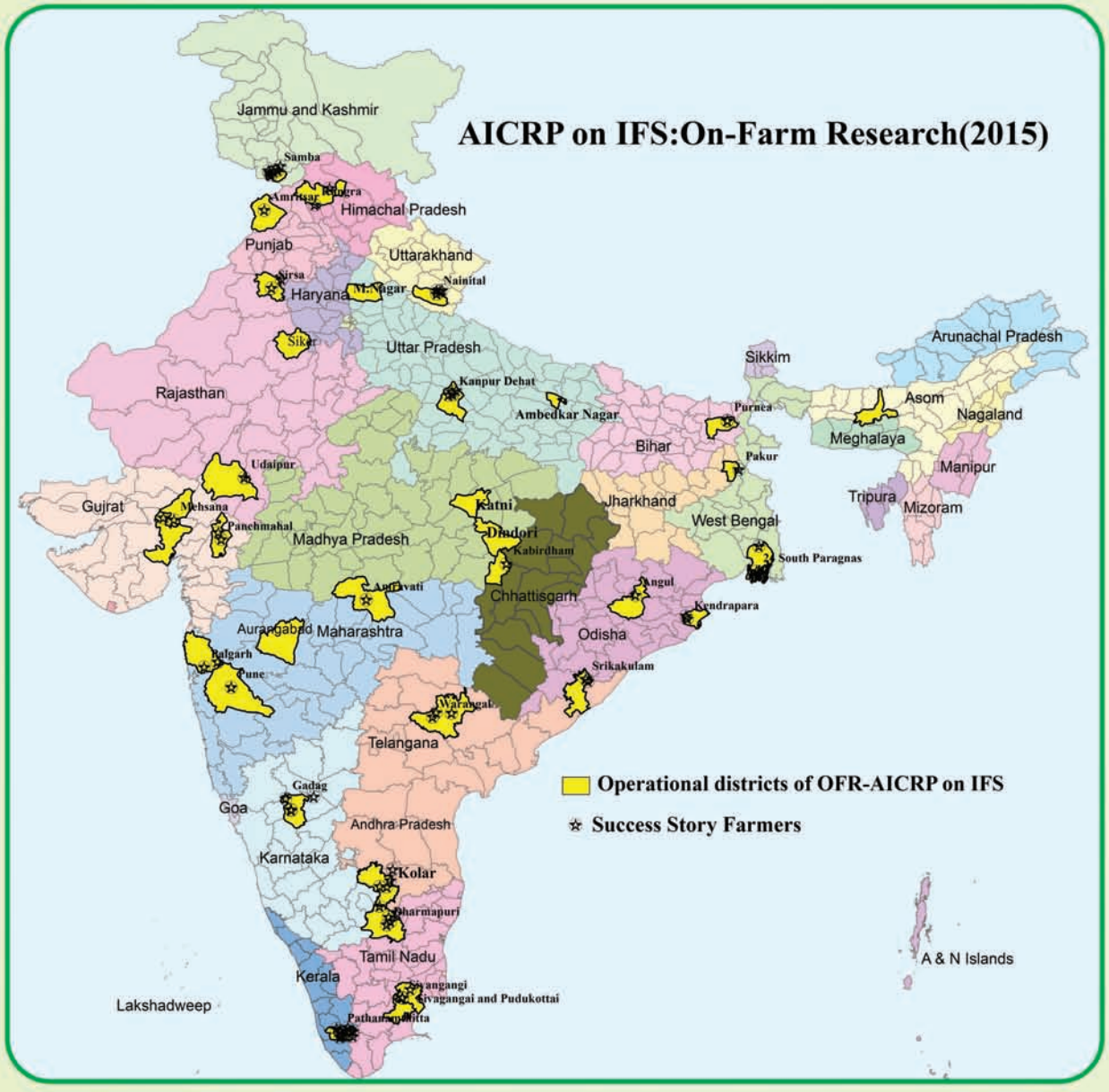
Farming Systems Research Success Stories

(Series 1)

Coordination Unit, AICRP on Integrated Farming Systems
ICAR-Indian Institute of Farming Systems Research
Modipuram, Meerut-250 110, Uttar Pradesh


AICRP on IFS:On-Farm Research(2015)
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Gujrat
Mehsana
Panchmahal
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Kabirdham
Jharkhand
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Kolar
Dharmapuri
Tamil Nadu
Kerala
Sivagangai and Pudukottai
Lakshadweep
A & N Islands
Operational districts of OFR-AICRP on IFS
Success Story Farmers

Farming Systems Research : Sucess Stories
(Series 1)

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Farming Systems Research
Success Stories
ICAR-AICRP on IFS

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FOREWORD

Availability of sufficient man power within the family, inbuilt diversity, hardworking nature with full time devotion for farming are considered to be the strength of small farms in India. However, the fragmented holdings, low level of literacy, resources and low risk bearing ability due to poverty are often their weaknesses that expose them to vicious cycle of poverty. The opportunities available with the small holders are low interest loan and subsidy schemes from government agencies, presence of more than one enterprise and also easy addition of livestock through family labour. Considering these points, diversification of small farms using farming system approach is essential mainly for reducing risks (associated with biotic and abiotic stresses, market price fluctuations and high input costs), meeting the requirement of family and market (food, fodder, fuel, fibre and fertilizer on the one hand, soil nutrients on the other hand and demand of diversified products in the market) and for sustainable improvement of income, employment and standard of living.

Multiplicity of farming systems in India especially in small holders is a major challenge for researchers involved in integrated farming systems research. Studies on various aspects of farming systems carried out in India indicates there cannot be blanket recommendation of farming system model for a particular location as the farms and systems are always temporally and spatially dynamic in nature and mostly decided by the farmer and his resources. Considering this point, farming systems research should be farmer participatory and done at farmers' field with the involvement of farmer family. I am happy to note that the on-farm research component of AICRP on Integrated Farming Systems have undertaken farmer participatory research in farming systems in a systematic way and come out with the "Farming Systems Research : Success Stories" from various locations of the country. I congratulate the editors and co-ordination unit of the Institute in bringing out the document. The document will be helpful to multiply the success in the nearby farmers field and at suitable locations. It will also act as eye opener for developmental agencies to promote interventions in farming systems perspective for improving the income of farm family.

(J.P. Singh)
Director

PREFACE

In India, contribution of small farmers to total farm output exceeds 50%, while they cultivate 44% of land. The holding sizes of marginal farms have decreased from the level of 0.40 ha in 1970-71 to 0.38 ha in 2010-11 and likely to reduce to the level of 0.32 ha with in this decade. By virtue of increased number of operational holdings (mainly due to fragmentation), their size is small but can be made profitable through interventions in farming system approach. In India, crop + livestock is the pre-dominant farming system and around 85 % of farm households practice it. Although, the natural integration of components exist, it lacks much needed recycling with in the farm for reducing external dependence on market. Performance study of existing farming systems in 732 marginal households in the country was taken up in 30 districts in 20 states under on-farm research of AICRP on IFS and it clearly reveals that existence of 35 types of farming systems with components as high as 5. Out of the sample surveyed and sub group of crop+ livestock system, crop + dairy is the major system practiced by 48 % of marginal holders followed by crop + dairy + goat (11%). Among the livestock category, dairy is practiced by 86 % marginal holders followed by goat (24 %) and poultry (21%). The other components such as fish, fruits, apiary, sheep etc are location specific. Further analysis of number of enterprises present in the farming system indicates, 52 % households are having two (example crop+dairy), 28 % farm households are having 3 (example crop+dairy +goat) and 11 % households are having 4 (example crop+dairy+goat+fish). Around 7 % households are having the single enterprise (either crop or dairy alone). These clearly establish that farmers are willing to integrate and enhance their income.

Farming system interventions were carried out through well planned farmer participatory on-farm experiments with the objective to enhance the income and livelihood of small holders in 30 district in 20 states under the aegis of AICRP on Integrated Farming Systems from 2011 to 2015. Some of the success stories emanating from the experiments are documented for the use of fellow farmers, planners and policy makers. The editors are very much thankful to the OFR centres of AICRP on IFS for documenting the stories and the Director, ICAR-IIFSR in supporting to bring out the document. Farmers who have put their sincere efforts while carrying out the on-farm research have certainly harvested the fruits of interventions and thanks are due to them also.

Editors

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Farming Systems Research
Success Stories
ICAR-AICRP on IFS

INTRODUCTION

Crop and livestock cannot be separated for small holder agriculture in India as crop + livestock is the pre-dominant farming system existing in the country and livelihood of 117 million marginal and small farm holdings revolves around this system. Small categories of farms are often subjected to weather vagaries like flood, drought and other natural calamities and farming remains risky. Vertical expansion in small farms is possible by integrating synergistic farming system components requiring less space and time and can ensure periodic income to the farmers. Integrated Farming System (IFS) is considered to be powerful tool and holds the key for ensuring income, employment, livelihood and nutritional security in a sustainable mode for small and marginal farmers who constitute 84.97 % of total operational holdings and has 44.31 % operational area. Integrated farming system meets the above goals through multiple uses of natural resources such as land, water, nutrients and energy in a complimentary way thus giving scope for round the year income from various enterprises of the system. Besides ever growing population, the consumption pattern in rural and urban areas is fast changing owing to the raising income and economic liberalization. The requirement of non-grain crops and animal products are increasing. Hence, farming system plays critical role in enhancing the income of farmers as well as production of multiple commodities using available resources. On-Farm Research (OFR) component of AICRP on Integrated Farming Systems was working with large number of marginal and small farmers from 2011 in 31 districts covering 20 states to systematically characterize the existing farming systems, identify the constraints, make collective, compatible and convenient farm interventions and study the changes. The successful farmer's stories are being documented and published in peace meal basis. A need was felt to compile all the farming system stories at national level for easy multiplication of success through various schemes.

AICRP on Integrated Farming Systems

The British Government in 1945 requested Dr. A.B. Stewart of Macaulay's Institute of soil research, Scotland (UK) to study the factor affecting agriculture production and recommend for quick adoption by the marginal farmers of India. Dr. Stewart toured length and breadth of undivided India (present India, Pakistan and) for two years and submitted a report in the year 1947. Two major recommendations of this report were:

- The country should be divided into various agro-climatic zones. In each of the zone, at least one model agronomic research centre should be established to conduct research on soil fertility management (cultural, pest and disease control) and cropping system.

- The results of practical utility emanating from these model agronomic centers should be tested on farmer's field in simple non-replicated trials, sampling all possible farming situations around each of the model agronomic centers.

The National Community Development Projects (NCDP) launched with great emphasis on Agriculture in October 1952, soon realized and emphasized that location specific production technology was seriously lacking. Immediately recognizing the importance of cropping systems and component technology research in the dominant agro-climatic regions of the country and adoption of such technology in the farmers field in agro-climatic zone, the Government of India sanctioned an "All India Co-ordinated Agronomic Experiments scheme" having two components; (a) on-station trials (b) on-farm trials. The brief history of AICRP on IFS is given below.

- **1956:**'Model Agronomic Experiments' were added and a scheme of"All India Coordinated Agronomic Experiments Scheme"was started as an ICAR Project.

- **1968-69**:Scheme was reshaped and sanctioned as "All India Coordinated Agronomic Research Project (AICARP)" with two components viz.; 'Model Agronomic Experiments' and 'Simple Fertilizer Trials'. AICARP contributed appreciably for the development of package of agronomic management practices for newly introduced high yielding varieties and thus played a critical role in bringing green revolution in India.

- **1989:** AICARP was upgraded into the "Project Directorate for Cropping Systems Research (PDCSR)" with "All India Coordinated Research Project on Cropping Systems (AICRP-CS)" at Modipuram (Meerut). The directorate was mandated to undertake and coordinate country-wide system-based basic and applied research in cropping systems perspective by adopting approach of 'On-Station Research'(basic and applied) at its headquarters as well as at main and sub centres of AICRP-CS, and 'On-Farm Research'(farmers' participatory) at on-farm research centres of AICRP-CS.

- **2004-05:** New plan scheme of "Network Project on Organic Farming (NPOF)"with 13 co-operating centres was added to the AICRP-CS under PDCSR.

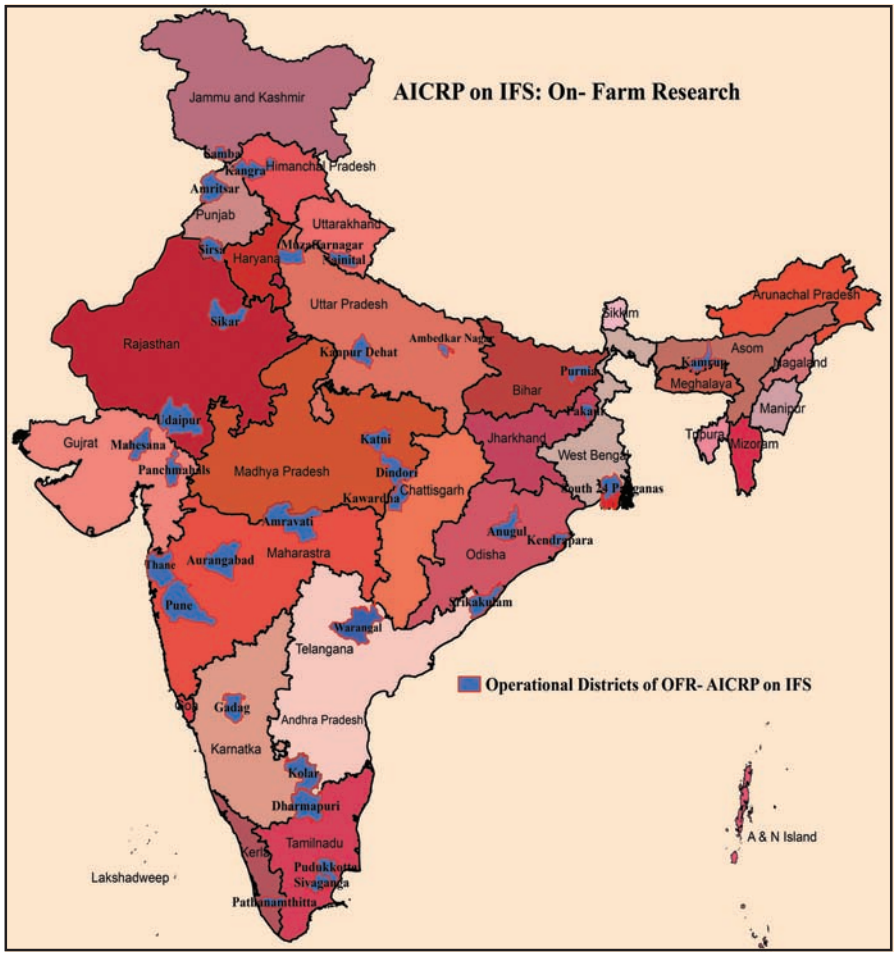
- **2010:** The mandate of PDCSR was further broadened to encompass the whole gamut of farming systems. Accordingly, the PDCSR and AICRP-CS schemes were renamed as "Project Directorate for Farming Systems Research" and "AICRP on Integrated Farming Systems" respectively.

- **2014:** The Project Directorate was given the status of full-fledged Institute and renamed as "Indian Institute of Farming Systems Research" (IIFSR) with 4 divisions (Integrated Farming Systems Management, Cropping Systems & Resource Management, Organic Agriculture Systems and Transfer of Technology, Refinement & Human Resource Development). The AICRP on IFS (was working with 25 main, 12 sub, 6 voluntary and 32 on-farm centres. The NPOF was further strengthened with 7 new co-operating centres.

The on-station, sub and voluntary centres were involved in development of region specific integrated farming system models from 2010 besides other IFS component technology development experiments. The on-station models were meant for basic research, education, extension and commercialization. The on-farm centres were involved in farmer participatory refinement and improvement of existing farming systems from 2011. Refinement and improvement in marginal and small farmers field was done by addressing location specific constraints and intentional integration of components including secondary agriculture for enhancing the income and livelihood of family. During the course, successful farmers and interventions are identified and documented as "Farming systems success stories" for its multiplication in suitable locations.

STUDY METHODOLGY

On-farm research experiments of AICRP on Integrated Farming Systems were conducted in farmers participatory mode by On-Farm Research (OFR) centres located in various State Agricultural Universities. The location of centres (2015) is given in map. Common methodology used for selection of farmers, systematic characterization, farm interventions and studying the changes is briefly given below.



Selection of district and farmers: Representative district in a NARP zone was selected for on-farm study. In each district, available blocks were categorized in to "high productive" and "low productive" based on the productivity of major crops and livestock. The blocks which were having less productivity than district or state productivity were categorized as low productive and the blocks which were having high productivity than district or state productivity were categorized as high productive. One block from each category was selected using random sampling for on-farm experimentation. In each block, three villages were identified randomly and in each village 10 farm households were identified for various on-farm research experiments of AICRP on Integrated Farming Systems. Thus, in each district 60 farm households (2 blocks X 3 villages X 10 farm households) were selected as per statistical requirement.

Systematic characterization: Characterization of existing farming system in the farm household is essential for understanding the constraints and temporal dynamics of the system. Hence, theidentified farm households were geo-referenced by collecting the latitude, longitude and altitude of each household and their fields. If fields are spread in more than one location, co-ordinates of each location were also collected. Benchmark data of general information which includes holding size, distance to market etc, family details including education level, vegetarian/non-vegetarian, primary occupation, details of farm land, household assets, farm machinery and equipment's, crop wise input used, production, family consumption, market sale and income were collected from each household using pre-designed proforma. The data on livestock components, production, income etc were also collected besides household expenditure pattern on various activities. Extent of participation of women in decision making of farming systems and perceived constraints in each component are also collected.

Farming System interventions: Farming system interventions were planned with identification of problem, constraints and available low cost options to address the constraints. Perception of farm family on interventions and farming system components were also taken while finalizing the critical need based interventions. Critical inputs such as seeds of improved varieties, nutrients (If K is not applied by farmer, then only Muriate of Potash is given as input), diversification of crops and cropping systems, improved management practices etc were done under crop or cropping systems diversification module. Low cost interventions such as timely

Artificial insemination, mineral mixture in feed, round the year fodder supply, deworming etc were done for livestock components besides farmer perception based livestock diversification with poultry, pig, goat, and sheep in marginal households for enhancing the income. The product diversification or processing was done in two ways *viz.,*changing the physical state of product or through the change in process of cultivation. The product diversification module consisted of making of flour from grains, oil from oilseeds, value addition through selected ingredients, organic kitchen garden etc. Capacity building of farm family was kept as separate module to train the farm family where in new crops, livestock species and other activities are introduced as a part of diversification approach in marginal households. Inputs of interventions were given only once to farmers and the total amount invested for each farm household was restricted up to Rs 10,000/ year only (varies with location to location and type of farming systems). The interventions were carried out in on-farm experimentsasmentioned below.

OFR 1 (On-farm crop response to application of major plant nutrients in pre-dominant cropping system): Seven common treatments such as control, N, $N+P_2O_5$, $N+K_2O$, $N+P_2O_5+K_2O$, N+P2O5+K2O+supplementation of deficient micronutrient based on soil test and farmer's practicewere tested in pre-dominant crops/cropping systems of the district. All the nutrients were applied at the recommended rates. In each village, 4 farm households were selected for the experiment.

OFR 2 (Diversification of existing farming systems under marginal household conditions): The experiment was designed with innovative approach in which changes are compulsorily made in all components of farming systems by way of introducing new crops, livestock species and product or processing techniques in marginal households aiming to increase the income of the family from a less land resource. The major strength of marginal household is having sufficient manpower (due to family size) for farm operations. Four modules comprising of **Cropping system diversification** (most efficient cropping systems was synthesized keeping in view of the farmers resources, perception, willingness, market and requirement other components in the system), **Livestock diversification**[(Mineral mixture + deworming+ round the year fodder supply for existing components) + introduction of location specific low cost livestock components viz., BYP, duckery, piggery, goat

etc)], **Product diversification** (Preparation of mineral mixture/value addition of market surplus products/Kitchen /roof gardening) and **Capacity building** (Training of farm households on farming systems including post harvest and value addition and assessing its impact) were implemented in 4 farm households in each village.

OFR 3 (On-Farm evaluation of farming system modules for improving profitability and livelihood of small and marginal farmers): The experiment was designed with holistic approach where in improvement of productivity of existing components of the farming system was concentrated by appropriate interventions besides farmer opinion based introduction of new components.Four modules comprising of **crop** (Low cost interventions in existing cropping systems based constraint analysis), **Livestock** (Low cost interventions in existing livestock components based on constraint analysis), **On farm processing & value addition** (On farm agro processing and value addition for marketable surplus) and **Optional** (Introduction of additional components based on households perception) were implemented in 2 farm households in each village comprising of 1 marginal and small household.

Studying the changes: Changesin productivity, production, marketable surplus, income, expenditure pattern of farm family, soil health etc were observed by collecting thedata on all aspects of household and farming systems over the years in pre-designed proforma and the same was compared with the benchmark data collected in the first year. At some locations, the numbers of other farmers who have adopted the interventions were also collected. Some of the successful interventions of OFR experiments are documented.

ANDHRA PRADESH

Farm income improvement through farming systems approach

GPS Location

Latitude	Longitude	Altitude (m)
18^{0}43'38.2'' N	083^{0}47'42.8'' E	109.0

In Andhra Pradesh, out of 10.7 m ha net cropped area 6.3 m ha is rain fed (58%). Srikakulam district is also a rainfed area with normal rain fall of 900-1100 mm. The farmers suffer from the crop failure because of weather aberrations. Shri Gedala Subbayya of Kodula veeragottam village with holding of 1.8 ha having 5 member family doing his own single cropping of rice in one ha during *kharif* and leaving the land fallow during *rabi* and *summer*. He has cashew orchard in about 0.8 ha with livestock of 5 indigenous cows,3 goats and 5 indigenous backyard poultry birds earning annual income of Rs 40000 only with his own family labour. However, he created a history in farm production through adoption of farming system modules in two years period under tribal sub plan (TSP) programme operating in the village under cluster approach.

Shri Subbayya has crop and livestock of his own but he does not have the knowledge of recycling the farm residue and composting of the residue by using cattle cow dung and he simply throughing the fresh cowdung on to the fields straight away and inviting the insect and weed seed residues into his farm. Moreover he does not feed his own indigenous cows with the nutritional feed and not knowing about the access of new type breeds of sheep and backyard poultry. After bench mark survey of his household, the concept of cropping system approach in the annual crop cycle viz. rice-greengram-sesame in place of rice-fallow was introduced. Technique of preparation of vermicomposting or arranging the small ring cement structure with the supply of earth worms was made, introduction of vanaraja birds in the backyard

poultry and supply of Nellore jodipi white sheep having highest weight gain in the shortest period were attempted in his farm as it was in the initial year. In a year, he made himself a model of recycling the crop and livestock wastes in a better way and the yield and economics realized by him are given below.

Benefits of interventions

Parameters	Unit (ha or numbers)	Details of interventions	Interventional cost (Rs)	Yield advantage (No. of times)	Net benefit (Rs) due to interventions
Cropping Systems	1.5 ha	Greengram (LGG 460), Sesame (YLM 17)	2000	8 times	18000
Livestock	15 birds	Vanaraja	900	6 times	6300
Vermicomposting	2 RCC rings	Method knowledge, worms	1900	3 times	7100
Sheep and goat	2	Nellore jodipi white and goat kid	4200	2 times	14000
Total			9000		45400

Vermicompost production @ 6t/year using RCC rings

Compost are prepared from the cow dung and poultry litters. A vermicompost unit (3ft x 3 ft) with 6 tonnes per annum capacity was also installed and running

successfully which meets all the nutrient needs especially organic manures of his crops. Biogas plant adjoining to the dairy farm installed to produce gas to cater the energy need of cooking and lighting of the house. Biogas slurry produced was also used for preparing of vermicompost.

Interventions in dairy and poultry

Once the household was dominated by the low investment energy, starved tribal poor farmer now slowly turning into store house of wealth in the cluster families and extending his support to the other farmers as a master trainee in farming systems concepts.

Documented by: K. Tejeswara Rao, Md. Latheef Pasha, V. Sridevi, M. Venkata Ramana, A. Upendra Rao, N. Lakshminarayana, P. Mounika and N. Venugopala Rao, OFR Centre, AICRP on IFS, Seethampeta, under Acharya N.G. Ranga Agricultural University, Andhra Pradesh

Kitchen garden and vegetables in farming system : New source of income for a tribal farmer maintaining vegetable outlet in weekly sandy

GPS Location

Latitude	Longitude	Altitude (m)
18^{0}42'36.8'' N	083^{0}50'51.5'' E	98.9

Shri Meenaka Rama Rao was one of the tribal farmers belonging to the jatapu special group of eastern ghats of Srikakulm district of Andhra pradesh of kodulaveeraghottam village with land holding of 1.2 ha with 4 members family. He is practicing single cropping of rice in one ha during *kharif* and leaving fallow during the *rabi* and *summer* seasons and having cashew orchard in about 0.2 ha with the livestock of 2 goats and 2 indigenous backyard poultry birds earns annual income of Rs 42000 only. Under tribal sub plan (TSP) programme he was selected for farming system improvement operating in the village with cluster approach. Under TSP the farmer was given the capacity building training on farming systems and an exposure visit to the live models of farming systems at Regional Agricultural Research station in Chintapalle was arranged. Through PRA and SWOT analysis it was understood

Vegetables production

Vegetables production in kitchen garden

that vegetable growing fetches a lot because of his marketing skills besides the introduction of the improved breed of poultry, sheep and goat. His cropping cycle was changed to rice-pulse-sesame.

Interventions & Benefits

Parameters	Unit (ha or numbers)	Cost (Rs)	Net benefit (Rs) due to interventions
Cropping Systems	1 ha	950	15050
Livestock	15 Birds	900	6300
Kitchen gardening & vegetable growing	0.2 ha	2000	25000
Sheep and goat	2	4200	9800
Total		8050	56150

He adopted innovative method of cultivating vegetables in pandal system for bitter gourd ridge gourd and bottle gourd by low cost perennial system. Mr. Menaka Ramana

Rao has adopted innovative method of cultivating vegetables especially gourds and other marketable brinjal, tomato and lady finger. The quality of vegetable is good because he always adopted the organic plant protection.

With the units of kitchen garden and vegetables, improved poultry, sheep and goat with the changed cropping system inputs worth of Rs 8050 has given additional income of Rs 56150 which is 7 times higher than interventional cost. The intergraded tribal development agency in the Srikakulam district appreciated the farmer with an appreciation letter given in the project annual meetings and tribal farmers scientists interaction meetings.

Documented by: K. Tejeswara Rao, Md. Latheef Pasha, V. Sridevi, M. Venkata Ramana, A. Upendra Rao, N. Lakshminarayana, P. Mounika and N. Venugopala Rao, OFR Centre, AICRP on IFS, Seethampeta under Acharya N.G. Ranga Agricultural University, Andhra Pradesh

Azolla makes farm women self sustainable in feeding livestock

GPS Location

Latitude	Longitude	Altitude (m)
18^{0}37'34.5'' N	083^{0}50'43.2'' E	95.6

Shrimati Savara Subbramma is a progressive tribal women small farmer with her four member household family and all are involved in the farming with the shortfall of annual employment. The household is in Nadimibillaguda village at kodisa panchayat in Seethampeta mandal of Srikakulam district having 2 ha area. She is having one ha of cashew garden and wetland area. She practices intercropping of turmeric and pineapple in cashew. Her livestock consists of two milk animals of holstein Friesian breed and backyard poultry of 8 birds. Traditional marketing avenues are followed to sell the farm produce with a annual income of Rs 82000.

"Azolla belongs to Algae. It grows on the top of the water so we call it as floating plant the scientific name is "Azolla Pinnaeta". It is wholesome feed for cattle's, hens and small ruminants too. The management of vanaraja hens becomes easy with azolla feeding. Mixture of kitchen waste, millets and feed with bran, small insects

Azolla production in RCC rings

Interventions & Results

Parameters	Unit (ha or numbers)	Cost (Rs)	Net benefit (Rs) due to interventions
Cropping Systems	1 ha	2400	22600
Livestock	15 no	900	6300
Azolla feeding	2	1500	15700
Triplet character goat	1	2100	4900
Total		6900	49500

Intervention of goat and azolla feeding to poultry

and grass, rice by products, household waste, crop by products are also being fed to birds. Shrimati Subbramma feeds azolla to cattle, poultry and goat.

The tribal farm women is self sustainable to maintain her own requirement of azolla to meet the feed requirements of her cattle, poultry and small ruminants and in holistic mode the concept and modules of farming systems adds an advantage to her livelihood and economic upliftment during the year of project operation in the village and still she is practicing the each individual modules.

Documented by: K. Tejeswara Rao, Md. Latheef Pasha, V. Sridevi, M. Venkata Ramana, A. Upendra Rao and N. Lakshminarayana, P. Sai Mahesh and N. Venugopala Rao, OFR Centre, AICRP on IFS, Seethampeta under Acharya N.G. Ranga Agricultural University, Andhra Pradesh

ASSAM

Sustainable Production and improvement in farm income through cropping and farming system as well as bio-waste recycling

Assam is situated between 24^0 to $28^018'$N latitude and $89^04'$ to 96^0 E longtitude. The climate is sub tropical humid with mean annual precipitation of 1900mm, 70% of which receive during April/May to September/October. The maximum temperature ranges between 36^0 to 38^0c during summer and minimum temperature falls down to 7^0c during winter.Its relative humidity during summer season remains around 80%; however,during winter it may reach as low as 60%. Due to cloudy weather sunshine hours are very less (on an average 4 hours per day) in summer season. Soils are mostly acidic (p^H 4.2 to 5.8) in all the zones except Hill zone where it ranges from acidic to neutral (4.5 to 7.1). The N, P and K status is generally low to medium.

Interventions

- In the winter rice – fallow system medium duration long slender grain rice variety (Rajendra Suwasini) was introduced as winter rice replacing long duration indigenous rice variety and introducing toria crop after harvesting of winter rice followed by summer green gram and black gram after harvesting of toria crop in

Toria crop after rice in the farmer's field with Apiary unit in the Silikha Sanathan village,Titabor

Piggery and Goatery component

upper and lower Silikha Sanatan village of Titabor sub-division of Jorhat district of Assam.

- Introducing improved variety (Joymoti) of summer rice in the winter rice – fallow system of Rangia Sub-division of Kamrup (rural) district of Assam in 8.0 ha area to utilize the water of Artisan well in the medium low land situation by providing rice seed and fertilizer.
- Introducing 3rd crop of tomato in winter rice – tomato system (i.e.it becomes winter rice – tomato – tomato system) in 8.0 ha area of the Golaghat district of Assam by providing fertilizer and pesticide.

Results

- In the winter rice – fallow system of North Bank Plain Zone of Assam under rainfed condition in medium land situation winter rice – niger/wheat/toria/pea/

Duckery component

***Azolla* multiplication and *Vermicompost* produced by the farmers under ECF programme in the Gossaigaon,Kokrajhar district of Assam**

rajmah were found to be suitable double cropping sequence.

- Under rainfed medium land situation in the Karimganj District of Assam winter rice – potato/rajmah/chilli/capsicum found to be suitable cropping sequences than that of winter rice – fallow/pumpkin sequence.
- In Darrang, Kamrup, Nalbari, Borpeta, Morigaon, Golaghat, Jorhat, Sibsagar, Dibrugarh, Tinsukia, and Karimganj districts of Assam under rainfed medium land situation K response was found highest followed by N and least by P in winter rice – autumn rice sequence.

TSP Programme under AICRP on IFS was carried out in Silikha Sanatan Village of Titabar subdivision, Jorhat district of Assam. The total household covered under the programme was 70 numbers.

