uniform colour and texture. Farmers will also learn modern methods for making jaggery cubes using silicon moulds and granular jaggery, which offer higher market value and longer shelf life. The training aims to enhance technical skills and promote safe, hygienic, and sustainable processing for better-quality products and higher income. Farmers were also informed about the importance of FSSAI registration, branding, and developing value-added products such as jaggery cubes and granular jaggery. Through continuous support and capacity building, the team encouraged them to adopt scientific and profitable agro-processing practices, paving the way for higher income generation and rural entrepreneurship in Kila Raipur.

FFP joint team advising farmers on upgrading the jaggery processing unit



GOVERNMENT OF INDIA
MINISTRY OF EDUCATION
(ASSISTANT COMMISSIONER)

UDYAM
Department of Small
and Medium Enterprises
(MINISTRY OF INDUSTRY AND COMMERCE)



GOVERNMENT OF INDIA
MINISTRY OF INDUSTRY AND COMMERCE
(ASSISTANT COMMISSIONER)

UDYAM REGISTRATION CERTIFICATE

UDYAM REGISTRATION NUMBER

NAME OF ENTERPRISE

TYPE OF ENTERPRISE

MAJOR ACTIVITY

SOCIAL CATEGORY OF ENTREPRENEUR

NAME OF UNIT/IN

UDYAM PIN-12-345678

MSD PROPOSAL NUMBER

T	Name	Age	DOB
1	2012-25	25	20/07/2012

MANUFACTURING

GENERAL

Particulars	Name of officials
1. Head Field Office	

Particulars	Name	Phone No.	Residential Address
1. Village Head			
2. Head of Block			
3. Panchayat Head			
4. District Head			
5. State	PR/2014		

18/07/2012

18/07/2012

OFFICIAL ADDRESS OF ENTREPRENEUR

STATE OF INCORPORATION / REGISTRATION OF ENTERPRISE

DATE OF COMMENCEMENT OF PRODUCTION / SERVICE

NATIONAL INDUSTRY (CLASSIFICATION CODES)

DATE OF UDYAM REGISTRATION

Type of Udyam	MSD No.	MSD Date	Status
1. MSU			
2. MSME			
3. MSSE			
4. MSSE			
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Registration of MSME for Kila Raipur Farmers through ICAR-CIPHET, Ludhiana

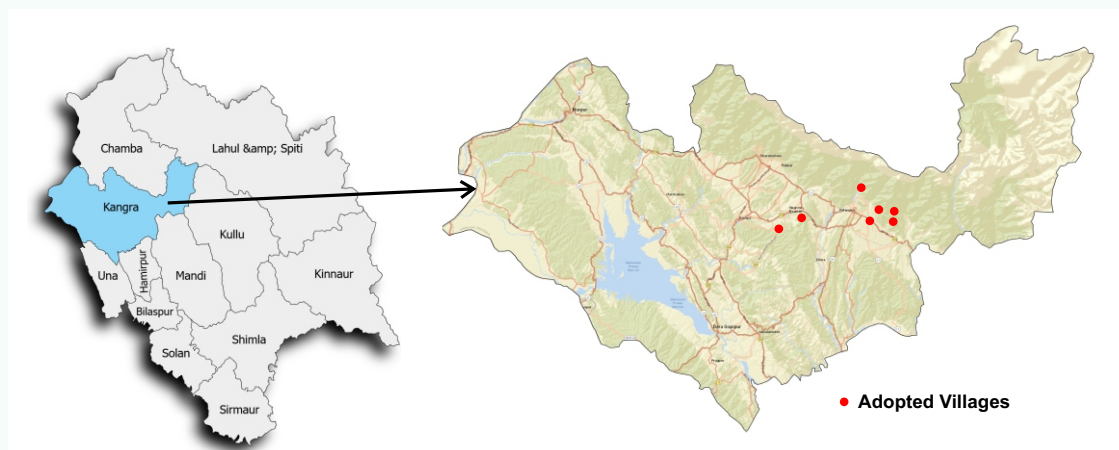
Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya (CSKHPKV), Palampur

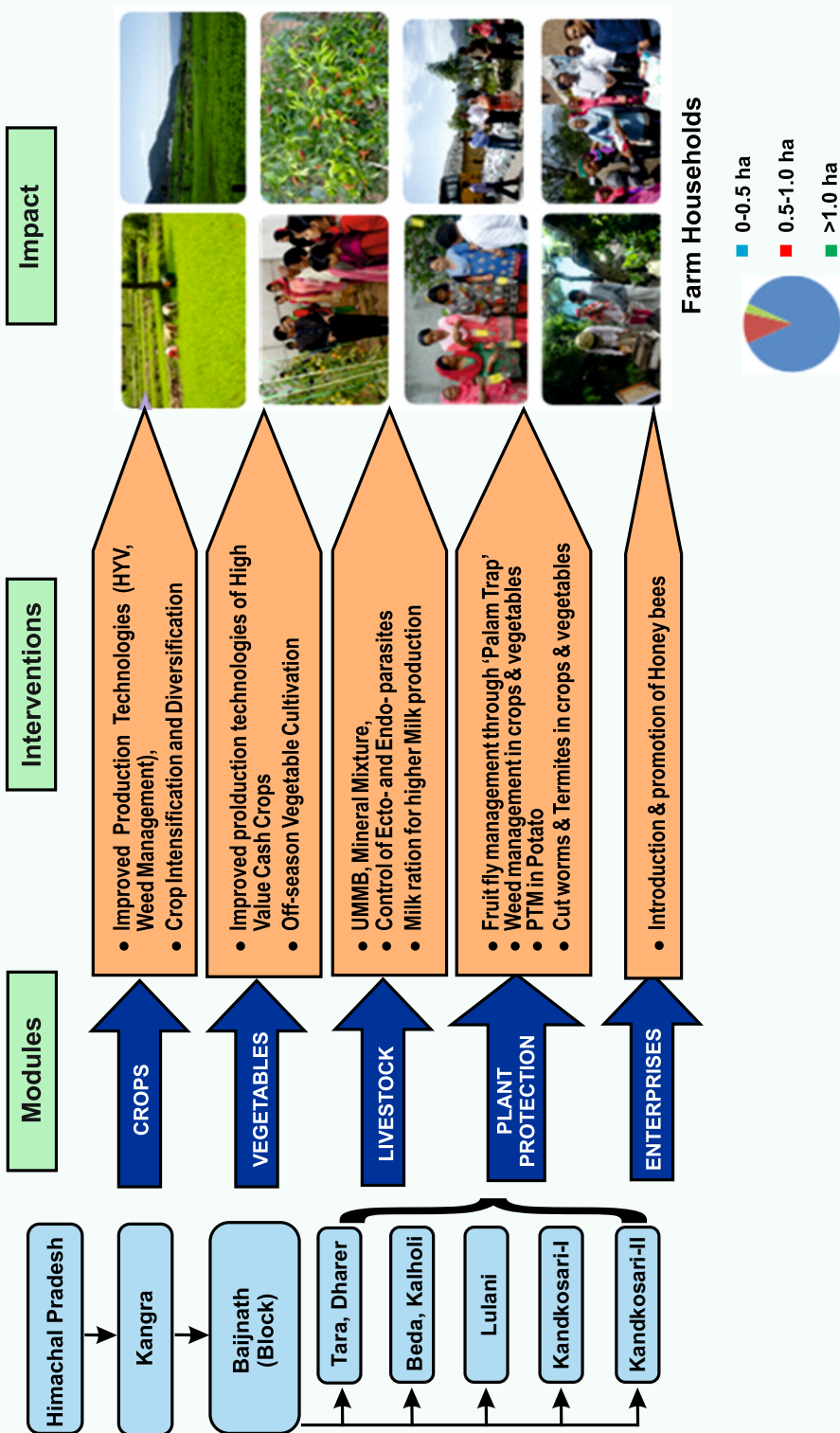
Transfer of improved farm production technologies for enhancement of rural livelihood security amongst the farm households of Kangra district of Himachal Pradesh

The Farmer FIRST Programme (FFP) was implemented by CSKHPKV, Palampur in Kangra district of Himachal Pradesh. The project covered a cluster of eight villages Chattarghar, Sagoor, Chakol Bedu-I, Chakol Bedu-II, Padhkar, Khajura Basti, Kandkosari-I, and Kandkosari-II. The region is characterized by small and fragmented landholdings, with more than 80% of households cultivating less than 0.5 ha. The major crops include wheat, paddy, maize, pulses, and vegetables, with maize-wheat being the predominant cropping system. Although nearly 80% of the district's cultivated land is rain-fed, irrigated tracts are primarily used for paddy during the kharif season. Additionally, livestock husbandry, particularly dairying with cows and buffaloes, is an integral component of rural livelihoods.

Research problem identification and prioritization

A baseline survey conducted in the project area identified several technological gaps in the proposed cluster, thereby underscoring the urgent need for targeted research and extension interventions. The major challenges included the non-availability of quality seeds of HYVs and planting materials, farmers' limited awareness of improved production and protection technologies, and inadequate processing infrastructure and the lack of necessary skills further constrained agricultural growth. Suboptimal animal health and feeding practices, together with declining soil productivity caused by excessive chemical use, also added to the challenges. Furthermore, restricted access to market intelligence, including timely information on prices and weather forecasts, exacerbated the situation. The application of farmyard manure (FYM) remained far below recommended levels, particularly in paddy and barley cultivation, which further limited productivity. At the same time, farmers faced threats from monkey menace, wild





Graphical Abstract : CSKHPKV, Palampur

and stray animals, as well as persistently low crop yields. Finally, limited resources and the adverse impacts of climate change created additional barriers to the adoption of improved, input-intensive technologies.

To enhance agricultural productivity, ensure sustainability, and secure farmers' livelihoods, the project was strategically designed to bridge technological gaps while simultaneously promoting sustainable farm-based practices. The core objectives centred on improving the productivity of cereal-based cropping systems through the adoption of superior crop varieties, efficient nutrient management, effective pest control, and soil conservation measures. In addition, the project sought to strengthen agri-horti intercropping systems by promoting eco-friendly practices and advancing agroforestry. To further boost dairy productivity, special emphasis was placed on the use of mineral mixtures, quality forages, and effective parasite management. Moreover, recognizing the unique challenges of landless farmers, the initiative promoted alternative income-generating activities such as mushroom cultivation and beekeeping. Furthermore, interventions in post-harvest value addition, diversification of cereal-based cropping with vegetables, and the adoption of improved vegetable production technologies were introduced to enhance income opportunities and ensure long-term agricultural sustainability.

COMPONENT-I:

Enhancing Farmer-Scientist Interface

On-campus and off-campus extension activities were systematically organized in various villages. In 2023-24, a total of 1,655 farmers participated in 33 activities. In 2024-25, a total of 886 farmers participated in 34 activities. This reflects a decrease in the number of farmers involved despite a slight increase in activities. These initiatives aimed to provide farmers with scientific knowledge and practical skills. Such skills help enhance agricultural productivity and strengthen livelihood opportunities. To meet these goals, farmers received hands-on training in scientific crop and vegetable cultivation. They also gained exposure to advanced plant protection methods. Integrated pest management practices were also shared. Special emphasis was placed on beekeeping and dairy farming. In these sessions, farmers learned efficient management practices to improve honey and milk production. Training covered animal healthcare, disease prevention, and balanced nutrition. These efforts supported enhanced livestock productivity. The programs also raised awareness about post-harvest value addition. This helped farmers process and market their



Farmer-scientist interaction

produce more effectively. As a result, these interventions gave farmers access to modern agricultural practices. They encouraged the adoption of sustainable techniques. This contributed to improving overall economic well-being.

COMPONENT-II:

Technology Assemblage, Application and Feedback

Economically viable and socially compatible technological options were developed to strengthen the agricultural systems across clusters of Gram Panchayats in the adopted villages. These options included adoptable modules on natural resource management, crop production, horticulture, and livestock, with a focus on enhancing crop production, bridging yield gaps, and improving animal health. In line with the field-specific challenges faced by farmers, different technological modules and activities were carefully prioritized and systematically implemented to address the identified issues. Through these interventions, the overarching goal was to ensure food and livelihood security for the farming community by promoting sustainable and practical solutions tailored to local needs.

Crop production module:

Farmers were found to have limited awareness regarding improved crop varieties, quality seeds, line sowing, balanced fertilization, and effective weed management in cereal crops. To overcome these gaps, high-yielding varieties of maize, paddy, and wheat were introduced, accompanied by the practice of line sowing to ensure uniform crop growth and higher productivity. At the same time, farmers were sensitized to the recommended use of basal fertilizer application in combination with farmyard manure for improving soil fertility. In addition, chemical methods of weed management practices were promoted to control infestations more effectively. Collectively, these interventions aimed to improve crop yields while fostering sustainable and efficient farming practices by replacing outdated seed varieties with high-yielding alternatives.

Maize: In the adopted area, farmers traditionally cultivated local maize varieties, which often resulted in low productivity. To address this challenge, maize hybrids such as FB-52A Gold and FPG-2744 were introduced under the project, coupled with the promotion of chemical weed management practices. In 2023-24, a total of 384 demonstrations were conducted on 17.5 ha, directly benefitting an equal number of farmers. The improved varieties recorded an average yield of 25.5 q/ha compared to 21.6 q/ha under the local check, showing a yield advantage of 16.8%. These demonstrations generated a net return of ₹ 38,468/ha with a BC ratio of 2.47, which was considerably higher than the check (₹18,416/ha; BC ratio 1.70). The results highlighted the significant gains in both productivity and profitability of adopting improved maize hybrids, encouraging farmers to gradually replace local cultivars with high-yielding ones.

Paddy: In 2023-24, a total of 750 demonstrations were conducted on 40.0 ha, benefitting an equal number of farmers, to promote improved paddy varieties such as HPR 2880, HPR 2795 and hybrid F1-2266. These improved varieties recorded an average yield of 31.4 q/ha, compared to 22.0 q/ha in the local check, thereby registering a yield advantage of 42.5%. The demonstrations generated a net return of ₹ 52,573/ha with a BC ratio of 2.74, which was substantially higher than the check (₹ 24,860/ha and BC ratio 1.92). Building upon this success, during 2024-25, a total of 453 demonstrations were conducted over 32.0 ha,

again benefitting an equal number of farmers. The improved varieties, including HPR 1068, HPR 2143 and HPR 2880 achieved an average yield of 27.6 q/ha against 19.9 q/ha in the check, reflecting a yield gain of 38.2%. These demonstrations resulted in a net return of ₹ 51,779/ha with a BC ratio of 2.41, as compared to the check (₹ 18,500/ha and BC ratio 1.57). Farmers showed a strong preference for these improved varieties and hybrids due to their higher productivity, profitability, and superior grain quality, which encouraged a gradual shift from traditional cultivars to high-yielding alternatives.

Wheat: During 2023-24, a total of 1,050 frontline demonstrations were carried out across 10.5 ha, directly involving an equal number of farmers. The varieties introduced included HPW 373, HPW 368, and HD 3226 achieved an average yield of 24.7 q/ha compared to 20.1 q/ha in the local check, thereby recording a yield advantage of 23.1%. These demonstrations generated a net return of ₹ 37,502/ha with a benefit cost (BC) ratio of 2.47, which was significantly higher than the check (₹ 10,951/ha and BC ratio 1.41). In 2024-25, building on this success, 279 demonstrations were conducted on 8.0 ha, benefitting an equal number of farmers. The improved varieties HPW 349, HPW 368, and HD 3226 recorded an average yield of 22.5 q/ha against 18.8 q/ha in the check, reflecting a yield gain of 19.8%. These demonstrations resulted in a net return of ₹ 37,508/ha with a BC ratio of 2.32, compared to the check (₹ 16,185/ha and BC ratio 1.64). Farmers expressed strong preference for these varieties not only due to higher grain and straw yields but also for their resistance to lodging and shattering, along with excellent chapatti-making qualities. Consequently, the adoption of these high-yielding varieties gradually replaced local wheat, contributing to higher productivity and profitability.



Demo on maize crop



Demo on paddy transplanting



Field visit to paddy demo plots



Demo on wheat crop

Vegetable production module:

Farmers initially had limited awareness regarding improved varieties, quality seeds, line sowing, and balanced fertilization in the cultivation of off-season vegetables such as French bean, pea, cucumber, cauliflower, chilli, okra, and radish. To bridge these gaps, a series of interventions was introduced. These included the promotion of high-yielding vegetable varieties and the adoption of optimized sowing and planting schedules to ensure profitable off-season production. In addition, the use of basal application of fertilizers in combination with farmyard manure was encouraged to improve soil fertility. Moreover, integrated pest and disease management (IPM/IDM) practices were implemented to provide better crop protection and reduce losses.

French bean: Demonstrations on the improved variety OP Falguni were carried out across farmers' fields during 2023-24 and 2024-25 to replace the local varieties. In 2023-24, 458 demonstrations covering 0.65 ha were conducted, directly benefiting 458 farmers. The variety Falguni recorded yields of 65.9-112.9 q/ha, which represented 18.2% to 21.3% increase over the local varieties. The BC ratio ranged from 2.92 to 4.75, compared with 1.75 to 2.94 for local checks, clearly highlighting its economic superiority. In 2024-25, 200 demonstrations were conducted on 0.26 ha, with 200 beneficiaries. The Falguni again outperformed local varieties, yielding 66.52 q/ha against 55.76 q/ha of the local check, reflecting a 19.29% increase. The BC ratio was 2.96 compared to 1.78 for local varieties, confirming its profitability. Beyond yield and economics, farmers preferred Falguni for its round, pencil-sized pods, which commanded premium market prices. Collectively, these attributes positioned OP Falguni as a profitable and desirable alternative to traditional French bean varieties..

Cauliflower: During 2023-24, demonstrations of the hybrid variety F1 White Gold were conducted on 75 farmers' fields across 2.0 ha to showcase its superiority over local varieties. The hybrid consistently recorded higher yields, ranging from 95.6 to 161.7 q/ha, which corresponded to yield advantages of 17.7% to 38.3% over local checks. In terms of profitability, the BC ratio for F1 White Gold varied between 2.97 and 4.15, while that of local varieties remained lower, at 2.12 to 2.95. Farmers showed strong preference for F1 White Gold owing to its higher curd yield and market acceptability, which ensured better returns compared to local cauliflower varieties.

Chilli: A total of 246 demonstrations were conducted on 0.5 ha in 2023-24 using chilli hybrids F1 Sakata 653. These varieties were highly accepted by farmers due to their superior performance over local checks. The hybrid F1 Sakata achieved a yield of 57.9 q/ha, which was 36.9% higher than the local check yield of 42.3 q/ha, while F1 Sakata 653 recorded 42.75 q/ha, showing a 20.1% advantage over the local yield of 35.6 q/ha. In terms of profitability, F1 Sakata recorded a BC ratio of 3.94 compared to 2.43 in the local check, clearly demonstrating their economic viability. Furthermore, in 2024-25, a total of 76 demonstrations were laid out on 1.2 ha. The demonstrated variety recorded a yield of this variety 43.23 q/ha, which was 20.75% higher than the local check (35.8 q/ha). The BC ratio of 2.57 was at par with the local check, but higher returns from demonstration plots highlighted the profitability of adopting this hybrid.

Okra: In 2023-24, a total of 431 demonstrations were conducted on 1.96 ha to evaluate the performance of improved okra variety Arka Anamika and okra hybrid F1-693. Arka Anamika recorded the highest yield of 94.6 q/ha, representing a 33.6% increase over the local check of 70.8 q/ha, along with a notable BC ratio of

4.12 compared to 2.76 in the local check, highlighting its profitability. Similarly, F1-693 hybrid yielded 65.4 q/ha, showing a 12.0% advantage over the local check (58.4 q/ha), with a BC ratio of 2.65 against 1.74 in the local variety. In 2024-25, a total of 263 demonstrations were conducted on 5.5 ha, where Arka Anamika again performed better with a yield of 65.8 q/ha, recording 12.59% higher yield than the local check (58.44 q/ha), while okra hybrid F1-693 yielded 66.35 q/ha, with a 13.53% increase over the same check. The profitability was also evident, as Arka Anamika registered a BC ratio of 2.84 and okra hybrid F1-693 achieved 2.96, both substantially higher than the 1.87 recorded in local varieties. These results clearly indicated that the demonstrated varieties not only enhanced productivity but also ensured higher economic returns, making them highly preferred by farmers.

