



Farmer FIRST Programme: Ensuring Food, Nutrition & Livelihood Security



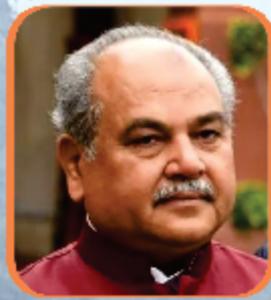
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Farmer FIRST Programme : Ensuring Food, Nutrition and Livelihood Security



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Foreword

The Farmers FIRST (Farm, Innovations, Resources, Science, Technology) programme aims at enriching Farmers-Scientist interface with focuss on technology assemblage, application and feedback, partnership and institutional building and content mobilization. Since 2016, Farmers First programme has made visible change in multidimensional aspects.

Three centres *viz.*, ICAR-IIHR, Bengaluru, ICAR-NIANP, Bengaluru and ICAR-CPCRI Regional Station, Kayamkulam are being implementing Farmers FIRST programme in Zone-XI through ICAR-ATARI, Bengaluru and covered 5438 farm families through 4214 technology demonstrations under different modules along with organization of 344 capacity development programmes and 1763 extension activities. Efforts were made to document the accomplishments over the years under this programme in the form of present publication.

The publication entitled "Farmers FIRST: Ensuring Food, Nutrition and Livelihood Security" presents the evidence based highlight on farmers practices vs technological interventions as well as vividly documented promising technological interventions adopted and out scaled by the participating institutions at each Farmer FIRST programme sites.

Dr.V.Venkatasubramanian, Director, ICAR-ATARI, Bengaluru and his FFP Team of Zone XI - Dr. B. Balakrishna, Principal Scientist, ICAR-IIHR, Dr. K. Letha Devi G, Senior Scientist, ICAR-NIANP, Dr.P.Anithakumari, Head & Principal Scientist, ICAR-CPCRI RS and Dr. D.V. Kolekar, Scientist, ICAR-ATARI deserves appreciation for bringing out the publication. I am sure that this publication will help policy makers, scientists, farmers, students and other stakeholders in agriculture to formulate strategies/research on farmer participatory extension for sustainable and equitable agricultural development.

(Udham Singh Gautam)
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Dr. Rajarshi Roy Burman

Assistant Director General (Agricultural Extension)

Message



The Farmer FIRST Programme was conceived and implemented by Indian Council of Agricultural Research to involve the practicing farmers for research problem identification, prioritization and to conduct experiments in farmers field utilizing the resources available with the farmers to privilege the smallholder agriculture operating in complex, diverse and risk prone situations through enhancing farmers-scientists interface. It is a farmer centric approach for research problem identification, prioritization and conduct of experiments and their management in farmer's conditions. The focus is on farmer Farm, Innovations, Resources, Science and Technology. The project is undertaken covering four major components *viz.*, Enhancing Farmer-Scientist Interface; Technology Assemblage, Application and Feedback; Partnership and Institution Building; and Content Mobilization.

The Farmer FIRST Centres *viz.* ICAR-IIHR, Bengaluru, ICAR-CPCRI, Kasaragod & ICAR-NIANP, Bengaluru under ICAR-ATARI, Zone XI, Bengaluru made commendable achievements and documented promising technological interventions adapted and out-scaled at each Farmer FIRST Project sites since inception of the project in 2016. Farmer FIRST Centres involved 5438 farm families and organised 4214 demonstrations under different modules along with 344 capacity development programmes and 1763 extension activities.

I complement the authors in bringing out the publication for FFP Centres under ICAR- ATARI, Zone XI, Bengaluru and acknowledge the cooperation of participating farmers in FFP villages. I hope, this publication will be of immense value to all the stakeholders engaged in implementation and spread of resilient technologies.

(Dr. Rajarshi Roy Burman)
ADG (AE)



Dr. V. Venkatasubramanian
Director
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Preface

Farmer FIRST (Farm, Innovations, Resources, Science, Technology) initiative was launched by ICAR to move beyond production and productivity; to privilege the small holder agriculture; and complex, diverse and risk prone realities of majority of the farmers through enhanced farmers-scientists interfaces. In this approach, the farmer is in a centric role for research problem identification, prioritization, conduct of experiments and its management in farmers' field conditions. It emphasizes resource management, climate resilient agriculture, production management, storage, marketing, supply chains, value chains, innovation systems and information systems.

Farmer FIRST Project (FFP) was sanctioned by Division of Agricultural Extension, ICAR, New Delhi during 2016-17 and it was implemented through ICAR-ATARI, Bengaluru at three institutes viz. ICAR-Central Plantation Crops Research Institute (CPCRI), Kasaragod (implemented at CPCRI Regional Station, Kayamkulam), ICAR-Indian Institute of Horticultural Research (IIHR), Bengaluru and ICAR-National Institute of Animal Nutrition and Physiology (NIANP), Bengaluru benefitting 5438 farm families through 4214 demonstrations under different modules along with 344 capacity development programmes and 1763 extension activities.

ICAR-ATARI Bengaluru congratulate all the three FFP centres of the zone for implementing the mandated activities of programme in befitting manner. To highlight this achievement on record, ICAR-ATARI, Bengaluru with the support of FFP centres of the zone is bringing out publication 'Farmer FIRST Programme: Ensuring Food, Nutrition and Livelihood Security'.

I acknowledge the support rendered by Secretary (DARE) & Director General (ICAR) and Deputy Director General (AE), ICAR to FFP centres of zone XI for their effective service to the farming community. My sincere thanks to ADGs (AE) ICAR and committee members Dr. S. Prabhukumar, Dr. A. K. Mehta and Dr. H. Philip for their effective monitoring and support

Bengaluru
01 November 2023


(V Venkatasubramanian)

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Chapter -1

Introduction about Farmer FIRST Programme

Farmer FIRST Programme (FFP) was sanctioned by Agricultural Extension Division of ICAR and implemented at three centres ICAR-Central Plantation Crops Research Institute (CPCRI), Kasaragod (implemented at CPCRI Regional Station, Kayamkulam), ICAR-Indian Institute of Horticultural Research (IIHR), Bengaluru and ICAR- National Institute of Animal Nutrition and Physiology (NIANP), Bengaluru since 2016-17 through ICAR-ATARI, Bengaluru.

This chapter covers following points:

- Approach of FFP
- Aims and objectives of FFP
- Components of FFP
- Genesis
- Project implementation, monitoring and evaluation
- Review
- Field visits



Agriculture sector has an important place in Indian economy. This sector plays a significant role in rural livelihood, employment generation and national food security. Proportion of Indian population depending directly or indirectly on agriculture for employment is more than that of any other sector; as high as 70 percent of rural household depends on agriculture for their livelihood, with 82 percent being small and marginal land holders. The small, marginal and landless tenant farmers are extremely vital for food security as land holdings are shrinking day by day. The contribution of farm women is also immense particularly in on-farm operations, harvesting, and post-harvest management and in other activities especially in horticulture and animal husbandry.

There is growing perception that the emerging demand of the farmers for recent technological interventions and institutional assistance are not adequately addressed. Also, extension system is not getting adequate feedback to plan and conduct demand driven extension services due to which a huge gap exists in the quality of extension output required at the farm level. The extension system should play a pro-active role in getting firsthand information about farmers' perceptions, feedback and develop more appropriate processes, methodologies and technologies for diverse farm environments.

India has witnessed a long history of planned agriculture extension service (AES) intervention. Government's Community Development Programme (1952) and National Extension Service (1953) were the foremost planned attempts to educate farmers regarding improved methods of farming. The other important area-based special programmes were Intensive Agricultural District Programme (1960), Intensive Agriculture Area Programme (1964), High Yielding Varieties Programme (1966), Operational Research Project (1974), Lab to Land Programme (1979) and IVLP (1995). The extension system, along with price

policy and procurement support, has often been credited for ushering in the Green Revolution in the 1960s. The initiatives of NAIP have extended the efforts towards improving rural livelihood of farmers living in less favoured, marginal or more complex environment.

At present, extension services are being provided mainly by the public sector through a network of the Indian Council of Agricultural Research (ICAR) Institutes, State Agricultural Universities (SAU), State Agriculture Departments (SADs), Krishi Vigyan Kendra (KVKs) and Agricultural Technology Management Agency (ATMA) spread across the country. In addition, such extension activities are also carried out by private agri-business companies and NGOs. The SAUs, SADs, ATMA, private companies and NGOs forms a part of first line extension system in India and have major responsibility of popularization of agricultural technologies. Being a part of front-line extension system, the ICAR through its vast network of institutes and Krishi Vigyan Kendras is involved in assessment and dissemination of latest agricultural technologies.

Continuing its legacy of introducing innovative frontline extension programmes, ICAR launched Farmer FIRST Programme (FFP) in the year 2016 primarily to promote farmer-participatory location-specific technology application for sustainable agriculture and livelihood security. The Farmer FIRST Programme (FFP) is an ICAR initiative to move beyond production and productivity, to privilege the small land holder and complex, diverse and risk prone realities of majority of the farmers through enhancing farmers-scientists interface. There are concepts and domains that are new in emphasis like resource management, climate resilient agriculture, production management including storage, market, supply chains, value chains, innovation systems, information systems, etc. The Farmer FIRST is developed as a farmer centric programme for research problem

identification, prioritization and conduct of experiments and its management in farmers' field. The focus is on Farm, Innovations, Resources, Science and Technology (FIRST) of the farmers. Two terms 'enriching knowledge' and 'integrating technology' qualifies the meaning of Farmer FIRST in Indian context. Enriching knowledge signifies the need for the research system as well as farmers to learn from each other in context to existing farm environment, perception of each other and interactions with the sub-systems established around. Technology integration is looked from the perspective that the scientific outputs coming out from the research institutions, many times do not fit as such in the farmers' conditions and thus, certain alterations and adaptations are required at field level for their acceptance, adoption and success.

Objectives of FFP

Farmer FIRST programme aims at enhancing farmer-scientist interface for technology development and application. It can be achieved with focus on innovations, technology, feedback, multiple stakeholder's participation, multiple realities, multi method approaches, vulnerability and livelihood interventions. The specific objectives are

- ◆ To enhance 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 performance of technologies and perception of the farmers about agriculture as a profession in the rural settings;
- ◆ To build network of linkages of organizations around the farm households for improving access

to information, technology, input and market.

- ◆ To institutionalize Farmer FIRST process.

Major activities of project are given under:

i) Enriching farmers–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 agroecosystems with focus on innovations and feedback.

iii) Partnership and institutional building

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

iv) Content mobilization

Using project as platform, having commodity institutions as partners to develop commodity specific contents for e-enabled knowledge sharing.

Keeping all efforts in view, farmer centric approach is only way to have sustainable agriculture and development. Farmers have their own traditional wisdom, so there is need to integrate indigenous knowledge with modern science. There is need to involve farmers as active partners in research for technology development and application. The innovations done by farmers should be documented and shared among other farmers for further up-scaling. There is need to shift from production to demand driven approach. Doubling the farmers' income is a major challenge. It can be achieved by conserving natural resources, institution building, farmers' involvement, and creation of market network and by collaborating with different national and state level developmental schemes.

Genesis

Project proposals under farmer FIRST Programme were invited through office order F.No.A.Extn. 26/10/2015-AE dated January 21, 2016 by Agricultural Extension Division of ICAR. Zonal Programme Management Committee (ZPMC) were constituted by Agricultural Extension Division of ICAR vide F.No. A.Extn.20-3/2011 AE-I, dated: 19.02.2016 for screening proposals and regular monitoring of implementation of FFP projects under Zone VIII, ATARI Bengaluru. Total of 10 proposal were received by zone VIII, ATARI Bengaluru. Out of 10, four proposals of ICAR-Central Plantation Crops Research Institute (CPCRI), Kasaragod (implemented at CPCRI Regional Station, Kayamkulam), ICAR-Indian Institute of Horticultural Research (IIHR), Bengaluru, ICAR- National Institute of Animal Nutrition and Physiology (NIANP), Bengaluru and Tamil Nadu Veterinary and Animal Sciences University, Chennai were recommended for consideration of Programme Management Committee at national level. These four centres' Principal Investigator made the presentation on 27.06.2016 before PMC which were then approved through office order F.No.A.Extn.20-3/2011-AE-I dated 28.10.2016. Zonal group meeting was organized at ATARI Hyderabad on 15 December 2016 to guide the implementing centres.

Project implementation, monitoring and evaluation

This programme was implemented at four centres ICAR-Central Plantation Crops Research Institute (CPCRI), Kasaragod (implemented at CPCRI Regional Station, Kayamkulam), ICAR-Indian Institute of Horticultural Research (IIHR), Bengaluru, ICAR- National Institute of Animal Nutrition and Physiology (NIANP), Bengaluru and Tamil Nadu Veterinary And Animal Sciences University, Chennai during the year 2016-17 through ATARI Bengaluru. The monitoring is done

by the Division of Agricultural Extension of ICAR. After reorganization of ATARIs, Tamil Nadu Veterinary and Animal Sciences University, Chennai was allotted to ATARI Hyderabad for coordination and monitoring. Initially each Farmer FIRST implementation centres were working with 800-1000 farm-families in villages through cluster approach. A team of scientist headed by the PI is constituted which is responsible for visiting the project site for the implementation of various modules. Along with implementing scientist, other scientists of the institute also undertake the task as required and get involved in different project activities related to problem identification, prioritization, technology assessment, refinement, technology development, input production and management and impact assessment. The Project team of each implementing centres have collaborated with farmers and other stakeholders, with other institutes scientists at village, district and state level interfaces. There is a development of strong linkage of NARES vis-à-vis farmers, development departments and other agencies. Along with proper implementation backed up by appropriate HRD initiatives for all the stakeholders, rigorous monitoring and evaluation are eloquently highlighted for the success of this flagship initiative. Periodical evaluation of the outputs and outcomes assumes critical importance to assess their performance and to justify the budget and other resources spent in the programme and to document good practices for up-scaling and out-scaling.

ICAR IIHR FFP project is implemented at cluster of 8 villages viz., Vasappana Doddi, Dodda Yerumgere, Chikka Yerumgere, Balepura, Kebbedoddi, Chikalegowdanadoddi, Hosadurga and Ramadurga Doddi of Kanakapura taluk of Ramanagara district in Karnataka. ICAR NIANP FFP project is implemented at cluster of 5 villages viz., Lekshmidvipura, Timmajanahalli, S. Nagenahalli, Gangasandra and Karnala of Doddaballapur taluk of Bengaluru Rural district in

Karnataka. ICAR CPCRI FFP project is implemented at cluster Pathiyoor panchayath of Muthukulam Block, Karthikappalli Taluk, of Alappuzha District in Kerala. The FFP institutes demonstrate technologies under different modules viz., crop, horticulture, livestock, NRM, enterprises and IFS as well as conduct need based capacity development programmes and extension activities. Since inception these centres have conducted 4214 demonstrations benefitting 5438 farm families covering following technologies under different modules along with 344 capacity development programmes and 1763 extension activities:

- **NRM:** Pond reclamation and refinement, bio resource management, Soil and water conservation practices and borewell recharge.
- **Crop:** Sesamum (Kayamkulam- 1, TMV 6,7& 4), cowpea (Kanakamoni and Hridya), green gram (CO-2), black gram (CO -6), ragi (ML- 365), pigeonpea (BRG- 5), field bean (HA- 4)
- **Horticulture:** Amorphophallus (Gajendra), turmeric (Pragathi and Prathibha), ginger (IISR Varada), Tomato (Arka Rakshak), chilli (Arka Haritha), tuberose (Arka Prajwal), beans (Arka Arjun), ridge gourd (Arka Prasanna), okra (Arka Anamika)
- **Livestock:** Health and fertility management, mastitis management, mineral nutrition, lameness management, fodder (Super Napier, CO-5), egg incubators, poultry (Gramapriya, Gramasree, BV 380)

Review: First National Review of FFP was conducted during 18-19 March 2017 at NAARM Hyderabad where four centres of zone presented progress report and it was appreciated by PMC. After reorganization of ATARIs, FFP centre of Tamil Nadu Veterinary and Animal Sciences University, Chennai shifted to ATARI Hyderabad for coordination and monitoring. Zonal review meeting was conducted at ATARI Bengaluru on 13.2.2018 for preparation of presentations for next

national review meeting. Second National Review of FFP was conducted during 21-22 February, 2018 at New Delhi where three centres of zone presented progress report and it was appreciated by PMC. The project is regularly reviewed by ZPMC and meetings were conducted on 16 April 2018, 11 June 2020, 6 August 2021, 17 August 2022 and 03 October 2023 through physical or online mode, in which suggestions were given for improvement. First of its kind Inter Zonal Review of FFP was conducted on 9 May 2019 for FFP centres of ATARI Bengaluru and Pune for cross learning where six centres of both the zone presented progress report and were suggested.

Field Visits: All the three FFP centres are regularly visited by Director, Nodal Officer of ATARI Bengaluru, ZPMC, PMC and Assistant Director General (AE) ICAR to ensure the proper implementation of mandated activities at field level, review of field activities and give suggestion to



Inter Zonal Review of FFP



Release of publications during Inter Zonal Review of FFP



FFP Zonal Review Workshop 2020



FFP Zonal Review Workshop 2021



FFP Zonal Review Workshop 2022



FFP Zonal Review Workshop 2023

overcome onsite implementation issues.

Dr. V. P. Chahal, ADG (AE) visited FFP centre of IIHR Bengaluru during 2018-19. Dr.S. Prabukumar, PMC member of FFP & Former Director of ATARI Bengaluru and Ludhiana visited FFP centre of CPCRI Kasaragod. Dr. M. J. Chandre Gowda, Chairman ZPMC FFP and Director ATARI Bengaluru, visited IIHR FFP on 05.04.2018. Dr. Bharat Sontakki, Head and Dr P. Venkatesan, Principal Scientist of Extension Systems Management division of NAARM Hyderabad visited FFP centre of NIANP Bengaluru on 05.01.2022.

Dr.V.Venkatasubramanian, Chairman ZPMC FFP and Director ATARI Bengaluru, visited CPCRI FFP in Pathiyoor Grama Panchayath on 18.11.2022. He interacted with FFP farmers and elucidated the scope of linkages and convergences with various agencies for multiplying the impact to benefit the social system through integrated farming

and strengthening value chain. He stressed on proper market facilities, branding, procurement and sharing benefits through self-help groups and organizing Farmer Producer Organizations (FPO). ATARI Director visited the Odanadu Farmer Producer Company Ltd. (OFPC) office and rural mart, shared his views to orient towards the diversified marketing scenario and other farmer linkage activities. The community coconut nursery of root (wilt) disease tolerant West Coast Tall poly bag seedlings maintained by ICAR CPCRI FFP in linkage with OFPC was appreciated. The farmer participatory experiment on bio nutri priming in coconut seedlings initiated during 2021-22 was visited. He also conducted field visits and interacted with farm women, SHG members, MGNREGS workers and encouraged them for adopting scientific farming activities and livelihood security in unison with FFP.



Field visit of Director ATARI Bengaluru to FFP of CPCRI Kasaragod

Team consisting of Dr.S. Prabukumar, PMC member of FFP & Former Director of ATARI Bengaluru and Ludhiana, and Dr. H. Philip, ZPMC member & Former Director of Extension, TNAU Coimbatore, Dr. D. V. Kolekar, Scientist and Member Secretary, ZPMC and Dr. Letha Devi G, Senior Scientist and P.I., FFP of ICAR-NIANP Bengaluru visited FFP centre of NIANP Bengaluru on 05.10.2023 (visited adopted villages viz. Lakshmidhevpura, Thimmojanahalli, S. Nagenahalli, Gangasandra, Karnala of Bengaluru Rural district). They had conversation with farmers



Director ATARI Bengaluru interacting with FFP farmers of CPCRI Kasaragod

about the technological interventions and their benefits of Farmers First project in the village. During the meeting various scientific activities of FFP such as fodder production, mastitis management, infertility management, lameness management, ragi production, clean milk production, vegetables production were discussed and suggestions were given. They also visited field activities and discussed with farmers. Suggestions were given for documentation, making feedback videos, telecasting of successful technologies, creating FPOs, startups etc.



Field visit to FFP of NIANP Bengaluru

Dr. V. Venkatasubramanian, Chairman ZPMC & Director, ICAR-ATARI Bengaluru, Dr. R. R. Burman, Assistant Director General (AE), ICAR, New Delhi, Dr. H. Phillip, Former Director of Extension, TNAU Coimbatore and Member ZPMC, Dr. A. K. Mehta, Former ADG (AE), ICAR New Delhi and Member ZPMC, Dr. S. Prabhu Kumar, Former Director, ATARI Bengaluru and



Field visit to FFP of NIANP Bengaluru

member of PMC, Dr. D. V. Kolekar, Scientist and Member Secretary, ZPMC, Dr. B. Balakrishna, Principal Scientist and PI, FFP, ICAR-IIHR, Dr. D. Rajendran, Principal Scientist, (Animal Nutrition), ICAR-NDRI Bengaluru, Dr. Krishnappa Balaganur, Scientist and Dr. Letha Devi G, Senior Scientist, and P.I., FFP of ICAR-NIANP Bengaluru visited FFP centre of IIHR Bengaluru on

06.10.2023 at FFP Cluster villages along with Farmers of FFP Cluster villages in Kanakapura taluk, Ramanagara district. ZPMC team visited different places to understand various technological modules and activities of the FFP, to evaluate them and to provide suggestions for refinement of project to the implementation team. The team visited demonstration plot of improved variety ragi transplanted field, sericulture rearing house, chilli

& tomato demonstration, small ruminant technology module, mushroom RTF bag production unit etc. After the visit ZPMC team had given suggestions for further improvement in implementation of FFP programme, such as out scaling, convergence, apiary promotion, bakery unit promotion, documentation of social benefits, marigold introduction in tomato, marketing, documentation etc.



Field visit to FFP of IIHR Bengaluru

The detailed achievement of each FFP centre in terms of implementation, module wise achievement, outcome of technology combinations, success stories, content mobilization, budget utilization, and lessons learned and way forward is given in subsequent chapters. This publication is designed to promote a better understanding of the achievements of FFP approach and to encourage its

adoption across various NARES institutions. Further, it would serve as a reference source for outcome-based achievements of other similar programmes. On the policy front, it is intended to pitch in for continued financial and other resources for taking up this and other similar initiatives for the empowerment of farmers, research, and development machinery.

Chapter -2

Farmer FIRST Programme of ICAR-Indian Institute of Horticultural Research, Bengaluru

Farmer FIRST Programme of ICAR-Indian Institute of Horticultural Research, Bengaluru is implemented at cluster of 8 villages viz., Vasappana Doddi, Dodda Yerumgere, ChikkaYeramgere, Balepura, Kebbedoddi, Chikalegowdanadoddi, Hosadurga and Ramadurga Doddi of Kanakapura taluk of Ramanagara district in Karnataka since 2016-17.

This chapter covers following points:

- 2.1. Genesis
- 2.2. Profile of adopted villages
- 2.3. Farmers practices vs. technological interventions
- 2.4. Technology assemblage, application and feedback
- 2.5. Enhancing farmer-scientist interface
- 2.6. Combination of technological interventions
- 2.7. Success stories and case studies
- 2.8. Outcome studies
- 2.9. Partnership and institution building
- 2.10. Content mobilization
- 2.11. Budget details



2.1. Genesis

Karnataka state has a total of 86.81 lakh holdings spread across 118.05 lakh hectares of the operated area. Marginal and Small farmers account for 80.41 per cent of the total holdings operating 43.94 percent of the total cultivated area. The gross cropped area was 120.59 lakh hectares. Out of the net area sown, the net irrigated area was 30.39 per cent. Food crops accounted for 77.20 per cent of the gross cropped area. Cereals accounted for 41.65 per cent whereas the share of oilseeds was 12.31 per cent and that of pulses was 21.15 per cent. Among cereals, maize accounted for the largest area (27.86 per cent), followed by paddy (26.37 per cent), sorghum (17.86 per cent), and finger millet (17.01 per cent). In terms of percentage share of the irrigated area to the total area, sugarcane accounted for the highest share followed by paddy. Karnataka is the leading state for horticulture crops with an area of 23.25 lakh hectare. Karnataka ranks first in area under plantation crops with 48.56 per cent of the area under horticulture crops. Vegetables occupy 20.64 per cent, fruit crops occupy 16.68 per cent and spices cover 12.81 per cent of the total horticulture area. The total value of horticulture produce was worth Rs.46254 crores during 2019-20. Cashew, spices, small onion, small cucumber, coffee and processed products of horticulture were the major exported commodities from the state. Karnataka has rich resources under livestock with 84.69 lakh cattle, 29.85 lakh buffalo, 61.69 lakh goats, 110.51 lakh sheep and 594.95 lakh poultry birds. The state produces 7901000 tonnes of milk, 59994 lakh eggs and 253604 tonnes of meat annually. Hence, due to congenial climate, we can find large number of horticultural crops are grown across the state extensively round the year.

Ramanagara district comprises four taluks Channapatna, Kanakapura, Ramanagara and Magadi. Ramanagara district falls under Eastern Dry Zone of Karnataka. The district has a

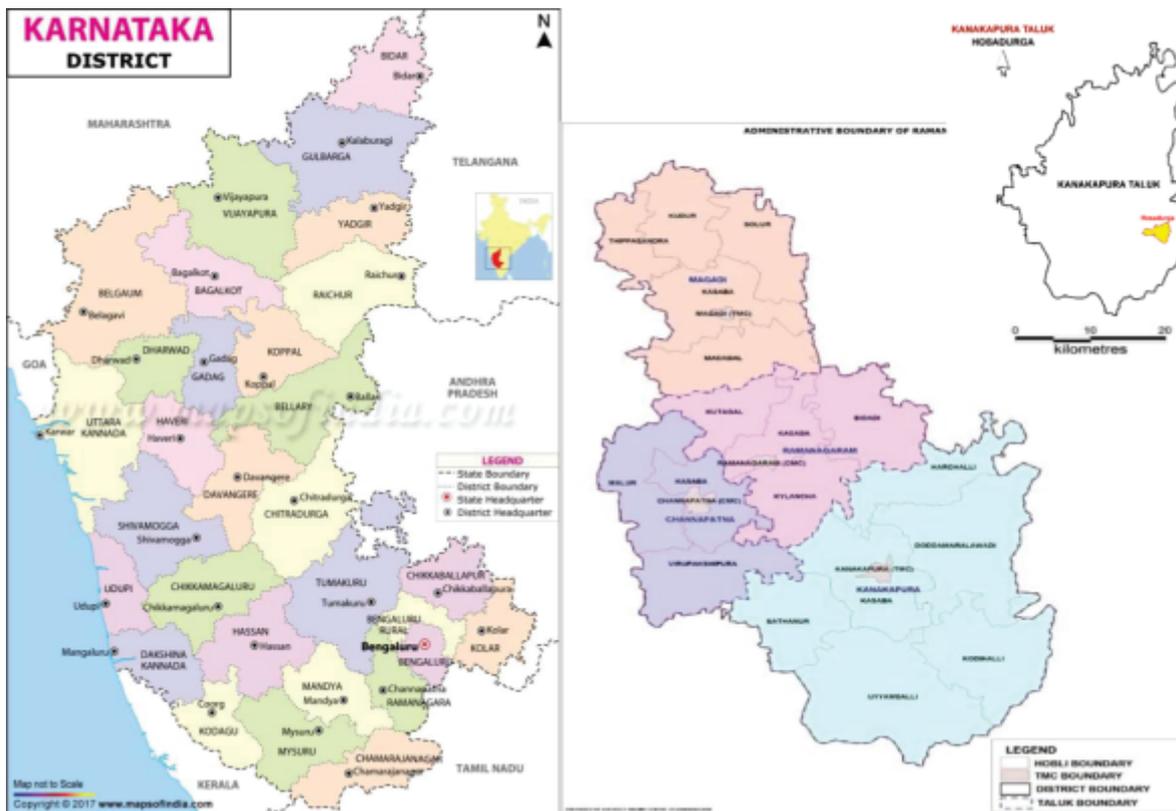
geographical area of 3,55,912 ha with Net area sown to an extent of 1,72,380 ha. The land utilization for agriculture is 35.43 per cent, other uncultivated land is 19.77 per cent and 17.21 per cent covered with forest. The area under irrigation is 25.46 per cent and the average rainfall is 874mm. The major agricultural crops grown in the district are finger-millet, paddy, maize, field bean and groundnut are the major oil seed crops. Horticulture is a major source of income for farmers in the district with an area of 58,971 ha accounting for 35.75 per cent of the net sown area. Mango, banana, tomato, brinjal, coconut, arecanut, citrus, betel vine are important horticulture crops grown in the district. Vegetable crops are grown in an area of 27,826 ha (47.18%), plantation crops in 26,364 ha (44.71%), flowers in 3914 ha (6.63%) and spices in 867 ha (1.48%). Mulberry cultivation, silkworm rearing and reeling activities are also predominant in the district. The cropping intensity of the district is 102.89 per cent and 4768 ha is under double cropped area.

The ICAR- IHR, Bengaluru has developed large number of varieties and technologies in different horticultural crops, which are being spread across the country to enhance, yield, productivity and quality of produce and income of farmers. Under this situation, the FFP project was implemented in a cluster of 8 villages' viz., Vasappana Doddi, Dodda Yerumgere, Chikka Yeramgere, Balepura, Kebbedoddi, Chikalegowdanadoddi, Hosadurga and Ramadurga Doddi of Kanakapura taluk of Ramanagara district during 2016-17. During planning and implementation various technological interventions through different modules, team of scientists from 6 ICAR institutes and UAS, Bengaluru were intensively involved in planning and implementation of various technologies in field crops, scientific dairy farming, small ruminant management, NRM, fisheries and horticulture.

In horticultural crops, many improved

varieties/hybrids, precision farming which comprises of INWM with application of micro nutrients, use of mulch and drip irrigation systems, IPM, IDM, GAP's in PHM and good marketing practices were integrated. All these practices were implemented as a holistic package, so as to enhance production, productivity, quality of produce and gross and net-income of the farmers. The Farmer FIRST Project had three folded plans for doubling the income through cost reduction, production enhancement and diversification of enterprises.

Along with these technologies, different schemes of developmental departments for promoting rural entrepreneurship were also integrated with the project through different synergy programmes in all the adopted villages. In addition to horticultural technologies, many technological interventions in crop, livestock, small ruminants and NRM were also implemented in all the adopted villages, to study how the diversification of enterprises can lead to income enhancement among various groups.



Location of the selected cluster of villages for implementation of FFP

2.2. Profile of adopted villages

The project was implemented in a cluster of 8 villages viz., Vasappana Doddi, Dodda Yerumgere, Chikka Yeramgere, Balepura, Kebbedoddi, Chikalegowdanadoddi, Hosadurga and Ramadurga Doddi. These villages are 24 KM away from Kanakapura taluk and 49 KM away from district head quarter Ramanagara. These villages are largely practicing dry land farming in resource poor condition and farmers are having less knowledge regarding improved precision farming technologies. Through PRA, identification and

prioritization of problems in different vegetable growers was undertaken for planning and implementation of different technological module. To solve those problems in all the selected cluster of eight villages many programmes were undertaken, including demonstration in farmers' field by providing all the essential critical inputs with complete technical guidance. Farmers were equipped with the essential knowledge and skills for adoption of these innovations. Brief profile of adopted villages under FFP is given in Table 1.

Table 1: Brief profile of adopted villages under FFP

Names of adopted villages	No. of families covered	Population	Major crops grown	Rainfall (mm)	Major enterprises
Vasappana Doddi, Hosadurga, Chikalegowdanadoddi, Dodda Yeramgere, Chikka Yeramgere, Ramadurga Doddi, Balepura, Kebbedoddi,	3997	7582	Ragi Redgram Horse gram Field Bean Tomato Chilli & Brinjal	854	Agriculture Horticulture Dairy Small Ruminants

2.3. Farmers practices vs. technological interventions

The details of farmer's practices vs. technological interventions introduced under Farmer FIRST Project are given in following Table 2.

Table 2: Module wise farmers practices Vs technological interventions

Intervention Category	Before (Farmers Practice)	After (Technological Interventions)
Crop module	Farmers were using local varieties in ragi like Karikaddi and Sharavathi as well as earlier improved varieties like GPU-28, GPU-30, and Indaf-7. In Redgram farmers were using local varieties like bhavanisagar and maruthi along with non-descript local varieties which had small red and white seeds. In oil seeds and pulses also they were using low yielding local varieties.	Introduction of dwarf varieties with high grain and straw yield, non-lodging, blast resistant ragi varieties like ML-365, GPU-67, KMR-204 and KMR 301; improved redgram varieties with drought and wilt resistance - BRG-2, BRG-3 and BRG-5; short duration, aroma rich, small and round seeded and viral disease resistant varieties of field bean (dolichos) like HA-3 and HA-4 of UAS, Bengaluru. Introduction of INM and IPM with bio-fertilizers (both for seed treatment and in main field) and bio-pesticides also to reduce the use of chemical fertilizers and PP chemicals.
Horticulture module	Farmers were cultivating many vegetables mostly local varieties and sometimes improved commercial varieties/hybrids of many companies. Important crops include tomato, brinjal, chilli, french beans, ridge gourd, cucumber, bitter gourd, cabbage, cauliflower, yard long beans, etc. Among the important fruit crops grown, banana, mango, papaya are the major crops and among flower crops marigold and	Introduction of ICAR-IIHR varieties in different vegetable, flower and fruit crops also changed the production scenario in the village. Introduction of Arka Arjun, Arka Sharath and Arka Sukomal varieties of french beans, powdery mildew disease resistant hybrids of chilli -Arka Haritha and Arka Meghana, triple disease resistant tomato hybrids like Arka Rakshak and Arka Samrat.

chrysanthemum were important ones. In all these crops farmers were cultivating commercial varieties / hybrids. Major drawback was in the production system of horticultural crops, as they were practicing flood irrigation with improper nutrient, pest, and disease management practices. Most of the production practices had deleterious effect on the yield and quality of the produce.

There was a very weak institutional linkage, particularly between farmers and developmental departments. This was mainly due to less organized efforts by the officials of developmental departments and farmers and lack of synergy programmes.

The technology based specific programmes for women empowerment was lacking in many villages, except for existence of women SHG's.

Introduction of improved varieties/ hybrids in other crops like papaya (Arka Prabhat), Marigold (Arka Bangara-1 and 2), Crossandra (Arka Ambara), chrysanthemum (Arka Aishwarya), rose (Arka Savi and Arka Parimala). Along with Introduction of institute improved varieties and hybrids, precision farming practices advised by the institute FFP team and diligent adoption of these practices such as drip irrigation, mulching, fertigation with WS fertilizers and micro nutrients spray, IPM, IDM and good packaging and PHM practices. Through FFP we have introduced many synergy programmes between all the developmental departments, particularly Horticulture, Agriculture, Sericulture, Animal Husbandry and Veterinary Services departments, on regular basis. Through FFP many specific programmes like mushroom cultivation, ornamental fish production, etc. were introduced to enhance technical knowledge, yield of many crops and income of farm women.

Livestock module

There was no care taken for clean milk production and it increases the mastitis disorder. Quality of milk was reduced due to mastitis disease and there is no care taken for clean milk production fat content and SNF content was low. Fodder scarcity was there. Balanced nutrition was a major problem due to which dairy animals were suffering from malnutrition, infertility problems and high feed cost. In case of small ruminants, followed traditional way of rearing and no vaccination for animals regularly, never fed extra concentrates and reproductive performance was low.

Introduction of improved varieties of fodder crops in fodder maize, sorghum and other grasses. Balanced nutrition with mineral mixture. Clean milk production practices and mastitis management programme were introduced. Animal Health Camp (Identification of infertility, mastitis, mineral deficiency, rumen disorders, hoof problems, malnutrition and for deworming, vaccination, distribution of mastitis kit and other medicine were given). In case of small ruminants protein supplements or concentrate supplement to enhance health and weight of animals, supplementation of minerals to reduce mineral deficiency and reproductive problems and awareness program on

		rearing of small ruminants were introduced. Enhanced polyculture practices of fisheries in small farmers ponds.
NRM module	There was no systematic study of soil/land types/soil inventory through soil survey, or preparation of the soil health cards (SHC). Farmers were lacking knowledge on SHC based recommendations or selection of suitable crops and none of them were practicing INM in either field or horticultural crops. Soil and water conservation practices are not practiced scientifically and no farmer was following borewell recharge practice	Activities such as survey & soil profiling, preparation and distribution of soil health card, assessment of land suitability map for field and horticulture crops and enterprises, completion of Land Resource Inventory, awareness on adoption of suitable crops and soil health management practices, soil and water conservation practices and activities on borewell recharge, introduction of integrated nutrient management for field and horticulture crops etc. were taken.
Enterprises module	There was no vegetable nursery and no farmer was growing mushrooms in any FFP village individually or in group	Nursery for quality vegetable seedling production by individual farmer and production of mushroom among women SHG were introduced in 2 villages.
IFS module	IFS was integral part of their production system. However, they were not practising economically viable combination of enterprises and they were not following scientific management practices in any conventional IFS module.	IFS modules such as field crops + french bean + mango + dairy farming + small ruminants, field crops + chilli + mango + dairy farming + small ruminants and field crops + tomato + mango + dairy farming + small ruminants were introduced.

2.4. Technology assemblage, application and feedback

Under this component, various modules; i.e., crop based, horticulture based, natural resources management (NRM) based, livestock based, enterprise based, and integrated farming systems (IFS) based were planned. The module-wise progress of technology assemblage, application and feedback has been enunciated as below:

2.4.1. Crop based module

The major problems prioritized in the crop based modules were the low level of adoption of high

yielding varieties and subsequently low production and income. Soil sample collection was done and samples were analysed, based on which nutrient recommendation and crop planning was done. Based on the priorities identified during PRA and the needs of farmers in the project area, it was identified that there was a requirement for improved varieties in all the major field crops cultivated by them such as ragi, red gram and field bean.

Demonstration of ragi varieties : In ragi many varieties such as ML-365, KMR-301, KMR-204, GPU-67, MR-1 & MR-6 were demonstrated, which

have special features like dwarf growth habit, high tillering capacity, blast and neck blast disease tolerance. These varieties were demonstrated in 620 ha area covering 1798 farmers since 2016-17. These varieties gave yield of 43.01 q/ha with net return of Rs.119270 /ha as compared to 22.60 q/ha with net return of Rs. 47977 /ha under local variety. The year wise number of farmers & area covered, yield and economics is given in following Table 3 and Figures

1& 2. The data is a true reflection of the slow and steady ascending rate of adoption of improved varieties of Ragi along with improved production practices from nutrient management to post-harvest technologies, which resulted in steady growth of total productivity and income (both gross and net-income) of all the ragi farmers over a period of six years. In addition to these, there is a gradual change in adoption of transplantation method of Ragi both in rainfed and irrigated condition.