Initially, a benchmark survey was conducted in the villages and the informations were generated on socio-economic and cultural behaviour of the peoples. The farmers of the villages were mostly marginal having land holding size on an average **0.53** ha. Rainfed rice mono-cropping using traditional long duration varieties with poor management practices were the predominant cropping practices of the locality. The villagers have been rearing livestock also such as cattle, goat and poultry birds besides rearing fishes in their ponds. However, the status of these components were very poor due to the facts that - local less productive breeds, imbalanced feeding & nutritional problem, shortage of fodder, unhygienic rearing, disease

Module	Interventions identified	Inputs supplied
Crop	*i*. Medium duration high yielding rice variety (Rajendra Suwasini: scented rice) was introduced. *ii*. Oilseed (Toria) and pulse (Green gram & black gram) crops were introduced in the sequence. *iii*. Horticultural crops such as banana, pine apple, Assam-lemon and tube-rose flower were introduced on the bank of the pond. *iv*. *Setaria* fodder-grass was introduced.	*i*. Rice seeds were supplied. *ii*. Seeds of TS-67, Pratap and PU-31 cultivar were supplied respectively for Toria, Greengram and Blackgram. *iii.* Planting materials for horticultural crops were supplied. *iv.* Rooted slips of *Setaria* grass were supplied
Piggery	Improved varieties of piglets need to be introduced.	Improved varieties of piglets (Breed Hempshire) were provided.
Goatery	Improved varieties of goat need to be introduced.	Two numbers of goats (*improved* breed *Beatle*) were provided.
Poultry	Improved varieties chick need to be	Five numbers (1 male:4 female) introduced of chicks (*Kalinga* breed) were provided to each of the farmer.
Duckery	Improved varieties of ducklings need to be introduced.	Five numbers (1 male: 4 female) of ducklings (*Khaki Campbell* breed) per farmers were provided.
Fishery	*i.* Existing fisheries of more than 60 farm families were renovated. *ii.* Construction of new fish pond *iii.* Rain water (from fish pond) during *rabi* season need to be utilized.	*i.* Fish fingerlings were provided. *ii.* Fish feeds were provided.
Apiary	Scientific management of apiary near crop field.	Apiary boxes were supplied.
Composting, Vermicomposting	Resource recycling (utilization of bio-wastes) from IFS was introduced.	Earthworms (species: *Eisenia foetida*) were supplied.

Project Director, PDFSR, Modipuram and Chief Agronomist, IFS A.A.U., Jorhat visiting the farmers benefited through the ECF programme at Gossaigaon, Kokrajhar, Assam

problems, lack of veterinary facility in the locality, unscientific management practices etc. were observed as some of the production constraints. Consequently, the economic status of the villagers were very pitiable.

During 2011-12 to 2013-14, under TSP Programme of AICRP IFS, AAU Jorhat Centre implemented with an amount of Rs.3,45,961.00 and identified Module wise interventions as well as inputs were supplied as presented in Table 1.

Training imparted to build capacity:

Farmers of the Silikha Sanatan Village of Titabar subdivision, Jorhat district of Assam were not aware of improved varieties and improved cultivation practices of different crops. They did not know about the scientific management of Livestock, Apiary and Fishery. They were least bothered about bio-waste and its recycling.

Thus, to build up the capacity of the farmers of the Silikha Sanatan Village (Titabar subdivision) trainings were imparted to the households on the following:

i. Socio-economic and sustainable development through Integrated Farming System (IFS), crop intensification and diversification;

ii. Field oriented programmes on IFS;

iii. Scientific way of cultivation & management of rice based cropping system;

iv. Benefits of *rabi* and summer crops after *Kharif* rice and their management practices;

v. Horticultural crops as a component of IFS and their improved production practices;

vi. Importance of fodder crops and their management in IFS;

vii. Fish production technology and scientific management of fishery as well as water harvesting structure;

viii. Production and management of different live-stock suitable under Assam situation *viz*. artificial insemination of the cattle,balance feeding and its management;

ix. Income generation from value addition of the farm produces;

x. Recycling of bio-waste in IFS;

xi. Production technology of vermicompost and principle & practices of Integrated Nutrient management;

Scientists from ICAR-IIFSR, Modipuram (UP) interacting with the farmers benefited through the TSP Programme in Silikha Sanatan Village of Titabar (Jorhat, Assam)

xii. Utilization of by-product as feed for cattle and fishes;

xiii. Utilization of bio-wastes for vermicomposting and composting;

xiv. Scientific rearing and management of Honey bee;

xv. Rainwater harvesting and its utilization to irrigate the *rabi* crops.

Impact after capacity building:

Immediately after training, the farmers were managing crops and other enterprises scientifically. They had started cultivating the medium duration improved rice variety along with the other *rabi* and summer crops in the sequence. Farmers were also utilizing bio-wastes for composting and vermicomposting which enable them to improve their cultivation in a sustainable way. Farmers have started rearing and managing other enterprises (such as Livestock, Apiary and Fishery) as well as horticultural crops scientifically as per the training provided to them in an integrated manner.

There were better nutrition of farm families from the produce of agriculture and allied sectors. Farmer's income generation was increased from Rs. 12,330.00 (before intervention) to Rs. 1,06,090.00 (after intervention) per hectare from the crop component, alone. There were 150%-500% from different livestock and 400% increase in monetary return of the farmers from fishery component of the system. Besides, there was additional income generation of Rs. 1014.00 per hive from the Apiary component of the system.

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BIHAR

Farming system interventions improves the income of marginal household

GPS Location

Latitude	Longitude	Altitude (m)
25^{0}55'61'' N	87^{0}31'67'' E	28.06

Shri Suraj Chouhan s/o Shri Raghunath Chouhan is residing in Kachnahar village, Jalal garh block, in Purnea district of Bihar was having family size 6 and the annual income from all sources of agriculture was only Rs 81871 from 0.9 ha.

Rice-maize and rice-wheat were the major cropping system with 2-3 cattle, 1-2 goat. The farmer was having problem of low yield in cereal, vegetable and milk due to lack of knowledge. The farmer was growing local variety of rice, maize and vegetables and also applying imbalanced nutrients to all crops. The details of interventions made are given below.

Component	Area	Pre-intervention	Post-intervention
Cropping system	0.6 ha	Rice-Wheat Rice-Maize Rice-cucumber	Rice-Maize Rice-cucumber-moong
Livestock	2	Cow	Cow + Goat
Fish	0.05 ha	Local	Rohu + Catla

Intervention in fish pond

Papaya in enhancement of pond

Intervention in maize

Improved seeds of crops, vegetables, green fodder, fish spawn and one goat (black Bengal) was provided by OFR Centre, Purnea to improve the income of the farmer through farming system approach. Approaches of crop diversification, goat rearing, fish rearing and vegetable cultivation from the piece of land along with training resulted in improved farm income. By adopting IFS the farmer felt self-dependency and provoking other farmers to work in this manner.

Documented by: D.K. Mahto and R.P. Sharma, OFR Agronomist, AICRP-IFS, Purnea, Bihar Agricultural University, Sabour, Bihar

Farming system diversification : Adds additional income to small holder

GPS Location

Latitude	Longitude	Altitude (m)
25^{0}55'40'' N	87^{0}31'64'' E	28.6

Shri Dhiraj Chouhan s/o sh. Raghuvansh Chouhan residing in Kachnahar village, Jalal garh, block in Purnea district (Bihar). The annual rain fall of the region is 1350 mm. The annual income from all sources of agriculture before intervention was Rs 80633 from 1.25 ha upon which 5 members family was living.

Intervention in maize

Rice-maize, rice-wheat with 2-3 cattle, 1-2 goat per household is the common farming system in the region. The farmer was having low yield in cereals, vegetables and livestock due to traditional practices, varieties and lack of scientific knowledge. The details of interventions and integartion are given below.

Parameter	Units	Pre intervention practices	Post intervention practices
Cropping system	0.75 ha	Rice-wheat, Rice-maize Rice-cucumber	Rice-Maize Rice-cucumber-moong
Livestock	2 no.	Cow	Goat (Black Bengal)

Parameter	Units	Pre intervention practices	Post intervention practices
Fish	0.06 ha	Common carp	Catla, rohu+mirgal
Vermicompost	2 no.	FYM	Vermicompost

Capacity building of farmers

Parameter	Units (ha or no.)	Detail of intervention	Cost (Rs.)	Yield advantage(%)	Net benefit (Rs.) due to to intervention
Cropping	0.2	Rice(R.Sweta)-	(Rice-985)	40	(Rice-Rs.5000
system		Maize(P-3396)	(Maize-2200)	42.5	Maize-7200)
	0.1	G.gram (SML-668)	250		720
	0.02	Hybrid var.(cucumber, lady'finger, bottle guard,Tomato	550	45	1750
Livestock	2	Green Fodder	500	32	2870
Fish	0.05	Improved fingerling	500	35	4200
Vermicompost	2	Earth worm	1000		6500
	Total	5985		28240	

Documented by: D.K. Mahto and R.P. Sharma, OFR Agronomist, AICRP-IFS, Purnea, Bihar Agricultural University, Sabour, Bihar

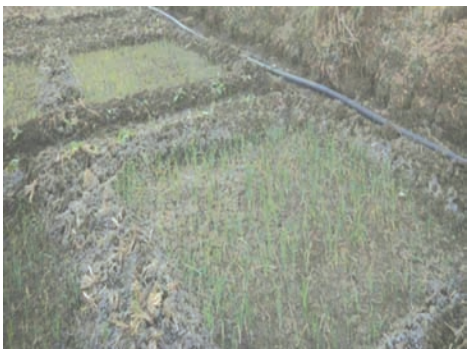
CHHATTISGARH

Multiplication of livestock components provides confidence in farming

GPS Location

Latitude	Longitude	Altitude (m)
21^{0}53'59.9'' N	081^{0}24'19.1'' E	292

Shri Itwari, a farmer in the village of Khandsara, block Kawardha, district Kawardha (Chhattisgarh), was having one ha and grows only rice/soybean-chickpea



Interventions in farming system approach

system with low yielding traditional varieties. He was convinced to take up integrated farming system to improve his income by OFR centre, Kawardha.

He adopted the combination of crop + cattle + goat + poultry system on his farm. He has grown high yielding crops in the cycle of rice/ soybean-chickpea + vegetable. He properly used each part of land, planted the horticultural fruit plants mango, guava, moringa, banana, papaya and used the nutritious vegetable and fruits for his own family consumption. Beside this, he sold the vegetables in the market and earned money year round. He could earn upto Rs 80,000/year from crop alone.

Besides cropping system he adopted other enterprises. He kept poultry and added milch cows and goats to the system. Then, taking his learning further, he set up an innovative self-sustaining feeding cycle. The poultry were fed with grain, broken rice and farm waste. The cattle were fed with crop residue, green fodder.

At the initial stage, he kept only two goats, two hen, one cock and one cow. The components are multiplied into 12 goats, 30 poultry and 2 cows. Now after adopting IFS component his income is 1,05,000/annum.

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Farming System Diversification rewards small farm holder with enhanced income and award from Hon'ble Governor of Chhattisgarh

GPS Location

Latitude	Longitude	Altitude (m)
21^{0}54'017'' N	81^{0}21'158'' E	310

Shri Pardeshi Ram Netam S/o Phuduk Singh Netam is an active farmer in Heerapur village of Kawardha block in Kabirdham district of Chhattisgarh. He was deriving livelihood from 1.30 ha land for his 6 member family including 3 childrens living in two room temporary hut house (*jhopadi*). Average annual rainfall of the region is only 800 mm with rice/soybean (*kharif)* -chickpea/wheat (*rabi)* as major cropping system with 1 local cow, 1 calf and 2 bullocks. He also maintained *deshi* poultry birds in backyard. The yield of rice (2500 kg/ha), soybean (1300 kg/ha), chickpea (1000 kg/ha) and cow (1 litres/day) was very low compared to achievable potential due to lack of skill and awareness on scientific practices including improved varieties and integration of components. The monthly net income from his farm was only Rs 6500 upon which his family was struggling to continue farming. The income was not sufficient to meet the family requirement for food, cloth including enough money for education of children. Shri Pardeshi Ram Netam had decided to sell his land and migrate from village to town for doing labour work.

On Farm Research (OFR) Centre of AICRP on Integrated Farming Systems under ICAR-IIFSR functioning in SantKabir College of Agriculture & Research Station, Kawardha under IGKV, Raipur, selected ShriPardeshi Ram Netam for conducting the on farm research titled ***"On farm evaluation of farming system modules for improving profitability and livelihood of small and marginal farmers"***. The OFR team of scientists identified the constraints in respect to crops, livestock and poultry. Low productivity of rice, soybean and chickpea were due to use of traditional varieties, imbalanced use of fertilizers (lower dose of nutrients), weed infestation and high incidence of pests and diseases. The low yield in cow was due to non-availability of sufficient green fodder.

Growing of vegetables in embankments of pond and on bunds

Effective recycling of wastes through portable vermicompost unit

IPM in chickpea with pheromone traps

Receiving award from Hon'ble Governor of Chhatisgarh, Shri Balramji Das Tandon for adopting scientific IFS model

The constraints were addressed through low cost and capacity building based interventions. His existing farming system of crops + dairy + poultry was diversified with ***scientific cropping system + cattle + goat + poultry + pig + fishery + duckery + mushroom + vermicompost****system*. The cropping system was changed with improved varieties and practices. The income augmenting was done through growing pigeon pea and vegetables on bunds and embankments of pond. He made the best use of his land by allocating 0.09 ha to fish pond. In the pond fingerlings (*rohu, catla, mirgal*) + ducks (15 no's) were reared together. He also

built poultry shed and kept poultry (*vanaraja*) in backyards and added 1 milch cow, 5 goats (Jamunapari) and 2 pigs (Large white Yorkshire) to best integrated the components. He was motivated to produce mushroom (oyster) in small hut. The poultry were fed with grain, broken rice and farm waste. Poultry litter and cow dung served as fish feed. The cattle were fed with green fodder grown in cropping system, crop residue and urea treated paddy straw. The 5 goats he had started with bred into ten goats. He has been given trainings from experts on all the new enterprises (fish, duck, poultry, pig, mushroom and vermicompost) integrated. The residues were recycled to the farm in the form of vermicompostwith portable unit. Woman of the house was imparted training on processing module and started to make *dal* from pulses, *badi* from vegetables, cleaning, grading of vegetables and dry products of mushroom. With the diversification of farming systems, household earns a monthly income of Rs 13475 which is more than 2 times of his original income. He has made permanent house (*pakka building*) and purchased 0.50 acre additional land from his savings. The family also meets the nutritional requirements from diversified products such as milk, egg, poultry meat and vegetables. The farmer is also training the other farmers of his village to start scientific IFS model.

Shri Pardeshi Ram Netam received the state **award from Hon'ble Governor of Chhattisgarh, Shri Balramji Das Tandon** for adopting scientific integrated farming system model and outstanding contribution in motivating other farmers in the village. The award was given during the Kisan Mela organized by KVK, Kawardha.

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GUJARAT

Improved farming system enhances income of small farm household

Agriculture and dairying are the main source of livelihood for the rural people of Mehsana district in North Gujarat. There are no any constraints regarding marketing of agricultural product as well as milk production through animals as there are APMC markets in each blocks and big Dudhsagar dairy collecting milk through number of Co-operative societies, respectively. Due to better dairy facility even large numbers of landless families are also engaged in dairy for their livelihood.

Shri Ashvinkumar M. Chaudhari having the family of 4 members in village Kamalpur, block-Chansma in Patan (Mehsana) district was deriving livelihood from 2 ha of irrigated land. The main cropping system was pearlmillet-mustard-fodder

Interventions in crops

sorghum. He tried to grow green gram, hybrid castor, hybrid cotton, fennel, wheat and some vegetables like radish, brinjal, chilli in small area. He was doing all his agricultural operations through hired tractor service.

He has four indigenous Gir cows which is having origin of Saurashtra area of Gujarat. Being a interested and enthustic farmer he was always ready for adoption of new agricultural technology which is beneficial. The milk yield of his cow was < 5 lit/day. For irrigation, he has one 800 feet deep tube well with 62 H.P. submersible pump on partnership basis.

The OFR centre, Mehsana selected Chansma block was selected for on farm evaluation of farming system modules for improving profitability and livelihood on participatory mode and looking to his interest in farming system, Shri Ashvinkumar was selected as a participatory farmer for research in 2010-11. The constraints in his farming which were identified were addressed with low/no cost interventions in crop, livestock and optional modules. In crop module, the constraint of low yield was sowing of local cultivar, imbalanced fertilizer application, high incidence of weeds and higher incidence of pest and diseases. In different crops these were addressed through supply of hybrid and improved varieties of seeds of hybrid castor, green gram, lucerne and vegetable. For control of weeds pre-emergence application of pendimethalin was applied and the imbalanced fertilizations addressed through recommended dose of fertilizers in all crops with micro nutrients to correct the deficiency in soil.

In oilseeds crops *viz*. mustard and hybrid castor, he was not aware about sulfer application for better yield and quality. This was addressed through 25 kg sulfer/ha as a basal dose. Both crop was grown as sole crop. To get additional yield with low cost intervention, mustard was intensified with lucerne (seed) to get extra seed income from lucerne after cutting of mustard and castor with fodder chicory to supply balanced nutritious fodder to animals in *rabi* and summer season. In hybrid cotton, main weed observed was barnyard grass which become severe under continous raining after sowing of cotton. This was controlled by pre-emergence application of pendimethalin and imbalanced fertilizer was corrected by adding 25 kg $MgSO_4$/ha.

Interventions in crop and vermicompost

To get nutritious fodder of lucerne and fodder sorghum, micro nutrients such as zinc and Fe @ 25 kg/ha were applied at the time of sowing.

Similarly in animal module constraints of low productive deshi breed, inadequate and imbalanced feeding and control of diseases were addressed through promotion of artificial insemination (AI), integration of concentrate with mineral mixture @ 50g/ day to each cow for feed, use of albendazole for deworming and vaccination as per schedule. For balance nutrients both legume and cereal fodder were applied with micronutrients during fodder production and to fed animals. Vermicompost unit was also integrated.

In optional module, the boundary plantation of ardu was made to stabilize the income. Vegetable seeds of different crops were provided in *kharif*, *rabi* and summer for meeting vegetables requirement of family. In the capacity building module, farmers of village was imparted training on integrated farming system and value addition.

The total cost of intervention in all the modules was only Rs.7350/year which contributed for additional income of Rs. 1,07,650/year within one year. The net return per rupee invested on intervention stands at 14.64. The house hold earns net income of 2,32,650/year which is 86% higher than benchmark. Besides more income the family also meets nutritional requirement by in house production of pulses, milk and vegetables. Nearby farmers are taking interests in adopting the modules as they are low cost in nature. The family gets additional employment of 45 man days due to intervention made in farming systems perspective.

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Better livelihood to tribal farmers through low cost interventions in farming systems

Indian Council of Agricultural Research, through IIFSR, Modipuram has sanctioned tribal sub plan project for better livelihood of tribals through addressing the constraints through different interventions in all farming system components. OFR centre of AICRP on Integrated Farming System operating in SDAU, S.K. Nagar selected tribal area of Amirgadh block having four different clusters *viz*. Khapa, Nichlo, bandh Upalo bandh and Karmadi in which 50 households were selected for farming system interventions.

Among the tribal households, Shri Sharma Bherabhai Ashabhai is an ethustic farmer residing with his parents having 0.70 ha and 6 member family depends on this land. In his fields, there was only one plant of sapota, one plant of mango on bund which was grown by his grandfather. He keeps two bullocks for farming and 1 medium size buffalo, 2 goats. The milk yield of his buffalo was 2-2.5 litres/day. The

Intervention for crops and animals

annual average rainfall of the region is 625 mm and he has one well with 7.5 H.P. submersible pump with partnership of his cousin for irrigation of his land. He was growing different crops *viz*. maize, cotton, castor, fennel as mono crop according to his indigenous method in small pieces. The net income obtained from marketable surplus of all the components was only Rs. 28600/year on which his family was living with struggle.

He was growing maize as a sole crop with local cultivar and followed by wheat. The major costs are ploughing, seeds, fertilizer irrigation, and harvesting and threshing which was about Rs. 7500/ha.

OFR scientists through interview identified constraints for his low income. The sole crop of hybrid maize was intensified with hybrid castor as relay crop in same field with improved resistant and high yielding hybrid variety GCH-7 by sowing at flowering stage of maize. Hybrid Bt. cotton was grown with micronutrients, MgSo4 and intercropped with cowpea (vegetable) for getting extra income within a short period. Constraints in wheat crop were addressed through replacement of his local variety by GW-496 and for better survival with optimum plant stand to save the crop from termite attack, seed treatment through recommended insecticide was applied.

Interventions in livestock and fennel

Intervention as horticultural plants: mango, sapota, pomegranate, lemon and guava

Fennel crop constraint was addressed through replacement of his local variety by GF-2 variety. In summer poor yield in pearlmillet was addressed through application of basal dose of phosphorus and pre-emergence weedicide atrazine for controlling of weeds. Okra local variety was replaced by hybrid and regular plant protection measures were applied through constant advice for better quality and yield in vegetables.

For supply of continuous green fodder improved fodder seeds of chicory and Lucerne with bacterial culture treatment was sown and napier hybrids was planted on irrigation channel. Mineral mixture was also added to the feed.

For better nutritional security, different fruit trees of horticulture *viz*. mango, jamun, custard apple, sapota, guava, pomegranate, lemon, drumstick were planted in rain water drainage which was surrounding his fields having small unuseful small size of trees and grown different fruit trees with different vegetables *viz*. cucumber, bottle guard, bitter guard, muskmelon for getting additional income. He has dried fennel in special method for getting green colour which got higher rate in market as compared to local drying in sun.

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Interventions in farming system increases the income and livelihood

GPS Location

Latitude	Longitude
24^{0}03'284'' N	71^{0}56'305'' E

Shri Babuji Thakor is the resident of Ratanpur village of Shihori block of Banaskantha district having five family members and deriving livelihood from 0.80 ha of land located on national highway which is 3 km away from taluk head quarter Shihori. Annual rainfall of region is 600 mm and maximum area is with Bt. Cotton - wheat and or summer pearl millet system. He is also growing vegetables for home need.

Besides these, he was also having 6 plants of teak, 10 plants of pomegranate, one plant of lemon, one plant of custard apple on bund, one local tree of mango and two buffaloes. The milk yield of buffalo was only 6 litres/day. Growing commercial hybrid cotton, hybrid castor in *kharif* and local variety of fennel, lucerne in *rabi* for fodder and summer pearl millet for staple food and fodder for his animals. In general, the productivity of all enterprises was low as compared to standards. The net income obtained from marketable surplus of all the components was about Rs 60,000/year on which his family was living.

OFR centre, Deesa under AICRP on Integrated farming system operating in S. D. Agricultural University, Sardarkrushinagar identified Shri Babuji Thakor during 2011 for conducting the participatory research of 'On farm evaluation of farming system module for improving profitability and livelihood of small and marginal farmers'. Farmer participatory research was conducted in the system perspective by identifying the module wise constraints and addressing of the same with no/low cost interventions in four modules namely crop, livestock, on farm processing and value addition and optional component. The farmer was interviewed and constraints for low income in Bt. cotton, castor, fennel and other crops were identified.

Mr. Thakor is very enthusiastic and interested for adopting new technologies. He knew and aware with method of Bt. cotton, Bt. seed production but he was not

Interventions in crop module

doing so. He was advised and inspired for producing cotton seed production instead of commercial cotton production. Necessary arrangement for male/female parent for seed cotton was provided from seed producer by OFR project. The commercial cotton was diversified with Bt. cotton seed production. Local fennel crop variety was replaced by improved fennel GF 2 variety and wheat variety was replaced by variety GW-322 with seed treatment of quinalphos for control of termite. In pearlmillet, a constraint was addressed through application of pre-emergence weedicide for control of weeds. For kitchen gardening, different vegetables seeds were provided for nutritional garden. Imbalanced fertilization in Bt. Cotton, was addressed through application of secondary nutrient *viz*. ($MgSo_4$), low cost of organic pesticide, quizalophos-ethile weedicide application to cotton and IPM practices with low cost pheromone trap for controlling pest in pomegranate constraint in castor was addressed through replacement of old variety by wilt resistant high productive GCH-7.

Similarly, in livestock module, adequate and balanced feeding and vaccination was made through providing mineral mixture, albendazole for deworming and advised for timely vaccination as per schedule. Balanced feed was addressed through supply of green fodder lucerne and *jowar/rajka bajra* in *rabi* and summer season by applying micronutrient ($ZnSO_4$) for better quality fodder.

Glimpses of interventions

In on farm processing and value addition module, explained for better remuneration through processing of fennel by picking of immature fennel umbels and special method of drying. Prepared shade under tree for better palatability and maintaining green color for fetching higher market price as compared to local method of drying fennel under sun light. After drying, fennel was threshed, sieved, cleaned and was packed in 1 kg attractive bag and sold in market.

Seed production of bt cotton was ginned in nearby ginning factory of Khasa village. Then seeds of cotton were treated with GAUCHO at home and ready printed pouch was purchased from market then packed in pouch of 0.450 kg. These pouches were sold to retailer and village farmers.

The byproduct of crops, weeds, farm residues and dung were used for making small vermicompost unit under shade of cluster apple tree with low cost intervention. Earthworms were provided in small quantity. Vermicompost produced was used in homestead kitchen garden and in pomegranate trees for better quality of fruits and

Glimpses of interventions

vegetables to satisfy the home need. The mango, custard apple and lemon fruits were used to satisfy the home need for nutritional quality.

Total cost of interventions in all the modules was Rs 9,900/year which contributed for additional income of Rs 1,26,400/year. The house hold earns net income of Rs 2,50,400/year which was 102% higher than previous year. Farmers are also evincing interest in adopting all modules as interventions are of low cost in nature. The family gets 240 man days of employment due to interventions made in farming systems perspective.

Animals were fed directly by whole plants of bajra and jowar. So there was about 25-30 per cent of fodder wastage. Cutting fodder by chaff cutter saved 25-30% of fodder. For getting green fodder throughout the year, improved seeds fodder seeds of rajka bajra, jowar and lucerne were given to the farmers. For control of pest, disease and weeds, provided know how as well as spraying pumps for getting better healthy crops.

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Low cost interventions in farming system improves the income and livelihood of marginal household

GPS Location

Latitude	Longitude
24^{0}16'169'' N	72^{0}05'218'' E

Shri Raju Damor having the family of 11 members deriving livelihood from the 0.80 ha area located in village Khapa, block Amirgadh, which is 40 km away from district head quarter Palanpur town of Banaskantha district of Gujarat state. The annual rainfall of the region is 650 mm, having Aravali mountain rows nearby. He was growing cotton, castor, maize, fennel and some vegetables with local varieties

Interventions in crop module

of okra, chilli, cowpea, brinjal and tomato in small areas for selling in local and for his house hold. Beside, he has one sapota plant, one custard apple, two bullock, one buffalo and four goats. The net income during 2009-10 obtained from marketable surplus of all components was Rs 25,000/year on which his big family was living with struggle.

During 2011-12, OFR centre, Deesa (Dist.Banaskantha) under AICRP on Integrated Farming System, identified Khapa, Nichlobandh; Upalobandh & Karmali cluster of villages in Amirgardh block for better livelihood through interventions to tribals by addressing the constraints for improving profitability, sustainability and livelihood of small and marginal farmers of 50 households in clusters of Amirgadh. The farmer participatory work was conducted by identifying the constraints in different components with low/no cost interventions in different modules viz. crop, livestock, value addition and optional.

Interventions in crop module

Interventions in livestock and horticulture

In crop module, the constraints for low yield was due to local cultivars of castor, cotton, fennel, pulses, wheat, mustard, maize, pearlmillet imbalance fertilizer usage, high incidence of pest and weeds which were addressed through recommended package of practices. The crops grown under wider spacing *viz*., cotton, castor, fennel, maize were intensified through castor + fodder lucerne & chicory, fennel + cauliflower whereas maize with castor relay cropping for increasing the land utilization with use of hybrid varieties of respective crops namely castor by wilt resistant higher yielder variety GCH 7, fennel by GF 2 and maize by hybrid pioneer.

To reduce the cost of fertilizers *viz*., *azospirrlum*, *azotobacter*, *rhizobium* and phosphorus solubilized bacterial culture were utilized through seed treatments and spray of micronutrients Fe and Zn on standing crops were done.

Similarly in case of livestock module, for better palatability and to reduce the wastage of fodder, hand chaff cutter was provided. The main constraint for poor yield was inadequate and imbalanced feeding which was addressed by growing the

grasses of improved and hybrid varieties of cereals and legumes fodder seeds viz, jowar, lucerne, rajka bajra and napier hybrids on bunds of channels. For balanced nutrition, use of mineral mixture for milch animals was advocated. They are advised for artificial insemination instead of using local bull and for control of diseases adoption of vaccination as per schedule was advocated.

For better livelihood through nutritional security for future in coming days, one each improved plant of sapota, mango, guava, lemon, pomegranate, drumstick, custard apple, papaya and banana were given. Seeds of vegetables in small pack pouch *viz*. cabbage, bhindi, tomato, onion, cow pea, bitter guard, spinach and bottle guard were given for kitchen gardening. New crop of turmeric was also introduced.

The total cost of interventions in all the modules were only Rs 9,700/- for addressing the constraints within one year. The household earns additional net income of Rs 79,300/year.

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Farming systems multiply the income of marginal household

Shri Kishanlal Mali resides in farm house of Hanmanpura village in Deesa block which is 4 km away from Deesa city of Banaskantha district. His six member family was deriving livelihood from 0.90 ha. His soil is sandy loam and has good irrigation facility with sprinkler irrigation and land is located on national highway. The average annual rainfall of the region is 650 mm with maximum area under groundnut-potato-summer pearl millet cropping system. He tried to grow *guar*, fodder *bajra* and some vegetables like okra, chilli, onion, brinjal in *kharif/rabi*/summer for his house purpose and to market for getting income to run his family. Besides these, he was also having two mango plants, 1 buffalo, 3 cross breed cow but due to more animals he was purchasing grass from nearby farmers and net profit from dairy was very low and he has one old tractor for agricultural operations. The average milk yield of his cow and buffalo was <7 and <6 litre/day, respectively. In general, the productivity of all the crops and animals was below the average of area. The net income obtained from marketable surplus of all the components was about Rs 1, 45,000/year on which his family was living.

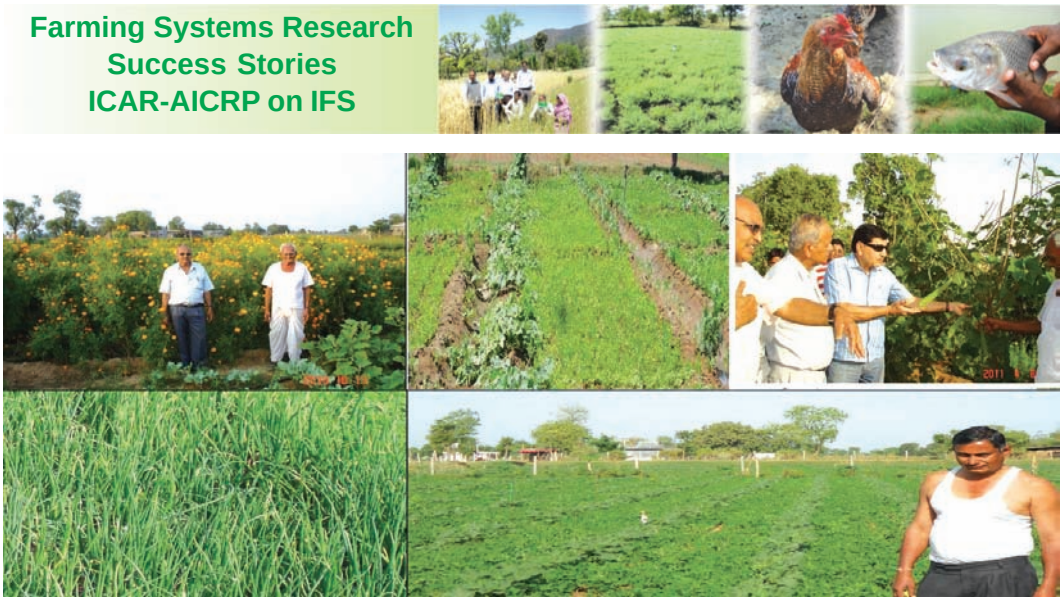
OFR centre, Deesa of Banaskantha district under AICRP on integrated farming system operating in S. D. Agricultural University, Sardarkrushinagar identified Shri Kishanlal Mali during 2010 for conducting research of “On farm evaluation of farming system modules for improving profitability and livelihood of small and marginal farmers”.

The farmer participatory research was conducted in the system perspective by indentifying the modules wise constrains and addressing of the same with low/no cost interventions in three modules namely crop, dairying, and optional (kitchen gardening). He was explained about plan to intensify his existing crops as well as introduction of new vegetable crops and fodder for getting more income and employment.