Pea: In 2023-24, a total of 379 demonstrations were conducted on 5.33 ha to evaluate the performance improved pea variety PB-89 and hybrid GS-10. Among them, hybrid GS-10 consistently recorded the highest yield of 99.4 q/ha, which was 51.1% higher than the local check (65.8 q/ha). It also achieved a superior BC ratio of 4.06 compared to 3.00 under the local variety. PB-89 also performed well, yielding 81.85 q/ha, which was 38.5% higher than the check (59.1 q/ha), with a BC ratio of 3.48 against 2.51. In 2024-25, a total of 336 demonstrations were carried out on 2.97 ha, where GS-10 again showed better performance with a yield of 82.55 q/ha, recording a 39.4% increase over the local check (59.2 q/ha). Its profitability was also evident, with a BC ratio of 3.56 compared to 2.45 under the check. PB-89 yielded 64.9 q/ha, 23.6% higher than the local check (52.5 q/ha), with a BC ratio of 2.89 as against 1.98 under the check. These results highlighted the consistent superiority of GS-10, which farmers preferred due to its straight, long, green pods with high market acceptability, making it the most profitable and widely adopted variety.

Radish: In 2023-24, a total of 158 demonstrations were conducted over 3.8 ha to evaluate the performance of improved radish varieties. The hybrid F1 No. 22 (MAHY 22) sown during the summer season, yielded 170.2 q/ha, which was 46.9% higher than the local check (115.9 q/ha). It also recorded an impressive BC ratio of 4.93 compared to 2.80 under the check, proving highly profitable for farmers. The variety 'All Season' also performed well in the winter season, yielding 90.5 q/ha, a 19.4% increase over the check (75.8 q/ha), with a BC ratio of 2.62 against 1.80. In 2024-25, a total of 79 demonstrations were laid out on 4.0 ha, where F1 No. 22 again excelled, producing 170.7 q/ha, which was 47.0% higher than the check (116.1 q/ha). Its profitability remained consistent with a BC ratio of 4.94 compared to 2.81 for the check. These results confirmed that F1 No. 22 is not only highly suitable for summer cultivation due to its slow bolting and reduced pith formation but also offers premium market prices, making it the most profitable option. Consequently, many farmers shifted towards summer radish cultivation, significantly enhancing their income.

Cucumber: In 2023-24, a total of 225 demonstrations were conducted on 1.0 ha to showcase the performance of improved cucumber hybrids. The variety F1 Malav recorded a yield of 151.2 q/ha, which was 33.8% higher than the local check (113 q/ha), while NS-404 yielded 153.65 q/ha, achieving a 36.0% increase over the check. The profitability was also notable, with BC ratios of 3.24 and 3.18 compared to 2.56 under the local check. In 2024-25, a total of 189 demonstrations were conducted on 1.0 ha with F1 Malav, which produced 122.25 q/ha, 27.1% higher than the check yield of 96.2 q/ha and maintained profitability with a BC ratio of 2.83 against 2.15 in the check. These results confirmed that improved cucumber hybrids,



Demo on French bean production



Demo on chilli production



Demo on pea production



Radish ready for sale

particularly F1 Malav and NS-404, consistently outperformed local varieties in both yield and profitability, making them highly suitable for commercial adoption in the region.

Turnip: In 2023-24, a total of 214 demonstrations were conducted on 1.42 ha to promote the improved turnip variety PTWG. The demonstrated plots recorded a yield of 85.15 q/ha, which was 11.7% higher than the local check (76.2 q/ha). The variety also showed better profitability, with a BC ratio of 2.59 compared to 1.76 under the local check. The adoption of PTWG, along with improved crop management practices such as line sowing, enabled farmers to achieve higher yields and increased economic returns, making it a more profitable option over traditional varieties.

Spinach: A total of 195 demonstrations were conducted over 0.40 ha using the spinach variety 'All Green', introduced to replace local cultivars and enhance both productivity and profitability. Interventions such as timely sowing and improved nutrient management contributed to its success. In these demonstrations, 'All Green' variety yielded 94.45 q/ha compared to 71.2 q/ha in local varieties, recording a 32.7% increase in productivity, with a BC ratio from the demonstrations reached 2.98, whereas the check variety recorded a lower BC ratio of 2.57. These results highlight the potential of 'All Green' to improve farmer income and encourage its wider adoption in the region.

Backyard kitchen garden

To strengthen nutritional security and ensure the year-round availability of fresh vegetables for rural households in the selected village, kitchen gardens were introduced and widely promoted. These

small gardens were strategically designed to provide a continuous supply of diverse vegetables, thereby enhancing the dietary intake of farming families. Each kitchen garden, established on an area of 150-200 m², was effectively utilized to maximize vegetable production. A wide range of seasonal crops such as tomato, brinjal, chilli, okra, french bean, colocasia, radish, palak, turnip, peas, cauliflower, and coriander were cultivated in small plots of 10-50 m² close to farmers' homes. To scale up this initiative, 150 demonstrations were organized in 2023-24 and followed by another 100 in 2024-25.



Demonstrations on kitchen garden

Farmers were also provided with improved vegetable varieties and regular technical guidance to ensure higher yields and effective crop management. In addition, staggered planting techniques were promoted, which enabled a continuous harvest of fresh vegetables across different seasons. As a result, kitchen gardens not only fulfilled the household consumption needs of farm families but also contributed to their economic well-being. Surplus produce was marketed, allowing many households to earn an additional income ranging from ₹ 10,000 to ₹ 16,000 annually. Thus, the initiative simultaneously enhanced food and nutritional security while promoting income generation, making vegetable cultivation a sustainable and economically rewarding household practice.

Livestock based module:

Backyard poultry: Backyard poultry farming was introduced in the operational area as a supplementary source of income, providing farmers with an additional livelihood option. Each unit consisted of chicks of the Him Samridhi breed, which is well known for its adaptability and high egg-laying potential. In 2023-24, a total of four units, comprising 150 birds, were established. The economic analysis of these units revealed encouraging results, with net returns per unit ranged from ₹ 5,300 to ₹ 6,150. The BC ratio also remained favourable, varying between 1.86 and 1.88, which reaffirmed the financial viability of backyard poultry as a low-investment yet high-return enterprise.

Beyond income generation, backyard poultry farming significantly improved household nutrition. Each unit produced an average of 395-425 eggs, ensuring the success of this initiative, farmers were regularly provided with technical guidance on poultry management, including proper feeding practices, vaccination schedules, and disease prevention measures. This technical support helped maintain flock health and enhance egg production. This expansion not only highlighted the potential of backyard poultry farming to grow into a sustainable business but also served as a motivating example for other farmers to adopt poultry farming as an additional income generating activity.

Animal husbandry based interventions: Under livestock management, a series of targeted were implemented across the selected cluster villages to address healthcare challenges and overcome nutritional deficiencies. To enhance milk production, livestock keepers were provided with proven technologies such as urea molasses mineral blocks (UMMB), milk ration, and mineral mixtures. In 2023-24, a total of 50 demonstrations were conducted for each technology, covering 50 lactating cows. The feeding protocol was carefully structured, wherein each animal received one UMMB brick for 15 days, 2-3 kg of milk ration, and 50 g of mineral mixture per day, thereby ensuring balanced nutrition and improved productivity.

In addition to nutritional support, veterinary clinical camps were organized to treat animals suffering from various ailments, while mass awareness campaigns were conducted for the control of ecto- and endo-parasites. A total of 600 milch animals were treated during 2023-24, which significantly improved their overall health status. These initiatives directly translated into higher milk yields, with average production increased from 4.0 kg to 5.0 kg per animal per day, reflecting a consistent improvement of 1.0 kg. In subsequent years, similar results were recorded, thereby validating the effectiveness of the interventions. Beyond milk yield enhancement, the program contributed to better reproductive performance. Treated animals exhibited timely return to heat cycles, which facilitated artificial insemination and strengthened herd management practices. Consequently, the combined impact of nutritional and healthcare interventions not only boosted milk production but also improved the health, fertility, and overall productivity of milch animals in the region.



Organization of animal health check-up camps

Enterprise based module:

Beekeeping: Under the FFP project, small-scale beekeeping units were introduced in the operational area to promote sustainable livelihood opportunities for farmers. To strengthen farmers' skills, short-term training programs on scientific beekeeping practices were organized for the selected participants. Following the training, each farmer was provided with bee hives along with essential equipment such as supers, bee veils, smokers, honey extractors, and other necessary tools to ensure efficient colony management and smooth honey extraction. Although some colonies were lost due to harsh rainy conditions and extreme winter temperatures, the surviving colonies showed steady growth. Consequently, farmers were able to harvest honey in adequate quantities each year, thereby securing both nutritional benefits and additional income.

Over time, honey production per colony showed noticeable improvement. In 2023-24, demonstrations, covering 2 beekeeping units with 120 boxes, recorded an average honey yield of 21.48 kg per box. The economic analysis revealed a gross cost of ₹ 2,200 and a gross return of ₹ 5,370, resulting in a net profit of ₹ 3,170 per box with a BC ratio of 2.44. In the following year (2024-25), two units with 100 boxes were demonstrated, achieving a higher average honey yield of 30.0 kg per box. The gross cost per box was ₹ 1,500, while the gross return reached ₹ 5,000, thereby providing a net profit of ₹ 3,500 per box and a BC



Demo on mushroom production

ratio of 3.33. These results highlighted that honey yield and profitability improved considerably when colonies were managed efficiently. Additionally, colony migration to areas with diverse floral resources was found to enhance honey production while simultaneously improving colony health.

Mushroom: Under the project, white button mushroom units were successfully established in the adopted area, creating a sustainable source of income for farmers. To initiate the activity, each farmer was provided with 10 kg capacity bags after attending short-duration training sessions. This intervention not only enhanced farmers' earnings but also equipped them with the practical skills required to manage small-scale mushroom production effectively. Continuous technical guidance was provided at every stage of cultivation. Regular field visits were carried out by project staff, along with the PI and Co-PIs, to monitor progress, address challenges, and provide timely solutions. Farmers also received hands-on training on key aspects such as compost preparation, spawn selection, environmental regulation, and disease management. As a result, the initiative strengthened both the technical capacity and economic resilience of participating farmers.

During demonstrations, the average mushroom production per 10 kg bag ranged from 1.80 to 1.87 kg. The economic analysis highlighted the profitability of the enterprise, with the BC ratio ranging from 2.83 to 2.94 per rupee invested, confirming the profitability of mushroom farming in the region. Over the years, the net return per bag has ranged from ₹ 128 to ₹ 136. Recognizing its potential, farmers were linked with the State Department of Horticulture to procure mushroom compost and spawn bags at subsidized rates, thereby ensuring cost-effective production. This initiative not only enhanced farmers' income but also contributed to the long-term viability of mushroom cultivation as a profitable agri-business. With continuous technical support from university experts, farmers successfully sustained their mushroom enterprises and secured substantial returns.

Section 2.6

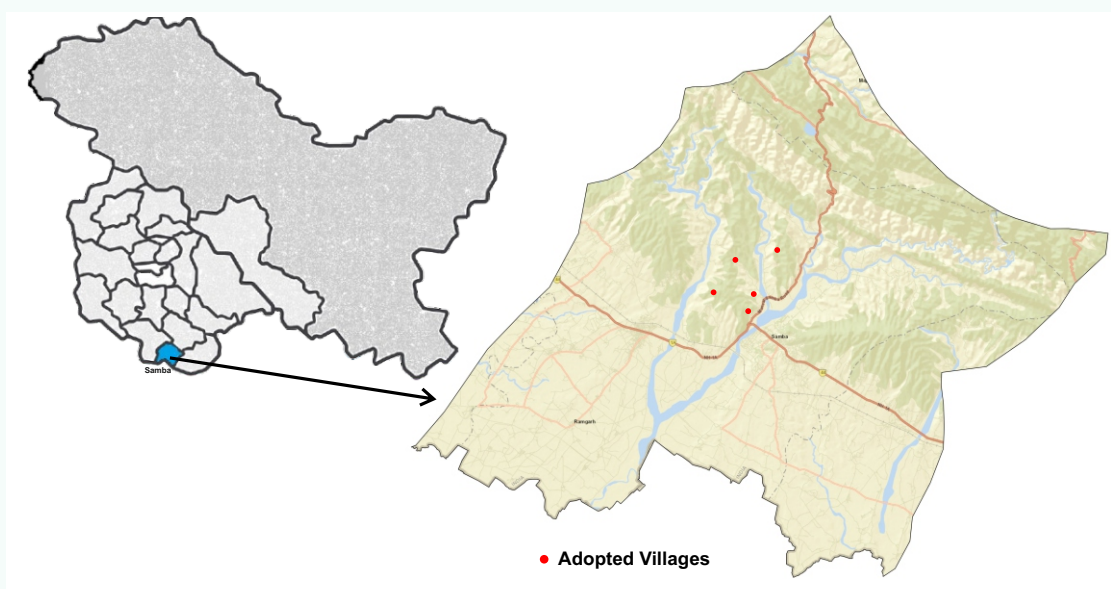
Sher-e-Kashmir University of Agricultural Sciences & Technology, Jammu

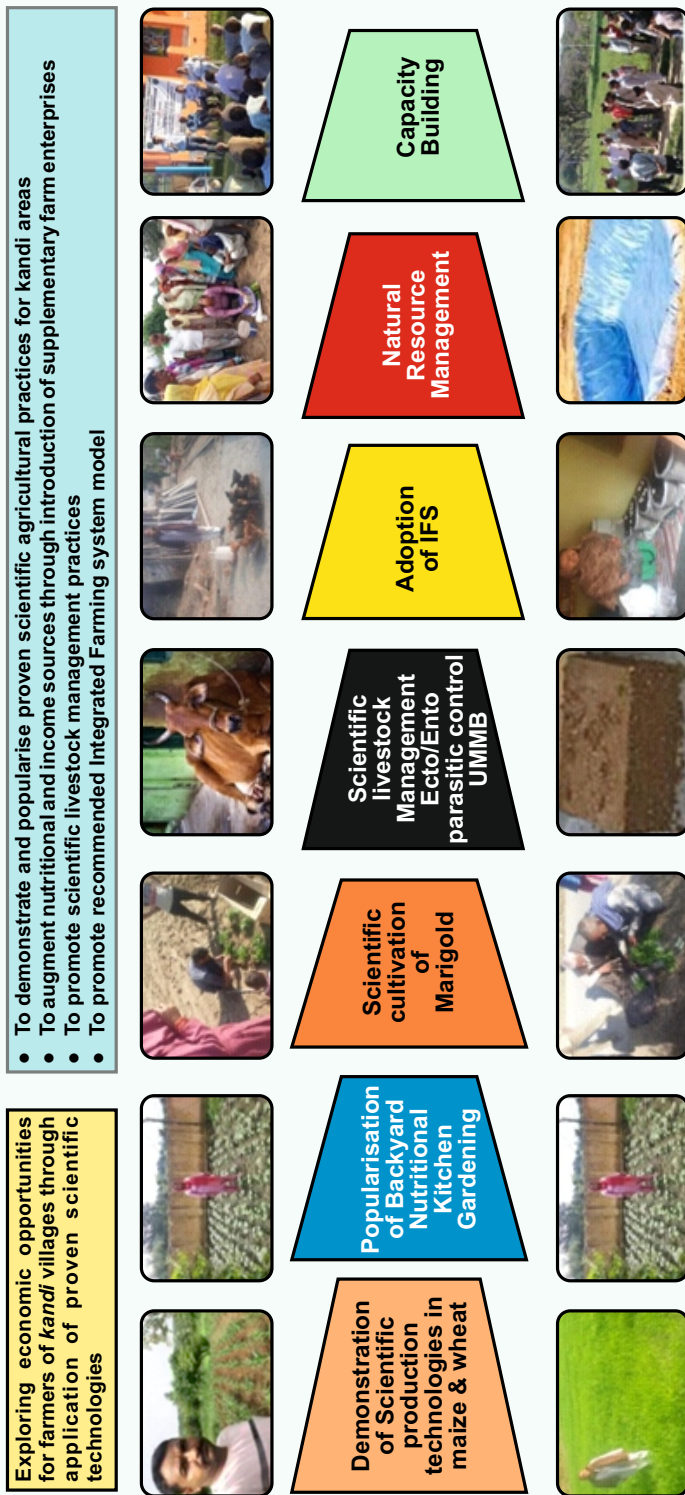
Exploring economic opportunities for farmers of Kandi villages through the application of proven rainfed technologies

Under the Farmer FIRST Programme, SKUAST-Jammu implemented a project across six villages in the Samba district of Jammu, namely Anandpur, Nagrota, Sadral, Sarmal, Sarain, and Daruie, titled "Exploring economic opportunities for farmers of Kandi villages through the application of proven rainfed technologies." The initiative seeks to address major agricultural challenges faced by the region. On average, nearly three-fourths of the farmers in the adopted villages are marginal, with landholdings of less than one hectare. The predominance of sandy loam soils presents further aggravates the situation, as they are characterized by low water retention, high infiltration rates, and increased susceptibility to erosion, all of which impede agricultural development. The maize-wheat cropping system serves as the backbone of the local economy, as 65-70% of the population depends on agriculture. Other important crops include paddy, jowar, barley, oats, and various vegetables. Agriculture in this region is entirely rainfed, receiving an average annual rainfall of 832.5 mm. Consequently, the success of farming is closely tied to rainfall patterns, which vary significantly from year to year, making agricultural outcomes unpredictable.

Research problem identification and prioritization

Based on the survey, several key challenges were identified in the adopted villages. The foremost issue is the uncertainty of rainfall results in inconsistent crop growth, reduced production, and fluctuating productivity. Soil analysis further indicated low organic carbon and phosphorus as the predominant nutrient deficiencies, thereby constraining crop output. In addition, the occurrence of crop diseases, coupled with the imbalanced use of fertilizers and ineffective pest management, adversely affects yields. Moreover, limited crop diversity along with market instability increases economic risks for farmers, thereby reducing





Graphical Abstract : SKUAST, Jammu

their resilience to fluctuating prices. In addition, weed infestations in both cereal and vegetable crops act as another barrier to productivity. Within the livestock sector, challenges such as mastitis, repetitive breeding, infertility, ectoparasites infestations, and low milk yield, all of which significantly diminish overall profitability.

Addressing these concerns necessitates the adoption of improved management practices, efficient resource utilization, and scientific interventions aimed at enhancing agricultural sustainability and strengthen farmer livelihoods. In response, the Farmer FIRST Programme has outlined objectives that include boosting the production and productivity of major cereals and vegetable crops, establishing mushroom production units to supplement farm income, and introducing quality backyard poultry breeds to support low-income households. In addition, the initiative seeks to enhance animal production in the district to bridge the demand supply gap while simultaneously improving farmers' income, employment opportunities, living standards, and nutritional security. Furthermore, the programme emphasizes the adoption of suitable technologies to reduce drudgery and ensure livelihood security for farm women. Alongside this, innovative models have been developed to strengthen linkages among agricultural stakeholders through ICT-based approaches. Lastly, economically viable and socially compatible technologies will be assessed and integrated into profitable coping strategies and sustainable integrated farming systems.

COMPONENT-I:

Enhancing Farmer - Scientist Interface

To ensure active multi-stakeholder engagement, a series of regular training programmes, farm visits, workshops, field days, kisan goshies, and other extension activities were organized. These initiatives promoted a continuous flow of ideas between farmers and stakeholders, enabling the identification of field-level challenges, the setting of research needs, and the development of location-specific technologies. In 2023-24, a total of 28 extension activities were conducted with the participation of 976 farmers, while in 2024-25, a total of 17 such activities were organized, engaging of 513 farmers. These sessions covered a wide range of agricultural aspects, including crop cultivation practices, disease management, integrated farming, livestock development, and value addition. In addition, awareness programmes on government schemes and participation in national conferences helped farmers remain updated about emerging opportunities and technological advancements. Through these collective efforts, the programme not only strengthened agricultural knowledge and promoted technology adoption but also empowered farmers, thereby demonstrating a strong commitment to enhancing productivity and sustainability within the farming



Farmer - Scientist interaction



Organization of Kisan Gosthi

community. Farm innovators were identified and groomed as technology agents under various themes. For revitalization of poultry farming, Sh. Pritam Singh from Sarain village was selected. For diversification and income generation, Sh. Rishpal Chand from Sadral village and Sh. Kelash Kumar Sharma from Nagrota were identified. To maximize income through mushroom farming, Sh. Subash Singh from Sarmal village was chosen, while for shifting to commercial okra cultivation for higher profit, Sh. Pritam Chand from Daruie village was selected.