Table 3: Demonstration of ragi varieties

Year	Farmers (No.)	Area (ha)	Yield (q/ha)		% increase in yield	Economics of Demo (Rs./ha)		Economics of check (Rs./ha)	
			Demo	Check		Gross return	Net return	Gross return	Net return
2016-17	40	16	34	20.0	70.0	79,050	94,000	46,500	24,000
2017-18	200	72.8	35.6	20.2	76.2	1,51,140	1,06,890	54,540	35,040
2018-19	345	119.2	34	22.0	56.25	1,57,650	1,12,500	69,300	42,800
2019-20	160	64	35	20	75.0	1,71,800	1,22,500	62,000	46,000
2020-21	233	100	52.5	24	118.75	1,72,987	1,26,000	74,400	55,200
2021-22	400	80	57.50	27	113	1,89,463	1,38,000	88,965	64,800
2022-23	420	168	52.50	25	110	1,90,575	1,35,000	90,750	68,000
Total/Average	1798	620	43.01	22.60	88.46	1,58,952	1,19,270	69,493.5	47,977.1

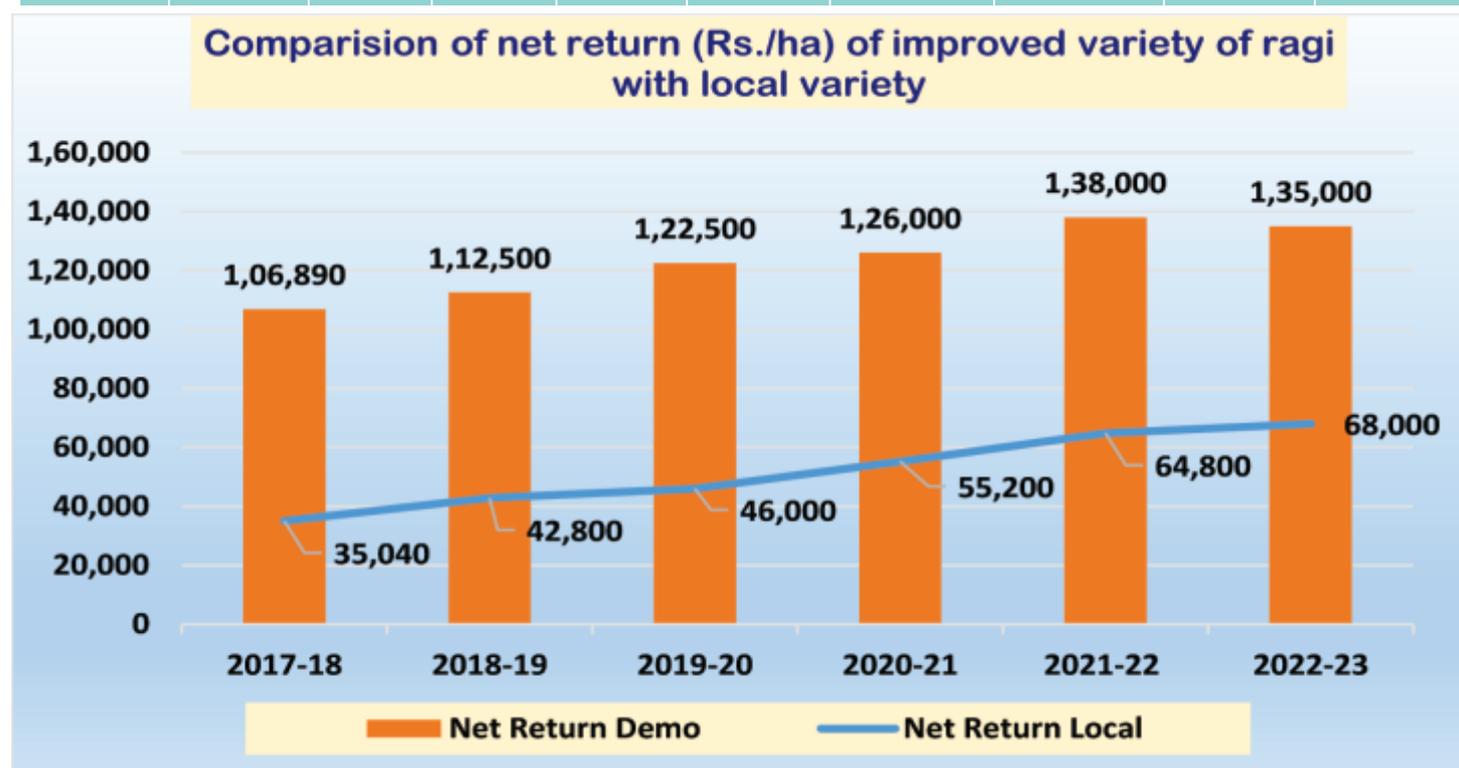


Figure 1: Comparison of net return of improved variety of ragi with local variety

Comparison of yield of improved variety of ragi with local variety

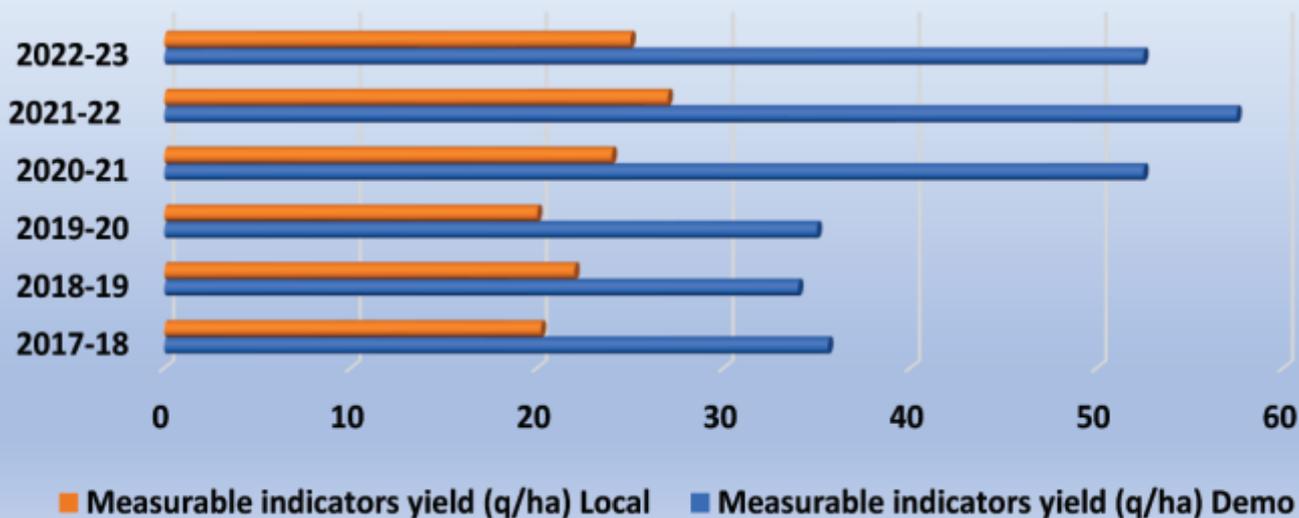


Figure 2: Comparison of yield of improved variety of ragi with local variety



Transplanted ragi

Demonstration of redgram variety BRG 2:

Redgram variety BRG 2 was demonstrated in 286 ha area covering 1084 farmers since 2016-17. It is resistant to drought and suitable for dry land farming and predominately grown as an intercrop with other field crops. BRG 2 gave yield of 6.48 q/ha with net return of Rs.33590 /ha as compared to 3.17 q/ha with net return of Rs. 14713 /ha under local variety. The year wise number of farmers & area covered, yield and economics is given in following Table 4 and Figures 3 & 4.

Comparison of netreturn (Rs.ha) of improved variety of redgram with local variety

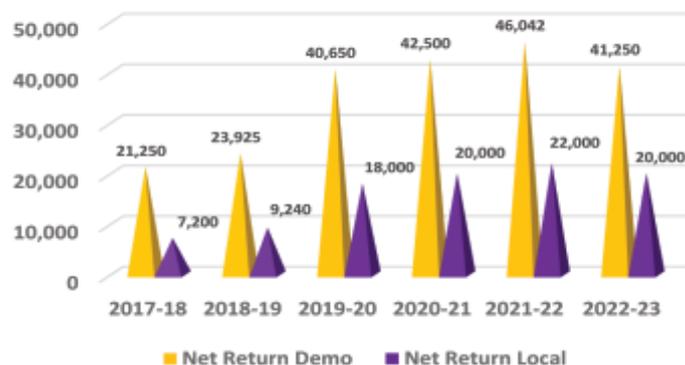


Figure 3: Comparison of net return of improved variety of redgram with local variety

Table 4: Demonstration of redgram variety BRG 2

Year	Farmers (No.)	Area (ha)	Yield (q/ha)		% increase in yield	Economics of Demo (Rs./ha)		Economics of check (Rs./ha)	
			Demo	Check		Gross return	Net return	Gross return	Net return
2016-17	38	8	6.2	3.0	106.7	31,310	19,510	15,150	6,550
2017-18	118	39.2	6.4	3.0	113.3	33,600	21,250	15,750	7,200
2018-19	129	41.2	6.5	3.2	103.1	35,425	23,925	17,440	9,240
2019-20	105	32	6.25	3.0	108.3	59,375	40,650	27,600	18,000
2020-21	152	20.0	6.5	3.0	117.0	56,250	42,500	28,750	20,000
2021-22	332	65.5	7.0	3.25	115.38	60,577	46,042	31,625	22,000
2022-23	210	80	6.50	3.75	73.33	55,250	41,250	31,875	20,000
Total/Average	1084	285.9	6.48	3.17	105.30	47,398	33,590	24,027	14,713

Comparison of yield of improved variety of Redgram with local variety

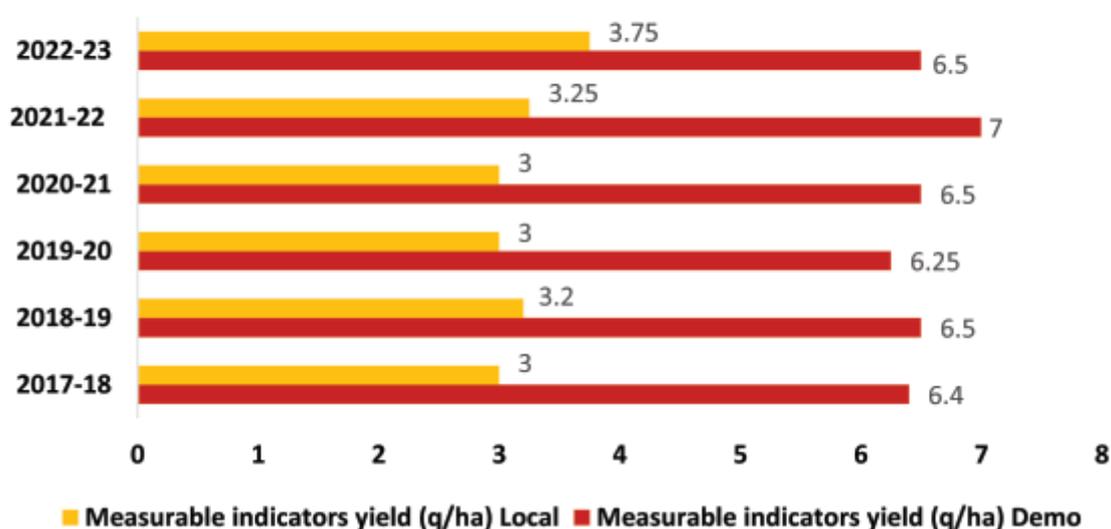


Figure 4: Comparison of yield of improved variety of redgram with local variety



Demonstration of wilt resistant redgram variety

Demonstration of field bean varieties: Field bean varieties HA-3 and HA-4 were demonstrated in 124 ha area covering 729 farmers since 2016-17 as intercrop. In field bean, late introduction of short duration, aroma rich, small and round seeded and viral disease resistant varieties of field bean (dolichos) like HA-3 and HA-4 of UAS, Bengaluru gave yield of 7.47 q/ha with net return of Rs.27419 /ha as compared to 2.93 q/ha with net return of Rs. 8683 /ha under local variety. The year wise number

of farmers & area covered, yield and economics is given in following Table 4 and Figures 5&6. These varieties have high priority in the market fetching good price. Impact of introduction of new varieties in field crop was highly significant in terms of increased area, productivity, market demand and good returns. All these factors influenced the farmers to continue to adopt these varieties, every year.

Table 5: Demonstration of field bean varieties

Year	Farmers (No.)	Area (ha)	Yield (q/ha)		% increase in yield	Economics of Demo (Rs./ha)		Economics of check (Rs./ha)	
			Demo	Check		Gross return	Net return	Gross return	Net return
2016-17	37	7	7.4	2.5	196.0	22,200	15,300	7,500	4,450
2017-18	86	13	7.4	2.5	196.0	28,860	20,410	9,750	5,070
2018-19	190	26	7.3	2.5	192.0	29,930	20,680	10,250	5,500
2019-20	40	8	7.5	2.5	200.0	43,500	30,700	13,250	7,500
2020-21	40	5	8.0	3.5	128.5	40,600	31,450	16,800	11,075
2021-22	226	45.2	8.5	4.0	112.50	44,660	34,595	18,480	12,183
2022-23	110	20	6.20	3.0	106.60	55,800	38,800	27,000	15,000
Total/Average	729	124.2	7.47	2.93	161.66	37,936	27,419	14,719	8,683

Comparison of net return (Rs./ha) of improved variety of field bean with local variety

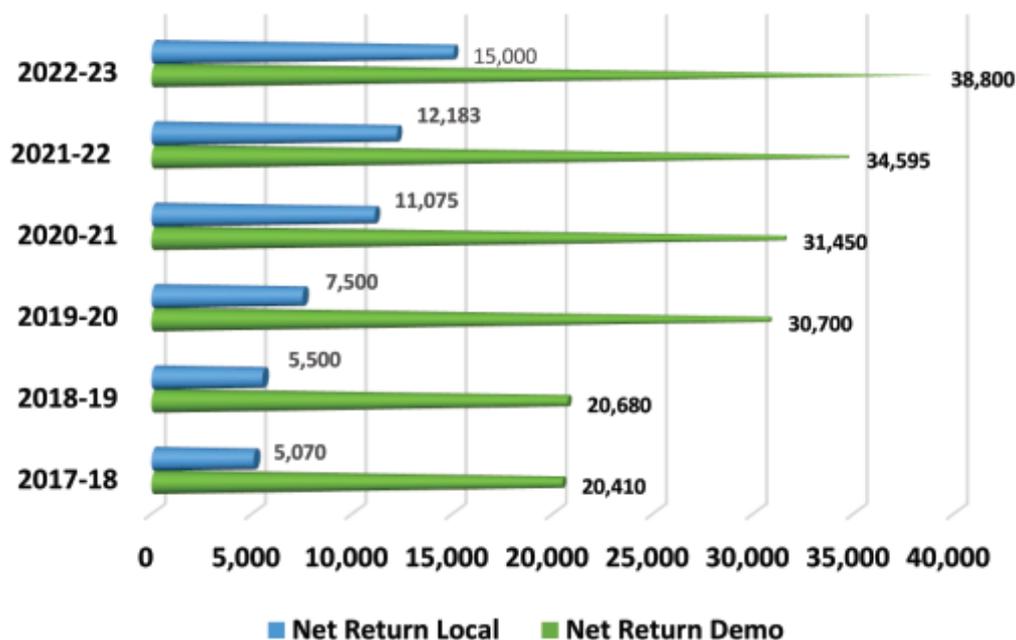


Figure 5: Comparison of net return of improved variety of field bean with local variety

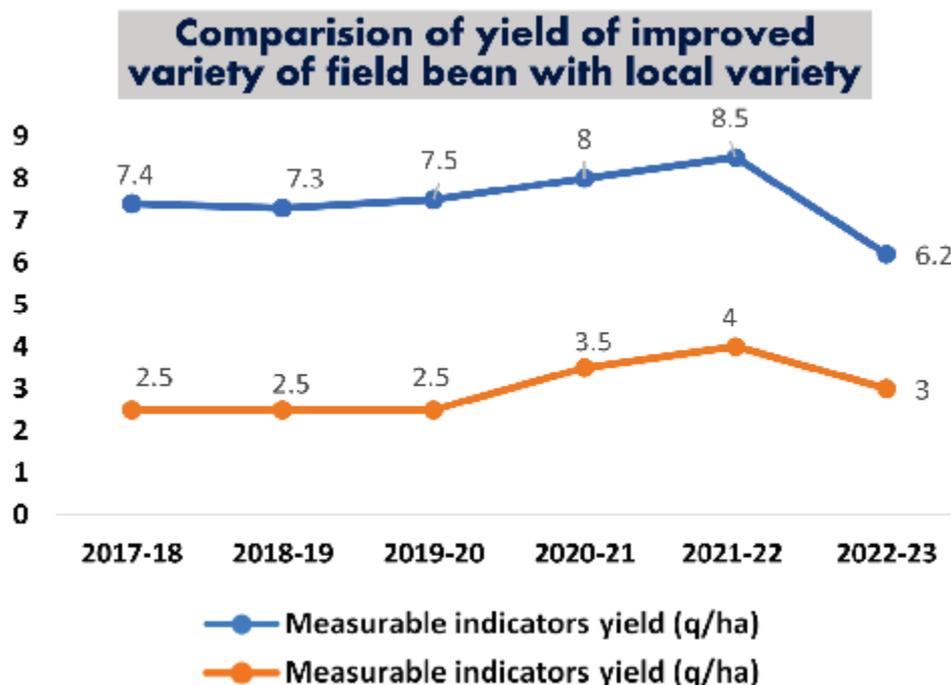
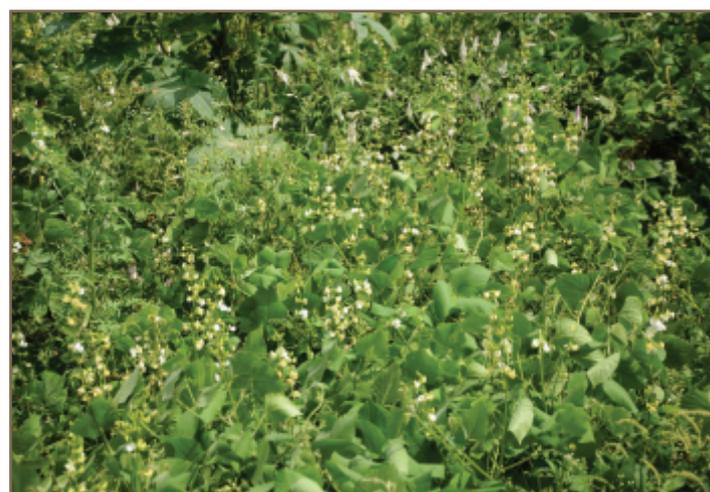


Figure 6: Comparison of yield of improved variety of field bean with local variety



Intercrop of HA - 4 variety of field bean in ragi

2.4.2. Horticulture based module

Precision farming interventions in different vegetable crops comprising introduction of improved varieties/hybrids, which are resistant to pests and diseases along with drip irrigation and use of 30 or 40 micron mulching sheet on raised beds, fertigation techniques using water soluble fertilizers with ventury system, integrated pest management and integrated disease management as a holistic package. This combination of new multiple disease resistant hybrids / improved varieties and precision farming was demonstrated in the entire cluster of villages in major vegetables,

flowers and fruit crops integrating with use of botanical and bio-pesticides.

Demonstration of tomato with precision farming package: Triple disease resistant (Bacterial Wilt, TLCV and Early Blight) tomato hybrid Arka Samrat was demonstrated in 24.7 ha area covering 75 farmers since 2016-17. Arka Samrat gave yield of 91 t/ha with net return of Rs.7,40,349/ha as compared to 48.93 t/ha with net return of Rs. 2,86,531 /ha under local variety. The year wise number of farmers & area covered, yield and economics is given in following Table 6 and Figures 7 & 8.

Table 6: Demonstration of tomato with precision farming package

Year	Farmers (No.)	Area (ha)	Yield (t/ha)		% increase in yield	Economics of Demo (Rs./ha)		Economics of check (Rs./ha)	
			Demo	Check		Gross return	Net return	Gross return	Net return
2016-17	08	2.8	70.0	39.0	79.4	10,15,000	6,86,400	2,75,000	1,52,500
2017-18	13	7.2	71.25	38.5	85.0	10,90,000	7,21,250	3,18,750	1,78,750
2018-19	13	4.6	122.75	59.75	106.7	11,50,496	7,40,496	5,94,915	2,78,665
2019-20	12	3.2	115	63.75	80.3	13,80,000	7,43,500	7,56,009	3,52,800
2020-21	5	1.5	106	58.5	81.2	12,72,000	6,84,550	7,18,500	3,23,000
2021-22	4	0.8	77.55	45.0	72.33	11,63,250	8,13,250	6,30,000	4,05,000
2022-23	20	4.6	74.50	38.0	96.05	10,43,000	7,93,000	5,32,000	3,15,000
Total/Average	75	24.7	91.00	48.93	85.85	11,59,107	7,40,349	5,46,453	2,86,531

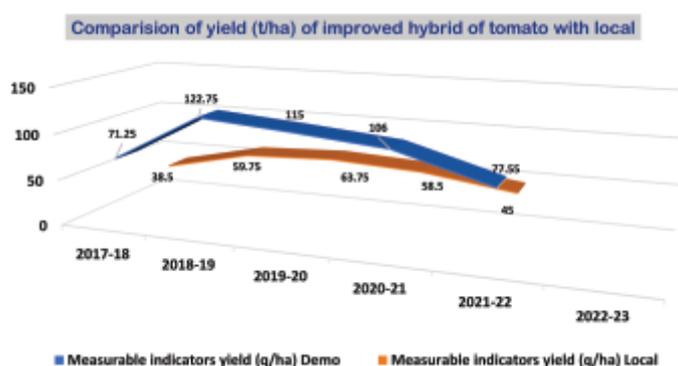


Figure 7: Comparison of yield of improved hybrid of tomato with local

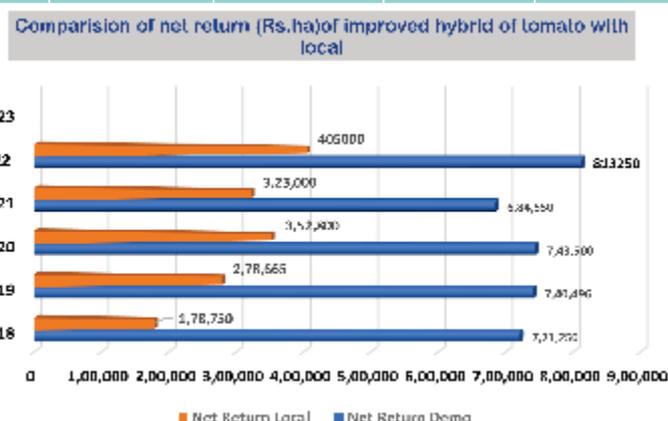
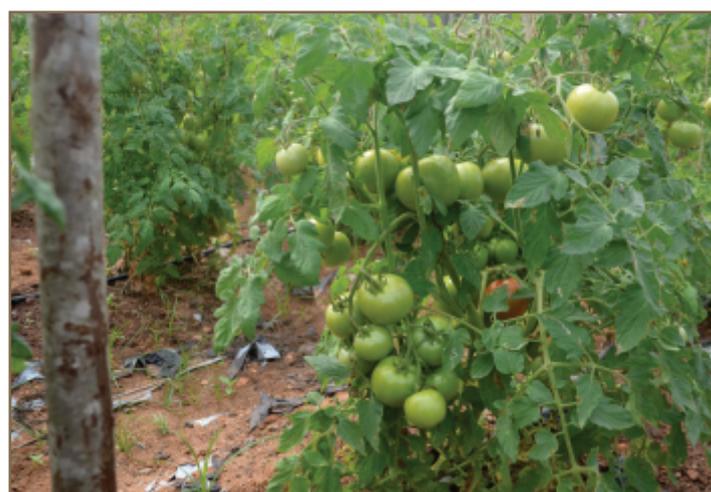


Figure 8: Comparison of net return of improved hybrid of tomato with local



Demonstration of tomato hybrid Arka Samrat

Demonstration of chilli with precision farming package: Powdery mildew disease resistant chilli hybrid Arka Harita of ICAR-IIHR was demonstrated in 21.32 ha area covering 84 farmers since 2016-17. Arka Harita gave yield of 36 t/ha

with net return of Rs.4,14,089 /ha as compared to 19.07t/ha with net return of Rs. 1,60,254 /ha under local variety. The year wise number of farmers & area covered, yield and economics is given in following Table 7 and Figures 9 &10.

Table 7: Demonstration of chilli with precision farming package

Year	Farmers (No.)	Area (ha)	Yield (t/ha)		% increase in yield	Economics of Demo (Rs./ha)		Economics of check (Rs./ha)	
			Demo	Check		Gross return	Net return	Gross return	Net return
2016-17	10	2.0	35	18.25	91.7	5,60,000	3,73,500	1,49,650	86,750
2017-18	17	7.2	36.5	18.0	102.7	6,13,200	4,43,650	1,55,000	90,000
2018-19	12	2.2	35	19.50	79.4	6,45,750	3,37,500	4,45,750	1,75,000
2019-20	07	1.6	40	21.25	88.2	6,40,000	3,68,000	3,36,004	1,80,600
2020-21	8	2.0	36	19.5	84.6	7,20,000	4,07,500	3,14,687	1,73,187
2021-22	9	1.52	36.32	21.0	72.98	7,64,092	4,50,472	3,49,303	1,92,238
2022-23	21	4.8	33.25	16.0	107.81	7,98,000	5,18,000	3,84,000	2,24,000
Total/Average	84	21.32	36.00	19.07	89.63	6,77,292	4,14,089	3,04,914	1,60,254

Comparison of yield (t/ha) of improved hybrid of chilli with local

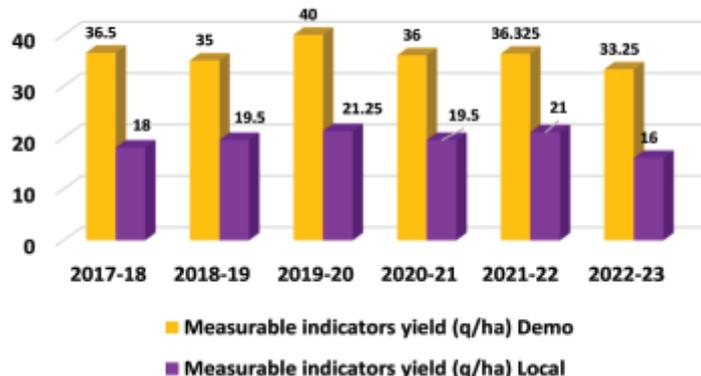


Figure 9: Comparison of yield of improved hybrid of chilli with local

Comparison of net return (Rs./ha) of improved hybrid of chilli with local

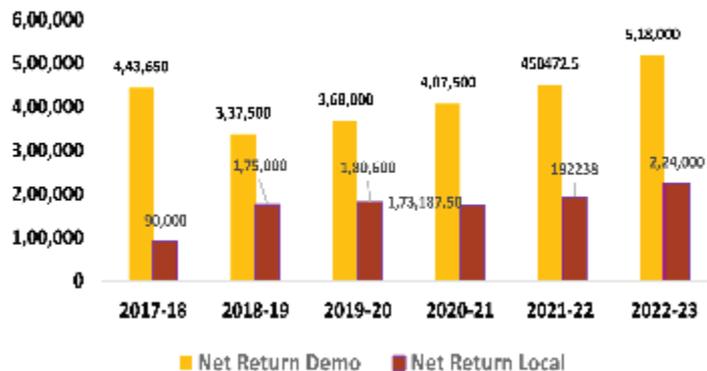


Figure 10: Comparison of net return of improved hybrid of chilli with local



Demonstration of chilli hybrid Arka Harita

Demonstration of French bean with precision farming package: Rust resistant pole type French beans variety Arka Sukomal and disease resistant French beans variety Arka Arjun were demonstrated in 9.6 ha area covering 40 farmers since 2016-17. These varieties gave yield of 15.05

t/ha with net return of Rs.2,50,445 /ha as compared to 7.55 t/ha with net return of Rs. 87,430 /ha under local variety. The year wise number of farmers & area covered, yield and economics is given in following Table 8 and Figures 11 & 12.

Table 8: Demonstration of French bean with precision farming package

Year	Farmers (No.)	Area (ha)	Yield (t/ha)		% increase in yield	Economics of Demo (Rs./ha)		Economics of check (Rs./ha)	
			Demo	Check		Gross return	Net return	Gross return	Net return
2016-17	4	0.9	14.0	6.5	115	3,29,000	2,02,500	1,07,250	68,450
2017-18	10	1.8	14.0	6.0	133.4	3,50,000	2,20,000	1,08,000	69,500
2018-19	9	2.5	15.0	8.75	71.5	3,93,750	2,73,750	1,87,500	87,500
2019-20	10	2.4	15.75	8.0	96.9	3,70,013	2,54,700	1,44,000	82,450
2020-21	7	2.0	16.5	8.5	94.1	4,19,925	3,01,275	2,05,750	1,29,250
Total/Average	40	9.6	15.05	7.55	102.18	3,72,538	2,50,445	1,50,500	87,430

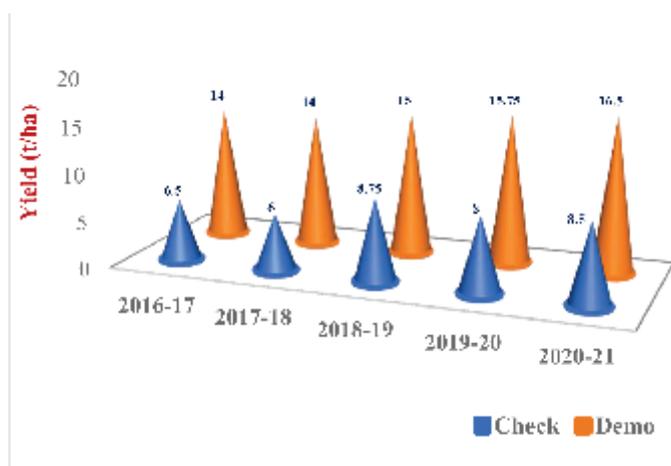


Figure 11: Comparison of yield of improved varieties of French bean with local

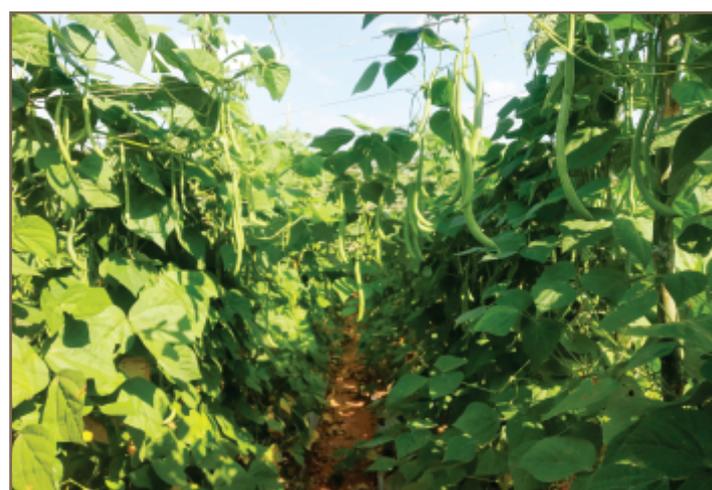


Figure 12: Comparison of net return of improved varieties of French bean with local



Demonstration of French beans variety Arka Arjun

Demonstration of tube rose with precision farming package: Tube rose variety Arka Prajwal was demonstrated in 9.5 ha area covering 37 farmers since 2017-18. Arka Prajwal gave yield of 25.94 t/ha with net return of Rs.24,89,070 /ha. The



Demonstration of French beans variety Arka Sukomal

year wise number of farmers & area covered, yield and economics is given in following Table 9. Tuberose was introduced as an intercrop in few mango orchards to enhance productivity and income of the farmers, now it has spread to large

number of farmers. Due to its better yield, good market demand and price, farmers were able to increase their income substantially. After 3 years of harvest, farmers who had adopted the variety in the

beginning i.e., during 2016-17 and 2017-18, removed the bulbs and sold, which fetched them very high income.

Table 9: Demonstration of tube rose with precision farming package

Year	Farmers (No.)	Area (ha)	Demo yield (t/ha)	Economics of Demo (Rs./ha)	
				Gross return	Net return
2017-18	4	0.8	17.5	20,91,250	15,00,000
2018-19	5	1.2	26	22,23,850	16,80,000
2019-20	8	1.8	35	28,67,500	22,80,000
2020-21	15	5.0	25	24,50,000	18,31,300
2021-22	5	0.7	26.20	28,12,750	21,96,750
Total/Average	37	9.5	25.94	24,89,070	18,97,610



Demonstration of tube rose variety Arka Prajwal

2.4.3. Livestock based module

Dairy farming: There was lack of awareness regarding good animal husbandry practices in the study area which was evidenced by prevalence of disorders like infertility, mastitis, malnutrition, hoof problems, parasitic infections, mastitis, mineral deficiency, rumen disorders etc. Under the dairy farming module, various technological interventions were introduced, such as improved feed management practices with protein rich, balanced feeds, mineral mixture and UMB; improved fodder seeds like maize, multi cut sorghum variety and few leguminous fodder crops

like lucerne, sesbania; mastitis kit, infertility treatment, clean milk production practices, deworming, vaccination, etc benefitting 5886 animals of 1440 farmers. The planned activities organised in the project villages comprised, sensitization of the beneficiary farm families on dairy animal health care and quality milk production. The interventions included, on-farm interactive sessions, Animal Health Camps, demonstrations and on-campus training programmes.

All the dairy animals in the project villages were

dewormed at regular intervals. On farm demonstrations on mastitis management were organised for sensitising the importance of early detection of clinical and sub-clinical mastitis with CMT kits, taking preventive measures with pre & post teat dips and follow-up measures. On farm demonstrations on clean milk production were organised to sensitise the farm families to enhance the adoption of clean milk production practices for quality milk production, introduction of stainless-steel milk containers, use of manually operated and automatic milking machines with two and three units and cow mats was encouraged by distributing them and also synergising with MPCS of KMF.



Demonstration of milking machine

Small ruminant management: Low protein supplements or concentrate supplement, nutrient deficiency, reproductive issues, parasitic infections, low weight gain, diseases, etc. were major issues in case of small ruminants. Based on the prioritized areas of improving the health and productivity of small ruminants, many technological interventions such as periodic deworming and vaccination, protein supplement, mineral mixture through scientific feed management, and organizing health camps exclusively for small ruminants were undertaken for 5012 animals of 766 farmers. All these interventions were very useful in increasing the body weight, fecundity and overall health of the animals. Other additional benefits includes reduction in kid, lamb mortality and total mortality,

Extension literature on hydroponic fodder, azolla cultivation, mastitis detection and indigenous dairy products were provided to dairy beneficiary farmers.

Due to all these interventions, 90 % of the repeat breeding cases were reduced significantly. Number of animals affected with mastitis was also reduced due to introduction of hygienic milk production practices. There was substantial increase in milk yield, fat and SNF content. Problems of malnutrition and infertility were solved, and availability of quality & energy rich green fodder for dairy cattle was improved.



Demonstration of improved fodder

improvement in reproductive performance of animals, etc. There was a slight improvement in maintaining the hygienic condition in animal housing. Overall, there was 15-20 percent improvement in general health indicators, growth and lamb/kid survivability.



Vaccination for small ruminants

2.4.4. NRM based module

Soil and water conservation practices: Soil and water conservation practices such as survey & soil profiling, preparation and distribution of soil health card, assessment of land suitability map for crops and Land Resource Inventory were undertaken in an area 5000 ha benefiting 2948 farmers. Extensive soil excavation was undertaken to identify constraints affecting crop production and land use option and to study profile characters and soil inventory. It helped the farmers in crop planning and soil health management. More than 3000 soil health cards were prepared and distributed to follow GAP's for soil health. Land suitability maps were prepared and assisted many farmers to understand and adopt suitable field and horticulture crops and enterprises. LRI was useful for developing advisory on effective soil health management in different crops. In addition, prevention of soil erosion through graded slopes, raised bed cultivation and mulching and drip irrigation to save water and fertigation to save quantity and cost of nutrient application were promoted.

Additionally, borewell recharge was initiated to harvest and conserve the rainwater for future purpose, which has clearly impacted on the increased pressure of pumping borewell water and water availability for long duration even during peak summer season. Owing to the intense digging of new bore-wells and over drafting in existing ones, the level of ground water is exhausting ruthlessly and as an effect, the majority of the bore wells have dried up because of the drought. It was bothering the farmers until new invention proved its importance with a development named bore-well recharge technique. It is an innovative practice which involves refilling of water tables with the rain water. This is one of the best water conservation technique where more defunct bore well were found due to dryness or water scarcity. There is an urgent need to increase the groundwater potential through artificial recharging techniques for rainfed areas.

Based on information gathered like slope, land use, topography, defunct bore well were identified. With available data we have implemented recharging technology for three borewells and observed the following benefits.

- **The level of water- yield enhanced:** By adopting this technology the level of water has improved. With proper management this technology even works for fully dried bore well. It is a completely tested method that involves simple steps.
- **Better quality of water:** Naturally filtered rain water purifies the water collected in the ground water tables.
- **Inexpensive produce:** As compared to other methods of water harvesting, bore well recharge technique is economical and affordable. To build a bore well recharge structure, it requires natural materials available in nearby area and therefore it is not expensive.
- **Permanent solution:** When a bore well is recharged, each year we will get some water by refilling the rain water itself and the bore well will be working in stable way.
- **We can modify it in easy way:** According to the land of the farm the bore well recharge technique can be practiced.
- **Soil and water erosion can be minimised:** This technology reduces risks of soil erosion by in-situ harvesting rainwater
- **Eco-Friendly choice:** It is not only a technique to addresses water shortage crisis but also safe and sound eco-friendly selection.

Integrated nutrient management (INM): In addition to these activities in soil and water conservation, INM was promoted in field crops and horticultural crops in 210 ha area benefitting 88 farmers based on the soil survey work. Preparation of inventory and crop suitability maps to different soil types was undertaken by NBSS and LUP, Regional Centre, Bengaluru. Both soil and foliar

nutrition components of INM were promoted, including micro- nutrient formulations of ICAR-IIHR in fruit and vegetable crops (Mango, Banana Special and Vegetable special). Impact was observed in many farmers' fields in terms of saving of cost and reduction in quantity of fertilizers, increased crop productivity, net income, quality of produce, enhanced marketability and market price.

Crop residue management: Crop residue management using Arka decomposer for effective utilization of residue from sericulture and other crops. This technology is highly beneficial to large



Demonstration of crop residue management

2.4.5. Enterprise based module

Large number of farmers and farm women have shown keen interest in starting many entrepreneurial activities in different areas. Need analysis was carried out among various group of farmers regarding suitable agriculture / horticulture based enterprises in FFP villages. Among these, few were identified as priority areas to start in one or two villages. Specific entrepreneurship activities



Oyster mushroom cultivation

number of farmers, since more than 30% farmers practice sericulture rearing 100 DFL's to 500 DFL's per batch, which results in large quantum of wastes, after every instar and also at the end of every crop. Its use resulted in reduction in the quantity of crop residue burnt particularly sericulture crop residue and number of days reduced for decomposition of crop residue. Awareness created among all the farmers in FFP villages on need for continuous use of eco-friendly method of crop residue management.



Collection of soil sample

include vegetable seedling production, production of tuberoses bulbs, hi-tech dairy farming, ragi cleaning machine and mushroom production. Many capacity building programmes were organized, assistance was extended to develop infrastructure to promote all these prioritized areas and technology support was given to interested entrepreneurs. The details of number of farmers benefited and annual income of each enterprise is given in Table 10.



Vegetable seedling production

Table 10: Details of enterprise based module

Enterprise	Technology demonstrated	Area covered (ha) / No. of units covered	Farmers covered	Annual income per farmer before intervention (Rs./year)	Annual income per farmer after intervention (Rs./year)
Nursery	Vegetable seedling production	0.1	1	92,500	3,60,000
Tuberose bulbs	Production and sale of tuberose bulbs	3.5	8	94,500	11,20,000
Dairy farming	High-tech dairy farming	20	1	7,47,700	16,84,800
Ragi cleaning machine	Automated ragi cleaning cum floor machine	> 200 ha	250	Yet to be assessed	
Mushroom production	Cultivation of mushroom production	02	35	Yet to be assessed	

2.4.6. Integrated farming systems (IFS) module

In order to enhance the total productivity and income of different enterprises in all the FFP villages, suitable combinations of enterprises were identified with a combination of improved production packages for each combination of crops and enterprises. Introduction of combination of interventions like, fields crops + French bean/ chilli/ tomato + mango + dairy farming + small ruminants has resulted in increase in the crop yield, overall productivity. There is also improvement in soil health, due to addition of large quantity of FYM, bio-pesticides and covering of soil with greens to reduce rate of decomposition of FYM. Income of the farmers increased from Rs.2,88,660/ farmer/year to Rs.8,23,575/ farmer/year from French beans combination. Under chilli crop combination of crops and enterprises, income was increased upto Rs.9,29,800 and in case of tomato crop combination with other enterprises income was up to Rs.12,06,850 per year. The year wise number of farmers covered and economics is given in following Table 11. This significant increase in income is mainly attributed to adoption of improved varieties, precision package and support of various

developmental departments through synergy programmes. Combination of interventions has increased income, improved the livelihood and nutritional security of farmers in all the adopted villages. The availability of vegetables has also increased in large quantity for consumption of the villagers.