In crop modules, the constrains of low yield was identified as lack of awareness of intensification in groundnut, sole cropping, local cultivar, imbalanced fertilizer

Interventions in crop module

application, high incidence of pest and weeds in groundnut. For getting more income from sole groundnut, it was addressed by intensified with marigold on compartmental bunds of *kharif* groundnut. The main object for selection of marigold was to increase land intensity as it is grown on compartment bunds which are made for irrigation purpose only which generally remain vacant throughout crop growth period of groundnut. For intensification in groundnut, marigold nursery was raised nearby corner of tube well. After growing groundnut in June through drilling at a spacing of 30 cm, after each 6 rows of groundnut crop one bund was raised at the time of sowing by tractor. On that raised bund, 20 days old marigold saplings was transplanted at intra row spacing of 60 cm and no fertilizer was given to marigold. The flower starts before festival of Navdurga fetches more price in market. His young son who was always going to market for serviing in mobile shop through motor bicycle, was carrying the flowers to market and there was no any problem of daily marketing of flowers.



Interventions in crop module

Groundnut was high yielding variety of introduced (Akhsay). The problem of white grub was addressed through seed treatment of quinalfos. The fertilizer cost in groundnut was reduced by treating the seeds with *rhizobium* culture. The disease of potato scab was addressed through seed treatment of Dithene M-45 and weed control by cenchor through sprinkler irrigation.

Similarly, in livestock module, constraints of imbalanced feeding was addressed through supplement of mineral mixture with concentrate @ 50 g / day. The local seeds of lucerne for fodder and *rajaka bajra* in *kharif* and summer were addressed through improved variety Anand 2 and *rajaka bajra*. For better nutritive quality, micronutrients in both the crops (Zinc sulphate @ 10 kg/acre was applied). For better palatability of fodder, he was advised to cut green fodder at proper stage before increase in lignin and to avoid wastage it was cut by hand *suda* which saved 25-30% fodder. Use of albendazole for deworming and vaccination as per schedule was also adopted.

In *rabi,* green coriander was sown for getting income through daily selling in market through multiple cutting. In February, the ridge guard vegetable was grown on bunds of coriander as an intervention of intensification without any extra land.

Interventions in livestock

The total cost of intervention in all the module was only Rs 9,610/year which contributed for additional income of about Rs 1,65,390/year. The net return per rupee invested on intervention stands 16.21 and house hold earns net income of Rs 3,10,390/year which is 114% higher than bench mark. The family gets 88 days of additional employment due to interventions.

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Intercropping castor brings cheers to farmers of North Gujarat

Hybrid cotton, hybrid castor and groundnut are important cash crop of Kachchha district as well as north Gujarat. Generally, these crops are sown as sole crop under different row spacing according to resources and capacity of soil. Now hybrid cotton, hybrid castor and groundnut are major pre-dominant crops due to their better adoptability, thrive well with good production, through agronomic manipulation of spacing and sowing time. The said crops can be converted in to intercropping/ relay cropping system through intensification. These crops offer great scope for growing in different types of crops as an intercrop and there by helps to harvest the potential productivity and minimize risk under climate hazard conditions in dry as well as irrigated conditions and satisfy the farmers need. Intercropping of short duration pulses like green gram, black gram, cowpea, cluster bean helps in building up of fertility status of soil by fixing atmospheric nitrogen. By growing different fodder crops *viz*. lucerne, chicory, carrot, maize provide green fodder for animals in farming system and also additional income to households. There is also possibility to grow high value oil seed crops sesame for better remuneration as compared to sole castor. Hybrid castor is a most prominent oil seed crops that can be grown as main or intercrop in cropping systems with long and short duration crops for better remuneration under north Gujarat conditions.

Efforts were made to generate additional income by growing different intercrops through supply of hybrid seeds/improved seeds of hybrid cotton, hybrid castor, lucerne, spices seeds for utilizing the space available between the two rows of hybrid cotton/hybrid castor through intercropping.

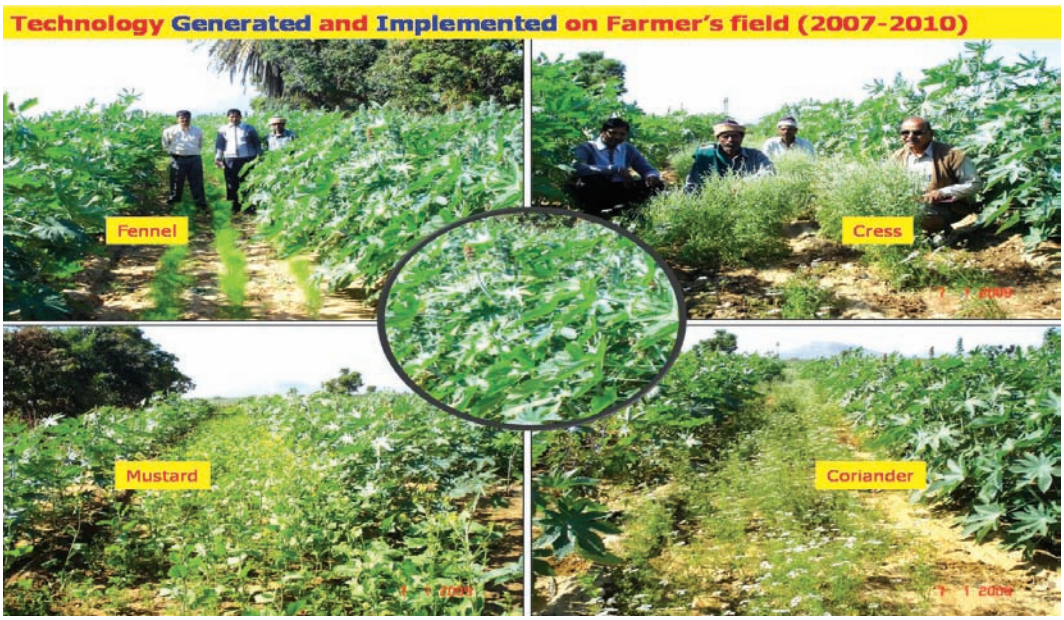
Mr. Nirmalsinh Zala an enthustic and progressive farmer of village Manjal from Nakhatrana block of Kachchha district was very interested regarding adoption of new technology. He is medium land holding farmer having 2 ha. He was growing hybrid cotton, hybrid castor and groundnut every year as traditional crops and getting average net income of Rs. 78,500. He was growing above said crops as a sole crop according to his traditional method and availability of implements. He has one tube well for irrigation. Due to sole crops under their traditional row spacing there was no

Income from sole crops (before interventions)

Existing crops	Yield (kg/acre)	Total income (Rs./acre)	Cost of cultivation (Rs./acre)	Net profit (Rs./acre)
Hybrid castor	1,200	48,000	18,000	30,000
Groundnut	800	32,000	15,500	16,500
Hybrid cotton	1,000	45,000	24,000	21,000
Total	3,000	1,25,000	57,500	67,500

any chance to grow/introduce any intercrop for increasing the intensity as well as additional income through intercrops.

At the time of farmers selection for on-farm research, he came in contact with OFR scientist of Bhachau centre in 2010. He and other farmers were advised and explained regarding new technology of intercropping in their existing traditional crops through agronomic manipulation of sowing time and row spacing. Due to his more interest in technology, he had accepted the proposal of intercropping/relay cropping.



For this purpose, he has spared his three acres of land to adopt intercropping modules in his existing crops of hybrid cotton, hybrid castor and groundnut.

In one acre each was sown for different type of intercropping modules *viz*. Hybrid cotton+hybrid castor, groundnut+hybrid castor, hybrid castor+sesame and hybrid castor+different spices and fodder crops as a demonstration in small area to satisfy homestead need in farming system perspective under crop module.

One acre of hybrid Bt. cotton was sown under advanced planting in third week of May for better use of spared tube well water as well as man power. Hybrid cotton sown at row spacing of 180 cm was intensified by hybrid castor variety GCH-2. One line of hybrid castor in between two rows of cotton at row spacing of 60 cm, with recommended package of practices. Another one acre of groundnut GG-2 sown in advance before onset of monsoon at 30 cm row spacing through irrigation. At the time of sowing bund was raised for irrigation as well as for protective irrigation after six rows of groundnut. After one month of sowing, of groundnut, hybrid castor variety

GCH-2 was dibbled on bund at 60cm intra-row spacing. All agricultural operations were carried out according to guidance of OFR Scientist, from sowing to harvest. Another one acre of hybrid castor was intercropped with oil seed crop sesame in 1:2 ratio. After maturity all the crops was harvested and economics was worked out particularly for additional income from intercrops.

In the same village, his cousin was also advised to grow different spices crops *viz*. fenugreek, cress, fennel and coriander for meeting the homestead need of spices and remaining for sale, where as fodder maize and carrot was grown for green fodder. Another two rows of fodder maize was grown as an irrigation water speed breaker for better irrigation to castor crop as soil was sandy and field was somewhat sloppy. The economics after intervention is given below.

Income after intercropping interventions

Crops	Total gross income main crop (Rs./acre)	Additional gross income (Rs./acre)	Total gross income (Rs./acre)	Total cost of cultivation (Rs./acre)	Cost of interventions (seeds)	Net profit (Rs./acre)
Hybrid cotton+ hybrid castor	48,000	36,400	84,400	32,000	600	51,800
Groundnut+ hybrid castor	32,000	29,650	61,650	23,500	600	37,550
Hybrid castor+ hybrid cotton	45,000	15,600	60,600	22,000	400	38,200
Total (3 acres)	1,25,000	81,650	2,06,650	77,500	1,600	1,27,550

By adopting intervention of intercropping in existing crop through agronomic manipulation it fetched additional income of Rs. 81,650 from three acers of land. Intercropping gave additional income of Rs. 36,400 from hybrid cotton+castor, Rs. 29,650 from groundnut+castor and Rs. 15,600 from hybrid castor+sesame respectively.

Social impact : As a result of intervention (different intercrops recommended by OFR, Bhachau), farmers of his village and nearby villages grown this type of crop modules


For Fodder
Maize
Lucerne
Carrot
Maize
Chikori


Hy.bt.cotton+hy.castor
Fenugreek
Isabgol

particularly groundnut of hybrid castor and hybrid cotton+hybrid castor in their fields. They have started replicating the system since 2009-2010 and they are benefitted through additional income as well as soil sustainability.

Summary : Many of the farmers have been encouraged by seeing the additional income generated as well as insurance against failure of one crop due to climatic hazard and fluctuation market price of grown crops through intercropping/relay cropping in existing crop of hy.cotton, groundnut, and castor. Now farmers of different districts of north Gujarat has started practicing this system of intercropping and relay cropping to a larger extent and getting additional income in cropping system perspective. The newly tested hybrid cotton+hybrid castor, groundnut+hybrid castor which can play a role model in bringing up the income of farmers of the north Gujarat particularly Mehsana, Kachchha, Patan, Banaskantha and Sabarkantha districts particularly and the zone as a whole.

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Sustainability and livelihood through mixed cropping of mustard and lucerne (seed production)

North Gujarat is dominated by agriculture + animal husbandry and animal husbandry + agriculture depending upon the resources available to small and marginal farmers. *Kharif* pearlmillet and *rabi* mustard is predominant cropping system since years but now a days due to abnormal weather condition, erratic and uneven rainfall, increase in irrigation facilities, low market price of pearlmillet and major problem of wild pigs has reduced the area of *kharif* pearlmillet. The different *kharif* crops *viz*. hybrid cotton, hybrid castor, pulses, fennel, sesame has taken its place as alternative crops. Mustard is well adopted and low cost oilseed cash crop having short duration in *rabi*. The majority of soil of north Gujarat is sandy loam to loamy sand in nature having poor soil fertility.

Due to animal husbandry based farming system, lucerne is important legume fodder grown by all the farmers having milch animals for supplying green fodder in *rabi* and summer season, which require costly seeds for sowing. Due to small holding and shy seeder crop, the seed yield of lucerne is generally not produced by small farmers as a sole crop which is sown as fodder. The unit cost of seed of lucerne is generally higher than any other legume crops.

Mustard is grown in large acreage as a sole crop and after cutting, summer pearlmillet is grown for staple food and dry fodder but now a day's looking to high production cost of summer bajra due to costly irrigation water, fertilizers, seeds and problems of higher rate of labour charges and poor rates of grains in market, summer pearlmillet crop uneconomical now a days.

Mustard research station, S.D. Agricultural University, Sardarkrushinagar has recommended mixed cropping as and alternate cropping system in mustard + lucerne (seed) for better remuneration for the farmers who are growing mustard as a sole crop in *rabi* and keeping field fallow during summer.

On farm participatory research project on farmers' fields selected Shri Chaudhary Fuljibhai during 2010-11 in village Kamalpur, Taluka-Chansma, Dist.-Patan to test

the mixed cropping of mustard with lucerne (seed) to see the efficiency of this system under intensification. He was given seeds of lucerne variety (Anand-2) and technical advice from crop sowing to harvest of mustard and lucerne.

Total cost of intervention was only Rs 3,300/acre which contributed for additional income of Rs 20,500/acre. Net return per rupee invested on interventions stands at 5.21. The farmer earns net income of Rs 17,200 which is 167% higher than sole mustard.

Sole mustard

Mustard yield	Total income (Rs/acre)	Cost (Rs/acre)	Net profit (Rs/acre)
810 kg/acre	24,300 @ 30/kg	14,000	10,300

Mixed cropping of mustard+ Lucerne (seed)

Crops	Yield (kg/acre)	Cost of intervention (Rs/acre)	Additional income (Rs/acre)	Total income (Rs/acre)	Net return (Rs/acre)	B:C ratio
Mustard +	810	_	_	_	10,300	_
Lucerne	180	3,300	20,500	44,800	17,200	5.21
				Total net return	27,500	

Besides, more income from seeds, family has met the extra legume fodder for lean period and improved the soil fertility. As a result of the low cost interventions, only extra cost of seed of lucerne and three irrigations with one spray of insecticide, better additional income through high seed cost of lucerne in market and better straw for lean period to feed dairy animals in May-June. It has helped to farmers to mitigate from crisis of nutritious proteineous dry feed. By seeing of this module the farmers of villages and nearby villages who grow only mustard and then left the field fallow have started mustard + lucerne module for more remuneration. This system not only increase soil fertility by adding atmospheric nitrogen, reduction in soil salinity and alkalinity and by increasing permeability of problematic soils as lucerne roots go deep up to 1 to 3 m.

Glimpses of interventions

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Management of internal parasites in cattles and buffaloes

The majority of the people of Panchmahal district in Gujarat are tribals. They adopt mixed farming which mainly includes crop production and animal husbandry. In general, tribal farmers keep more number of cows and buffaloes as compared to non-tribal farmers. The average milk productivity of cows and buffaloes owned by tribal farmers is very low. There are several reasons for the low milk productivity of cows and buffaloes. These includes poor nutrition, unhygienic cattle sheds, un-availability of green fodder round the year, lower genetic potential of local breed, lack of vaccination, internal parasites and disease. Internal parasites many times remain un-noticed which result in poor health and lower the milk production. Sometimes they cause death of young animals also.

In general farmers of Panchmahal district adopt mixed farming which includes field crop + animal husbandry and/or poultry. Low milk production and poor heath of animals due to internal parasites was identified as problem for on-farm research.

During routine visit to adopted farmers, it was doubted that some of the animals might be suffering from internal parasites. The faecal samples of 82 animals were collected and sent to Department of Parasitology, College of Veterinary Science and Animal Husbandry, Anand Agricultural University, Anand (Gujarat) for detailed analysis. Out 82 samples, 22 (26.83%) had dangerous parasitic protozoa namely Coccidia and Cilliates. The Head of Department informed that these parasitic

Oral feeding of medicine to Coccidia infested buffalo

protozoa are very dangerous as they can cause diarrhoea varying in severity from watery faeces to blood. Dehydration, weight loss, depression, loss of appetite and occasionally death may also occur. Even less severe infection, where there are no signs of the disease, may affect the growth and health of an animal.

To control these parasites, sulphadimidine 5 g x 20 bolus for adult animals and 5 g x 6 bolus for young calves was recommended. Accordingly, all the infected animals have been treated. One month after treatment, faecal samples of treated animals were collected and analysed. This time all the previously infected animals were found free from the parasitic protozoa.

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Impact of improved variety of *kharif* maize

Maize is the predominant cereal crop of Panchmahal district of Gujarat state. In Panchmahal, maize is cultivated in area of 1.10 lakh ha during *kharif* season having average productivity of 1206 kg/ha. It is a staple food of tribal people. It plays a significant role in ensuring livelihood security and augmenting income farmers. Generally, farmers of Panchmahal district grow white seeded local varieties during *kharif* season. As a result the average productivity of this crop is poor in this area. In general farmers of Panchmahal district adopt mix farming which includes field crop + animal husbandry and/or poultry. Majority of the farmers follow maize and rice-maize cropping system. Growing of local variety was identified as major constraint for low productivity.

The maize variety GM-6 developed by Main Maize Research Station, Anand Agricultural University, Godhra is one of the best composite varieties developed for maize growing areas. It is extra early (75 - 80 days), drought escaping and white flint grained variety for marginal environment of tribal belt of Gujarat. It is also resistant to maydiys leaf blight, brown stripe downy mildew and curvularia leaf spot. Seeds of this variety were provided to the contact farmers of 3 villages each of high and low productive blocks of Panchmahal district. In all, seeds were given to 12 contact farmers under OFR 3 experiment. Frequent and need based advisory was provided to all the farmers right from sowing to harvest. The advisory included training, visit by agronomist and field staff, telephonic advisory and supply of critical inputs including seeds.

Adoption of improved composite variety of maize in place of local variety increased the average grain yield of maize from 1665 to 2021 kg/ha. Fodder yield of maize also increased from 1982 to 2434 kg/ha. Higher grain yield strengthened the food security of tribal people. Increase in fodder due to improved variety provided more fodder to the cattle and buffaloes. The net income of farmers also increased by Rs. 5006/ha.

Yield and economics of varietal intervention in *kharif* maize

House hold no.	Area (ha.)	Before intervention Grain yield (kg/ha)	Before intervention Fodder yield (kg/ha)	After intervention Grain yield (kg/ha)	After intervention Fodder yield (kg/ha)	Cost of intervention (Rs/ha) (seed)	Additional profit
1	0.4	1625	1875	1950	2375	600	4625
2	0.4	1750	2125	2125	2550	600	5125
3	0.5	2400	2800	2900	3480	600	7260
4	0.4	1800	2188	2188	2625	600	5313
5	0.6	1500	1833	1833	2200	600	4467
6	0.6	1333	1600	1617	1933	600	3750
7	0.48	1583	1875	1906	2292	600	4431
8	0.36	1600	1944	1944	2333	600	4656
9	0.36	1389	1667	1667	2083	600	3844
10	0.48	1667	1979	2021	2417	600	4879
11	0.2	1750	2000	2150	2600	600	5800
12	0.36	1667	1944	2083	2500	600	5928
Mean	0.43	1665	1982	2021	2434	600	5006

Composite variety of maize GM-6

Impact : Looking to the performance of GM-6 maize, other farmers of same villages have grown GM-6 in the next season.

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Enhancing farm income through crop diversification

In Panchmahal district of Gujarat, maize-maize and rice-maize is the predominant cropping system in upland and low land areas, respectively. Maize is cultivated in 1.10 lakh ha during *kharif* season and 0.25 lakh ha area during *rabi* season. The average productivity of maize is 1206 and 1611 kg/ha during *kharif* and *rabi* season, respectively. Thus, the productivity of maize-maize system is low. Being highly nutrient exhausting crops, it removes high amount of nutrients from soil. Nowadays, this crop is highly damaged by the wild pigs. Looking to above constraints in maize-maize system, there is need to diversify cropping system. This system can be replaced by Bt cotton. In Gujarat, Bt cotton is the most widely grown crop. It is cultivated in the more than 25 lakh ha area. In general farmers of Panchmahal district adopt mixed farming which includes field crop + animal husbandry and/or poultry.

Nine farmers adopting maize-maize cropping system were convinced to grow Bt cotton as diversified crop. They were given complete technical knowledge of growing Bt cotton, right from land preparation to harvest of crop. Seeds of Bt cotton "Hybrid 6" were provided to farmers.

Yield and economics of existing cropping system (maize-maize)

House hold No.	*Kharif*						*Rabi*					Total
	Area (ha)	Grain yield (kg/ ha)	Fodder yield (kg/ ha)	Cost of culti-vation (Rs/ ha)	Total income (Rs/ha)	Net income (Rs/ha)	Grain yield (kg/ ha)	Fodder yield (kg/ha)	Cost of culti-vation (Rs/ ha)	Total income (Rs/ ha)	Net income (Rs/ha)	Net income (*Kharif + Rabi*) (Rs/ ha)
1	0.60	1670	2080	12000	26910	14910	2420	2920	17000	40220	23220	38130
2	0.48	1560	2030	10000	25355	15355	2500	3020	15600	41560	25960	41315
3	0.24	1560	2080	12500	25480	12980	2920	3500	16000	48460	32460	45440
4	0.24	1670	2190	15630	27185	11555	3130	3750	14500	51940	37440	48995
5	0.36	1530	1940	13000	24740	11740	2500	3060	15000	41680	26680	38420
6	0.48	1560	2080	12000	25480	13480	2080	2500	15600	34540	18940	32420
7	0.48	1670	2190	14000	27185	13185	2500	2500	16000	40000	24000	37185
8	0.36	1530	1940	12500	24740	12240	2640	3060	14500	43500	29000	41240
9	0.24	1670	2290	14500	27435	12935	2500	3130	15800	41890	26090	39025
Mean		1602	2091	12903	26057	13153	2577	3049	15556	42643	27088	40241

All the farmers successfully cultivated Bt cotton. Data on cost of cultivation, net and gross income of existing (maize-maize) were recorded.

Yield and economics of diversified system (Bt cotton)

House hold No.	Area (ha)	Seed Cotton yield (kg/ha)	Total Income (Rs/ha)	Cost of cultivation (Rs/ha)	Net profit (Rs/ha)	Additional profit over existing system (Rs/ha)	Per cent increase in profit over existing system
1	0.60	2830	127350	55000	72350	34220	89.75
2	0.48	2900	130500	52000	78500	37185	90.00
3	0.24	2850	128250	55000	73250	27810	61.20
4	0.24	3000	135000	60000	75000	26005	53.08
5	0.36	2780	125100	52000	73100	34680	90.27
6	0.48	2400	108000	47500	60500	28080	86.61
7	0.48	2600	117000	50000	67000	29815	80.18
8	0.36	2500	112500	45000	67500	26260	63.68
9	0.24	2600	117000	45000	72000	32975	84.50
Mean..		2718	122300	51278	71022	30781	77.70

Grain yield of *kharif* and *rabi* maize was 2091 and 2577 kg/ha, respectively. The respective value for net income was Rs. 13153 and 27088/ha. In all, net income of the existing system was Rs. 40141/ha. The average seed cotton yield of Bt cotton in diversified system was 2718 kg/ha. The average net income was Rs. 71022/ha. Thus, there was additional net profit of Rs. 30781/ha over existing system which is 77% higher than maize-maize system.

Diversification of maize with Bt cotton

Looking to the performance of Bt Cotton, others farmers have also grown Bt cotton from ensuing season.

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HARYANA

Success of marginal farmer with IFS approach

GPS Location

Latitude	Longitude
$29^0$36'597'' N	$75^0$07'829'' E

Shri Pala Ram is a marginal farmer in village Farwain of block Sirsa in Sirsa district of Haryana having only 0.25 ha land. Cotton-Wheat is the predominant cropping system in the region. The most of farmers of this region rear buffalo and cow as dairy animals. The annual income of Shri Pala Ram from agriculture was only Rs. 62300. It was difficult for him to look after his family of five members with his small piece of land. He was getting 2800 kg seed cotton yield and 4000 kg wheat yield/ha. He was having one buffalo and one cow. Buffalo was giving 2000 liters milk during lactation and cow was giving 1600 liters milk during lactation. His net income from crops and livestock component was Rs. 30830 and Rs. 31470 respectively.

As part of on-farm research constraints were identified. In crops, it was identified that farmer was applying recommended doses of nitrogen and phosphorous through DAP and urea fertilizers. But, he was still not aware about the increasing deficiencies of $ZnSO_4$ and potash. In livestock, there was imbalance nutritional feeding. The farmer was feeding his livestock with wheat bhusa and green fodder only. Farmer was not


Training of farmers on Integrated Farming System


Nutritional kitchen garden

doing any kitchen gardening. The processing of milk was not in practice at his farm. He was simply selling milk to the middle man.

As a part of experiment, in an area of 0.1 ha, the recommended doses of $ZnSO_4$ (25 kg/ha) and potash (100 kg/ha) were applied in crops. In case of livestock milch animals were fed with 10 kg of mineral mixture & 100 kg of nutritional feed/animal. Nutritional kitchen garden was started. He was told that he can save his day to day expenditure on buying of vegetables from market through kitchen garden. Milk was processed in the form of ghee to have more profit. In livestock diversification, goat was integrated to get additional income.

The productivity of cotton and wheat increased by application of $ZnSO_4$ and potash. It was found to be 2900 kg/ha in cotton, whereas it was 5100 kg/ha in wheat. The balanced nutrition to livestock resulted in increase in milk production upto 25 liters/month in cow & 17 liters/month in buffalo.

He was guided to develop nutritional kitchen garden at his farm. He did the same and he saved Rs 2500-3000 during the first year by reducing market expenditure on vegetables. The farmer was told about the benefit of goat rearing. He was convinced and started with one goat. Within six months goat gave birth to two kids. After three months, he sold one kid for Rs. 2800. The goat is giving regular income to farmer. Being satisfied with goat rearing, he has purchased one more goat. At present he is having two goats and one kid. He is now fully convinced that he can earn better in goat rearing and planning to expand it further using farming system approach.

Ghee making as household activity

Integration of goat

Documented by: Anil Kumar Mehta,Cotton Research Station, Sirsa under CCS Haryana Agricultural University, Hisar, Haryana

HIMACHAL PRADESH

Low cost interventions in farming systems perspective triples net income

GPS Location

Latitude	Longitude	Altitude (m)
31^{0}46'90'' N	76^{0}22'25'' N	496

Shri Ramesh Chand s/o Shri Dhuni Chand having the family of three members was deriving his livelihood from 0.48 ha of land located in village Luthan, Block Dehra in Kangra district of Himachal Pradesh. The area receives annual rainfall of 1902 mm with mean minimum and maximum temperature of 15.5 & 23.7^{0}C, respectively. Maize-wheat and rice-wheat are the prominent cropping system with crops+livestock as the prominent farming system in the region. Buffalo & cow are the main livestock reared by farm households.

Shri Ramesh Chand used to grow maize in the *kharif* and wheat in the *rabi* in almost all the area with a little area under green fodder crop for feeding buffalo. In general, the productivity of rice, wheat and livestock was very low (Maize: 1830 kg/ha, wheat: 1800 kg/ha and milk yield of buffalo: 3 liters/day). With the prevalent farming system being adopted by him comprising two crops in the sequence (maize-wheat), rearing a buffalo & growing fodder, he was earning net income of only ₹ 9100/year on which his family was surviving.

Optional module of kitchen garden

During 2011, On-Farm Research Centre of AICRP on Integrated Farming Systems operating in Kangra district

Diversification with improved Gobhi-sarson in *rabi* (HPN-3)

Introduction of cauliflower for enhancing income

Improved variety of wheat (HPW-236)

under CSK HPKV, Palampur identified Shri Ramesh Chand for conducting on-farm research experiment on on-farm evaluation of farming systems modules for improving livelihood of small and marginal farmers.

Benchmark survey was conducted and module wise constraints were identified and these constraints were addressed with low/no cost interventions in four modules namely, cropping system, livestock, value addition and optional based on farmers' perception and need.

In crop module, constraints of use of low yielding traditional crop varieties, imbalance and inadequate nutrient application and improper weed management were identified. These were addressed by using improved crop varieties, applying balanced and recommended nutrient doses, scientific management of weeds/pests, and diversifying the existing cropping systems. Similarly, in livestock module, the major problems of low milk yield which was due to inadequate and imbalance fodder supply particularly during *rabi* season was addressed through supplementation of mineral mixture and making round the year green fodder production by growing fodder sorghum in *kharif* and berseem+oats in *rabi*.

The existing cropping system was diversified by introducing rice (var. Kasturi Basmati) & pulse (black gram), in *kharif* and oilseed (gobhi sarson) and vegetable (onion) during *rabi* in the system.

To overcome the constraint of low price of surplus crop produce, manual seed grading of wheat and the constraint of lack of technical know-how for raising vegetable crops in the kitchen garden was addressed by growing seeds/seedlings of seasonal vegetables on scientific lines in the kitchen garden which helped raising the net income through sale of surplus produce, besides, fulfilling the family requirement. As result, the surplus produce of wheat which was manually graded for seed was liked and procured by nearby farmers in the village

Three years study on the household revealed that average total cost of intervention of ₹ 6690/year on account of inputs in all the modules, resulted in additional income of ₹ 31978/year. Currently, the household earns net income of ₹ 27943/year which is more than three times than the before interventions.

Besides, the higher income, the family meets the nutritional requirements by in house production of quality products of pulses, oilseeds, vegetables and milk. Nearby farmers are also showing interest in adopting all the modules as these are of low cost in nature.

Documented by: S.K. Sharma, S.C. Negi, S.S. Rana and S.K. Subehia, AICRP-IFS, Chaudhay Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya, Palampur

Interventions in farming system doubles net income of a marginal farm household

GPS Location

Latitude	Longitude	Altitude (m)
32^{0}06'83'' N	75^{0}56'09'' E	470

Shri Roshan Lal s/o Shri Ram Ditta having the family of four members was deriving his livelihood from 0.40 ha located in village Moch, Block Fatehpur in Kangra district of Himachal Pradesh. The annual rainfall of the area is 1902 mm with mean minimum and mean maximum temperature of 15.5 & 23.7^{0}C, respectively. Maize-wheat and rice-wheat are the prominent cropping system and crop+livestock is the prominent farming system in the region. Buffalo and cow are the main livestock species and few families are rearing 2-3 goats or sheep/household also.

Shri Roshan Lal had grown maize and paddy in *kharif* and wheat in *rabi* with little area under green fodder for feeding his 2 buffaloes (one milking and one dry). Average yield of maize harvested by him was 1800 kg/ha and rice & wheat were around 1600 kg/ha. As such, the productivity of both the crops was very low. Also, the milk yield of buffalo was < 3 liters/day.

With the prevalent farming system being adopted by him comprising two main cropping systems (maize-wheat and rice-wheat), rearing 2 buffaloes (one lactating and one dry) and growing some vegetables in the kitchen garden and fodder, he was earning net income of only ₹ 7300/year.

During 2011, On-Farm Research Centre of AICRP on Integrated Farming Systems operating in Kangra district under CSK HPKV, Palampur identified Shri Roshan Lal for conducting on-farm research experiment on on-farm evaluation of farming systems modules for improving livelihood of small and marginal farmers.

Benchmark survey was conducted and module wise constraints were identified and these constraints were addressed with low/no cost interventions in four modules

Diversification with Gobhi-sarson (HPN-3): key for enhancing income

namely, cropping system, livestock, value addition and optional based on farmers' perception and need.

Three years study on the household revealed that with average total cost of intervention of ₹ 4136/year in all the modules, an additional income of ₹ 19877/year was realized. Currently, the household earns net income of ₹ 14921/year which is more than two times than before interventions. Besides, the higher income the family meets the nutritional requirements by in house production of quality products of pulses, oilseeds, vegetables and milk.

Documented by: S.K. Sharma, S.C. Negi, S.S. Rana and S.K. Subehia, AICRP-IFS, Chaudhay Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya, Palampur

Balanced fertilization in crops : key for improving income

GPS Location

Latitude	Longitude	Altitude (m)
31^{0}54'37'' N	76^{0}16'90'' E	518

Shri Dev Raj having the family of four members was deriving his livelihood from 0.20 ha of land located in Hatli, Block Dehra in Kangra district of Himachal Pradesh. The annual rainfall of the area is 1902 mm with mean minimum and mean maximum temperature of 15.5 & 23.7^{0}C, respectively. Maize-wheat and rice-wheat are the prominent cropping system and crop+livestock is the prominent farming system in the region. Buffalo and cow are the main livestock species and few families are rearing 2-3 goats or sheep/household also.