COMPONENT-II:

Technology Assemblage, Application and Feedback

To enhance crop productivity, reduce yield gaps, improve animal health, and strengthen food and livelihood security in the adopted areas, a range of economically viable and socially acceptable technological solutions were developed. In this direction, various modules focusing on crops, horticulture, enterprises, and livestock were designed to address specific challenges, thereby providing a strategic framework for promoting sustainable agriculture.

Crop based Module:

To replace traditional broadcasting methods, the project promoted line sowing using seed drills. This technique ensures uniform seed placement, better seed soil contact, and improved germination, which together contribute to higher yields. Moreover, line sowing supports better crop establishment, enables efficient utilization of resources, and facilitates effective weed management. It also optimizes the application of fertilizers and pesticides while allowing the use of mechanized operations. As a result, this adoption has significantly enhanced both agricultural productivity and resource use efficiency. Furthermore, by introducing advanced sowing techniques, the project team has successfully mechanized farming practices in the adopted area, thereby improving farmers' profitability.

Increasing maize productivity and income in Samba district: The intervention was undertaken with the objective that adopting the recommended package of practices would significantly enhance crop yields. To achieve this, demonstrations were conducted in 2023-24 on the maize hybrid Dekalb-9144 against the check variety Kanchan, integrating recommended critical inputs. A total of 443 demonstrations were carried out over 72.0 ha, benefiting 443 farmers. The results showed that demonstration plots achieved a yield of 24.8 q/ha compared to 19.3 q/ha in check plots, marking a 28.5% increase and clearly highlighting the effectiveness of improved practices. The economic analysis further indicated substantial gains, with net returns of ₹ 34,139/ha and a BC ratio of 2.93 in demonstration plots, as against ₹ 22,337/ha and a BC ratio of 2.30 in check plots. These findings confirmed that the adoption of high yielding maize hybrid along with recommended agronomic practices significantly enhanced productivity and profitability in Samba district. The results also demonstrated that farmers can secure higher income and improved livelihood security under rain-fed conditions by adopting scientific crop management practices (Figure 6.1).

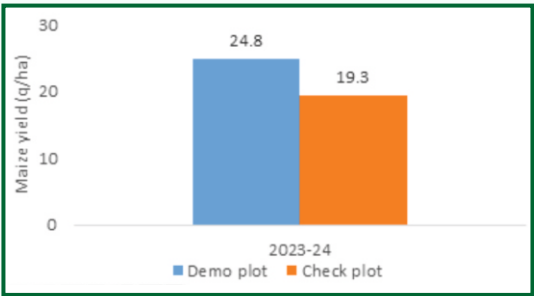


Fig. 6.1: Comparison of maize yield (q/ha) between demo and check plots

Enhancing farm profitability through toria crop: During 2024-25, the toria crop was introduced in the villages of Sarmal and Anandpur in the Uttervehni area. Since farmers in this region had significantly reduced maize cultivation due to frequent damage by monkeys and other wild animals, the introduction of toria provided a promising alternative. Although occasional losses from peacocks were reported, the crop otherwise suffered minimal damage, making it a suitable replacement. Consequently, a total of 13 demonstrations were conducted on one hectare on toria variety RSPT-6. Furthermore, the crop was harvested by the end of December, which slightly delayed wheat sowing, however, all farmers managed to plant wheat afterward and obtained good yields. In comparison, the check plots yielded 6.7 q/ha with a net income of ₹ 9,016 and a BC ratio of 1.29, whereas the demonstration plots recorded an improved yield of 7.8 q/ha, a net income of ₹ 16,632, and a BC ratio of 1.53. Thus, the results clearly indicate that improved toria cultivation practices almost doubled the net returns and enhanced overall profitability, as reflected by the increase in the BC ratio from 1.29 to 1.53.

Enhancing wheat productivity and income under rain-fed areas: In the adopted area, scientists observed a significant yield gap in wheat cultivation due to the limited adoption of scientific inputs and modern farming techniques. Baseline assessments revealed that farmers were reusing grains from the previous year as seeds and applying little to no fertilizers and herbicides. To address this issue, demonstrations were conducted during 2023-24 and 2024-25 to introduce high-yielding wheat varieties under rain-fed conditions. In 2023-24, demonstrations were carried out on 59.6 ha on 397 farmer's field using the variety HD-3237 against the check variety HD-2967. The results showed that demonstration plots recorded a yield of 27.5 q/ha compared to 23.4 q/ha under traditional practices, reflecting a 17.4% yield increase. This improvement enhanced net returns to ₹ 36,627/ha with a BC ratio of 2.40, compared to ₹ 27,643/ha and a BC ratio of 2.09 in check plots.

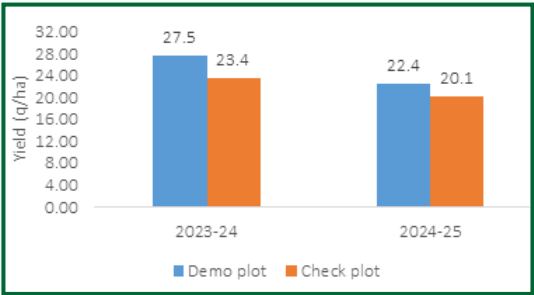


Fig. 6.2: Comparison of wheat yield (q/ha) between demo and check plots

Similarly, in 2024-25, a total of 47 demonstrations were conducted on 10.0 ha using the variety DBW-222 against the same check variety (HD-2967). The demonstration plots achieved a yield of 22.4 q/ha as compared to 20.1 q/ha in check plots, indicating an 11.4%



Demo on wheat crop



Demo on maize crop

increase in productivity. Consequently, the demonstrations generated a net return of ₹ 33,818/ha with a BC ratio of 2.01, as against ₹ 27,605/ha and a BC ratio of 1.84 in traditional practices. The results clearly demonstrated that the adoption of high yielding varieties, coupled with improved agronomic practices, significantly enhanced wheat productivity and profitability under rain-fed conditions. These interventions not only bridged the yield gap but also empowered farmers to achieve higher income and better livelihood security. The yield comparison between the demo and check during 2023-24 and 2024-25 is presented in Figure 6.2.

Horticulture Based

Introduction of commercial cultivation of okra in wild animal-prone areas: Farmers in the adopted villages often suffer severe losses due to damage caused by wild animals such as monkeys, wild pigs, peacocks, and wild cows, which particularly affect maize and wheat crops. To mitigate these challenges, farmers were encouraged to cultivate okra, as its spiny surface effectively deters wild animals. In 2023-24, demonstrations of the variety Jammu Okra-05 (Seli Special) were conducted against the local check variety. A total of 8 demonstrations were organized on 0.3 ha, benefiting 8 farmers. The results proved highly effective, as demonstration plots recorded yields of 82.0 q/ha compared to 68.5 q/ha in check plots, showing a 19.7% increase in productivity. Economically, okra cultivation generated net returns of ₹ 1,15,451/ha with a BC ratio of 2.46, whereas traditional practices provided only ₹ 85,889/ha with a BC ratio of 2.12. Beyond offering protection from wild animals, okra cultivation provided significantly higher profitability compared to other crops, making it a viable alternative for farmers in vulnerable areas. Moreover, this intervention not only safeguarded adjacent crops from animal damage but also inspired neighbouring farmers to adopt okra cultivation, thereby creating new income opportunities. The success of this initiative has sparked growing interest, with many farmers planning to expand okra cultivation in the coming seasons to counter wild animal threats and enhance earnings.

Promotion of backyard kitchen gardens for nutritional security: Nutri-gardens, each measuring 154 m² area, were established in the adopted villages primarily benefiting farm women. Each garden was divided into 12 sections to promote the cultivation of diverse and seasonal vegetables. Seeds and seedlings of ten major vegetables tomato, knol khol, chilli, cauliflower, brinjal, methi, spinach, coriander, broccoli, and radish were provided, along with fruit plants like guava, lemon, and mango for boundary planting. The adoption of these improved varieties, together with the application of scientific cultivation techniques, not only led to increased yields but also enhanced the nutritional quality of the vegetables



Demo on okra crop



Demo on kitchen gardening

consumed by farmers. Consequently, this initiative contributed significantly to improved household food security while simultaneously providing economic benefits through surplus production.

Marigold cultivation: This intervention aimed to enhance the income of small farmers by promoting non-cereal based activities such as flower cultivation. In the adopted area, farmers received training in scientific crop management and were provided with improved marigold varieties, along with guidance on proper spacing, nutrient management, and intercultural operations such as earthing up and pinching. In 2023-24, two demonstrations were conducted on 0.1 ha with the variety local selection of Narangi against the check desi/local variety. The results showed a yield of 53.75 q/ha in demonstration plots compared to 41.25 q/ha under traditional practices, representing a 30.3% increase. This yield improvement enhanced net returns to ₹ 62,000/ha with a BC ratio of 3.53, as compared to ₹ 28,500/ha and a BC ratio of 2.22 in the check plots. The results clearly demonstrated that the introduction of improved marigold varieties and scientific cultivation practices not only increased yields but also doubled farmers' income. In addition, marketing linkages with flower dealers at Bahu Fort and Chichi Mata Temple in Jammu and Samba districts ensured better procurement opportunities, reduced transportation costs, and improved market access.

In 2024-25, demonstrations were further expanded with the variety Ez Ketki yellow and Ez Mrunal orange against the check variety local Gutti. A total of six demonstrations were conducted on 0.05 ha. Demonstration plots recorded a yield of 60.0 q/ha as compared to 36.9 q/ha in check plots, reflecting a remarkable 62.6% increase. This intervention generated net returns of ₹ 4,48,100/ha with a BC ratio of 4.74, significantly higher than ₹ 1,44,900/ha and a BC ratio of 2.24 under traditional practices. One of the beneficiaries, who earn his livelihood as a pandit (priest), has a regular need for flowers because of the frequent cultural and religious activities in his locality. The village of Anandpur (Utterbehni) is especially renowned for conducting "Pind Daan" rituals on every Amavasya, resulting in a consistently high demand for flowers throughout the year. Overall, the Farmer FIRST project intervention significantly enhanced the profitability and economic stability of small farmers through non-cereal diversification (Figure 6.3).

Fruit tree plantation: Building on the successful partnership with Lupin Pharmaceutical Pvt. Ltd. in 2023-24, horticulture interventions were further enhanced in 2024-25. Biochar-based trials were conducted in lemon, mango, and apple orchards to assess its role in moisture retention during dry spell. Additionally, 100 apple plants (variety HRMN 99) were planted in adopted villages on a 50% cost-sharing basis, promoting farmer ownership and orchard care. These efforts advanced sustainable horticulture, income diversification, and risk reduction

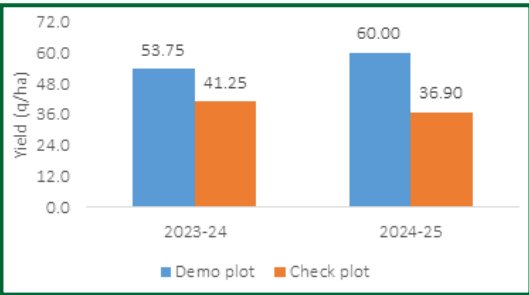


Fig. 6.3: Comparison of marigold yield (q/ha) between demo and check plots



Demo on marigold

in the Kandi region of Samba district. From orchards established in 2024-25, a 68.10% plant survival rate was recorded. An on-farm assessment was conducted to evaluate the survival and mortality of four perennial horticultural species *Citrus limon* (lemon), *Mangifera indica* (mango), *Carissa carandas* (karonda), and *Malus domestica* (apple) planted under the project in July 2024 across selected villages along the Devika River. Observations recorded in August 2025 showed that out of 837 plants established, 570 survived while 267 were lost, resulting in a survival rate of 68.10% and a mortality rate of 31.89%. These results indicate a moderate establishment success of the perennial horticultural crops under the prevailing agro-climatic conditions.

Enterprise Based Module

Promotion of Mushroom cultivation: In the adopted villages, most farmers are small and marginal, with landholdings of less than 0.5 ha. Recognizing mushroom cultivation as a profitable option for additional income, the FFP team initiated training and demonstrations to encourage its adoption. In 2023-24, a total of 75 farmers were supported through demonstrations of white button mushroom. The average yield per bag reached 2.25 kg, with a gross cost of ₹ 125 per bag and a gross return of ₹ 310 per bag, resulting in a net return of ₹ 185 per bag and a BC ratio of 2.48. Encouraged by this success, in 2024-25, demonstrations were expanded to 47 farmers, where the yield improved to 2.6 kg per bag. The economics were even more favourable, with a gross cost of ₹ 120 per bag and a gross return of ₹ 325 per bag, providing a net return of ₹ 205 per bag and a BC ratio of 2.71. These interventions clearly demonstrated the economic viability of mushroom cultivation, motivating farmers to adopt it as a sustainable income generating enterprise. As a result, many farmers have now begun preparing compost for large-scale cultivation, while others purchase ready-to-use bags. The initiative has not only diversified income sources but also enhanced livelihood security, making mushroom farming a flourishing enterprise in the project area.

Beekeeping for income diversification: Crop production and livestock rearing are dominant activities in the project area, while beekeeping has traditionally been considered as a side-line enterprise. However, small-scale beekeeping can significantly strengthen the livelihood security of small and marginal farmers. Recognizing the potential, the FFP team promoted beekeeping by organizing training and capacity-building programmes. In 2023-24, four farmers were supported to establish four beekeeping units comprising 100 boxes. The average honey production was 11.5 kg per box, with a gross cost of ₹ 934 per box and a gross return of ₹ 3,450 per box, resulting in a net return of ₹ 2,516 per box and a BC ratio of 3.69. Building on this, in 2024-25, two farmers set up two units with 95 boxes. Although the honey yield declined slightly to 8.5 kg per box, the economics remained profitable, with a gross cost of ₹ 708 per box and a gross return of ₹ 2,350 per box, leading to a net return of ₹ 1,642 per box and a BC ratio of 3.32. These interventions demonstrated that beekeeping is a low-cost, high-return enterprise that not only supplements household income but also reduces farmers' dependence solely on crop cultivation. Moreover, with improved hive management, migration practices, and support for honey processing, bottling, and branding, farmers are now better positioned to sustain this enterprise as a reliable source of income diversification.

Vermicomposting using HDPE beds: As part of the project, vermicomposting in HDPE beds was introduced as an eco-friendly, cost-effective method to convert farm and household waste into nutrient-rich compost. This



Demo on mushroom production



Demo on vermicomposting

practice enhances soil fertility, improves structure, and reduces reliance on chemical fertilizers, promoting sustainable agriculture. To encourage adoption, 10 training and demonstration sessions were conducted in the adopted villages, focusing on hands-on guidance for setting up vermi-beds, preparing bedding, layering compost. These units can produce nearly 30 tonnes of high-quality vermicompost annually, improving soil health, water retention, and vegetable yields while strengthening livelihoods.

Livestock Based Module

Promotion of Backyard Poultry: This initiative significantly improved the socio-economic conditions of farmers by promoting backyard poultry farming, which provided additional income, employment opportunities, and a means to combat malnutrition. Resource-poor farmers were encouraged to adopt this low-investment practice, primarily benefiting from meat and egg sales. To support them, regular training sessions were organized by FFP team experts. During 2023-24, more than 1,000 Chabro birds were distributed among 62 farmer families in the adopted villages, while in 2024-25, over 500 Chabro birds were supplied to 5 farmer families. These birds were specifically selected for their adaptability to local conditions and their higher productivity. As a result, farmers not only achieved better income but also diversified their livelihoods beyond crop farming. Consequently, backyard poultry farming has emerged as a sustainable livelihood option and an effective tool for rural economic empowerment, enabling farmers to earn a steady income and enhancing overall agricultural productivity.

Demonstrations on mineral mixture: The FFP team identified poor nutrition as a key constraint affecting indigenous cattle, leading to low milk yields and health issues. Farmers mainly relied on fodder, with limited use of mineral supplements due to cost and lack of awareness. To address this, training and on-farm demonstrations were conducted to highlight the role of minerals in enhancing fertility, immunity, and productivity, with experts providing on-site guidance for proper adoption. In 2023-24, a total of 17 demonstrations were conducted on Holstein Friesian cattle, covering 17 animals. The daily milk yield of the demonstration group increased to 10.25 litres per animal, compared to 9.69 litres in the check group, showing a 5.8% rise. The economics also reflected significant gains, as the demonstration group achieved a gross return of ₹ 15.9 per litre with a net return of ₹ 1.42 per litre and a BC ratio of 1.42, while the check group recorded only ₹ 4.86 per litre net return with a BC ratio of 0.44. These findings showed that mineral mixtures increased milk yield, improved profitability, and enhanced farm productivity, animal health, and economic sustainability for rural households.



Demo on backyard poultry



Demo on goatry unit

Impact of goatry intervention on farmers' livelihoods: The goatry intervention, launched in collaboration with Lupin Pharmaceutical Pvt. Ltd., has proven effective in improving the livelihoods of participating farmers. In 2024-25, each farmer received a flock of five goats valued at ₹ 25,000, contributing only 20% (₹ 5,000) themselves. Over the year, outcomes were mixed but overall positive. Farmer Sh. Rishpal Chand maintained five goats by purchasing additional animals and earned ₹ 20,000 from sales, increasing his flock's present value to ₹ 50,000. Farmer Sh. Reshma experienced high mortality but retained one goat and two kids, valued at ₹ 18,000. Sh. Ramesh Chand and Sh. Jhinder Pal each kept four goats, with a present value of ₹ 48,000. The total value of all units rose from ₹ 1,00,000 to ₹ 1,64,000, reflecting significant asset growth. This initiative has provided an alternative income source and motivated farmers to expand goat farming as a reliable subsidiary occupation alongside crops.

NRM based module:

Effect of biochar application on soil moisture retention in orchard crops: Biochar, a carbon-rich material derived from organic waste, is a sustainable tool that helps orchard crops withstand water stress and promotes better growth under limited water conditions. An experiment was conducted across six farm trials with mango, lemon, mosambi, and apple to evaluate biochar's effect on soil moisture compared to the Recommended Dose of Fertilizer (RDF) and farmers' traditional practices. Each trial included four treatments like T1 (RDF), T2 (biochar 5 t/ha, 56 g/tree), T3 (biochar 2 t/ha, 140 g/tree), and T4 (farmer's practice). Results showed that biochar at 5 t/ha significantly improved soil moisture, enhancing crop growth, drought resilience, and nutrient use efficiency, while lower doses also provided benefits. Conventional fertilizer and traditional practices were less effective in retaining soil moisture. These findings demonstrate that biochar is an effective soil amendment for sustainable orchard management, particularly under water-limited conditions.

Integrated Farming Systems (IFS) based Module

Enhancing Agricultural Income and Productivity through IFS in Rainfed Areas: Agriculture in rainfed regions poses challenges for small and marginal farmers with less than one hectare, relying on uncertain rainfall (400-700 mm) and limited irrigation. Frequent dry spells, soil diversity, topography, and risks from wild animals lead to unstable yields. To address these issues, integrated farming systems (IFS) were introduced, combining crops with livestock, mushroom farming, poultry, beekeeping, horticulture, and

vermicomposting. This approach diversified income, improved soil fertility, reduced reliance on external inputs, and enhanced climate resilience. Twenty IFS units were established, generating 22-55 additional workdays and local employment. In Samba district, J&K, IFS adoption increased productivity, profitability, food and nutritional security, and promoted sustainable resource use, emerging as a transformative model for stable and resilient rainfed agriculture.