Additionally, there is a continuous flow of income in the form of cash, which has helped large number of farmers to venture into various productive activities. Other socio-economic attributes of these interventions are increase in risk bearing ability, adoption of innovative technologies in all their farm activities, investment/ expenditure in the non-farm activities and frequency of consumption of good quality food like high protein meat, chicken, pulses and vegetables. Few farmers have also invested in purchasing new farm machineries. Sudden increase in income also had negative effect on the farm families, like increased consumption of alcohol, no cultivation or discontinuation of farming activities for short period, poor participation in extension activities, etc.

Table 11: Details of Integrated Farming Systems (IFS) module

Details of intervention	2016-17			2017-18		2018-19		2019-20		2020-21		2021-22	
	Farmers covered	Annual income before intervention (Rs / farmer / year)	Annual income after intervention (Rs / farmer / year)	Farmers covered	Annual income after intervention (Rs / farmer / year)	Farmers covered	Annual income after intervention (Rs / farmer / year)	Farmers covered	Annual income after intervention (Rs / farmer / year)	Farmers covered	Annual income after intervention (Rs / farmer / year)	Farmers covered	Annual income after intervention (Rs / farmer / year)
Field Crops + French bean + Mango + Dairy Farming + Small Ruminants	07	2,88,660	6,09,328	36	7,12,635	30	7,34,700	20	7,75,060	12	8,23,575	11	8,44,376
Field Crops + Chilli + Mango + Dairy Farming + Small Ruminants	10	3,50,848	7,76,385	28	7,82,450	25	8,32,978	15	8,88,360	20	9,29,800	21	8,72,054
Field Crops + Tomato + Mango + Dairy Farming + Small Ruminants	16	5,37,910	10,95,350	20	11,10,578	18	11,79,381	12	12,63,860	08	12,06,850	08	12,26,075
Total	33			84		73		47		40		40	



Demonstration of intercrop of ragi + field bean



Demonstration of intercrop of ragi + mango

2.5. Enhancing farmer-scientist interface

Under this component, various capacity building programmes and extension activities organised by FFP centre for enhancing farmer-scientist interface are given below :

Capacity building programmes: Thematic area wise capacity building programmes organized under FFP are presented in Table. Farmers empowerment was done through organization of 400 capacity building programmes under different thematic areas related to agriculture and allied sector and trained 2670 farmers. Thematic area wise number of programmes and participants details is given Table 12.



Capacity building programme

Table 12: Thematic area and institute wise capacity building programmes organized under FFP

Thematic area	Total	
	Programmes (No.)	Farmers (No.)
Capacity building and group dynamics	106	293
Crop production	38	315
Entrepreneurship development	20	63
Farm implements	14	128
Livestock production and management	49	239
Natural resource management	37	495
Nutrition security	8	163
Plant protection	69	286
Processing and value addition	14	137
Production of inputs at site	-	-
Soil health and fertility management	29	346
Women empowerment	16	205
Total	400	2,670

Extension activities: To create more awareness among farmers in agriculture and allied sectors, different extension activities were organized by the institute which are presented in Table. A total of

552 extension programmes were organized by FFP institutes with the participation of 4788 farmers. Extension activity wise number of programmes and participants are given in Table 13.

Table 13: Extension activities organized by FFP institutes

Extension activity	Total	
	Programmes (No.)	Farmers (No.)
Advisory Services	176	892
Celebration of important days	06	296
Diagnostic visits	109	454
Exhibition	04	124
Exposure visits	27	271
Ex-trainees Sammelan	18	145
Farmers' seminar/workshop	12	109
Field Day	03	267
Film Show	14	138
Group discussions	108	530
Kisan Ghosthi	00	-
Kisan Mela	05	244
Method Demonstrations	36	989
Plant/animal health camps	34	329
Total	552	4,788



Field day on Arka Prajwal



Participation of FFP farmers in National Horticulture fair

2.6. Combination of technological interventions

The technology combinations shown in Table 14 with six groups provided interesting features. It showed that highest income could be realized in

combinations of different enterprises. Year wise net income (Rs./family/year) under different combinations of technological interventions is given in Table 15.

Table 14: Change in net income (Rs./farmer/year) of farm families under different combinations of technological interventions

Combination	Combination of Enterprises	Lowest	Highest	No of families covered
A. Rainfed condition				
C1	Ragi + Redgram + Dolichos + Dairy Farming + Small Ruminants	1,24,060	3,43,916	185
C2	Ragi + Redgram + Dolichos + Mango	1,64,070	3,78,112	160
B. Irrigated condition				
C3	Field Crops + French bean + Mango + Dairy Farming + Small Ruminants	2,88,660	8,44,376	50
C4	Field Crops + Chilli + Mango + Dairy Farming + Small Ruminants	3,50,848	8,72,054	65
C5	Field Crops + Tomato + Mango + Dairy Farming + Small Ruminants	5,37,910	12,26,075	52
C6	Fruits + Vegetables + Flowers	4,62,179	16,29,271	34

Table 15: Year wise change in net income (Rs./farmer/year) of farm families under different combinations of technological interventions

Sl. No.	Combination of Enterprises	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
A. Rainfed condition								
C1	Ragi + Redgram + Dolichos + Oilseeds + Dairy Farming + Small Ruminants	1,24,060	2,24,458	2,47,385	2,47,450	3,04,700	3,19,550	3,43,916
C2	Ragi + Redgram + Dolichos + Oilseeds + Mango	1,64,070	3,13,420	3,44,385	3,48,605	4,09,510	4,02,700	3,78,112
B. Irrigated condition								
C3	Field Crops + French bean + Mango + Dairy Farming + Small Ruminants	2,88,660	6,09,328	7,12,635	7,34,700	7,75,060	8,23,575	8,44,376
C4	Field Crops + Chilli + Mango + Dairy Farming + Small Ruminants	3,50,848	7,76,385	7,82,450	8,32,978	8,88,360	9,29,800	8,72,054
C5	Field Crops + Tomato + Mango + Dairy Farming + Small Ruminants	5,37,910	10,95,350	11,10,578	11,79,381	12,63,860	12,06,850	12,26,075
C6	Fruits + Vegetables + Flowers	4,62,179	7,78,884	13,99,508	14,64,333	17,49,627	16,12,859	16,29,271

A. Rainfed Condition: In the resource constrained production situation, various combination of crops and enterprises were introduced to suit the resource conditions of various categories of farmers and to ensure the sustainable production and assured income to the farmers. Two major combinations (C1 and C2) are described in the following paragraphs. These combinations were worked out keeping in view the resource conditions, suitability of the technology and assured income to the farm families. Impact of these combinations of crops and enterprises is described in the following paragraphs.

C-1: Combination of technological interventions of field crops (ragi + redgram + dolichos) + small ruminants + dairy farming: In this combination, along with improved varieties and holistic package in field crops, we have introduced good feeding, hygienic animal production, health and other management practices for dairy animals and small ruminants, which resulted in increased net income from Rs.1,24,060 to Rs.3,43,916 per annum/ family with this combination of crops and enterprises (Figure 13). Apart from increase in crop yield, there

is increase in yield and quality of milk, improved weight and health of small ruminants. Support from synergy programmes of the developmental departments (Agriculture, Animal Husbandry and Veterinary Services, KMF, Watershed Development) also helped to increase the income. Combination of field crops and livestock enterprises in rainfed production system has been adopted by large number of farm families (185) in all the FFP villages. Following are the contributing factors;

- In field crops, introduction of suitable high yielding, disease resistant varieties with other improved attributes like high fodder and grain yield in ragi, good aroma and attractive round seeds in dolichos, have led to increased average net income.
- Introduction of mastitis kit has helped in effective prevention and detection of sub-clinical and clinical mastitis. It has reduced the overall incidence of mastitis, improved the quality of milk such as increase in fat content from 2-2.5 to 3.5-5.0 and SNF upto 8.5 along

with increase in total milk yield.

- Introduction of critical inputs like urea molasses mineral block licks enhanced the digestibility of cattle feed, mineral mixture protein supplementation for augmentation of productive performance of dairy cattle and it has led to additional income through increased milk yield.
- Introduction of cow mats among dairy farmers has resulted in avoidance of the hoof injuries, improved health and correction of fertility levels in animals, which also helped in higher rate of conception, leading to additional gain of average 280 milch days per inter-calving period in 35 animals. The cow mats also reduced the veterinary expenses upto Rs.1250 per animal per month.
- Introduction of fodder crops like maize and sorghum makes fodder easily available and there is reduction in fodder procurement cost. Additional return of Rs.3500 was observed by sales of increased fodder yield by spending additional cost of Rs.650/month.
- After distribution of feed and mineral mixture and providing vaccination for small ruminants, weight of the animals has increased from 14-16 kg to 18-20 kg and there was increase in reproductive performance of the animals. Economic impact of the increased reproductive efficiency needs to be assessed.

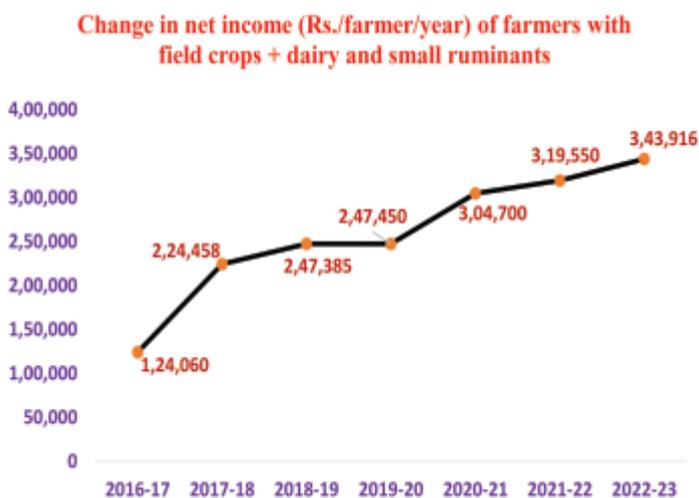


Figure13:Change in net income of farmers with combination of field crops + dairy and small ruminants

C-2: Combination of technological intervention of field crops (ragi + redgram + dolichos) + horticulture (mango): Among the farm families who have adopted C-2 combination of enterprises, the annual average net income increased from Rs.1,64,070 per farmer per annum to Rs. 3,78,112 per farmer per annum in the combination of field crops with mango (Figure 14). This combination of field crops and mango in rainfed situation was also adopted by good number (160) of farm families in all the FFP villages. Following are the contributing factors;

- In field crops, introduction of suitable high yielding, disease resistant varieties for dry land farming resulted in increased average net-income.
- Application of mango special (foliar formulation) and other micro nutrients, as a part of INWM package among mango growers led to increase in number of fruits and fruit size. Introduction of IPM practices like methyl eugenol (Pheromone) traps to control fruit fly and neem soap and neem seed kernel powder to manage hopper and other pests helped in reducing their incidence and fruit drop. These technologies created awareness among farmers regarding insect traps and neem seed powder. Good PHM practices helped in maintaining quality and fetch better price for their produce.
- A large number of households are leasing out the mango orchid and getting income upto Rs.75,000 to Rs.87,500 per hectare per annum from 15-20 years old orchards. While some of the households who have adopted ICAR-IIHR package and marketing fruits on their own are getting Rs.1,85,500 to Rs.2,02,750 as annual income per hectare.
- Intercrop of ragi in mango crop led to efficient utilization of inter space and additional yield and income to the farmers.

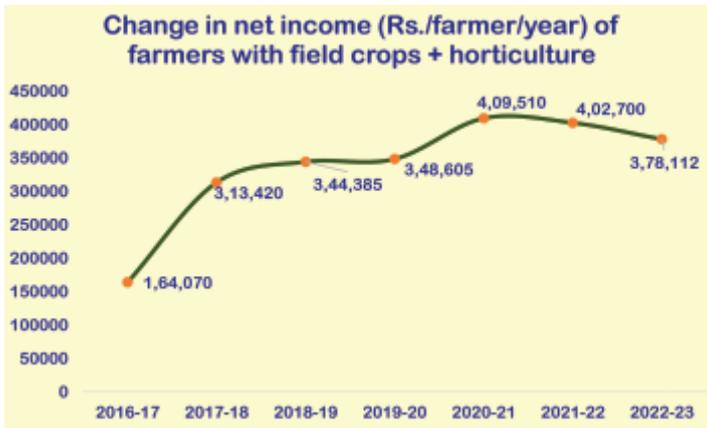


Figure 14: Change in net income of farmers with combination of field crops + horticulture

B. Irrigated Condition: There is a wide range of diversified combination of crops and enterprises being adopted by farmers with irrigation facility. We have considered only few major combinations (C3, C4, C5 and C6) largely adopted by the farmers in FFP villages for assessment of impact. In irrigated production system, there are many families who have adopted individual crops and enterprises on small scale, which ranges from 15 to > 100 farm families. However, when the combination of crops with different enterprises were considered, number of farm families were less, which ranges from 34 to 60 with varied range of income. These farmers have also adopted different combination of technological interventions. Details are explained in different combination of crops and enterprises from C3 to C6.

C-3: Combination of technological intervention of field crops + horticulture (French bean+ mango) + dairy farming + small ruminants: Combination of horticultural crops played a significant role in changing the production and income scenario of the farmers of FFP villages. After careful selection and introduction of suitable varieties in all the crops cultivated by the farmers, there was a complete shift in adoption pattern and very significant change in income. The annual average net income was increased from Rs.2,88,660 per farmer/annum to Rs.8,44,376/farmer/annum among the farmers who

have adopted the combination of field crops, horticulture (French beans + mango), dairy farming and small ruminants (Figure 15). Following are the contributing factors;

- Introduction of improved high yielding varieties which are disease tolerant in cereals and pulses has increased the average net-income of farmers.
- Introduction of disease resistant, high yielding, improved varieties of French bean of ICAR-IIHR like Arka Arjun and Arka Sharath led to increase in yield levels upto 16.5 tons/ha compared to 8.5 tons/ha yield of farmers' varieties like Bangalore local and solar seeds. Along with the improved varieties, other technologies like mulching, drip irrigation and micro nutrients application were also introduced, which helped them to reduce water usage, compared to their earlier practice of flood irrigation. It also reduced the growth of weeds and maintained the optimum wet condition to enhance the crop yield. Arka varieties are resistant to moong bean yellow mosaic virus, leaf rust and bacterial blight diseases. Keeping quality of pods is 5-6 days after harvest. Hence, there is an additional net - income from these varieties.
- In all these combinations of interventions, there is also an increase in additional income from other enterprises like mango cultivation and livestock.

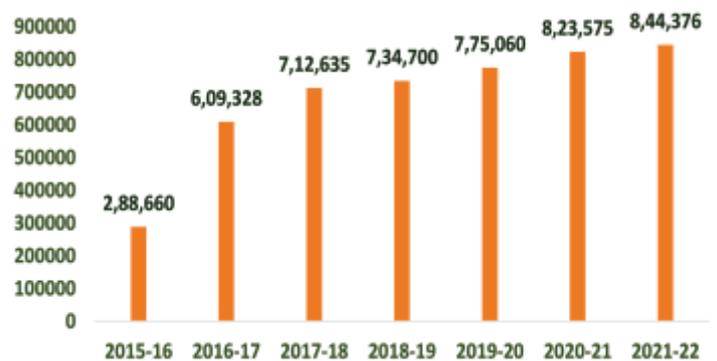


Figure15:Change in net income, (Rs./farmer/year) of farmers with combination of field crops + horticulture + dairy farming + small ruminants

C-4: Combination of technological interventions of field crops + horticulture (chilli+ mango) + dairy farming + small ruminants: In this combination, along with field crops, we have introduced high yielding, powdery mildew resistant and thrips tolerant chilli hybrids Arka Meghana and Arka Harita. Due to these the annual average net income was increased from Rs. 3,50,848 / farmer / year to Rs. 8,72,054 / farmer / year due to the combined effect of field crops, horticulture (chilli + mango), dairy farming and small ruminants (Figure 16). Following are the contributing factors;

- Introduction of improved, high yielding, disease tolerant cereals crop varieties increased the average net-income of farmers.
- Introduction of disease resistant hybrids like Arka Haritha and Arka Meghana in chilli led to higher yield i.e., 36 tons/ha compared to 19.5 tons/ha yield with farmers varieties like kadaroli and sankeshwara, in addition to other private company hybrids. Along with new hybrids, we introduced the precision farming package in chilli crop like mulching, drip irrigation, fertigation, and foliar application of micro nutrient, which was completely adopted by the farmers along with our new hybrids. This technology also changed the farmers practice like flood irrigation, flat bed cultivation with conventional crop management. From ICAR-IIHR package, farmers were able to maintain the optimum soil moisture condition throughout the crop period. Since, Arka varieties are resistant to powdery mildew disease and tolerant to sucking pests (thrips) with good keeping quality upto 5-7 days after harvesting, it led to increase in additional net income with precision package in chilli. These interventions also increased the net income from other enterprises like mango cultivation and livestock.
- Area under drip irrigation of vegetables increased in all the villages, due to financial assistance from department of horticulture, Govt. of Karnataka through synergy programme.

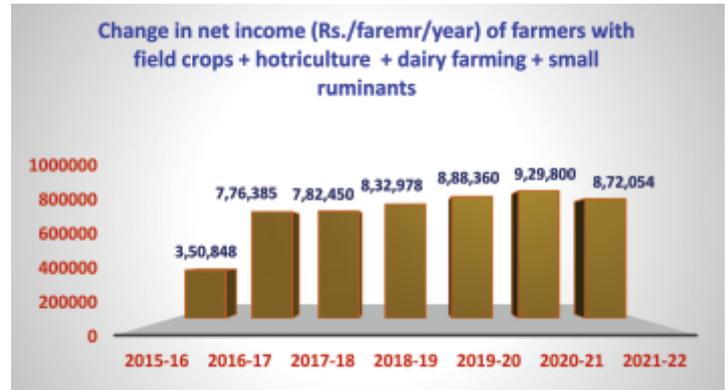


Figure 16: Change in net income of farmers with combination of field crops + horticulture (chilli+ mango) + dairy farming + small ruminants

C-5: Combination of technological interventions of field crops + horticulture (tomato + mango) + dairy farming + small ruminants: In this combination, triple disease resistant tomato hybrids Arka Rakshak and Arka Samrat were introduced, which increased annual income from Rs. 5,37,910 to Rs. 12,26,075 /farmer/year due combination of field crops, horticulture (tomato + mango) crops, dairy farming and small ruminant management (Figure 17). Since tomato hybrids has very good shelf life of 10 to 12 days, many farmers sent / sold their produce to distant markets (Tamil Nadu and Kolkata). Following are the contributing factors;

- Introduction of improved, high yielding, disease tolerant varieties of cereals and pulse crop varieties increased the average net-income of farmers
- Intercrop of Ragi with mango enhanced yield levels of both the crops, which led to higher income.
- Introduction of ICAR-IIHR tomato hybrids Arka Rakshak and Arka Samrat led to higher average yield of 77.55 tons / ha compared to 45 tons yield / ha of local varieties and other private company hybrids like Shivam and Abhinav. Precision farming package in tomato crop like mulching, drip irrigation, fertigation, micro nutrient application, was completely adopted by the farmers along with new hybrids. This technology eliminated the farmers practice like flood irrigation and they were able to maintain the

optimum soil moisture condition throughout the crop period. Arka Rakshak and Arka Samrat hybrids are resistant to three diseases like Bacterial wilt, TLC Virus and Early Blight.

- Increase in crop yield by 2.3 to 3 times due to introduction of triple disease resistant hybrids (resistant to bacterial wilt, leaf curl virus and early blight); and adoption of precision farming package. Fruit weight was 72-78 g with good keeping quality of 10-12 days from harvest.
- On-site production of seedling / regular supply chain of good quality vegetable seedlings was established to ensure disease free, healthy and good quality seedling availability. It is one of the critical factor for successful cultivation of tomato crop in FFP villages.

Change in net income (Rs./farmer/year) of farmers with field crops + horticulture + dairy farming + small ruminants



Figure17: Change in net income of farmers with combination of field crops + horticulture (tomato + mango) + dairy farming + small ruminants

C6: Combination of technological interventions of fruits + vegetables + flowers:

In this combination, all the major horticultural crops, introduced to farm families, was considered. The annual average net income was increased from Rs.4,62,179 to Rs.16,29,271/farmer/year due to the combined effect of adoption of improved varieties/ hybrids and precision production packages in fruits, vegetables and flowers (Figure 18). Following are the contributing factors;

- In fruit crops, Application of mango special (foliar formulation) and other micro nutrients, as a part of INWM package among mango growers

led to increase in number of fruits and fruit size. Introduction of IPM practices like eugenol traps, neem seed kernel powder and chemical like melathion to control fruit fly and other pests led to reduction in fruit fly incidence and fruit drop. These technologies created awareness among farmers regarding fruit fly traps and easily available neem seed powder. Good PHM practices also helped them to fetch better price for their produce.

- Introduction of multiple disease resistant hybrids in vegetable crops led to significant increase in yield.
- In 2017, Tube rose (Arka Prajwal) was introduced in the adopted villages, which has changed the overall scenario of cultivation of flower crops. It gives higher yield of 25 ton/ha and price ranges from Rs.40 to Rs.120/kg. Farmers call it as ATM of the flower growers, due to its daily income. Cost of production is comparatively lower than other flower crops because this variety does not demand much plant protection due to fewer incidences of pest and diseases and also it is nematode tolerant.
- Introduction of precision farming for all these horticultural crops resulted in high net-income, in many cases the income was doubled with in a span of just 1.5 years. It also helped in conserving natural resources, particularly borewell water, to the tune of 35 to 55%.

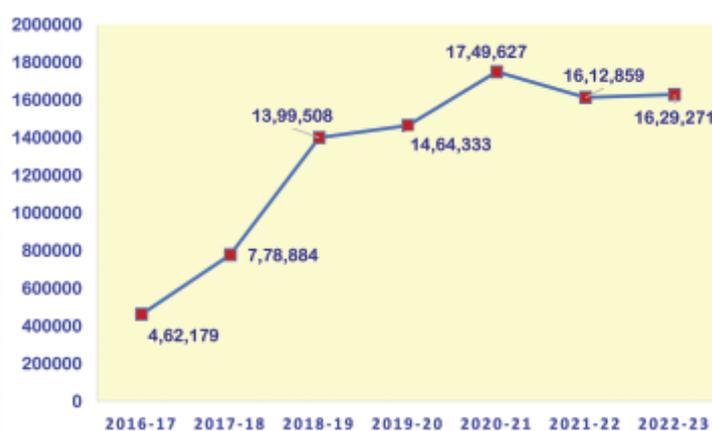


Figure 18: Change in net income (Rs./farmer/year) of farmers with combination of fruits + vegetables + flowers

Some of the general factors responsible for increased income (doubling) of large number of farm families are given below.

- Good support from the developmental departments (Horticulture, Agriculture, Animal Husbandry and Veterinary Services) to develop necessary infrastructure, creating awareness, in organizing field-based training and other HRD programmes through synergizing the activities between FFP and all the department programmes.
- Coordinated and timely efforts of all the stakeholder institutes in planning and implementation of various technological modules and field-based activities.
- Arranging market tie-up with distant markets for various horticultural crops, particularly for tomato and chilli crop.
- Involvement and cooperation of all the members, chairman and officers of local Gram Panchayat, developmental departments in implementation and monitoring various field based programmes and activities.
- Supply of critical inputs like seeds and planting materials of improved varieties / hybrids in vegetable, flower and fruit crops, eco-friendly bio-products like Bio-pesticides, Bio-products (Arka decomposer, AMC, Bio-fertilizers, etc.), Botanical pesticides (Neem & Pongamiasoaps), sticky traps, pheromone traps, etc. for safe and quality production.

2.7. Success stories and case studies

I. Precision Farming of Tuberose for higher and sustainable income: Soil and climate is highly suitable for production of tuberose, soil is well drained sandy loam with moderate water holding capacity and good fertility. There is a demand for loose flowers of tuberose in local and in distant markets at Hosur (60 KM's distance) and Bengaluru (80 KM's distance) in large quantity. Farmers preferred to cultivate this crop, as it yields

throughout the year and fetches continuous income. One of the major challenges encountered in production of good quality tuberose loose and cut flowers was lack of good quality planting materials (bulbs) of HYV's. Farmers were unaware of the importance of scientific cultivation practices and marketing strategies of tuberose and other flower crops. The root knot nematode and wilt diseases were major problems in successful tuberose cultivation. Hence, there was demand for resistant varieties and use of integrated approach for effective crop management.

ICAR-IIHR hybrid Arka Prajwal was introduced, which bears single type flowers on tall and sturdy spikes. Tuberose is generally cultivated and propagated through bulbs. Flower buds of Arka Prajwal are slightly pinkish in colour with white colour flowers. The individual flowers are large in size and flowers have a better shelf life compared to other local varieties. The spikes are also being used for cut flower purpose.

The institute is working in all clusters of six adopted FFP villages using whole family approach for holistic development of the villages. Based on situation analysis, many need-based programmes like capacity building programmes, timely supply of critical inputs such as planting materials (bulbs), bio-pesticides, plant protection chemicals, etc., were arranged for the farmers. Farmers were given complete technical guidance by a team of scientists at all stages of crop production of Arka Prajwal hybrid tuberose. Critical information like treating bulbs with 0.2 per cent captan solution and 0.2 per cent Dimethoate before planting to prevent incidence of fungal diseases and mealy bug respectively was given. These technological interventions were implemented through demonstration with farmer participation and were continuously evaluated for their performance in terms of socio economic and technological indicators / parameters. Changes were observed in

terms of enhanced yield, quality and income among all tuberose farmers.

Initially, tuberose was introduced as an intercrop in few mango orchards to enhance productivity and income of farmers. Later, it was spread among large number of farmers, who started cultivating it as mono crop. Along with improved variety of Arka Prajwal, precision farming packages were introduced, which includes raised bed cultivation, drip irrigation, fertigation, integrated management of nutrients, pests and diseases and Post harvest management. Due to higher yield and good market demand and price, farmers were able to increase their income substantially. After 2 years of



Intercrop of tuberose in early stages of mango orchards

II. Improved varieties and production techniques in field crops: A large majority of the (>70% farmers) farms are under rainfed production systems and all the farm families are cultivating field crops. Favourable farming situation exist (micro-farming situation, resource conditions, food habits, socio-economic conditions, etc.) for cultivation of field crops. Soils and climatic conditions are also highly favourable for production of field crops. In all the adopted villages, farmers were using seeds of local varieties and multiple cropping system due to easy availability of local seeds. Majority of the farmers were happy with local varieties despite their low yield (e.g. Ragi 6 to 8 q/ac), susceptibility to diseases and lack

continuous harvesting of flowers, farmers who have adopted this variety in 2016-17 and 2017-18 removed the bulbs and sold it to other farmers in FFP villages and also to the farmers of other districts in Tamil Nadu and Karnataka, which fetched them very high income. Totally (from sale of both crop and bulbs), farmers were able to earn Rs.18,31,300 net income per ha. Once the crop starts yielding (4 months after planting of bulbs), it gives continuous flowers with higher yield of 15 tons/ha per annum. Average price for this flower is Rs.60 to Rs.80/kg. The cost of production of tuberose crop is comparatively lower than other flower crops because this variety requires minimal care and has resistance to nematodes and wilt.



Harvesting the tuberose flower

awareness about HYV's availability and good crop management practices (INM, IPM, poor PHM, etc.).

Introduction of high yielding improved varieties which are disease resistant, dwarf stature having high tillering capacity and drought tolerance in ragi crop like ML-365 and MR-6, BRG-2 and BRG-4 in redgram, HA-3 and HA-4 in Field bean crops has helped them to enhance the yield and income substantially. INM, IPM, good PHM was also introduced in these crops to ensure good quality produce. The institute is working in all the six adopted villages through cluster mode for holistic development of the villages using whole family approach in all the FFP villages. Conducted need-

based field level trainings, demonstrations with distribution of critical inputs and technical knowledge on all aspects of scientific cultivation practices. Due to continuous guidance on integrated technological know-how regarding sowing or transplanting, irrigation on proper time, proper application of fertilizers, weed management and plant protection measures given by FFP scientists team, farmers were able to reap the benefits of higher revenue. These technological interventions were effectively implemented through demonstration with farmer participation and were

continuously evaluated for their performance in terms of socio economic and technological indicators/parameters.

Because of these improved varieties and integrated production techniques, there was an increased cropped area and more than 350 households are using improved varieties in field crops. Increase in yield was upto 70 – 80% more as compared to other local varieties. The detailed crop and variety wise yield and economics is given in Table 16.

Table 16: Crop and variety wise yield and economics

Sl. No.	Crop	Variety	Yield (q/ha)	Gross Income (Rs/ha)	Net Income (Rs/ha)
1.	Ragi	ML 365	35	1,15,500	86,000
		MR-6	33.75	1,11,375	81,875
2.	Redgram	BRG-2	16.25	1,54,375	1,18,750
		BRG-4	18.5	1,75,750	1,40,125
3.	Field Bean	HA-3	7.5	43,500	24,375
		HA-4	10	58,000	38,750



Field bean grown as intercrop with ragi and mango crop



Demonstration redgram

III. Cultivation of vegetables with mulching and drip irrigation:

Large number of farmers were cultivating local varieties of vegetable crops which are susceptible to diseases under flood irrigation, with no mulching, poor plant protection measures. The soil is with sandy loam to clay loam texture, moderate to good WHC and drainage which is suitable for vegetable production. Temperature

ranging from 16°C to 34°C and moderate annual rainfall of 750-800 mm is very much suitable for many vegetables production all-round the year. In Kanakapura taluk of Ramanagara District, more than 80% farmers were not cultivating vegetables using drip irrigation system because of lack of knowledge and awareness and also due to poor resource condition to adopt the system. Very few

(<20%) farmers were using drip irrigation and fertigation and zero adoption of plastic mulching. Majority of the farmers were using low yielding, disease susceptible hybrids / varieties. Hence the yield levels were very low.

The water is effectively utilized through cost effective drip irrigation system in all the farmers' demonstration fields. To adopt the hybrid varieties, drip irrigation system was made mandatory. Hence, all farmers were provided with drip irrigation system. Horticulture department helped in expanding the area of vegetable crops, in spreading of drip irrigation systems in all the vegetable growers' fields. This helped in saving water, nutrients, labour, cost, and time and increase accuracy of water supply to each plant as per its requirement. UV stabilized, 40 micron, black-white plastic mulch sheets was introduced to save water, avoid weeds and spread of pest and diseases and to conserve loss of nutrients. The institute is working in all the six adopted villages through cluster approach for holistic development of the villages through whole family approach under the umbrella of FFP. Conducted group meetings and monitored the demonstration plots at regular intervals. During planning and implementation of mulch and drip irrigation intervention, a team of scientists was intensively guiding the farmers in vegetable farming. Use of mulch and drip irrigation system helped in enhancing the production, productivity and quality of produce and income to the farmers. These technological interventions were arrived at after intensive interaction and need assessment of

farms in all the adopted villages. Then demonstration was organized in farmers' fields and were continuously evaluated for their performance in terms of socioeconomic and technological indicators / parameters. The beneficiary farmers were grouped into technology intervention groups based on the type and number of technologies implemented. Changes were observed and enhancement of yield, quality of produce and the income were assessed among each selected group.

This resulted in increase in water use efficiency by 90-95% over traditional flood irrigation system. There was saving of cost, labour and nutrients along with reduction in incidence of pest and diseases, increase in yield by 70-75% as compared to regular practices and increase in area under double cropping and irrigated area under vegetable crops. The detailed crop and variety wise yield and economics is given in Table 17.

Farmers have expressed that they are very happy with the ICAR-IIHR varieties in different vegetable crops and ready to adopt vegetable production in large area using drip irrigation, fertigation and mulching, but there should be extensive support to establish drip irrigation system with financial assistance from the department of horticulture along with continuous technical guidance from the scientists. Area under improved vegetable varieties and hybrids is gradually increasing in both adopted and also in the surrounding non-adopted villages through

Table 17: Crop and variety wise yield and economics

Sl. No.	Crop	Variety	Yield (t/ha)	Gross Income (Rs/ha)	Net Income (Rs/ha)
1.	Tomato	Arka Rakshak	130	11,25,925	7,00,925
		Arka Samrat	115	11,75,067	7,80,067
2.	Chilli	Arka Haritha	35	6,45,750	4,45,750
3.	French Beans	Arka Arjun	15.75	3,93,750	2,73,750

horizontal expansion, with little technical support from the FFP team. The trend of area expansion will continue, if the synergy with Department of Horticulture continues with financial assistance to



Arka Rakshak tomato with precision farming

IV. Enhanced income through horticultural enterprise:

Mr. Rajendra Hegde, 48 years old medium farmer is residing at Kebbedoddi village, Kanakapura Taluk, Ramanagara District and have education upto high school. His family comprises of his wife and one son. He has 2 ha land with 15 years of farming experience. He is innovative and highly inquisitive to learn and use latest technologies in farming. Due to lack of technical knowledge regarding improved method of vegetable cultivation, information on improved varieties/hybrids, price volatility, low yield and fluctuating income from old vegetable varieties, he did not venture into change. However, the farmer is very enthusiastic to learn and adopt innovations. After exposure to the institute technologies during RHF-2018, he started showing serious interest to learn and adopt new technologies.

Farmer was given ICAR-IIHR's high yielding, triple disease resistant tomato hybrid (Arka Rakshak), French beans (Arka Sharath) & Ridge Gourd varieties (Arka Prasan). Soil testing, analysis and recommendation of need based fertilizers was also done. Introduction of precision farming with support under FFP in the form of critical inputs like micro irrigation system - drip irrigation system;

bring more area under drip irrigation and development of contact farmers by IIHR team for technical guidance on GAP's in vegetables.



Chilli with precision farming

black & silver mulch; other inputs like fertilizers, botanical and bio-pesticides & selected chemicals for pest & disease management during 2019-20 helped him to effectively manage the crop.

Traditionally the farmers in this region were growing vegetable crops as recommended by the nearby nursery men, without heeding much to any specific requirement. With the inception of the Farmers FIRST project and successive field visits, farmers' scientist interaction meets enabled to introduce the high yielding, disease resistant vegetable varieties. It was difficult to convince the farmer initially. Then from 2018, improved varieties were introduced such as triple disease resistant hybrid Arka Rakshak in tomato; Arka Sharath variety in French bean which is photo-insensitive, round, string less, preferred variety in market; and Arka Prasan variety in Ridge gourd - an open pollinated and early and high yielding variety (42-45 days for first picking).

There was substantial increase in the income of farmer after adoption of ICAR-IIHR varieties and technologies. On the other hand, nutritional and livelihood security were also improved. He had kept farm accounts regarding inputs used and returns gained from different crops and seasons. Under

subsidiary enterprise the farmer was technically guided regarding nursery of vegetable seedling production, scientific dairy management and improved varieties of field crops. Adoption of these improved varieties and technologies gave higher gross and net returns with higher benefit cost ratio compared to his earlier practice. Additionally,

there was increase in number of pods per plant in French bean, higher yield and reduced cost of pesticides in Arka Rakshak tomato hybrid compared to the earlier varieties. These parameters helped him to enhance substantial yield and income from all the crops. The detailed crop wise yield and economics is given in Table 18.

Table 18: Crop wise yield and economics

Sl. No.	Crop	Average Yield (t/ac)		Gross income (Rs/ac)		Net income (Rs/ac)	
		Before	After	Before	After	Before	After
1.	Tomato (Arka Rakshak)	24.5	52	2,88,006	6,24,000	1,40,274	4,54,000
2.	French Bean (Arka Sharath)	3.5	6.75	87,500	1,51,875	45,800	1,03,875
3.	Ridge gourd (Arka Prasanna)	4.8	10.5	1,68,000	3,50,175	1,05,500	2,10,000



Plot of Arka Rakshak tomato

V. Doubling farmer income through floriculture:

Mr. Mahadevaiah, aged 51 years and belongs to medium farmer category with 1.8 ha land resides in Balepura village, Kanakapura Taluk, Ramanagara District. He studied upto II PUC, his family comprises of his mother, wife, one son and one daughter. He has 25 years of farming experience, mainly cultivating field crops and vegetables. He was facing lack of knowledge on crop diversification, GAP's, minimal irrigation facilities, labour scarcity, poor resource condition. He was practicing flood irrigation for fruit and vegetable crops. He was interested in adopting all the GAP's and explore new crops like Tuberose.

ICAR - IIHR's tuberose crop variety Arka Prajwal,

which is cultivated commercially for its fragrant cut, loose flowers, and for perfumery industry was introduced for the first time in Balepura village. Based on soil test and considering other agro ecological situations, 300 kg bulbs (planting material) of Arka Prajwal for about 1500 sq. mtr. (less than half an acre) costing Rs.36,000/- was planted as intercrop in young mango orchard. He was also given bio-pesticides like *Trichoderma viridae*, *T. harzianum*, *Pochonia chlamodesporium*, *Paecolo myceslillacinous*, as a prophylactic measure to avoid the nematode infestation and other root borne diseases; inputs for precision farming like micro irrigation (drip irrigation) system, micro-nutrients, fertigation inputs; other inputs like

fertilizers, botanical pesticides, plant protection chemicals were given for holistic crop management with efficient management of nutrients, pests and diseases.

During the PRA exercises conducted in Balepura village, income enhancement through crop diversification was one of the priority areas identified by the farmers. As a follow-up, many on farm capacity building programmes, farmer - scientist's interaction meeting focused on commercial cultivation of tuberose and other crops were organized in the village. To encourage crop diversification, distribution of need based critical inputs and technical guidance were given. Crop monitoring through regular and timely field visits by the team of scientists and field staff or crop advisory to the farm was highly helpful. They were also given critical information through SMS, WhatsApp messages, video calls etc., which helped to learn and adopt the innovations better.

Cultivation of tuberose has changed the totals scenario of cultivation of flower crops in the entire cluster villages of FFP, which was hitherto unknown to the farmers. Eight farmers adopted the

crop within one year, looking at the quick and excellent results (benefits). Mr. Mahadevaiah of Balepura village planted Tuberose crop in the month of July, 2017, started harvesting from November, 2017. A good yield of 6.7 tons was harvested up to October 2018. Cost of cultivation was Rs. 78,000/- and gross income was Rs. 4,76,000/- for 1500 sq m area. Sold the flowers at an average rate of Rs.70/- per kg, and the net income realized was Rs. 3,98,000/- from the flowers alone and bulb yield was 5 tons per 1500 sq m and he sold it for Rs. 100 per kilogram and he got an income of Rs. 5,00,000/- from bulbs alone. Overall, he realized the net returns of Rs. 8,98,000/- per 1500 sq. m area in one and half years. Apart from this income, he also earned Rs.40,000 per season from 4 years old mango plantation. The intervention of Tuberose cultivation in mango-based farming system enabled him to generate a total net income of Rs. 8,98,000/- from less than half acre area, in a span of one and half year. He is the first farmer to introduce Arka Prajwal variety Tuberose under Farmers FIRST project.



Arka Prajwal variety of tuberose crop as intercrop in mango



Harvesting flowers of Arka Prajwal tuberose

2.8. Outcome studies

The economic benefits gained by the farmers, who have adopted various technologies is given in the report along with few success stories. Overall socio-

economic impact study is yet to be taken up. Summary of the outcome of selected technologies of various institutions introduced in the project villages is given below in Table 19.