Shri Dev Raj used to grow maize on 0.16 ha and rice on 0.04 ha in *kharif* and wheat in almost all the cultivated area during *rabi*. He had one local cow and one bullock. In addition to this, he used to work for wages in the nearby fields to fulfill daily needs of his family. Preliminary interaction/surveys revealed that productivity of crops was very-very low at his farm. The average yield of maize, rice and wheat were 800-1000, 1200 and 1000 kg/ha. With the prevalent farming system being adopted by him comprising of growing three crops in a year, rearing a local cow and a bullock, and making some cash earnings through labour work, he was investing ₹ 4400/year and earning net income of only ₹ 4000/year.

Besides, use of traditional crop varieties, the major constraint identified for low productivity at his field was imbalance and inadequate nutrient application to all crops being grown by him. It was found that he was using only nitrogenous fertilizers (urea) for all the crops & that too at less than recommended rates. He was applying N @ 50 kg/ha during each season without considering any time and method of application.

During the year 2012, on-farm research unit of AICRP on Integrated Farming Systems operating in CSK HPKV Palampur in Kangra district identified Shri Dev Raj for conducting on-farm research on crop response to plant nutrients in predominant cropping systems.

Portion of his field measuring 0.06 ha was selected for conducting the experiment. Maize variety HQPM-1 and wheat variety HPW-236 were grown during *kharif* and *rabi* respectively. Six treatments comprising control, N, NP, NK,NPK, NPK+Zinc based on soil test were applied to both the component crops of the sequence. Recommended doses of N, P & K for maize (90, 45, 30 kg/ha) and wheat (80, 40, 40 kg/ha) were applied. Comparison of treatments was made with farmer's practice which was maintained just adjacent to the experiment. The yield data were collected for various treatments & economics of the treatments were calculated as per the prevailing market prices of inputs and the produce.

Balance fertilization in maize-wheat system during 2012-13

Treatments	Maize Yield (kg/ha)		Wheat Yield (kg/ha)		Cost of Cultivation (Rs./ha) (Kharif+Rabi)	Net Returns (Rs./ha) (Kharif+Rabi)	Net Returns per rupee invested
	Grain	Straw	Grain	Straw			
Control	1380	2513	1249	2748	39236	11298	0.28
N	1745	3108	1499	2998	40792	19778	0.48
NP	2645	4232	2373	4060	46102	43673	0.94
NK	2380	3968	2123	3498	41174	38823	0.94
NPK	3174	4695	2873	4810	47555	59601	1.25
NPK+Zinc	3306	5290	3123	4997	50432	63420	1.25
Farmer's Practice	1428	2540	1374	2936	39427	16523	0.41

The results revealed that recommended dose of NPK resulted in significantly higher maize and wheat grain as well as straw yields .Recommended nutrient application (NPK) recorded 122% higher maize grain yield & 109 % higher wheat grain yield over farmer's practice. As a consequence, net returns from NPK treated plots were 260% higher than the farmer's practice. Net returns per rupee invested was also more with the application of recommended NPK (1.25) as compared to farmer's practice(0.41). The farmer was very much satisfied with the performance

Comparative performance of scientific and farmers' practice

Visit of OFR staff of Northern states

Farmers family in farmers' practice

of crops at his experimental field. Treatment differences were clear at the field. His field was also visited by Director, ICAR-IIFSR and OFR Agronomist and Field Assistants from Northern states during OFR Regional during training for OFR staff held at CSK HPKV Palampur in April 2013.

Documented by: S.K. Sharma, S.C. Negi, S.S. Rana and S.K. Subehia, AICRP-IFS, Chaudhay Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya, Palampur

JAMMU AND KASHMIR

Improved package improves income of maize-wheat system

GPS Location

Latitude	Longitude	Altitude (m)
$32^0$42'051'' N	$075^0$09'344'' E	621.6

Maize and wheat are two major crops grown in the Samba district of Jammu and Kashmir. The annual rainfall received is 1142mm. The major constraint of the area for low yielding surfaced was the application of imbalanced nutrients (urea and DAP only). Shri Prem Singh having 1.2 ha located in village Kuralta, Samba district was adopted for the addressing the constrains on experimental basis. Nutrient application used by the farmer before intervention per hectare in maize – wheat crops was 28.98, 27.27 kg N and P_2O_5 with FYM @ 1.5 t/ha. Yield of crops obtained by the farmer before intervention is given below.

Season	Crop	Variety	Grain yield (kg/ha)	Price (Rs/kg)	Straw yield (kg/ha)	Price (Rs/kg)	Total net returns (Rs/ha)
Kharif	Maize	Local	2690	14	5480	2	28140
Rabi	Wheat	Local	2680	14.80	4180	3	33204
Total	-	-	5370	-	9660	-	61344

On-Farm Research Centre of AICRP on IFS located in Samba district under the Sher-e-Kashmir University of Agricultural Sciences & Technology, Jammu conducted the on-farm experiment on response of crops to applied nutrients in farmers participatory mode. Recommended dose of N, P2O5, K2O and ZnSO4 @ 90:60:30:20 kg/ha to mazie and 100:50:25:20 kg/ha to wheat was tested in improved variety along with farmers package. The results are given below.

Season	Crop	Variety	Grain yield (kg/ha)	Price (Rs/kg)	Straw yield (kg/ha)	Price (Rs/kg)	Total net returns (Rs/ha)
Kharif	Maize	Kanchan	3380	14.00	6740	2	40800
Rabi	Wheat	PBW 175	3620	14.80	5770	3	51886
Total	-	-	7000	-	12510	-	92686
Difference	-	-	+1630	-	+2850	-	+31342

Response of maize and wheat to applied nutrients and improved package in Samba district of Jammu and Kashmir. Due to improved variety of maize and wheat with balanced application of nutrients, farmer received Rs. 31342/ha as additional net returns with investment of only Rs. 4400/ha on account of seed and additional fertilizer cost.

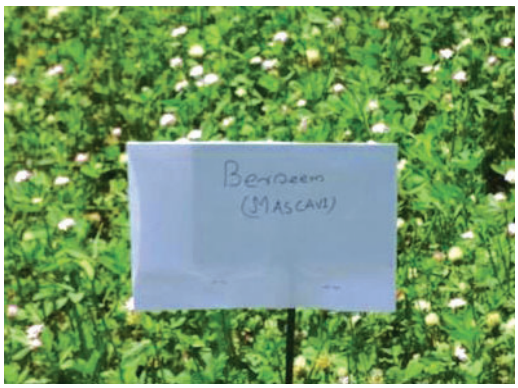
Documented by: Ashok Kumar Gupta, N.P. Thakur, D. Kachroo and A.W. Katoch, OFR Centre, Samba, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu (J&K)

IFS interventions improves income of small farm household

GPS Location

Latitude	Longitude	Altitude (m)
$32^0$37'692'' N	$074^0$54'269'' E	314.5

Shri Ramesh Kumar s/o Basant Ram in Tanda village of Vijaypur block is a small farmer having holding of size 1.6 ha was selected under AICRP on for on-farm research during 2011-12. The farmer was traditionally having crop+dairy farming system cultivating rice-wheat system, berseem and fodder with cow. The lower crop and livestock yield was identified as constraints due to use of local/own seed, use of imbalanced nutrients (N and P only), lack of technical knowledge about crop cultivation and imbalanced feeding of livestock. After getting in contact with OFR team the farmer was taught to use balanced fertilizers and improved seeds for crops and supplement of mineral mixture to dairy animals. Diversification of crops was also under taken with early rice, vegetable pea and summer blackgram. The farmer was also supported by providing vanaraja poultry chicks for background poultry and mushroom



Berseem

Vanaraja poultry

Dhingri mushroom for higher income

Improved package of wheat

(Dhingri) for enhancing the income from farm. Due to the IFS interventions, farmer is getting round the year income The income obtained is given below.

Particular	Traditional method (Rs)	IFS interventions (Rs)	Additional (Rs)	% income over traditional method
Cost (Rs)	7683	75620	+3937	5.5
Net income (Rs)	190377	240350	+49973	26.2

Capacity building on mushroom production

Documented by: A.K. Gupta, Anil Gupta, N.P. Thakur, D. Kachroo, J.K. Baru and Kuldip Sharma, OFR Centre, Samba, Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu and Kashmir

Improved package of rice–wheat system improves income

GPS Location

Latitude	Longitude	Altitude (m)
32^{0}33'490'' N	074^{0}59'235'' E	312.8

Shri Khazan Singh having holding of 0.6 ha in Badali village of Samba district of Jammu and Kashmir grows rice-wheat and maize-wheat systems. OFR Centre of AICRP on IFS under Sher-e-Kashmir University of Agricultural Sciences and




On-farm nutrient response of rice-wheat system in Samba district of Jammu and Kashmir

Technology, Jammu conducted the on-farm nutrient response in rice-wheat system. The results of expenditure and income are given below.

Particulars	Farmers package	Improved package with balanced nutrients	Additional	%
Cost (Rs/ha)	44410	47540	3130	7.0
Net Income (Rs/ha)	67710	87867	20157	29.7

Visit of monitoring team on-fam experiments

Farmers package: Basmati 370 variety with 40:40 kg N and P_2O_5 and 1.5 t/ha of FYM to rice and local/own seed of wheat with 40:50 kg N and P_2O_5.

Improved package: Basmati 370 variety with 30:20:10:20 kg N, P_2O_5, K_2O and $ZnSO_4$/ha and PBW 550 wheat with 100:50:20 kg N, P_2O_5, K_2O/ha.

Documented by: Ashok Kumar Gupta, D. Kachroo, N.P. Thakur and Gh. Mohd., OFR Centre, Samba, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu (J&K)

Improved farming system enhances income of marginal farm household

GPS Location

Latitude	Longitude	Altitude (m)
32^{0}38'026'' N	074^{0}53'521'' E	310.3

Shri Saudagar Mal a resident of Bassikhurd, Block Vijaypur, Samba having 0.8 ha area came into contact with scientists of OFR centre, Samba of AICRP on IFS under Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu of during survey. It has been found that the farmer was cultivating only rice during *kharif* and wheat during *rabi*. The main constraints identified were: use of local seed, low crop yield, use of imbalanced fertilizer, lack of technical knowledge about crop cultivation, imbalance feeding/rearing of livestock and conventional method of crop cultivation.

Improved packages of practical in integrated farming system approach

Farming Systems Research Success Stories ICAR-AICRP on IFS

With the consistant efforts and interactions of the scientists of AICRP on IFS, the farmer agreed to integrate more profitable components in farming system mode. The improved and high yielding variety of paddy (PB 370), wheat (PBW 550), technical knowledge about crop cultivation, use of balanced nutrients (potash and Zn), crop diversification of wheat with vegetable pea and black gram, mineral mixture for better nutrition of animal and mushroom cultivation for improving profitability and livelihood of farmer was undertaken.The income obtained through IFS interventions are given below.

Particular	Traditional method (Rs)	IFS interventions (Rs)	Additional (Rs)	% income over traditional method
Cost (Rs)	35740	40460	4720	13.2
Net income (Rs)	95766	135784	40018	41.7

Mineral mixture to livestock and mushroom for income enhancement

Documented by: A.K. Gupta, N.P. Thakur, D. Kachroo and Dheeraj Rajwal, OFR Centre, Samba, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu (J&K)

Fruits of crop diversification : Double income

GPS Location

Latitude	Longitude	Altitude (m)
$32^0$41'526'' N	$75^0$09'589'' E	606

Shri Dhantar Singh of Mugwal village of Samba district having 0.8 ha of land was growing only maize-wheat with local variety and traditional practices. He came in to contact with OFR Centre, Samba of AICRP on IFS under Sher-e-KAshmir University of Agricultural Sciences and Technology, Jammu. After assessing the constraints, scientists sugeested the crop diversification with pulses, vegetables for raising the

Diversification of maize-wheat system with maize, vegetables and pulses

income. THe farmer immediately agreed and practiced under the guidance of OFR scientists.

The income of the farmer doubled due to crop diversification with better B : C ratio.

Practices	Cropping system			Cost of cultivation	Net return (Rs/ha)	B : C ratio
	Kharif	*Rabi*	Summer	(Rs/ha)		
Farmers' package	Maize	Wheat	-	45806	64969	1.4
Crop diversification/ intensification	Maize (kanchan) + okra	Potato (Kufri badshah)	Onion (N 53)	98510	167913	1.7
	Maize + blackgram	Vegetable pea	Okra	65000	120000	1.8

Diversification of maize-wheat system with okra, vegetable pea and onion

Documented by: Ashok Kumar Gupta, Dileep Kachroo, N.P. Thakur and A.W. Katoch, OFR Centre, Samba, Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu and Kashmir

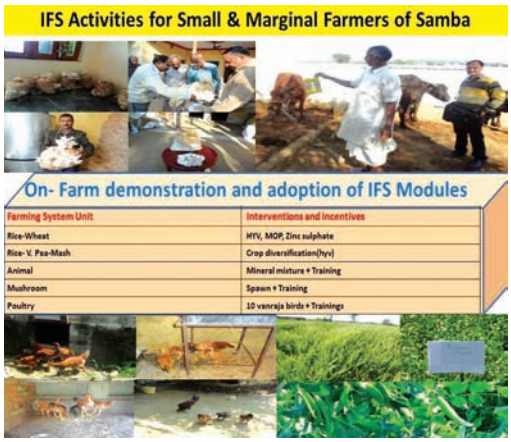
IFS interventions changes life style of marginal farmer

GPS Location

Latitude	Longitude	Altitude (m)
32^{0}37'210'' N	074^{0}55'760'' E	329.5

Shri Sultan Mohamad resident of Sarore village in Samba district of Jammu and Kashmir came to contact with the scientists of AICRP-IFS during field visit. He told his problem that he along with his son having no source of earning during the off season. He was having 0.9 ha and conventional cultivation of crops and rearing of livestock which were less profitable. The farmer was growing local basmati, a tall variety susceptible to lodging in *kharif* and local variety (own ssed) of wheat during *rabi.*

Critical inputs and inspiring training programme were organised for achieving the objectives. The local basmati was replaced with high yielding variety of Pusa 1121 which increased the yield from 2500 to 3500 kg/ha which 40 % increase over the traditional variety without any additional cost of cultivation. In addition, early rice



Glimpses of IFS interventions

Shri Sultan attending the training of mushroom cultivation at OFR office, Dhiansar

variety IET-1410 during *kharif,* vegetable pea during *rabi* and blackgram during summer was introduced to make diversification more stronger.

Berseem local variety was replaced by Mascavi and the yield increased from 2500 to 3500 in 0.05 ha area. High yielding variety of wheat PBW-550 was grown in which yield increased from 2000 to 3390 kg/ha.

In case of dairy, the poor feeding constraint was addressed by providing the critical inputs of improved additional feed for Rs. 10/day/milch animal and Rs. 6/day for mineral mixture. The milk yield increased by 1.2 kg/day/animal. Additional income of Rs. 30/day/animal by investing Rs. 16/day/animal was realized with B : C ration of 1.88. Two additional new subsidiary enterprises of less capital were added for increasing the income and for the judicious utilization of family labour.

Backyard Poultry :- 20 nos. of Vanraja birds were provided to the farmer for livestock diversification along with the training on scientific poultry production. The farmer family could not get 1800 no's of eggs which was sold @ Rs. 5/egg and 64 kg of meat sold @ Rs. 150/kg. Net income of Rs. 10,150/- was obtained by investing Rs. 8450/- with B : C ratio of 2 : 2.

Oyster Mushroom :- 100 nos. of polythene bags having production capacity of 10 kg mushroom was prepared by the farmer under the guidance of mushroom expert with cost of Rs. 4760. Gross income of Rs. 10040/- was realized with B : C ratio of 2.11. The details of improvement in income from 0.9 ha is given below.

Particulars	Existing (Rice-wheat, berseem + dairy)	IFS interventions (Crop diversification + dairy + poultry + oyster mushroom	% increase
Gross Income (Rs.)	75000	1,44000	92
Cost (Rs.)	45000	70000	56
Net income (Rs.)	30000	74000	147

The lifestyle of farmer has changed as he has constructed pacca cattle shed, good dwelling house, increased the number of livestock and enjoying the farming operations throughout the year.

Documented by: Ashok Kumar Gupta, NP Thakur, D. Kachroo, Anil Gupta and AW Katoch, OFR Centre, Samba, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu (J&K)

JHARKHAND

Diversification of wheat with chickpea doubles income

GPS Location

Latitude	Longitude	Altitude (m)
24^{0}26'607'' N	087^{0}43'476'' E	188.1

Shri Vijay Besra of Narayangarh village of Maheshpur block in Pakur district in Jharkhand was having 0.2 ha and with traditional practice, earning only Rs 5850/year. The 7 member family was struggling with this meagre amount. The interventions of diversifications of wheat with chickpea (variety Uday) during *rabi* resulted in additional income of Rs 9190/ year.

Diversification with chickpea

Paramenter	Pre intervention	Post intervention
Cropping system	Rice-Wheat (0.2 ha)	Rice (0.2 ha) - Wheat (0.1 ha), Chickpea (0.1 ha)
Gross income (Rs)	11050	18700
Cost (Rs)	5200	3660
Net income (Rs)	5850	15040

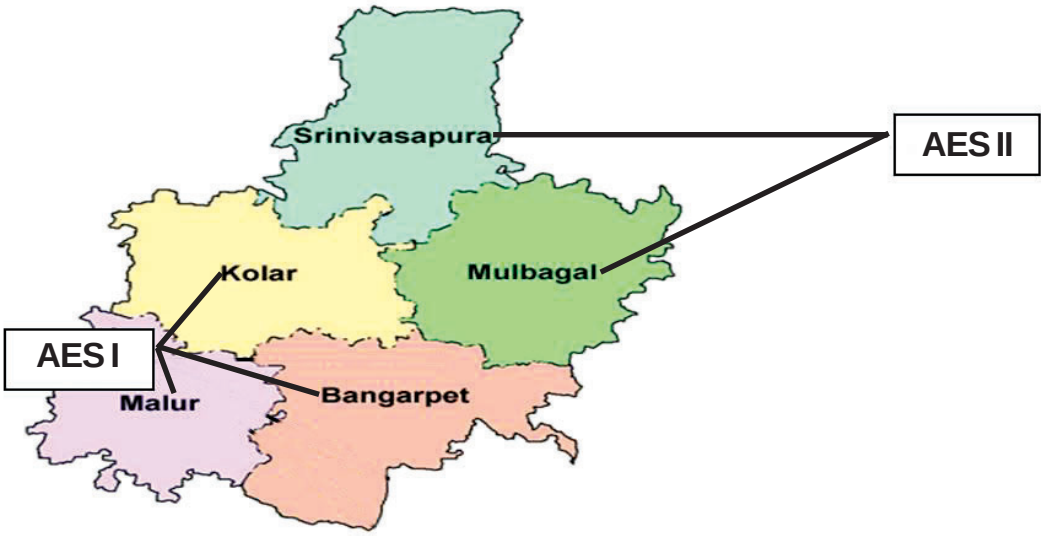
Documented by: W. Aind, OFR Agronomist, OFR Centre, Pakur, Birsa Agricultural University, Ranchi (Jharkhand)

KARNATAKA

Improving the livelihood security of small and marginal farmers through integrated farming system perspective has been the main mandate of the project operating at Kolar district of Karnataka. This district is famous for its MILK and SILK production. However, in earlier years it was also known for GOLD as KOLAR GOLD FIELD's where mining was being done.

The field work and data collection has been executed by the staff of AICRP on IFS, University of Agricultural Sciences, Hebbal, Bangalore as a OFR Centre with mandated district Kolar starting from 2011-12.

The success stories presented are the outcome of OFR-3 (holistic approach) and OFR-2 (innovative approach) experiments done in farmers field in participatory mode.



MAP OF KOLAR DISTRICT

IFS principles and practices improves income of marginal farmer

GPS Location

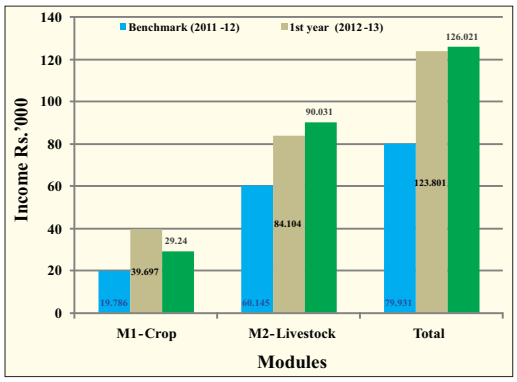
Latitude	Longitude	Altitude (m)
13^{0}18'8'' N	78^{0}02'07'' E	870

Livestock + crop system was adopted by Shri Srinivas in 0.22 ha. Before IFS interventions, he produced field crops, fodder and vegetables with an income of only Rs. 19,786 (25%). The livestock components consisted of cow, buffalo, sheep, poultry and rabbit with an income of Rs. 60,145 (75%).

The interventions from 2012-13 to 2013-14 were made by the project for crops were improved varieties of finger millet and maize, micro nutrients, bio fertilizers and trichoderma for disease management.

The income from vegetables alone increased to Rs. 39,697 during 1st year and Rs. 29,240 in 2nd year.

In livestock improved fodder varieties (CO_4), mineral mixture (NIANP), sheep and Swarnadhara chicks (5+1) were introduced providing income of Rs. 84,104 and Rs. 90,031 for first and second year respectively.



Product diversification and capacity building activities through introduction of vermi composting by supply of vermi bags and azolla cultivation through supply of concrete rings along with training produced additional income of Rs. 6,750. Nutritional security of farm family was also considered by introducing kitchen garden kit along with seedlings of lemon, drumstick and curry leaves.

Thus, Shri Srinivas increased his income from his traditional farming system having Rs. 79,931 to Rs. 1,23,801 in first year and further improved to Rs. 1,26,021 in second year with adoption of IFS principles and practices.

Documented by: A.P. Vishwanath, A.S. Shashi Kiran and S.N. Anilkumar, OFR Centre, AICRP on IFS, Kolar under University of Agricultural Sciences, Bengaluru, Karnataka

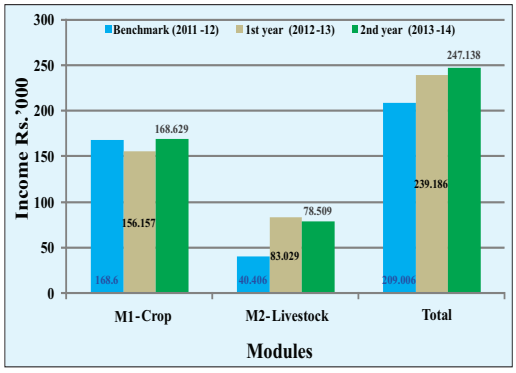
Farming system with sericulture : Earning in lakhs by marginal farm household

GPS Location

Latitude	Longitude	Altitude (m)
13^{0}16'718'' N	78^{0}13'387'' E	835

Crop + livestock farming system was followed by Shri Krishna Murthy in 0.87 ha. During the Bench Mark year 2011-12, his crop component consisted of sericulture (0.8 ha) and fodder maize (0.03 ha) providing a total income of Rs. 1,68,600 (80%). The livestock component consisted of milch cow, 3 sheep and 10 local poultry birds providing a total income of Rs. 40,406 (20%). Thus, the total income of Shri Krishna Murthy in the bench mark year was Rs. 2,09,006 from 0.8 ha.

In the crop component, in addition to the existing sericulture and fodder maize, improved varieties of finger millet (ML-365) inter cropped with improved dolichos (HA-4), redgram (BRG-1) and maize along with micro nutrients and biofertilizers were used. The income derived from crop component was Rs. 1,56,157 (65%) and Rs. 1,68,629 (68%) for 2012-13 and 2013-14, respectively. In case of livestock component, mineral mixture for cow and sheep, introduction of poultry Swarnadhara (5+1), Multipurpose trees Melia dubia and Azolla as feed supplement were made. The



income derived was Rs. 83,029 (34%) and Rs. 78,509 (31%) for the year 2012-13 and 2013-14, respectively.

Product diversification and capacity building activities were under taken by providing vermi bags for vermi composting along with azolla culture and rings including trainings and demonstration. Improving nutritional security of farm household was done through the supply of Kitchen garden kit and seedlings of drumstick, lemon and curry leaves.

Thus, Shri Krishna Murthy increased his income from Rs. 2,09,006 in the benchmark year upto Rs. 2,39,186 in first year and Rs. 2,47,138 in second year. The cumulative effect of these income would be seen through the increase incurred in the further years.

Documented by: A.P. Vishwanath, A.S. Shashi Kiran and S.N. Anilkumar, OFR Centre, AICRP on IFS, Kolar under University of Agricultural Sciences, Bengaluru, Karnataka

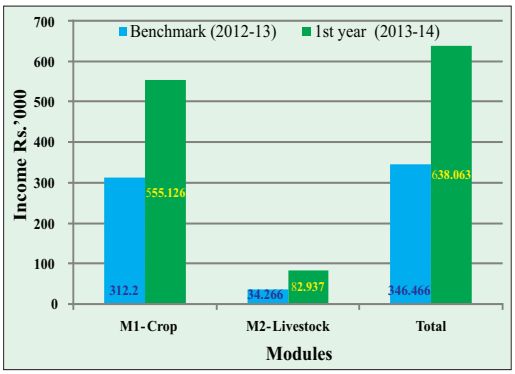
Earn six lakhs from crop (mulberry, finger millet and South African tall maize) + dairy (cow & buffalo)

GPS Location

Latitude	Longitude	Altitude (m)
13^{0}16'96'' N	78^{0}13'47'' E	843

Crop + livestock farming system was followed by Shri Narayan Reddy in 1.1 ha. During the Bench Mark year 2012-13 crop component consisted sericulture and finger millet yielding a total income of Rs. 3,12,200 (90%). The livestock components consisted of milch cow, bullock and buffalo (local) providing a total income of Rs. 34,266 (10%). Thus the total income of Shri Narayan Reddy in the bench mark year was Rs. 3,46,466 from 1.1 ha.

IFS interventions commenced from 2013-14 and during the first year improved varieties of finger millet and South African tall maize were introduced which provided a total income of Rs. 5,55,126 (87%). In case of livestock, cow mineral mixture, azolla feeding and introduction of multipurpose trees (Melia dubia) as technological intervention provided a total income of Rs. 82, 937 (13%).



Product diversification and capacity building activities were under taken by providing vermi bags along with azolla culture and rings including training and demonstration. Improving nutritional security of farm household was done through the supply of kitchen garden kit and seedlings of drumstick, lemon and curry leaves.

Shri Narayana Reddy improved his income from Rs. 3,46,466 to a total income of Rs. 6,38,063 during the first year of IFS interventions.

Documented by: A.P. Vishwanath, A.S. Shashi Kiran and S.N. Anilkumar, OFR Centre, AICRP on IFS, Kolar under University of Agricultural Sciences, Bengaluru, Karnataka

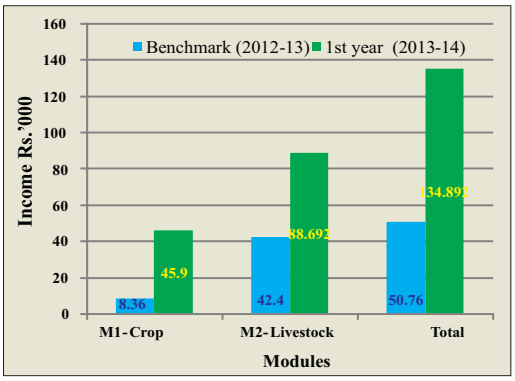
Farming sytem intervention doubles income of marginal household

GPS Location

Latitude	Longitude	Altitude (m)
13^{0}45'28'' N	78^{0}23'21'' E	810

Crop + livestock farming system was adopted by Shri Subba Reddy, in 0.49 ha. During the bench mark year 2012-13, Shri Subba Reddy earned only Rs. 8,360 by cultivating maize, finger millet and fodder grass and the income from livestock consisting of 4 HF cows and 2 local poultry was Rs. 42,400 with a total income of Rs. 50,760.

IFS interventions commenced from 2013-14 and during the first year improved varieties of finger millet and South African tall maize and use of bio fertilizers for vegetables were introduced which provided a total income of Rs. 45,900 (34%). In case of livestock improved mineral mixture for cow and sheep with azolla production was introduced along with introduction of multi purpose tree (*Melia dubia*) which provided a total income of Rs. 88, 692 (66%).



Product diversification and capacity building activities were under taken by providing vermi bags along with azolla culture and rings including training and demonstration. Improving nutritional security of farm household was done through the supply of kitchen garden kit and seedlings of drumstick, lemon and curry leaves.

Thus Shri Subba Reddy improved his income from Rs. 50,760 to total income of Rs. 1,34,592 during the first year of IFS interventions. The cumulative effect of this income would be seen through the increase incurred in the further years.

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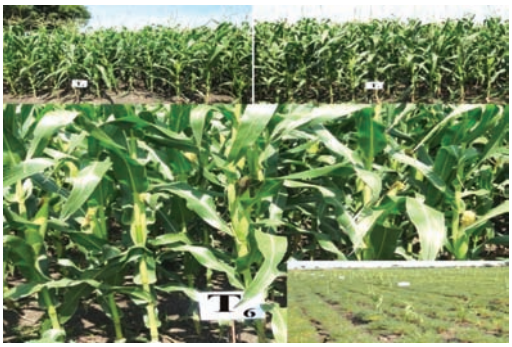
Response of hybrid maize-chickpea system to balanced nutrient application

GPS Location

Latitude	Longitude	Altitude (m)
$15^0 41'$ N	$75^0 28'$ E	525

Shri Devangouda Basangouda Karigoudar in Surkod village, Naragund block, Gadag district of Karnataka was selected for on-farm experiment on response of crops to improve applied nutrients. He was having 1.6 ha land with Rs 36,600 as net income/year. Five member family was surviving with mearge income.



Balanced application of nutrients to maize

The major constraints identified are use low yielding maize/chickpea varieties and lack of balanced application of nutrients. Interventions such as use of high yielding hybrid maize (Super M 900) and chickpea (JG-11), application of recommended dose of plant nutrients to maize (150: 75: 37.5:25 kg/ha N, P_2O_5, K_2O, $ZnSO_4$) and chickpea(25: 50: 0:15 kg/ha N, P_2O_5, K_2O, $ZnSO_4$) and split application of N to maize were to increase the yield of maize-chickpea system.

Crop	Pre intervention		Post intervention		% increase
	Yield (kg/ha)	Net income (Rs/ha)	Yield (kg/ha)	Net income (Rs/ha)	in net income
Hybrid maize	3983	19155	5000	38000	98
Chickpea	1072	17515	1300	24340	41
Total	-	36670	-	62340	70

Impact : About a dozen farmers are adopting the techniques' adopted by the farmer in increasing the yields of maize and chickpea system.

Documented by: S.M. Hiremath, OFR Centre, AICRP on IFS, Gadag under University of Agricultural Sciences, Dharwad (Karnataka)

Integrated farming system modules improves the profitability and livelihood of marginal farmer

GPS Location

Latitude	Longitude	Altitude (m)
15^{0}23' N	75^{0}36' E	684

Shri Basayya Patrayya Sashvihallimath residing in Kalasapur village, Gadag block, Gadag district in Karnataka was having 1 ha land to support his family of 9 members. He was earning only Rs 14000 from his land.

Existing cropping practice

Crop	Area(ha)	Yield(kg/ha)	Net income(Rs/ha)
Groundnut	0.6	300	5,000
Bt. cotton	0.4	400	9,000
Total	1.0		14,000

Improvement in income due to interventions

Module	Net income (Rs.)	Additional income (Rs.) over M_0	% increase over M_0
Existing farming system	14,000	-	-
Crop intervention	21,500	7,500	53
Livestock intervention	15,900	1,900	13
Value addition	15,200	1,200	8
Vermicomosting	15,000	1,000	7
Nutritional kitchen garden	15,500	1,500	10

Interventions in crop, livestock, processing and optimal module

The other benefits obtained are regular and stable income to the farm family, round the year engagement of farm family and good productivity due to recycling of farm waste.