For the year 2023-24, the analysis of different IFS models clearly highlights that diversification with enterprises such as mushroom, dairy, floriculture, horticulture, and backyard poultry significantly enhanced farmers' income compared to conventional crop-based practices. Among the models, mushroom-based systems proved highly profitable, with the Mushroom-Dairy combination yielding the maximum net income of ₹ 92,000, followed by Mushroom-Agri-Dairy systems where incomes ranged from ₹ 49,010 to ₹ 78,400. Horticulture-Agriculture-Dairy also emerged as a highly rewarding system, mainly due to commercial okra cultivation, which contributed a substantial net income of ₹ 1,44,500. Similarly, Agriculture-Floriculture-Mushroom and Agriculture-Backyard Poultry-Dairy systems generated encouraging net returns, ranging from ₹ 32,880 to ₹ 36,600 and ₹ 11,300 to ₹ 37,776, respectively. In contrast, conventional maize, wheat, and fodder alone provided relatively low net incomes between ₹ 1,980 and ₹ 7,485. These findings demonstrate that integration of high-value enterprises like mushroom, okra, floriculture, and livestock within IFS models is a more sustainable and profitable pathway for small and marginal farmers.

The IFS models during 2024-25 showed diverse income-generating options by combining crops, livestock, mushrooms, floriculture, and horticulture. Among these, the Horticulture-Agriculture-Dairy system performed the best, recording the highest net income of ₹ 1,41,873, primarily due to commercial okra cultivation and dairy. The Agriculture-Floriculture-Mushroom system also generated high returns (₹ 1,34,200), supported by paddy, mushroom, floriculture, and dairy enterprises. Similarly, the Mushroom-Agriculture-Backyard system and Agriculture-Backyard poultry-Dairy system earned ₹ 1,14,911 and ₹ 1,03,872 net income, respectively, through integration of crops, backyard poultry, and dairy. Meanwhile, the Mushroom-Dairy-Agriculture system yielded ₹ 96,275, which was lower compared to others but still profitable. Overall, the inclusion of high-value enterprises like mushroom, floriculture, horticultural crops, and dairy ensured higher profitability and sustainability of the farming systems compared to conventional crop-based farming.

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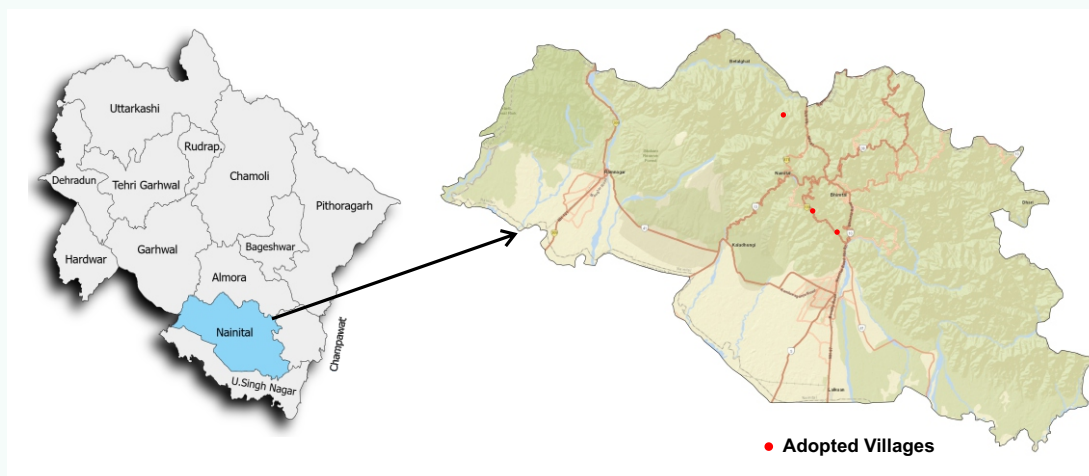
Enhancing Livelihood Opportunities of Farming Community in the Mid-hills of Uttarakhand

The GBPUAT, Pantnagar, conceptualized the Farmer FIRST Programme titled "Enhancing Livelihood Opportunities of Farming Community in the Mid-hills of Uttarakhand." The project was extensively implemented in the villages of Dogra, Jeoli, Syalikhhet, and Suryajala in Bhimtal block, Nainital. Among these, Suryajala is the newly adopted village. In Suryajala, where 70 farm families were covered, the major challenges identified included low crop yields, poor household income, limited technical knowledge, and the absence of effective marketing channels. In Syalikhhet, 50 households were adopted, of which 88% marginal farmers are primarily cultivating wheat, paddy, urd, and maize. Similarly, in Dogra village, a total of 30 households were adopted, and 95% of them are marginal farmers. Farmers in this village are particularly engaged in vegetable cultivation, growing crops such as okra, brinjal, chilli, french beans, tomato, radish, green leafy vegetables, and cabbage. Likewise, in Jeoli, a total of 60 households were adopted, with 85% belonging to marginal farmers and the remaining 15% falling into medium and large farming categories. In addition to field crops, these villages also grow horticultural crops including strawberry, mango, pear, banana, papaya, and tejpatha. Furthermore, wage employment forms a major component of livelihoods, as many households work in nearby areas due to the villages' proximity to the Nainital Highway.

Research problem identification and prioritization

The adopted villages face multiple challenges, including undulating terrain, fragmented landholdings, water scarcity, and frequent wildlife threats, all of which make agriculture both difficult and less remunerative. As a result, most communities depend primarily on subsistence farming. Consequently, these constraints have triggered large-scale migration, with male out-migration being especially prominent. The baseline survey highlighted critical gaps in vegetable cultivation practices. Farmers neither treat seeds nor adopt plant protection measures, leading to heavy disease related losses. This situation is further aggravated by the absence of post-harvest management practices such as proper packaging, storage, and marketing. Although a nearby canal serves as the main source of irrigation, water scarcity continues to be a major challenge, particularly during the summer months (April to June). Moreover, while all households rear cattle mainly buffaloes and cows around 80% of farmers report low milk productivity, leaving little surplus for sale. Productivity is constrained by the predominance of local breeds, combined with year round fodder shortages and limited knowledge of scientific feeding practices. Therefore, farmers urgently require technical guidance on fodder enrichment and conservation, along with timely access to veterinary services, in order to improve livestock productivity and secure better livelihoods.

Given the fragility of the mountain ecosystem, achieving a balance between development and environmental conservation remains a pressing challenge. In response, the project was designed to enhance farmers' income and promote economic empowerment through the introduction improved technologies and sustainable livelihood options such as poultry farming, beekeeping, and mushroom cultivation. In this direction, the project not only emphasizes the adoption of improved vegetable varieties



but also promotes the use of bio-control measures and imparts primary processing skills to strengthen farmers' capacities. Additionally, it seeks to improve market access by facilitating the collective marketing of vegetables and fruits through farmer groups, thereby enhancing bargaining power and reducing dependence on intermediaries. Moreover, the initiative aims to expand opportunities in poultry farming by equipping farmers with both critical inputs and essential skills. Finally, recognizing the burden of labour intensive agricultural activities, the project gives special attention to reducing drudgery among farm women through the introduction of labour saving tools. In every aspect, special emphasis was placed on the newly adopted village, Suryajala, followed by the previously adopted villages Jeoli, Syalikhhet, and Dogra.

COMPONENT-I:

Enhancing Farmer - Scientist Interface

During 2023-24, a total of 640 farmers participated in 26 capacity building activities, whereas in 2024-25, a total of 614 farmers engaged in 24 activities conducted across the adopted villages. To strengthen agricultural and livestock management practices, a series of training programs were organized. Poultry management training was conducted repeatedly for beneficiaries, while farmers were also introduced to mushroom cultivation techniques, particularly button mushroom production. In addition, training sessions focused on key agricultural practices such as mulch application, fodder production, vegetable cultivation, and seedbed preparation, all aimed at improving crop productivity. Equal emphasis was placed on livestock development, with special attention to the rearing of local breeds of Plains goats in the mid-hills. Furthermore, targeted training for Self-Help Group (SHG) members was conducted to enhance decision-making and entrepreneurship skills in beekeeping enterprises. Moreover, off-campus training programs further provided farmers with practical exposure and hands-on learning opportunities equipping them with essential skills for diversified income generation. Collectively, these interventions not only enhanced technical knowledge but also contributed to higher productivity and the promotion of sustainable livelihood opportunities in the region. Two farmers from each of the four villages were identified as innovator to serve as key resource persons for technology dissemination and capacity building. Accordingly, special emphasis was placed on grooming them through exposure visits, farmer-to-farmer interactions, and training sessions conducted by professionals to enhance their entrepreneurial skills. The identified farmers included Govind Paladia and Tulsi Jeena from Dogra, Pooran Chandra Pandey and Shekhar Chandra Bhatt from Jeoli, Indra Devi and Ganga Bisht from Syalikhhet, and Dolly Surya and Deepa Surya from Suryajala.



Farmer-scientist interaction



Farmer-scientist interaction

COMPONENT-II:

Technology Assemblage, Application and Feedback

Under this component, a broad spectrum of interventions was implemented across multiple modules, leading to a substantial increase in agricultural output in the adopted villages. These scientific measures not only enhanced farmers' technical knowledge but also accelerated the adoption of innovative technologies, which in turn played a pivotal role in encouraging reverse migration. Consequently, migration rates declined markedly, with particularly visible impacts in Jeoli and Syalikheth. The initiative also strengthened marketing channels for processed honey, vegetables, and poultry products, thereby improving farmers' market access and income opportunities. At the same time, the interventions significantly empowered hill women by reducing drudgery. In Syalikheth, for instance, the backyard poultry initiative led to a two fold increase in women's income. This not only enhanced their financial resilience but also improved nutritional security by ensuring a steady supply of home produced eggs and meat for household consumption. Furthermore, the adoption of drudgery reducing technologies improved work efficiency, minimized physical strain, and optimized working hours, enabling women to carry out agricultural and household activities with greater ease and proficiency.

Crop based modules:

Cultivation of fodder crop: Cattle rearing is a common practice across nearly all households in the study area, with dairying serving as an important supplementary source of income. However, a persistent challenge is the shortage of quality fodder, which varies depending on farmers' socio-economic conditions. Since most farmers depend on tree leaves and forest grasses for year round feeding, they often supply unchaffed fodder, leading to nutritional stress. This practice not only reduces milk yield but also makes animals more vulnerable to diseases. To address this challenge, demonstrations on the improved fodder maize variety Pant Sankul Makka-3 (PSM-3) were carried out during the kharif season. In 2023-24, a total of 52 demonstrations covering 1.8 ha were conducted, benefiting 52 farmers. Similarly, in 2024-25, a total of 30 demonstrations over 0.4 ha were implemented, covering 30 beneficiaries. These results clearly demonstrate that the adoption of PSM-3 not only helped to bridge fodder shortages but also enhances farm profitability, thereby contributing to improved livestock nutrition and productivity in the region.

Horticulture based modules:

The survey indicated that nearly 80% of farmers in the study area still rely on low-yielding local varieties, largely sourced from local markets or middlemen where seed quality is often unreliable. This practice

contributes to low productivity and poor farm returns. To address this constraint and enhance agricultural output, improved vegetable seed varieties were distributed among selected farm families. The intervention resulted in notable improvements in yield and quality, which directly translated into higher farm incomes. In addition, the initiative promoted the wider adoption of improved varieties in combination with cost-effective and locally suited cultivation practices, thereby ensuring both economic gains and long-term sustainability of vegetable production in the region.

Coriander: In 2023-24, a total of 146 demonstrations were conducted on 2.2 ha using the improved coriander variety Pant Haritima to showcase its superiority over the local check. The demonstrated variety recorded a yield of 72.0 q/ha, which was 24.4% higher than the local check (57.9 q/ha). Profitability was also superior, with a BC ratio of 3.90 compared to 3.04 for the check. Similarly, in 2024-25, a total of 100 demonstrations were laid out on 1.4 ha, where Pant Haritima recorded a yield of 70.0 q/ha, 17.1% higher than the local check (59.8 q/ha). The BC ratio was 3.67 against 2.34 for the check. These findings clearly establish the economic and agronomic advantage of Pant Haritima, leading to strong farmer preference due to its consistent higher yield, profitability, and reliability across production seasons.

Okra: During 2023-24, a total of 122 demonstrations were conducted out on 1.8 ha with the improved variety Parbhani Kranti against the local check Arka Anamika. The demonstrated variety achieved a yield of 112.0 q/ha, representing a 34.0% increase over local check (83.6 q/ha). The BC ratio also reflected higher profitability (3.58) compared to the check (2.55). In 2024-25, a total of 94 demonstrations were laid on 1.2 ha, where Parbhani Kranti yielded 106.8 q/ha, showing a 22.8% higher than the check (87.0 q/ha). The BC ratio remained significantly favorable at 3.50, as against 2.31 for the check. These results consistently confirm the superiority, economic viability, and farmer acceptability of Parbhani Kranti, making it a reliable option for enhancing okra productivity and profitability in the mid-hill region.

French bean: In 2023-24, a total of 102 demonstrations were conducted on 2.4 ha with the variety Pant Anupama against the local check VL Bean-2. The demonstrated variety recorded a yield of 74.6 q/ha, 25.8% higher than the check (59.3 q/ha), with a BC ratio of 3.70 compared to 2.47 under the check. In 2024-25, a total of 90 demonstrations laid out on 1.0 ha further confirmed its superiority, as Pant Anupama yielded 72.8 q/ha, which was 18.2% higher than the check (61.6 q/ha). The BC ratio was also higher (2.96) compared to the local check (1.96), ensuring better returns for farmers.

Bitter gourd: In 2023-24, a total of 130 demonstrations were conducted on 0.8 ha with Pant Karela-1 compared to the local check Pragati. The variety achieved a yield of 91.5 q/ha, which was 33.2% higher than the check (68.7 q/ha). Its BC ratio was also higher at 4.05 against 2.76 in the check. In 2024-25, a total of 124 demonstrations were conducted on 0.4 ha, where Pant Karela-1 recorded a yield of 85.8 q/ha, which was 22.6% higher than the check (70.0 q/ha). Although the BC ratio reduced slightly to 3.05, it was still significantly higher than the check (1.88), reflecting clear profitability.

Ridge gourd: During 2023-24, a total of 120 demonstrations were conducted on 0.7 ha using the improved sponge gourd variety Pant Torai-1 against the local check Hari Chikni. The demonstrated variety recorded a yield of 102.8 q/ha, representing a 30.6% increase over the local check (78.7 q/ha), with a BC ratio of 3.79 compared to 2.77 in the check. In 2024-25, a total of 112 demonstrations were laid out on 0.3 ha, and Pant Torai-1 recorded a yield of 89.9 q/ha, which was 20.0% higher than the local check (74.9 q/ha). Its BC ratio (3.46) again proved superior to the check (1.82), making it highly profitable.

Onion: In 2023-24, 43 demonstrations were carried out on 2.0 ha using the improved onion variety Agrifound Light Red against the local check Nasik Red. The demonstrated variety recorded a yield of 198.6 q/ha, which was 24.2% higher than the check (159.9 q/ha). Profitability was also superior, with a BC ratio of 4.07 against 3.10 in the check. In 2024-25, a total of 30 demonstrations were conducted on 2.0 ha, where Agrifound Light Red yielded 179.9 q/ha, a 13.9% increase over the check (158.0 q/ha). The BC ratio again favoured Agrifound Light Red (3.73) over the check (2.14), reaffirming its superiority in both productivity and economic returns.

Chilli: In 2023-24, a total of 146 demonstrations were carried out on 1.6 ha with the improved chilli variety Pant C-1 compared to the local check Divya Jyoti. The demonstrated variety achieved a yield of 66.3 q/ha, which was 33.7% higher than the check (49.6 q/ha). Its BC ratio (4.00) was also superior to the check (2.73). In 2024-25, a total of 95 demonstrations were laid out on 1.0 ha, where Pant C-1 recorded a yield of 63.8 q/ha, showing a 25.1% increase over the check (51.0 q/ha). Its BC ratio was 3.81 against 2.31 in the check, confirming its profitability.

Bottle gourd: In 2023-24, 114 demonstrations were conducted on 0.6 ha with Pant Lauki-3 compared to the local check Pusa Naveen. The demonstrated variety recorded a yield of 210.3 q/ha, which was 29.1% higher than the check (163.0 q/ha). Its BC ratio of 3.88 compared to 2.81 in the check. In 2024-25, 128 demonstrations were conducted on 0.4 ha, where Pant Lauki-3 yielded 188.4 q/ha, showing an 18.5% increase over the check (159.0 q/ha). The BC ratio was also superior at 3.92 compared to 2.50 in the check, ensuring higher profitability.

Turmeric: In 2024-25, a total of 146 demonstrations were conducted on 0.6 ha using Pant Pitabh against the local check Prabha. The improved variety recorded a yield of 76.8 q/ha, which was 19.6% higher than the check (64.2 q/ha). Profitability was also evident, with a BC ratio of 3.80 compared to 2.19 in the check, demonstrating clear economic benefits.



Input distribution to farmers

Livestock based modules:

Backyard poultry: The introduction of backyard poultry farming with improved breeds such as Uttara fowl, Kadaknath, and Rhode Island Red (RIR) has created new livelihood opportunities for women. In the newly adopted village of Suryajala, one-month-old birds were distributed along with starter feed, encouraging farmers to take up poultry production as an economic venture. Similarly, in other adopted villages, women farmers have been engaged in poultry farming since the beginning of the project and have successfully transformed it into a sustainable and viable source of income. During 2023-24, a total of 50 units were established, covering 750 Uttara fowl birds distributed to farmers. On average, each unit produced 166

eggs compared to 112 in the check, showing a 48.2% increase. The intervention resulted in a net return of ₹ 1,335 per unit with a BC ratio of 5.11, which was significantly higher than the check (₹ 699, BC ratio 2.66). Encouraged by these results, the initiative was expanded in 2024-25 with 40 units of mixed breeds Uttara fowl, Kadaknath, and RIR benefiting 40 farmers with 330 birds. Egg production increased to 148 per unit compared to 98 in the check, reflecting a 51% gain. The economics were also favourable, yielding a net return of ₹ 1,245 per unit with a BC ratio of 3.0, compared to ₹ 310 and a BC ratio of 1.35 in the check. Thus, the backyard poultry intervention not only enhanced egg production and profitability but also enabled women to secure steady incomes, strengthened their role in rearing indigenous poultry, and contributed to the long-term sustainability of household livelihoods.

Enterprise-based modules:

Beekeeping: The farmers of adopted village have been engaged in honey production and processing of its by-products. Under the project, efforts were made during 2023-24 and 2024-25 to strengthen marketing channels, enabling honey producers to sell their produce and gain profits throughout the year. In 2023-24, a total of 55 beekeeping units with 2,400 boxes were established, while in 2024-25, 50 units with 2,150 boxes were maintained. The average honey production ranged from 24.9 kg to 26.5 kg per box during these years. Economic analysis of the demonstrations revealed net returns between ₹ 7,231 and ₹ 6,656 per box, with a BC ratio ranging from 3.01 to 2.11, highlighting the profitability and viability of scientific beekeeping practices.



Visit to beekeeping unit



Honey extraction

Value addition: To enhance value addition, honey and honeycomb wax processing units were also established under the project. The honey processing unit handled 4,232 kg of raw honey, yielding 3,820 kg of processed honey. With a processing cost of ₹ 18 per kg and a selling price of ₹ 300 per kg, farmers earned a profit of ₹ 77 per kg over raw material. Similarly, the honeycomb wax processing unit processed 516 kg of raw wax into 498 kg of refined wax. At a processing cost of ₹ 20 per kg and a selling price of ₹ 320 per kg, this resulted in a profit of ₹ 40 per kg. Additionally, in Suryajala village, a spice grinding and mixing unit was established to support farmers cultivating crops such as turmeric, coriander, chilli, and tejpatta. Along with the processing facility, packaging materials and machinery were provided to enable farmers to pack and market their produce efficiently. Farmers expressed great satisfaction with this intervention, as the unit not only reduced their dependency on outside facilities but also allowed them to process produce for both sale and household consumption at their convenience.