Table 19: Outcome of selected technologies

Sl. No.	Crops and Technologies	Outcome of technologies	Economic benefits in 3 Years (Rs./ha/family)
1.	Improved varieties of field crops (ragi, redgram, fieldbean, etc.)	<ul style="list-style-type: none"> • There is an increase in area under new varieties from 0.3 to 0.75 ha in the FFP adopted villages during 3 years • Marketable surplus and marketability of crops has increased and farmers have obtained higher income from sale of more quantity of produce • Increase in yield by 18% to 50% and income by 45 to 91 % in different crops and varieties 	2,64,104
2.	Vegetable crops - Tomato: Arka Rakshak and Arka Samrat hybrids	<ul style="list-style-type: none"> • Area under institute hybrids is increasing gradually in FFP adopted and also in other surrounding villages and blocks of Ramanagara district. • Tomato yield of farmers increased by 134 % and the net-income has increased from Rs.6,58,000 in 2017-18 to Rs. 8,80,000 in 2019-20 per ha. • Cash flow and Risk Bearing Ability of farmers has increased substantially due to continuous flow of income for a long duration (>4 months), which also helped farmers to invest more in other technologies and spend more in farm infrastructure and non-farm activities. 	18,50,000
	Chilli: Arka Meghana and Arka Harita	<ul style="list-style-type: none"> • There is a gradual increase in area and demand for these hybrids, particularly for Arka Harita due to its resistance to powdery mildew disease and dark green and medium sized fruits. • Fruit yield of farmers increased by 69% and the net-income from Rs.2,70,562 in 2017-18 to Rs. 3,60,750 in 2019-20 per ha. • There was huge cash flow for a longer duration, both in winter and rabi seasons, which helped the farmers to cultivate larger area, which normally left fallow, and increase overall income from farm activities. 	9,36,912
	French beans	<ul style="list-style-type: none"> • Due to resistance to Rust, Bacterial blight and Viral diseases along with higher yields and excellent quality pods, many farmers increased area under French beans of IIHR varieties. • Yield of French beans increased from 5.8 ton per ha during 2017-18 to 6.5 ton/ ha during 2019-20 and the total income increased from Rs. 2,32,187 / ha in 2017-18 to Rs. 2,92,500 per ha during 2019-20. • There is increase in market demand and price due to disease free, stainless and better-quality pods. 	7,89,387

<p>3. Flower crops tuberose Arka Prajwal variety</p>	<ul style="list-style-type: none"> • There is a sudden increase in area and demand for the planting materials of this hybrid, due to good and quick economic return from daily harvest of loose flowers for local market. • Due to continuous demand, farmers are harvesting loose flowers and earning money daily. Hence it is considered as ATM of farmers. • Farmers have earned at least Rs.4.50 lakh per 0.5 acres from flowers and Rs.6.00 to Rs.8.00 Lakhs per acre from selling planting materials -bulbs. Hence, it is a highly remunerative crop in FFP villages. • There is a huge demand for planting materials (bulbs) from new farmers, but due to paucity of funds and higher cost of bulbs (650-700 Kg bulbs per acre costs Rs.1,00,000/- to Rs.1,10,000/-), it was not possible to provide through the project. • Hence, after taking crops for 14 to 16 months farmers themselves started removing bulbs and selling them to other farmers @Rs.80/- to Rs.100/- per Kg. and earning about Rs.4 to 6 lakhs per 0.5 acres (by selling 5 to 6 tons/ 0.5 acres) • Farmers are also procuring the planting materials from neighbouring state -Tamil Nadu, directly from farmers' fields. However, there is need of quarantine for ensuring purity and quality of bulbs. • Risk Bearing Ability to adopt other agricultural innovation and investment in infrastructure has increased among Arka Prajwal farmers, due to continuous flow of income. 	<p>20,00,000</p>
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2.9. Partnership and institution building

As per the objectives of the project, all the important developmental departments at taluk (block) level were involved at various stages of planning and implementation of the Famer FIRST project. Details of the institutions and organizations involved in various phases of the project during the current year, along with their specific contribution in implementation of the project, is given in the following Table 20. Large number of farm families received good assistance under various programmes and schemes of the developmental

department/institutions in the FFP villages, which amount about Rs.1.19 crores for the last three years. This was made possible due to strengthening of the linkages by the FFP team between institutions and farmers through many synergy programmes, which were planned and effectively implemented with the coordination and assistance of different departments and institutions. This is facilitating us in spreading many technologies suitable for different farming systems in all the selected FFP villages and also to create larger impact of the programme.

Table 20: Details of convergence with the institutions and organizations

Sl. No.	Organization/ Department	Area of convergence with acreage / financial assistance	No. of Farm families	Amount of financial assistance (Rs.)
1.	Department of Horticulture, Govt. of Karnataka	Establishment of drip/micro-irrigation system-80 acres	66	45,80,000
2.	Department of Horticulture, Govt. of Karnataka	Precision farming in vegetable and flower crops-38 acres	20	2,28,000
3.	Department of Horticulture, Govt. of Karnataka	Micro-irrigation and precision farming in fruit crops (Banana and Guava)- 14 acres	8	7,70,000
4.	Department of Agriculture and Watershed, Govt. of Karnataka	Development of Krishi Honda (Farm ponds) and Check-dams for harvesting and storage of rainwater	40	16,000,00
5.	Department of Agriculture and Watershed, Govt. of Karnataka	Fish pond construction	17	25,50,000
6.	Department of Animal husbandry and Veterinary services	260 dairy cows	85	1,30,000
7.	Milk Producers Cooperative Society of KMF	Organizing animal health camps, hygienic milk production, awareness on scientific animal management practices clean milk production,scientific feed management, cow mats-130 andmilking machines- 5.	328	5,28,870
8.	Department of Sericulture, Govt. of Karnataka	Establishment of drip/micro-irrigation system- 8 acres for mulberry orchards- 25 acres	12	4,80,000
9.	Department of Sericulture, Govt. of Karnataka	Scientific Sericulture	60	6,000,00
10.	SCSP programme of the institute	Sharing of inputs for field crops, seedlings of vegetable crops, fruit and coconut plants, PHT, poultry chicks, etc. 155 acres	146	25,65,000
11.	SKRDP group	Women empowerment, mushroom production technology and ornamental fish production	135	1,00,000
	Total		817	1,19,31,870

2.10. Content mobilization

FFP centre published a total of 15 extension literature of various aspects, which were then distributed among over 1500 farmers. Additionally, three booklets were prepared and provided to 650 farmers. To enhance technical communication, one WhatsApp groups was created, through which 15000 relevant messages were shared with 80 farmers in the project area. Furthermore, FFP centre developed five videos on pertinent aspects for the benefit of the farmers. The FFP centres extended their reach through the publication of research papers, technical articles, and coverage of technical content in local print media. The project teams from FFP centre collectively published five research papers. Among these, only one featured in prestigious journals with a NAAS rating of more than six, while four were published in journals with a NAAS rating between 4 and 6. Additionally, a total of four technical articles were published in different magazines. Furthermore, local print media provided coverage on various technical aspects, with a total of five instances reported in relation to the specific project. Other content mobilization activities are given below:

- **Development of information system, database of all farmers:** Developed the database of all the farmers (basic information, socio-economic status, cropped area, yield and other production details of field and horticultural crop, subsidiary enterprises, community and village resources, etc.) who have adopted various technological interventions spread by the FFP team in all the villages. Information on various programmes and schemes of different developmental departments, which was useful to the farmers of FFP village was also collected and distributed to all the villages and also to individual families, through local Panchayath, leaders, MPCS, SHG's, etc., so that it can be made use by the farmers and also by the members of various local institutions.
- **Identification and pooling of transferrable technologies of different institutions:** After conducting PRA in the villages and prioritization of problems for identification of suitable technologies, the inventory of technologies available with each institute was listed and only the most relevant and suitable technologies to different micro-climatic situations were identified for implementation under FFP. The list includes all the technologies available with all ICAR institutes of Bengaluru and UAS, GKVK, Bengaluru. This inventory of technologies was also useful to plan for various synergy programmes with different developmental departments and institutions under the single umbrella of FFP.
- **Preparation of knowledge models on various aspects of horticultural and field crops, dairy farming, etc.:** Various members of the project team from different institutes have developed suitable knowledge modules and they were used extensively in spreading various technological innovations developed by each institute. Following are the various aspects on which important modules were used in different crops and enterprises by the FFP project team.
- **Content management platform enabling offline and online access:** All the knowledge models on various aspects of horticultural and field crops, dairy farming and small ruminant management, soil health cards, etc. were shared among the farmers and their groups through WhatsApp. No specific online platform was developed for sharing of content of different technological modules of the project. However, a large information available in Kannada and English languages (text, books and folders, video films, mobile applications, etc.) on improved production packages of ICAR-IIHR technologies available through mobile applications, on the institute website and other forums were shared with all the farmers of the project area.

The research papers published details are given below:

Balakrishna, Hebbar, S. S., Kowsalya, K.S, Atheequlla, G A, Venkattakumar, R., 2020. “Improving livelihood of tomato farmers through multiple disease resistant hybrids and precision farming: The farmer first approach”. GREEN FARMING (An International Journal of Applied Agricultural & Horticultural Sciences) Vol. 11, Issue No. 6, November-December 2020.

B. Balakrishna, Kowsalya K. S, Supriya B. B, Atheequalla G. A, Manjunath B. L. and Shankar S. Hebbar. 2022. Enhancing livelihood of small farmers through cultivation of Arka Prajwal variety of tuberose. Indian Farming Journal, Vol 72 (8), pp. 22-24.

B. Balakrishna, Atheequalla G. A, Sujatha A. Nair, Supriya B. B, Usha Bharati, Uma Maheshwari and

Kowsalya K. S. 2022, Enhancing productivity and income of small farmer through new varieties and precision farming. Indian Farming Journal, Vol 72 (8), pp. 70-72.

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2.11. Budget details

The details of budget sanctioned and budget utilized during 2016-23 is given in Table 21.

Table 21: Budget sanctioned and budget utilized during 2016-23.

Year	Budget Sanctioned (Rs.)	Budget Utilized (Rs.)
2016-17	31,38,000	29,55,000
2018-19	13,86,347	14,78,419
2019-20	19,50,000	19,99,930
2020-21	16,50,000	16,74,410
2021-22	23,00,000	22,58,745
2022-23	23,00,000	23,06,111



Chapter -3

Farmer FIRST Programme of ICAR-Central Plantation Crops Research Institute, Kasaragod

Farmer FIRST Programme of ICAR-Central Plantation Crops Research Institute, Kasaragod is implemented at cluster Pathiyoor panchayath of Muthukulam Block, Karthikappalli Taluk, of Alappuzha District in Kerala since 2016-17.

This chapter covers following points:

- 3.1. Genesis
- 3.2. Profile of adopted villages
- 3.3. Farmers practices vs. technological interventions
- 3.4. Technology assemblage, application and feedback
- 3.5. Enhancing farmer-scientist interface
- 3.6. Combination of technological interventions
- 3.7. Success stories and case studies
- 3.8. Outcome studies
- 3.9. Partnership and institution building
- 3.10. Content mobilization
- 3.11. Budget details



3.1. Genesis

Kerala state has a total cropped area of 2627577 ha, out of which net sown area was 2023073 ha, with a cropping intensity of 130 per cent. The state has 75.83 lakh land holders and most of them belong to marginal (96.33%) category. In the gross cropped area of 25.69 lakh hectares in 2020-21, food crops comprising paddy, pulses, tapioca, ragi, small millets, sweet potato and other tuber crops occupied 11.03 per cent. Paddy is the major cereal crop cultivated in 2.02 lakh ha area. The state is known for horticulture crops; coconut is cultivated in 7.69 lakh ha area occupying 29.9 per cent of total cultivated area. Kerala has a substantial share in the four plantation crops such as rubber, tea, coffee and cardamom. These four crops together occupied 7.11 lakh ha, accounting for 27.7 per cent of the total cropped area in the state. Pepper (4.09%) and banana (3.78 %) are the other two major horticultural crops occupying good share of the cultivated area. Cashew is cultivated in an area of 43090 ha. The state has been focusing on vegetable development programmes with the objective of attaining self-sufficiency in vegetable production. Livestock and fisheries are the emerging sectors with focus on processing, value addition, farm and non-farm enterprises and agri-business development.

Alappuzha district consists of six taluks spread over 12 development blocks, 72 panchayaths, and six municipalities. Being a typical coastal district of Kerala, it has been a famous tourist destination with many religious, historical and cultural land marks. It is the smallest district of Kerala with area 1414 sq km but with the highest population density of 1501 persons/sq. km as per 2011 census. Out of the total cultivated area (86423 ha), 40300 ha is under irrigation. The major farming system is the coconut based homesteads with integration of animal husbandry including backyard poultry/duck rearing. The other major crops are paddy, tapioca, banana, vegetables and spices. Of the gross cropped

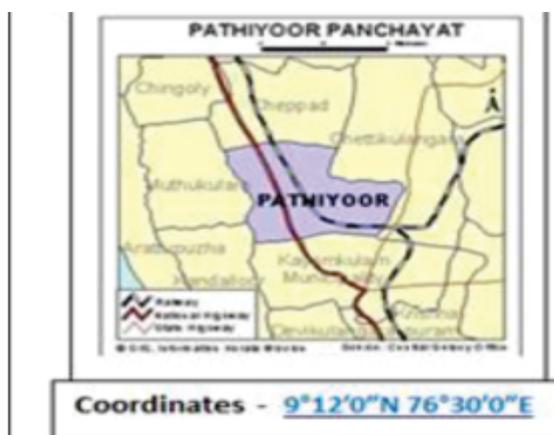
area of 110118 ha, paddy-paddy-legume/ sesame/vegetables/fallow, rice–fish integrated systems and homestead gardens form the major cropping systems. There were only 4 ha under cowpea, 616 ha under pepper, 81 ha under ginger, 43 ha under turmeric, 476 ha under banana, 418 ha under tapioca, 675 ha under elephant foot yam, 154 ha under yam and 2306 ha under vegetables. One of the major crops of Alappuzha that is sesame was only in 18 ha and coconut in 33227 ha. Fodder crops were in 117 ha. The productivity of rice in the district was 2.8 tonnes/ha and cured turmeric 2.05 tons/ha, tapioca 32 tons/ha, sesame 339 kg/ha, coconut 5628 nuts/ha. There are 462 homestead ponds in the district. The soil type of the district is mainly sandy loam and sandy soil; clayey loam in the Kuttanad paddy area.

The ICAR- Central Plantation Crops Research Institute (CPCRI) was established in 1916 as Central Coconut Research Station, and was later taken over by the Indian Council of Agricultural Research (ICAR). At present, ICAR CPCRI focuses on research in coconut, arecanut and cocoa. The headquarters of the institute is situated at Kasaragod, Kerala and the two regional stations, at Kayamkulam (Kerala) and Vittal (Karnataka). The extension activities of ICAR CPCRI includes training programs, front line demonstration, outreach programs. ATIC also provides regular and updated information and technologies to the farming communities and the visitors.

The Farmer FIRST Program is crucial in the district as it suffers from widespread coconut root disease. Sandy loam soils are deficient in nutrition, intercropping is declining and land conversion is rampant. Water logging is also a problem in areas where paddy land is converted. The district has the lowest per capita land availability in the country, and the challenge is to reach out to a large number of farmers with appropriate strategies for effective technology transfer in the field.

Since November 2016, the Farmer FIRST Programme titled 'Participatory technology integration to empower and ensure livelihood security of farmers in Alappuzha district' has been implemented in Pathiyoor panchayath, Alappuzha district. The programme involves 1000 farm families and covers a total area of 1627 ha. The coconut root (wilt) disease poses a significant risk to the coconut-based livelihood systems. The FFP provides a participatory evaluation and experimentation of a resource-based income model of coconut to address the disease's impact.

The FFP aims to double the productivity and income to thrive the disease-based risks. The programme addresses the lacuna of technology integration for doubling the farmer's income in the small and marginal land holdings under the homestead system through individual and group interventions under different modules. The FFP models provide up-scalable options that require refinement and integration with farmer innovations. The adoption of these technologies could be enhanced by involving the extension agencies/ social institutions under the FFP.



Location of the selected cluster of villages for implementation of FFP

Community or group approach (farmers' organizations, women self-help groups, rural youth clubs, and other rural social organizations/ agencies for involving, participating, and providing leadership) needs further impetus in these areas through FFP interventions under various modules. Social participation and group dynamic skills are required for overcoming the small and marginal size of coconut holdings and achieving scale of economics.

The FFP aims to double farmers' income through six different modules, including crop, horticulture, livestock, NRM, value addition, and IFS. This provides opportunities for technology integration, appraisal, and evaluation, regulating the supply chain, and involving farmer organizations. The programme was implemented based on the participatory rural appraisal exercises and focus group discussion in 38 locations, involving farmers, farm women, and people's representatives, as well as a questionnaire-based survey of 750 randomly selected farmers. This project envisages a paradigm shift in terms of ensuring quality research output by taking into consideration the Farm/Farmer, Innovation and Resources.

3.2. Profile of adopted villages under FFP

The adopted Pathiyur panchayath consists of two

revenue villages, Pathiyoor and Keerikkad. The total number of farm families is 4220, with a total population of 33925. The major crops grown in the area include coconut, paddy, tubers, vegetables, and spices. Sesamum is mostly followed in coconut-based Integrated Farming Systems (IFS). The area receives an average of 2800 mm rainfall annually, and the major livelihood consists of agriculture, farm labour, livestock, poultry, fisheries, and combinations and integration of these components.

The FFP interventions and models were upscaled to two gram panchayaths, Devikulangara and Oachira, of Alappuzha and Kollam districts, respectively, covering a total area of 3620 ha and 4229 farm families. Major crops in Devikulangara grama panchayath are coconut, tubers, livestock, fisheries, and IFS and in Oachira Panchayat coconut, areca nut, banana, pepper, tapioca, colocasia, ginger, and betel leaves. The FFP convergence model is approved to be implemented in eight panchayats of Muthukulam Block, Alappuzha district, with financial support of 20 lakhs (2023-25) from the district panchayat, indicating the viability and feasibility of FFP modules in upscaling or replicating. Brief profile of adopted villages under FFP is given in Table 22.

Table 22: Brief profile of adopted villages under FFP

Names of adopted villages	No. of families covered	Population	Major crops grown	Rainfall (mm)	Major enterprises
Pathiyoor and Keerikkad, Alapuzha district	4220	33,925	Coconut, Paddy, Tubers, Vegetable spices, sesamum	2800	Agriculture, farm labour, livestock, poultry, fisheries, small enterprises
Devikulangara, Alapuzha district	2899	22,583	Coconut, tubers, spices, sesamum	2900	Agriculture, farm labour, livestock, poultry, fisheries, tourism
Oachira, Kollam district	3704	28,103	Coconut, paddy, tubers, spices,	2564	Agriculture, fisheries, tourism

3.3. Farmers practices vs technological interventions : The details of farmers practices Vs technological interventions introduced under Farmer FIRST Program are given in following Table 23.

Table 23: Module wise farmers practice Vs technological interventions

Intervention Category	Before (Farmers Practice)	After (Technological Interventions)
NRM Module	Soil testing was not practiced, low extension interventions and no soil health card program	Soil test based nutrient management: Four soil sampling campaign organized in 980 ha area involving 290 farmers. Grid (5ha) based soil testing (1000 ha) done and 272 Soil health card distributed.
	Management of homestead ponds and fish farming as an IFS economic component were absent	Pond reclamation and refinement for water conservation: 72 farm ponds were rejuvenated. 3.5 lakhs quality fingerlings (Thilapia and Anabas) provided and 5 training programs conducted. First time introduced commercial cultivation for homestead consumption and scientific pond fisheries.
	Technology awareness and adoption absent among the farmers	Biopod technology in poultry farming: 20 households adopted biopod technology for waste management and reported 18 percent feed cost reduction in the initial phase of 4 months and the cannibalism reduced significantly.
	Organic recycling without scientific orientation which lacks sustainability and resource management.	Scientific organic recycling introduced in 48 homestead plots
Crop Module	All coconut gardens affected, yield and health reduced by 50 to 60%. Regular adoption of management practices was very low.	Integrated Root (wilt) disease management introduced
	No nutrient management in coconut	Application of dolomite, MgSo ₄ and micro nutrient mixture – Kalpa poshak for seedlings and Kalpa vardhini for bearing palms.
	Only Local varieties of sesamum had been sparsely cultivating on subsistence manner	Introduced improved varieties Kayamkulam 1, TMV 6 and TMV 7.

	No cultivation of groundnut before FFP.	Groundnut cultivation introduced.
	No cultivation before FFP	Introduced IIMR Hyderabad Little millet variety DHLM 36-321as intercrop in coconut garden.
	No cultivation before FFP	Introduced UAS Bengaluru proso millet variety DHPM 27-69 17 as intercrop in coconut garden.
Horticulture Module	Cultivation of local varieties	Introduced turmeric cultivation with high yielding variety IISR Prathibha & Pragati.
	Cultivation of local varieties	Introduced IISR Mahima variety of Ginger
	Severe nematode attacks reported in amorphophallus	Integrated nematode management and Gajendra variety introduced.
	Cultivation of local varieties	Technologies introduced were HYV of diascorea (CTCRI - Sreekeerthy), vegetables (IIHR and KAU varieties) and APAU varieties of colacassia
Livestock Module	Very low adoption or no adoption of cow mat in livestock units	Introduced cow mat for GAP in livestock units
	High feed cost-challenge to dairy farmers and low integration of HYV of fodder in the homesteads.	Introduced and evaluated suitability of high yielding fodder varieties such as Susthira, Super Napier, Co 3, Co5, and Hybrid Napier.
	Low access to quality breeds	Introduced seven egg incubators for chick and duckling production - directly benefited 325 poultry farmers and Rs.1.128 lakh average annual income of the incubator units
	Less availability of indigenous breeds	Introduced Indigenous breeds of poultry
	There was incidence of mastitis disease and farmers had no proper access to veterinary management practices	Proper awareness and distribution of mastitis prevention kit.
IFS Module	IFS plots maintained unscientifically and devoid of farm planning for integration of farm components.	IFS plots were supported with scientific training and component integration. An area of 19.4 ha has been covered through the intervention. Systematic Farm planning skills of farmers improved to 64 % from NIL

Enterprises Module	Traditional vessels used had less efficiency.	Virgin Coconut Oil cooker (CPCRI technology) introduced. 80 percent drudgery reduction and 30% more recovery of oil; also found B:C ratio of the VCO unit is 1.69
	Coconut seedling production in traditional manner.	Keraprobio- bio priming of poly bag coconut seedling was introduced.
	Value addition coconut enterprises were not effectively working	Value addition enterprises were introduced with the help of CPCRI's technological aid and expertise training.

3.4. Technology assemblage, application and feedback

Under this component, various modules; i.e., crop based, horticulture based, natural resources management (NRM) based, livestock based, enterprise based, and integrated farming systems (IFS) based were planned. The module-wise progress of technology assemblage, application and feedback has been enunciated as below:

3.4.1. Crop based module

Integrated root (wilt) disease management in coconut: The major priority was to address the low adoption rate of integrated root (wilt) disease management practices, which resulted in a reduction in the overall health and yield of coconut palms. CPCRI has developed a technology for integrated root (wilt) disease management. The technology involves soil test-based nutrient management, INM, IPM, and basin management. This technology can help to double the yield and improve the health of palms. Additionally, micro-nutrient mixes for seedlings (kalpaposhak) and bearing coconut palms (kalpavardhini) have been demonstrated for 16000 palms in 250 coconut farmers' gardens. Due to the high labour costs and a shortage of coconut climbers, individual farmers were unable to adopt plant protection activities for coconut. Therefore, an area-wide pest and disease management program was initiated under the Farmer FIRST Programme (FFP) for 14620 palms, with the assistance of the Coconut Producers

Society (CPS). The CPS facilitated area-wide activities, and the respective farmers shared the entire climbing charges of Rs.50 per palm. A soil sample collection campaign was also conducted with the facilitation of the respective CPS. Based on the soil testing, entire phosphatic fertilizers for all the crops could be avoided, saving more than Rs. 4.01 lakhs.

Five training programmes were conducted in the fields, which were ably supported with regular field visits to the demonstration plots. Advisories were provided through telephone, e-kalpa mobile app, and field diagnostic visits. The interventions resulted in a 62.50% increase in yield per hectare (7087 nuts/ha in demonstration plots compared to the check 4358 nuts/ha). The net income of coconut farmers in diseased areas increased from Rs. 32619 to Rs. 63919 after FFP interventions. The following Table 24 provides the year-wise number of farmers & area covered, yield, and economics, and the net income is shown in the Figure 19.

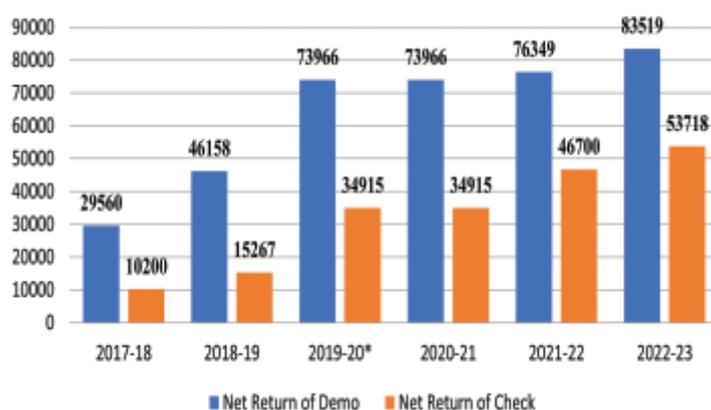


Figure 19: Year wise comparison of net income (Rs./ha) from coconut demonstration

Table 24: Demonstration of integrated root (wilt) disease management in coconut

Year	Farmers (No.)	Area (ha)	Yield (nuts/ha)		% increase in yield	Economics of Demo (Rs./ha)		Economics of check (Rs./ha)	
			Demo	Check		Gross return	Net return	Gross return	Net return
2017-18	252	98.0	5832	4290	35.94	1,16,640	29,560	85,800	10,200
2018-19	252	98.0	6348	4327	46.71	1,33,308	46,158	90,867	15,267
2019-20	215	95.7	7002	4366	60.45	1,61,046	73,966	1,10,515	34,915
2020-21	215	95.7	7002	4366	60.45	1,61,046	73,966	1,10,515	34,915
2021-22	215	95.7	7712	4400	75.40	1,69,664	76,349	1,20,014	46,700
2022-23	302	127	8628	4400	96.01	1,89,816	83,519	1,36,773	53,718
Total/Average	1451	610.1	7087.3	4358	62.50	1,55,253	63,919	1,09,080	32,619



IRDM demonstration in coconut

Demonstration of High yielding varieties (HYV) of sesamum: Demonstrated high yielding varieties, Kayamkulam 1, TMV 6 and TMV 7 with scientific management in 326 ha area covering 1724 farm families since 2016-17. The year wise number of farmers & area covered, yield and

economics is given in following Table 25. FFP interventions have achieved 100 percent replacement of local varieties with KAU HYV with participatory assessment resulting in 34.36 q/ha yield and Rs. 58253 /ha net income.

Table 25: Demonstration of high yielding varieties Kayamkulam 1, TMV 6 and TMV 7

Year	Farmers (No.)	Area (ha)	Yield (q/ha)		% increase in yield	Economics of Demo (Rs./ha)		Economics of check (Rs./ha)	
			Demo	Check		Gross return	Net return	Gross return	Net return
2016-17	50	1.64	21.8	10.3	257.28	54,500	27,732	25,750	7,509
2017-18	189	20.00	34.1	Replaced		85,250	58,482	NA	NA
2018-19	236	35.00	34.8	with		87,000	60,232	NA	NA
2019-20	281	56.28	35.8	HYVs		89,500	62,732	NA	NA
2020-21	300	65.50	37.4		263.10	93,500	65,450	NA	NA
2021-22	320	70.00	37.8		263.80	94,960	66,472	NA	NA
2022-23	348	77.80	38.8		267.30	97,000	66,676	NA	NA
Total/Average	1724	326.22	34.36		262.90	85,958	58,253	NA	NA



Sesamum improved variety demonstration

Other technology interventions under crop module: The cultivation of new crops has been introduced in order to improve climate resilience. Pulses, groundnut, finger millets (Payur 2), hybrid Napier fodder (CO5), African tall variety maize, traditional medicinal rice varieties (Navara and Rakthashali), HYV of KAU Sreyas, little millet IIMR variety DHLM 36-3, proso millet IIMR variety DHPM 27-69, and sorghum IIMR variety M 35-1 have been grown as intercrops in coconut gardens. These crops have thrived under severe summer conditions with minimal input resources and have been cultivated over an area of 65.24 hectares, yielding an average income of Rs.10,000 to 20,000 per hectare. By implementing this crop-

based module through convergence, 369.11 hectares of fallow coconut gardens have been consolidated.

This intervention has increased the employment opportunities for farm women in MGNREGS and provided a balanced nutritional diet. The program has also improved the knowledge and technologies of cultivation practices of the participants, with a 68.5% increase in knowledge and technology and a 57.8% increase in adoption. A total of 631 farm households have benefited directly through these crop-based modules, covering an area of 270 hectares. The number of farmers, area covered, yield, and economics for each intervention are given in the following Table 26.



Demonstration of fodder



Demonstration of finger millet

Table 26: Demonstration of high yielding varieties and intercrops

Technology interventions	Far mers (No.)	Area (ha)	Yield (q/ha)		% increase in yield	Economics of Demo (Rs./ha)		Economics of check (Rs./ha)		Horizontal spread	
			Demo	Check		Gross return	Net return	Gross return	Net return	No. of farmers	Area (ha)
Pulses as intercrop in coconut garden	62	29.2	32	11	190.9	2,88,000	1,95,840	99,000	64,350	128	137
Groundnut cultivation as intercrop in coconut garden	48	6	10.5	NA	100	84,000	57,120	NA	NA	103	16
Soil and moisture conservation + INM in coconut palms	30	16.6	7530 nut/ha	4210 nut/ha	78.85	1,58,130	1,10,691	88,410	61,887	2,480	140
Grain maize cultivation	14	3.24	5	NA	100	20,000	12,000	NA	NA	1,250	50
Fodder- Hybrid napier (CO 5), Fodder maize (African tall variety)	195	80	50	10	400	15,000	10,500	NA	NA	306	93
Finger millet variety Paiyur 2 of TNAU	88	90	9.0	NA	100	47,000	27,000	NA	NA	281	300
Paddy cultivation with traditional medicinal rice varieties- Navara and Rakthashali and HYV of KAU Sreyas	140	18.6	21	14	50	1,05,000	73,500	70,000	45,500	51	20
Little millet IIMR variety DHLM 36-3	21	10	12.5	NA	100	12,50,000	87,500	NA	NA	In State millet mission this FFP model assessment and results were accepted for upscaling in the policy document. 250 ha identified. Yet to start	
Proso millet IIMR variety DHPM 27-69	17	10	15	NA	100	1,50,000	1,05,000	NA	NA		
Sorghum IIMR variety M 35-1	16	6.7	20	NA	100	1,80,000	1,26,000	NA	NA		

3.4.2. Horticulture based module

Horticultural crops were mainly grown as intercrops in coconut gardens, which are cultivated in individual farmer plots in a contiguous manner. The major issues were low knowledge and non-adoption of HYV of intercrops, especially tubers and spices, subsistence-level cultivation for home needs only, and a non-commercial attitude that prevents investing in technology adoption. Various technologies were introduced, including HYV of ginger (IISR - Mahima), turmeric (IISR - Prathibha

and Pragathi), amorphophallus (CTCRI - Gajendra), diascorea (CTCRI - Sreekeerthy), vegetables (IIHR and KAU varieties), and APAU varieties of colacassia and yam. Additionally, recommended scientific cultivation practices were implemented. The varieties were evaluated through participatory experimentation, and IISR - Pragathi, CTCRI - Gajendra, and KAU/IIHR vegetable varieties were ranked as the most suitable crops for the local condition with high yield and acceptability. The convergence with MGNREGS

and involvement of progressive farmers, and Coconut Producers Societies created a replicable model for other panchayaths as well. The Responsible Extension Approach (REA) was developed by scientists to facilitate the production of quality planting material. This method involves the following steps for the spread of new varieties:

- Introducing HYV from the ICAR Institutes.
- Forming social responsible groups comprising agricultural experts, local people representatives, women SHGs, progressive farmers and representatives of general public for REA interventions.
- Cultivation in identified contiguous area through land consolidation and convergence with MGNREGS.
- Technical facilitation by concerned ICAR Institute and FFP team, supervising, culling out of diseased, regular field visits, training programmes before and during the activities.
- MoU with the groups to provide quality plant materials free of cost for area spread to other wards to a maximum of 40 – 50 % of their total harvest.
- The groups formed for production of planting material should also agree with the MoU. Within three years of RES, these varieties can be responsibly and rapidly spread to all 19 wards of the panchayat.
- Land consolidation strategy for assimilating one to three acres contiguous area as one unit,

Introduction of HYV, participatory assessment of suitability/consumer/market potential, expert facilitated planting material production, free exchange of 40% of the planting material among farmers and groups through which 21.4 tons of planting material horizontally spread in an area of 354 ha within 2 years. The adoption of this strategy led to scientific management practices, and a 100% improvement in knowledge. Additionally, gender equity was demonstrated in technology access.

- The RES enabled knowledge and skill about the varieties and the planting materials among farm women and coconut growers by 71.02%. This has surpassed the technology demonstration and OFT through social consensus and conviction.
- The percentage increase in yield of these crops compared to the check varieties was 66 – 200% and the net return ranged from 2.2 – 2.6 lakhs/ha for amorphophallus, ginger and turmeric.

Demonstration of turmeric varieties:

Demonstrated high yielding varieties IISR Prathibha and Pragathi with scientific management in 12 ha area covering 82 farm families since 2018-19. Year wise number of farmers, area covered, yield and economics are given in following Table 27. FFP interventions have achieved 100 percent replacement of local varieties with IISR Prathibha and Pragathi with participatory assessment resulting in 113.67 q/ha yield and Rs. 267500 /ha net income.

Table 27: Demonstration of high yielding varieties IISR Prathibha and Pragathi

Year	Farmers (No.)	Area (ha)	Yield (q/ha)		% increase in yield	Economics of Demo (Rs./ha)		Economics of check (Rs./ha)	
			Demo	Check		Gross return	Net return	Gross return	Net return
2018-19	17	2.15	95	48	97.9	3,80,000	2,67,500	1,92,000	1,02,000
2019-20	25	3.85	117	Replaced	NA	5,61,600	3,81,888	NA	NA
2020-21	40	6	129	with HYVs	NA	8,84,002	6,01,121	NA	NA
2021-22 & 2022-23	The varieties replaced the local varieties in 45 hectares and FPO of turmeric farmers registered under NABARD and the adoption is continuing in two blocks								
Total/Average	82	12	113.67	48	97.9	4,70,800	2,67,500	1,92,000	1,02,000



Demonstration of turmeric



Demonstration of turmeric harvesting

Demonstration of amorphophallus variety:

Improved varieties of amorphophallus, which are commonly consumed and in high demand in coconut homesteads, were not being utilized due to lack of awareness, access, and adoption. Gajendra variety was introduced with scientific management as an intercrop in 19.7 hectares of coconut gardens, covering 647 farmers. The Table 28 below shows the number of farmers, area covered, yield, and economics year-wise, while the Figure 20 shows the net returns. Through FFP interventions, the Gajendra variety replaced local varieties with 100 percent success, resulting in 148 q/ha yield and Rs.

444000 /ha net income after participatory assessment. This variety was rated as the best for culinary purposes in terms of taste, texture, and acceptability. However, nematode infestation severely affected its utilization for further planting material multiplication and area spread, leading to reduced farmer income. This was addressed through a Participatory Technology Development (PTD) process initiated in an area of 100 hectares, with the technology package validated by farmers for adoption in 750 hectares in the Muthukulam block, after two years of PTD and linkage with ICAR CTCRI.

Table 28: Demonstration of high yielding variety Gajendra

Year	Farmers (No.)	Area (ha)	Yield (q/ha)		% increase in yield	Economics of Demo (Rs./ha)		Economics of check (Rs./ha)	
			Demo	Check		Gross return	Net return	Gross return	Net return
2016-17	72	2	100	75	78.57	4,00,000	2,48,000	3,00,000	1,25,000
2017-18	98	2.8	110	Replaced	NA	4,40,000	2,98,000	Replaced with HYV	
2018-19	135	3.6	130	with	NA	5,20,000	3,84,000		
2019-20	157	5.2	170	HYV	NA	6,80,000	5,35,000		
2020-21	185	6.1	230		NA	9,20,000	7,55,000		
		19.7							
2021-22	In the FFP location Gajendra variety was found to be severely affected by nematodes and it was observed as a susceptible variety. Hence PTD was undertaken for evolving IPM								
2022-23	Evolved technology package through farmer participatory technology development program. The gall index was reduced to nil or 1 from 5 which is the maximum								
Total/Average	647	19.7	148	75	78.57	5,92,000	4,44,000	3,00,000	1,25,000

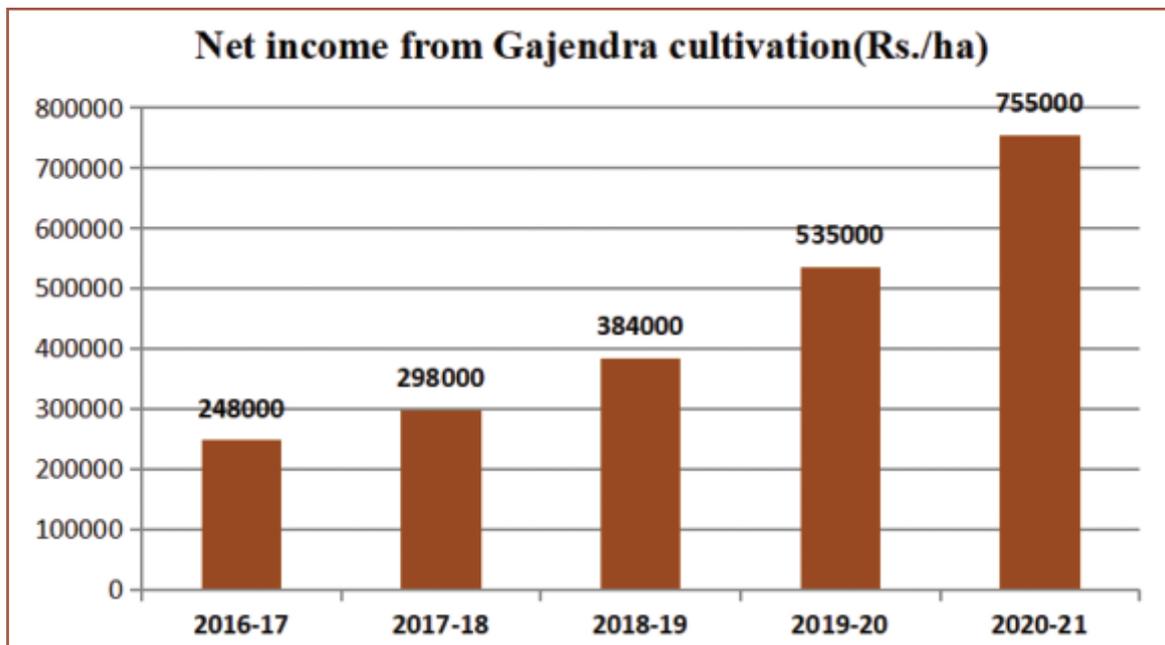


Figure 20: Net income from Gajendra variety



Demonstration of amorphophallus



Demonstration of amorphophallus harvesting

Other demonstrations under horticulture module:

In an area of 12.68 hectares, covering 167 farm families, various agricultural interventions were demonstrated. These include the IISR Varada variety of ginger, integrated nematode management

in coconut intercrops, tissue culture for banana cultivation, and nutritional garden. The following Table 29 provides information on the number of farmers and the area covered, as well as the yield and economics for each intervention.