Documented by: S.M. Hiremath, OFR Centre, AICRP on IFS, Gadag under University of Agricultural Sciences, Dharwad (Karnataka)

Diversification of farming system provides additional income

GPS Location

Latitude	Longitude	Altitude (m)
15^{0}44' N	75^{0}74' E	565

Shri Shenkargouda Hanmanthgouda Eti in Dandapur village, Navalagund taluk, Gadag district of Karnataka is having 1 ha of area from which he was getting income of Rs 33600/ha only and 4 members of his family were depending on this mearge income.

Existing farming system practice

Crop	Area (ha)	Seed yield (kg)	Net income (Rs/ha)
Hybrid maize	1.0	1800	10,800
Chickpea	1.0	600	12,000
Livestock	2 cows		10,800
Total			33,600

Improvement of income due to interventions

Module	Net income (Rs./house hold) over M_0	% increase
Existing farming system(bench mark)	33,600	-
Crop diversification		
Hybrid maize – chickpea	38,400	68
Sunflower – chickpea	24,500	7
Bt. Cotton + pea	27,000	18
Livestock diversification	12,360	14
Poultry diversification	Egg laying yet to start	-
Product diversification from milk	1,000	100
Total income due to diversificatio	1,03,260	-
Additional	69,660	-





Interventions in crop and livestock for improving profitability

Documented by: S.M. Hiremath, OFR Centre, AICRP on IFS, Gadag under University of Agricultural Sciences, Dharwad (Karnataka)

Response of groundnut – *rabi* sorghum system to balanced application of nutrients

GPS Location

Latitude	Longitude	Altitude (m)
15^{0}22' N	75^{0}37' E	688

Shri Shankarappa Malleshappa Huyilgol in Kalasapur village of Gadag block Gadag district of Karnataka is having 0.8 ha on which his 4 members family are thriving. His annual income was only Rs 13,734.

Use low yielding varieties of ground nut and *rabi* sorghum and poor response to applied nutrients were identified as causes for low yield. High yielding groundnut (GPBD-4) and rabi sorghum (M-35-1) varieties with application of recommended dose of plant nutrients to groundnut (25: 50: 25:25 kg/ha N, P_2O_5, K_2O, $FeSO_4$) and *rabi* sorghum (50: 25: 0:15 kg/ha N, P_2O_5, K_2O, $ZnSO_4$) was adopted as part of the

Yield and income before intervention

Crop	Pod / grain yield (kg/ha)	Net income (Rs/ha)
Groundnut	1,000	6,675
Rabi sorghum	999	7,059
Total		13,734

Yield and income due to improved varieties and balanced application of nutrients

Crop	Yield (kg/ha)	Net income (Rs/ha)	Additional income (Rs)
Groundnut	1,450	20,087	13412
Rabi sorghum	1,166	7,095	36
Total		27,182	13448

on-farm nutrient response trial. With the application of recommended dose of plant nutrients to groundnut there was a substantial increase in the pod yield of groundnut and income.

Impact: Fifteen nearby farmers convinced about the importance of recommended dose of plant nutrients (25: 50: 25: 25 kg/ha N, P_2O_5, K_2O, $FeSO_4$) to groundnut in increasing the pod yield of groundnut and practicing the same.

Documented by: S.M. Hiremath, OFR Centre, AICRP on IFS, Gadag under University of Agricultural Sciences, Dharwad (Karnataka)

KERALA

Integrated farming system : Way to boost farm income

GPS Location

Latitude	Longitude	Altitude (m)
9°44'465'' N	76°60'709'' E	13

The village Kunnanthanam in Mallappally block is considered as a vegetable bowl of Pathanamthitta district, Kerala. Shri Vijayan Nair is a small farmer mainly

Vegetable production in coconut plantations

concentrating on vegetable production and cultivating yard long bean using local varieties. The region experiences an average rainfall of 3000 mm with coconut and vegetables as main crops. He is survived by his wife, mother and two children. He is earning an annual income of Rs 1,01,270 from agriculture including rearing of animals. He is following a coconut based farming system with much emphasis on vegetable production covering an area of 0.8 ha. The farmer was having a dairy unit with two milch animals of HF cross bred. This again supplements his annual income. Thirty numbers of west coast tall variety of coconut is present in his farm.

The farmer was realising low yield levels with high cost of production. Also the 30 coconut palms grown were not managed well and the interspaces were not fully utilized for growing other cash crops. The rearing cost was high due to stall feeding of animals with concentrates. The crop residues generated were not recycled. The milk produced was sold at milk society even though there is ample scope for retail marketing and fetching higher price. The major constraints studied were brought to the notice of the farmer and it was discussed and a farm plan was prepared.

The technical interventions to be attempted were proposed and it was implemented in 2011-12 with a financial assistance of Rs 10000 per household. The technical interventions made consists of mineral nutrition in coconut palms and the interspaces were utilized for raising banana Nendran (500 suckers). The local variety of Yard long bean was replaced by HYV Lola. Mineral mixture @ 50g/animal/day was included in the feeding schedule to improve the general health of animal and to upgrade the milk quality. Retail sale of milk was undertaken after subjecting the milk to cleaning, filtering and packing in small plastic containers. Recycling of crop residue was undertaken in portable vermicomposting unit using earth worms.

The crop residue obtained from coconut as well as banana was recycled as mulching and for vermi-composting. The palms were applied with crop residues at 50 kg/palm. About 5000 kg of crop residues were vermicomposted and through 5 harvests, 1000 kg of vermicompost was obtained and it was recycled for vegetables. The net returns obtained during 2012-13 and 2013-14 are given below.

Net returns from IFS modules

IFS Modules	2011-12 (Benchmark)	2012-13	2013-14
Crop module (coconut, banana, vegetable)	64820	139600	135010
Livestock (milch animals)	36450	39928	59540
Processing (retail sale of milk)	Nil	1988	22080
Optional module (production of vermicompost)	Nil	4080	8500
Total	101270	185646	225130

Impact : The farmers engaged in vegetables productions (75 Nos.) had come forward to avail the improved variety of lola and started cultivating. Also the crop residue management through vermicomposting was adopted by 5 more farmers in the local area.

Shri Vijayan Nair was selected as the best farmer for vegetable cultivation under ATMA, Mallapally block. He was also recognised at village level during the karshakadhinam celebration of Chingam-1 organised by the Department of Agriculture.

Documented by: Thomas Mathew, Jacob D. and Mathew Thomas C., OFR Centre, AICRP on IFS, Thiruvalla under Kerala Agricultural University, Vellayani, Kerala

Farming system approach for sustainable and steady income

GPS Location

Latitude	Longitude	Altitude (m)
9°34'024'' N	76°31'960'' E	7

Shri Alex Joseph is a marginal farmer from Niranam grama panchayat of Pulikeezhu in Pathanamthitta district of Kerala. Coconut and rice based cropping systems are predominant system in this area. Dairy is a subsidiary occupation in this region. The total annual net income was Rs. 92194 during bench mark year.

The farmer is following a coconut based farming systems under garden land situation and while under wet land ecosystem it is rice based. Coconut is grown in an area of 0.24 ha with west coast tall as the variety. While paddy occupies an area of 0.4 ha with the HYV of Jyothi. He was generating a total net income of Rs 23194 from crops and Rs 69000 from livestock unit of 4 milch animals belonging to HF breed.

The nut production per coconut palm was only 67/year which is very low and can be further increased through appropriate agrotechniques. The interspaces were not utilized. The weed spectrum in rice was very high. Manual weed control measures

Roof gardening

Crop diversification

were followed which has increased the cost of cultivation. The dairy unit consist of 4 milch animals and the milk produced was marketed in the milk society. It was priced according to the reading of fat content and SNF. However, farmer was unable to get maximum price because of the low fat content. The *Garcinia* obtained from the trees planted along the boundary were cured using conventional methods and obtained lesser price in the open market. Vegetables required for the family was purchased rather than growing within the farm.

The farmer was made aware of the limitations and a farm plan was prepared. The technical interventions proposed were implemented during 2012-13 with a financial assistance of Rs 10000 worth physical inputs. Manurial schedules followed in coconut were supplemented with additional nutrients like Mg and importance were given to K nutrition. Banana was taken as a intercrop in coconut garden. Chemical weed control measures using post harvest herbicide was used and the cost of cultivation was brought down in paddy. Mineral mixture was included in the feeding

Net returns from IFS modules

IFS modules	2011-12(Benchmark)	2012-13	2013-14
Crop Coconut, Banana, Rice	23194	53428	67944
Livestock Milch animals	69000	77600	84920
Processing Garcinia	Nil	3000	3600
Optional Terrace gardening	Nil	410	1800
TOTAL	92194	134438	158264

Garcinia drier

Mineral mixture to livestock

schedule of milch animals and the quality of the milk and milk production was improved. A processing unit to cure Garcinia was set up by fabricating the country made drier with steel angular pipes. This has improved the quality of the produce with more colours and aroma. Grow bags were supplied to undertake terrace gardening of vegetables and the home requirement of vegetables was met and the family expenditure on vegetable purchase was reduced.

The crop residue obtained as straw from paddy was used for feeding milch animals and the dung produced was recycled for manuring coconut as well as banana. The crop residue of banana was used as a mulch in coconut basins.

The farmer obtained a total net income of Rs 1.34 lakhs and1.58 lakhs during 2012-13 and 2013-14 respectively. There was many fold increase in production as well as income as compared to the bench mark.

The terrace gardening with vegetables started for domestic consumption was fascinated by nearby farm households and 10 farmers had come forward to take up vegetable cultivation in grow bags. Use of mineral mixture followed for milch animals was also adopted by many dairy farmers in order to upgrade the quality of milk.

Shri Alex Joseph was selected as a best dairy farmer by the Niranam milk marketing society of dairy department and for supplying maximum milk to the society.

Documented by: Thomas Mathew, Jacob D. and Shahul Hameed K.O., OFR Centre, AICRP on IFS, Thiruvalla under Kerala Agricultural University, Vellayani, Kerala

Farming system approach for better livelihood

GPS Location

Latitude	Longitude	Altitude (m)
9^{0}34'76'' N	76^{0}48'716'' E	6

Sri George Veeran was selected as a lead farmer in Niranam village of Pulikeezhu block Pathanamthitta district of Kerala to experiment the low cost interventions in farming systems perspective. The area experiences an annual rainfall of 300cm with monsoonic inundation during *kharif* season. The size of the family is 4 with the annual income of Rs 163844 from agriculture. The cropping system of the region consists of coconut based in garden land situation and rice based under wet land eco-system. The livestock production consists of duck farming and rearing of milch animals.

The coconut production per plant was only 80 nuts/yr. The coconut is cultivated in an area of 1 ha with west coast tall variety. Rice is grown in 1 ha with traditional variety. The dairy unit consist of 2 crossbred Jersey and HF. Nutmug is grown as intercrop in coconut garden.

Productivity of existing coconut was declining due to poor soil health management resulting in the yellowing of lower leaves. Interspaces of coconut were not utilized effectively. Nutmeg grown as intercrop in coconut was having poor fruit set. Farmer was facing shortage of skilled labour for harvesting coconut. The productivity of paddy

Cownut for micronutrient application to coconut

was found to be low due to the use of traditional varieties and incidence of pest and diseases. The farmer is having dairy unit consisting of one Jersey and one Holstein Friesian breed but was facing heavy loss due to high feed cost and occasional incidence of mastitis.

Technical and low cost interventions made consist of application of magnesium sulphate and setting up pheromone trap to control red palm weevil in coconut. Intercropping with banana was undertaken. The traditional rice variety was replaced with multiple resistant high yielding variety Uma. Provision of cowmat in the cattle shed was made to ensure the sanitation. Azolla was grown in artificial tank to supplement the cattle feed with forage and to reduce the feed cost. Also green fodder production with CO3 variety of hybrid napier was also initiated. The cattle shed was provided with ceiling fans to have free flow of air and to reduce the severity of hotness and heat during summer. Mineral mixture was supplemented along with concentrate to enhance quality of milk and to maintain the general health of animal.

The farmer was selling the harvested coconut in raw form where it fetches a low price. Product diversification and value addition were carried out by converting the coconut into copra and milling for coconut oil. The coconut oil thus obtained was packed in small containers and it was branded for retail sale. This enabled the farmer to get high profit rather than selling in raw nuts. Two beehives were installed not only to trap honey but also to improve the pollination of crops in coconut and nutmeg. There was 5 to 10% improvement in fruit set in case of nutmeg after introduction honey bee in the system.

Intervention in nuting


Oil extraction from coconut

Net income from various farm enterprises of Sri. George Veeran before (2011-12) and after (2012-13) technical and low cost interventions

Sl. No.	Farm enterprise	Net Income (Rs.)		
		Before intervention (during 2011-12)	After intervention (during 2012-13)	2013-14
1	Crop (coconut, banana, nutmeg, rice)	1,33,144	2,12,642	268236
2	Livestock	30,700	34,200	37320
3	Processing and value addition	Nil	4650	27000
4	Other income (Apiculture)	Nil	1600	2700
	Total	1,63,844	2,53,092	3,35,256

The crop residues like paddy straw was fed to the milch animals. The dung produced was used as a bulky organic manure for coconut, nut mug and banana. In addition to this crop residue collected from the standing crops were used as organic mulch.

Technical intervention made in the crop module alone had profoundly increased the net returns. The technical interventions with respect to crop, livestock and processing had made in farming system perspective substantially increase the total returns.

Since nutmug was planted in raised mounts to overcome the ill effects of water stagnation during heavy floods, it had made other farmers to take up the cultivation of nutmug through land configuration and gained confidence to raise intercrops in coconut.

Sri. George Veeran was awarded for his outstanding achievements in enhancing the productivity of crops by the Nirinam gram panchayat and department of agriculture.

Documented by: Thomas Mathew, Jacob D. and Shahul Hameed K.O., OFR Centre, AICRP on IFS, Thiruvalla, under Kerala Agricultural University, Vellayani, Kerala

Farming system for stabilized farm income

GPS Location

Latitude	Longitude	Altitude (m)
9⁰45'380'' N	76⁰69'910'' E	26

Shri Kuttappan Nair is a progressive small farmer from Anicadu village of Mallappally block in Pathanamthitta district of Kerala. The region experiences an annual rainfall of 3000 mm, his 6 member family consists of wife, children and grandchildren. He was earning an annual net income of Rs. 158970 from agriculture consisting of field crops, horticulture crops and livestock. The cropping system of the tract is mainly coconut and it is followed by rubber. Rearing of livestock is undertaken and it is mainly milch animals.

The farmer is having a coconut plantation having west coast tall variety with 150 palms producing 79 nuts per palm/year. He is following a multi storey cropping system with nutmug as a intercrop in an area of 1.8 ha. In addition to this, he is raising cucurbitaceous vegetables with local varieties in an area of 0.2 ha.

The manurial schedule followed for the palm was insufficient to meet the nutrient requirement and caused depletion in the soil nutrient status and affecting the soil health. Premature fall of nutmeg fruits and premature opening of the fruit were found

Vermicompost production

Nutmeg and mace storage

to be the major constraints associated with nutmeg production. Vegetable production was undertaken with cucurbitaceous vegetables using local varieties. But often came across crop failures due to the outbreak of pest and diseases. The milch animals were fed using industrially manufactured inputs and mineral mixture was not included in the feeding schedule. This has affected the quality of milk with respect to fat content. The nutmeg seeds and mace collected were not stored in proper container. As a result of this, the price of the nutmeg seeds and mace obtained was less than the market price. The crop residues generated were not recycled other than burning.

The farmer was made aware of the major constraints associated with crop productivity and technical programme envisaging the intervention to be made was prepared based on the discussion held with the farmer. The programme was implemented during 2011-12 with a total financial assistance of Rs 10000 worth inputs and it is being continued. The technical intervention consists of manuring and management of coconut palms to enhance the nut production. Mineral nutrition with Boron and other major nutrients for nutmeg to overcome the premature fruit fall and early splitting. Fodder production with hybrid napier variety CO3 was initiated to reduce the reliance on cattle feed concentrate and to bring down the rearing cost. Mineral mixture was included in the feeding schedule to increase the quality of milk with respect to fat content. The nutmeg seeds and mace collected was dried using artificial media and stored in steel bins inorder to avoid the deterioration during storage and to keep up the desired moisture level. The crop residues generated from the field were recycled after vermicomposting it in portable vermicomposting unit. The overall output of the various enterprises in terms of net returns is given below.

Net returns from IFS modules

IFS modules	2011-12 (Benchmark)	2012-13	2013-14
Crop (coconut, nutmeg, vegetables)	130200	178347	271338
Livestock (milk production)	28770	43870	19540
Processing (improved storage and drying of nutmeg seeds and mace)	Nil	8000	8813
Optional vermicomposting	Nil	1915	6740
Total	158970	232132	306431

Vegetable production

Cowmat and mineral mixture intervention for livestock

The crop residues collected from coconut and nutmug were partially recycled and the rest was used for vermicomposting. The manure generated was used for vegetables. The farm yard manure obtained from the animals was used for manurial application in coconut, nutmug and banana.

Many farmers (10 Nos.) have started growing nutmug as a intercrop in coconut plantation. Also installed vermicompost unit to generate manure and to recycle the crop residues. The improved variety of snakegourd variety Kaumudi cultivated was disseminated among the fellow farmers to replace the local variety.

Shri. Kuttappan Nair being a progressive farmer was recognised by the department of agriculture during Karshadhinam celebration of Chingam-1 at Anicadu Krishi Bhawan.

Documented by: Thomas Mathew, Jacob D. and Sanal Kumar P.S., OFR Centre, AICRP on IFS, Thiruvalla under Kerala Agricultural University, Vellayani, Kerala

Crop diversification and multiple harvest of products through farming system

GPS Location

Latitude	Longitude	Altitude (m)
$9^0$45'380'' N	$76^0$66'767'' E	37

Shri Saji Eapen is a progressive farmer hailing from Anicadu village of Mallapally block in Pathanamthitta district of Kerala. The family consist of 3 members and he was generating an annual net income of Rs 1,62,900 from agriculture. This area is dominated by coconut and rubber based cropping system. Livestock production is taken up in smaller scale with cattle as milch animal.

The farmer is following a coconut based farming system consisting of coconut as the main crop, inter cropped with pepper in an area of 0.96 ha. The average nut production per palm was 55 nuts/year. The pepper vines are trained on live standards with a average production of 1.1 kg/vine/year. Cucurbitaceous and leguminous vegetables are also grown. The livestock unit consist of two she buffaloes maintained for milk production. Improved varieties were used for vegetable production. The coconut palms cultivated are west coast tall variety while the pepper variety is

Vermicompost unit

Intercropping of banana


Interventions in livestock

Karimunda. The farmer was getting a total net income of Rs. 53900 from crops and 109000 from livestock.

The coconut palms planted have not come to bearing stage fully. Only 30% started bearing with a average nut production of 55 nuts/palm/year. Late bearing is a problem observed with coconut. The crop management followed was not sound enough to bring the palms to early bearing. The pepper vines trained in live standards consist of two hundred vines and produced an average yield of 1.1 kg/vine/year. The productivity of pepper can be further increased by taking appropriate measures

Interventions in nursery

against quick and slow wilt. Cucurbitaceous and leguminous vegetables grown were irrigated using conventional methods like basin irrigation. Availability of water for irrigation during summer months was a major constraint for the vegetable production. The inter spaces in coconut garden were not utilized fully. Cash crops like banana could be raised to generate more income in addition to the existing intercrops. The milk production obtained/lactation was comparatively low in she buffaloes. The availability of green fodder was limited and mainly depending on grazing of natural grass. The pepper harvested was sun dried and marketed. The price obtained for the black pepper was far below the open market price because of the low quality. The vermicompost unit already constructed was not commissioned and recycling of crop residues was not undertaken.

Considering the above constraints observed with crop, livestock and processing, technical programme consisting of technical interventions to be attempted was formulated and a financial assistance of Rs 10000 in terms of physical inputs was provided to undertake the programme. Agrotechniques consisting of manuring, intercultural operations and irrigation were followed in coconut garden. The pepper vines trained in live standards were subjected to lopping during May-June and Sep-Oct and plant protection measures with foliar and soil application of *Pseudomonas* and *Trichoderma* were carried out. The interspaces were effectively utilized by cultivating banana. Fodder production was also initiated with CO3 (Hybrid Napier). The area earmarked for vegetable was brought under drip irrigation and use of water was economised. The buffaloes were fed with green fodder produced and mineral

Net returns from IFS modules

IFS modules	2011-12 (Benchmark)	2012-13	2013-14
Crop (coconut, pepper, banana, vegetables)	59900	156844	293724
Livestock (Buffaloes, 2 nos)	109900	1118636	87960
Processing (pepper)	Nil	2520	21900
Optional (vermicomposting)	Nil	2380	7480
Total	169800	280380	411034

mixture was administered in the feeding schedule to improve the general health of animals and prolong the lactation period. The green pepper produced was subjected to boiling water for one minute and then sun dried using appropriate silpaulin sheets. The vermicomposting unit was made functional by providing earthworms and the crop residues were recycled. The output from various enterprises in terms of net returns are given below.

The crop residues collected from coconut were applied as organic mulch in coconut basins while the lopping collected from live standards of pepper was applied as green leaf manure and the crop residues of banana was used for vermicomposting and the manure obtained was used for vegetable production.

The drip irrigation installed for vegetable production was appreciated by many farmers from VFPCK (Vegetable and Fruit promotion council of Kerala) as the region is having short fall and scarcity of water for irrigation during summer.

Shri. Saji Eapean is acting as the president of agricultural marketing society of VFPCK at Anicadu. He has got much recognition for the production and the supply of vegetables to the agricultural marketing society of VFPCK.

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Farming system enterprises for higher income

GPS Location

Latitude	Longitude	Altitude (m)
9⁰32'07" N	76⁰49'474'' E	6

Shri Thomas Mathew, is a marginal farmer of Kadapra panchayath of Pulikkeezhu block in Kerala. The size of the family is 5 with an annual income of Rs. 41460. As the area forms major part of the upper Kuttanad, rice is the major crop in wet land. Duckery and dairy are major livestock component.

The farmer was following a coconut based farming system with coconut as the main crop in upland and rice in wet land. Coconut is cultivated in an area of 0.28 ha with 25 palms. The average nut production per palm was 45nuts/year. Rice is grown in an area of 0.68 ha with production of 4275 kg using variety Uma. The coconut variety west coast tall was cultivated generating an annual net income of only Rs. 4160. The livestock production consists of 2 milch animals of HF cross breeds. The milk production /animal was at 8.5 lit./day generating a total net income of Rs. 37300.

The major constraints associated with the farming system were identified and analysed. Coconut being the major crop in the multi storey cropping and it should

Intercropping of banana

Interventions in coconut

have the top most canopy. Over shading and crowding of other vegetation over coconut had reduced the productivity. Also inadequate supply of nutrients had resulted in yellowing of leaves. The interspaces were left idle and no intercrops were grown. The soil pH of the rice soil was at 5 to 5.5 and resulted in poor soil health. The milk yield /animal were low and the general health of the animal was not satisfactory. Sale of milk was carried out in bulk and raw coconut was marketed. The domestic requirement of vegetable was met through local purchase incurring additional expenditure from family budget.

Based on the study a detailed report consisting technical interventions in terms of inputs were undertaken involving a total financial cost of Rs.10000/- . The technical interventions consist of removal of unwanted vegetation and shade regulation. Mineral nutrition with potash at 1200g /palm. Application of Magnesium sulphate at 500g/palm/year to reduce the yellowing effect. Intercropping of coconut with banana variety Nendran (250 suckers) have been done. Application of lime @ 200 kg to

Crop	Organic waste	Recycling of wastes (kg)		
		2011-12	2012-13	2013-14
Coconut	Crop residue	1200	1500	1300
Banana	Crop residue	-	12500kg	13750Kg
Rice	Straw	2800 kg	3400kg	3200
Milch animals	Dung	3000kg	8000 kg	8030

Net income due to interventions

Name of enterprise	2011-12 (Benchmark)	2012-13	2013-14
Coconut	4160	3400	20516
Banana	-	39003	43900
Rice	6940	17330	33764
Milch animals	37300	78389	13260
Sale procedure of milk	-	2775	8880
Terrace kitchen gardening	-	375	1200

Intervention in livestock

Terrace gardening with polybags

overcome the problem of soil acidity was done in rice. Inclusion of mineral mixture in the feeding schedule to improve the general health of animal and to upgrade the fat content sale proceeds of milk after filtering and cleaning in small containers were also done. Supply of grow bags and hand sprayer were provided and promote terrace gardening to produce vegetables for domestic consumption.

The crop residues of coconut and banana were recycled for application as mulches in coconut basins. The straw produced was fed to the milch animals. The dung produced was applied as bulky organic manure to coconut and banana.

The terrace kitchen gardening using grow bags had made special attention to the fellow farmers (30 nos) in the region. Many had made enquiries to procure and purchase the grow bag and also the media to be prepared for grow bag.

The farmer is recognized as a progressive farmer by Kadapra Krishibhavan and for the milk production and supply at milk marketing society, Kadapra of Dairy Department.

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Farming systems for livelihood and income generation from below sea level

GPS Location

Latitude	Longitude	Altitude (m)
$9^0$38'79" N	$76^0$54'55'' E	8

Shri M.C. Cherian, is a marginal farmer raising coconut at peringara village of Pulikkeezhu Block in Pathanamthitta District of Kerala. This region forms a part of Karappadams of Kuttanad ecosystem. The total rainfall is received around to 3000 mm with flood problem during monsoon periods. Farmer is having a family size of 6 nos with earning of Rs. 59260. This region is having coconut based farming under garden land situation and rice based in wet lands. However, rice is the major crop. The livestock production covers duck farming as major enterprise followed by dairy. Fish farming is also undertaken in water bodies located in and around the farms.

The farmer is having a coconut based farming system cultivated in an area of 0.96 ha. The nut production/palm is 75 nuts and net returns of Rs. 31210. The she buffaloes produces 5.5 litre/day/animal. The gross income from milk production after domestic use ranges to the tune of Rs. 36000. It was marketed in the milk marketing society.

Interventions in Coconut and Banana

Soil health deterioration due to high Soil acidity was a major problem affecting the productivity of coconut. Yellowing of coconut leaves due to the deficiency of Mg was found in extreme scale. Inadequate supply of K for palms had reduced the size of nuts and production. The interspaces of the coconut garden were not efficiently utilized for raising cash crops. The water body around the farm was not utilized and it was remaining idle. Coconut harvested was marketed in local market in raw form. Grading and pricing was not followed. The existing pond was also not utilized for fish production.

The above constraint was analyzed and the technical interventions to be made was prepared with a financial outlay of Rs.10, 000 and implemented in 2011-12. Lime application at 1 kg/palm/year was advocated and followed. Banana variety Nendran was cultivated in the inter spaces of coconut using 250 suckers. A duckery unit with 50 ducklings was started to utilize the water body. Marketing of coconut was made after grading and coconut seedlings were raised from selected mother palms. The 200 fingerlings of pearl spot were raised in the pond situated beside the house.

The crop waste collected from coconut and banana was used for mulching in coconut basin. Similarly the dung produced from the buffalo unit was utilized for manuring coconut and banana.

Pisciculture in the backyard pond

Crop	Organic debris	Waste recycling (kg)		
		2011-12	2012-13	2013-14
Coconut	Crop residue	7000	7000	7350
Banana	Crop residue	12500	12500	13250
Buffalo	Dung	10950	8960	10950

Net returns as influenced by technical intervention in Farming system

Name of enterprise	2011-12 (Benchmark)	2012-13	2013-14
Coconut	31210	71488	182505
Banana	-	36248	48350
Livestock	28050	34850	35220
Duckery unit	-	29500	23440
Sale of coconut after grading	-	6850	12980
Pisciculture	-	1640	6950
Total		180576	309445

The technical interventions like manuring and management in coconut had drastically improved the nut production and net returns. Intercropping with banana had provided additional income in to the total returns. Similarly the animal husbandry aspects followed and duck farming in water body had increased total income of the farmer. Effective utilization of resources and new marketing avenues had generated more income.

Coconut seedling production undertaken had attracted many farmers from the village and supply chain of coconut seedlings were created.

The farmer was recognized and honoured during the Karshakadhinam celebration of Chingam 1 by the Grama Panchayat and Department of Agriculture.

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Agricultural prosperity through integrated farming system

GPS Location

Latitude	Longitude	Altitude (m)
9⁰33'62" N	76⁰01'82'' E	5

Shri Thomas P. Abraham, is a small farmer from Kadapra village of Pathanamthitta District in Kerala. The climate is humid with an annual rainfall of 3000 mm. Rice and coconut prevails. The livestock production consists of duck farming and milch animals. The farmer is cultivating coconut in an area of o.64 ha with 100 palms yielding 5800 nuts/year. Rice is confined to an area of 0.52 ha with a grain production of 2900 kg. The livestock unit consists of 3 milch animals producing 4800 litres of milk/year.

The coconut palm cultivated was giving low productivity due to imbalanced nutrition. The role of potash in the nutrition of coconut is very important for early bearing and increasing bunch numbers. The soil health problems arose due to low soil pH leading to high acidic conditions. The milk production/animal/lactation was low and duration of lactation period was short. The Garcinia obtained from the trees planted along the boundary was dried using traditional country driers. The domestic

Interventions in cococnut

vegetable requirement was met through local purchase from market. The above constraints identified were studied in details and a farm plan was prepared consisting of technical interventions to be undertaken.

Mineral nutrition with potash at 1200g/palm was followed to over come the button fall and poor fruit setting. Lime application @ 200kg/acre was carried out to improve the soil health condition and soil acidity for rice. Mineral mixture was included in the feeding schedule of the animals at 30g/day/animal to increase the milk production. Angular frame work consisting of metallic mesh mounted for drying the Garcinia fruits and to improve the quality. Grow bags (20 Nos) were provided to takeup terrace gardening to supply vegetables for domestic consumption and a hand sprayer was provided to control the incidence of pest and diseases.

The crop residues collected from coconut was recycled in to the system. The straw generated was fed for the milch animals. The dung produced was used as organic manure for coconut and other intercrops.

Crop	Organic waste	Recycling (kg)		
		2011-12	2012-13	2013-14
Coconut	Crop Residue	3600	2000	5200
Rice	Straw	3500	3500	3600
Milch animals	Dung	3000	6700	12045

Net increase of farm enterprises as influenced by Technical interventions.

Name of enterprise	2011-12 (Benchmark)	2012-13	2013-14
Coconut	16392	21748	75583
Rice	24428	32155	39122
Milch animals	36220	48420	49620
Procuring of Garcinia	-	600	2250
Terrace kitchen gardening	-	345	750
Total	60648	103268	167325

Grow bag vegetable cultivation

The manurial practices followed in coconut had brought down button fall and improved the fruit setting and increased the net return. Correction of soil acidity problems in rice soil with lime had increased the out put and net returns. Domestic vegetable requirement through terrace gardening had taken new steps to supply vegetables worth for Rs. 345/- and 750/- per year. The improved method of curing Garcinia fruits was brought to the notice of farm house holds (46 nos) in and around the area. The angular fabrication using wire mesh kept over the oven had gained importance in the area.

The farmer was recognized further for his enthusiasm and keen interest in rice production and selected as a lead farmer under ATMA, Pathanamthitta District.

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Farming system in upper Kuttanad for better profit

GPS Location

Latitude	Longitude	Altitude (m)
9⁰40'937" E	76⁰55'090'' N	4

Upper Kuttanad forms a major part of Kuttanad ecosystem and Peringara Village comes under the purview of Kuttanad agro system. Shri K.C.Thomas is a progressive farmer in southern tract coming under Pulikeezhu block of Pathanamthitta district in Kerala. This tract is subjected to inundation during monsoon and experiences an annual rain fall of 3000 mm. Size of the family is 4 with an annual income of only Rs. 59260 from agriculture prior to the implementation of interventions. The cultivated area is dominated by rice and coconut based farming system. Duck farming forms as a subsidiary occupation. Dairy animals are also maintained for domestic milk production.

Shri K.C. Thomas is following a coconut based farming system under garden land ecosystem with an area of 0.76 ha. Rice based cropping system is practiced in an area of 1.2 ha. He is having dairy unit with 2 HF cross breeds. He has cultivated west coast tall as the coconut variety with nut production of 4920 nuts/year. Rice variety Uma producing 6300 kg of grain and 5000 kg of straw was grown. The Pisciculture undertaken in rice-fish rotation could generate an out put of 250 kg of fish only.