Mushroom production: The introduction of mushroom cultivation in adopted villages successfully encouraged beneficiaries, particularly unemployed youth and women, to consider it as a small-scale



Value addition of turmeric



Training for farm women on value addition

enterprise. Training programs played a crucial role in motivating farmers, as their primary reason for participation was a strong interest in adopting mushroom cultivation as a business venture. On button mushroom cultivation, a total of 50 demonstrations were conducted in 2023-24 and 30 demonstrations in 2024-25. The yield per bag ranged from 2.5 to 2.8 kg, generating net returns of ₹ 190 and ₹ 255 per bag, respectively. These results highlighted the enterprise's strong potential to enhance the livelihoods of low-income groups. While the initiative has demonstrated significant income-enhancing opportunities, long-term engagement in mushroom farming requires addressing the challenges faced by growers. Encouraged by the profitability, farmers have now started producing mushrooms throughout the year and established local market linkages for regular sales. Local hotels and restaurants have emerged as major buyers, providing favorable prices to growers. In addition to marketable surplus, farmers have also begun consuming mushrooms at the household level, ensuring nutritional benefits for their families. To support sustainability, experts provided continuous training and held regular discussions to resolve growers' doubts and challenges. However, for long-term engagement, continued access to training, quality inputs, and market support will be essential to strengthen this emerging enterprise.

Marketing by farmer groups: Marketing of fresh and processed agricultural products was facilitated through the formation of farmers' groups specifically established for marketing and network development. The aim was to establish at least one marketing group under each project intervention, enabling farmers in the project area to sell their produce more effectively and create stronger marketing linkages for the future. Each group consisted of 20-30 farmers, including women, who collaborated to promote their produce in local markets, maximize profits, and share risks collectively. In the financial year 2025-26, five farmers' groups were actively involved in marketing agricultural products. The Suryajala Spices Group (20 members) marketed turmeric, coriander, and red chili products, earning ₹ 1,65,000. The Jeoli Honey Group (28 members) sold honey from diverse flora, generating ₹ 3,65,780. The Suryajala Mahila Mushroom Sangathan (20 members) focused on fresh button mushrooms, earning ₹ 1,86,790. The Suryajala Sabzi Sangathan (26 members) marketed seasonal fresh organic vegetables, earning ₹ 3,20,000. Lastly, the Syalikhet Mahila Poultry Group (30 members) sold organic eggs and meat, earning ₹ 3,65,400. These groups clearly demonstrated the benefits of specialization, value addition, and collective marketing, enabling farmers not only to enhance profitability but also to gain stronger visibility in local markets and ensure more sustainable livelihoods.

ICAR-Indian Institute of Soil & Water Conservation, Dehradun

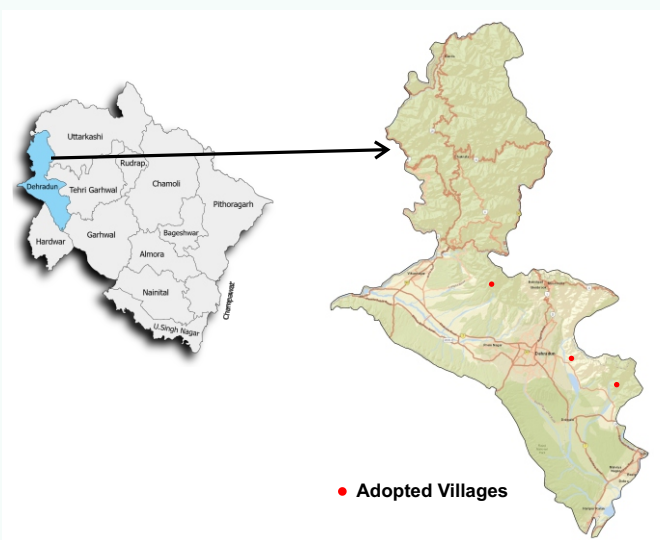
Farmer Participatory Technology Application for Sustainable Resource Management and Livelihood Security in North-Western Himalaya

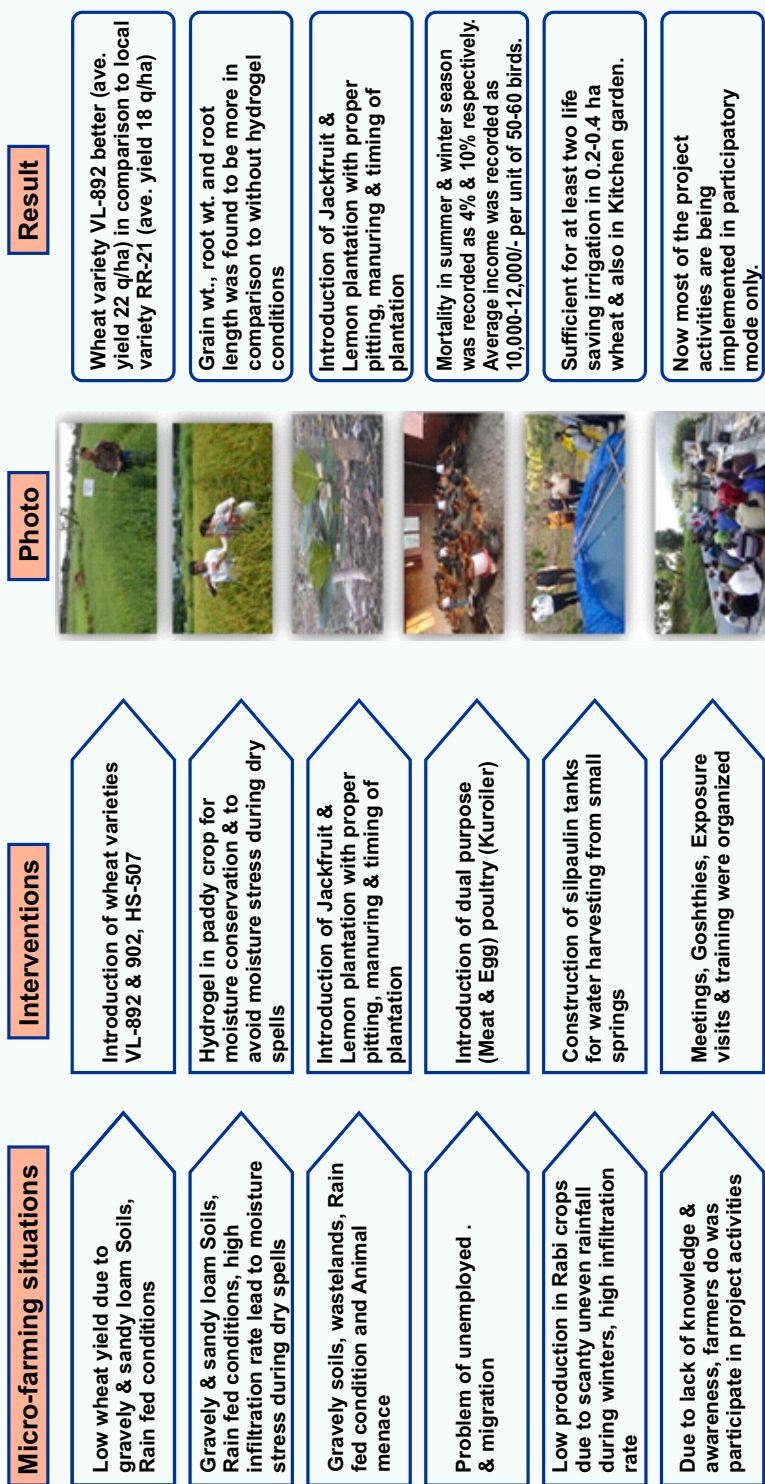
The ICAR-IISWC, Dehradun, implemented the Farmer FIRST Programme titled "Farmer Participatory Technology Application for Sustainable Resource Management and Livelihood Security in North-Western Himalaya" in the Raipur block of Dehradun district, Uttarakhand. The project encompassed major hamlet groups namely Koti Gaon, Sindwal Gaon, Badasi Grant, Kudial Gaon, and Kaloowala. Based on the survey findings, the landholding pattern in the project area revealed a predominance of marginal and small farmers, with 59.96% of households categorized as marginal, 23.33% as small, 12.15% as medium, and only 2.10% as large farmers, while 2.43% of the population was landless. Consequently, this distribution highlights the socio-economic vulnerability of the majority of the farming community, rendering them heavily reliant on natural resources and external technological interventions to enhance agricultural productivity and secure their livelihoods.

Research problem identification and prioritization

Agriculture in the North-Western Himalayas is shaped by diverse agro-climatic conditions, fragmented landholdings, and limited resources, all of which pose major challenges to sustainable development and livelihood security. In particular, the Raipur block of Dehradun faces multiple constraints, including undulating topography, land degradation, and predominantly rain-fed farming systems. The hilly terrain accelerates soil erosion and reduces water retention, thereby making agriculture highly vulnerable to erratic rainfall. Moreover, the region's sandy loam to silty clay loam soils, though porous, are marked by high infiltration and permeability, which restricts the availability of moisture for crops. The situation is further aggravated by the presence of 30-45% gravel content, lowering soil fertility and productivity.

In terms of landholding, the structure is skewed; 59.96% of farmers are marginal, while 2.43% of the population is landless. Consequently, economic opportunities remain constrained, limiting the adoption of modern agricultural practices. This compels most farmers to rely on low-input, subsistence farming, which provides only meagre returns. Adding to these difficulties, frequent crop damage caused by monkeys, wild boars, and elephants reduces agricultural security even further. As a result, unemployment





Graphical Abstract : ICAR-IISWC, Dehradun

and migration have become widespread, since the scarcity of livelihood opportunities forces many rural youth to move to urban centers in search of work.

Addressing these challenges, therefore, calls for a comprehensive approach that includes sustainable resource management, soil conservation, livelihood diversification, and effective wildlife mitigation strategies, all aimed at enhancing farm productivity and ensuring economic stability. Moreover, considering the predominance of small and marginal landholdings, it becomes essential to improve resource-use efficiency, boost agricultural productivity, and expand sustainable livelihood opportunities for the farming community. In this context, the implementation of the FFP project in resource constrained regions emerges as a model for sustainable rural development in hilly areas. Furthermore, by integrating scientific innovations with traditional knowledge and practices, the project not only strengthens resilience and promotes economic growth but also ensures long-term environmental sustainability for local farming communities.

COMPONENT-I:

Enhancing Farmer - Scientist

Interface As part of the initiative to strengthen the farmer-scientist interface, a series of activities was organized across all adopted villages to provide both technical guidance and practical knowledge to farmers. During 2023-24, four activities were conducted with the participation of 189 farmers, while in 2024-25, this number increased to six activities involving 264 farmers. Through these events, farmers actively engaged with the FFP project team, discussing field level challenges and receiving



Farmer-Scientist Interaction

valuable insights for improving agricultural practices. In addition to these interactions, animal health camps were organized to address livestock-related issues and promote better management practices. Farmers were further introduced to advanced agricultural techniques through structured training programs and exposure visits, which enhanced their practical understanding of innovative farming methods. Specific on-farm training sessions were held on the use of hydrogel in rainfed paddy and wheat cultivation, enabling farmers to optimize water retention and increase productivity. Furthermore, specialized training on horticulture-based alternate land use systems was provided, encouraging crop diversification and promoting sustainable land management.

COMPONENT-II:

Technology Assemblage, Application, and Feedback

Crop based module:

High-yielding varieties were introduced in the project area to evaluate their suitability for the Doon Valley. Despite the challenging conditions of gravelly, low-fertility soils, nearly all the tested varieties performed exceptionally well, surpassing the performance of existing local varieties. Overall, the introduction of these improved varieties led to significant gains in productivity, profitability, and grain quality, demonstrating their

adaptability to the region's marginal soils. Their performance highlighted their potential as reliable and viable alternatives to traditional varieties in the Doon Valley.

Maize: During 2023-24, the maize variety Tay-Tay was demonstrated in an area of 4.0 ha, benefiting 69 farmers. The recorded average yield was 18.0 q/ha, showing a 63.6 percent increase over the local check (11.0 q/ha). In addition to its yield advantage, Tay-Tay gained popularity because of its bold grain size, attractive red colour, and superior taste. Farmers also valued its ability to produce three cobs per plant compared to only two in other varieties, along with its nutrient rich perception. Moreover, as the variety does not require annual seed replacement, it reduces input costs and ensures sustainability, thereby offering higher economic returns with a BC ratio of 4.50 compared to 2.75 in local maize. In 2024-25, a total of 67 demonstrations were conducted on 7.0 ha with the improved maize variety Kanchan. The variety recorded an average yield of 22.0 q/ha, which was 57.1 percent higher than the local check (14.0 q/ha). Economically, Kanchan proved advantageous with a BC ratio of 4.00 compared to 2.50 for the check. Farmers appreciated its higher yield potential, better grain quality, and adaptability to local conditions. Consequently, Kanchan emerged as a profitable option, contributing to improved productivity and farm income in the region.

Paddy: New crop varieties were introduced under demonstrations and are also being sold as seed to farmers in nearby areas at better prices. In 2023-24, demonstrations on improved paddy varieties were conducted with Pusa Basmati-1 and Pusa Basmati-1692 across a total of 6.0 ha, benefiting 29 farmers. Pusa Basmati-1 recorded an impressive average yield of 40.0 q/ha compared to 19.0 q/ha in the local check, while Pusa Basmati-1692 yielded 35.0 q/ha against 19.0 q/ha in the check. These demonstrations not only improved yields but also ensured significantly higher profitability. Pusa Basmati-1 achieved a gross return of ₹ 1,76,000/ha, compared to ₹ 62,000/ha in the check. Similarly, Pusa Basmati-1692 resulted in a gross return of ₹ 1,35,000/ha, against ₹ 57,500/ha in the check. Farmers appreciated these varieties not only for their higher productivity and profitability but also for their superior grain quality, which enhanced their market acceptability. Building on this success, during 2024-25, paddy demonstrations were carried out with variety VL Dhan-88 over 5.0 ha, benefitting 30 farmers. VL Dhan-88 recorded an average yield of 35.0 q/ha compared to 19.0 q/ha in the local check, indicating a significant yield advantage. The economic returns were also encouraging, with a gross return of ₹ 132,000/ha, while the check variety provided ₹ 57,500/ha. During 2024-25, farmers preferred VL Dhan-88 owing to its higher yield potential, better adaptability to local conditions, and greater profitability.

Finger Millet: In 2023-24, a total of 79 demonstrations of the improved finger millet variety VL Mandua-380 were conducted on 12.0 ha, benefitting 79 farmers. The variety recorded an average yield of 10.0 q/ha compared to 7.0 q/ha in the local check, reflecting a good yield increase. Economically, VL Mandua-380 proved profitable with a net return of ₹ 38,000/ha and a BC ratio of 4.80, whereas the local check returned ₹ 23,600/ha with a BC ratio of 3.36. Building on this success, during 2024-25, VL Mandua-380 was demonstrated on 4.0 ha, achieving an average yield of 9.0 q/ha against 6.0 q/ha in the local variety. These demonstrations enhanced farmer income and highlighted the variety's potential for wider adoption in the region.

Urdbean: In 2023-24, the improved urd variety Vallabh urd-1 was demonstrated over 4.0 ha for 44 farmers, producing an average yield of 8.0 q/ha, which was higher than the local check (5.0 q/ha). The economic



Field visit to finger millet demo



Field visit to paddy demo

performance was also superior, with a net return of ₹ 84,000/ha compared to ₹ 48,000/ha for the local variety. In 2024-25, the variety URD PU-9 was demonstrated on 7.0 ha, recording a yield of 10.0 q/ha under demonstration compared to 5.0 q/ha in the local check. This not only significantly improved productivity but also increased profitability, demonstrating the effectiveness of improved urd varieties in boosting farm income.

Wheat: During 2023-24, wheat varieties including VL Gehun-953, VL Gehun-967, DBW-187, DBW-370, and DBW-332 were demonstrated on 35.0 ha, benefiting 189 farmers. These varieties yielded an average of 34.4 q/ha, more than double the 16.4 q/ha obtained from local varieties. The demonstrations also proved economically beneficial, with a net return of ₹ 72,340/ha and a BC ratio of 5.23, compared to ₹ 26,440/ha and a BC ratio of 2.63 in local checks. These results underscored the superior productivity and profitability of improved wheat varieties, making them a viable option for enhancing cereal production in the region.

Horticulture based module:

The vegetable production module has significantly improved household access to fresh vegetables and fruits throughout the year. Before the project, families relied heavily on purchasing produce from the market, which was often limited in availability and expensive, particularly during the summer season and after heavy rains. The introduction of improved vegetable varieties significantly enhanced yield, profitability, and quality. Their adoption provided farmers with opportunities for increased income and demonstrated the suitability of these varieties for wider cultivation in the region. With the establishment of kitchen gardens, households now have a reliable source of organic, chemical-free vegetables and fruits. The proximity of these gardens to homes ensures easy management and eliminates concerns related to watch and ward. Additionally, regular technical guidance from the project team helps families maintain their gardens efficiently, adopt best practices, and optimize production, thereby promoting both food security and nutritional well-being.

Cucumber: In 2024-25, the cucumber variety RK-100 was demonstrated over 2.0 ha, benefiting 40 farmers. The variety recorded an average yield of 90.0 q/ha compared to 60.0 q/ha in the local check, indicating an excellent yield improvement. In terms of economics, RK-100 provided a net return of ₹ 25,000/ha with a BC ratio of 3.50, while the local variety returned ₹ 14,000/ha with a BC ratio of 2.40. These results demonstrated the high productivity and profitability of the improved cucumber variety, promoting its adoption among local farmers for better farm income.

French Beans: During 2024-25, the high-yielding French bean variety Pant Anupama was demonstrated on 1.5 ha, benefiting 45 farmers in the project area. The variety produced an impressive average yield of 160 q/ha, significantly higher than the 70 q/ha recorded in the local check. This remarkable performance resulted in a net return of ₹ 4,90,000/ha, clearly demonstrating the variety's superior productivity and profitability. The adoption of Pant Anupama not only enhanced farmers' income but also encouraged the cultivation of high-yielding, market-oriented French bean variety.

Sponge Gourd: The sponge gourd variety Pusa Chikni was demonstrated on 0.6 ha, benefiting 89 farmers in the project area. The variety achieved an average yield of 150 q/ha, markedly higher than the 100 q/ha recorded in the local variety, reflecting significant productivity improvements. This enhanced performance translated into greater profitability for the farmers, making Pusa Chikni a promising option for adoption.

Okra: A total of 62 demonstrations on the okra variety Purna were conducted on 1.5 ha, producing 170.0 q/ha as against 90.0 q/ha in the local check. The net return from this variety was ₹ 1,93,000/ha, indicating its effectiveness in enhancing both productivity and economic returns. The consistent performance of Purna across multiple demonstrations highlights its reliability and potential for wider adoption among farmers.

Bitter Gourd: Bitter gourd variety Arka Harit was demonstrated on 0.8 ha at 70 farmers' fields, yielding 180.0 q/ha compared to 120.0 q/ha in the local check. The variety recorded a gross return of ₹ 3,67,000/ha, demonstrating its excellent performance and profitability under local conditions. Its superior yield and adaptability make Arka Harit a promising option for farmers seeking higher productivity and better economic returns.

Bottle Gourd: A total of 55 demonstrations were conducted on bottle gourd variety Pusa Majari on 1.2 ha, achieving a yield of 280.0 q/ha against 160.0 q/ha in the local variety. The demonstration generated a net return of ₹ 3,65,000/ha, highlighting its potential for higher income generation. The consistent performance of Pusa Majari across different farmer fields indicates its suitability and reliability for wider adoption.

Tomato: Tomato variety Vaishali was demonstrated on 1.5 ha, wherein 82 farmers were benefited, producing 250.0 q/ha compared to 140.0 q/ha in the local check. The net return was ₹ 5,80,000/ha, emphasizing its high yield potential and economic benefits for farmers. The variety's adaptability and consistent performance make Vaishali a valuable choice for enhancing tomato production in the region.

Moringa: A total of 38 demonstrations on the Moringa variety PKM-1 were conducted over an area of 0.7 ha. The variety recorded an impressive average yield of 200 q/ha, compared to 115 q/ha in the local check, indicating its superior performance under local conditions. Economically, PKM-1 proved highly advantageous, generating a net return of ₹ 3,92,000/ha, thereby demonstrating its significant potential to enhance farm income. The adoption of this variety can not only improve farmers' profitability but also encourage the cultivation of nutritionally rich and market-demanded crops, contributing to sustainable agriculture and livelihood security in the region.