Demonstration of ginger



Demonstration of vegetable garden

Table 29: Demonstration of high yielding varieties and intercrops

Technology interventions	Far mers (No.)	Area (ha)	Yield (q/ha)		% increase in yield	Economics of Demo (Rs./ha)		Economics of check (Rs./ha)		Horizontal spread		
			Demo	Check		Gross return	Net return	Gross return	Net return	No. of farmers	Area (ha)	
Ginger cultivation (IISR Varada)	36	3.2	142	86.9	63.40	4,97,000	3,03,170	2,60,700	1,59,027	23	15	
Integrated nematode management in coconut inter crops	30	3.5	Gall index -5	Gall index -0	100	11,20,000	7,61,600	NA	NA	30	4	
Tissue culture banana cultivation	51	0.98	200	125	60	4,00,000	2,72,348	2,50,000	1,09,480	58	31	
Nutritional garden	50	5	For household purposes. for year round availability of fresh vegetables for families								2,500	40

3.4.3. Livestock based module

The major problems of livestock / poultry farmers are the high feed cost and mastitis disease causing heavy loss. For sub-marginal land holdings below 0.1ha, income improvement could be achieved through poultry units which require very low resources. Technologies implemented in this module were to reduce the feed cost through introduction and participatory experimentation with different green fodder sources such as TNAU CO5, fodder maize, azolla, hydroponics, poultry breeds like Gramasree and Gramapriya and BV-380, low cost egg incubators for sustainable poultry units, introduction of cow mats and mastitis prevention kit among 300 livestock farmers. Efforts were made to establish linkage with veterinary hospital for clinical technical support, cost share of 30-50 per cent by beneficiary farmers and convergence with MGNREGS, women SHGs, panchayath committee for area wide fodder

cultivation in all the 19 wards. Supply of planting materials to livestock farmers free of cost or Rs.3 - 4 per kilograms on demand, or exchange of planting materials and technology support through farmer to farmer extension mode enabled rapid adoption of the technologies.

The mastitis disease was reduced by 78% as per the clinical records of veterinary hospital due to mastitis prevention kit; Use of cow mat reduced lameness by 76 %; Milk yield increased by 21 % in summer season according to the adopters. Egg production was improved by 1500 eggs per day fetching a gross income of Rs. 9000 per day in the panchayath and Rs. 32.85 lakhs per annum with an average gross income Rs. 45625/unit. The intervention also aided to increase the consumption of milk and eggs in the FFP households. The total beneficiaries of this module were 581 households.



Dairy farming demonstration



Poultry farming demonstration

3.4.4. NRM based module

The major problems in this module were unscientific nutrition management in farming, silted or unused ponds in homesteads and water scarcity for drinking purpose or agriculture due to absence of water conservation which is very critical in this sandy loam tract of Alappuzha district. The technologies demonstrated in this module were soil test based nutrition, homestead pond reclamation and water conservation and pond fish culture for increased income and quality protein.

Soil test based nutrient management: Four soil sample collection campaigns were organized by dividing the entire panchayath into three parts and training programmes were organized in three locations. Soil sample collection campaigns were organized in 19 wards linking panchayath members, Coconut Producers Societies (CPS) and coconut farmers on a 5 ha grid basis. A total of 272 soil health cards were issued to farmers for soil test based nutrient management. The intervention has benefited a total of 1168 farmers, covering an area of 980 hectares. Soil test based nutrition management resulted in 20-30 per cent reduction in cost of fertilizers in coconut and other crops. P fertilizers reduced to 25 percent of recommended dosage resulted in savings of Rs. 4 lakh in the FFP panchayath. Awareness and Knowledge improved from 12.4 % to 78.2 %.

Pond reclamation and refinement for water conservation:

In an area of 1.34 hectares, 72 farmers invested in the rejuvenation of a pond in Homestead. This was made possible with the technical support and training provided by FFP, as well as the link with the Department of Fisheries in Kerala state. The farmers and FFP shared the cost of 3.5 lakhs quality fingerlings of Anabas and Nile tilapia, with farmers contributing 30% and FFP contributing 70%. This intervention helped to conserve 5360 cubic meters of water, generating an average revenue of Rs. 31771 per unit in 2019 and gross income of 22.875 lakhs in the entire FFP project area. As a result of this intervention, water scarcity during summer reduced to less than 10%.

Biopod technology in poultry farming:

20 households adopted biopod technology for waste management and reported 18 percent feed cost reduction in the initial phase of 4 months and the cannibalism reduced significantly. Egg laying period extended by 10 days and weight gain on 120th day increased by 27% than fed birds.

Organic recycling:

Scientific organic recycling introduced in 48 homestead plots which yielded 6.2 tons of compost production per year and Rs.1.25 lakh income per annum. Knowledge improved from 14.7 % to 63.9%. Awareness on relative advantages of vermi compost in farming improved to 100 %.



Introduction fishery after pond reclamation



Pond reclamation

3.4.5. Enterprise based module

The major problems in enterprise based intervention were the lack of supply chain and processing units in the FFP area. The focus group discussion (FGDs) and PRA along with the regular and frequent field visits and direct interaction with the farmers indicated the scope for coconut processing unit for coconut oil, virgin coconut oil and coconut food products, Vermicompost production, Kalpakam Keraprobio production etc.

Coconut based food products: In this module, two coconut processing units were started, including 3 copra driers for primary processing of coconut to copra. Two virgin coconut oil (VCO) cookers were also provided from FFP for production of quality VCO resulted into 80 percent drudgery reduction and 30% more recovery of oil. Training programmes were organized along with practical skill sessions by ICAR-CPCRI scientists. These units were serving as training centres also. 314 coconut farmers from Ernakulam, Kollam, Alappuzha and Thiruvananthapuram districts visited these units during the period. The coconut production units realized an income of Rs.6.60 lakhs per annum, besides facilitating procurement and supporting fellow coconut farmers.

Kalpakam Keraprobio production: Another unique “science based rural enterprise is Kalpakam Keraprobio” unit by FFP for production of the ICAR CPCRI developed bio-input *Basillus megatherium*- Keraprobio. Seven rural youths were given training programme for a week in ICAR CPCRI, Kasaragod. The seedling root growth improved by 40% and morphological indicators showed high quality attributes in 12 month old seedlings. The product was rated as supreme quality by the microbiology laboratory and catered the need of 6500 farmers of four districts with 40.3 tons of production. A total of 6.8 tons of Keraprobio was produced with a net income of Rs.65,000 per year.

Vermicompost production: Three vermicompost production units were started with livestock farmers under this module. Technical knowledge, continuous support in design of unit and information about production of vermicompost from organic wastes were provided. These vermicompost units were designed to prevent the rhinoceros beetle, which is a major pest of coconut, from entering and breeding. Around 2 to 3 tons of vermicompost could be produced per year earning of Rs. 40000 per year per unit.



Turmeric processing enterprise



Virgin coconut oil enterprise

3.4.6. Integrated farming systems (IFS) module

The major problem with farming units is the unscientific intervention, largely driven by the need to meet the household's immediate needs. This approach does not allow for an optimal technology mix for IFS. A participatory assessment of resources, needs, and market demands is necessary for selecting the most appropriate choices. To address these challenges, ICAR CPCRI is developing an appropriate combination of IFS based on land holding size, farm family members' needs and willingness, and available resources.

The lessons learned so far include the importance of direct marketing, external input production, and the creation of a neighbourhood market for farm fresh products at a premium price. These measures can sustain the IFS units and facilitate the doubling of farmers' income. The IFS farmers can earn an annual income of Rs.1.298 lakhs, which can be distributed throughout the year, in addition to catering household needs. However, it is important to note that farm family labour is critical in running an IFS unit. Year-wise number of farmers, area, and annual income, data is given in below Table 30 and Figure 21.

Table 30: Demonstration of coconut based integrated farming system

Year	Area covered (ha)	Farmers covered	Income per farmer due to this intervention (Rs.)	Annual income per farmer before intervention (Rs.)	Annual income per farmer after intervention (Rs.)
2016-17	1.2	20	NA	1,20,132	1,20,132
2017-18	5.3	97	35,423	1,25,432	1,50,855
2018-19	7.6	200	47,400	1,38,600	1,76,000
2019-20	10.0	265	52,354	1,43,238	1,85,592
2020-21	13.5	312	65,465	1,47,458	1,92,923
2021-22	15.0	329	63,020	1,52,070	2,05,090
2022-23	17.5	350	64,075	1,58,037	2,18,112
Total/Average	70.1	1573	54,623	1,44,139	1,98,762

Annual income of IFS farmers(Rs./farmer)- comparison pre and post FFP

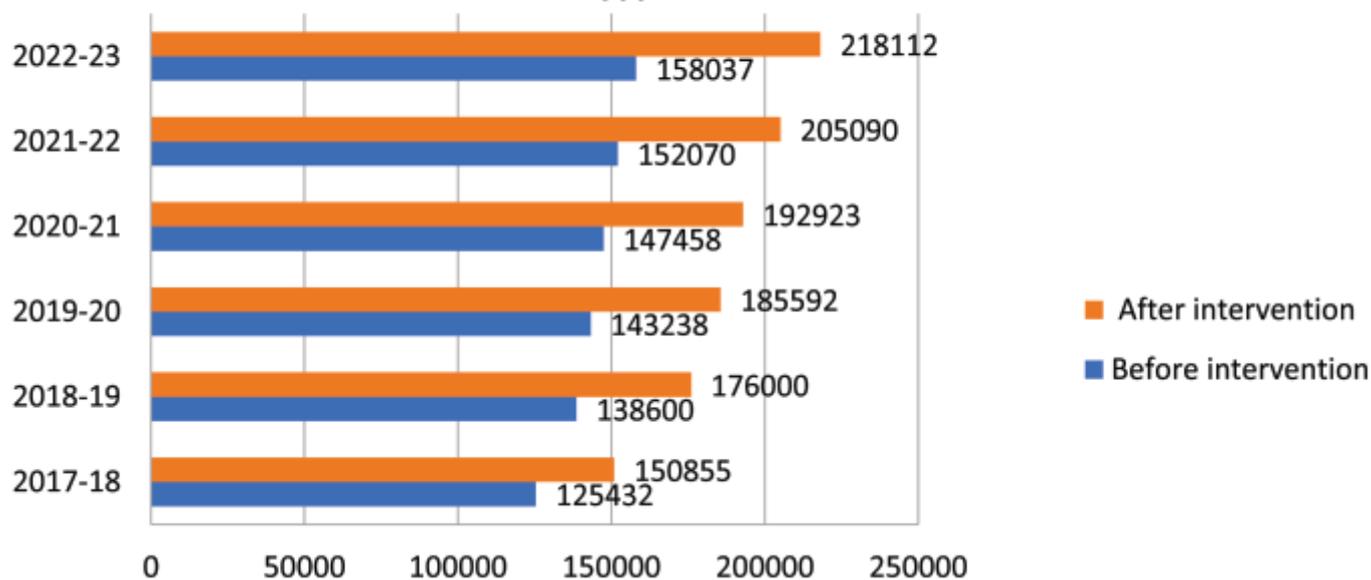


Figure 21: Year wise annual income per farmer



Coconut based IFS demonstration



Vegetable based IFS demonstration

3.5. Enhancing farmer-scientist interface

Under this component, various capacity building programmes and extension activities organised by FFP centre for enhancing farmer-scientist interface are given below:

Capacity building programmes: Thematic area wise capacity building programmes organized

under FFP are presented in Table. Farmers' empowerment was done through organization of 422 capacity building programmes under different thematic areas related to agriculture and allied sector and 12515 farmers were trained. Thematic area wise number of programmes and participants details are given in the below Table 31.

Table 31: Thematic area and institute wise capacity building programmes organized under FFP

Thematic area	Total	
	Programmes (No.)	Farmers (No.)
Capacity building and group dynamics	62	1,817
Crop production	61	1,285
Entrepreneurship development	24	422
Farm implements	10	209
Livestock production and management	17	631
Natural resource management	36	1,080
Nutrition security	50	1,081
Plant protection	28	1,142
Processing and value addition	12	192
Production of inputs at site	40	1,312
Soil health and fertility management	21	1,011
Women empowerment	61	2,333
Total	422	12515



Training on fish farming



Training on mushroom cultivation

Extension activities: To create more awareness among farmers in agriculture and allied sectors, different extension activities were organized by the institute. A total of 2022 extension programmes

were organized with 18102 farmers' participation. Extension activity wise number of programmes and participants are given in the below Table 32.

Table 32: Extension activities organized by FFP institutes

Extension activity	Total	
	Programmes (No.)	Farmers (No.)
Advisory Services	372	3543
Celebration of important days	35	918
Diagnostic visits	540	1940
Exhibition	93	2006
Exposure visits	25	608
Ex-trainees Sammelan	33	1250
Farm Science Club	32	693
Farmers' seminar/workshop	19	348
Field Day	39	918
Film Show	23	472
Group discussions	222	914
Kisan Ghosthi	27	842
Kisan Mela	16	994
Method Demonstrations	526	2397
Plant/animal health camps	20	259
Total	2022	18102



Experience sharing by farmers through AIR programmes



Harvest festival of sorghum

3.6. Combination of technological interventions

The technology combinations shown in Table 33 with 10 groups provided interesting features, which showed that the highest income could be realized through combinations of enterprises, as the value chain is enhanced with the processing of farm

produces. Another observation is the importance of including livestock to obtain decent income for marginal land-holding farmers. Year wise net income (Rs./family/year) under different combinations of technological interventions is given in Table 34.

Table 33: Change in net income (Rs./farmer/year) of farm families under different combinations of technological interventions

Combination	Combination of Enterprises	Lowest	Highest	No of families covered
C1	Integrated Root (wilt) disease management + KalpaVardhini	41,030	9,97,66.80	175
C2	Sesamum -Kayamkulam 1, TMV 6, TMV 7, TMV 4 + INM	21,350	90,228	360
C3	Planting material production + Area expansion of HYVs of amorphophallus	26,481	51,432.42	293
C4	Coconut + Turmeric cultivation (HYVs) + Ginger cultivation (HYVs)	28,400	7,38,450.5	213
C5	Hydroponics + Cow mat + Mastitis kit + Fodder cultivation	1,78,500	2,76,480	162
C6	Egg incubators (Duck and poultry) + Marketing linkage system	5,200	88,720	325
C7	Poultry units + Poultry breed evaluation in demonstration plots	10,800	40,249	74
C8	Fish farming + Pond reclamation and refinement for water conservation	38,579.45	54,002.10	172
C9	Coconut oil and VCO production + Marketing led value chain development	25,600	8,00,024	72
C10	Coconut + Intercrops + Livestock + Vermicomposting	28,000	48,900	312

Table 34: Year wise change in net income (Rs./farmer/year) of farm families under different combinations of technological interventions

Sl. No.	Combination of Enterprises	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
C1	Integrated Root (wilt) disease management + KalpaVardhini	41,030	44,621	52,300	59,850	90,240	95,016	99,766
C2	Sesamum -Kayamkulam 1, TMV 6, TMV 7, TMV 4 + INM	21,350	28,249	32,000	32,000	85,000	83,522	90,228
C3	Planting material production + Area expansion of HYVs of amorphophallus	NA	NA	NA	26,481	45,000	49,635	51,432
C4	Coconut + Turmeric cultivation (HYVs) + Ginger cultivation (HYVs)	NA	2,84,000	3,22,000	2,85,607	6,87,500	7,17,500	7,38,450
C5	Hydroponics + Cow mat + Mastitis kit + Fodder cultivation	NA	NA	NA	1,78,500	2,16,000	2,44,800	2,76,480
C6	Egg incubators (Duck and poultry) + Marketing linkage system	NA	NA	NA	52,000	71,000	82,540	88,720
C7	Poultry units + Poultry breed evaluation in demonstration plots	10,800	12,960	16,277	21,486	26,858	31,692	40,249
C8	Fish farming + Pond reclamation and refinement for water conservation	NA	NA	NA	38,579	42,364	42,751	54,002
C9	Coconut oil and VCO production + Marketing led value chain development	NA	25,600	1,07,000	2,40,000	6,65,105	7,34,110	8,00,024
C10	Coconut + Intercrops + Livestock + Vermicomposting	28,000	28,500	30,215	32,800	40,000	44,200	48,900

C1. Combination of technological interventions of integrated root (wilt) management + nutrient mixture:

The root (wilt) disease incidence is estimated to cause a loss of 998 billion rupees, which have the impact on lakhs of small and marginal farmers. The technology combination of IRWDM and application of ICAR-CPCRI nutrient mixture kalpavardhini could improve the income by 143 per cent (Rs./family/year) over 7 years of FFP intervention in 55 ha covering 175 farm families and 16500 coconut palms (Figure 22). Following are the contributing factors;

- Improved awareness, knowledge and adoption of integrated root (wilt) management in coconut.
- Farmers have gained confidence in investing back into coconut cultivation based on the positive results and impact of adopting integrated root (wilt) management practices.
- Soil conditions have improved through the implementation of soil test-based nutrition management and the recycling of organic waste from intercrops (data analysis provided).
- To ensure the sustainability of the impact, participatory selection and GIS mapping of root

(wilt) disease-free mother palms are conducted for community-level healthy seedling production. This will improve the genetic potential of coconut palms in the locality, resulting in better performance in management.

- The intervention was facilitated through training programs, diagnostic field visits, advisory services in the field/mobile phones/social media, extension literature, popular articles and documenting and uploading success stories in CPCRI FFP you tube channel.

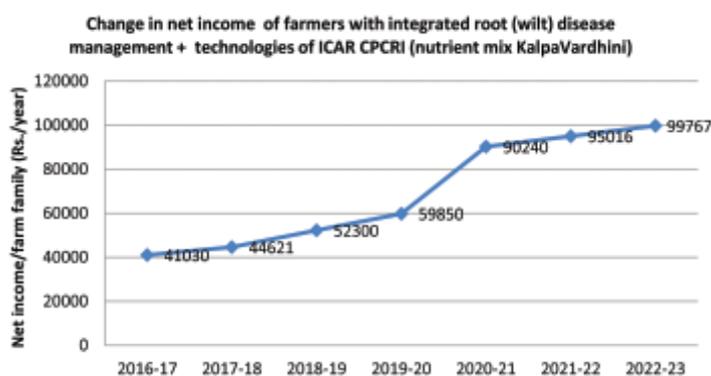


Figure 22: Change in net income of farmers with combination of IRWDM + Kalpa Vardhini

C2. Combination of technological interventions of sesamum technologies:

Sesame is a traditional oil seed crop of onattukara tract of Kerala, extended in three taluks, viz., Karthikappally, Karunagappally and Mavelikkara of Kollam and Alappuzha districts. This crop obtained the GI status for these location in 2022. The average net income improved by 3.4 folds in comparison to pre FFP data. The average net income (in Rs./family/year) has improved from Rs. 21350 in pre-FFP period to Rs. 90228 in post-FFP period (Figure 23). Following are the contributing factors;

- Sesame and paddy were recorded as most discontinued crop during the initial PRA and survey. The area under sesame in the FFP panchayath was increased from 2.4 ha (pre-FFP) to 203 ha (post FFP).
- High yielding varieties released by KAU (Kayamkulam-1, Thilak, Thilathara, Thilarani, Thilothama), TMV-4,5,6,7 and SVPR-1 of the

TNAU were assessed in participatory mode and Kayamkulam-1, Thilak and TMV-6 &7 were best suited in terms of oil content, tolerance to phyllody disease and yield.

- The FFP has achieved the area spread of the assessed varieties.
- Full replacement of local varieties with high yielding varieties in the FFP and neighbouring panchayaths.
- The practice of growing sesame as a subsistence crop after second crop paddy has changed to intercropping in coconut gardens and sole cropping in open areas, under good management practices.
- The intervention was facilitated through training programs, diagnostic field visits, advisory services in the field/mobile phones/social media, extension literature, popular articles and documenting and uploading success stories in CPCRI FFP you tube channel.
- Market avenues were created with good publicity on the quality product and a small processing unit for sesame oil production has been initiated under FFP.

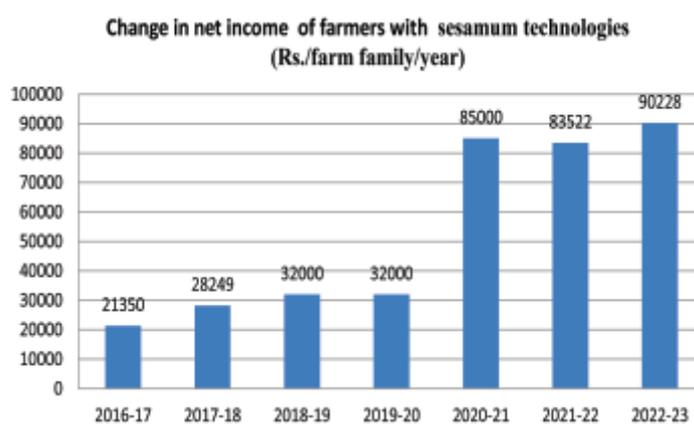


Figure 23: Change in net income of farmers with combination of sesamum technologies

C3. Combination of technological interventions of planting material production and area expansion of HYVs of amorphophallus:

Tuber crops as intercrop in coconut garden is very popular among the coconut farmers due to its usefulness in terms of farm family consumption, year long storage for food security and as a suitable intercrop in coconut

gardens. Amorphophallus or elephant foot yam (EFM) is one of the most popular tubers in culinary preparations of homesteads as well as the cultural offerings for local festivals of Onattukara tract. Under the crop module of FFP, the combined interventions have led to a significant increase in the total net income per family per year from Rs. 26000 to Rs. 51432, through a combination of planting material production and cultivation of EFM as an intercrop (Figure 24). This intervention has benefitted 293 farmers, particularly women self-help groups, in an area of 45.63 ha. Following are the contributing factors;

- Full replacement of local varieties of amorphophallus with ICAR-CTCRI variety Gajendra
- Participatory assessment of Gajendra variety; rated it as the best for culinary purposes in terms of taste, texture, and yield (8 to 10 kg/corm).
- Adoption of good agricultural practices and PTD on emerged problem like nematode infestation has helped in maintaining continued adoption.
- Responsible extension strategy (RES) evolved and tested in FFP in terms of planting material production facilitated by FFP team and local committee enabled faster spread and adoption of Gajendra variety in all the 19 wards of panchayath within two years of introduction.
- The intervention was facilitated through training programs, diagnostic field visits, advisory services in the field/mobile phones/social media, extension literature, popular articles and documenting and uploading success stories in CPCRI FFP you tube channel.

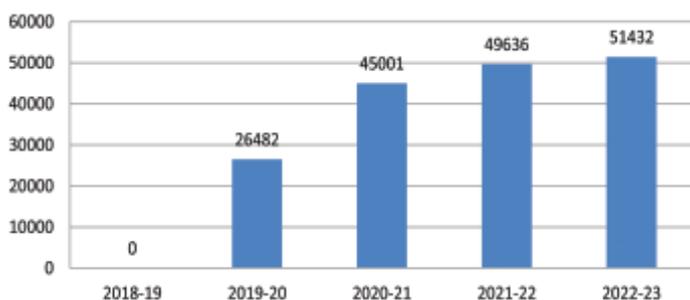


Figure 24: Change in net income (Rs./farmer/year) with combination of planting material and HYV of amorphophallus

C4. Combination of technological interventions of coconut + turmeric cultivation (HYVs) + ginger cultivation (HYVs): Spices are traditionally being cultivated as intercrops in coconut gardens for family needs, it provides income either through raw and processed produces. Turmeric and ginger are common annual spices besides perennial spices like black pepper and nutmeg. Net income (Rs./family/year) has improved by 1.6 fold from Rs.284000 in pre FFP to Rs. 738451 in post FFP benefitting 213 farmers including women SHG members through intercrop in 24.6 ha of coconut gardens(Figure 25). Following are the contributing factors;

- Increased area of turmeric and ginger crops in coconut gardens from subsistence level to commercial level
- HYV of turmeric (ICAR IISR Pratibha,Pragati and Suvarna) and ginger (ICAR IISR Mahima and Varada) have replaced the local varieties
- Enabled rapid adoption of the varieties through responsible extension approach and achieved cultivation in 19 wards of FFP panchayath within two years
- The intervention was facilitated through training programs, diagnostic field visits, advisory services in the field/mobile phones/social media, extension literature, popular articles and documenting and uploading success stories in CPCRI FFP you tube channel.
- Procurement of fresh turmeric and processing unit was initiated under FFP.

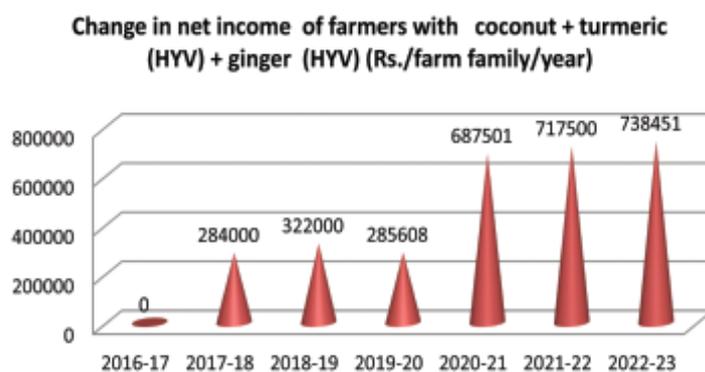


Figure 25: Change in net income of farmers with combination of coconut + turmeric (HYV) + ginger (HYV)

C5. Combination of technological interventions of hydroponics + cow mat for GAP in livestock units + mastitis kit campaign + fodder cultivation:

Livestock is the most critical component in improving the income of farm family under homestead system. The technology of combination of hydroponics + cow mat for gap in livestock units + mastitis kit distribution + fodder cultivation improved the income by 54.89 per cent among 162 farmers covering area of 31 ha (Figure 26). Following are the contributing factors;

- Farmers with livestock units having ten or more animals were introduced to hydroponics as a supplementary source of green fodder. The NIANP Bengaluru motivated adoption through field visits and method demonstrations. As a result, farmers sustained the adoption of hydroponics
- A campaign was launched to promote prophylactic measures for mastitis, and distributed 300 mastitis kits. These kits were made available in collaboration with the veterinary clinic of the FFP, panchayat and contained Povidone-iodine, bleaching powder, mastitis testing tray, and chemicals from the IIVB, Trivandrum. Clinical records show that these measures reduced the incidence of mastitis by 78%.
- Adoption of cow mat reduced incidence of foot and mouth disease, summer fatigue and reduced the drudgery of farmers in cleaning cow sheds.
- HYVs of fodder crops from TNAU (CO-5, CO-3, African tall maize, Multi cut and single cut sorghum) and KAU (Susthira, Hybrid napier) were introduced as an income generating enterprise among women groups.
- The interventions were facilitated through training programs, diagnostic field visits, advisory services in the field/mobile phones/social media, extension literature, popular articles and documenting and uploading success stories in CPCRI FFP you tube channel.

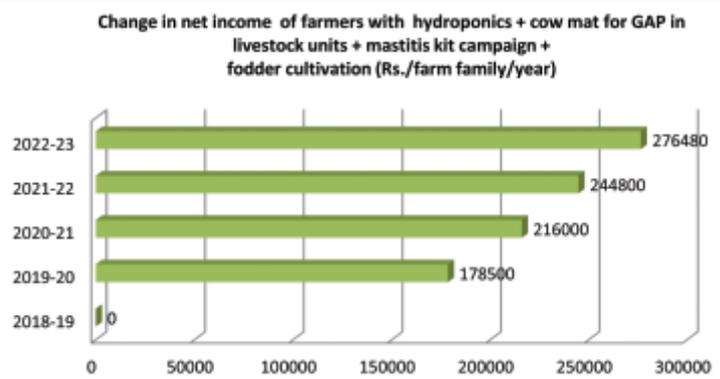


Figure 26: Change in net income of farmers with combination of hydroponics + cow mat for GAP in livestock units + mastitis kit + fodder cultivation

C6. Combination of technological interventions of egg incubators for decentralized chick production + marketing linkage + poultry:

Backyard poultry for home needs is very popular among women as a low cost and manageable unit of layer birds. In the PRA and problem prioritization FGDs one of the major problems recorded was the non-availability of quality chicks of duck and layers. Duck rearing is a profitable venture in the FFP location since water bodies are available in plenty. The combination of egg incubators for decentralized chick production (duck and poultry) + marketing linkage has improved the annual income for seven rural educated youth by 58.73 per cent (Figure 27). A group of women farmers formed a unit to manage one-day-old chicks until they were two to three months old and ready for marketing. This intervention benefitted 325 households in both the FFP adopted and non-adopted villages. As a result, these households were able to achieve self-sufficiency in egg production. Following are the contributing factors;

- Demonstrated the relative advantage of high yielding breeds of KAU (Gramapriya, Gramasree, Giriraja and Kairali), BV-380 and selections of indigenous breeds of poultry (Kadaknath, Ind Bro brown, Aseel) and duck breeds of Chara and Chempally.
- The incubator units are currently selling 5000 to 6000 chicks/ducklings per year to more than 80 poultry units.

- The interventions were facilitated through training programs, diagnostic field visits, advisory services in the field/mobile phones/social media, extension literature in linkage with veterinary department and KVASU, popular articles and documenting and uploading success stories in CPCRI FFP you tube channel
- Marketing linkage system with FPO, Kudumbasree and poultry group was formed for marketing of eggs and chicks.

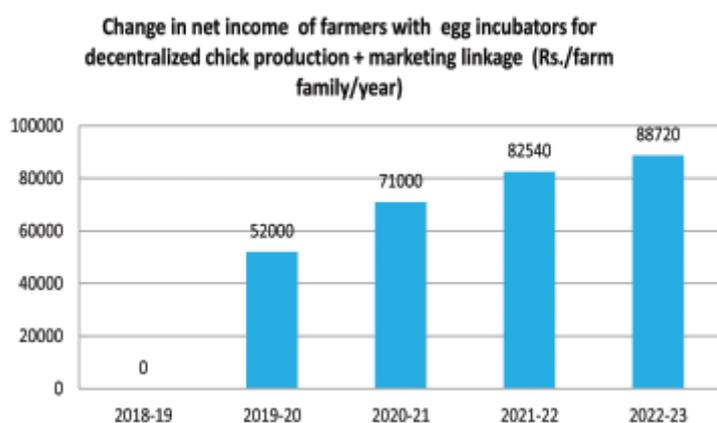


Figure 27: Change in net income of farmers with combination of egg incubators for chick production + marketing linkage + poultry

C7. Combination of technological interventions of poultry + poultry breed evaluation: Backyard poultry units were invariably present in majority of homesteads of Kerala catering for nutrition, daily income for the women and kitchen waste management. The PRA exercise revealed that the poultry units were at mere subsistence level for home needs. Hence high yielding poultry breeds were introduced for participatory assessment involving 74 farmers. The initial income in the pre FFP period was Rs.10800 per farm family per year which was doubled (2.43 fold) with the FFP interventions (Figure 28). Gramasree and Gramapriya were provided at a share of 60 per cent from FFP and remaining 40 per cent from participating farmers. With the facilitation of FFP, 88 IFS farmers were able to rear ducks in their ponds. Following are the contributing factors;

- Training programs and facilitation of clinical problems, linking with veterinary hospital.
- Method demonstration and skill enhancement of women poultry farmers in oral vaccination of chicks.
- Introduction of high yielding breeds released by KAU and selections of local breeds for production of chicks and ducklings
- The existing poultry units were upgraded by introducing high-yielding breeds and refining the poultry sheds scientifically.
- The panchayat achieved self-sufficiency in egg production, with a daily production of 1550 eggs.
- Total egg production (duck and layers) was improved from 3700 eggs/day to 13690 eggs/day in the entire panchayath during the full egg production stage of birds.
- Market linkage established through FPO, Kudumbasree women SHG units and local traders.

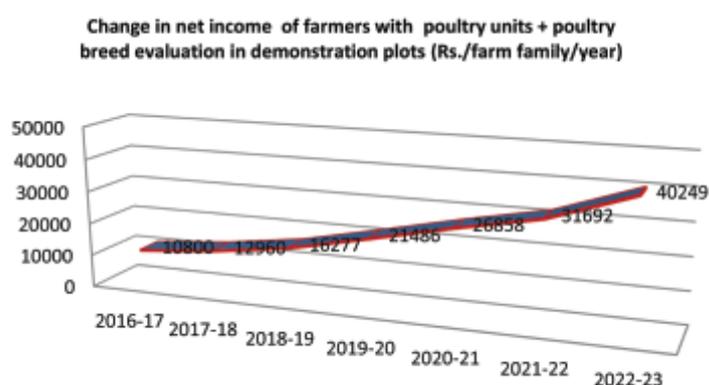


Figure 28: Change in net income of farmers with combination of poultry units + poultry breed evaluation

C8. Combination of technological interventions of fish farming + pond reclamation and refinement for water conservation: Alappuzha district is characterized with homestead ponds for water conservation, rearing fishes for home consumption, for small scale irrigation and for livestock needs. The field visits and the transect walk before the project implementation helped to envisage the potential of homestead ponds for commercial fresh water fish culture and enabling water conservation

through scientific FFP interventions. The income per fish pond unit was zero before the intervention, the average income per family per year was Rs. 38579 during the initial year of intervention. This income improved over time and reached Rs. 54002 by the fourth year (Figure 29). The intervention benefitted 1072 homestead farmers. Following are the contributing factors;

- Surveyed and documented existing homestead ponds of farmers, recorded their area and capacity.
- A group meeting was coordinated with all the farmers, and activities to be implemented in a participatory mode were discussed. These activities included the reclamation and refinement of existing ponds by the farmers themselves, as well as the provision of quality fingerlings and advisory services during the intervention by FFP
- Training programmes conducted in coordination with Dept. of fisheries, Kerala, and documentation of success stories, marketing linkage with fish farmers groups were made.
- Established farm school on fish culture for small and marginal IFS unit with component such as bio floc, natural pond fisheries, aquaponics and artificial pond.
- Innovations in pond fisheries and experiential learning of participating farmers could be exchanged and communicated for timely and effective problem solving, which contributed to the success of this intervention.
- The type of fishes to be cultured is decided in farmers group meeting considering their experiences in soil type, seasons and water availability etc during the year. 3.5 to 4 lakhs fingerlings of anabas (*Anabas testudineus*) and tilapia (*Oreochromis niloticus*) were cultured per year in fresh water ponds.

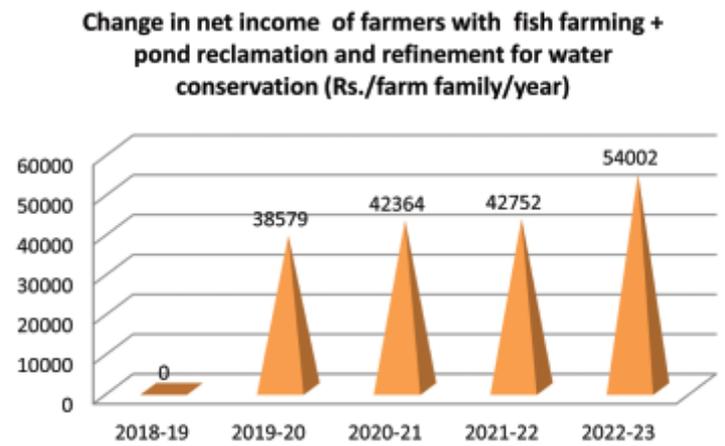


Figure 29: Change in net income of farmers with combination of fish farming + pond reclamation and refinement

C9. Combination of technological interventions of coconut oil and VCO production + marketing led value chain development: Coconut is a major crop of every homesteads in the FFP panchayaths. Coconut palms play an important role in the nutritional self sufficiency of farm family, as the base crop of homesteads and major slice of farm income. Processing of coconut were limited to home needs such as for coconut oil and food products like coconut chutney powder, cookies etc. FFP interventions under EDP module initiated the concept of commercial level coconut value addition with few units with coconut oil and virgin coconut oil as the major product. Efforts for value addition of husk and shell could not be materialised due to various social problems. However, the income (Rs./family/year) of the processing units doubled from Rs.25600 to Rs.80024 over sixth year(Figure 30). Following are the contributing factors;

- Training programs for imparting skills in value addition.
- Campaigns launched on value added products potential of coconut, and nutritional advantages.
- Technology transferred under MOU with CPCRI and FFP farmer groups on virgin coconut oil production and copra driers. Provided three virgin coconut oil cookers and four copra driers under FFP.

- The market led value chain on coconut evolved from farmer producer company with FFP farmers as shareholders with NABARD support, procurement of raw nuts, quality coconut seedling production through community nursery, farmers shop for input purchase enabling technology adoption and for marketing value added products under the brand name of the FPO were arranged.
- The FFP farmer producer company was provided with processing unit requirements such as coconut milk extractor, VCO cooker, Pulveriser, copra drier, packing materials etc.
- Documentation and publication of success stories in coconut value addition as popular articles, TV and Radio programs, participation in exhibitions with coconut products and videos uploaded in CPCRI FFP You Tube channel.

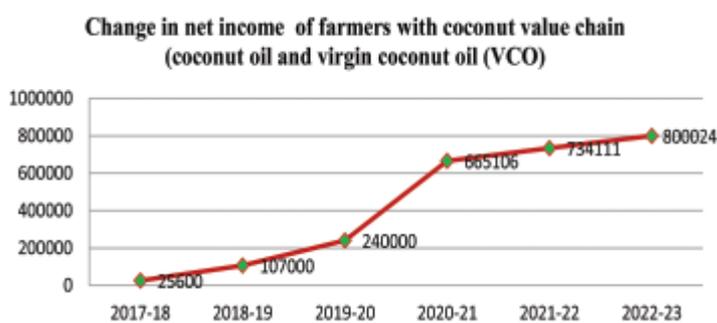


Figure 30: Change in net income (Rs./farmer/year) of farmers with combination of value chain development and VCO production

C10. Combination of technological interventions of vermicomposting units for IFS farmers as additional income in Livestock based Coconut system:

Disposal of cow dung was one of the major problems faced by livestock farmers of marginal holding in maintaining proper hygiene in the units. One of the technological interventions demonstrated was the vermin composting of organic waste with cow dung mixture. The existing units were graded up with proper technology adoption and increased the quantum of vermin compost production. The additional income (Rs./family/year) from vermin compost units in

livestock based coconut IFS system was improved by 74 per cent from Rs.28000 to Rs.48900 (Figure 31). Following are the contributing factors;

- Training programs and method demonstrations in vermin composting technology
- Shifted to commercial vermin compost production with support from FFP
- ICAR CPCRI earth worms replaced commonly used earthworms, which is more efficient and could digest hard organic waste of coconut palms with high lignin content.
- Procurement and marketing of vermicompost and enriched vermin compost with trichoderma at a premium price of Rs.30/kg
- Vermicompost could be utilised for other farm based enterprises like seedling production and multiplication of bio agents such as, pochonia for nematode management and trichoderma multiplication

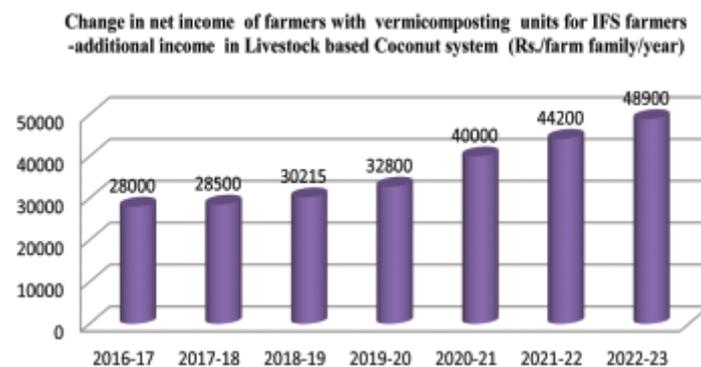


Figure 31: Change in net income of farmers with combination of vermicomposting in Livestock based Coconut system

3.7. Success stories and case studies

I. Integrated root (wilt) disease management in coconut :

The Onattukara sandy loam tract in Alappuzha district is mainly comprised of marginal land holdings, with an average coconut garden size of 0.4 hectares. The soil in this area is deficient in Magnesium and Boron, has medium levels of Nitrogen and organic carbon, high in pH and Phosphorous content, and low in Potash content, as per soil test results. Identified problems include low economies of scale, low adoption rate, irregular

management of debilitating disease, fluctuating coconut prices, and increasing input costs, particularly for chemical fertilizers like Potash.