The imbalanced nutrition followed in coconut were hindering the productivity as potash is important for coconut. The incidence of root wilt disease was also noticed. Application of magnesium sulphate can bring down the yellowing carried by phytoplasma. Soil health problems in rice-fish rotation was associated with low soil pH (<5.5). The milk production/lactation was not obtained at expected level. The pisciculture undertaken in paddy field after rice was taken as single system which again affects the total returns. Traditional methods were followed to market milk thereby fetching lower price for the milk produced.

The constraints identified was discussed in detail with the farmer and the technical interventions was formulated and implemented during 2012-13. The technical interventions of mineral nutrition in coconut with potash and magnesuim sulphate at recommended dose and lime application @ 600 kg in rice – fish rotation was undertaken. Mineral mixture @ 30 g/animal/day was administered to improve the general health and increasing the length of lactation and timely conception. A duckery unit with 50 ducklings were integrated with pisciculture to form a two tier system. The movement of duck in water make paddling effect and increased the oxygen contact and provided favourable condition for fish production. The sale proceed of milk was modified and packed in polythene covers after filtration and removal of sediments, thereby fetching higher price. Standard fish feeds were provided to improve the body weight of the fish and to increase the total output.

The organic wastes produced from coconut was used for recycling and it was applied for mulching in coconut basins. The straw produced was used as feeds to cattle. The dung produced was used for manuring the palms and enriching the water during the periods when fish farming was followed.

Mineral Nutrition with K and Mg had increased the net production and net return as compared to the pre intervention period. Similarly there was additional income

Net returns influenced by technical interventions of IFS approach

Name of enterprise	2011-12 (Benchmark)	2012-13	2013-14
Coconut	11600	11674	61714
Rice	48769	72660	83650
Livestock	18225	10945	26134
Duckery unit	-	21000	20960
Sale proceeds of milk	-	3320	26134
Pisciculture	13000	17500	23000
Total	91594	137099	241592

with respect to processing and introduction of duckery unit in rice fish rotation systems. Also the feeding schedule implemented for Pisciculture had raised the body weight and generated more income during the post technical intervention period.

The farm households (66 nos) in and around the village having water bodies started raising fingerlings. Also fish farming was under taken along with rice following a rice-fish rotation in areas where there is accessibility for the impounding of water and drainage. The duckery unit along with fish farming on a 2 tier systems also gained much importance among farmers.

The farmer is recognized for his intellect in pisciculture and he was honoured as a progressive and best farmer for rice-fish rotation by the department of Fisheries, Government of Kerala.

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Integrated Farming System : A better option for stabilized income

GPS Location

Latitude	Longitude	Altitude (m)
9⁰45'410" N	76⁰61'060'' E	21

Shri Hariharan T.P., is a young farmer engaged in coconut based farming system and resides in Kunnamthanam village of Mallappally Block of Pathanamthitta district in Kerala. The family consists of 4 members. The region experiences a total rain fall of 3000 cm with dry spells during January-March. He was gaining a total net returns of only Rs. 39812 from agriculture. Coconut based system is predominant and It is followed by rubber. The livestock production consists of mainly mich animals. Buffaloes and goat rearing are at limited extent. Back yard poultry is undertaken in some households.

Shri Harikrishnan is having 25 palms cultivated in an area of 0.2 ha. The average nut production per palm was 48/year with total production of 1200 nuts generating Rs. 9600. Yard long bean variety lola was grown in an area of 0.20 ha with a production of 500kg. The dairy unit consists of 4 milch animals with an average milk

Intercropping of Banana

Milk sale through value addition

production of 9 litres/animal/day. The milk was sold at Rs. 30/litre generating a gross income of Rs. 1,29,600.

The constraints in limiting the productivity of crops and livestock were studied. The productivity of coconut was low due to imbalanced nutrition. The vegetable was grown year after year without any crop rotation. This has increased the incidence of pest & disease. The general health of the animal was not up to the expected level and the milk production per lactation was low. The animal was not conceiving timely. Traditional methods are followed for marketing the milk. The crop residues generated in the farm was burnt instead of recycling.

The constraints identified were analysed and technical interventions were formulated and implemented during 2012-13. Mineral nutrition with potash was undertaken @ 1200g /palm/year to overcome the imbalanced of nutrition. Crop rotation using banana (Nendran) was carried out. Mineral mixture @ 30g /animal/ day was included in the feeding schedule. Marketing of milk was modified using polythene covers as containers after filtration and removal of sediments. The crop residues generated from coconut and banana was recycled and a part was used for vermicomposting using a portable vermicompost unit.

Intercropping in coconut with Banana had increased the net returns many fold. There was marginal increase in milk production and net returns with respect to the

Net income influenced by technical interventions in farming system perspective

Name of enterprise	2011-12 (Benchmark)	2012-13	2013-14
Coconut	4912	5522	16319
Banana	-	85396	109899
Milch animals	34900	46348	46240
Retail marketing	-	6788	12232
Manure prod.through vermicompost	-	6086	9250
Total	39812	150140	193940

Portable vermicomposting unit

feeding of mineral mixture for milch animals. The vermicompost produced added additional income.

Seventy six farmers from near by areas visited farm to get infromation on portable vermicomposting to generate manure and for recycling of crop residues.

Shri Harikrishnan is considered as a progressive farmer at Kunnamthanam Krishibhavan. He is recognized for the outstanding performance in vegetable farming and actively involved in the marketing of vegetables through VFCK.

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Multiple enterprises for higher net returns

GPS Location

Latitude	Longitude	Altitude (m)
9^{0}42'051" N	76^{0}74'578'' E	65

Shrimati Ambily, is a small farmer at Kuttanadu village in Pathanamthitta district of Kerala. She was getting a total net income of only Rs. 59420 from agriculture. Coconut based farming system is dominating in the region. Rice is grown in wetlands. Rearing of milch animals are also undertaken in limited numbers.

The farmer is having a coconut based farming system with coconut as the main crop in an area of 0.72 ha with 120 numbers of palms. The nut production per palm was 50 nos/year. Rice is also grown in wetlands in an area of 0.72 using traditional varieties with production of 1250 kg/ acre. She was having two crossbred milch animals of Holstein Frisian. The milk production/animal was 9.51/day. The farmer was able to realise total net income of Rs 32620 from crops and Rs 26800 from livestock respectively.

The annual nut production per palm was found to be low and the productivity of coconut palms have to be improved. Also the interspaces were not effectively utilized for accommodating other crops. This was again affecting the total returns of the farmer. Provision of cash crops like banana as intercrops could boost the total income of the farmer. Traditional varieties were used for rice cultivation and it required replacement with multi resistant HVY. The general health of the animal was poor and it was not conceiving timely for getting one lactation per year. Also the milk produced was having low fat content and SNF. This again caused lesser price for the milk at the milk society. The milk production cost was unaffordable due to the dependency on concentrates and cattle feed. The enormous crop residues generated in the farm was burnt causing environmental problems and it was not recycled into the system.

The above constraints were studied in detail and accordingly a detailed farm plan with technical interventions were formulated. The technical intervention formulated consists of mineral nutrition with potassium @ 1200g/palm, replacing the traditional variety of rice with multi resistant HYV (Uma) and intercropping in coconut with 250 nos of banana (Nendran). In livestock, mineral mixture @ 30g/ day/animal was administered to improve the general health of the animal and upgrading the quality of milk production. Azolla unit (size 2.5x1.5x0.2 m) was

Potash application to coconut

Other technical interventions

Net returns influenced by technical interventions in farming systems perspective

Name of enterprise	2011-12 (Benchmark)	2012-13	2013-14
Coconut	29220	34765	82316
Banana	-	33190	50085
Rice	3400	12842	20589
Livestock	26800	40060	30005
Processing	-	2260	100700
Total	59420	123117	283695

established to bring down the feed cost by reducing the intense use of industrially manufactured feeds. Value addition with respect to milk and coconut was also initiated. Milk was marketed in small container after filtering and cleaning. Similarly coconut after harvest was subjected to grading and price was fixed as per the nut size. A portable vermicompost was set up to decompose the crop residues generated in the farm and produce vermicompost.

The dairy farmers (123 nos.) in and around the village had arrived and collected the information for setting up azolla unit. It was quite appreciable that feeding azolla and including it in the feeding schedule could bring down the cost of milk production and improve the quality of milk. The farmer is recognised by the Kuttanadu Krishi Bhavan and considered as a progressive farmer who can take up new ventures.

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Farming system : A new dimension for progress and success

GPS Location

Latitude	Longitude	Altitude (m)
9⁰41'996" N	76⁰74'075'' E	34

Farming system approache aim for overall development of the farmer and enables to generate income from different enterprises operating in a farm. Shri C.H. Salim, is a marginal farmer from Perumpetty village in Mallappally block of Pathanamthitta in Kerala . He was having a family of 5 members and was earning a total annual income of Rs 77400 from agriculture. He is following a coconut based farming system comprising of coconut as the main crop and rearing 4 milch animals in addition to the existing cropping system. Coconut and rubber based cropping system are prevalent in this region. The livestock production envisages dairying as a subsidiary occupation in limited land holdings. Rearing of sheep and goats are at limited extent.

This farmer owns a land area of 0.58 ha with 85 coconut palms. The variety is west coast tall with a age above 30 years. The nut production per tree was only 50

Honeybee intervention

Intervention in livestock

Intercropping of banana

nuts/year. The farmer was rearing 4 milch animals and the annual milk production was 4320 litres. The average milk yield/animal was 9 litres/day. The milch animals are Holstein Frisian crossbreeds. The farmer was gaining a total net income of Rs 22800 from crops and Rs 54600 from 4 milch animals.

The crop residues obtained from coconut and banana were recycled and used as organic mulch in coconut basins and for banana crop. The farm yard manure produced was also used as a bulky organic manure for palms and intercrops and it was recycled within the system and the soil health was maintained.

The manurial application and cultural practices followed were not sufficient enough to meet the nutritional requirement of the crop and hence it became one of the major constraints to enhance nut production. The coconut was planted at distance of 7.5 m to 9 m. The interspaces were not fully utilized and intercrops were not raised. This has again affected the total economic returns. The milch animals reared were not managed properly. The animals were subjected to mastitis disease due to poor sanitation and farmers have to spare heavy expenditure on veterinary aid to overcome the problem. Also feed supplementary like mineral mixture were not included in the feeding schedule. The milk produced was marketed at Milk society

of dairy department. But the marketing of milk through retail sale was not exploited. There was no additional enterprise taken up to increase the gross income.

The farmer was made aware of the constraints in his farming system and he had agreed to adopt technical interventions. As a result, a detailed technical programme with respect to crop, horticulture, livestock and processing were prepared. The crop modules consist of technical intervention with mineral nutrition of coconut and intercropping with banana (250 nos.). In case of livestock, in order to improve the health and sanitation of the milch animal was undertaken through provision of cowmat. Mineral mixture was also supplied to maintain the general health of the animal and to prolong the lactation period. Processing and value addition was also given emphasis. The milk produced was marketed locally after cleaning and filtering, packing in small containers. A milk can for storing and distributing was supplied. A beehive was also installed to generate additional returns and to improve fruit setting of cross pollinated crops.

The technical intervention made with respect to coconut like manuring and intercropping had appreciably increased the net returns of the farmer. Also the provision of cowmat in cattle shed had increased the health and sanitation of the animal, thereby bringing down the incidence of mastitis, foot and mouth disease. Similarly new marketing avenues were explored like retail selling of milk which also improved the income. Additional enterprises like bee keeping was also supplementing income to the existing system.

Net returns influenced by technical interventions in farming systems perspective

Name of enterprise	2011-12 (Benchmark)	2012-13	2013-14
Coconut	22800	23442	57958
Banana	-	51060	84718
Livestock	54600	61080	48760
Processing	-	620	13800
Total	77400	136202	205236

The dairy farmer (50 Nos) of Kuttanadu milk society had visited the farm to experience the use of cowmat in cattle shed. The farmers visited were also interest to install beehives at their homesteads.

Shri C.H. Salim is a lead farmer of ATMA in Pathanamthitta. He was selected as the best farmer by the district farmers club of NABARD, Pathanamthitta. He was also honoured as a progressive farmer during the Karshakadhinam celebrations of Chingam-1 by the Department of Agriculture, Pathanamthitta.

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MAHARASHTRA

IFS increased profitability and livelihood of marginal farm household

GPS Location

Latitude	Longitude	Altitude (m)
18^{0}42'005'' N	73^{0}46'745'' E	603

On-Farm Research centre of AICRP on Integrated Farming Systems, Pune operating in Mahatma Phule Krishi Vidyapeeth, Rahuri has selected Shri Murlidhar Damu Hagawane for conducting on-farm research of "On-farm evaluation of farming system modules for improving profitability and livelihood of small and marginal farmers". The farmer participatory research was conducted in the system perspective by identifying the module wise constraints and addressing of the same with low / no cost interventions in four modules namely crop, livestock, on-farm processing / value addition and optional (horticulture). Shri Murlidhar Damu Hagawane having the family of 4 adults was deriving livelihood from 0.6 ha. The annual rainfall of the region is 744.9 mm with maximum area under rice-wheat, pearlmillet-wheat, pearlmillet-chickpea, soyabean-onion and horticultural crops. However, Shri Murlidhar Damu Hagawane sown cereals, Oilseeds, pulses fodder crops and somevegetables in order to get sufficient income for his family. Besides these, in horticultural component, he was having Mango (2), Lime (1), Aonla (1), Drumstick (1) Tamarind (1) in field as well as on border of field. In animal component there are 2 HF cow, and two deshi buffalo. The milk yield of cow/buffalo was only <5-10 litres/ day due to shortage of green fodder round the year and lack of mineral deficiency. The net income obtained

Interaction with farmer

Components of integrated farming system model

Component	Kharif		Rabi		Summer	
	Area ha	Crop	Area	Crop	Area	Crop
Crop	0.35	Soyabean	0.36	Onion	0.30	Pearmillet
	0.10	Groundnut	0.15	Wheat	0.01	Smooth Gourd
	0.10	Maize (fd)	0.02	Maize (fd)	0.01	Bitter Gourd
	0.02	H. Napier	0.02	Garlic	0.01	Bottle Gourd
			0.02	H. Napier	0.02	H. Napier
Animal	0.01	Animal shed Cow - 2 Buffalow - 1	0.01			
Value Addition	-	Sieve for grading of grains and 1 Ghee making instrument	-			
Optional	backyard area plantation	Mango (kehser 2) Lime (Phule sarbati 1) Aonla (1) Drumstick (com 1) Tamarind (local 1)				
Total	0.60		0.60		0.38 (0.22 fallow)	

Component wise cost and benefit due to interventions

Components	Unit (ha or numbers)	Cost (Rs)	Yield advantage (%)	Net benefit (Rs) due to interventions
Cropping Systems	0.55 ha	8337	12	8700
Livestock	Cow (J)-2 Bufflow-1	610	100	24160
Value Addition	1 Sieve grading of grains and 1 Ghee separator	250	51	300
Optional components Horticulture	Mango - 2 Lime - 1 Amala - 1 Drumstick - 1 Tamarind - 1	140	64	1250
Total		9337	268	34410

Economics and employment of farming system (0.60 ha)

Particulars	Bench mark 2012	After interventions 2013	% increase over bench mark
Gross in income (Rs)	180030	252400	40
Total (Rs)	64020	96940	17
Net income (Rs)	123010	155460	26
Employment generation (Mandays)	202	251	24

from marketable surplus of all the components was only Rs 44830/year from which his family were thriving.

After interventions the productivity of soybean, pearlmillet, wheat and onion was increased by 18%, 58%, 17% and 31% respectively.

Documented by: M.M. Desai, Y.C. Sale and R.H. Pawar, OFR Centre, Pune under Mahatma Phule Krishi Vidyalaya, Rahuri (Maharashtra)

Integrated farming system for sustainable food production

GPS Location

Latitude	Longitude
18^{0}50'090'' N	74^{0}19'924'' E

Shri Vijay Popatrao Dundkar was selected for conducting the research of "On-farm evaluation of farming system modules for improving profitability and livelihood of small and marginal farmers" in Ramling village of Shirur block of Pune district of Maharashtra.

Shri Vijay Popatrao Dundkar having the family of 6 members (3 adults and 3 children's) was deriving livelihood from the 1.2 ha area. The annual rainfall of the region is 744.9 mm. Besides field crops, the farmer had 8 mango, 6 guava, 30 sapota and 2 coconut plants in field as well as on border of field. In animal component, there were 4 HF cow, two deshi bullocks and four local goats. The milk yield of cow was <12 litres/day due to shortage of green fodder for round the year feeding and lack of use mineral mixture. In general, the productivity of all crops, was low compared to standards. The net income obtained from marketable surplus of all the components was only Rs 1,90,000/year.

In crops, the constraints of low yield crop cultivars, imbalanced fertilizer application, high incidence of pest and weeds in pearlmillet, wheat, groundnut, greengram, maize and sorghum for fodder was addressed through low cost interventions such as replacing the low yield variety of wheat, groundnut, greengram, maize, sorghum with high yielding cultivars such as NIAW-301, JL-501, Vaibhav, Africantall, Ruchira respectively. Low cost IPM practices were also followed. Similarly, in livestock module, for mitigating the problem of shortage of green fodder throughout the year, the farmer were supplied with improved root ships of Hybrid Napier of Phule Jaywant for green fodder production. Lack of use of mineral mixture was constraints of low fat and milk production which was addressed by supplying mineral salt lick as low cost inputs. Artificial Insemination (AI) was led to conception of cow and delivery of improved calf. The vermibed and vermiculture were supplied as low cost intervention for production of vermicompost from farm residue under value addition module. In the on-farm processing /grading, the house women was

Components of integrated farming system

Component	*Kharif*		*Rabi*		Summer	
	Area (ha)	Crop	Area (ha)	Crop	Area (ha)	Crop
Crop	0.20	Pearl millet	0.10	Maize Fodder	0.20	Fodder
	0.10	Sugarcane	0.15	sorghum fodder	0.20	Vegetables crops
	0.05	H. Napier	0.35	wheat	-	-
	0.05	Cluster bean	0.10	Sugarcane	0.10	Sugarcane
	0.40	Sapota +	0.05	H. Napier	0.05	H. Napier
	Intercrops in	Lucerne 0.10	0.05	Onion + garlic	0.05	-
	Sapota	Greengram 0.05	0.40	Sapota +	0.40	Sapota+Lucerne(fd)0.10
		Groundnut 0.10	Intercrops in Sapota	Lucerne(fd)0.10	intercrops in Sapota	
	0.05	Maize fodder		Maize (fd)0.05		
	0.20	sorghum fodder		Chickpea 0.10		
	0.05	cluster bean				
Animal	0.02	Animal shed Cow-2 Bullocks-2 Goat 1 Poultry Birds-10				
Value Addition	0.01	Vermi Compost				
Optional	Border plantation	Mango-8 Curry leaf-1 Guava 6 Coconut 2				
Total	1.13 (0.07 Fallow)		0.83 (0.37 fallow)		1.03 (0.17 fallow)	

Greengram (Vaibhav)

Groundnut as intercrop in fruit crop

supplied with grading sieve for grading of food grains and they were trained for making quality pickle from mango available at farm and ghee from the excess milk. Apart from

Monitoring from ICAR-IIFSR, Modipuram

Optional component: Poultry birds

these, backyard poultry with improved local breed was integrated under optional module. After intervention the productivity of sugarcane, pearlmillet, wheat, groundnut and onion was increased by 14, 261, 80,11 and 64% respectively.

Economics and employment of farming system (1.20 ha)

Particulars	Bench mark 2010	After intervention 2011 (First year)	After intervention 2012 (Second year)	% increase in first year	% increase in second year
Total cost (Rs)	120300	143000	148230	18	23
Gross income (Rs)	190000	240000	400400	26	110
Net return (Rs)	70000	97000	252170	38	260
Employment generation (Mandays)	486	674	593	38	22

Besides the higher income, the family meets the nutritional requirement by in house production of quality grains such as cereals, pulses, milk and milk products, egg, fruits and fruit products. Nearby farmers are also evincing interest in adopting all the modules as these are of low cost in nature. The family gets additional employment due to the interventions made in farming systems perspective.

Documented by: M.M. Desai, Y.C. Sale and A.G. Nikarad, OFR Centre, Pune under Mahatma Phule Krishi Vidyalaya, Rahuri (Maharashtra)

Fruits of diversification

GPS Location

Latitude	Longitude	Altitude (m)
20^{0}48'988'' N	77^{0}38'118'' E	103.2

Shri Damoder Daulat Aade resident of Ajani village which is located in Nandgaon Khandeshwar block of Amravati district is having 1 ha area of land. Four family members were dependend on land for livelihood with farm income of Rs 58000.

Short duration drought and pest resistant variety of soybean (JS 9305) and intercropping pigeon pea (PKV Tara) followed by summer sesame (NT 11) was made in 0.20 ha. The crops were supplemented with balanced fertilization. No of irrigations required for summer ground nuts were 7-8 but summer sesame required only 3-4 irrigations. As the seed rate required for ground nut is more than sesame leads to more money requirement, and also more labour intensive crop which leads into more cost of cultivation.

Diversification with pigeonpea and sesame

Crop diversification with soybean + pigeonpea and sesame

Parameters	Unit (ha or numbers)	Pre intervention	Post Intervention
Cropping Systems	0.20	Soybean- fallow-summer ground nut	Soybean + pigeon pea-summer sesame
Gross income (Rs)		21946	23296
Cost (Rs)		12099	7325
Net income (Rs)		9841	15971

Near about 30 % increase in yield was obtained due to the diversification. The summer sesame crop was visited by nearby farmers and 25-30 farmers were contacted with him about sesame cultivation. The net income increased to Rs 15971 due to diversification.

Parameters	Unit (ha or numbers)	Details of Interventions	Cost (Rs)	Yield advantage (%)	Net benefit (Rs) due to interventions
Cropping Systems	0.20	Change in variety, balanced fertilization, intercropping, low input crop selected.	3282	30	15971

Documented by: Varsha Tapre, OFR Centre, Amravati under Panjabrao Deshmukh Krishi Vidyapeeth, Akola (Maharashtra)

Improved income in rice-rice system through balanced nutrient application

GPS Location

Latitude	Longitude	Altitude (m)
18^{0}26'87" N	73^{0}11'90'' E	52

Shri Lakshman Bhiku Bamugde from Bahe village, Roha block, Raigad district having 1.10 ha was getting income of only Rs 24721/annum. The mean annual rainfall of the region is 3100 mm with rice-rice as the pre dominant cropping system. Family of 5 memebers depending on rice-rice system for their livelihood. The yield and net income obtained before intervention is given below.

Crop (1.1 ha)	Yield (kg/ha)	Net income (Rs/ha)
Kharif rice	3,945	16,323
Rabi rice	3,120	8,398
Total	7,065	24,721

Farmer's method of rice transplanting

Line transplanting of rice

Use of low yielding rice variety which are less responsive to plant nutrients, lack of optimum dose of plant nutrients and non split application of N were identified as major constraint in rice-rice system limiting the yield.

Use of high yielding hybrid rice (Sahyadri) in *kharif* and karjat-3 in *rabi* with application of recommended dose to rice (120: 50: 50:6 kg/ha N, P_2O_5, K_2O, $ZnSO_4$) and split application of N was practiced as interventions to improve the yield income. The improvement in yield and income are given below.

Crop (1.1 ha)	Yield (kg/ha)	Net income (Rs/ha)	% increase in net income
Kharif rice	6560	36,210	121
Rabi rice	4750	16,023	90
Total	11310	52,233	111

Farmer's management

Bumper yield of rice due to proper nutrients management

About sixteen other farmers are adopting balanced nutrient application method by contacting the farmer which helps to increase the yield and production of rice in the region.

Documented by: S.B. Bhagat, OFR Centre, Palghar under Dr. B.S.K. Krishi Vidyapeeth, Dapoli (Maharashtra)

ODISHA

Livelihood security for small farmer through low cost interventions

GPS Location

Latitude	Longitude	Altitude (m)
21^{0}02'598'N	84^{0}50'679'E	225.3

Shri Trilochan Sahu from Handiguda village in Chhendipada block of Angul district in Odisha is a small farmer with farm holding of 1.6 ha. He had primary education only but his keen interest in farming has made him a successful farmer in the district. With the income from farming he maintained his family of six with one college going and two school going childrens. Low cost interventions in crops, vegetables, fruit crops, dairy and poultry supported by the on-farm research centre of AICRP on Integrated Farming Systems, Angul, Orissa University of Agriculture and Technology have substantially increased his standard of living.

The cropping systems practiced by the farmer were rice-groundnut/ garden pea-fallow and cowpea- fallow-green gram. Before the interventions in 2012-13, he was taking rice in 0.4 ha and cowpea in 0.032 ha in *kharif* season. In *rabi* he was taking groundnut in 0.04 ha and garden pea in 0.12 ha and in summer, green gram in 0.016 ha. Out of these crops his annual income was Rs. 24800 with net return of only Rs. 10800. Besides, he was having 35 mango plants in 0.2 ha and 25 cashew nut plants in 0.2 ha. He was earning only Rs. 27000 as net profit from the orchard. However, his major share of income was from the dairy unit with three lactating cross bred cows. The annual gross and net profit out this component was Rs. 92400 and Rs. 40000, respectively. The poultry component realized an annual net profit of only Rs. 1000. The whole farming system was managed with 247 man days through his family labour.

Income from different farming system components before intervention and related constraints

Crops/ Livestock/ others	Gross income (Rs)	Net income (Rs)	Cropping systems	Constraints related to the identified problem
Rice	14800	4800	Rice - groundnut/ garden pea - fallow	Imbalanced fertilizer, poor plant protection
Vegetables	10000	6000	Cowpea - fallow-green gram	Low fertilizer dose, poor plant protection, no vegetables in *kharif* and summer season
Mango	17000	11000	35 plants in 0.2 ha	Low fertilizer dose and no organic manure
Cashew nut	10000	6000	25 plants in 0.2 ha	Low fertilizer dose and no organic manure
Cow	92400	40000	3 cross bred	Imbalanced feed, no vaccination
Poultry	10500	1000	Local (10 Nos.)	Inadequate feed, broiler bird of White Vancob breed
Total	154700	68800	-	-


Interventions in crop modules (maize for green cob)

The major constraints identified for crops were imbalanced fertilizer application and poor plant protection measures. In fruit trees, no organic manure was used. The

major portion of cow dung was used for fuel purpose. No mineral mixture was fed to the milch cows. Shri Sahu was procuring broiler chicks of White Vancob breed and reared these birds for 9 to 11 weeks, but the birds were not properly fed which resulted in low body weight and low income. The component was not cost effective also.

Low cost interventions were made in the existing farming systems supported by the On-Farm Research Centre, AICRP on Integrated Farming Systems, Angul. Vegetables like colocasia, bitter gourd and lady's finger in *kharif* and onion, cowpea, cabbage in *rabi* were introduced. Seeds of hybrids and high yielding varieties of the vegetables were used. Adequate and balance plant nutrients were applied to each

Interventions made in existing components of the farming system and monetary returns

Parameters	Post-intervention	Details of Interventions	Interve-ntion Cost (Rs)	Yield advantage (%)	Net benefit (Rs) due to interventions
Cropping systems	Rice - groundnut/ garden pea/ maize/ potato - green gram Vegetables (colocasia, bitter gourd, lady's finger) - vegetables (onion, cabbage, cauliflower) -vegetables (brinjal, cowpea)	Seeds, pesticides, balanced nutrients	5462	38	28490
Livestock	4 cross bred cows	*Azolla* as feed, mineral mixture, health care	1225	5.6	3250
Fruits	Mango (35 plants), cashew nut (25 plants) with pruning	Pruning of trees, balanced nutrients	645	18	13500
Poultry	182 (Dual purpose birds of Vanaraja and Blackrock breeds)	32 Vanaraja chicks, 2 kg starter feed, *Azolla* as feed	652	15	35440
	Total		7984		80680


Interventions in crop module

crop. Timely plant protection measures were taken. Maize crop was also introduced for green cobs as it had a good marketability and after the harvest of cobs the leaves were used as green fodder for the animals. *Azolla* was multiplied in small pits and were fed to the animals and birds. Mineral mixture was given to the milch cows to increase the milk production. Perennial fodder grass hybrid napier and annual oat were cultivated in 0.08 and 0.02 ha, respectively. This supplemented the green fodder requirement of the cows throughout the year. In poultry component, dual purpose back yard poultry Vanaraja was introduced. These coloured birds fetched better market price as compared the broilers of white Vancob breed. The farmer then procured chicks of other coloured breed like Blackrock which is also in great demand for meat.


Interventions in livestock module

The dead, diseased, unproductive and undesired branches of mango and cashew nut trees were pruned. On an average 25 kg fuel wood was available from each plant/ year. This reduced the dependency of the farm family on dried cow dung as fuel. The cow dung was used for composting. The trees were fertilized with both organic and inorganic fertilizers, twice a year in July and September.Crop residues from the vegetable crops (1330 kg), cow dung (26280 kg) and poultry litter (200 kg) were composted and recycled in crops as organic manures. The whole farming system required 336 man days which was mostly managed by the family labour.

The interventions of different inputs worth of Rs. 7984 increased the net profit by Rs. 80680. After the interventions, the total annual gross return and net returns were Rs. 302390 and 149480, respectively. With the substantial increase in the livelihood resources of Sri Trilochan Sahu through these low cost interventions, the nearby farmers must be encouraged to follow him.

The following 'no cost' or 'very low cost' innovative practices followed by Shri Sahu attracted the attention of the neighbouring farmers.

- *Azolla* culture in small pits for feeding dairy animals and poultry birds.
- Yam cultivation in mango orchard.
- Country bean trailing to the mango plants during *kharif*.
- Climbers like bottle gourd and wash gourd trailing to the thatches (roof tops) of residential house and cattle shed.
- Pruning of mango and cashew nut trees, pruned materials used as fuel wood, as a substitution to the dry cow dung to some extent.
- Chopped inflorence and pseudostem of banana plants as poultry feed.
- Feeding animals with the green leaves of maize plants after the green cobs are harvested.
- After harvest of cabbage and cauliflower the leaves are fed to animals and chopped to feed the poultry birds.

Documented by: Alok Kumar Patra, Susanta Kumar Swain, L M Garnayak and K N Mishra, On-Farm Research Centre, Angul of AICRP on Integrated Farming Systems, Orissa University of Agriculture and Technology, Bhubaneswar

High returns from low cost interventions in farming system approach

GPS Location

Latitude	Longitude
$20^0$31'400'' N	$086^0$18'371'' E

Agriculture is the main stay of the industry less Kendrapara district of Odisha. About 86% farmers of the district are of small and marginal category with average holding of 1.11 ha. The annual rainfall of the region is around 1500 mm with maximum area under rice-fallow and major domesticated ruminants are cow and goat. It becomes difficult to ensure livelihood security for a farm family with a single crop with such small holding. A well tuned integrated farming system fitting well with the farm family is a suitable strategy for augmenting the income and employment of the small and marginal farmers of the district. Taking this into account, a study was conducted by On Farm Research Centre (AICRP on IFS), Kendrapara in the farm unit of a marginal farmer, Shri Prasanta Kumar Behera of Kanarpur village of Derabish block in Kendrapara district of coastal Odisha. Prasanta, aged 38 years, was earning only Rs. 30,113 from his 0.68 ha of land to support his 6 member family (4 adults and 2 children). Shri Behera was cultivating crops like paddy during *kharif* and green gram, black gram, and vegetables like tomato, cucumber, ridge gourd during *rabi*. Low yield from the crops (3625 kg/ha in paddy, 400 kg/ha in green gram & black gram), banana (70 small bunches from 130 plants),coconut (60 nuts/15plants), only 420 litres of milk/year from a desi cow and 145 kg of fish from his 0.1ha pond was insufficient to support his family in a sustainable manner. Besides these, he was also having a pair of bullocks.