Backyard Nutritional Gardens: A total of 227 demonstrations were conducted on summer and winter vegetable cultivation under the backyard nutritional garden initiative. The primary objective was to enhance household consumption while enabling families to earn additional income through the sale of surplus produce in local markets. Farmers were also sensitized to the role of backyard gardens in ensuring nutritional security, motivating them to adopt and sustain this practice in the long run. To strengthen the initiative, kitchen gardens

were designed and established using scientific layout plans, which ensured efficient use of space and improved crop productivity. As a result, households reported improvements in vegetable production, dietary diversity, and savings. The wider variety of vegetables consumed also contributed to better nutrition and health. Overall, backyard nutritional gardens have emerged as a sustainable model for enhancing food security, improving health outcomes, and supporting economic resilience.

Bamboo plantation in degraded lands: Under the initiative to restore and utilize degraded lands, bamboo species such as *Bambusa tulda*, *Bambusa balcooa*, and *Bambusa nutans* were planted. A total area of 7.4 ha was brought under bamboo plantation, covering 70 farmers' fields across 9 hamlets. These plantations not only contribute to soil and water conservation but also provide long-term livelihood opportunities through sustainable bamboo-based income generation.

Introduction of Fruit Trees: In the Western Himalayan mid-hill region, farmlands with steep slopes (60-100%) are typically covered with gravelly soils. Although the area receives about 1,600 mm of rainfall annually, the high gravel content reduces moisture retention, resulting in poor yields and frequent crop failures during the post-monsoon (*Rabi*) season. Consequently, most fields remain fallow in *Rabi*, leaving farmers with limited income opportunities. To address this challenge, horticulture was promoted with low water requiring and wildlife tolerant species such as gumless jackfruit, lemon, and bael. Other fruit saplings such as mango, guava, amla, bamboo, and jamun were also planted. The major constraint, however, was the rapid water infiltration rate (6.5-12 cm per hour), which caused irrigation water to drain beyond the root zone. Young plants required frequent watering, but the available sources were both distant and of low discharge (0.7-1.5 L/min), with 80-90% conveyance losses further reducing effective supply. To overcome these limitations, a low-cost irrigation system was introduced. Small poly-lined (Silpaulin) water tanks of 3,000-6,000 liters were constructed close to plantations, coupled with drip irrigation to minimize water loss and maximize efficiency. This intervention led to remarkable improvements in plant survival, achieving success rates of 80-90.5%. It also reduced labour demand, saving about 30 man days per 300 plants in water application. These labour savings enabled farmers to devote more time to other agricultural operations, ultimately improving farm productivity, profitability, and sustainability in the region.

Livestock based module :

During 2023-24, a total of 152 household poultry units were initiated under the project. In 2024-25, an additional nine units were independently initiated by farmers for the production of eggs, chicks, and meat.



Backyard nutritional garden



Director of ICAR-IISWC, Dehradun visiting the project area

Around 10% of the beneficiary farmers were motivated to develop larger poultry units with 200-300 birds, employing free-range, caged, or mixed rearing systems as a sustainable source of livelihood and food. On average, each bird produced 300-350 eggs over a 12 month rearing period and reached a live weight of 2.0-2.5 kg within 10-12 months. Poultry performance was higher in summer compared to winter in terms of survival, growth, and profitability. The poultry production cycle ranged from 12 to 24 months, with egg-laying commencing after six months and continuing up to 18 months. Progressive economic returns were observed, with Vanaraja birds achieving up to 72% laying and Kuroiler birds 55%. Approximately 30% of the eggs and meat produced were consumed within the household, while the remainder was sold at ₹ 10-14 per egg and ₹ 250-300 per kg live weight, depending on the season and production levels. Demand and profitability were notably higher during the winter and festive seasons.

Before the project, only 1.6% of farm families kept backyard poultry, predominantly local, non-descript breeds (90%). Following the interventions, adoption increased to 28% with improved breeds. Specifically, 22 Kuroiler and 102 Vanaraja small-scale/backyard units have been successfully established, leveraging local resources and household environments as income-generating enterprises. Consequently, demand for eggs and birds has doubled, leading to a significant increase in farmers' incomes in the adopted villages. Poultry rearing has proven to be an important livelihood strategy, acting as a buffer against fluctuations in food, cash, and household resources. It has helped improve nutrition, reduce malnutrition, and enhance overall household food security. The family poultry model for meat and egg production emerged as the most popular intervention among farmers, improving income, diversifying nutritional options, and supporting local farming, while also reducing rural migration.

Enterprise based module:

Nursery management: Under the nursery raising intervention, the nursery was managed and maintained over an area of 7.5 ha. Onion variety Gulmohar was cultivated, yielding a profit of ₹ 4,19,000 at a selling price of ₹ 12,500 per quintal. In addition, nursery production of fruit crops such as lemon, mango, and litchi was also undertaken. Lemon grafted saplings of varieties Pramalini and Balaji were sold at ₹ 60 per plant, generating ₹ 74,000 as profit. Similarly, mango grafted saplings of variety Mallika recorded a profit of ₹ 10,900, while litchi grafted saplings of variety Rose Scented earned ₹ 8,600. Moreover, mango scions of variety Mallika were sold at ₹ 5 per scion, contributing ₹ 1,100 to the total income. Altogether, the nursery activities generated a total profit of ₹ 5,13,600, reflecting the economic viability and profitability of diversified nursery production under the project.

Seed production of HYV varieties: In 2023-24, seed production demonstrations were undertaken with high-yielding varieties of finger millet, maize, urd, and paddy. Finger millet variety VL Mandua-380 was particularly successful, with 21 farmers producing 8.5 quintals of seed. This seed was sold at ₹ 5,500/qt, generating ₹ 46,750, and benefitting 37 farmers who purchased it. Similarly, the maize variety Tay-Tay was adopted by 10 farmers, producing 2.0 quintals of seed, which sold for ₹ 3,000 per quintal, earning ₹ 6,000 and reaching 7 purchasing farmers. Urd variety Vallabh Urd-1 was produced by 6 farmers, yielding 1.5 quintals of seed, sold at ₹ 15,000 per quintal, generating ₹ 22,500. In paddy, three farmers produced 2.5 quintals of Pusa Basmati-1 seed, sold at ₹ 8,000 per quintal, bringing in ₹ 20,000. Altogether, 40 farmers sold 14.5 quintals of seed across four crops, generating ₹ 95,250, while 63 farmers purchased these seeds for cultivation.

Building on this success, seed production efforts expanded in 2024-25 with larger demonstrations. For finger millet, 24 farmers produced 8.5 quintals of VL Mandua-380 seed on 4.0 ha, selling it at ₹ 5,500 per quintal and earning ₹ 46,750. In maize, the improved variety Kanchan K 25 was introduced with 67 demonstrations over 7.0 ha, producing 2.0 quintals of seed, which fetched ₹ 3,000/qt, generating ₹ 6,000. Similarly, the urd variety URD PU-9 was taken up by 67 farmers, producing 1.5 quintals of seed, which sold at ₹ 15,000 per quintal, earning ₹ 22,500. In paddy, the improved variety VL Dhan-88 was adopted by 30 farmers across 5.0 ha, producing 2.5 quintals of seed, which sold at ₹ 8,000 per quintal, bringing in ₹ 20,000. Overall, in 2024-25, a total of 188 farmers produced 14.5 quintals of seed across four crops, generating a total profit of Rs. 95,250. These seed production programs not only enhanced farmer incomes but also strengthened local seed availability. The widespread adoption and purchase of these improved varieties reflect their strong adaptability and potential for wider dissemination in the region.

Improved composting technique: Under the FFP project, various methods for recycling and composting animal and farm waste were evaluated in the adopted villages. Aerobic composting in pucca pits and portable vermi-beds proved superior to the traditional heap method, with nitrogen content highest in the aerobic pucca pit compost (1.60%), and followed by the portable vermi-bed method (1.14%). Both aerobic composts had a C: N ratio below 15:1, indicating high-quality compost with readily mineralizable nutrients, whereas the traditional heap method had a very high C: N ratio of 40.1:1, which can lead to nutrient immobilization when applied to the field. Compost produced through the pucca pit method was applied to wheat (variety VL Gehun-953), resulting in improved total yield, greater plant height, longer ears, and more



Seed certification team inspecting farmers' field



Nursery management



PRERNA Self Help Group



Compost preparation in portable vermi-beds

grains per ear. Farmers reported that, in addition to dung, leftover animal feed, green fodder, and dry tree leaves could be incorporated into the compost, and their use significantly reduced termite problems. The pucca pit compost was recognized as nutrient-rich, practical, and easy to prepare, and farmers with fewer animals could also utilize kitchen and household waste for composting, making it a simple and effective method to enhance soil fertility and crop productivity.

Marketing by farmer groups: At FFP Centre ICAR-IISWC, Dehradun, several farmer groups have been supported to promote entrepreneurship and value-added products. The PRERNA Self Help Group (8 members) markets mostly millet-based and organic products, including pickle, millet laddoo, papad, honey, processed ginger and turmeric, and maize and mandua atta. The Lemon Production Group (2 members) produces lemon fruits and grafted saplings (Permalin, NA-7, Balaji), while the Onion Nursery Group (19 members) supplies Gulmohar seedlings. The Mango Grafting and Mango Scion Groups (3 members each) focus on grafted saplings and scions of the Mallika variety, and the Litchi Grafting Group (2 members) produces Rose Scented saplings. The Poultry Production Group (18 members) raises Vanraja, Kuroiler, and desi birds for eggs and meat. These initiatives enhance local employment and provide high-quality agricultural and allied products to the market.

NRM based module:

Spring rejuvenation to meet out the irrigation and drinking water requirements:

In Koti Maychak Panchayat, approximately 50-60 families face severe drinking water shortages during the summer months, particularly in April, May, and June. In response, the village panchayat requested the implementation of spring rejuvenation works to alleviate the water scarcity. Water discharge from the springs was monitored throughout the year, revealing a gradual decline of about 0.5 liters per second per month starting from February. The discharge varied seasonally, with the minimum observed in the first week of June at 2.10 liters per minute and the maximum in October at 65.0 liters per minute for Source I. Source II exhibited a similar trend, with flows ranging from 20.0 liters per minute to 94.5 liters per minute in the respective months. To augment spring flows, the partial catchment area was treated with staggered trenches measuring 2 m × 0.30 m × 0.45 m, with a total of 76 trenches dug to capture surface runoff during the monsoon season. These sources are being monitored fortnightly to evaluate the impact of the treatment. Observations over the second and third years indicate a clear improvement in Source II, where discharge increased from 10 liters per minute to 20 liters per minute. However, Source I showed no improvement, with discharge decreasing from 10 liters per minute to 5 liters per minute, likely due to the subsurface slope direction. For enhanced results, the catchment area under the reserve forest was surveyed by an expert team, and efforts are ongoing to expand the trenching area. Farmers reported that the intervention has nearly eliminated drinking water shortages during summer. Moreover, the success of this project provides a replicable model for other nearby areas facing similar problems. The approach is cost-effective and can even be implemented under MNREGS.



Measurement of water discharge

Partnership and Institution Building

The Partnership and Institution-Building component comprises two key aspects: the development of partnership models and the mobilization and capacity building of farmer groups. It promotes collaboration among farmers, research institutions, government agencies, and private organizations. The developed partnership models facilitate effective knowledge exchange, efficient resource utilization, and improved market access. Additionally, farmer groups and cooperatives are strengthened through training programs, workshops, and exposure visits, which enhance their technical expertise and financial literacy, leading to improved agricultural practices, higher productivity, and sustainable economic growth.

PAU, Ludhiana

The collaboration brought together multiple organizations to support farmers through advisory services, training, and resource facilitation. The Farmer Advisory Service Centre, Sangrur, provided region-specific farming guidance, also organized trainings on different aspects. The Punjab Forest Department contributed by promoting environmental awareness and supplying plants. Cooperative societies strengthened farmer linkages, and machinery manufacturers improved access to modern equipment. Animal feed producers supplied quality feed, while NABARD facilitated credit schemes to enhance financial support. A self-help group of 10 women initiated mushroom pickle processing, and another group of farmers received training in mushroom cultivation. Beekeepers were organized to collectively manage entrepreneurial and marketing activities. A custom hiring centre at Chatha Nanhera made farm machinery, including the Happy Seeder, available to farmers. Additionally, two Eco Clubs were established to promote environmental conservation, cleanliness drives under Swachhata Abhiyan, and tree plantation initiatives.

GADVASU, Ludhiana

The centre adopted a convergence approach to enhance the efficiency and impact of the project by fostering partnerships with multiple stakeholders. Key collaborators included village panchayats, PAU, Ludhiana, NABARD, and the State Department of Animal Husbandry. These partnerships facilitated technical guidance, contributed to strategic planning, and supported input procurement, thereby strengthening the overall implementation and effectiveness of project activities.

ICAR-CIPHET, Ludhiana

Farmers were linked with experts in processing and value addition, enabling them to improve the quality of their produce. They were also provided guidance on obtaining AGMARK and FSSAI certifications to ensure compliance with quality standards. Furthermore, farmers were connected with established processing units, and Farmer Interest Groups (FIGs) were formed to strengthen collective participation and market access.

CSKHPKV, Palampur

Farmers were connected with local vendors to facilitate the direct sale of their produce, including vegetables, mushrooms, honey, and other products developed under the project. This linkage ensured a reliable market for farmers, allowing them to obtain fair prices and reduce dependence on intermediaries. To promote facilities and technology transfer, collaborations were established with various institutions such as the State Department of Agriculture, Punjab National Bank, KCC Bank, State Department of Horticulture, and the State Forest Department.

SKUAST, Jammu

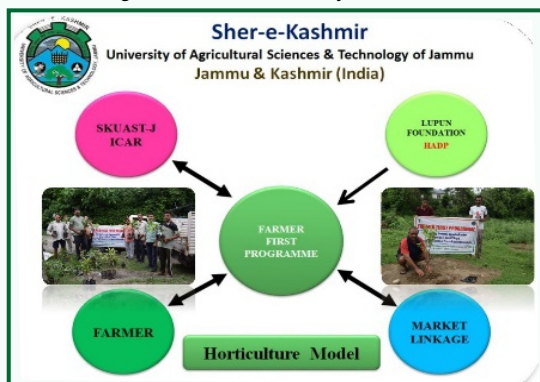
Different Self-Help Groups (SHGs) were formed in the area, including All Women Vegetable Growers in Anandpur, Sarmal, and Sadral villages, as well as Commodity Interest Groups for Backyard Poultry in Anandpur village. To strengthen the already existing mushroom-related group, an arrangement under the Farmer FIRST Programme was made with Samta Mushroom Producers Limited at Nud, enabling farmers to sell their mushrooms directly to the FPO at prevailing market prices. During 2023-24, a partnership was established with Lupin Pharmaceuticals Pvt. Ltd. to strengthen horticultural interventions under the project. As part of these efforts, biochar-based experiments were conducted in lemon, mango, and apple orchards to assess its effectiveness in improving soil moisture retention, particularly during dry spells. These interventions not only supported climate-resilient horticulture but also contributed to improved productivity and long-term sustainability in the region. This initiative aimed to promote sustainable horticultural practices while enhancing income diversification and minimizing production risks for farmers in the Kandi region of Samba district.

GBPUA&T, Pantnagar

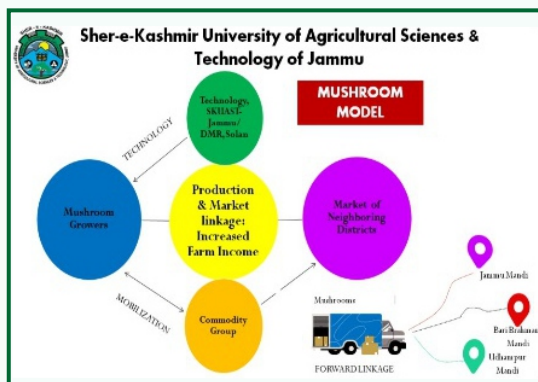
A joint monitoring team was formed to oversee project activities and provide continuous support to farmers. Moreover, to strengthen farmers' production and marketing capabilities, strategic linkages were established with various organizations and institutions. These collaborations facilitated better access to resources, technical expertise, and market opportunities, thereby contributing to the overall success of the project.

ICAR-IIS&WC, Dehradun

Various partnerships were established with different organizations and departments to facilitate knowledge sharing, input support, and technical assistance. For instance, Tarai Development Corporation (TDC) and VPKAS, Almora, collaborated to provide technical expertise in wheat seed production. In addition, state line departments, including agriculture, horticulture, animal husbandry, and forestry, offered veterinary specialists' guidance on animal health and disease management. Furthermore, KRIBHCO facilitated interactions between scientists and farmers while providing fertilizers and micronutrients to boost agricultural productivity. Patanjali, Haridwar, supported the cultivation and marketing of medicinal plants, contributing to livelihood security.



Partnership model with Lupin Pharmaceutical Pvt. Ltd., SKUAST-Jammu



Partnership model for mushroom, SKUAST-Jammu

Content Mobilization

This component of Content Mobilization includes: (1) the Development of an information system and database, (2) the Identification and pooling of transferable technologies available with various institutions, (3) the Preparation of knowledge models, and (4) the Establishment of a content management platform enabling both online and offline access. The institute-wise report is provided below:

PAU, Ludhiana

To document and disseminate successful interventions, a series of videos were developed with the objective of creating awareness and motivating other farmers. These include a comprehensive video outlining the project's objectives and impact, as well as short clips featuring farmers' experiences and success stories in their own words. Furthermore, various agricultural machines and equipment were made available to farmers at different centres to enhance field operations. At cooperative societies, tools such as the Happy Seeder, direct seeder planter, seed-cum-fertilizer drill, leveller, disc harrow, and bund former planter were effectively utilized during peak agricultural seasons. Moreover, the PAU Smart Seeder at FADC, Sangrur, was employed for in-situ wheat sowing in standing paddy stubble, while a honey extraction machine at PAU, Ludhiana, facilitated honey processing. To further strengthen information dissemination, farmers were subscribed to Kheti Sandesh, a digital newspaper by PAU Ludhiana, thereby keeping them updated with the latest advancements in agriculture and allied sectors.

GADVASU, Ludhiana

The centre actively developed and disseminated various extension materials to support farmers, including technical literature, booklets, videos, and research publications. These materials covered all project interventions and were distributed among the farming community to enhance their technical knowledge. All farmers from the adopted villages subscribed to the university's monthly magazine to stay informed about the latest scientific farming techniques. Additionally, WhatsApp groups were created to share timely technical updates, effectively connecting adopted farmers.

ICAR-CIPHET, Ludhiana

To provide farmers with valuable information on processing techniques, pamphlets and technical bulletins were developed covering honey, pulses, jaggery, turmeric, and wadi processing. These materials offered step-by-step guidance on best practices, quality improvement, and value addition. The content was made available in English, Hindi, and Punjabi to ensure accessibility for farmers across different regions. By distributing these resources, the initiative aimed to enhance farmers' knowledge, improve processing efficiency, and enable them to maximize profits from their produce. Additionally, various success stories were documented and uploaded on YouTube to further inspire and inform the farming community.

CSKHPKV, Palampur

The Centre actively developed and disseminated technical literature, booklets, videos, and other publications to support farmers. Comprehensive extension materials covering various interventions were prepared and distributed to enhance farmers' awareness and knowledge.

SKUAST, Jammu

Several WhatsApp groups were created to connect members of the scientific community with farmers from selected villages, thereby facilitating real-time knowledge sharing and technical support. In addition, literature covering various aspects of crop cultivation and livestock farming was distributed to enhance farmers' understanding and improve their agricultural practices. Furthermore, panchayat-wise resource persons were identified under the project to ensure the effective dissemination of relevant information to farmers in each village. The same network is also utilized to collect feedback from farmers, enabling timely action and resolution of issues faced at the village level.

GBPUA&T, Pantnagar

Literature covering various aspects of crop cultivation and livestock farming was distributed to enhance farmers' knowledge and skills. In addition, specialized training sessions on mushroom production were organized for farmers from different villages. To ensure practical support, experts regularly visited farmers to provide technical guidance and address specific field level challenges.