Technological interventions:

- Soil testing campaign for soil test based nutrition (SBTN) management.
- Demonstrations, area wide scaling up, Campaigns regarding - Integrated management of root (wilt) disease affected coconut [SBTN + organics 25-30 Kg /palm/year + MgSo4 (500g/palm/year) + Dolomite (1 Kg/palm/year) + basin management with 100 g cowpea sown and incorporated with initiation of flowering].
- A pilot level adoption/demonstration of customized nutrient mixtures (including micro nutrients) Kalpavardhini for 9650 bearing coconut palms (500 g/palm/year in two split dose), Kalpaposhak for coconut seedlings (100 g/seedling/year in two split dose).
- Area wide approach of plant protection for 9300 palms of coconut in a contiguous area was done in collaboration with farmers

Efforts made by institute/methodology:

- Pre project data collection from 750 coconut farmers on knowledge (low level for 72%), and adoption (8-10%).
- 19 ward level Focus Group Discussion (FGD) session involving 378 coconut farmers.
- Linkage with 19 Coconut Producer Societies (CPS) for identification of demonstration plots, technology transfer and outreach programs and facilitation of area wide plant protection, distribution of fertilizers and soil sample collection campaigns. A total of 3 soil collection campaign and field level training programs were organized.
- Off and on field training programmes (39 trainings) were conducted on scientific management practices and scientific technologies for the selected coconut farmers.
- Farmer participation in farm planning is a

compulsory exercise to be done by the farmers for delineating the resources available and the gaps and potential of their coconut plots. This exercise brought out clarity to the farmers and the FFP team regarding decision making tool for planning the experiments and technology adoption.

- Extension literatures, mass media, method demonstrations, field visits were adopted.

Output, outcome and impact:

- The interventions of root (wilt) disease affected coconut palms resulted in significant increase in yield from 4305 nuts to 8210 nuts with 90.71 percent increase in productivity per hectare. The net income per hectare per year increased from Rs 67244 to Rs. 1,32,181 during seven years of FFP interventions.
- Technology spread to 1806 farmers in adopted villages, 140 farmers in non adopted villages. 9200 farmers adopted due to convergence through Department of Agriculture - Kera Gramam Program (500 farmers in each panchayat), local panchayat coconut support scheme (17500 palms- 580 farmers) and Ochira Panchayath- schedule caste coconut farmers program (375 farmers). Utilization of mass media and social media, linkage and convergence and farmer to farmer or group to group dissemination enabled effective reach out.

II. Reviving glory of the GI crop sesame through FFP:

The FFP Panchayath-Pathiyoor is situated in the Onattukara sandy soil tract of Alappuzha district. The area is unique in producing superior quality sesame, which is a traditional crop that has been intervened with the culture of the society. The crop was awarded with GI status. The crop was cultivated in only 2.4 ha area before FFP intervention with local variety, low adoption of scientific management, and residual moisture after paddy harvest. Major problems identified were;

- According to the pre-FFP survey and PRA, all the farmers have marginal land holdings and the paddy-sesame cropping pattern was one of the most discontinued crops. However, since sesame is geographically suitable for this location, it was taken up.
- The paddy fields were converted to garden lands or hoeing plots and left fallow.
- None of the farmers had knowledge or adoption of recommended practices or HYV released for the area. Additionally, there was no project or program support from the local self-government or Department of Farmer Welfare and Agriculture Development for the revival of this crop in a converted manner.

Technological interventions:

A rapid survey and PRA was conducted along with pre project Focus Group Discussions (FGD) in all the 19 wards of the FFP Panchayath. Based on the problem prioritized following interventions were planned and undertaken.

- Participatory experimentation of released HYV by Kerala Agricultural University (Kayamkulam -1, Thilak, Thilathara, Thilothama and SVPR-1), and Tamil Nadu Agricultural University were undertaken in 25 locations with one acre plots.
- Kayamkulam-1 and Thilak of Kerala Agricultural University were found to be highly suitable and have relative advantage of 38 percentage higher yield, 48.2 % oil content. Kayamkulam-1 is resistant to drought and easily adopt to climate variation. Both Kayamkula-1 and Thilak varieties were 60-70% more tolerant to phyllody and leaf spot diseases compared to other crops.
- Training programs were conducted in all the wards, 19 off campus trainings benefiting 232 farmers, with linkages from Kerala Agricultural University, Panchayath members and women SHG's.
- Through the Model Convergence program with MGNREGS, women farmers were able to gain

additional employment opportunities and receive extra wages. The program led to the employment of 207 more labourers and an additional wage of Rs 4,51,110 in sesame cultivation.

- 123 field visits were made at each crop stages of sesame to 38 spots of 19 wards, 12 mass media coverage in newspaper, TV and Facebook of FFP were done.
- 1000 copies of extension literature on sesame cultivation technologies and product diversification were distributed.
- Initiated production and marketing of “Pathiyoor Karshaka Ellenna (Thil Oil)” involving procurement of sesame from the groups.
- 48 individual farmers also revived the cultivation of sesame.

Output, outcome and impact:

- Area under HYV of sesame increased from nil to 139 acres (1.64 ha to 56.28 ha) and total area improved from 2.4 ha to 230 ha per year
- Net income per ha increased from Rs. 27732 to Rs. 66676.
- Technology spread to 3819 farmers in adopted villages, 127 farmers in non adopted villages. 10300 farmers adopted due to convergence through Department of Agriculture - Sesamum Development Program (500 farmers in each panchayat), state government GI crop support scheme (5180 farmers) and Muthukulam Block panchayat in 8 Grama panchayats- Convergence with MGNREGS program (12000 women SHG farmers group members)
- 100 percent replacement of local varieties with HYV Kayamkulam 1 & Thilak and assessed TNAU varieties (TMV 6,7,4)
- Value addition unit for sesame oil production has started
- Onattukara Development Agency (ODA) and Department of Agriculture, Kerala accepted the FFP model for participatory assessment and area

spread intervention in 20 panchayats since 2022-23.

- Climate resilience assessed for scattered and early sowing, and as inter crop in coconut gardens.
- The revival of sesame cultivation was made possible through the convergence of MGNREGS with four groups in 2016-17, which gradually increased to 50 women groups in 2019-20. A total of 281 farmers, including 232 women farmers and 49 individuals, have benefited from this initiative.
- The total yield/production has increased tremendously from 7.87 q to 270 q which led to increase in household consumption and income. The total net income realized in the FFP Panchayath was Rs 47.84 lakh contributing to the goal of doubling farmer's income.
- A study among the cultivators clearly indicated an improvement of 84.3% on knowledge on HYV, 80.12% on spacing and 78.3% on importance of Integrated Nutrition Management.

III. The farmer who tripled his income through livestock based integrated system:

Sri. Gopalakrishna Pillai M, is a retired banker from Punjab National Bank. After retirement, he developed keen interest in livestock farming and started with four animals. However, due to lack of scientific knowledge and skills to manage, gaps in marketing of milk, and lack of processing or value addition, he failed in his attempt. Cow dung disposal was also a major problem, creating an unhygienic situation. This prompted him to visit both failed and successful livestock farmers to learn from them practically. Currently, he has one hectare of land, 47 milking cows, and 20 calves, including Gir breed. He linked with veterinary department of FFP area and followed good practices such as cow mat mastitis kit, cream separator, milking machines chaff cutter, value addition of milk, organic manure production, drying of cow dung and sale, selling

fresh cow dung, organic vegetable cultivation, fish pond, biogas plant, bio digester, fodder crops- CO 3, CO5 (fodder grass) and fodder maize, hydroponics etc. under guidance of FFP which resulted into 3.29 folds income as shown in Table 35.

Social support and ecological services:

- ✓ Green swatch income - Model for maintaining hygienic livestock rearing through value addition of cow dung and animal wastes
- ✓ Regular employment provided to 3 laborers and 2 part time laborers
- ✓ The model farmer was introduced and the message taken to society through newspaper, television, and 5 episodes in All India Radio(AIR), Thiruvananthapuram and published two technical article in LEISA India
- ✓ Quality organic manures for organic farmers, thus promoting organic farming practices
- ✓ Preparation of bio suppression compost enriching with trichoderma and Pochonia
- ✓ The Farm is serving as FARM SCHOOL and more than 1000 students and farmers visit per year
- ✓ Spreading the message of farming and relevance of family farming in creation of bio happiness, decent income, recycling economics, social acceptance and providing quality nutritious food to society



Farmer with dairy farm

Table 35: Component wise interventions with income details

Sr No.	Components	Pre FFP	Post FFP Interventions	Post FFP gross income (Rs. lakhs) per year	Post FFP net income (Rs. lakhs) per year
1.	Fresh Milk	158 L/day	350 L/day @Rs.52	63.87	32.29
2.	Vermicompost	Nil	6000 kg/year @Rs.20	1.20	0.94
3.	Shade dry cowdung	Nil	2000 kg /year 2 Rs.15	0.30	0.21
4.	Fresh cowdung	0.42	100-120 kg/day @Rs.3	1.05	0.82
5.	Vegetables	NIL	500 kg	0.18	0.10
6.	Fish –pond fisheries	Nil	1500 fish fingerlings	1.75	1.08

IV. Integrated Farming System—success anecdote of a marginal farmer : Sri. Muraleedhara Paniker is practicing dairy based integrated farming system with coconut and sustainable intercrops with components as shown in Table 36.

Table 36: Component wise interventions with income details

Sr No.	Components	Area (Acre) / Number	Production (Q/ Litre/ No.)	Gross income (Rs./year)	Net income (Rs./year)
1.	Coconut	110 nos	6160 nos	1,23,200	87,776
2.	Vegetables	0.10 acre	2.50 q	6,250	4,750
3.	Tuber crops	0.05 acre	7.00 q	24,500	17,150
4.	Banana	150 nos	17.50 q	31,250	19,250
5.	Cow	1 milching	2160 L	1,05,000	52,500
6.	Poultry	80 nos	24000 nos	1,44,000	93,600
7.	Fish	100 nos	0.5 q	12,500	6,250
Total				4,46,500	2,81,276

His average daily income of Rs. 1200-1300, and his annual income is Rs. 4.46 lakh from dairy products and coconut-based integrated intercrop components. His average farm income is Rs. 1.23 lakh from coconut, Rs. 1.05 lakh from the dairy unit, Rs. 1.44 lakh from the poultry unit, Rs. 31250 from banana cultivation, Rs. 12500 from fisheries, and Rs. 30750 from intercrop cultivation, including vegetables and tuber crops. The direct marketing of dairy products has significantly increased his income, and the scientific adoption of cow mat, mastitis kit, and fodder cultivation has reduced the incidence of disease and cost minimization, respectively.



Farmer with banana plot

V. Farmer Producer Organization (FPO) Odanadu farmer producer Company Ltd. of FFP beneficiaries CPCRI as POPI Funded by NABARD: Registered on December 31, 2019 (No. U01110KL2019PTCO60976) was formed with financial support from NABARD. The activities undertaken were; setting of a laboratory for decentralized production of Kera Probio a bio fertilizer in the brand name 'Kalpakam' for coconut & vegetables. Technology transferred with MoA signed with ICAR-CPCRI. Production of 'Kalpa Vardhini' fertilizer mixture for bearing coconut palms. MoA signed with ICAR-CPCRI dated October 2020 and kalpa Poshak technology on December 2023. Initiated “Market Outlet” of FFP farmers' produces through procurement by FPO on December 18, 2020. Adv. U. Prathibha, Hon. MLA, Kayamkulam inaugurated the function & launched first sale of coconut seedlings.

Procurement of turmeric and coconut -20000 coconut, tender nut, organic manures, 1.2 t of turmeric annually. Products such as CNO, VCO,

and turmeric powder are being marketed. The mutually agreed upon price with minimum 10-15 percent higher procurement price provided to farmers immediately. Produced and marketed 40 T of Kalpa Vardhini for 5 districts 28000 bearing coconut palms with doorstep delivery mode.

Convergence programme on 'Coconut rejuvenation project' with FPO & ICAR CPCRI FFP in co-operative & participation of Pathiyoor Panchayaths Coconut Producers Society and women farmers as a long term program for improving genetic material base by selection of root (wilt) disease free & high yielding mother palms from 19 wards of FFP Pathiyoor Panchayath, establishing community nursery, provided 40 per cent additional price to the respective farmers for seed nuts procured and linking with panchayath Agricultural projects. Mobile App developed for assessing the field activities, procurement details, crop produce position of availability in each locality, performance appraisal of FPO staff.



FPO market outlet



FPO procurement and sales counter

3.8. Outcome studies

3.8.1. Outputs and Outcome of FFP interventions:

The various outputs of Farmer FIRST Program for interventions in the crop modules, horticulture, livestock, natural resource management, entrepreneurship development and value addition

and Integrated Farming System in terms of field visits, training programs, publications, organic inputs & bio fertilizers utilised, soil test based chemical fertilizer utilized, plant protection chemicals, high yielding varieties/hybrid seeds (cereals, millets, oilseeds, spices, pulses, fodder

crops, fruit crops), tools and machineries. The output in each category is furnished below:

I. Field visits: The Cumulative total of field visits was 1255 with an average of 179/year with an average of 12 field visit in pre-FFP period which improved to 179 field visits/year in the post FFP. An average of 15-20 farmers were personally met and interacted for their problem diagnosing, solving and for taking feedback. Thus, a total of 12,000 to 15,000 farmers were personally met by FFP teams at field level for various technical and extension objectives. This resulted in early diagnosis of field problems reduced economic loss, triangulation of field results, weather changes and evolving participatory solution, correcting technology adoption methods in fields, assessing technology effectiveness, confirmation and documenting farmer innovations.

II. Training programs: During the period a total of 204 training programs were organized with an average of 29 trainings per year. There were only 2 training programs being conducted in the pre-FFP. Training programs was organized on-farm mode benefitting 8670 farmers with an average of 1239 farmers per year. A study was conducted to assess the impact of training programs that were conducted for women farmer self-help groups using the Kirkpatrick method of training evaluation. The study found that 86.11% of SHG members participated in the training programs, and 91% of the training participants reported an increase in crop productivity due to the knowledge and adoption of the technologies imparted. Additionally, more than 60% of the participants adopted more than 4 technologies. In terms of skills acquired, 13.3% acquired more than 6 skills, 40.7% acquired 4 to 5 skills, and 43.8% acquired 1 to 3 skills.

III. Publications: The publications of technologies, activities, announcements and success stories included print and mass media including

newspapers, All India Radio and television. The FFP utilized social media like whatsapp, facebook and youtube channel for reaching out to the large mass. The total output in terms of publication are 53 print publications including extension folders, technical bulletins, training manuals, popular article and research papers. The social media include formation of 12 whatsapp group with 751 active FFP participants, the YouTube channel (Farmer FIRST CPCRI channel) and 23 videos of success stories were uploaded with more than 13,300 views and 66 programs relayed through all stations of Kerala state and Lakshadweep of All India Radio and CPCRI FARMER FIRST Face book page with 492 posts on various activities.

IV. Organic inputs & bio fertilizers utilised: The adoption and knowledge of organic inputs among farmers were relatively high compared to other technologies. The figure below displays the quantity of bio-fertilizers and organic inputs provided by FFP. The organic inputs of 16.68 tons were utilized by farmers and women farmers of SHG cultivation across the FFP modules. The data indicates that usage increased from 1.96 tons per year in pre-FFP to 2.38 tons per year in post-FFP, which is a significant improvement. Farmers commonly apply organic inputs such as cow dung, ash, green manure, and bone meal. FFP provided support in establishing Kera probio (ICAR CPCRI technology - a biofertilizer and plant growth promoter) for large-scale production, seven composting units, procurement and marketing of vermicompost, shade-dried cow dung, and enriched organic manures.

V. Soil test based chemical fertilizer use: Chemical fertilizers usage in fields were found to be not as per the recommended dosage, the escalating cost of fertilizers and price fluctuations of farm produces upset the economic balance of farming outcome. The strong proponents of organic farming by several agencies also deter farmers from adopting

the recommended chemical fertilizers. The soil test based fertilizer application was made popular among FFP farmers through 5 ha grid based soil testing campaign and by issuing soil health cards. The CPCRI FFP supported participant farmers/farm women SHG members by providing total of 165.93 tons of chemical fertilizers including urea, super phosphate, muriate of potash, magnesium sulphate, kalpavardhini (customized nutrient mixture of ICAR CPCRI) and coconut mixture. In the pre-FFP period, usage was 8.96 tons per year, which tripled to 23.70 tons per year by 2022-23. Based on soil test results, phosphatic fertilizers were reduced to 20% of the recommended dosage. However, K fertilizers had to be applied 1.5 times more than the recommendation due to an acute shortage in soil test results. The awareness, acceptance, and effective results were demonstrated to the trained farming communities and farmers/women farmer groups. As a result, they paid 40% of the quantity on a payment basis from farmers' cooperative societies with their Aadhar numbers. Hence, the actual quantity of chemical fertilizers used comes to 232.3 tons per year, which is a significant impact of FFP in several modules.

VI. High yielding varieties and hybrid seeds:

Awareness, knowledge and adoption of HYV and hybrids of inter crops, were improved from nil status. The total adoption of HYV seeds and planting materials of various crops (Tubers, fodder, oil seeds, spices, pulses, fruit crops, coconut, paddy etc.) were introduced and popularized through appropriate extension strategies and approaches. The total seeds /planting material of released varieties of crops from Kerala agricultural University, University of Agricultural Sciences, Bengaluru, Andhra Pradesh Agricultural University, Tamil Nadu Agricultural University and several ICAR Institutes across the country was 18354.56 tons per annum. The average use of HYV were 2622 kg per year from no adoption level. This

intervention in crop, horticulture, and IFS modules is a success story of FFP. It has enabled building access to participatory assessment of the suitability of crop varieties, introducing new crops, and spreading them across an entire panchayat in just 2 to 3 years. HYV/Planting materials multiplication groups were formed for horizontal transfer and adoption, and quality seeds were affirmed by farming communities as the critical input for productivity.

VII. Tools and machinery: Mechanization of small farms is critical in the present era of scarcity and high cost of human labour, especially for skilled works like coconut climbing. Hence FFP interventions attempted to introduce and provide skill up gradation in small machineries. The FFP provided 113 small tools and machineries including garden tillers, brush cutters, coconut climbing machines, power operated sprayers, and tools. Custom hiring centre initiated at the behest of FFP funding and managed by the FFP farmer Producer Organization (FPO) and it supports 80 to 130 farmers on an average providing the facilities for farming.

3.8.2. Direct and indirect outcome of FFP interventions:

I. Soil nutrients addition outcome of intensification cropping systems in coconut gardens under FFP interventions:

In the FFP panchayats area wide adoption of crops (HYV/Hybrids) were undertaken by ensuring continued adoption. Good agricultural practices such as incorporating and recycling of organic residues instead of burning was one of the major practices advocated. A total area of 124.4 hectare of area under various crops were taken up for the analysis as shown in Table 37. Soil testing campaigns under the leadership of trained master farmers on 5 ha grid based sampling before and after interventions were done. It was estimated that the

total carbon recycling potential of these crop residues were highest in ginger followed by sesamum, turmeric, ragi, maize and elephant foot yam as indicated in Figure 32.

Table 37: Area under various crops were taken up for the analysis

Sr No.	Crop	Sampled Cropped Area (ha)
1.	Amorphophalus (EFY)	9.4
2.	Turmeric	5.8
3.	Ginger	4.3
4.	Ragi	34.5
5.	Sesame	62
6.	Maize	8.5

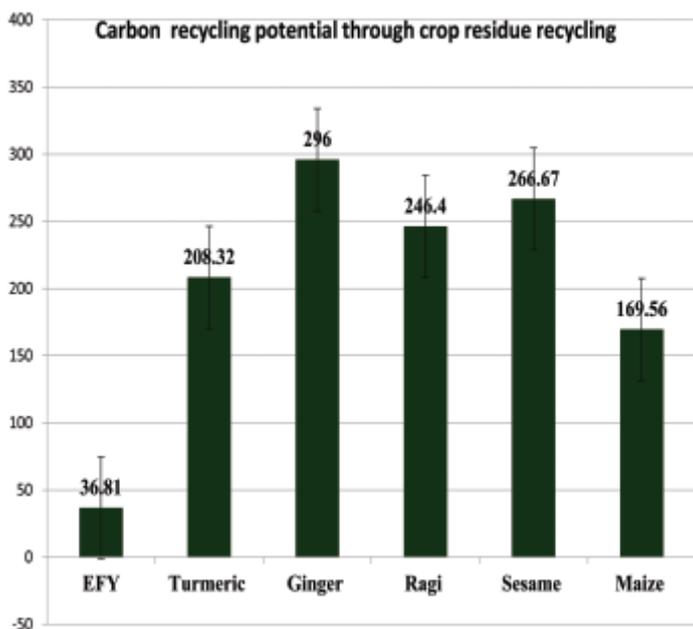


Figure 32: Carbon recycling potential through crop residue recycling

The potential nutrient addition in terms of NPK indicated that turmeric, ginger, ragi and sesamum contributed more nutrients than maize and elephant foot yam. The Figure 33 shows the Potential nutrition addition (kg/ha) through crop residues in FFP interventions. The above figures showed that organic carbon, available P, K, Ca, Mg, Mn and B were significantly changed after the intervention. The Economic equivalent: Rs. 1207 per ha in terms of nutrients was recorded.

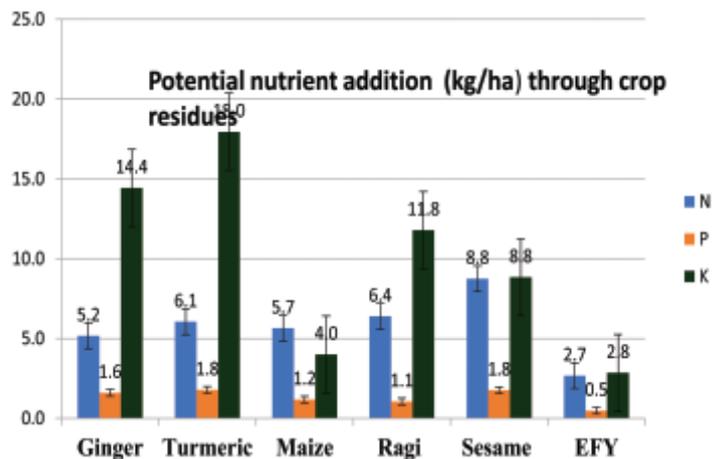


Figure 33: Potential nutrient addition (kg/ha) through crop residues

II. Outcome of FFP interventions among women farmer Self Help Groups (SHGs):

The women farmers of the FFP panchayaths were found to have a landholding size of upto 11 cents (0.04 ha) indicating very low level of land area for farming. The ICAR-CPCRI FFP evolved a land consolidation strategy for bringing out the potential and the apparent resources of women farmers in terms of experience land location specific practical orientation in terms of choice of the crop and post-harvest operations. The major categories of crops cultivated by forming more than 80 women SHGs and in convergence with the MGNREGS program of GOI through local self-government were sesame, tubers, vegetables, millets, and fodder crops.

The total net income of women self-help groups during 2017 was Rs.8.97 lakhs from the adoption of scientific management, high yielding varieties and the extension and technological support from the FFP. According to the data presented in the Tables 38 & 39, it was shown that by the year 2022-23, the total net income of women self-help groups (SHGs) from these crops increased to Rs. 12.85 lakhs. This represents an increase of 43.25% in total net income, as well as an 88.36% increase in income for the individual women group members. These increases are attributable to the FFP MGNREGS convergence interventions involving women SHGs.

Table 38: Total income women group (2017)

Sr. No.	Crop	Groups	Members involved	Rs. in lakh per year per group		
				Gross income	Cost	Net income
1	Sesamum	15	83	7.97	1.59	6.38
2	Tubers	12	78	1.98	0.64	1.35
3	Vegetable	11	92	0.66	0.23	0.43
4	Millets	6	43	0.58	0.51	0.66
5	Fodder	6	30	0.18	0.043	0.15

Table 39: Total income women group (2022-23)

Sr. No.	Crop	Groups	Members involved	Rs. in lakh per year per group		
				Gross income	Cost	Net income
1	Sesamum	11	74	12.12	3.13	8.99
2	Tubers	14	51	1.94	0.38	1.56
3	Vegetable	11	82	1.83	0.29	1.54
4	Millets	8	24	0.91	0.41	0.50
5	Fodder	5	17	0.32	0.06	0.26

III. Outcome of FFP Interventions among women

SHGs: The impact of the FFP interventions among the women farmers were analyzed in terms of number of training programmes attended, economic impact on women farmers in terms of increase in monthly income and savings, extent of adoption of technologies, skills learned from FFP, and improvement in yield of various crops cultivated. The training programmes were designed to cater the needs of the women farmer groups in off campus mode.

Follow up visits, method demonstrations; diagnostic field visits and interactive meetings were done for the training effectiveness. 95 percent of the women farmers adopted more than three technologies after FFP such as High yielding varieties, spacing, chemical fertilizers and organic inputs for plant protection. The productivity or yield improvement in the crops cultivated under FFP as per the women farmers perception indicated that even though 5.56 % perceived Lower yield when compared to pre FFP, majority (94.44%) could get more yield after FFP due to GAP and HYV.

IV. Outcome of IFS interventions in FFP:

The coconut homestead based integrated farming systems (IFS) were followed traditionally with coconut as the base crop and inclusion of intercrops and other farm components to meet the farm family needs, livestock and poultry feeds as well as for marketing to obtain short term and regular farm income. A comparative study was conducted involving a sample size of 40 FFP and non-FFP farmers, each randomly selected to form the study sample for data collection. The results indicated that the average area of the IFS homestead gardens was 0.94 acre (0.38 ha) and 0.61 acres (0.25 ha) among non-FFP farmers. This suggests that all the sampled farmers have marginal land holding sizes. For marginal landholders, IFS is a suitable option for doubling their farm income by integrating various components in an intensive and resource-efficient manner. Interactive farm planning sessions were organized among ten groups, and farm plans were formulated in a participatory mode customized to the individual farmer's needs, resources, aptitude, and attitudes. The interventions and component choices in FFP were as follow:

- Scientific integrated root wilt disease management practices for improving productivity of coconut palms
- Initiated adoption of recent technologies of customized fertilizer mixtures (Kalpa Vardhini and Kalpa Poshak) along with soil and moisture conservation
- One of the component choices in FFP was to implement a cropping system that involves intercropping with high-yielding and hybrid varieties, along with a cafeteria of crops.
- Addition and intensification of farm components like fisheries, poultry, GAP in livestock, Value addition and marketing etc...

Where as in the non-FFP IFS plots the systems comprised of intercrops among coconut and farming components without any farm planning or scientific considerations of integration. The average gross income per hectare of the FFP farmers was Rs.12.55 lakh/year and Rs.4.63 lakh/year for non-FFP farmers, indicating the utility of farm planning and participatory integration of components customized based on farm family needs will lead to doubling of farmers income. The socio-economic variables of participating IFS farmers such as market orientation and social participation were found to be significantly different among the FFP and non FFP farmers particularly in low and high categories (Figure 34). The result indicated that only 12.86% of the FFP farmers were in the low market orientation where as 46.67% of non -FFP farmers fall in that category similar positive change could be noted in the high market orientation category with only 13.33% of non-FFP IFS farmers compared to 57.14% of FFP IFS farmers indicating the impact of FFP interventions in IFS module.

Well-planned extension interventions and strategies can enhance the social participation of farmers, providing them with better access to knowledge, linkages, and interaction. This participation can also enable them to become

members of different groups, actively interact with the local community, and participate more actively in gramasabha, FPOs, and women's groups. The extension interventions of FFP resulted in 55.71% of the FFP IFS farmers in the high-level category, while only 50% of the non-FFP category reached this level. The low category of social participation was evident with only 7.00% among the FFP and 30.00% among the non-FFP (Figure 35).

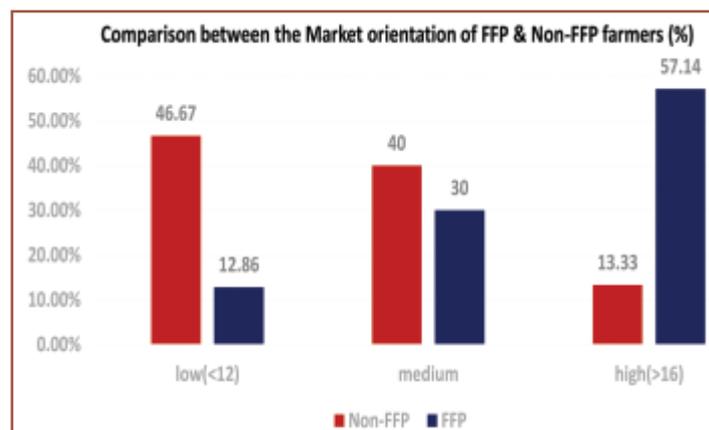


Figure 34: Comparison between the market orientation

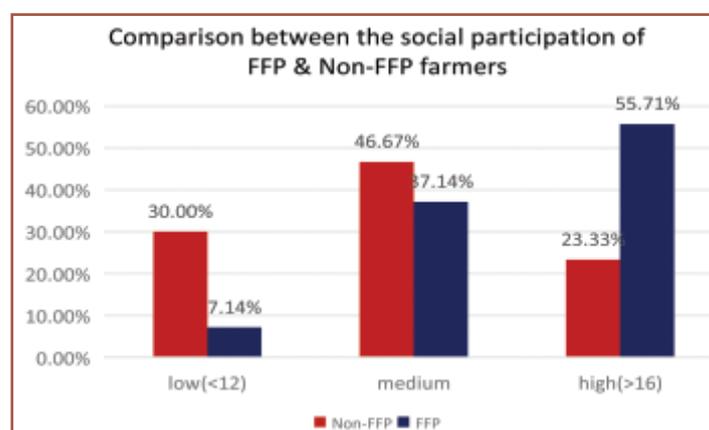


Figure 35: Comparison between social participation

Simpson's Diversity index (SDI) is a measure of the diversity in an IFS plot which takes in account of each species as well as the relative abundance of each species. The diversity in an IFS unit will definitely contribute to the risk resilience of the farmer and study showed that the SDI of the IFS unit of the FFP farmers is 0.55 compared to 0.29 of the non-FFP farmers, this result also pointed out that a scientific integration of diversity in a unit area can

contribute to the income and the confidence of the farm family. An attempt was made to compare the diversity index based on the area of IFS unit; the SDI of the IFS unit with more than 1.00 acre was found to be higher (0.55) than the IFS unit with less than one acre area (0.37).

3.9. Partnership and institution building

In the pursuit of enhanced project efficiency and impact, FFP centre strategically employed the powerful strategy of convergence. Within this framework, this centre forged partnerships with diverse multi-stakeholders, including village panchayats, MGNREGS, Krishi Vigyan Kendras (KVKs), NABARD, the State Department of Agriculture, State Department of Horticulture, State Department of Animal Husbandry, Dairying & Fisheries, KRIBHKO, Forest departments, Department of Health and Family Welfare, Banks, among others. The extent of partnerships with multiple institutions, showcases the breadth and depth of collaborative efforts established by FFP centre to amplify the effectiveness of project activities. The details about Convergence with MGNREGS is given below:

The state of Kerala is characterized by the prosperity of small and marginal land holdings and coconut-based homestead systems. At the national level, Alappuzha district has the lowest per capita availability of land, with 150 inhabitants per square kilometer. This can be compared with the Kerala state figure of 860 per square kilometer and 464 per square kilometer of area. According to the pre-FFP data documentation, women members' access to land for farming is very low or meager. Hence, a shift in the extension approaches for women SHGs was evolved through CPCRI FFP at Pathiyoor. The social approaches used in FFP MGNREGS Convergence are given below:

- Land consolidation of 480 acres from 102 individual farmers' holdings for farming women SHGs in MGNREGS for crop/horticulture/NRM

modules of FFP interventions. The fallow inter spaces in coconut gardens of farmers of respective wards were shared free of cost on a mutual social agreement facilitated by ward members (people's representatives) and women SHG leaders.

- Training programs, linkage with MGNREGS units of the Panchayath, regular and frequent visits, WhatsApp group for problem-solving, method demonstration of each farming unit, support with HYV crop varieties/critical inputs.
- Women SHGs were made partners in participatory evaluation/experimentation of various modules

The major impact of the convergence intervention of CPCRI FFP and MGNREGS in the FFP Pathiyoor was a creation of 72491 additional man days of which more than 95% were women farmers/labourers contributing to an additional wage of Rs.1.9645061 crores compared to the pre FFP period data. There were steady increase in the number of workers, total man days and total wages earned during the convergence period. The total wages emerged from the FFP MGNREGS convergence due to increase in area of 354 ha of additional cultivation of HYV of intercrops /sesamum was Rs.3.01 crores in pre FFP which was increased to Rs. 4.975 crores as per the data published.

3.10. Content mobilization

FFP centre published a total of 22 extension literature of various aspects, which were then distributed among over 20386 farmers. Additionally, seven booklets were prepared and provided to 5810 farmers. To enhance technical communication, 12 WhatsApp groups were created, through which 14670 relevant messages were shared with 751 farmers in the project area. Furthermore, FFP centre developed 29 videos on pertinent aspects for the benefit of the farmers. The FFP centre extended their reach through the

publication of research papers, technical articles, and coverage of technical content in local print media. The project teams from FFP centre collectively published five research papers. All five of them were published in journals with a NAAS rating between 4 and 6. Additionally, a total of 28 technical articles were published in different magazines. Furthermore, local print media provided coverage on various technical aspects, with a total of 93 instances reported in relation to the specific project. Other content mobilization activities are given below:

- **FFP You tube channel :**

(https://www.youtube.com/results?search_query=farmer+first+cpcri) uploaded on success stories and other technological interventions. Total views in you tube – 14.2 K views (450 subscribers). The videos uploaded includes individual farmers success stories, group cultivation and farmer clusters success stories and experience sharing of good agricultural practices for the locations and online training programs organized for the FFP farmers.

- **FFP facebook :**

(<https://www.facebook.com/farmerfirst.cpcri>) Uploaded 29 videos and 601 photos on success stories and other technological interventions of FFP. (772 Subscribed) . Regularly the activities of FFP are being uploaded for sharing the information and for up scaling by other panchayats.

The research papers published details are given below:

Anithakumari P., N. Mahima Mohan, and K.Muralidharan (2021). Impact of training programmes for women farmer groups under Farmer FIRST Programme. Indian research journal for extension education. 21(2&3):8-15

Anithakumari P., Arun Kumar Sit and B. Midhun. (2021). Knowledge integration through 'e-Kalpa'- a cloud based interactive mobile app for coconut farmers. International Journal of Economic Plants. 8(2):109-112

Anithakumari P. and S. Jayasekhar (2019). Leadership and social intelligence of coconut farmer leaders and implications in extension services. Journal of plantation crops. 47 (3) : 158-166

Anithakumari P., Selvamani V., Chandran K.P. and K. Muralidharan (2019). Socio personal dimensions of Red Palm Weevil management of coconut in homestead farming systems. In Book of Abstracts: Outsmarting the red palm weevil. A global challenge, Red Palm Weevil Symposium, International Plant Protection Congress (IPCC 2019). 10-14. November 2019, Hyderabad, India. Pp:9-10

Anithakumari P., Arun Kumar Sit and B. Midhun (2021). Knowledge integration through 'e-kalpa' - a Cloud based interactive mobile App for coconut farmers. International Journal of Economic Plants. 8(2): 109-112B.

3.11. Budget details

The details of budget sanctioned and budget utilized during 2016-23 is given in Table 40.

Table 40: Budget sanctioned and budget utilized during 2016-23.

Year	Budget Sanctioned (Rs. in lakh)	Budget Utilized (Rs. in lakh)
2016 -17	27.30	27.30
2017 -18	37.4250	37.4250
2018 -19	29.28483	29.28483
2019-20	16.49873	16.49873
2020-21	14.54894	14.54894
2021-22	21.50	21.50
2022-23	15.49631	15.49631



Chapter -4

Farmer FIRST Programme of ICAR-National Institute of Animal Nutrition and Physiology, Bengaluru

Farmer FIRST Programme of ICAR- National Institute of Animal Nutrition and Physiology, Bengaluru is implemented at cluster of 5 villages viz., Lekshmidvipura, Timmajanahalli, S. Nagenahalli, Gangasandra and Karnala of Doddaballapur taluk of Bengaluru Rural district in Karnataka since 2016-17.

This chapter covers following points:

- 4.1. Genesis
- 4.2. Profile of adopted villages
- 4.3. Farmers practices vs. technological interventions
- 4.4. Technology assemblage, application and feedback
- 4.5. Enhancing farmer-scientist interface
- 4.6. Combination of technological interventions
- 4.7. Success stories and case studies
- 4.8. Outcome studies
- 4.9. Partnership and institution building
- 4.10. Content mobilization
- 4.11. Budget details



4.1. Genesis

Karnataka state has a total of 86.81 lakh holdings spread across 118.05 lakh hectares of the operated area. Marginal and Small farmers account for 80.41 per cent of the total holdings operating 43.94 percent of the total cultivated area. The gross cropped area was 120.59 lakh hectares. Out of the net area sown, the net irrigated area was 30.39 per cent. Food crops accounted for 77.20 per cent of the gross cropped area. Cereals accounted for 41.65 per cent whereas the share of oilseeds was 12.31 per cent and that of pulses was 21.15 per cent. Among cereals, maize accounted for the largest area (27.86 per cent), followed by paddy (26.37 per cent), sorghum (17.86 per cent), and finger millet (17.01 per cent). In terms of percentage share of the irrigated area to the total area, sugarcane accounted for the highest share followed by paddy. Karnataka is the leading state for horticulture crops with an area of 23.25 lakh hectare. Karnataka ranks first in area under plantation crops with 48.56 per cent of the area under horticulture crops. Vegetables occupy 20.64 per cent, fruit crops occupy 16.68 per cent and spices cover 12.81 per cent of the area. The total value of horticulture produce was worth Rs.46254 crores during 2019-20. Cashew, spices, small onion, small cucumber, coffee and processed products of horticulture were the major exported commodities from the state. Karnataka has rich resources under livestock with 84.69 lakh cattle, 29.85 lakh buffalo, 61.69 lakh goats, 110.51 lakh sheep and 594.95 lakh poultry birds. The state produces 7901000 tonnes of milk, 59994 lakh eggs and 253604 tonnes of meat annually.

In Bengaluru Rural district, agriculture is the main occupation, along with subsidiary enterprises like floriculture, animal husbandry, sericulture, bricks making and garment factories. Field crops are cultivated over 50,000 ha of agricultural land and the major crops are finger millet, maize, redgram, fieldbean, bengalgram, horsegram, groundnut and

sunflower. Fruits like grapes, mango, banana, etc. are cultivated over 10,000 ha. Commercial cultivation of vegetables like tomato, potato, cabbage, chilli, brinjal, Green leafy vegetables is practiced in 6,500 ha. Dairy, backyard poultry and fisheries are generating additional income to the farmers. The soil and climatic conditions are congenial for the cultivation of mulberry, rearing of silkworms, and production of silk, besides other agro-based industries.