During the process of farmer's participatory research on "on-farm evaluation of different farming system modules", constraints limiting the system productivity and profitability were identified with each component of the existing system of Shri Prasanta. Suitable and affordable low/no cost interventions were identified for intervention. Low yielding local variety of paddy, pulses and vegetables, poor soil,

nutrient and pest management practises both in field and plantation crops, rearing desi cow with imbalanced feeding and no medication, improper fingerling stocking with no water quality management in pisciculture were addressed by HYV and hybrid variety in paddy(JKRH-1,Ranidhan), black gram(PU 31), tomato(Chiranjivi), soil application of paper mill sludge (PMS) to correct soil acidity, zinc and other micronutrients to rice and vegetables, bacterial fertiliser in pulses, IPM measures with use of neem based pesticide, pheromone and yellow trap in field crops, lime and antifungal treatment in banana, boron in coconut , artificial Insemination (AI) in cow, albendazole for deworming and vaccination, integration of azolla and mineral mixture in cattle feed, proper fingerling stocking with IMC, Pacu and Pongatius, liming and plankton monitoring in fish pond, introducing mushroom cultivation, low cost cool chamber for proper vegetable storing and promoting preparation of value added products like coconut oil, rice chunks ,ghee by farm women for raising household income.

These low cost interventions has resulted in increase in paddy yield by 25.8%, pulse yield by 22.6%,milk yield by 135% and fish yield by 28%.During 2012-13 and 2013-14 the average cost of all the interventions was only Rs 17,524/year which contributed for additional income of Rs 62000/year. The average net return was Rs

Technological interventions on profitability of the farming system

Module	Gross returns (Rs)		Net returns (Rs)		Additional cost (Rs)	Additional return (Rs)
	BM	PI	BM	PI	BM	PI
Crop	58610	103607	13130	38006	6667	24876
Livestock	6300	21050	2923	10857	4263	7934
Fish	11600	20320	6500	14740	1643	8240
Value addition	0		0	2661	873	2661
Others (KG, Fruit, Mushroom)	7770	39660	7560	26638.5	4079	19079
TOTAL	84280	184637	30113	92903	17523.5	62790

BM- Benchmark, PI-Post intervention, KG-Kitchen garden

An emerging tissue culture banana bunch

Azolla culture

Chunks from blackgram

Plankton monitoring for fish feed

Vegetable plucking in kitchen garden

Round the year green in KG

92,000/year which is around 200% higher than benchmark. Apart from this, around 6700 kg of straw/stover has been recycled in the system, as cattle feed, mushroom production, fuel, compost making and 5200 kg of cow dung as manure for farm and fuel for family.

Nearby farmers have also shown their interest in adopting these low cost technologies like use of HYV seeds, use of rhizobium in pulses, yellow traps for insect control, liming in fish pond and azolla as animal feed in their farming and animal rearing practices.

Documented by: Susanta Kumar Swain, Alok Kumar Patra, L.M. Garnayak and K.N. Mishra, OFR Centre, AICRP on IFS, Kendrapara, Orissa University of Agriculture and Technology, Bhubaneswar, Odisha

Income has no margin for innovative marginal

GPS Location

Latitude	Longitude
20^{0}32'090'' N	086^{0}17'586'' E

Shri Keshab Jena, a marginal farmer having the family of six members, was deriving livelihood from 0.70 ha area in village Darabal of Derabis block (85 km towards north-east from Bhubaneswar) in Kendrapara district of Odisha. Climate of the region is characterized by hot summer and high humidity during rainy season, dry winter and low diurnal range of temperature throughout the year. Annual normal rain fall of the district is 1556 mm, which is almost 7% higher than normal rainfall of the state. Most of the farmers of the locality practise rice-fallow system of cropping and have cow and goat as the major livestock component.However, Shri Keshab Jena tried to grow green gram, black gram, jute and some vegetables like brinjal, bittergourd and tomato after the rice in order to get sufficient income to run his family. Besides these, he was also having few coconut trees, a mango plant, one desi cow, two bullocks and four goats. The milk yield of cow was only less than 2 litres/day. He was able to harvest only 10 kg of local fish from the small pond of 320 m^2 in his farm. In general, the productivity of all crops, animals and fish was very low compared to standards. The net income obtained from marketable surplus of all the components was only Rs 18,600/year on which his family was thriving with struggle.

Family of Shri Keshab Jena

On-Farm Research unit of Kendrapara district under AICRP on Integrated Farming Systems operating in Orissa University of Agriculture and Technology, Bhubaneswar identified Shri Jena during 2011 for conducting the

research of “On-farm evaluation of farming system modules for improving profitability and livelihood of small and marginal farmers”. The farmer participatory research was conducted in the system perspective by identifying the module wise constraints and addressing the same with low / no cost interventions in four modules namely crop, livestock, on-farm processing and value addition and optional module for taking up any intervention suitable to the micro farming situation of the farmer.

In crop module, the constraints of low yield crop cultivars, imbalanced fertilizer application, high incidence of pest and higher incidence of weeds in jute was addressed through replacing the local variety of paddy with high yielding JKRH-401,Ranidhan and Hanseswari, bitter gourd with Sathi and tomato with Deepti, Chiranjivi ,balanced fertilizer with zinc application to rice, application of rhizobium and paper mill sludge to pulses, IPM practices with low cost yellow trap, pheromone trap, neem based pesticide and ash treatment to pulses & vegetables and quizalofop-ethyl weedicide application to jute. Similarly, in livestock module, constraints of low productive desi breed, inadequate and imbalanced feeding and no vaccination was addressed through promotion of Artificial Insemination (AI), integration of azolla and mineral mixture for feed, use of albendazole for deworming and vaccination as per schedule. During last two years AI has led to production of three cross bred calves, one of which is in lactating stage. In fisheries, the constraint was identified as seasonal derelict pond with short culture period which was addressed by stocking of quick growing species of pacu, pongatius and silver carps. Apart from these, backyard poultry with improved breed of Vanaraja, duckery with Khaki Campbell and paddy straw based oyster mushroom was integrated under optional module. In the on-farm processing and value addition module, the house women were trained for making quality pickle from mango and ghee from the excess milk for which low cost inputs like hand blender/milk frother were provided. Also grading of paddy and pulses and improved retting method of jute were advocated for adding value to the produce. These low cost interventions has resulted in increasing paddy and jute yield by 7 %, pulse yield by 14-15%,vegetable yield by 50%,milk yield by 300 % and fish yield by 500%. In addition to this, around 7300 kg of straw/stover has been used as cattle feed, mushroom production, fuel, thatching, vermicompost making and 7700 kg of cow dung, goat droppings and poultry litter has been recycled as manure and fuel.

Azolla feeding to poultry

Ghee making by frother

Kharif vegetable cultivation

Oyster mushroom cultivation

Pheromone trap in hybrid paddy

Receiving Best farmer award

Effect of technological intervention on profitability of the farming system

Module	Gross returns (Rs)		Net returns (Rs)		Additional cost (Rs)	Additional return (Rs)
	BM	PI	BM	PI		
Crop	62318	115699	15612	46314	8274	30702
Livestock	3575	20536	1477	6630	3811	5153
Fish	700	7070	600	4350	1420	3750
Value addition	0	-	0	2375	924	2375
Others (poultry, duckery, fruits, mushroom, etc.)	1000	7868	1000	3628	1690	2628
Total	67593	151172	18689	63296	16119	44607

BM- Benchmark, PI-Post Intervention

The total cost of interventions in all the modules was only Rs 16,119/year which contributed for additional income of Rs 44,607/year. The household earns net income of Rs 63,300/year which is more than 200 % higher than benchmark. Besides the higher income, the family meets the nutritional requirement by in-house production of quality products such as vegetables, pulses, milk, egg, mushroom and fish. For his substantial achievement Sri Keshab Jena has received an award of best farmer from the Hon'ble Governor of Odisha on the occasion of celebration of the Foundation Day of Orissa University of Agriculture and Technology on 24th August 2013. His success has motivated the farmers of adjacent areas for evincing interest in adopting all the modules as these are successful and low cost in nature.

Documented by: Susanta Kumar Swain, Alok Kumar Patra, L.M. Garnayak and K.N. Mishra, OFR Centre, AICRP on IFS, Kendrapara, Orissa University of Agriculture and Technology, Bhubaneswar, Odisha

RAJASTHAN

Integrated farming system doubles small holder income

GPS Location

Latitude	Longitude
$24^0$21'44'' N	$73^0$97'23'' E

Shri Laxman Lal Teli s/o Shri Bheru Lal Teli resident of village Ajolia ka Kheda, block-Gangrar, district Chittorgarh in Rajasthan was having family size of 5 with annual income from agriculture Rs 1,50,000.




Interventions in crop and livestock components

The farmer was having 2 buffaloes, 1 cow & 2 bullocks of local breed with low milk yield.

The farmer having no knowledge of improved crop varieties , vegetables and fruits. He was having no knowledge of cross breeding and better feeding habits.

Improved seed and recommended doses of fertilizers for the crops, vegetables and fruits, was introduced. Mineral mixture for milch animals alongwith feeding habits to the milch animals also made as interventions. At the same time, the farmer also trained for preparation of pop corn at large scale.

Particular	Mixed farming (Traditional crops + Deshi Cow)	IFS interventions (Improved seed + Vegetables + Mineral Mixture)	Improvement in Income (%)
Area	1.25 ha	1.25 ha	142.8
Gross income (Rs)	1,50,000	3,85,000	
Expenditure (Rs)	80,000	2,15,000	
Net income (Rs)	70,000	1,70,000	

Documented by: L.N. Dashora and Hari Singh, OFR Centre, Udaipur under Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan

TAMIL NADU

Realizing respectable revenue through farming system approach

GPS Location

Latitude	Longitude	Altitude (m)
$10^0$12'289'' N	$078^0$37'150'' E	120.4

Shri Francispritto, an active progressive farmer hailing from a small hamlet namely Ammayenthal located in Thirupathur Block of Sivagangai District, Tamil Nadu having the family size of 6 members which includes 2 adult and 4 children was deriving livelihood from 1 ha of land. The average annual rainfall of the region is 940 mm with maximum area under rice–rice cropping system and there is no dearth of resources and is bestowed with all natural resources. Ultimately, the annual net income obtained from marketable surplus of all the components was only Rs. 75230/year.

Nevertheless, Shri Francispritto used to grow rice during monsoon period and subsequently blackgram, groundnut and some vegetables like okra, brinjal, chillies, tomato, raddish and onion during summer in order to get sufficient income to meet

Capacity building and interventions in crops

Crop diversification with fodder

out daily expenditure of his family. In addition to this, he has a flair for livestocks and had maintained 2 crossbred cows and a calf. He was also maintaining few desi birds in his backyard. In general, the productivity of rice, blackgram, groundnut and vegetables was low as compared to potential yield due to non adoption of improved cultivation practices.

During the year 2011, On-Farm Research Centre, Dryland Agricultural Research Station, Chettinad, functioning under Tamil Nadu Agricultural University selected Shri. Francispritto for implementing the on-farm research titled “On-farm evaluation of farming system modules for improving profitability and livelihood of small and marginal

Vegetable intervention


Interventions in crop and livestock

farmers". The on-farm research was conducted in farming system perspective through farmer's participatory approach by identifying the module wise constraints and addressing the same with no or low cost interventions.

With regard to crop module, the major constraints for low yield in rice, blackgram, groundnut and vegetables were growing of traditional varieties (T9 in blackgram, TMV 7 in groundnut and local conventional varieties in vegetables), weed menace, non availability of labourer during peak period of cultivation, imbalanced nutrition (higher dose of N and lower dose of K), poor fruit setting in vegetables and fruit borers and YMV in vegetables, high incidence of stem borer, leaf folder, BLB in rice, collar and


Interventions in livestock

root rot in groundnut, pod borer and YMV in blackgram were identified through bench mark survey. Similarly, in animal husbandry, the main constraints for low milk yield was due to lack of green fodder, mineral deficiency and keeping of non descriptive animals. Whereas, in the case of backyard poultry the major constraints were poor egg laying capacity, poor feed conversion ratio and higher mortality rate owing to non adoption of vaccination scheduling and poor nutrition.

Regarding crop components, the constraints were counteracted through no and low cost and knowledge based interventions such as replacement of local and traditional variety with high yielding varieties and hybrids (for summer rice MDU 5 against ADT 39 and ADT 43) VBN 5 for T9 in blackgram, VRI 7 for TMV 7 in groundnut, NOKH 1001 okra against No. 10), balanced fertilization which includes soil test crop response (STCR) based fertilizer application for all crops including foliar nutrition with TNAU groundnut consortia and TNAU pulse wonder during 50% flowering stage, pests surveillance based IPM strategies which includes traps, bioinoculants and nano pesticides. To address the labour scarcity, weed menace and poor crop establishment, seed drill sowing in rice (direct seeded rice against transplanting in rice), blackgram and groundnut was introduced to maintain inter and intra row spacing. To alleviate weed problem early post emergence herbicides such as bispyribac sodium & Azimsulfuron, imazithapyr and quizalfop-ethyl in rice and pulses, respectively were demonstrated and test verified.

With respect to livestock components, problems were addressed by year round supply of green fodder with the help of Bajra Napier Hybrid CO 5, supplementation of location specific mineral mixture, Artificial Insemination (AI) with jercy and HF, vaccination and deworming at regular intervals. In addition to this, regular hands on training on clean milk production was also imparted and required critical inputs were given to the animal components. The constraints observed in the backyard poultry were addressed by introducing dual purpose chicks Namakkal (NKL) 1 and Giriraja with proper nutrition and vaccination to check the mortality at the early stage. Apart from this, azolla cultivation and low cost silpaulin vermicompost production were also integrated under optional module. Under the on-farm processing and value addition module, the family women was imparted training on cleaning, grading and packaging of vegetables during lean period.

To enhance the productivity of existing transplanted rice, direct seeded rice (DSR) during summer and System of Rice Intensification (SRI) method of rice cultivation during *rabi* season have been introduced and through this intervention, an additional net income of Rs.9850 and Rs7490 was realized, respectively. With respect to groundnut, intervention consisting of seed drill sowing, improved variety (VRI 7) with foliar nutrition of groundnut consortia has increased the pod yield by 516 kg compared to conventional TMV 7 variety which resulted in an additional net income of Rs. 14310 with an additional cost of only Rs. 2200. In blackgram, with low interventional cost of Rs.650 an additional income of Rs. 2350 was realized. In okra, NOKH 1001 has been introduced against No. 10 which resulted in 300 kg extra yield and Rs.6000 higher net income than that of conventional No.10 variety.

With respect to milk yield, the average milk yield of a cow was only 7.5 litres/day (morning 4.0 litres and evening 3.5 litres) which is very low as compared to standard owing to the poor nutrition and poor health care. Due to year round supplementation with CNH CO 4, location specific MN mixture and proper vaccination and other health care, an additional milk yield of 900-1000 ml/animal/day, increased the lactation period (224 days), enhanced the conception rate and reduced inter calving period (339 days) were realized besides increasing the net income of Rs 11230/year/animal.

Through rearing of backyard poultry with improved breed Namakkal (NKL) 1 and Giriraja, an additional income of Rs 2800 was realized over conventional breed and rearing methods. In addition to this, 275 kg of poultry droppings was obtained which was effectively utilized for soil fertility improvement.

Improvement in yield and economics of crop and livestock components

Particulars/household	Farmers practice (before Intervention)	Improved practice (after Intervention)
Rice (*Rabi*)	Conventional	SRI (System of rice intensification)
Yield (kg)	2600	3330
Cost of cultivation (Rs)	15500	17500
Gross income (Rs)	33800	43290
Net income (Rs)	18300	25790

Particulars/household	Farmers practice (before Intervention)	Improved practice (after Intervention)
Rice (Summer)	Transplanting	DSR (Direct seeded rice)
Yield (kg)	2200	2750
Cost of cultivation (Rs)	14750	11500
Gross income (Rs)	26400	33000
Net income (Rs)	11650	21500
Groundnut	TMV 7	VRI 7
Yield (kg)	645	1161
Cost of cultivation (Rs)	7000	9200
Gross income (Rs)	20640	37150
Net income (Rs)	13640	27950
Blackgram	T9	VBN 5
Yield (kg)	75	125
Cost of cultivation (Rs)	2100	2750
Gross income (Rs)	4500	7500
Net income (Rs)	2400	4750
Okra	No.10	NOKH 1001
Yield (kg)	900	1200
Cost of cultivation (Rs)	10500	12000
Gross income (Rs)	22500	30000
Net income (Rs)	12000	18000
Dairy		
Milk yield (litres)	1680	1985
Cost of cultivation (Rs)	21500	24500
Gross income (Rs)	30240	35730
Net income (Rs)	8740	11230
Backyard poultry		
Cost of cultivation (Rs)	3500	5200
Gross income (Rs)	12000	16500
Net income (Rs)	8500	11300
Farming system (crop + dairy + backyard poultry)		
Gross income (Rs)	150080	203170
Cost (Rs)	74850	82650
Net income (Rs)	75230	120520
Additional cost (Rs)	-	7800
Additional net returns (Rs)	-	45290

As a whole, the additional cost of intervention involved in all the modules over conventional method was only Rs7800/year which contributed an additional income of Rs 45290/year. Within one year, the net return per rupee invested on all the interventions stands at 5.80. The household earns net income of Rs 120520/year which is 60% higher than benchmark. Besides the higher income, the family meets the nutritional requirement by in house production of quality products such as dhal, milk, egg and fresh vegetables. Neighboring farmers are also evincing greater interest in adopting all the modules as these are of low cost in nature. The family gets additional employment of 48 man days due to the interventions made in farming systems perspective.

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Family farming village

Ammayenthal village is located in the newly formed Sivagangai district of Tamil Nadu which is carved out from erstwhile composite Ramnad district during 1995. It is bounded by Pudukkottai on the North East, South East by Ramnad District, North West by Trichy District, South West by Madurai and Virudhunagar Districts.

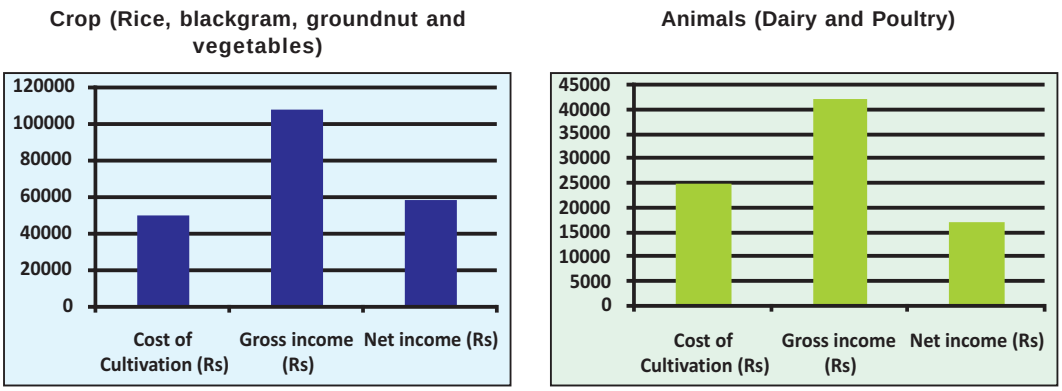
The total geographical area of Ammayenthal village is 35 ha and consists of 24 households which are coming under North Illayathankudi revenue village of Thirupathur block, Sivagangai District, Tamil Nadu. Open well is the main source of irrigation for this village. However, the tanks and borewells are also the major sources of irrigation. The average annual rainfall of the region is 940 mm with maximum area under rice–rice cropping system.

Rice is the principal crop in this village (15 ha), cultivated during *kharif*, *rabi* and summer seasons with a production of 5.70 tonnes. Groundnut is the principal oil seed crop which is grown both under irrigated and rainfed conditions during Summer and *kharif* seasons, respectively. Regarding pulses, cow pea, greengram and blackgram also grown under both irrigated as well as rainfed conditions. The predominant cropping systems followed in this village are rice (Sep.-Jan.) – rice (Mar.-Jun), rice (Sep.-Jan.) – groundnut (Mar.-Jun), rice (Sep.-Jan.) – blackgram (Mar.-Jun) and Groundnut (Dec.-Mar.) – Vegetables/Maize (Apr.-Jun.). In livestock, cross bred cows

and backyard poultry are the predominant system with the average milk and egg production of 7.5 liter/day and 140 eggs/ year/bird.

The major constraints in the crop production faced by the farmers are paucity of laborers particularly during peak period of cultivation, non availability good quality, high yielding and disease resistant varieties, weeds menace in crop cultivation which results in reduced crop yield, lack of technical knowledge and awareness on Improved Production Technologies (IPT) and poor marketing price for their products owing to lack of marketing information and market linkages. Pertaining to the livestock component, non availability of improved breeds and green fodder during lean period, lack of technical knowledge on scientific management of animal rearing and sudden outbreak of pests and diseases are the major problem witnessed by the farmers.

The average cost of cultivation and gross income realized from all the crop and animal components by the farm families is furnished below.



Economics of crop and animal components before intervention

The house hold details of Ammayenthal village are as follows.

- The majority of the house holds belongs to the backward cast having small and medium land holdings (less than 2.5 ha).
- Farmers diversify crops for food and animal fodder such as rice, blackgram, groundnut, vegetables and cumbu napier grass, pillipesera and fodder cowpea.

Capacity building and other intervention in the village

- Participation of women in farming is based on the category.
- There are gender specific tasks or degrees of work specialization in crop production
- Men have higher off farm earning in urban areas/town/cities than women and more men in villages near the cities are engaged in non farm activites
- There is a wider gender gap in education and womens lack of access to technical knowledge

Participatory Technology Development (PTD)

Farming system in Ammayenthal village of Sivagangai District is complex, diverse, laborious and cumbersome. The development of technologies particularly for farming system should take a different approach from the conventional type of on station research. On farm Research (OFR) within the context of farming systems was emphasized since 2008 as part of the ICAR-AICRP-IFS sponsored scheme. This initial effort aimed to develop farmer centered research methods involving the use of multi disciplinary approach and setting the stage for use of participatory methods. The farming system modules have significantly helped in incresasing the productivity, meeting house hold needs, generating income and employment with low investment cost.

Weeding Drudgery

In the past, the farmers were doing weeding operation with the help of hand hoe for garden land crops and manual weeding in the case of rice by women labourers which is labourious, time consuming and cumbersome process. In view of this, controlling the weed menace in crop cultivation, seed drill sowing to ensure row spacing was conducted in rice, blackgram and groundnut at Ammayenthal village of Thirupathur Block of Sivagangai Distrcit, Tamil Nadu. It was intended to supress the weed infestation and make weeding process easier in rows and thereby minimising the weeding drudgery, other agronomic and intercultural activities particularly for women. This resulted in saving the seed rate, seed cost, minimising the labour requirement for weeding and other intercultural activities besides maintaining the optimum plant population load which led to higher per plant productivity.

Drudgery Reduction

Women in this village attended manifold duties in home as well as on the farm, while the men migrate to urban areas in search of better employment mostly as mason and painting. Women perform most of the activities in agriculture such as sowing/planting, weeding, harvesting and threshing which involve more drudgery and are time consuming. Thus, under marginal and small house hold conditions, where the socio economic condition of the farmers is poor, it is necessary to develop low cost and gender specific technologies in crop production. In this regard, seed marker for line sowing in pulses, cono weeder and power weeder in direct sown rice, manual decorticator and stripper in groundnut and fruit plucker in okra were introduced and popularized among the women farmers for drudgery reduction thereby reduced the labour cost, energy and time. In this manner, drudgery for labour is managed besides significant reduction in cost of production.

Crop diversification

Crop diversification with short duration blackgram and groundnut in the existing rice- rice system was found to be productively promising and this technology enhanced the cropping intensity, gave additional remuneration of Rs.75000/ha besides improving the soil fertrility status through addition of crop residues and

biological nitrogen fixation. Therefore, crop diversification with high value blackgram and groundnut was considered to be the best suited for rice-rice system under changing climatic conditions with a built in compensation provision for rice crop failure by the said high value crops.

Role of women in family farming

In recent years, there has been a greater focus on complex, diverse and risk, prone agriculture in rural areas like Ammayenthal village where marginal and small farmers are located with resource poor condition. Though, rice is the major crop grown during peak season in this village, farmers do also grow blackgram, groundnut and vegetables after rice is harvested.

In Ammayenthal village, women played an important role in all farming activities such as selection of crops, variety, weeding, spraying, harvesting and marketing. Moreover, due to the migration of men to the cities for better job activities, the demand for labour, particulalry during the peak period of cultivation prevailed in this village, is met by the increasing the participation of women through hired and exchange of labour including children during morning hours and holidays. Certain farming activiteis such as trainsplanting, weeding, harvesting and threshing and other post harvest activies are mostly done by farm women.

Labour Exchange Model

Previoulsy, women from middle class and high class families did not participated in physical activities in farming viz., sowing/planting, weeding, harvesting and threshing. Usually, they have hired the labour from outside and paid the wages as cash. Whereas, women in backward class work on their own farm and sometimes they have hired for skill oriented farm activities on need basis. In some cases, on an average, women spent half a day, walking long distances to collect green fodder and gather green weeds when working in others fields. Thus, they are the worst affected when drought occurs because this means that they have to walk farther to collect animal fodder. There have been cases where poor, landless women labourers have been paid lower wages because they have been provided with the weeds as feed after weeding by the owners of the farm.

Inorder to improve the efficiency of women labour, reduce the cost of cultivation and increase the income of the farm, labour exchange module has been introduced among all categories of the family under AICRP-IFS, PFR scheme. In this method, most of the women in the village, work on their own farm and in the fields of farmers of the same village as exchange labour. The wages is paid usually in the form of kind, money and goods. Most of the time, land owners exchange their resources such as fertilizers, seeds and other critical inputs to the labourers and it gave the ownership feeling and strenghthen amiable relationship between owners and labourers which leads to enhanced efficiency, timely operation and resulted in higher remuneration with less cost of production.

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Balanced fertilization in rice

GPS Location

Latitude	Longitude	Altitude (m)
$10^0$12'329'' N	$78^0$37'097'' E	121

Mrs. P. Jeokilinton W/o Pilavendran, an enthusiastic lead farmers residing in a small village called Kuruvadipatty, Thirupathur block of Sivagangai District, Tamil Nadu having the family size of 4 members which includes 3 adults and one children. She was acquiring livelihood from 0.8 ha of land in her native village. The average annual rainfall of the region is 940 mm and the existing predominant cropping and farming system followed in her native village is rice–rice and cross bred dairy cows particularly with jery, respectively. Before the intervention, the annual net income obtained from marketable surplus of rice was only Rs. 19560/- per year owing to poor nutrient management practices for that he was thriving with her family.

Mrs. P.Jeokilinton used to grow medium duration rice variety ADT 39 which is the ruling rice variety of this region particularly during *kharif* and *rabi* season. In general, the productivity of rice was low as compared to the potential yield owing to the adoption of poor and imbalanced fertilization which resulted in higher cost of cultivation and higher incidence of pests and diseases.

Panoramic view of the experimental field

In the past, she was practicing conventional method of fertilizer application such as excess dose of N (175 kg/ha and low dose of P (50 kg/ha) and K (375 kg/ha) without doing the soil testing which resulted in higher cost of cultivation and higher incidence of pests particularly leaf folder, stem borer, diseases like blast and Brown Plant Hopper (BPH) besides reducing the filling efficiency. During the year 2011, On-Farm Research Centre, Dryland Agricultural Research Station, Chettinad, functioning under Tamil Nadu Agricultural University selected Mrs. P.Jeokilinton for implementing the on-farm research entitled “On-Farm crop response to plant nutrients in pre-dominant cropping systems”.

The problem of low yield in rice is counteracted by low cost intervention and knowledge based intervention called soil test crop response (STCR) based nutrient management techniques as against the blanket recommendation. The available nutrient status of the soil is low in N (214 kg/ha), medium in P (11 kg/ha) and K 255 kg/ha) and low in Zn (0.5 ppm). To enhance the N use efficiency and diagnose N content in leaves to decide about the top dressing of fertilizers, split application of N with real time N management strategy through Leaf Colour Chart (LCC) had been demonstrated under OFR programme and accordingly N @ 46 kg/acre was applied at four equal splits during vegetative, tillering, flowering and panicle initiation stage. Whereas, with respect to P and K nutrients, the required dose of P (25 kg/acre as basal) and K (25 kg as basal and 12.5 kg at 25 DAT and remaining 12.5 kg at 45 DAT) was applied at the appropriate crop growth stages as per the STCR based recommendation which resulted in low incidence of leaf folder, stem borer, blast

Farmer being inculcated with importance of balanced nutrition and split application

Real time N management through LCC

and BPH as noticed in the on farm trials during both the seasons of study. With respect to yield, yield attributing characters such as leaf area index (LAI), total tillers per hill, productive tillers per clump, grains per panicle and grain filling efficiency are improved through balanced fertilization besides reducing the cost of cultivation up to Rs. 750/ha towards purchase of urea and Rs. 2250/ha towards the spraying charges of PP chemicals. In addition to the N, P and K nutrients, micro nutrient Zn was also applied as basal @ 25 kg/ha as $ZnSO_4$ which had the direct impact on the yield and yield attributing characters of rice.

To enhance the productivity of existing ADT 39 rice, balanced fertilization which consisting of NPK along with micro nutrient Zn, N management through LCC and P and K through STCR during both the season of study have been adopted and through this intervention, an increased grain yield of 1550 kg/ha as compared to conventional practices which resulted in an additional net income of Rs. 22825/ha was realized with additional interventional cost of only Rs. 2413/ha.

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Wealthy income from farming system

GPS Location

Latitude	Longitude	Altitude (m)
$10^0$15'944'' N	$78^0$44'490'' E	103

Shri. Sakthivel S/o Karuppiah an active progressive farmer residing from a small village called Meyyapatty located in Thirumayam Block of Pudukottai District, Tamil Nadu having annual rainfall of 685 mm with maximum area under rice-blackgram/ sesame cropping system. He is having the family size of 5 members which includes 2 adult and 3 children and was deriving livelihood from 1.2 ha of land. Eventually, the annual net income obtained from marketable surplus of crop and livestock components was only Rs. 83240/year.

He was cultivating puddled transplanted rice (PTR) during *kharif* season and subsequently blackgram and sesame during summer in order to get sufficient income to meet daily expenditure of his family. In addition to this, he had maintained 2 crossbred jercy cows and two calves. He was also maintaining a small amount of desi birds in his backyard. Over all, the yield of component crops such as rice

Implementation of SRI method of rice cultivation over (Puddle Transplanted Rice) PTR

Introduction of improved varieties VBN 5 in blackgram and white seeded SVPR 1 in sesame

(2000 kg/ha), blackgram (250 kg/ha), sesame (600 kg/ha) and milk yield from two cross bred jerky cows (3150 litres per year) was low as compared to potential yield due to non adoption of improved technology packages.

During the year 2011, On-Farm Research Centre, Dryland Agricultural Research Station, Chettinad, functioning under Tamil Nadu Agricultural University chosen Shri. Sakthivel for implementing the on-farm research entitled “On-farm evaluation of farming system modules for improving profitability and livelihood of small and marginal farmers”. The on-farm research was conducted in the system perspective

Clean milk production and low cost silpaulin vermin compst production

Performance of NKL 1 and Giriraja under backyard poultry rearing system

mode through farmer's participatory approach by identifying the module wise constraints and addressing the same with no or low cost interventions.

The major constraints in crop module for low productivity in rice, blackgram and sesame were utilization of traditional varieties, weed menace, imbalanced nutrition (higher dose of N and lower dose of K), high incidence of stem borer, leaf folder, blast, bacterial leaf blight in rice, collar and root rot and yellow mosaic virus in blackgram and sucking pests, pod borer and phyllody in sesame were identified through bench mark survey. Similarly, in livestock module, the main constraints for low milk yield include lack of green fodder and mineral deficiency. Whereas, in the case of backyard poultry the major constraints were poor egg laying capacity, poor feed conversion ratio and higher mortality rate owing to non adoption of vaccination scheduling and poor nutrition.

The constraints were addressed through no cost, low cost and knowledge based interventions such as replacement of local and traditional variety with high yielding varieties such as VBN 5 for T9 blackgram, SVPR 1 for local sesame variety, balanced fertilization which includes Soil Test Crop Response (STCR) based fertilizer application for all crops including application of micro nutrients, foliar nutrition with TNAU pulse wonder during fifty percent flowering stage, pests surveillance based IPM strategies which includes traps, bioinoculants and nano pesticides. To alleviate weed problem early post emergence herbicides such as bispyribac sodium &

Azimsulfuron, imazithapyr and quizalfop-ethyl in rice and pulses, respectively were demonstrated and test verified.