ICAR-IISWC, Dehradun

Various technologies developed by ICAR-IISWC, Dehradun, along with other ICAR institutes and SAUs, and suitable for the North West Himalayan region, were integrated and implemented in the FFP adopted villages. These project findings are being communicated to farmers through mobile-based agro-advisory services, with a focus on soil and water conservation for hill agriculture. Moreover, an innovative knowledge sharing platform was developed to disseminate agricultural best practices and soil and water conservation techniques among farmers in the North Western Himalayan region.

Details of dissemination of successful project outputs through: Farmer-farmer, Mass media system, Cross-visit, Meeting in the field, Development of extension material, Farmer to farmer exchange, Project site meetings and interaction and Distribution of literature:

PAU, Ludhiana

Under the project, six farmers' innovations were documented. The project received wide coverage in mass media, which significantly enhanced its visibility and outreach. After learning about the project through fellow farmers and media reports, farmers from seven adjoining villages approached the team to request inclusion of their villages under the initiative. In addition, various booklets and leaflets related to the project's interventions are in the process of publication and are expected to be released in the coming months. Furthermore, numerous meetings with individual farmers and farmer groups have been organized to discuss and guide them on different interventions implemented under the project. The books have been distributed among the beneficiaries to enhance their technical knowledge and promote improved farming practices. These include Prali di Suchajji Sambh Sambhaal Krn Wale Uddami Kissan (Punjabi), Happy Seeder Manual (Punjabi), Package of Practices for Kharif Crops (Punjabi), Cultivation of Vegetables under Greenhouse (Punjabi), Package of Practices for Rabi Crops (Punjabi), Package of Practices for Vegetable Crops (Punjabi), and Management of Italian Honey Bees (Punjabi). These publications aim to equip farmers with practical and region-specific guidance for better productivity and sustainable agricultural development.

GADVASU, Ludhiana

Around 8-10 beneficiary farmers from each village in the operational area were selected as lead farmers or farmer promoters to facilitate "farmer-to-farmer" extension within their own and neighbouring villages. These lead farmers actively promoted livestock development interventions and demonstrated the outcomes of the inputs provided to them. The complete set of project bulletins and folders was distributed among the beneficiaries' families to enhance their knowledge. In addition, various training sessions, interactions, field days, camps, and awareness campaigns were organized across the operational area to provide need-based guidance and support to the farmers.

ICAR-CIPHET, Ludhiana

Meetings were organized with farmers to guide them on processing various agricultural products, helping them enhance value addition and marketability. This initiative aimed to equip farmers with practical knowledge and technical insights, enabling them to establish and operate efficient processing units. The interventions of the Farmer FIRST Project were presented at the Industry Interface Fair on Agro-Processing (CIPHET-IIFA 2024) and at the Kisan Mela held from 3-5 October 2024.

CSKHPKV, Palampur

Multiple platforms, including Facebook, newspapers, and the WhatsApp group "FFP CSKHPKV", were effectively utilized to disseminate agricultural technologies among farmers. In addition, to ensure continuous knowledge sharing and awareness, farmers were provided with literature on various technological interventions along with copies of Parvatiya Kheti Bari, a quarterly magazine published by CSKHPKV, Palampur.

SKUAST, Jammu

Weekly site meetings and interactive sessions were organized to monitor the progress of various modules and to identify the challenges and issues faced by farmers. These interactions served as an effective platform for farmers to share their concerns, while allowing experts to provide timely solutions, technical guidance, and support for improving agricultural practices.

GBPUA&T, Pantnagar

Self-Help Groups (SHGs) were formed to promote the dissemination of agricultural technologies among farmers. To further strengthen technology transfer, instructional videos were developed to provide offline access to key farming practices. Additionally, a WhatsApp group was created to connect scientists and farmers from selected villages, facilitating real-time knowledge sharing and technical support.

ICAR-IIS&WC, Dehradun

A five-day training programme was organized for members of Women Self Help Groups on the theme "Processing of Fruits and Vegetables." The programme covered key topics such as jam and jelly making, pickle preparation, millet laddoo and biscuit production, packaging techniques, quality control, local and national marketing strategies, sustainability concerns among entrepreneurial groups, development of entrepreneurial traits, and balancing farm and group activities. Additionally, a one-day Farmer Field School was conducted on "Processing and Marketing of Medicinal Crops." The major

topics discussed included the cultivation of medicinal and aromatic crops on rainfed and degraded lands, processing and marketing avenues, and seed production programmes during Kharif and Rabi seasons at the farmer level. The event also addressed issues related to fruit and vegetable production, wild animal menace, cluster-based farming, local marketing strategies, entrepreneurial traits among farm communities, and the practical know-how of various enterprises.



Farmers participating in GADVASU Pashu Palan Mela



Training organized for farmers at ICAR-CIPHET, Ludhiana



Farmers' stall installed at Mela, ICAR-CIPHET, Ludhiana



Diagnostic field visit, SKUAST-Jammu

Other Achievements

On-site input production and management like Vermicomposting, nursery of planting material, seed production, residue management, etc.

Conducting field studies on socioeconomic perspective and impact evaluation

Any award and recognition received by the FFP Team/farmers

PAU, Ludhiana

Farmers were honoured for their exemplary efforts in crop residue management by the Worthy Vice-Chancellor of PAU, Ludhiana, Dr S.S. Gosal. Farmer Information Centres were established in each project village to facilitate knowledge sharing and advisory services. A Custom Hiring Centre was also set up at Chatha Nanhera, where a group of ten farmers actively rented out essential farm machinery, including the Happy Seeder, Chopper, and Zero Till Drill, to resource-poor farmers. As a result of these interventions, nearly 60% of the wheat area was brought under Happy Seeder, Super Seeder, and Smart Seeder sowing methods, compared to none initially. Moreover, short-duration paddy varieties were adopted on over 75% of the cultivated area in the project villages and extended to nearly 50% of the adjoining villages. One farmer initiated commercial seed production, while another established a ber orchard intercropped with vegetables. These efforts collectively contributed to a significant reduction in paddy straw burning and enhanced awareness about in-situ CRM technologies across neighbouring villages.

GADVASU, Ludhiana

Women farmers in the project villages were trained in value addition of milk through demonstrations on paneer and whey drink preparation. Bag silage making was also demonstrated, along with its physical evaluation, to raise awareness among farmers about the quality of good silage. Additionally, on-field demonstrations of vermicomposting were conducted for beneficiary farmers as an entrepreneurial approach. The project also included field studies to assess the socioeconomic impact of interventions, and regular agro-livestock advisory services were provided to farmers in the operational area. Efforts were made to create awareness about waste management of dairy animals and the hazards of crop residue burning. Notably, S. Harmeet Singh from Moom village in Barnala district participated in the DLFA Pashu Mela at Chadika, Moga, in 2023, where his Nili-Ravi bull won second prize.

ICAR-CIPHET, Ludhiana

The project team received the ISAE Commendation Medal 2023 during the 57th Annual Convention of the Indian Society of Agricultural Engineers at UAS, Raichur from 6th to 8th November 2023. The project team also won the Best Oral Presentation Award for the paper titled “Role of Agro-Processing in Increasing Farmer's Income” at the same convention.

CSKHPKV, Palampur

A nursery unit was established in the adopted area to provide farmers with quality seedlings and planting materials. Furthermore, training sessions were organized to educate farmers on quality

seed production for various crops, thereby promoting improved yields and the adoption of better agricultural practices.

SKUAST, Jammu

Marigold and vegetable seedlings were raised on farmers' fields through a participatory approach and subsequently distributed to other farmers in nearby villages for further production. Moreover, on-site residue management programs were organized, during which farmers were taken to demonstration sites where fellow farmers, acting as resource persons, showcased the residue management process for compost making.

GBPUA&T, Pantnagar

Training programs were organized to aware farmers on raising high-quality vegetable nurseries, thereby enhancing productivity and improving seedling management. Furthermore, a nursery was established in the adopted area to supply farmers with superior seedlings and planting materials, which in turn promoted large-scale cultivation and the adoption of improved agricultural practices.

ICAR-IIS&WC, Dehradun

Field studies on socioeconomic perspectives revealed key constraints such as migration-related labour shortages, low social prestige of village residents, lack of group-working culture, limited transparency, unequal benefit sharing, low risk-taking ability among rural youth, unclear roles between farming and business, and inadequate support from government and non-government agencies. Hon'ble Agriculture and Farmers Welfare Minister Sh. Shivraj Singh Chauhan visited the project area and addressed a Kisan Chaupal under VKSA on 06.06.2025. The project received the Best Paper Presentation (Oral) Award for the paper "Alternate Land Use System for Degraded Lands in the NWH Region for Enhancing Farmers' Income" at the National Conference (LNSWSEC-2024) held at ICAR-IISWC, Dehradun. FFP farmer Sh. Subhas Kothari was awarded Rs. 25,000 by the Government of Uttarakhand for his contribution to vermicompost production. The project also holds copyrights for two five-minute videos: "Alternate Land Use System for Rainfed Agriculture" and "Self Help Group-A Better Option for Livelihood Security."

GLIMPSES OF OTHER ACTIVITIES CONDUCTED UNDER THE PROJECT



Vermicomposting unit, GADVASU, Ludhiana



Polylined water harvesting tank, CSKHPKV, Palampur



Farmer's visit to nursery unit, GBPUAT, Pantnagar



Vermicomposting unit, ICAR-IISWC, Dehradun



Farmer awarded by Vice Chancellor, PAU, Ldh.



Awardee farmer S. Harmeet Singh with Nili-Ravi bull, GADVASU, Ldh



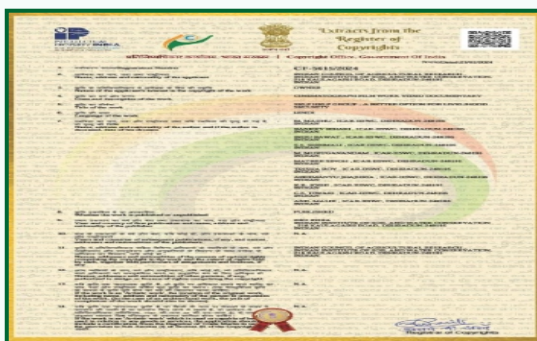
Vermicomposting unit, SKUAST-Jammu



Marigold nursery raising, SKUAST-Jammu



Best oral presentation award, ICAR-IISWC, Dehradun



Copyright for five-minute video, ICAR-IISWC, Dehradun

Publications

Research Papers

1. Jadoun, Y.S., Singh, J., Hundal, J.S., Kasrija, R., Kansal, S.K., Sharma, R.K. and Kaur, N., 2024. Effect of Mineral Mixture Supplementation on Productive and Reproductive Performance of Buffaloes under Farmer FIRST Project. *Indian Journal of Animal Nutrition*, 40(3): 283-287.
2. Chawla, R., Talwar, G., Singh, A., Singh, A., Tulla, G.K., and Singh, P., 2025. Assessment of technology intervention for preparation of paneer and characterization employing Principal Component Analysis (PCA). *AMA-Agricultural Mechanization in Asia Africa and Latin America*, 56(5): 21177-21187.
3. Mann, S., Dixit, A.K. and Shrivastav, A., 2025. Development and performance optimization of a taro (*Colocasia esculenta*) peeling machine for enhanced efficiency in small-scale farming. *Scientific Reports*, 15(1): 11336.
4. Mann, S., Balakrishnan, R. and Singh, L., 2025. Development and performance evaluation of a compact honey moisture reduction unit. *Journal of Food Science and Technology*, 1-10.
5. Mann, S., Balakrishnan, R., Mohapatra, S. and Kotwaliwale, N., 2025. On-Farm Processing and Marketing Models for Farmers of Developing Countries. In 2025 ASABE Annual International Meeting (p. 1). *Transactions of American Society of Agricultural Engineers*.
6. Chaudhary, D.R., Rana, S.S., Bhushan, L., Kumar, S., Sharma, P., Kumar, P., Sharma, K.D., Thakur, Y.P., Kumar, A., Singh, R. and Sheoran, P., 2024. Farming system diversification: An insight on strengthening the livelihood in a hilly ecosystem. *Indian Journal of Agricultural Sciences*, 94(3-1): 34-40.
7. Sharma, R., Sharma, P., Vaid, A., Sheoran, P., Murai, A.S., Ankit, and Singh, M., 2025. Varietal diversification in wheat crop under rainfed condition of Samba, Jammu & Kashmir. *Journal of Community Mobilization and Sustainable Development*, 20(3): 948-952.
8. Ansari, M., Rana, K., Arya, N., Kandpal, A.S., Kumar, A., Bhatt, L. and Kamboj, A., 2025. Impact of drudgery reduction tools on the working of farm women: a study under Farmer FIRST programme in mid hills of Uttarakhand, India. *International Journal of Agriculture Extension and Social Development*, 8(3): 42-50.
9. Rana, K., Kumar, A., Arya, N., and Kashyap, S.K., 2023. Assessment of training programme on the knowledge level of beekeeping farmers under ICAR-Farmer FIRST Programme in mid hills of Uttarakhand. *The Pharma Innovation Journal*, 12(12): 1651-1656.
10. Ansari, M.A., Rana, K., Arya, N., Kandpal, A.S., Kumar, A., Bhatt, L. and Kamboj, A., 2025. Enhancing Rural Livelihoods and Empowering Mid-Hill Women through Gender-Sensitive Targeted Interventions: A Study under Farmer FIRST Project in Uttarakhand. *International Journal of Applied Agricultural Sciences*, 11(5): 172-184.

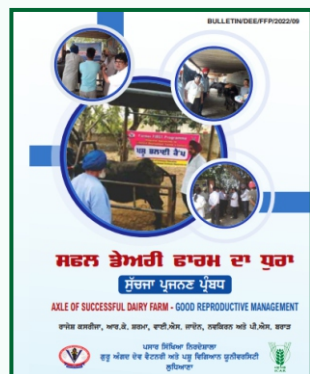
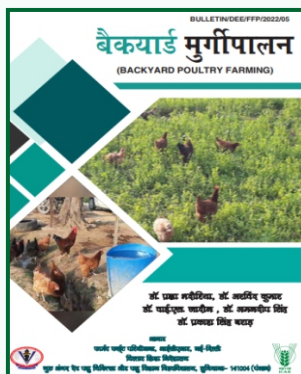
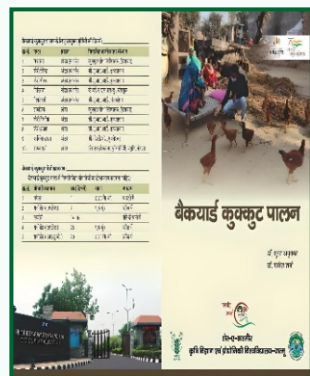
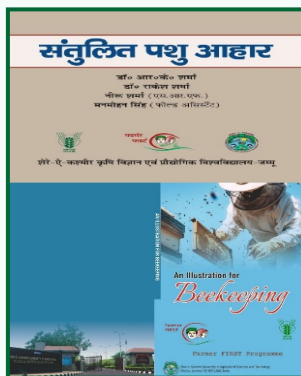
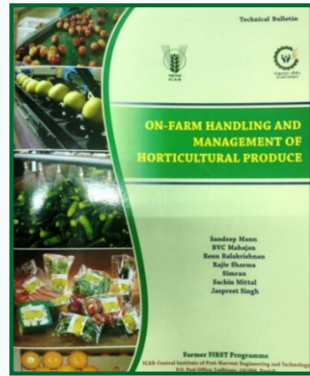
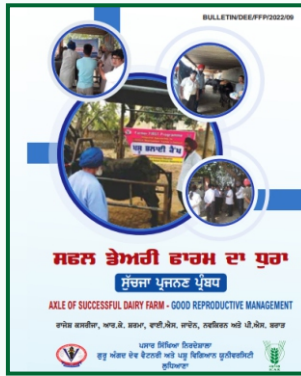
Detail of content mobilization by FFP centres

FFP centre	Extension literature developed for farmers (leaflets/pamphlets/etc.)		Booklets prepared on different technologies		No. of groups created	WhatsApp		No. of videos developed
	Extension publication (No.)	Distributed to farmers (No.)	No. of booklets	No. of to farmers (No.)		Distributed farmers	No. of messages sent	
PAU, Ludhiana	2	400	0	0	5	254	110	8
GADVASU, Ludhiana	3	237	0	0	6	300	100	4
CIPHET, Ludhiana	3	100	3	40	3	70	150	2
CSKHPKV, Palampur	4	1000	0	0	2	160	325	6
SKUAST, Jammu	5	250	0	0	8	99	95	5
GBPUA&T, Pantnagar	4	220	0	0	2	98	84	2
IIS&WC, Dehradun	2	450	0	0	1	212	114	2
Total	23	2657	3	40	27	1193	978	29

Detail of publications and coverage in local newspapers

FFP Centre	Research articles (No.)			Popular articles (No.)	Coverage in local newspapers (No.)
	< 4.0 NAAS rating	4-6 NAAS rating	>6 NAAS rating		
PAU, Ludhiana	0	0	0	2	2
GADVASU, Ludhiana	0	1	1	24	10
ICAR-CIPHET, Ludhiana	0	0	3	1	5
CSKHPKV, Palampur	0	0	1	4	15
SKUAST, Jammu	0	1	0	1	10
GBPUA&T, Pantnagar	0	3	0	6	11
ICAR-IIS&WC, Dehradun	0	0	0	1	6

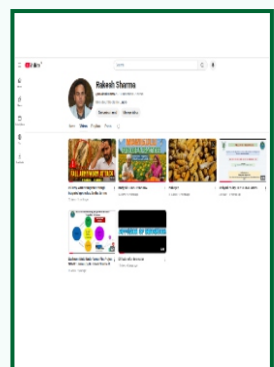
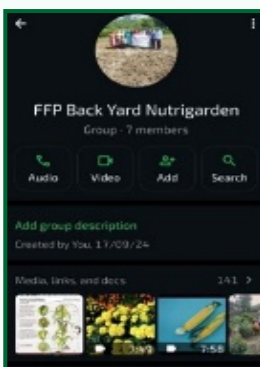
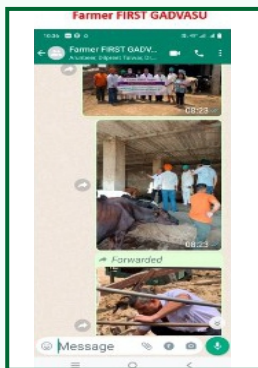
GLIMPSES OF PUBLICATIONS UNDER THE FFP



MEDIA COVERAGE UNDER THE FFP



MEDIA PLATFORMS UNDER THE PROJECT



Section 7.0

Meetings & Workshops

Proceedings of Action Plan Workshop of FFP 2024-25 held on 29.04.2024

The Action Plan Workshop for FFP 2024-25 was held on 29.04.2024 in the conference hall of ICAR-ATARI, Ludhiana. The meeting was chaired by Dr. Parvender Sheoran, Director, ICAR-ATARI, Ludhiana. Dr. Ashish Santosh Murai (Nodal Officer, FFP) welcomed the Principal Investigators (PI), Co-PIs and project staff from PAU, Ludhiana; GADVASU, Ludhiana; and ICAR-CIPHET, Ludhiana. The meeting aimed to discuss the identified issues in the adopted as well as joint village, prioritize problems, assemble technologies, and define the roles of PIs and Co-PIs in the project. In the meeting, the FFP center-wise as well as commonly selected village following highlights were addressed:

PAU, Ludhiana

- There will be no Co-PI from KVK/FASC
- Resource-based benchmark surveys must be conducted in the newly adopted villages
- Mapping of the entire village must be based on grid-based sampling
- Soil mapping must be completed so that soil-based nutrients can be recommended to the farmers
- Microbial studies can also be incorporated to assess soil health
- Data from benchmark surveys should be presented to exhibit the problems and prioritize them
- Some interventions must be carried out through participatory modes, such as seed production and the application of zinc-based nutrients for fortification
- The team will publish 3 research papers with NAAS rating >6.00 and two popular articles/success stories

GADVASU, Ludhiana

- The team will publish 4 research papers with NAAS rating >6.00
- The team has the option to include either a Dairy Technologist or a Dairy Engineer as a Co-PI
- A person from the Department of Agronomy, PAU Ludhiana can be included as Co-PI to look after the crop production-based modules

ICAR-CIPHET, Ludhiana

- The team will publish 3 research papers with NAAS rating >6.00
- All Self-Help Groups (SHGs) are encouraged to be registered with NRLM, and new groups (such as FIGs) must also be registered
- A scientific impact assessment of the groups at CIPHET, Ludhiana, is necessary
- The assessment format will be presented by May 30, 2024 (Dr. Soumaya)

Joint Action Plan for common selected village

- Dr. Kuldeep Singh and his team, along with Dr. Renu Balakrishnan, will develop the survey schedule by 10 May 2024



Joint action plan workshop of Ludhiana-based centres for common FFP village

- The survey schedule will be presented on 13 May 2024 through virtual mode (Dr. Pankaj, PAU, Ludhiana)
- Soil sampling will start from 10 May 2024 [Dr. Vajinder Kalra (PAU), Dr. Arunbeer Singh (GADVASU), Mr. Jaspreet Singh (CIPHET), Mr. Parminder Singh (PAU), Mr. Dharminder (GADVASU)]
- Analysis of collected data (Director, ICAR-ATARI, Ludhiana)
- A survey of nearly 100 farm families will be carried out (Dr. Rajesh Kasrija & Dr. Ravdeep Singh, GADVASU; Dr. Pankaj Kumar & Dr. Shivani, PAU; Dr. Renu Balakrishnan & Dr. Soumaya Mohapatra, CIPHET)
- Data entry will be updated by 10 May 2024
- Rural health status of the women and Animal health status data must be collected
- Presentation of problems, identification and prioritization will be done on 6 June 2024

Zonal Review Workshop of Farmer FIRST Programme (FFP) organized on August 13-14, 2024

The ICAR-Agricultural Technology Application Research Institute (ATARI), Ludhiana, organized the Zonal Review Workshop of the Farmer FIRST Programme (FFP) on August 13-14, 2024. The workshop was presided over by Dr. Parvender Sheoran, Director of ICAR-ATARI and Chairman of the Zonal Programme Management Committee (ZPMC). The workshop was graced by the presence of eminent members of the ZPMC, including Dr. Randhir Singh, Former Assistant Director General (Extension), ICAR; Dr. Prem Chand, Senior Scientist, ICAR-NIAP, New Delhi; and progressive farmers Mr. Lakhvir Singh from Muktsar, Punjab, and Mr. Jitender Chauhan from Shimla, Himachal Pradesh. During the workshop, Principal Investigators (PIs), Co-PIs, and other project team members from seven FFP centers presented their progress for the year 2023-24, along with the Action Plan for 2024-25. The workshop was attended by approximately 50 participants, including ZPMC members, FFP project teams, and scientists and staff of ATARI, Ludhiana. The second day of the workshop featured a field visit to the adopted village of Chatha Nanhera in the Sangrur district.