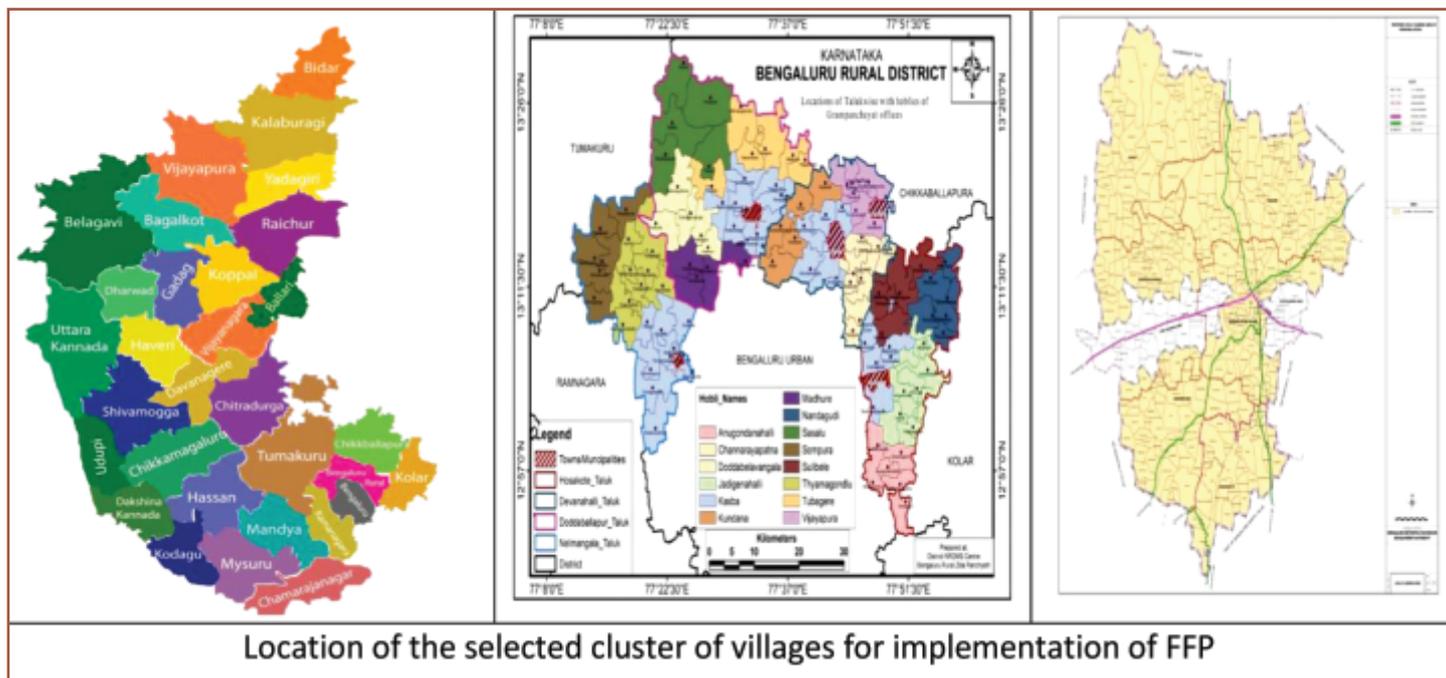
The ICAR-National Institute of Animal Nutrition and Physiology is mandated to conduct basic and fundamental research with respect to animal feed resource management using physiological-nutritional approaches to improve animal productivity and profitability of livestock farmers. As part of extension activities, the institute has Institute Village Linkage Programme (IVLP) under which the scientists of the institute visit the adopted villages for educating farmers on aspects like farm animal nutrition, reproduction, management practices and animal production and for testing and refining the technologies developed at the institute. The institute is popularizing the technologies mainly through Institute Village Linkage programme for the field veterinarians of animal husbandry department, extension officers of milk federations and other governmental and non-governmental agencies. The dissemination is carried out through organizing workshops and interactive meetings of field veterinarians, extension officers, policy makers, planners, feed manufacturers and farmers. Several talks have been delivered highlighting the various technologies, their importance and their impact on improving animal productivity. In addition, the institute carries out an innovative initiative scheme of Mera Gaon Mera Gaurav (MGMG). Under this scheme, groups of scientists are formed and a total of 59 villages are selected within 100km radius to provide farmers with required information, knowledge, advisories, create awareness about the improved agriculture

and programmes & schemes of government related to agriculture and allied sectors on regular basis.

A gap exists in the quality of research output required at the farm level and that being developed. It is also being perceived that the research system should play a pro-active role in reaching to the farmers for getting first hand information, farmers' perceptions, feedback on generated technologies and develop new, more appropriate processes, methodologies and technologies for diverse farm environments. Farmer FIRST project provides a platform of creating linkages, capacity building, technology adaptation and application, on-site input management, feedback and institution building. Project helps immensely to engage scientists to undertake technology application directly in active partnership and blending the knowledge base of farmers. FFP aids in perception change among scientists to realize ground realities and develop technologies as per needs of farming community at large, enhance farmers - scientists' interface and enrich knowledge of all stakeholders.

A surge in demand by farmers about recent institutional technologies and also research system is not getting adequate feedback to plan and conduct demand driven research thereby, a huge gap exists in the quality of research output required at the farm level and that being developed. In response to emerging challenges, ICAR developed the modalities for the Farmer FIRST project for its implementation by ICAR institutes and agricultural universities. Farmer FIRST Programme (FFP) aims at enhancing the production, productivity and income of farmers through farm family approach and also by integrating various enterprises in the farm and ensures recycling of farm wastes and utilizing all the available resources most economically and efficiently.

NIANP Bangalore started FFP project from November, 2016 in a cluster of 5 villages which consists of 650 households of Doddaballapura taluk, Bangalore rural, Karnataka. Participatory Rural Appraisal (PRA) was undertaken by multidisciplinary team of scientists for the selected villages, to collect the baseline data of the village and stakeholders. Under 'Farmer FIRST' programme of NIANP, livestock health related intervention programmes were carried out which brace farmer's upliftment. The selected villages come under Doddaballapura Taluk, Bangalore; which suffered from dearth of water availability, green fodder availability, awareness about livestock health and nutrition, and preventive measures. The baseline data of each individual was carried out through face-to-face interview and group discussions for formulating the required module. Distinct modules were tailored according to the needs of livestock holders. A regular check and follow-up was made on animal fertility and health management which aided in resolving repeat breeding and anoestrous disorders. Area Specific Mineral Mixture (ASMM) was given to increase the fat percent of milk, while to curb lack of availability of green fodder, fodder seeds were provided, imbibed the skills of azolla cultivation and silage preparation techniques were taught. Awareness about quality milk production, lameness and mastitis were campaigned to enhance the importance of quality milk and animal health besides providing them with mastitis kit and rubber mats. Under enterprise module, folks were encouraged to rear goat and grow mushroom for financial independence. There is a need of high-quality animal products in today's world. Ensuring farmers with necessary tools and knowledge of advanced techniques in livestock would help in mitigating the odds and reaching the essential goals.



Location of the selected cluster of villages for implementation of FFP

4.2. Profile of adopted villages under FFP

FFP was carried out in one cluster (5 villages) in Rural Bangalore district of Karnataka. The district comes under the Eastern Dry Zone (Zone-V) of Karnataka and has diversified farming systems. These villages too often suffer from deficit and capricious rainfall conditions and the resultant phenomenon of crop failure. The contribution of horticulture is quite substantial to the economy. The village has considerable tracts under horticultural crops like mango and grapes. Betel vine gardens are also seen in many places. Animal Husbandry is being practiced since generations as an adjunct to agriculture. Cultivable lands are mainly rainfed and dry farming is a characteristic feature of the cluster village. By and large these areas are agriculture oriented area where, ragi is the main crop. The climatic condition is salubrious and very agreeable, it is devoid of extremes but rainfall is meager and has no major river flows, irrigation facilities are also limited. Major crops grown are finger millet, maize, redgram, fieldbean, bengalgram and horsegram while fruits like grapes, mango, banana, etc. are cultivated and vegetables like tomato, potato, cabbage, chilli, brinjal are grown. Dairy, backyard poultry and piggery are generating additional income to the farmers.

Most prevalent livestock found in the selected area was H.F. and Jersey crossbred cattles while only few buffaloes were found however few folk's rear hen, sheep and goat but not on a commercial venture only for domestic purpose. For dairying, naturally available green fodder material, weeds from cropping areas, roadside grasses and debris of cultivated crops are fed as feed. Feeds were also purchased like concentrates, rice husk and groundnut cake. Main source of income for households is from dairying, agriculture followed by fattening of sheep and goat. The major problems found in the village were inclement weather conditions, dry spell which lead to scarcity of water, lack of knowledge on technology about storing green fodder & feeding habits about cattle, preventive measures about animal health management, dearth information about animal house keeping and its maintenance. Rodents were an added troublesome in fodder stock collection. Due to erratic weather condition green fodder availability was meager and problematic, which compelled them to purchase feed at high cost. Total agriculture land availability in these villages is about 1300 acre with a total of 650 households. Brief profile of adopted villages under FFP is given in Table 41.

Table 41: Brief profile of adopted villages under FFP

Names of adopted villages	No. of families covered	Population	Major crops grown	Rainfall (mm)	Major enterprises
Lekshmidvipura, Timmajanahalli, S. Nagenahalli, Gangasandra, Karnala	650	3,184	Ragi, Maize, Redgram and Vegetables	755	Agriculture and Dairying

4.3. Farmers practices Vs technological interventions under FFP

The details of farmers practices Vs technological interventions introduced under Farmer FIRST Project are given in following Table 42.

Table 42: Module wise farmers practices Vs technological interventions

Intervention Category	Before (Farmers Practice)	After (Technological Interventions)
Crop Module	Low yielding varieties of ragi, pigeon pea were commonly cultivated	Improved varieties of Ragi ML 365 and Pigeon pea BRG 5 was introduced.
Horticulture Module	Varieties of vegetables from private companies were being cultivated at higher seed cost. Pest/disease tolerance was not a criteria for selection of varieties and seeds	Improved vegetable varieties such as tomato (Arka Rakshak), chilli (Arka Haritha), beans (Arka Arjun), ridge gourd (Arka Prasanna), okra (Arka Anamika) demonstrated.
Livestock Module	40% of farmers fed mineral mixture only for milking animals. Heifers were not fed with mineral mixture. High incidence of mastitis	NIANP developed Area Specific Mineral Mixture was fed to milch animals California Mastitis Test kit along with SOP and required training was provided to all farmers.
	Only 19 out of 500 farmers produced the green fodder. Others purchased fodder from nearby villages and fed only the available quantity at available times. Most farmers fed dry straw of finger millet every day.	Seeds of CoFS 31, sesbania and agathi were distributed to farmers having irrigation facilities. Three fodder nurseries were developed in the field.
	Mastitis kit: It was not used/known to farmers; affected animals were subjected to curative treatment of mastitis, usually at a cost of Rs 1250/ month. Each time the loss of milk was to the tune of 40-50 litres/ month (Rs.1000-1250/ month) Cement floor/ stone slabs/mud floor without good drainage, which led to the issue of	Mastitis kit: California Mastitis Test kit along with SOP and required training was provided to all farmers. Lameness management protocol with Cattle shed flooring using Cow mats

	laminitis in animals. Only 74 households used cow mats.	along with supplementation of tri sodium citrate @ 10 gm per day for a month was provided to the farmers.
	Services of veterinary doctors were used for AI and repeat breeding was a major challenge.	Fertility management: Services of veterinary doctors were used for AI and repeat breeding was a major challenge. Heifers were unfed, for which supplemental feed along with fertility management protocol were implemented.
	Hand milking was the most common practice. Unhygienic milking hands and utensils were the source of infection for mastitis. Milking machine was used by none.	Milking machine introduced for clean and hygienic milk production and drudgery reduction
IFS Module	Mono cropping	Mixed Cropping + Livestock
Enterprises Module	No mechanisation of dairy farming, Low employment among rural youth	Setting up of custom hiring centre with rural youths.

4.4. Technology assemblage, application and feedback

Under this component, various modules; i.e., crop based, horticulture based, natural resources management (NRM) based, livestock based, enterprise based, and integrated farming systems (IFS) based were planned. The module-wise progress of technology assemblage, application and feedback has been enunciated as below:

4.4.1. Crop based module

The major problems prioritized in the crop based modules were the low level of adoption of high yielding varieties of crops and subsequently low production and income. Soil sample collection was done and samples were analysed, based on which nutrient recommendation and crop planning was done. Accordingly, two improved varieties of ragi variety ML 365 and redgram variety BRG 5 were recommended by experts from NBSS & LUP, RS, Bengaluru and UAS, Bengaluru.

Demonstration of ragi variety ML 365: Ragi

variety ML 365 were demonstrated in 436 ha area covering 381 farmers since 2018-19. Ragi ML 365 gave yield of 29.06 q/ha with net return of Rs.1,21,720 /ha as compared to 23.4 q/ha with net return of Rs. 96,346 /ha under local variety. The year wise number of farmers & area covered, yield and economics is given in following Table 43.



Demonstration of ragi variety ML 365

Table 43: Demonstration of ragi variety ML 365

Year	Farmers (No.)	Area (ha)	Yield (q/ha)		% increase in yield	Economics of Demo (Rs./ha)		Economics of check (Rs./ha)	
			Demo	Check		Gross return	Net return	Gross return	Net return
2018-19	51	45	27.9	24.4	14.34	1,25,438	1,16,504	1,08,946	1,00,811
2019-20	78	82	26.8	24.1	11.20	1,20,493	1,11,559	1,07,607	99,472
2020-21	94	115	29.6	27.1	9.23	1,33,082	1,24,148	1,21,002	1,12,867
2021-22	87	109	29	20.4	42.16	1,30,384	1,21,450	91,086	82,951
2022-23	71	85	32	21	52.38	1,43,872	1,34,938	93,765	85,630
Total/Average	381	436	29.06	23.4	25.86	1,30,654	1,21,720	1,04,481	96,346

Demonstration of redgram variety BRG 5:

Redgram variety BRG 5 was demonstrated in 370 ha area covering 352 farmers since 2018-19. BRG 5 gave yield of 9.62 q/ha with net return of

Rs.1,06476 /ha as compared to 7.06 q/ha with net return of Rs. 60416 /ha under local variety. The year wise number of farmers & area covered, yield and economics is given in following Table 44.

Table 44: Demonstration of redgram variety BRG 5

Year	Farmers (No.)	Area (ha)	Yield (q/ha)		% increase in yield	Economics of Demo (Rs./ha)		Economics of check (Rs./ha)	
			Demo	Check		Gross return	Net return	Gross return	Net return
2018-19	44	30	9	6.9	30.43	1,09,098	98,960	67,778	58,844
2019-20	78	82	9.6	6.8	41.17	1,16,371	1,06,233	66,796	57,862
2020-21	83	90	8.9	7	27.14	1,07,886	97,748	68,761	59,827
2021-22	64	78	9.6	7.1	35.21	1,16,371	1,06,233	69,743	60,809
2022-23	83	90	11	7.5	46.66	1,33,342	1,23,204	73,672	64,738
Total/Average	352	370	9.62	7.06	36.12	1,09,098	1,06,476	67,778	60,416



Demonstration of redgram variety BRG 5

4.4.2. Horticulture based module

The horticultural crops were cultivated mostly as intercrops with main crops and also multiple cropping methods were followed in a contiguous manner. The core hassles identified were the lack of knowledge about HYV crops and its package of practices. In addition, they were unaware of economic importance in the market about horticulture crops. The technologies introduced were HYV's of tomato(Arka Rakshak), beans(Arka Arjun), ridge gourd(Arka Prasanna), okra(Arka Anamika & Arka Nikita), spinach(Arka Anupama), chilly(Arka Kyathi & Arka Harita), bottle gourd(Arka Bahar) and drum stick(PKM1) along with the scientific method of cultivation. The varieties were evaluated through participatory experimentation IIHR vegetable varieties were ranked as most suitable to the local condition with high yield and acceptability. The approach evolved for quality planting material production facilitation by scientists could achieve area spread of new varieties in the following steps.

- Introducing HYV from the ICAR Institutes to FFP.
- Forming social responsible groups comprising agricultural experts, local people representatives, women SHGs for cultivation, progressive farmers and representatives of general public for interventions.
- Technical facilitation by concerned ICAR Institute and FFP team, supervising, culling out diseased, regular field visits, training programmes before and during the activities.
- A MoU with the group to provide quality plant materials free of cost for a area spread to other wards to a maximum of 40 – 50 % of their total harvest.
- The groups initially formed for the further production of planting material and distribute it to other farmers in their own and neighbouring villages.

- The percentage of increase in yield of HYV crops were compared with local varieties, which showed 47.4% increase in tomato, beans, okra, spinach, chilly, bottle gourd showed an increase range between 25 to 27.3%.
- Area under vegetable crops has increased three times over the period of 6 years and income improvement of 1.5 times is observed with Arka Bheem onion variety. An onsite nursery by rural youth for vegetable seedling production is developed
- On an average there was 71.38% of increase in the net returns.

Details of area under vegetable crops and number of farmers growing it is given in Figures 36 & 37.

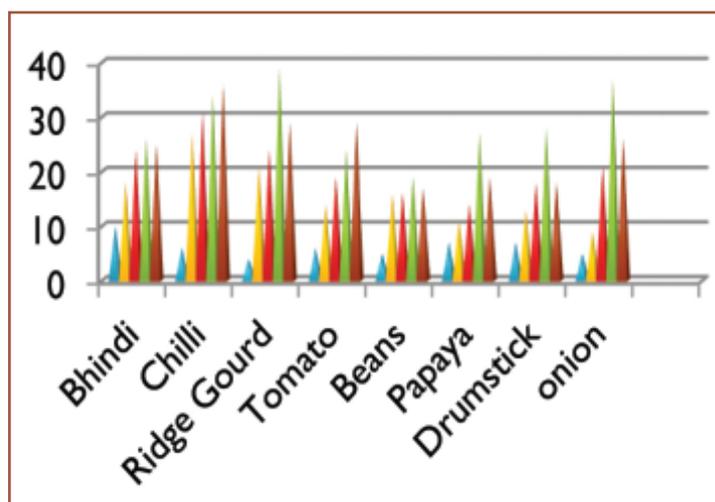


Figure 36: Area under crops (ha)

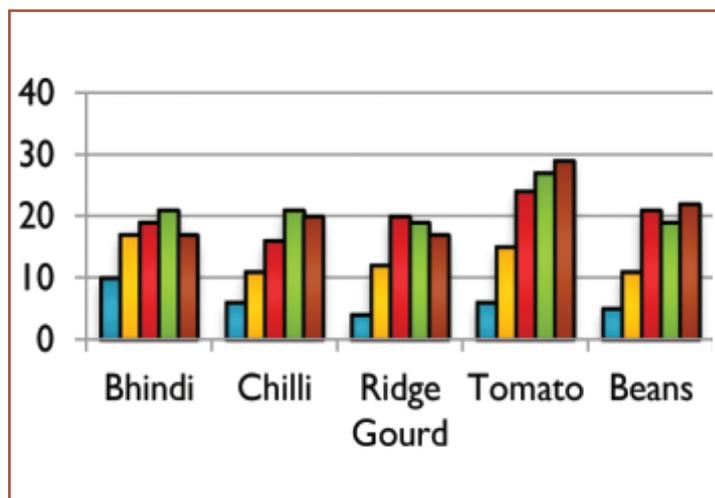


Figure 37: No. of Farmers growing vegetable

Demonstration of beans variety Arka Arjun :

Arka Arjun variety of field beans was introduced, which has demonstrated better performance as compared to local varieties. A total of 53 farmers were benefitted from this intervention covering an area of 15.5 ha and with an average net income of

Rs. 95338 /ha. This variety was widely accepted for its better yield and higher resistance to pests and diseases. The year wise number of farmers & area covered, yield and economics is given in following Table 45.

Table 45: Demonstration of beans variety Arka Arjun

Year	Farmers (No.)	Area (ha)	Yield (q/ha)		% increase in yield	Economics of Demo (Rs./ha)		Economics of check (Rs./ha)	
			Demo	Check		Gross return	Net return	Gross return	Net return
2017-18	9	1.4	31.3	26	20.38	1,02,378	91,811	96,785	87,871
2018-19	15	5	32.5	27.4	18.61	1,04,576	94,009	99,126	90,212
2019-20	5	0.56	33.4	23.4	42.73	1,05,780	95,213	97,890	88,976
2020-21	5	1	32.5	24	35.41	1,04,600	94,033	91,690	82,776
2021-22	7	4	34	27.1	25.46	1,12,398	1,01,831	1,02,382	93,468
2022-23	11	3.4	31.6	24.8	27.41	1,05,700	95,133	99,150	90,236
Total/ Average	53	15.36	32.55	25.45	28.33	1,05,905	95,338	97,837	88,923



Demonstration of beans variety Arka Arjun

Demonstration of ridge guard variety Arka Prasanna :

Arka Prasanna variety of ridge gourd was introduced, which has demonstrated better performance as compared to local varieties. A total of 55 farmers were benefitted from this intervention covering an area of 35.3 ha and with an average net income of Rs. 147349 /ha. This variety had long and juicy fruits, which was widely accepted by the farmers. This had a horizontal spread to 5 nearby villages covering 164 farmers. The year wise number of farmers & area covered, yield and economics is given in following Table 46.



Demonstration of ridge guard variety Arka Prasanna

Table 46: Demonstration of ridge guard variety Arka Prasanna

Year	Farmers (No.)	Area (ha)	Yield (q/ha)		% increase in yield	Economics of Demo (Rs./ha)		Economics of check (Rs./ha)	
			Demo	Check		Gross return	Net return	Gross return	Net return
2017-18	12	6.9	69	61	13.11	1,47,892	1,32,980	1,27,800	1,15,910
2018-19	14	7.6	68.5	60.3	13.59	1,39,230	1,38,833	1,17,040	1,05,150
2019-20	7	2.37	66	61.8	6.79	1,92,300	1,78,300	1,25,320	1,13,430
2020-21	6	4	67.3	60.8	10.69	1,56,481	1,34,600	1,47,400	1,35,510
2021-22	9	8.9	76	65	16.22	1,83,450	1,64,230	1,13,230	1,01,340
2022-23	7	4.5	64.6	58	10.61	1,58,520	1,35,150	1,45,000	1,02,500
Total/Average	55	35.3	68.56	61.15	11.83	1,62,979	1,47,349	1,29,298	1,12,307

Demonstration of okra variety Arka Anamika : Arka Anamika variety of ladies finger was introduced, which has demonstrated better performance as compared to local varieties. A total of 40 farmers were benefitted from this intervention covering an area of 13.8 ha and with an average net income of Rs. 47263/- per ha. This variety had long

fruits and was easy to harvest, which was widely accepted by the farmers. This had a horizontal spread to 5 nearby villages covering 74 farmers. The year wise number of farmers & area covered, yield and economics is given in following Table 47.

Table 47: Demonstration of okra variety Arka Anamika

Year	Farmers (No.)	Area (ha)	Yield (q/ha)		% increase in yield	Economics of Demo (Rs./ha)		Economics of check (Rs./ha)	
			Demo	Check		Gross return	Net return	Gross return	Net return
2017-18	7	1.9	14	11	27.3	47,610	38,686	28,900	22,394
2018-19	9	3	15.3	12.3	27.2	56,189	47,265	37,850	31,344
2019-20	4	0.87	16.8	13.2	26.3	72,500	63,576	47,800	41,294
2020-21	5	1.4	14.5	11.6	26.1	67,250	58,326	39,100	32,594
2021-22	6	1.8	13.8	10.1	25.9	67,935	59,011	45,250	38,744
2022-23	9	3.6	12.8	10.8	27.3	25,640	16,716	21,600	15,094
Total/Average	40	13.8	14.5	11.5	26.7	56,187	47,263	36,750	30,244



Demonstration of okra variety Arka Anamika

4.4.3. Livestock based module

The foremost constraints of livestock was green fodder availability all the year around, high feeding cost, rural folks were unaware of preservation techniques of green forage, low fat percentage in milk, lameness, repeat breeding and mastitis. Henceforth, the technologies were implemented to combat these issues and raise the income of farmers. Cow mats were distributed to reduce lameness which accounted for 62.5% of reduction in veterinary expenses. While Animal Health & Fertility Management were carried in regular intervals to treat repeat breeders along with normal health check-up of animals, 75% of repeat breeding animals were completely cured by regular treatment. Area specific mineral mixture was given to upsurge fat level in milk which attributed for 2.5% increase in milk yield. California Mastitis Kit (CMT) was provided to keep a check on occurrence of mastitis since the first stage along with it tri-sodium and pre & post dip were given to control mastitis as a precautionary measure, where, all these efforts have accrued for 83% reduction in veterinary expenses. A COFS-31 of multi-cut variety fodder



Demonstration of Fertimin

Demonstration of mastitis management: Under mastitis management, mass screening of animals were conducted to identify the affected animals and a multi strategic approach was used targeting milch animals as well as dry animals. A total of 256 animals of 121 farmers were covered resulting into

seeds was introduced among farmers along with preservative technique like silage and growing of hydroponics using locally available materials and azolla was given to increase the yield of milk. All these collective efforts has aided in complete economic facelift among dairy farmers.

Demonstration of Animal Health & Fertility Management:

A technology for improving reproductive efficiency in dairy animals “FERTIMIN PLUS” was developed in Participatory Technology Development mode, which has shown more than 90% results. A total of 129 farmers and 149 animals were covered under Fertimin Plus technology intervention, which was widely adopted by all the farmers due to which conception improved by 66.7 % giving additional net return of Rs. 38200 per animal. There is a high demand for the technology and efforts are being made to identify a group of 5-6 youth at the village level, to whom technology can be transferred and they can take up for sustained production and supply for the farmers.



additional income of Rs. 19800 per animal and technology has been taken up by milk societies and the horizontal spread of 7 villages has been reported. There is 81% technology adoption in mastitis management practices.



Demonstration of mastitis kit

Demonstration of mineral nutrition: The Area Specific Mineral Mixture developed by the institute has been given to 109 animals covering 103 farmers, and it has resulted in milk yield improvement by almost a litre as well as it has

positive effect on correcting reproductive disorders in animals with additional net return of Rs. 15980 per animal. The technology has reached more than 100 farmers covering about 1254 animals to nearby villages.



Demonstration of mineral nutrition

Demonstration of lameness management: Under this module, animals were screened on ass scale to identify problems, awareness campaigns and demonstrations were organized frequently. Individual animals were followed up for incidence and frequency of lameness and reproductive issues. Critical inputs provided include rubber mats, biotin and Zinc Sulphate. Farmer benefitted an annual Rs. 24000 savings on veterinary expenditure and time saved in cleaning sheds of 60 minutes/day.



Demonstration of cow mat

Demonstration of HACCP based quality milk production: Under this module, 852 animals of 652 farmers were screened on large scale to identify problems, awareness campaigns and demonstrations were organized frequently and a

customised QMP kit was developed and farmers were trained to use them. Critical inputs provided include QMP Kit, Tri sodium citrate, anti biotics and neem oil. Milk samples of animals were tested regularly for its quality and microbial load.



Demonstration of QMP kit

Demonstration of fodder production: An area of 67 acres and 75 farmers were covered under fodder production module. Co-FS 29, Co-FS 31 and a few fodder trees were introduced. The technology has

spread to about 1500 farmers in nearby 6 more villages. It has given a net return of Rs 13565 /annum/farmer.



Demonstration of improved fodder

4.4.4. NRM based module

The major problems in this module were unscientific nutrition management in farming, silted or unused ponds in homesteads and water scarcity for drinking purpose or agriculture due to absence of water conservation which is very critical in this clayey mixed, loamy skeletal and rocky land tract of Doddaballapura district. The technologies demonstrated in this module were soil test based

nutrition in the whole panchayath, homestead pond reclamation and revival for water conservation and pond fish culture for increased income and quality proteins for diet of households. Soil sample collection was organized for nutrient check in soil. Soil health card were prepared and given to farmers who were not having it. To reduce soil erosion during rainy season soil conservation through bund cultivation method was followed which has abetted

to 62 farmers in the area covering 12 ha of agricultural cultivable land.

A few crops such as Marigold, Sun hemp, cow pea etc., were planted along the bunds so as to reduce soil erosion and retain moisture. It has helped to improve soil water holding capacity over a period of 4 years of time. An area of 27 acres of fallow land was able to bring under cultivation as soil moisture



Black soldier larvae technology

4.4.5. Enterprise based module

The enterprise module was introduced to empower rural inhabitants economically and to reduce the drudgery faced while milking and also as an employment opportunity for youth. 70 farmers were given mushroom cultivation training at IIHR, out of which 49 families are practicing cultivation of mushroom with economic returns about Rs. 2100 per month and annually about Rs. 25,200. As the area is near to metropolitan city marketing, demand and sales were comparatively good. Two trainings were organized for a group of 53 farm women each and critical inputs were provided. They were formed two groups and an arrangement for procurement of mushroom packets of 200 gm each was created with a few retailer outlets in the nearby places.

status improved. Waste management technology was transferred among women for preparing organic manure through waste decomposition. Black soldier larvae technology was used in collaboration with NBAIR, Benaguru for waste decomposition. A training and demonstration for the same was organized at the field.



Demonstration of waste decomposition

Door step delivery services of milking machine were given by youth for which they charge a very subtle fee, it not only reduced the drudgery but also economically empowered youths in the village. By mutual consent of each farm families milking time was fixed. It covers around 54 dairy families with income around Rs.7,000 per month and Rs.84,000 annually. Use of milking machine and chaff cutter was not practiced by farmers prior to interventions. After successful introduction of milking machine and chaff cutters, now 31 farmers have purchased milking machines and 11 farmers have purchased chaff cutters.



Demonstration of milking machine

4.4.6. Integrated farming systems (IFS) module

Planned adaptation is essential to increase the resilience of agricultural production to climate change. Management practices that increase agricultural production under adverse climatic conditions also tend to support climate change adaptation because they increase resilience and reduce yield variability under variable climate events. Under climate resilient farming 10 farming families were covered, due to intervention there was

an income surge of Rs.11,260 per month. Before intervention annual income was only about Rs. 87653 but after intervention it was around Rs. 114531. Some of the practices that were followed was in-situ moisture conservation, residue incorporation instead of burning, water harvesting and recycling for supplemental irrigation, growing drought tolerant varieties, water saving technologies, location specific agronomic and nutrient management, improved livestock feed and feeding methods.



Intercrop based IFS model



Dairy based IFS model

4.5. Enhancing farmer-scientist interface

Under this component, various capacity building programmes and extension activities organised by FFP centre for enhancing farmer-scientist interface are given below:

Capacity building programmes: Thematic area wise capacity building programmes organized

under FFP are presented in Table. Farmers empowerment was done through organization of 174 capacity building programmes under different thematic areas related to agriculture and allied sector and trained 3108 farmers. Thematic area wise number of programmes and participants is given in the Table 48.

Table 48: Thematic area and institute wise capacity building programmes organized under FFP

Thematic area	Total	
	Programmes (No.)	Farmers (No.)
Capacity building and group dynamics	17	398
Crop production	13	334
Entrepreneurship development	12	239
Farm implements	10	105
Livestock production and management	62	1072
Natural resource management	8	110
Nutrition security	0	0
Plant protection	14	262
Processing and value addition	0	0
Production of inputs at site	10	105
Soil health and fertility management	16	255
Women empowerment	12	240
Total	174	3108



Capacity building programme

Extension activities: To create more awareness among farmers in agriculture and allied sectors, different extension activities were organized by the institute which are presented in Table. A total of

771 extension programmes were organized by FFP institutes with the participation of 13492 farmers. Extension activity wise number of programmes and participants are given in Table 49.



Animal health camp

Table 49: Extension activities organized by FFP institutes

Extension activity	Total	
	Programmes (No.)	Farmers (No.)
Advisory Services	440	4213
Celebration of important days	23	1059
Diagnostic visits	63	896
Exhibition	12	622
Exposure visits	0	0
Ex-trainees Sammelan	8	404
Farm Science Club	4	98
Farmers' seminar/workshop	8	324
Field Day	28	970
Film Show	0	0
Group discussions	35	694
Kisan Ghosthi	16	610
Kisan Mela	6	658
Method Demonstrations	44	890
Plant/animal health camps	84	2054
Total	771	13492

4.6. Combination of technological interventions

The technology combinations shown in Table 50 with six groups provided interesting features. It showed that highest income could be realized in combinations of different enterprises. Year wise net income (Rs./family/year) under different

combinations of technological interventions is given in Table 51. A total of 650 families were covered under all the interventions and the average net income has changed across all the five groups by about 76%. Out of 650 farmers, income has been doubled for 159 farmers.

Table 50: Change in net income of farm families under different combinations of technological interventions

Sl. No.	Combination of Enterprises	Farm family (No)	Net income (Rs/farmer/year)(2017)	Net income (Rs/farmer/year)(2023)	Change %
C1	Mineral Nutrition+ Mastitis Kit+ Cow mats	151	72689	124612	71.4
C2	Fodder + Mastitis Kit+ Cow mats	147	118147	208045	76
C3	Ragi/Red Gram +Fodder+ Mineral Nutrition+ Mastitis Kit+ Cow mats	224	171398	279014	62.8
C4	Vegetables+ Mineral Nutrition+ Mastitis Kit	66	197892	317560	60.5
C5	Vegetables+ Mineral Nutrition+ Mastitis Kit+ Cow mats + Fertility Management	55	260083	516423	98.6

Table 51: Year wise change in net income (Rs./farmer/year) of farm families under different combinations of technological interventions

	Combination of Enterprises	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
C1	Mineral Nutrition+ Mastitis Kit+ Cow mats	72,689	76,456	82,347	98,723	1,09,874	1,24,612
C2	Fodder + Mastitis Kit+ Cow mats	1,18,147	1,23,089	1,26,786	1,46,978	1,76,256	2,08,045
C3	Ragi/Red Gram +Fodder+ Mineral Nutrition+ Mastitis Kit+ Cow mats	1,71,398	1,98,641	2,01,876	2,34,904	2,48,021	2,79,014
C4	Vegetables+ Mineral Nutrition+ Mastitis Kit	1,97,892	2,18,078	2,34,046	2,69,189	2,89,143	3,17,560
C5	Vegetables+ Mineral Nutrition+ Mastitis Kit + Cow mats + Fertility Management	2,60,083	2,89,175	3,56,890	4,56,189	4,98,123	5,16,423

C1. Combination of technological interventions of mineral nutrition, mastitis kit and cow mats: The average annual net income per farmer of the 151 farmers increased from Rs. 72689 in March 2018 to Rs. 124612 in March 2023 due to the combination effect of mineral nutrition, mastitis kit and cow mats (Figure 38). Following are the contributing factors;

- Introduction of mastitis kit has resulted in reduction in number of milk loss days by 4, resulting in avoidance of Rs. 1250 income loss per month, due to mastitis. Additionally, average reduction in veterinary expenses per month was Rs. 750 in this case, resulting in additional income of Rs. 2000 per animal per month. The added cost in this intervention was Rs. 175 per animal per month.
- Introduction of cow mats for lameness management has resulted in additional benefit of Rs. 2900 per animal per month with additional expenses of Rs. 225 per animal per month. The advantages of intervention include reduction in veterinary expenses, correction of reproductive issues and drudgery reduction in cleaning the premises.
- Introduction of fodder (green fodder, fodder trees etc.) resulted in increase in number of farmers growing fodder from 41 to 147 in the villages. The area under fodder expanded from 14 acres to 75 acres.
- Additional availability of fodder resulted in reduction in cost involved in procurement of

fodder for Rs. 2100 per animal per month. The additional returns from fodder cultivation were Rs. 2325 per animal per month, but with an additional expense of Rs. 475 per month

- The promotion of green fodder resulted in timely availability of quality fodder, and excess fodder was converted to silage and stored for lean period
- Mineral mixture feeding lead to increase in milk yield, milk fat content and reproductive performance of the animal.
- Use of mastitis detection and treatment kit reduced the incidence of sub-clinical mastitis by 37% (71 out of 192 cow got benefitted). The overall milk quality (reduction in Somatic Cell Count in milk) improved by 50% over 3years period.
- Additional income through Milk Yield Increase- @ 1.0 litre/day/animal-Rs. 9000 by feeding Mineral mixture
- Cow mats resulted in correction of infertility issues in 55 animals, who got conceived, leading to additional gain of average 300 milch days.
- Gain due to mastitis, Rs.15000/animal/yr, 5 days milk days and reduction in veterinary expenses of Rs.9000/animal/yr. Total income by introduction of mastitis kit is Rs.24000/yr.
- Net income by introduction of cow mats, Rs. 34800/yr due to reduction in Veterinary expenses, correction of reproductive issues, time and drudgery reduction in cleaning.

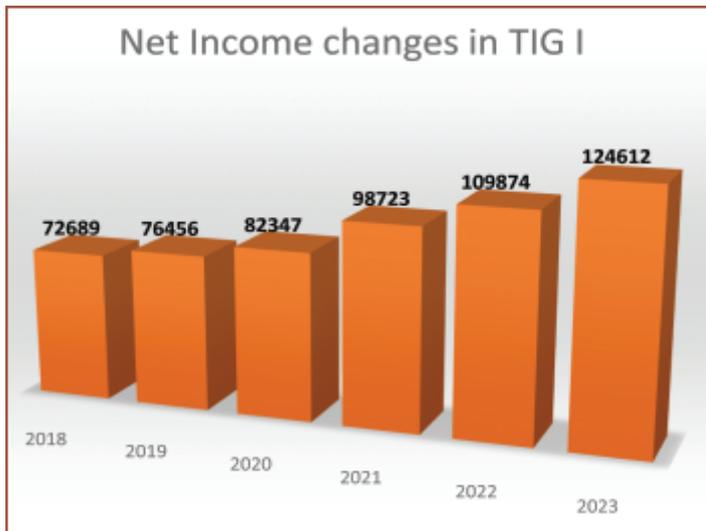


Figure 38: Change in net income(Rs./farmer/year) of farmers with combination of mineral nutrition, mastitis kit and cow mats

C2. Combination of technological interventions of fodder, mastitis kit and cow mats :

The average annual net income of 147 farmers, increased from Rs. 118147 in March 2018 to Rs. 208045 in March 2023 due to the combination effect of fodder, mastitis kit and cow mats (Figure 39). Usage of cow mats by farmers increased from 93 to 247, few of them procuring the cow mats on their own after seeing the positive results of the intervention. Following are the contributing factors,

- There was a 50% decline in number of incidence of subclinical mastitis from 4 to 2 times, every quarter and reduction in 37% in number of animals getting mastitis infection.
- The overall quality of milk poured at the society was improved, with 50% reduction in Somatic Cell Count (SCC) over the three years of intervention.
- The intervention of cow mats has resulted in correction of fertility issues (repeat breeding) in 37 animals, who got conceived, leading to additional gain of average 300 milch days.
- There is a visible impact in terms of milk quality, as measured by SCC, Electrical conductivity of milk and microbial load. The cleanliness in animal shed and premises improved considerably, as measured by the cleanliness score for the animal shed premises.

- In case of mineral mixture feeding, net returns (after deducting cost of feeding mineral mixture) is Rs 7700 per animal per month, leading to net additional benefit of Rs. 600 per animal per month. This is in terms of additional milk yield and improvement in milk fat content, apart from improvement in reproduction performance of animal.
- Reduction in fodder procurement cost Rs.25200/yr/animal and added return to household by selling fodder Rs. 27900/yr/animal by spending Rs.5700/ yr/animal on cultivation, transportation, etc.
- 3 fodder and 4 tree fodder nurseries developed in village for on site production of quality fodder slips and saplings. 1Kg of hydroponic fodder feeding by reducing 0.1Kg Concentrate and 1Kg Green fodder. In total hydroponic fodder and azolla unit reduces the cost of feeding. Net returns- 3,000 (Market value of extra green fodder produced).
- Save in loss due to mastitis, Rs.15000/animal/yr, 5 days milk loss due to mastitis and reduction in Veterinary expenses Rs.9000/animal/yr. Total income by introduction of mastitis kit is Rs.24000/yr.
- Net income by introduction of cow mats, Rs. 34800/yr due to reduction in Veterinary expenses, correction of reproductive issues, time and drudgery reduction in cleaning.

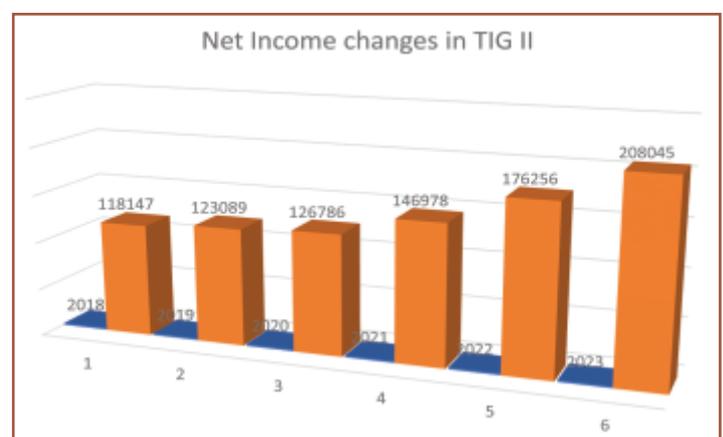


Figure 39: Change in net income (Rs./farmer/year) of farmers with combination of fodder, mastitis kit and cow mats

C3. Combination of technological interventions of ragi/pigeon pea, fodder, mineral nutrition, mastitis kit and cow mats:

The average annual net income of the 77 farmers increased from Rs. 171398 in March 2018 to Rs. 279014 in March 2023 due to the combination effect of ragi/pigeon pea, fodder, mineral nutrition, mastitis kit and cow mats (Figure 40). Following are the contributing factors,

- Introduction of cow mats has resulted in correction of repeat breeding issue in 18 animals, which got conceived, leading to additional gain of average 300 milch days.
- Area under fodder crops expanded from 12 acres to 27 acres in this case. Additionally 4 fodder nurseries were developed in the village, for onsite production of quality fodder slips and 3 fodder tree nurseries were developed in the villages.
- Introduction of hydroponic fodder unit and azolla helped in reducing the cost of feeding. For each 1 kg of hydroponic fodder, 0.1 Kg of concentrate and 1 Kg of green fodder can be reduced, leading to net cost reduction of Rs. 4.5 per Kg of hydroponic fodder fed.
- Introduction of ragi variety ML 365 helped in increasing yield and net returns as compared to local varieties. The average net returns were Rs. 30,000 per ha, as compared to Rs. 14,000 in case of local variety.
- Introduction of pigeon pea variety BRG 5 helped to increase crop yield as well as stover yield, as compared to local variety.
- Average net income of ragi variety (ML-365, Rs.30,000/ha) is more compared to Local variety (Rs.14,000/ha). Pigeon pea variety (BRG 5) increases crop and stover yield compared to local variety.
- 3 fodder and 4 tree fodder nurseries developed in village to on site production of quality fodder slips and saplings. 1Kg of hydroponic fodder feeding by reducing 0.1Kg Concentrate and 1Kg

Green fodder. In total hydroponic fodder and azolla unit reduces the cost of feed. Net returns-3,000 (Market value of extra green fodder produced).