Inaugural Session

At the outset, Dr. Parvender Sheoran warmly welcomed the participants and outlined the aims and objectives of the Farmer FIRST Programme, setting the context for the discussions. He emphasized the significance of the workshop for the future evaluation and enhancement of the programme. Dr. Sheoran

also stressed the need for publishing high-quality research articles, technologies, and methodologies derived from the outcomes of the first phase of the FFP. Dr. Ashish Santosh Murai, Nodal Officer FFP provided an overview of the programme and its notable achievements in the Zone-I during 2023-24.

Dr. Prem Chand emphasized the critical role of farmers in the FFP, underscoring that trials and experiments are conducted directly on their fields. He noted that the collaborative approach of the FFP would yield better results if executed systematically, with farmers placed at the core of all experimental activities.

Dr. Randhir Singh highlighted the importance of meticulous planning, design, and formulation of action plans and strategies for the effective implementation of the programme. He also encouraged revising strategies that do not deliver the anticipated outcomes. He reiterated that farmers, as the primary stakeholders of the programme, should be regularly consulted to ensure timely feedback.

Mr. Lakhvir Singh, a progressive farmer from Sri Muktsar Sahib, Punjab, shared his insights into contemporary farming practices. He acknowledged the significant role of research institutions in enhancing the economic conditions of farmers, while also pointing out the challenges currently faced by the farming community. He urged the FFP centers to address these pressing issues.

Mr. Jitendra Chauhan, a progressive farmer from Himachal Pradesh, discussed the existing gaps between institutional knowledge and its transfer to farmers. He emphasized the importance of technology adoption and suggested that farmers engage more deeply in agricultural studies, akin to other scientific disciplines.

Technical Session

Chairman	Dr Parvender Sheoran, Director, ICAR-ATARI, Ludhiana
Expert Members, ZPMC	Dr Randhir Singh, Dr Prem Chand, Sh Jitender Chauhan and Sh Lakhvir Singh
Convener	Dr Ashish Santosh Murai, Nodal Officer FFP, ICAR-ATARI, Ludhiana
Rapporteurs	Dr Renu Balakrishnan, Scientist, ICAR-CIPHET, Ludhiana Dr Vajinder Pal Kalra, PAU, Ludhiana
Presentations by FFP Centres	GADVASU, Ludhiana; CSKHPKV, Palampur; ICAR-CIPHET, Ludhiana; PAU, Ludhiana; SKUAST, Jammu; ICAR-IISWC, Dehradun; GBPUA&T, Pantnagar

General recommendations:

- KVK should not be an implementing partner in the FFP.
- The project title and objectives should align with the technological interventions of each module, and the outcomes should be presented accordingly. Co-PI-wise roles and responsibilities should be defined.
- The action plan should address specific scientific problems. FFP is focused on identifying problems and solving them through scientific methods, rather than merely demonstrating solutions. The research component in the project and its results should be highlighted rather than merely showcasing demonstration results.
- Along with improving yield through studies, focus on reducing post-harvest losses, enhancing processing, packaging, and marketing be ensured through technology modules.
- More work should be done to enhance both the publication aspects and technology certification.

- Resources should be utilized efficiently to avoid waste, along with prioritizing precision and effective use over extensive but inefficient efforts.
- The value of every rupee invested must be calculated for each FFP project through a well-defined methodology. For this, Dr Soumya (CIPHET) under the guidance of Dr Anil Kumar (GBPUAT) and Dr Prem Chand (ZPMC) would develop a comprehensive format to study the same by 30 September 2024.
- Extension-based and other studies may be organized as a part of students' dissertations or projects so as to develop a systematic and comprehensive database to support the probable unknown.
- Data presented during the workshops or elsewhere must include ranges along with averages.
- Ensure all data is uploaded on the FFP portal.

FFP Centre specific recommendations:

PAU, Ludhiana

- The recommendations and achievements should be written in a concise form.
- The presented data lacks a farmer-linked and market-led approach. Although the collected data is sufficient, consulting an economist or statistician could enhance the analysis.
- Objectives should align with the technological interventions of each module.
- Evaluate the environmental footprints wherever applicable.
- An IFS (Integrated Farming System) model should be developed for more farmers; ensure farmers' data is mentioned and the information is concise.

GADVASU, Ludhiana

- Technological interventions need to be identified and prioritized based on defined objectives.
- Consider the availability of funds while selecting technologies as well as a number of farmers under study.
- Focus on technologies that will have the greatest impact and benefit for farmers within the FFP.

ICAR-CIPHET, Ludhiana

- The economic data for the enterprise module should be presented over the years instead of just a year considering the life and cost of the respective machine. Preferably, indicators like break-even point, payback period and Internal Rate of Return should also be presented for an enterprise.

CSKHPKV, Palampur

- Ensuring livelihood security requires household income enhancement over the years. Therefore, data on income enhancements, reduction in vulnerability, and access to resources and their indices should be calculated. Such data should be collected and presented during the workshops.
- Include Integrated Crop Management (IPM) practices in the module and engage team members from various scientific fields to support this effort, rather than just focusing solely on evaluating the changes resulting from altering crop varieties.
- Cropping intensity is an important indicator; therefore, it must be mentioned wherever necessary.

- Adopt a multi-component approach and assess its impact on farmers' income. Indicators must be identified through benchmarking to establish comparative advantage. Indicators of the benchmark survey need to be updated.
- Re-evaluate the backyard poultry concept and incorporate innovative research approaches that could enhance farmers' income.
- Honey-based blending for value processing should be included.
- Animal-based interventions must ensure care for endo and ecto parasites. Collaboration with the State Department can be explored for such interventions.

SKUAST, Jammu

- Based on the results of soil analysis, targeted interventions may be designed to address soil-related problems and balanced fertilization.
- The return on each rupee invested should be determined mathematically. All centers should use the same type of mathematical equations for this calculation methodology.
- Interventions on the demonstration of mineral mixture should be withdrawn.
- In the NRM module, include details on herbicides and sowing methods. The sample size may be decreased according to the available resources.
- More work is needed on extension approaches in popularizing FFP interventions, their effectiveness and wider applicability.

GBPUA&T, Pantnagar

- The progress was not found satisfactory; however, revise the action plan for 2024-25 in accordance with the project title and resource availability and effective implementation and submit before 15.10.2024. Curtail the Action Plan by 50% considering limited resources and effective implementation.
- Include the baseline survey and the percentage increase in farmers' income in the progress reports.
- PI and Co-PI-wise roles and responsibilities must be defined and communicated to ATARI, Ludhiana latest by 15.09.2024.

ICAR-IISWC, Dehradun

- Consolidated five-year report (Phase-I: 2016-17 to 2022-23) must be submitted till 31.09.2024.
- PI and Co-PI-wise role and responsibilities must be defined and communicated to ATARI, Ludhiana latest by 15.09.2024.
- Along with the research work, the focus should also be on good quality publications and technology certification.

Joint Action Plan (PAU, GADVASU and ICAR-CIPHET, Ludhiana)

- Reduce the modules in the joint action plan according to the available resources.
- The Integrated Crop Management (ICM) approach should focus on promoting short-duration varieties, alternate wetting and drying, study parameters with and without crop residue management, smart seeder and surface seeder technology.

- ICM should be based on the soil sample test results, and soil health cards should be provided to farmers.
- Zn fortification in the form of foliar and soil application should be included as a part of the module.
- Crop diversification should emphasize on sugarcane-based intercropping system.
- The IFS module should include vegetable farming, beekeeping and mushroom farming as components.
- The livestock module should focus on addressing infertility through trace minerals and precision tool management.
- The enterprise module should concentrate on chemical-free jaggery production and oil seed processing.
- A revised Joint Action Plan must be submitted to ATARI, Ludhiana, by 31 August 2024.

ZONAL REVIEW WORKSHOP ORGANIZED ON AUGUST 13-14, 2024, ICAR-ATARI, LUDHIANA



Methodological Workshop of FFP organized on February 11-12, 2025

The ICAR-ATARI, Ludhiana, organized a Methodological Workshop of the FFP on February 11-12, 2025. The workshop was presided over by Dr Parvender Sheoran, Director, ICAR-ATARI, Ludhiana, and was graced by the presence of Dr P. Venkatesan, Principal Scientist, and Dr N. Sivaramane, Principal Scientist, ICAR-NAARM, Hyderabad. During the workshop, Co-PIs and project team members from Ludhiana-based FFP centres PAU, Ludhiana; GADVASU, Ludhiana; and ICAR-CIPHET, Ludhiana presented their progress for the year 2024-25, along with the Action Plan for the jointly adopted village, Kila Raipur. The workshop was attended by 14 participants, including project members. At the outset, Dr. Parvender Sheoran warmly welcomed the participants and outlined the aims and objectives of the FFP, setting the context for the deliberations. Dr Ashish Santosh Murai, Nodal Officer, FFP, provided an overview of the programme and its notable achievements under ATARI, Zone-I, Ludhiana.

Dr Venkatesan and Dr Sivaramane emphasized the importance of conducting a comprehensive impact assessment of the project, focusing on the estimation of return on investment (ROI) and the economic impact of various agricultural interventions. They also discussed the concepts of internal rate of return (IRR), the need to account for social costs, and the significance of quantifying the economic benefits of technology adoption. Emphasis was also placed on assessing the socioeconomic aspects, technological awareness, and direct benefits to farmers. The discussion concluded with a strong emphasis on the need to quantify the benefits of technology adoption and to consider the real, tangible advantages derived from technological interventions. The second day featured a field visit to the adopted villages of all three FFP centres.



Glimpses of the visit of the team to Punjab-based FFP centres

Annexures

Annexure - I

Center-wise details of FFP adopted villages

Name of FFP centre	Title of FFP project	Name of selected villages (District)	No. of farm adopted families	Location	
				Latitude (°N)	Longitude (°E)
PAU, Ludhiana	Technology application and up scaling for sustaining natural resources and augmenting farm income: farmers led market linked approach	1. Bhojowali (Sangrur)	312	30.34489	75.92165
		2. Bhadalwadh (Sangrur)	112	30.42406	75.56696
		3. Chatha Nanhera (Sangrur)	796	30.06944	75.88389
		4. Taranji Khera (Sangrur)	210	30.10583	75.91472
		Total	1430		
GADVASU, Ludhiana	Integrated approaches for livestock development: farmer's context	1. Mehal Kalan (Barnala)	95	30.52707	75.56843
		2. Hamidi (Barnala)	85	30.46687	75.60722
		3. Kalala (Barnala)	142	30.49522	75.52330
		4. Dhaner (Barnala)	145	30.56712	75.51166
		5. Chananwal (Barnala)	215	30.50503	75.48544
		6. Moom (Barnala)	237	30.55355	75.49127
		7. Pamal (Ludhiana)	20	30.83748	75.73954
		Total	939		
ICAR-CIPHET, Ludhiana	Processing and value addition of agricultural produce for enhancing farmers income and employment in production catchment	1. Bharta Khurd (SBS Nagar)	25	31.05724	76.07927
		2. Rahon (SBS Nagar)	80	31.05275	76.11907
		3. Dharamkot (SBS Nagar)	15	31.09042	76.08681
		4. Balachour (SBS Nagar)	20	31.05788	76.30004
		5. Jalaldiwal (Ludhiana)	15	30.61468	75.57134
		6. Bandi (Bathinda)	20	30.08558	74.84194
		7. Abohar (Fazilka)	20	30.14453	74.19552
		8. Gagga (Patiala)	15	30.02080	76.10250
		9. Kandhargarh (Sangrur)	20	30.38472	75.97500
		Total	230		
Joint village by PAU, GADVASU, CIPHET Ludhiana	Technology application and upscaling for sustaining natural resources and augmenting farm income: farmers led market linked approach	1. Kila Raipur (Ludhiana)	805	30.76240	75.82347
		Total	805		
CSKHPKV, Palampur	Transfer of improved farm production technologies for enhancement of rural livelihood security amongst the farm households of Kangra district of Himachal Pradesh	1. Chattarghar (Kangra)	90	32.04796	76.56972
		2. Sagoor (Kangra)	80	32.15895	76.60605
		3. Chakol Bedu-I (Kangra)	50	32.03756	76.61959
		4. Chakol Bedu-II (Kangra)	50	32.03756	76.61959
		5. Padhkar (Kangra)	50	32.09178	76.58889
		6. Khajura Basti (Kangra)	50	32.09176	76.58786
		7. Kandkosari-I (Kangra)	65	32.08035	76.69874
		8. Kandkosari-II (Kangra)	65	32.08036	76.69874
		Total	500		

Name of FFP centre	Title of FFP project	Name of selected villages (District)	No. of farm adopted families	Location	
				Latitude (°N)	Longitude (°E)
SKAUST, Jammu	Exploring economic opportunities for farmers of kandi villages through application of proven rainfed technologies	1. Anandpur (Samba)	64	32.38386	75.34435
		2. Nagrota (Samba)	45	32.37281	75.03408
		3. Sadral (Samba)	33	32.39133	75.03191
		4. Sarmal (Samba)	14	32.38132	75.04195
		5. Sarain (Samba)	114	32.38221	75.07578
		6. Daruie (Samba)	133	32.35529	75.06019
		Total	403		
GBPUA&T, Pantnagar	Enhancing livelihood opportunities of farming community in mid-hills of Uttarakhand	1. Jeoli (Nainital)	60	29.33440	79.51640
		2. Syalikhhet (Nainital)	50	29.55650	79.45620
		3. Dogra (Nainital)	30	29.32260	79.52170
		4. Suryajala (Nainital)	70	29.32240	79.52520
		Total	210		
ICAR-IISWC, Dehradun	Farmer participatory technology application for sustainable resource management and livelihood security in North-Western Himalaya	1. Koti Gaon Hamlets (Dehradun)	167	30.60830	77.78120
		2. Sindwal Gaon hamlets (Dehradun)	175	30.25770	78.23910
		3. Badasi Grant hamlets (Dehradun)	275	30.25120	78.16870
		4. Kaluwala (Dehradun)	363	30.21775	78.16153
		5. Kudial Gaon (Dehradun)	273	30.55827	78.46871
		Total	1253		
ICAR-ATARI, Ludhiana		GRAND TOTAL	5770		

Annexure - II

Centre-wise details of Principal Investigators under FFP

Sl. No.	FFP Centre	Name of PI	Contact No.	E-mail Id
1.	PAU, Ludhiana	Dr Kuldeep Singh	98889-00329	pandhu-65@pau.edu
2.	GADVASU, Ludhiana	Dr Parminder Singh	98728-21140	pmschawla@gmail.com
3.	ICAR-CIPHET, Ludhiana	Dr Sandeep Mann	94630-43396	sandeep_mann76@yahoo.com
4.	CSKHPKV, Palampur	Dr D.R. Chaudhary	82194-52084, 94598-34160	drc_dee@rediffmail.com
5.	SKUAST, Jammu	Dr Rakesh Sharma	70062-16962	sharmar1975@gmail.com
6.	GBPUA&T, Pantnagar	Dr M.A. Ansari	95489-83306	aslam1405@yahoo.com
7.	ICAR-IISWC, Dehradun	Dr Bankey Bihari	94589-75199	biharibankey_bankey@yahoo.co.in

Expenditure detail of FFP centres based on the AUCs

(Amount in Rupees)

Year	FFP Centre	Revised Estimate			Expenditure			Closing balance		
		Capital	General	Total	Capital	General	Total	Capital	General	Total
2023-24	GADVASU, Ludhiana	400440	867000	1267440	399560	867000	1266560	440	0	440
2023-24	CSKHPKV, Palampur	200000	1275000	1475000	199906	1273277	1473183	94	1723	1817
2023-24	PAU, Ludhiana	250000	867000	1117000	249940	865467	1115407	60	1533	1593
2023-24	CIPHET, Ludhiana	600000	799000	1399000	598029	799000	1397029	1971	0	1971
2023-24	GBPUAT, Pantnagar	350000	867000	1217000	314624	865007	1179631	35376	1993	37369
2023-24	IISWC, Dehradun	0	918000	918000	0	882229	882229	0	35771	35771
2023-24	SKUAST, Jammu	100000	867000	967000	99979	865634	965613	21	1366	1387
2023-24	ATARI, Ludhiana	999560	1224000	2223560	999118	1223997	2223115	442	3	445
2023-24	Total	2900000	7684000	10584000	2861156	7641611	10502767	38844	42389	81233
2024-25	GADVASU, Ludhiana	0	1200000	1200000	0	1200000	1200000	0	0	0
2024-25	CSKHPKV, Palampur	0	1200000	1200000	0	1199950	1199950	0	50	50
2024-25	PAU, Ludhiana	0	1200000	1200000	0	1180915	1180915	0	19085	19085
2024-25	CIPHET, Ludhiana	0	1200000	1200000	0	1200000	1200000	0	0	0
2024-25	GBPUAT, Pantnagar	0	1000000	1000000	0	970669	970669	0	29331	29331
2024-25	IISWC, Dehradun	0	1000000	1000000	0	996989	996989	0	3011	3011
2024-25	SKUAST, Jammu	0	1200000	1200000	0	1198334	1198334	0	1666	1666
2024-25	ATARI, Ludhiana	0	1000000	1000000	0	1000000	1000000	0	0	0
2024-25	Total	0	9000000	9000000	0	8946857	8946857	0	53143	53143



Farmer
FIRST



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