- Additional income through Milk Yield Increase- @ 1.0 litre/day/animal-Rs. 750. by feeding Mineral mixture
- Cow mats use has led to the Correction of repeat breeding issue in 18 animals, leading to an additional calf in a year.

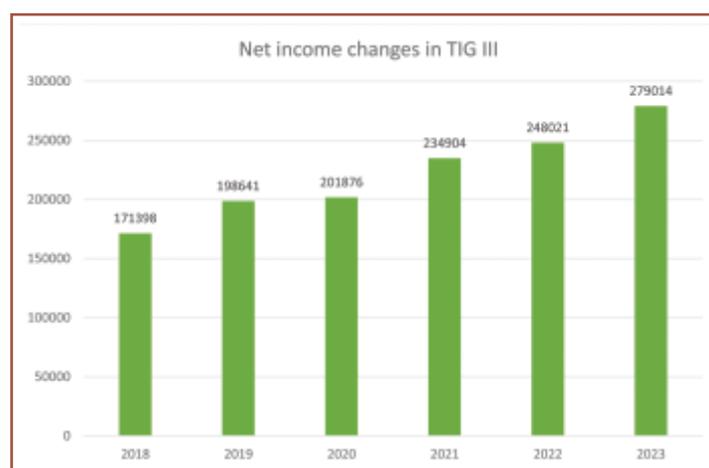


Figure 40: Change in net income (Rs./farmer/year) of farmers with combination of ragi/pigeon pea, fodder, mineral nutrition, mastitis kit and cow mats

C4. Combination of technological interventions of vegetables, mineral nutrition and mastitis kit:

The average annual net income of the 66 farmers increased from Rs. 197892 in March 2018 to Rs. 317560 in March 2023 due to the combination effect of mastitis kit, mineral nutrition and vegetables (Figure 41). Following are the contributing factors,

- Number of farmers growing vegetables has increased from 21 to 66 in the villages
- Increase in area under vegetables: from 2.5 acres to 12.5 acres in Onion, Tomato and Drumstick
- Increase in farm income by changing crops: Rs. 37,000 from Ragi crop/ha/season, Rs. 92000 from Onion crop in same area. Rs. 81000 from Ridge Gourd and Rs.96000 from Tomato and Rs. 1.2 lakhs from Drumstick
- On site nursery for seedling production of vegetables established and 3 rural youths

attracted towards seedling production in the village.

- Increase in area under vegetables: from 2.5 acres to 12.5 acres in Onion, Tomato and Drumstick
- Several farmers under this group has changed their crop from field crops to horticultural crops, which led to increase in their income. However, availability of irrigation facility was necessary for changing the crops, which acted as a limiting factor for many of the farmers.

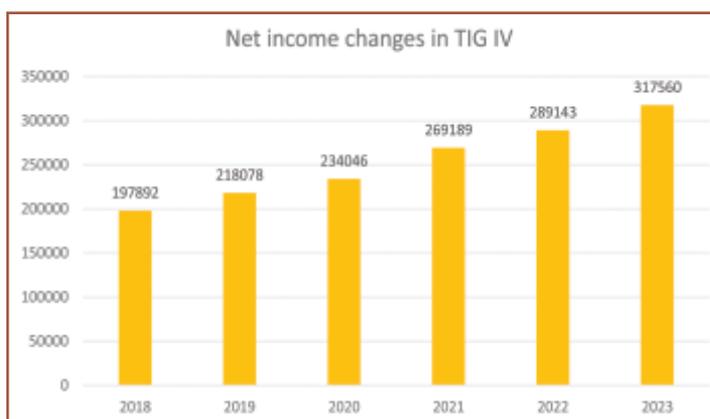


Figure 41: Change in net income (Rs./farmer/year) of farmers with combination of vegetables, mineral nutrition and mastitis kit

C5. Combination of technological interventions of fertility management, vegetables, mineral nutrition, mastitis kit and cow mats: The average annual net income of the 55 farmers increased from Rs. 260083 in March 2017 to Rs. 516423 in March 2022 due to the combination effect of cow mats, mastitis kit, mineral nutrition, fertility management and vegetables (Figure 42). Following are the contributing factors,

- Total 114 animals affected by reproductive disorders, out of which 106 cases were resolved in one time treatment and 90 % of the repeat breeding and anoestrous disorders solved in single intervention
- One missed cycle is equals to 21 milk days of an animal and calf loss of Rs. 6,000 and one early calving leads to additional gain of average 300 milch days.
- 90 % of the repeat breeding and anoestrous

disorders solved in single intervention

- One early calving leads to additional gain of average 300 milch days.
- The Fertimin Plus technology developed under the project has benefitted many dairy farmers, to bring the animal into heat and to get it conceived, leading to reduction in veterinary expenses as well as resolving the reproductive issues in animals.

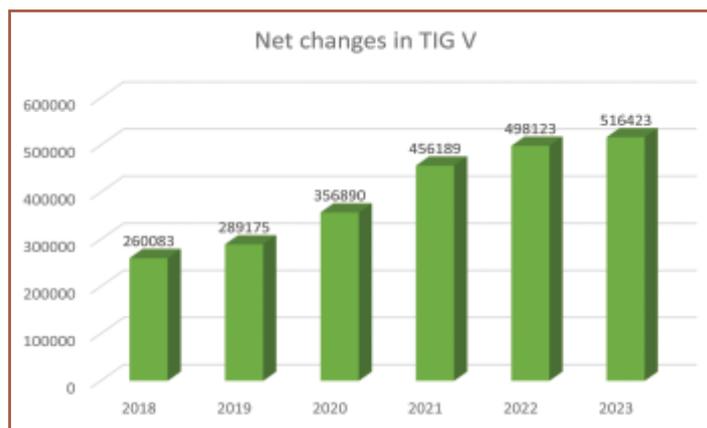


Figure 42: Change in net income (Rs./farmer/year) of farmers with combination of fertility management, vegetables, mineral nutrition, mastitis kit and cow mats

Other than above intervention groups, attempt have been made to calculate the changes in net income as per farmer categories and details are given in Table 52. There is a positive change in the net income of small medium and large farmer categories. The changes are significant in small farmer category.

Table 52: Farmer categories and changes in net farm income

Farmer Category	Net income (Rs./farmer /year) 2016-17	Net income (Rs./farmer /year) 2022-23	% Change
Small Farmer	43000	96400	124
Medium Farmer	89000	119500	34.3
Large Farmer	272000	478000	75.7

Other than farm income changes, data was analysed to see the social changes that has happened among the farm women and it was found that there is significant improvement in access to technology, adoption of technologies and social participation among farm women (Table 53).

Table 53: Social change among the farm women

Farmer Category	2017-18	2022-23	% Change
Net Income (Rs/farmer/year)	29000	74000	155
Access to technology (%)	23	89	66
Adoption level (%)	41	94	53
Social Participation (%)	30	90	60

The data below was obtained from the cooperative milk societies in the adopted villages, and it can be seen that milk production has improved considerably and it can be taken as an indicator of

impact of interventions on milk yield of animals, whereas the number of farmer members pouring milk remained the same over the period (Tables 54 & 55).

Table 54: Annual milk poured in Society

Name of Society	Annual Milk Poured (Litre)				% Increase (2018-22)
	2018-19	2019-20	2020-21	2021-22	
Lakshmidvipura	2,40,302	2,51,870	2,59,147	2,97,516	24
S Nagenahalli	1,70,270	2,28,007	2,16,068	2,89,305	70
Thimmajanahalli	28,929	1,09,126	1,07,303	1,19,038	311

Table 55: No of farmers pouring milk in Society (2017-21)

Name of Society	No. of Farmer Members			
	2017-18	2018-19	2019-20	2020-21
Lakshmidvipura	73	77	77	72
S Nagenahalli	95	97	106	106
Thimmajanahalli	22	25	26	29

4.7. Success stories and case studies

I. Quality milk production: Livestock based farming system in small and marginal holdings in continuous basis. The animals were kept in highly unhygienic conditions. The housing facilities were not standard and cleaning of the premises was not done regularly. The milking vessels were not cleaned properly. The personal hygiene of the milker was also not taken care of before milking. These conditions lead to drudgery for farm-women as most of the milking operations were managed by them. There was very high occurrence of mastitis (clinical and sub clinical) upto 74% among the 600 animals screened, leading to fibrosis and complete black out of udder and not yielding milk. Milk

samples screened had shown high somatic cell count and microbial load. Thus, animals became less productive causing considerable economic loss to the farmer.

To improve the quality of the milk produced and to enhance livestock production performance, a need based Quality Milk Production protocol program was designed by the team, which is in line with standard HACCP protocols for quality milk production. Total of 500 households were covered under this intervention. The method used for implementing this technical intervention was conducting specialized training sessions for selected trainer farmers apart from mass awareness campaigns on importance of quality milk

production and various clean milk production practices. Contact farmers were identified for technology follow up and spread. Demonstration of clean milk production practices was carried out in different time periods. A quality milk production kit was introduced. The milk samples were analysed for clinical and sub clinical mastitis as well as somatic cells at regular intervals (pre intervention, throughout the intervention and post intervention period). Curative treatment of mastitis was done on identified clinical and sub clinical cases, through administration of tri sodium citrate along with follow up calls on weekly basis.

The somatic cell count of the milk samples were



reduced by 27% and incidence of mastitis has reduced by 50% in the animals. This led to reduction in incidence of rejection of milk by cooperative society and a reduction in costs involved in veterinary medicines and fee payment towards doctor. The hygienic conditions of the animal housing premises have improved considerably. The intervention has helped in reducing the veterinary expenses by Rs. 600 per month per animal and less incidence of mastitis has impacted in avoiding a production loss of average 4 days at the rate of 12 litres milk per day. Thus, the farmer gets an additional income of Rs. 1200 per month per animal.



Quality milk production demonstration

II. Combating challenges of mastitis to improve animal production and farm income: Livestock based farming system in small and marginal holdings in continuous basis. In clinical form the abnormality of the udder and watery milk with clots or flakes are visible. But subclinical mastitis is difficult to detect. Subclinical form results in somatic cell count above 200000/ml. This affects milk quality, milk quantity and milk processing for further production of dairy products. Antibiotic is used to eliminate infection in mastitis. But antibiotic is not the single solution for mastitis prevention. A Proper control programme needs to be followed for prevention and control of contagious mastitis in a dairy herd.

A need based mastitis management program was designed by the team to address both clinical and subclinical mastitis, using CMT test kit. Total of 500 households were covered under this intervention. Under the farmers FIRST project our team has selected 100 dairy cattle infected with subclinical mastitis in S. Nagenahalli village. The selected dairy farmers were trained regarding environment cleanliness, udder cleanliness, dry cow therapy, milking procedure etc., for effective prevention and control of contagious mastitis in a dairy herd. The method used for implementing this technical intervention was conducting specialized training sessions for selected trainer farmers apart from mass awareness campaigns. For mastitis prevention

and control kits that contained pre and post dip germicide solutions for dipping teat during milking are distributed. Curative treatment of mastitis was done on identified clinical and sub clinical cases, through administration of tri sodium citrate along with follow up calls on weekly basis.

Incidence of mastitis has reduced by 50% in the animals. This led to reduction in incidence of rejection of milk by cooperative society and a reduction in costs involved in veterinary medicines and fee payment towards doctor. The hygienic conditions of the animal housing premises have improved considerably. The intervention has helped in reducing the veterinary expenses by Rs. 600 per month per animal and less incidence of mastitis has impacted in avoiding a production loss of average 4 days at the rate of 12 litres milk per day. Thus, the farmer gets an additional income of Rs. 1200 per month per animal.

III. Lameness management to improve production and reproduction performance in animals:

Livestock based farming system in small and marginal holdings in continuous basis. Lameness in cattle is recognized as one of the most economic problems confronted by the milk producers' worldwide. Lameness is the state of abnormal gait caused due to pain or discomfort from any hoof or leg injuries & or disease. It is a clinical sign or symptom of a disorder that affects musculoskeletal system leading to deviation in locomotion. This deviation may be caused by metabolic or systemic disturbance, injury to musculoskeletal system or infection. Lameness in dairy cows is one of the most important welfare, health, and productivity problems in intensive dairy farming. The direct and indirect expenses associated with lameness cases could be reduced by early diagnosis and treatment as it might decline the number of severely lame animals. Restricted movement of lame animals causes reduced productive and reproductive efficiency.

Curative treatment of lameness among animals through provision of rubber mats and oral supplementation of biotin and zinc sulphate. Total of 50 households were covered under this intervention in 2019. The method used for implementing this technical intervention was conducting specialized training sessions for identified farmers apart from mass awareness campaigns regarding importance of lameness management and how it can improve hygienic conditions of animal shed and reduce drudgery involved in cleaning. The foremost cause of lameness in the adopted villages was hard surface of floor in animal sheds, which was either stone slabs or cemented floor. Standing on hard surface for long duration was leading to lameness in animals. Rubber mats were provided to one hundred identified lame animals. Oral supplementation of biotin and zinc sulphate was provided to the animals.

This has been a win-win situation for the farmers, by reducing the drudgery of cleaning operations in the shed and mats provided additional comfort to the animals. The incidence of lameness has come down in the area. The hygienic condition of the animal housing premises and quality of milk has improved after the intervention. Cow mats resulted in correction of infertility issues in animals, who got conceived, leading to additional gain of average 300 milch days. Additionally veterinary expenses were reduced considerably due to this intervention.



Lamenes management



Cow mat demonstration

IV. Two way success of generation of rural employment and reduction in drudgery involved in hand milking:

Under the enterprise based module of Farmer FIRST Project of ICAR-NIANP, a number of challenges were identified through personal interactions and visits. These identified problems were prioritized, based on the quantum of economic losses incurred apart from the number of animals and number of farmers affected by these problems. Two major problems identified and prioritized were unemployment among rural youth and drudgery of hand milking for the rural women. In most of the cases, the women in the family did the milking of the animals and there is a lot of drudgery involved in milking of animals, especially in case of high yielding animals. It takes about 10-15 minutes for each animal to complete milking operations and the person managing the milking operation has to sit on the hard floor, putting pressure on his/her knees and thighs. The situation becomes worse in times of hot summers and cold winters. At the same time, there were a lot of unemployed youth in the villages. Under the farmers FIRST project it was thought to introduce milking machine as a service at farm doorstep. The method used for implementing this technical intervention was conducting specialized training sessions for selected youth apart from mass awareness campaigns regarding importance of machine milking and how it can improve hygienic

conditions of animal shed and reduce drudgery involved in hand milking.

Initially two trolley mounted portable milking machines were provided to two identified youth, who were ready to provide the services of milking the animal. They carry the machine using the two wheelers and milk the animals on a payment basis. The milker charges a nominal amount of Rs. 5 per animal per day (twice milking a day). The needy farmers are registered for the milking services and the payment is done on a weekly basis. The operation and maintenance of the machine is carried out by the youth, whereas the project team meets requests for major service for the machine.

The youth, who were otherwise unemployed, now found an enterprise opportunity within their own village, with 6 hours time spent a day for the same. This has been a win-win situation for the farmers, by reducing the drudgery of milking operations and employment opportunity for the unemployed youth. The incidence of mastitis has come down in the area and the quality of milk has improved after the intervention. The hygienic conditions of the animal housing premises have improved considerably. The intervention has helped rural youth who now earns Rs.3500-4000 a month, with 6 hours time spent a day for the same. This additionally saves around 30-45 minutes of hand milking efforts by farmer/farm women, which they are now effectively utilizing for their other activities.

4.8. Outcome studies

Outcome of the FFP interventions among women SHGs:

The outcome of the FFP interventions among the farmers were analyzed in terms of number of training programmes attended, economic impact in terms of increase in monthly income and savings, extent of adoption of technologies, skills learned from FFP, and improvement in yield of various crops cultivated. The training programmes were designed to cater to the needs of farmers in off campus mode. Follow up visits, method

demonstrations; diagnostic field visits and interactive meetings were done for the training effectiveness. The impact on extent of technology adoption after FFP also furnished statistically significant change.

The data showed that 90 percent of the farmers adopted more than three technologies after FFP such as high yielding varieties, QMP kit and organic inputs for plant protection. Acquisition of skills is the most important objectives of the training programmes. A few critical skills were identified in farming through focus group discussions. The skills focussed were clean milk production management. The acquisition of skills showed an increasing trend and more than half of them acquired 50 percent of additional skills in farming operations. The improvement in skill acquisition among the farmers were found to be statistically significant. The economic empowerment of farmers were analyzed in terms of investment for education of children, banking operations, demanding higher price for production, investing in farming/ household activities, savings, entertainment etc. It was found that half of them falls in the medium category of economic empowerment and 10 percent of them had the high level of economic empowerment.

4.9. Partnership and institution building

In the pursuit of enhanced project efficiency and impact, FFP centre strategically employed the powerful strategy of convergence. Within this framework, this centre forged partnerships with diverse multi-stakeholders, including village panchayats, Krishi Vigyan Kendras (KVKs), NABARD, the State Department of Agriculture, State Department of Horticulture, State Department of Animal Husbandry, Dairying & Fisheries, Forest departments, Department of Health and Family Welfare, Banks, among others. The extent of partnerships with multiple institutions, showcases the breadth and depth of collaborative efforts established by FFP centre to amplify the

effectiveness of project activities.

4.10. Content mobilization

FFP centre published a total of 7 extension literature of various aspects, which were then distributed among over 2465 farmers. Additionally, three booklets were prepared and provided to 2465 farmers. To enhance technical communication, two WhatsApp groups were created, through which 1178 relevant messages were shared with 650 farmers in the project area. Furthermore, FFP centre developed 7 videos on pertinent aspects for the benefit of the farmers. The FFP centre extended their reach through the publication of research papers, technical articles, and coverage of technical content in local print media. The project teams from FFP centre collectively published seven research papers. Among these, five featured in prestigious journals with a NAAS rating of more than six, while two were published in journals with a NAAS rating between 4 and 6. Additionally, a total of 9 technical articles were published in different magazines. Other content mobilization activities are given below:

- **Development of information system, database of all farmers:** A database of all the farmers covered under FFP across five villages (baseline information.) has been developed. This database acts as the basis for comparing the results of interventions and helps in analysing the impact of various interventions. Information on various programmes and schemes of different developmental departments, was also collected and disseminated through local Panchayath, leaders, MPCS, SHG's, etc., so that it can be made use by the farmers and also by the members of various local institutions.
- **Inventory of transferrable technologies of different institutions:** A detailed agroecosystem analysis was conducted as a part of PRA for identification and prioritization of

problems, thereafter an inventory of technologies available with different NARS institutes were made. The list includes all the technologies available with all ICAR institutes of Bengaluru and UAS, GKVK, Bengaluru. This inventory of technologies was also useful to plan for various synergy programmes with different developmental departments and institutions under the single umbrella of FFP. A number of extension folders and two technical bulletins on various technologies were published, which were distributed to farmers. Additionally, a few technical bulletins and calendar of activities, vaccination chart etc., were also developed and distributed.

- **Content management platform enabling offline and online access:** Technology modules covering crops, horticulture, livestock, NRM etc., were prepared in the form of audio, video documentaries and the same has been uploaded on to FFP portal with ICAR, NIANP website, Facebook and YouTube accounts of the institute. A specific WhatsApp group has been created to connect the farmers and scientists on real time basis. Many field based (on-farm) and on-campus HRD programmes were also organized for spreading of the content of various technologies through personal interaction and knowledge sharing. Four Farmer Field Schools were organized during the period of 2018-23.

The research papers published details are given below:

Rohit Kumar, Mukund A Kataktaaware, S Senani, G Letha Devi, M Sivaram, and Ramesha KP.2019. Risk factors associated with incidence of hoof disorders in crossbred dairy cattle under field conditions. Intl. J. Curr. Microbiol. App. Sci. 8 (4) : 2 2 8 4 - 2 2 9 2 . doi <https://doi.org/10.20546/ijcmas.2019.803.272>

Maneesh Kumar Ahirwar, Mukund Amritrao Kataktaaware, Heartwin Amaladhas Pushpadass,

Sakthivel Jeyakumar, Soumitra Jash, Sayyad Nazar, Letha Devi G, John P.Kastelic and Kerekoppa Puttaiah Ramesha. 2018. Scrotal infrared digital thermography predicts effects of thermal stress on buffalo (*Bubalus bubalis*) semen. Journal of Thermal Biology. 78: 51-57. doi <https://doi.org/10.1016/j.jtherbio.2018.09.003>

Letha Devi G, Adbhai AD, Kataktaaware MA, Mech A, Pal DT, Giridhar K, Arangaswamy A, Senani S, Niketha L.2020. A critical control points-based approach for reduction of mastitis incidence in dairy farms of Karnataka. Indian Journal of Animal Sciences, 90:357-361. (IF: 0.294 NAAS: 6.29)

Letha Devi G, Adhiguru P, Mech A, Kataktaaware MA, Chaithra G, Niketha L. 2021. Livelihood vulnerability analysis to climate variability and change risks of livestock farming in Karnataka. Indian Journal of Extension Education, 57:1-5. (IF: Nil NAAS: 5.95)

Letha Devi G, Pal D T, Arangasamy A, Giridhar K, Mech A, Kataktaaware M A, Reddy G B M, Narayanaswamy B, Ramamurthy V, V P Chahal, Chaithra G J and Bhatta R. 2021. Improving livelihood security of farmers through technological interventions for sustainable livestock farming. Indian Farming. 71(10): 146–148.

Rohit Kumar, Mukund A. Kataktaaware, S. Senani, M. Sivaram, Letha Devi G, L. Niketha and K.P. Ramesha. 2021. Risk Factors Associated with the Lameness in Crossbred Dairy Cattle Maintained Under Field Conditions. Journal of Animal Research: 11 (3): 01-09.

Letha Devi G. 2019. Awareness of Livestock Farmers on ICT tools. Journal of Extension Education. 31(3): 6357-6361.

Arangasamy A, Pal D T, Letha Devi G, Niketha L,

Mech A, Senani S, Kataktalware M A, Reddy G B M, Giridhar K and Bhatta R. 2022. Enhancing fertility at early ages in heifers by supplementing critical nutrients of reproduction. *Indian Farming*. 72 (08): 42-43

Letha Devi G, Pal D T, Giridhar K, Arangasamy A, Mech A, Kataktalware M A, Reddy G B M, Ramamurthy M, Narayanaswamy B N and Chaithra G J. 2022. Technological interventions for doubling farm income: An analysis of Farmer FIRST approach. *Indian Farming*. 72 (08): 73-75

Letha Devi G, Mech A, Gorti R and Sejian V. 2022. Assessment of Water Use Efficiency in Dairy Production Systems. *Indian Journal of Extension Education*. 158(2): 198-201.

Prashant Kumar, Kataktalware M A, Jeyakumar S, Kumaresan A, Das D.N, Letha Devi G., Ramesha K P. 2022. Seasonal Variation in Sexual Behaviour of Deoni (*Bos indicus*) Bulls. *Indian Journal of Animal Research*. 1(3): 1-4.

Arangasamy A, Pal D T, Letha Devi G, Niketha L, Mech A, Senani S, Kataktalware M A, Reddy G B M, Giridhar K and Bhatta R. 2022. Enhancing fertility at early ages in heifers by supplementing critical nutrients of reproduction. *Indian Farming*. 72 (08): 42-43

Letha Devi G, Pal D T, Giridhar K, Arangasamy A, Mech A, Kataktalware M A, Reddy G B M, Ramamurthy M, Narayanaswamy B N and Chaithra G J. 2022. Technological interventions for doubling farm income: An analysis of Farmer FIRST approach. *Indian Farming*. 72 (08): 73-75

4.11. Budget details

The details of budget sanctioned and budget utilized during 2016-23 is given in Table 56.

Table 56: Budget sanctioned and budget utilized during 2016-23.

Year	Budget Sanctioned (Rs. Lakhs)	Budget Utilized (Rs. Lakhs)
2016-17	52.56	26.38
2018-19	37.0	36.90
2019-20	24.50	21.32
2020-21	15.50	15.39
2021-22	17.00	16.99
2022-23	18.0	17.95



Chapter -5

Important lessons from the Farmer FIRST Programme

The farmer FIRST Programme is being implemented at three FFP Centres viz. ICAR-Central Plantation Crops Research Institute (CPCRI), Kasaragod (implemented at CPCRI Regional Station, Kayamkulam), ICAR-Indian Institute of Horticultural Research (IIHR), Bengaluru and ICAR- National Institute of Animal Nutrition and Physiology (NIANP), Bengaluru since 2016-17. This chapter covers the important lessons learned from implementation of three Farmer FIRST Programmes during 2016-23 under Zone XI, ATARI Bengaluru.



Important lessons from the Farmer FIRST Programme

The farmer FIRST Programme is being implemented at three FFP Centres *viz.* ICAR-Central Plantation Crops Research Institute (CPCRI), Kasaragod (implemented at CPCRI Regional Station, Kayamkulam), ICAR-Indian Institute of Horticultural Research (IIHR), Bengaluru and ICAR- National Institute of Animal Nutrition and Physiology (NIANP), Bengaluru since 2016-17. Different modules such as crop, horticulture, livestock, NRM, enterprises and IFS were demonstrated along with need based capacity development programmes and extension activities. Following are the important lessons learned from implementation of three Farmer FIRST Programmes during 2016-23 under Zone XI, ATARI Bengaluru:

- Identification and prioritization of problems through PRA helps in effective planning and implementation of all suitable technological interventions in the FFP villages.
- Basic information on existing production system, crops, animals, varieties and technologies adopted by the farmers should be collected. This will help us in comparing the final results of various technological interventions undertaken in the project. Complete inventory of soil and land helps in identification of suitable crop varieties and technological interventions for enhancing the soil, crop and animal productivity.
- Facilitation, by the coordinating FFP centre, of planning and implementation of technological modules, synergy programmes with stakeholder departments and related institutions, arranging critical inputs and organizing capacity building programmes by all the stakeholders is very crucial in dissemination, acceptance and adoption of innovations.
- Organizing different capacity building programmes for farmers at regular interval (at least once in fortnight) by all the stakeholders is essential for creating awareness, developing interest, facilitating adoption of technological interventions, which enhances and sustains productivity and income of farm families.
- All the technological interventions and developmental programmes should be viewed, planned and implemented holistically, considering various crops, animals and enterprises managed by the farm families. So that the desired output in terms of increased yield, better quality produce, enhanced income is easily achieved by the farmers.
- Synergy programmes of developmental departments and other stakeholder institutions should be planned and implemented from the beginning of the programme. These collaborative programmes are highly useful in developing and improving various infrastructure in the village and in mechanization of various activities, which in turn facilitates sustainable production and enhances the productivity and income of farmers.
- Farmers adopt a combination of various technologies in agriculture and allied farm-based activities depending on their land holding, risk bearing ability and resource level. Hence, resource mapping of all the families in FFP villages should be done in the beginning, which gives us a fair idea to identify the most suitable combination of crops, varieties, production techniques and enterprises to each family. So that innovations can be easily introduced to all the selected farm families in the project area and farmers would easily accept, adopt and be able to manage them effectively, efficiently and economically.
- Documentation of all the information, success stories, time series data (at least for 20-25% of the families) of all the enterprises of farm families is very crucial to identify the impact of technological interventions, to differentiate the

change in resource, infrastructure, productivity and income level, at individual farm family, group, village and community level. It would also help us to identify, recognise and support the most interested farmers, who can become techno-agents of FFP and the institutes

- Continuous monitoring and evaluation of implementation of various activities and technological interventions by the expert team is essential. It helps in supporting the farmers to understand and adopt the technologies completely and holistically
- Publicity programmes should be organized to create awareness among non-adopters and to spread effective and successful technologies on large scale. However, publicity programmes should be avoided for the technologies / programmes of small achievements, which can be spread in the cluster of villages only. However, if there is any unknown difficulties or problems like new diseases, pests and other constraints in agriculture and allied activities in the village, we should take all measures to publicize them immediately. It should also be brought to the notice of concerned scientists, departments and to all the concerned as soon as possible to prevent the large-scale damage.
- In the beginning of the project implementation, arranging all the essential critical inputs at right time in the village helps farmers to adopt technology completely. However, arrangements need to be done for production of seeds and seedlings, planting materials of latest varieties and hybrids in the village or in the nearby hobli, so that adoption of such varieties and hybrids will be continuous and spreads to the neighbouring villages also.
- Demonstration of the new varieties and technologies should be done at least for three to four years so as to completely convince all the interested farmers in the selected villages. Complete information and knowledge should be given to all the farmers, which facilitates large

scale spreading and adoption of the technologies.

- Visit and capacity building programmes on various technologies should be organized in the institute (on-campus) and in the villages or in the demo plots (on-farm) at regular interval. So that knowledge on various technologies is imparted at regular interval. This would help farmers to be aware, develop interest and adopt all good and suitable technologies.
- Skill oriented training programmes on different enterprises and technologies like dairy farming, mushroom cultivation, nursery management, ornamental fish production, precision farming, seed production techniques in vegetable crops, etc. should be continuously organized, which helps interested farmers to become entrepreneurs. This would also help in production and supply of some critical inputs at village level and farmers will become self-dependent and technology becomes more sustainable.
- Regular visit of scientists to the farmers' field and interaction with them helps in understanding the researchable issues in each crop and technologies. This will pave the way to reduce the research and extension gap and also in developing more innovations and refinement of the existing varieties, breeds, production / management practices.
- FFP is one of the excellent fora to make the officers and field executives to learn more about innovations and to understand the technologies holistically, which in turn help them to refine their programmes and schemes to suit the field requirements of the farmers.
- Involvement of local farmers / youth/ farmers group and the local institutions would help in strengthening and sustaining the linkage between research institutes, developmental departments and farming community. So that all the institutional benefits are directly percolated to the needy farmers in the village.

Chapter -6

Way forward for the Farmer FIRST Programme

The farmer FIRST Programme is being implemented at three FFP Centres *viz.* ICAR-Central Plantation Crops Research Institute (CPCRI), Kasaragod (implemented at CPCRI Regional Station, Kayamkulam), ICAR-Indian Institute of Horticultural Research (IIHR), Bengaluru and ICAR- National Institute of Animal Nutrition and Physiology (NIANP), Bengaluru since 2016-17. This chapter covers the way forward from implementation of these Farmer FIRST Programmes.



Way forward

Farmer FIRST programme is a unique concept of directly involving farmers from the planning to implementation of different location specific interventions and it has benefitted the farmers. The farmers and their available resources, along with their experiences and knowledge is the most key component in the approach. The Farmer FIRST Programme is being implemented since 2016-17 onwards with the approved objectives and interventions in the six modules viz. such as crop, horticulture, livestock, natural resource management, EDP and IFS. This FFP clearly demonstrated the output in terms of number of programs area being implemented, linkages and convergence formed and the number of farm families in the program. The outcomes were impressive in terms of clustering of farmers, formation of FPO for FFP beneficiaries, full replacement of local varieties with high yielding varieties, value chain enhancement, doubling the income of women SHG members and farmers, convergence model with social platforms like MGNREGS, process documentation and for technologies evolved through participatory technology demonstration and process models evolved and also replicating the model. The way forward of this program should be based on an exit policy for maintaining and sustaining the achievable targets and in taking forward to other areas with customized framework as given below:

- The FFP is field based programme, designed and implemented for holistic development of all the enterprises in the selected village with assured and complete participation of all the beneficiary farm families in the cluster of selected villages. Hence, any future programme should have all the attributes of this project. i.e., programmes should be action oriented, focused on holistic development with participation of farmers and multiple-institutions and multiple technologies

in different enterprises suitable and compatible with production system.

- The innovation research and technology plays an important role in the Farmers FIRST to reorient toward the changing needs and the project appraisal techniques that are ought to be followed. There is need to record implementation strategy, monitoring mechanism of all the centers in one document as well as issues addressed in the programme since documentation of our achievements, impacts and outcomes are important. The most important thing is documentation which is the key factor in any implementation to an extension scientist. It is also important to highlight previous years result and finding. Documentation of technological modules helps to spread successful technological modules across the country in similar agro-climatic and production situations. Documentation of social benefits received by the beneficiary farmers through technological interventions could be done. There is need to revisit all efforts to strengthen, to redefine methodology and to give finer tuning.
- It has been already six to seven years since the project was initiated, it is time to review components after identification of needs, assessing new research issues. Exit policies need to be planned if the FFP programme is to be ended in 2026, so that improved technologies could continue like sustainability fund, seed production or multiplication hub etc. Exit strategy, sustainability, out scaling; output should be planned to reach other part also where there are similar conditions. Sustainability and exit policy through FPOs and farmer clusters. The empowerment of the local self govt. at grass root level is a sure step for a forward looking plan of action. Developing business models, bio fortified varieties, value chain system, mobilization, product documentation should be

given more importance.

- Participation of village, hobli and talukas level local institutions are very important for mobilizing the people, resources and production of crop and animals, even for organizing a small programme at the village level. It should be based on the socio-economic-political situation of the villages. Sustained efforts in continuous participation of local institutions in all the activities and programme of FFP or any such programmes will bring in the desired changes and development of the society, which is the core objective of our programmes.
- Effective implementation of all the activities from selection of interested farmers, building their capacity in technology and resources through different sources, to management of the soil, crops, animals, enterprises, etc. to enhance the productivity and income of individual farm families is very crucial and should be based on sustainable efforts, irrespective of the season, land / animal holding, resource levels and nature of existing adoption level of innovations. This has given us a clear message that overall achievement in terms of enhanced efficiency and productivity of farm based activities is only possible with complete participation of all categories of farm families at all level of programme planning and execution. Hence, we need to ensure complete participation of all the farm families in the programme, so that holistic approach can be easily followed in promotion of technologies to change the socio-economic dynamics and to bring new changes for holistic development of the village.
- Participatory technology development, process-based technology refinement and innovations are important. This technology is a way forward addressing field level emerging problem in short, medium and long term utilisation of research outputs and benefits to farming community.

Technology assessment evaluation and integration for area spread awareness and adoption need to be done. Technology based entrepreneurship as an innovation for ensuring access to critical inputs and enabling faster and effective horizontal technology dissemination among farmers need to be promoted.

- The FFP intervention outcome and impacts points for customization according to location, crops and cropping systems options of technology integration and social engineering for maximum inclusiveness is important. Taking this model to the policy makers for coherence and inculcating in the farming development approaches with wider stake holder participation and investment need to be explored.
- The framework and process of FFP can be decided for wider and identifiable targets with a plan of action to solve the identified challenges and impediments with more convergence and linkages with entrepreneurs, FPOs, government agencies, farmer organisations and private firms.
- Extent of diffusion, out-scale, how many technologies could find place in state departments' package of practices and also problems faced by the farmers should be documented. FFP centres need to upscale, out-scale and expand interventions to other villages. Large scale replication of successful models could be done. There is need to highlight horizontal spread studies and provide elaborate data which is good for reporting.
- There is a need to demonstrate and upscale the potential gains for the farming community and society through technology and social integration for successful value chain at broader perspectives. An upscaling plan of selected technology integration capsules in a participatory and convergence mode at block panchayath and district panchayath level and further to state wide implementations need to be

explored. Creating linkages for support from the line departments, non-governmental organizations and other stakeholders will be key to sustaining the interventions. Efforts should be made to create a few agri startup units of likeminded group of youth, so that some of the successful interventions can be taken up by them and sustain for a longer time. The scope of linkages and convergences with various agencies for multiplying the impact to benefit the social system through integrated farming and strengthening value chain need to be explored.

- Working with officials of various developmental departments through their different schemes and programmes would definitely increases the rate of adoption over a wide area at quickest possible time and it also helps creating good infrastructure at rural areas, which will complement and supplement the efforts of research institutions to promote the technologies. Hence, while implementing any dynamic, field based and market driven innovations, synergy programmes with all the developmental departments should also go hand in hand with technological interventions, so that it is beneficial for all the stakeholders to achieve their objective.
- Respecting the group dynamics and planning the introduction of technologies, sharing of inputs and other resources of the project and working out and implementation of the suitable synergy programme with the developmental departments and institutions also needs to be done by involving and complete participation of all the farm families, So that, equity, social justice and development can be easily achieved among all social-economic groups of the villages. This would also ensure enhancing overall productivity of the village and bring in quick and sustainable development of all the sectors in the selected villages.
- Many technological interventions were made based on the needs and resource levels of clientele groups, synergy programmes of the developmental departments and strength of the scientific expertise of the all the participating institutions. Hence, the programmes should have all the relevant and useful participation of concerned stakeholder institutions and effective and continuous implementation of synergy programmes for development of good infrastructure required for extensive promotion of all the enterprises in the village. This will bring the assured development of all the areas of agriculture, horticulture, animal husbandry, rural enterprises, etc. as planned and designed during the conception stage of any field based programmes.
- Mass media for creating awareness of technologies and their spread because of its useful mass effect could be explored. Each centre has to develop 3 to 5 minute videos for benefit of larger community. The feedback videos from benefitted farmers also should be documented.
- Based on the performance of the clusters or villages review critically, the units which have reached the saturation or not performing well could be stopped. There is need to give more concentration on new clusters, provide advisory services and linkages based on the farming system and resources. Efforts should be concentrated on new villages and 75 percent of the resources could be allocated to them remaining 25 percent could be spent on already existed villages.
- It is important to have data regarding farmers, farm women to know about gender equality, what are the successes, failures, recommendations, action taken, constraints in different enterprise. Reasons for non-adoption should be studied and details of consequences,

demerits, constraints for non-adoption should be studied. Concept of up scaling in case of gender empowerment in farming and making visibility of role of women in agriculture integrated farming systems and nutritional self sufficiency of farm families should be promoted.

- One of the major strength of our FFP is promotion of market driven technologies in crop and animal science technologies and also linking of farmers group with new markets and cost effective marketing strategies with group approach / cluster approach. This has given big boon for large scale adoption of new varieties and technologies, more so in horticultural crops. Hence, all the future activities and programmes needs to focus on marketing strategies for effectively linking of the production of crops and animals from the planning stage of any programmes. So that, it is very easy for the institutions to promote the latest technologies, which are market driven.
- Based on the challenges and constraints/ complaints in connection with FFP interventions, the marketing problems need to be

addressed and the proper market facilities, branding, procurement and sharing benefits through self help and organizing themselves through Farmer Producer Organizations (FPO) is important. Area wide cultivation of crops with decentralised procurement and processing mechanism through FPO in addition to the marketing avenues at decentralised level is important. There is need of conducting a study tour to successful marketing models and adopting grading and processing for income improvement.

- Any technological interventions can be introduced in any production system, if they are suitable for micro-production system of different categories of farmers, brings in quick and large scale economic impact, driven by market demands and based on resource levels of farmers. Hence, if we are taking care these four critical parameters of evaluation of impact of technological interventions at planning stage of any programme, it is very important for us to achieve the planned development systematically and constructively.