With respect to livestock components, problems were counteracted by year round supply of green fodder with the help of Bajra Napier Hybrid CO 5, supplementation of location specific mineral mixture, Artificial Insemination (AI) with jercy and HF and proper scheduling of vaccination and deworming at regular intervals. In addition to this, regular capacity building programme on clean milk production was also imparted him and required critical inputs were given to the animal components through this experiments. The constraints observed in the backyard poultry were addressed by introducing dual purpose chicks Namakkal (NKL) 1 and Giriraja with proper nutrition and vaccination to check the mortality at the early stage. Apart from this, azolla cultivation and low cost silpaulin vermicompost production were also integrated under optional module. Under the on-farm processing and value addition module, the family women was imparted training on cleaning, grading and packaging of vegetables during lean period.

To enhance the productivity of existing puddled transplanted rice (PTR), System of Rice Intensification (SRI) method of rice cultivation was introduced and through this intervention, an additional net income of Rs.8950 was realized. With respect to blackgram, intervention consisting of improved variety VBN 5 in combination with foliar nutrition of pulse wonder has increased the pod yield of 150 kg as compared to conventional T9 variety which resulted in an additional net income of Rs. 5200 was obtained with additional interventional cost of Rs.800. Regarding sesame, with low interventional cost of Rs.2000 an additional income of Rs. 15000 was realized.

With respect to milk yield, the average milk yield of a cow was only 7.5 litre per day (morning 4.0 litres and evening 3.5 litres) which is very low as compared to standard owing to the poor nutrition and poor health care. Due to year round supplementation with CNH CO 5, location specific TANUVAS mineral mixture and proper vaccination and other health care, an additional milk yield of 900 ml/animal/day, increased the lactation period (225 days), enhanced the conception rate and reduced inter calving period considerably (336 days) were realized besides increasing the net income of Rs. 11680/year from two milch animals.

Through rearing of backyard poultry with improved breed Namakkal (NKL) 1 and Giriraja, an additional income of Rs. 4100 was realized from an additional investment of Rs 1900. In addition to this, 290 kg of poultry droppings was also obtained which can be effectively utilized for enhancing the soil fertility status.

Particulars/ Household	Farmers Practice (Before Intervention)	Improved Practice (After Intervention)
Rice	PTR	SRI
Yield (kg)	2000	3050
Cost (Rs)	10800	15500
Gross income (Rs)	26000	39650
Net income (Rs)	15200	24150
Blackgram	T9	VBN 5
Yield (kg)	250	400
Cost (Rs)	4200	5000
Gross income (Rs)	10000	16000
Net income (Rs)	5800	11000
Sesame	Local (Black)	SVPR 1 (White)
Yield (kg)	600	650
Cost (Rs)	10000	12000
Gross income (Rs)	48000	65000
Net income (Rs)	38000	53000
Dairy		
Yield (kg)	3150 litre/year	3840 litre/year
Cost (Rs)	37500	41000
Gross income (Rs)	69300	84480
Net income (Rs)	31800	43480
Backyard Poultry		
Cost (Rs)	3600	5500
Gross income (Rs)	12500	18500
Net income (Rs)	8900	13000
Farminf system (Cropping system + dairy + backyard poultry)		
Cost (Rs)	66100	79000
Gross income (Rs)	165800	223630
Net income (Rs)	99700	144630

Source: AICRP-IFS, OFR centre: DARS, Chettinad-630 102, Sivagangai district

All together, an additional cost of intervention involved in all the modules over conventional method was only Rs12900/year which contributed an additional income of Rs 44930/year. Within one year, the net return per rupee invested on all the interventions stands at 2.83. The household earns net income of Rs 144630/year which is 31 % higher than benchmark. Besides the higher income, the family meets the nutritional requirement by in house production of quality products such as dhal, milk, egg and fresh vegetables. Apart from nutritional security, soil fertility status of the farmers holding is improved through addition of organic matter (vermicompost, composts and poultry droppings) and crop residue in their field itself instead of going for residue burning which reflected in remarkable improvement in the organic carbon status (0.50 %). Now, other farmers are also evincing greater interest in adopting all the modules as these are of low cost in nature. The family gets additional employment of 41 man days due to the interventions made in farming systems perspective.

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Mechnized cultivation for reducing drudgery

The on-farm research experiments on Direct Seeded Rice (DSR) were conducted at Ammayenthal village which has the total geographical area of 35 ha and consists of 24 households which are coming under North Illayathankudi revenue village of Thirupathur block, Sivagangai District, Tamil Nadu. Open well is the major source of irrigation for this village. However, the tanks and borewells are also the major sources of irrigation. The average annual rainfall of the region is 940 mm with maximum area under rice–rice cropping system and there is no dearth of resources and is bestowed with all natural resources.

Constraints: With rice farming activities picking up in Sivaganga district, rice farmers have been struggling to get farm workers for labour intensive activities such as transplantation, weeding and other inter cultural operations owing to migration of agricultural labourers to other sources of livelihood activities. Paucity of agricultural labourers particularly during peak period of cultivation further worsen the situation which leads to delayed sowing/transplanting and weeding which results in poor yield. Traditionally, farmers of Ammayenthal village used to grow rice through manual puddle transplanting (PTR) and they were looking for an alternative crop establishment method to PTR because of its higher labour, energy and water use. For transplanting operation alone, they used to hire 15 women labour to cover an acre of land and the approximate cost towards the transplanting was around Rs.3000 per acre on contract basis. Consequently, mechanization in rice cultivation

Crop establishment of DSR through happy seeder

Capacity building on DSR and Performance DSR during Kharif 2013 season

is gaining momentum among the farming communities across the state, due to acute labour shortage, unavailability of skilled labour, steep increase in wages and other expenses. Looming water crisis and energy shortage, water-intensive nature of PTR cultivation and escalating labour costs drive the search for alternative crop establishment methods to increase water productivity in rice cultivation, Direct seeded rice (DSR) has received much attention because of its low-input demand. It involves sowing pre-germinated seed into a puddled soil surface (wet seeding), standing water (water seeding) or dry seeding into a prepared seedbed (dry seeding). Considering this, Dryland Agricultural Research Station, Chettinad, Tamil Nadu Agricultural University has implemented a series of 20 on-farm research experiments on direct seeded rice during *Rabi* and *Summer* 2013-14 season under AICRP-IFS, scheme to enhance productivity and net income of rice farmers.

Sowing was done by utilizing the tractor drawn happy seeder with incline plate metering mechanism which favored the altering of inter and intra row spacing. Consequently, seeds were sown with a spacing of 25x25 cm which facilitated easy operation of power weeder and other inter cultural operations.

For better germination, establishment of rice seedlings and success of DSR, placement of rice seeds at the optimum depth (2-3 cm for clay loam and 3-4 cm for sandy loam) is pre requisite. The risk of gaps in the intra row and inter row spacing due to machine vibration was very low in this inclined plate type metering system. Therefore, optimum plant population load was maintained in all the on-farm trials

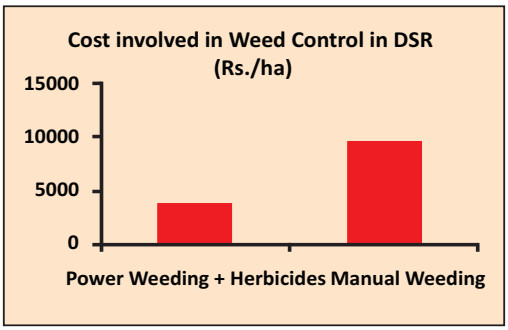
Power weeding in DSR at 20 DAS at Thirupathur Block of Sivagangai

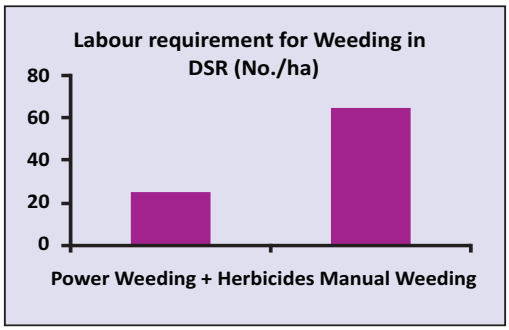
which resulted in higher productivity as compared to PTR. Apart from plant density, longer irrigation intervals, passing of cono and power weeder at fortnightly intervals with proper weed and nutrient management practices resulted in higher crop yield of 7420 kg/ha as compared to manual broadcasting (6090 kg/ha), manual PTR (5700 kg/ha).

Weed poses a series problem in DSR and an effective weed management was a big challenge for the adoption of DSR by the rice growing farmers. Since, DSR does not required any puddling operation unlike PTR where standing water suppress and prevent the germination and growth of many weed species. Whereas, weed flora in the DSR was diverse and the crop weed competition in DSR was higher than the PTR. Manual weeding is laborious, time consuming and cumbersome now a days. Hence, effective weed management strategy with new molecules of pre and early post and post emergence herbicide application in integration with agronomic practices *viz*., power weeding/cono weeding is pivotal for the success of DSR. The predominant weed flora observed in the on-farm experimental trials were *Cyperus sp., Echninochloa, Fimbristylis sp., Leptochloa, Sphenochlea sp.,* and *Marshellia sp., Eclipta.* Application of pretilachlore @ 0.5 kg a.i./ha at 5 DAS as pre emergence and early post emergence with Azimsulfuron @ 20 kg a.i./ha at 15 DAS in integration with power and cono weeder had effectively controlled all the types of weed flora including sedges. The advantages of the DSR over the conventional broadcasting and PTR are as follows.

Comparative performance of Chemical Weeding Vs Manual Weeding

Weed Management Practices (in ha)	Power Weeding + Herbicides	Manual Weeding	Saving (Rs/ha)
Cost involved	3750	9750	6000
Labour requirement	25	65	40





Comparative performance of DSR Vs Manual Broadcasting

Establishment Method (in ha)	Broadcasting (Tractor harrowing)	Broadcasting (Country plough harrowing)	Seed Drill Sowing
Time Taken (in hrs)	2.5	12.5	1.5
Seed Rate (kg)	90	90	30
Labour for sowing	1	4	1
Cost involved for sowing (Rs)	2500	3000	1500
Irrigation intervals (days)	9	9	9
Yield (kg/ha)	5700	6090	7420
Cost of cultivation (Rs/ha)	27550	28050	19350
Gross return (Rs/ha)	77220	81250	96460
Net return (Rs/ha)	49670	53200	77110

Based on the results of the on-farm trials conducted at Ammayenthal village of Sivaganga District, revealed that the highest yield of 7420 kg/ha was recorded under DSR method of crop establishment. With respect to cost of cultivation, higher values were recorded under machine transplanted rice (Rs.35250/ha) followed by manual

Comparative performance of SRI Vs Manual and Machine PTR

Establishment Method (in ha)	Manual PTR	Machine PTR	SRI
Time Taken (in hrs)	8	5	8
Seed Rate (kg)	75	37.5	7.5
Labour for planting	50	3	40
Cost involved for planting (Rs)	7500	8750	6000
Irrigation intervals (days)	7	7	10
Yield (kg/ha)	5700	6400	7600
Cost of cultivation (Rs/ha)	34750	35250	25900
Gross return (Rs/ha)	74100	83200	98800
Net return (Rs/ha)	39350	47950	72900


Celebration of Farmers day and farmers meet at DSR field

PTR (Rs.34750/ha) and the least values were noticed with DSR (Rs.19350/ha) which is followed by SRI (Rs.25900/ha). Though the highest gross return was recorded under SRI method of rice cultivation (Rs.98800/ha) which is higher than that of DSR (Rs.96460/ha), it failed to provide higher net return (Rs.72900/ha) due to its higher cost f cultivation (RS.25900/ha) as compared to DSR.

DSR could able to produce on par yield and even higher yield than that of traditional PTR besides minimizing cost of cultivation (Rs.8200/ha, labour saving

Performance of short duration MDU 5 under DSR and manual PTR during *rabi* 2014

and crop matured 7 days earlier than PTR. According to the feedback from the local farmers revealed that labour and water savings are the major drivers of DSR adoption in Sivaganga District. After seeing, the beneficial effects of DSR method of establishment, many farmers in this region have adopted the DSR technique.

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Diversification of crop components in farming system for profit maximisation

GPS Location

Latitude	Longitude	Altitude (m)
$12^0$20'810'' N	$78^0$16'877'' E	398

V. Madhu, a graduate farmer doing farming for the past 18 years has been chosen by the AICRP-IFS, Paiyur for trial of "Diversification of existing farming systems under marginal household conditions". He belongs to an interior village called Kavapatti in Kaveripattinam block of Krishnagiri district. His land holding size is 0.82 ha. His cropping activity revolved around *kharif* rice followed by *rabi* rice and ragi aggregating to a gross cropped area of 1.56 ha. He is also having 30 coconut trees as bund crop around his farm which are around 20 years old. He has 2 HF cow as the animal component. He cultivated rice var. BPT 5204 which is highly susceptible for BPH and blast. Under conventional method, he used more seed and applied more of nitrogen (130 kg/ha) and lesser phosphorus (23 kg/ha) and potassium (30 kg/ha). Also, his pest management cost was higher (Rs. 8250/ha). Similarly, for ragi he used seeds from unknown sources and varieties. Nutrition was also improper. Though, he had cross-bred HF cows, the feeding habits and

Intervention in crop module

Intervention in crop module

maintenance pulled down milk yield and profitability. The annual income from cropping was Rs. 41833 and from animal Rs. 21180.

By analysing his resources and acceptance level for new technologies, the OFR team has drawn up a plan to intensify rice and ragi cultivation along with part diversification into vegetables and his acceptance was radish among the vegetables. In rice, the team introduced a private rice variety in the place of BPT 5204 so as to have a non monetary input against pests. Then, also advocated SRI which the farmer got convinced and gone for cultivation over an area of 0.82 ha during kharif 2013 from which the farmer harvested an yield of 5856 kg with an investment of Rs. 49231 and realised a net profit of Rs. 38184. During *rabi* ragi var. Paiyur 2 was raised in an area of 0.4 ha from which the net income was Rs. 15370 with the investment of Rs. 10900.

As part of diversification he raised 2 successive crops of radish in an area of 0.27 ha each with the variety Pusa Chethi. He adopted all the technologies from seed to harvest like FYM application @ 6.75 t/ha, maintaining population 67/m^2 and application of 50:100:50 kg NPK/ ha. Need based pest management and only two sprays he has taken mainly to ward off sucking pests. The cost involved was Rs. 37035 for which the net returns realised was Rs. 91212. Similarly, for animal component, the local fodder was replaced with COCN 4 which is a high yielder (>300 t/ha/annum) with very good palatability and higher crude protein (20%). Also, mineral mixture with supplemental concentrate feed was recommended. Proper

Technical interventions

Intervention of green fodder

vaccination and other animal health maintenance were ensured. This resulted in an enehanced milk production from 4875 litres to 5930 litres. The expenditure has also up from Rs. 65000 during bench mark year to Rs. 72248. The corresponding increase in net income was from Rs. 21180 to Rs. 27400. In all the annual net income of the bench mark year was Rs. 63013 which rose to Rs. 178893 due to the intensification and diversification activities. The other direct benefits are enhanced employment from 470 man days to 545 man days. Also the waste recycling got increased from 6.0 tons in bench mark year to 15.2 tons in the interventional year.

By seeing the profitability of this farmer, the fellow farmers are also now started to use pest tolerant varieties, SRI technique, optimum plant population, balanced crop nutrition, need based pest management, diversification to profitable crop, inclusion of improved variety of fodder component and animal maintenance.

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Water scarcity didn't deter profitability of farming

GPS Location

Latitude	Longitude	Altitude (m)
$12^0$13'166'' N	$78^0$12'089'' E	462

V. Murugesan is doing farming for the past 15 years and has been chosen by the AICRP-IFS, Paiyur team for the trial of "Diversification of existing farming systems under marginal household conditions". He belongs to the village called Baisuhalli in Karimangalam block of Dharmapuri district. For the past couple of years, this block has experienced around 30% rainfall deficit (only 630mm received). His land holding size is 1 ha. His major income was from animals followed by cropping. His cropping activity revolved around field crops as major along with horticulture crops aggregating to a gross cropped area of 1.20 ha. He is also having 18 coconut trees as bund crop around his farm which are around 10 years old. He has 5 HF cow as the animal component. He cultivated rice var ADT 39 with sublime dose of fertilizers and his yield was 3.5 t/ha. He also grew ragi and fodder sorghum from locally sourced seeds and realised lower income. His income was Rs. 55050 from these crops for a capital of Rs. 42810. He also cultivated turmeric and due to rhizome rot he got only Rs.310 as his net income for the investment of Rs. 27690. He had 5 cross-bred HF cows. The feeding habits of bund grazing coupled with sorghum

Monitoring

Intervention in crop module

roughage could able to give him Rs. 76030 for a capital of Rs.127900. The annual income of the predominant system of Dairy+ cropping was Rs.131390 with investment of Rs.198400.

By analysing his resources and acceptance level for new technologies, the OFR team has drawn up a plan to intensify along with part diversification into vegetables. The plan was done mainly by considering water availability. He decided to sell off 2 animals in mid way due to severe water scarcity for farming. He has cultivated groundnut TMV 7 variety in an area of 0.22 ha with an investment of Rs.11784 he realised a net income of Rs.14959. Population maintenance by line sowing and all the recommended practices were adopted. Since, he sold as tender coconut; he got a net income of Rs.12132 from 18 coconut trees alone. With proper prophylactic measures, he cultivated turmeric BSR 1 variety with recommended package of practices and realised a net income of Rs.19621 from an area of 0.20 ha. For this his expenditure was only Rs. 14959.

As part of diversification he raised three crops of successive okra in an area of 0.12 ha each totalling 0.36 ha with the variety Shakthi. He has been advised to adopt all the technologies from seed to harvest as per crop production guide. The cost involved was Rs. 27237 for which the net returns realised was Rs. 23410. Similarly, for animal component, the bajra napier COCN 4 was raised in an area of 0.10 ha. This is a high yielder (>300 t/ha/annum) with very good palatability and higher crude protein (20%). Also, mineral mixture with supplemental concentrate feed was recommended. Proper vaccination and other animal health maintenance

Monitoring and capacity building

were ensured. This resulted in an enhanced milk production even with 3 animals.. The expenditure was Rs. 123948 and the corresponding net income was Rs.84993. In all the net income of all the activities was Rs.196025 due to the intensification and diversification activities for a capital infusion of Rs.194672. The other direct benefits are enhanced employment from 285 man days to 395 man days. Also the resource recycling got increased from 6.50 tons in bench mark year to 7.75tons in the interventional year.

Average size of land holding (ha): 1

Particulars	Bench mark year 2011-12				Interventional year 2013-14			
	Agricultural crops	Horticultural crops	Animals activity	Annual	Agricultural crops	Horticultural crops (diversification)	Animals activity	Annual
Major crops	Rice, Ragi, Fodder sorghum, Coconut (18) Bund	Turmeric	HF	-	Coconut, Groundnut	Bhendi, Tomato, Fodder grass	HF	-
Mean cropped area (ha)/ no. of animals	0.80	0.40	5.00	1.20	0.22	0.9	3	1.12
Mean expenditure (Rs)	42810	27690	127900	198400	12864	57860	123948	194672
Mean net income (Rs)	55050	310	76030	131390	26898	84134	84993	196025
REY (Rice equivalent yield) kg/ha or mean milk yield	7528	2154	7950	17632	3059	10923	5845	19826

During major part of the year, the green fodder developed has helped him to save labour on grazing of animals and by that way he saved around 60 man days. These saved days were used in vegetable cultivation. Also, during summer the only green available in the farm was the fodder crop and was more than sufficient to feed his animals. His increased income was 49% higher than the bench mark year. Performance of fodder crop component of this farmer has been so impressive and he has helped 15 fellow farmers to raise the same variety by sparing the sett materials. He has also raised kitchen garden in the waste unused land nearby his well with gourds twice. This served for the nutritional security of the family besides some income due to the disposable of surplus production.

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Diversification of rice based farming system into profitable vegetable based farming system

GPS Location

Latitude	Longitude	Altitude (m)
$12^0$19'129'' N	$78^0$09'639'' E	474

G. Palani is having a rich experience in rice farming over 25 years who has been chosen by the AICRP IFS OFR Paiyur team for the trial of "Diversification of existing farming systems under marginal household conditions". He belongs to an village called Errahalli in Kaveripattinam block of Krishnagiri district. Detailed bench mark survey has been done. His land holding size is 0.40 ha. His cropping activity revolved around kharif rice followed by rabi rice aggregating to a gross cropped area of 0.80 ha. He is also having 22 coconut trees as bund crop around his farm which are around 22 years old. He has 2 HF cow and 2 HF heifer calves as the animal component. He cultivated rice var BPT 5204 which is highly susceptible for BPH and blast under conventional method in which he used more seed (75 kg/ha) and applied medium quantity of nitrogen 115 kg/ha) and lesser phosphorus (23 kg/ha) and potassium (35 kg/ha). Also, his pest management cost was higher. Though, he had cross-bred HF cows, the feeding habits and maintenance were poor. He

Monitoring of on-farm research experiments

followed the feeding of bund grass and hand hold grazing by family members as the common practice. He has subabul (protein supplement) as border crop. The annual income from cropping was Rs. 22946 and from animal Rs. 33610.

By analysing his resources and acceptance level for new technologies, the OFR team has drawn up a plan to diversify rice cultivation diversification into vegetables. Since, his family is fully concentrating into farming only,he showed interest in cultivation of short duration vegetables namley radish and onion so on. Because of poor profitability in rice farming as experienced by him used the OFR team to venture completely into horticulture based system by skipping rice. The location of the farm also helped him for the desire.

He raised three crops of radish in different bits of the farm over an area of 0.22 ha each aggregating to 0.66 ha. The variety Pusa Chethi was used by him. He adopted all the technologies from seed to harvest like FYM application @ 6.75 tons/ ha, maintaining population 67 per sqm, application of 50:100:50 kg NPK/ ha. Need based pest management and on an average of the three crops, his pesticide use was restricted to only 2 rounds and mainly to ward off sucking pests. The total cost involved was Rs.57132 for which the total net returns realised was Rs.73868. He also cultivated tomato over an area of 0.26 ha during rabi for which he incurred an expenditure of Rs.12000. Due to market glut, though his yield was 6570 kg, resulted in a net loss of Rs.4500. He cultivated onion in 0.20 ha with an investment of Rs.28562 and his net income was Rs.12480. His bhendi crop over an area of 0.06 ha gave

Interventions in crop module

Intervention of HF cow

him a net income of Rs.3665 for an expenditure of Rs.18735. His coconut trees gave him a net income of Rs.4400. All the cultivation practices were as per the recommendations of the team based on crop production guide of the university. Similarly, for animal component, the bajra cumbu napier COCN 4 was introduced over an area of 0.06 ha which is a high yielder (>300 tons/ ha/ annum) with very good palatability and higher crude protein (20%). The subabul border crop + agathi raised is being used as protein supplement. Also, mineral mixture with supplemental concentrate feed was recommended. Proper vaccination and other animal health maintenance were ensured. The heifers also calved. This resulted in an enhanced milk production from 4000 litres to 8575 litres. The expenditure has also up from Rs.51890 during bench mark year to Rs.77737. The corresponding increase in net income was from Rs.33610 to Rs.110067. In all the net income of the bench mark year was Rs. 56556 which rose to Rs.149754 due to the intensification and diversification activities. The other direct benefits are enhanced employment from 255 man days to 340 man days. Also the resource recycling got increased from 6.0 tons in bench mark year to 10.2 tons in the interventional year.

Though he had taken a complete risk of moving to newer crops of horticulture, the OFR team was successful in infusing confidence and needed techniques to shore up his income. Now, he has become a confident person and expecting more income in the coming years.

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Farming system approach for profit maximisation

GPS Location

Latitude	Longitude	Altitude (m)
12^{0}37'546'' N	77^{0}58'231'' E	731

Shri Sadanallappa, a small farm holder residing in Samanapalli village (30 km from Hosur) of Shoolagiri block, Krishnagiri District of Tamil Nadu was earning the livelihood for his four member family from 1.12 ha area through agriculture and allied activities. The bimodal rainfall of the region contributes 900 mm from which many farmers grow rice/fingermillet-vegetable (mostly tomato) system. Contrary to others, Shri Sadanallppa have utilized his land for growing Tissue culture banana (Grand naine) in 0.7 ha, rice in 0.2 ha during kharif and tomato in 0.2 ha during rabi. He was growing local variety of fodder in 0.04 ha to meet the fodder requirement of livestock one cross bred cow and a calf. Besides these, he had 18 coconut, 20 teak and 1 tamrind trees on the bund. He was getting net return of Rs 2 lakhs/ annum by investing Rs 1.83 lakhs in 2009-10.

On-farm research unit of Krishnagiri district under AICRP on Integrated Farming Systems operating in Tamil Nadu Agricultural University, Coimbatore identified Shri.Sadanallappa as one among the 12 study farmers for on-farm evaluation of farming system modules for improving profitability of small and marginal farmers. Critical constraints in crop and livestock were addressed through low and no cost interventions in various modules. In case of banana, low cost technique of bunch

Covering of banana bunches for enhancing uniform maturity and quality

Growing of cabbage based on market assessment

Cleaning and grading of paddy helped to get additional price of Rs 0.50/kg

covers (Rs 10/cover) was used along with no cost technique of balanced nutrition. Bunch cover is a proven method to enhance the uniform maturity; weight gain; blemish and pathogen free bunches and upon ripening attractive golden yellow colour. This helped the farmer to get an additional one rupee per kg of the yield and the wholesale buyers preferred the produce by paying the premium rate.

In case of rice, application of recommended dose of nutrients (150:50:50 kg NPK/ha) along with 25 kg $ZnSO_4$ /ha was resorted. Since, all the farmers in the area were growing only tomato during *rabi*, the price of tomato goes below the breakeven point leading to loss at many times. The farmer was trained and motivated to grow cabbage (variety Hari rani) in 0.2 ha instead of tomato based on the market assessment. In addition, the farmer was asked to clean and grade the paddy before selling through which he got additional price of Rs.0.50 per kg. Low cost interventions of supplementation with mineral mixture, replacing the local variety of fodder with

Co CN 4 Cumbu Napier

Waste recycling through vermicomposting

Azolla to meet protein diet of livestock

CO CN 4 (Cumbu Napier hybrid), azolla for supplementation of protein in the diet were included in the livestock module to maintain animal health and enhance productivity. Vermicomposting through vermi bags for effective recycling of farm and home waste was also added with proper capacity building under optional module. Earlier, the farmer did not have vermicompost and azolla culturing for feed for animals and manure. The total cost of the interventions was only Rs 35000/annum from which he got an additional benefit of Rs 55,000/annum. Net return per rupee invested on low cost interventions stands at 1.57 after two years. The total net return obtained from all the modules work out to Rs 2.90 lakhs/annum with an investment of Rs 2.18 lakhs/annum. The phenomenal increase in income was due to the growing of cabbage in place of tomato based on market assessment. The farmer arranged the capital money of Rs 2.18 lakhs for investment in his field from the banana buyer and sale of cabbage which gives money in 90 days time. Shri Sadanallappa has now taken 0.20 ha of additional land on lease for cultivation from the savings and diversified the cropping system by cultivation of tube rose.

Expenditure			Receipt		
Particulars	**Cost (Rs.)**		**Particulars**	**Cost (Rs.)**	
	2010-11	**2011-12**		**2010-11**	**2011-12**
Crop component	114920	132364	Crop component	290950	534660
Animal Component	67963	80624	Animal Component	91330	52696
Value addition	0	530	Value addition	0	1050
Optional	0	4810	Optional	0	0
Total Cost	**182883**	**218328**	Total Returns	**382280**	**588406**
			Net Returns	**199397**	**370078**

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Family farming: A money spinner

GPS Location

Latitude	Longitude	Altitude (m)
12^{0}12'963'' N	78^{0}11'339'' E	457

Mrs. L. Velumani, the farm women because of his son who has desire for profitable farming and daughter in law took the highest risk of complete crop diversification. After the sudden demise of her husband, she became the family head and took to full time farming. Though she worked in farm, direct involvement in decision making was not there earlier. Her son after marriage started giving a helping hand in farming as a full timer. The OFR, Paiyur team adopted her for the trial of "On-farm evaluation of farming system modules for improving profitability and livelihood of small and marginal farmers". She belongs to the village called Baisuhalli in Karimangalam block of Dharmapuri district. Detailed bench mark survey has been done. Her land holding is 1.14 ha. The predominant farming system followed by her was field crops+ dairy. Due to water scarcity, she grew mainly green gram, groundnut and fodder sorghum. With the available water, she had crops over an area of 1.08 ha. She realised a net income of Rs. 29408 for the investment of Rs. 30092 during the bench mark year. Similarly for the 3 HF animals, she incurred an expenditure of Rs.21800 and got a net return of Rs. 25800.

Interventions in crop module

Intervention of tuberose cultivation with drip irrigation

Her family laid drip irrigation system in 0.70 ha with the help of NHM subsidy of Rs. 60000 so as to use the available water judiciously. The tuber rose variety 'Prajwal' from IIHR was recommended and from sourcing of tubers, planting and maintenance, the family adopted the OFR team recommendations for forming broad beds and furrows and planting, family labourers were in the field daily. Weeding, earthing up, pest management and plucking were done by the three family members only. Early morning, all the three will be in the field for doing regular field operations and plucking flowers. By 7 am, Mr.Suresh, her son will drop the fresh flowers to the local transporters to deliver the flowers at Bangalore before 9.30 am. During 2013-14 alone, they have harvested 6144 kg of tube rose flowers spread over a 7 month period earning Rs. 1,57,694 as net income. She raised Cowpea Co 6 in an area of 0.20 ha and received a net returns of Rs. 8583 with an expenditure of Rs. 6317.

In all, the total annual net income of the family was Rs.55208 during the bench mark year. In the interventional first year, the family's annual income was Rs.1,90,382. An increase of 244% was observed over bench mark.

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SRI as a social movement through on farm research programme of AICRP on IFS

On Farm Research Centre, Paiyur is implementing the AICRP IFS programme in an interior village of Kavapatti (Marudheri Panchayat) of Kaveripattinam block, Krishnagiri district from 2013-14; is one of the six villages. This study village falls in North Western zone (NWZ) of Tamil Nadu. NWZ is blessed with bimodal rainfall and this block also has Krishnagiri Reservoir Project which supplies around 180 days of water even during near normal rainfall years. Predominant farming system of the village is field crops+ dairy and mainly rice based and HF cow is very well part of all the farm families. The gross cropped area of the village will be around 500 ha. The village assessment showed that only very few of the farmers have heard about SRI and only one farmer has tried in a small part earlier. For the OFR programme 60 farm holdings have been taken. Be it nutrient response studies, diversification/ intensification studies or profitability studies, the Paiyur team made it a point to advocate rice cultivation under System of Rice Intensification (SRI) only.

In that sense, preseason meetings were conducted by the agronomist and field staff as a team to create awareness about SRI and its simple adoption techniques on the five principles. For all the 60 farmers, critical inputs namely DAP/ Potash(short supply during the period)/ $ZnSO_4$ and needed capacity building programmes in very small groups of 5 or 6 have been imparted. At each stage, the confidence level of the trial farmers in turn community was taken care for adoption. As the first principle, in the

Capacity building and nursery practice

Planting and training

place of 40-50 kg of rice seeds per ha what the farmers used, 10-12 kg was made to be adopted. In well puddled soil either green manure or green leaf manure or well decomposed FYM was applied and raised beds with a width of 1.0 meter were raised. On which after application of well powdered DAP@ 1.0 kg per 40 sqm pre-germinated seeds were just sprinkled over an area of 120 sqm so as to have seedlings that will be sufficient for 1.0 ha planting. The sown seeds were covered with paddy straw mulch immediately to induce uniform and quicker germination. At the end of third day the mulch was removed and irrigation was done just to wet the top of the beds. Upon necessity, irrigation was done always just to wet the beds. Because of these practices, within 13-15 days, high vigour quality seedlings of around 15cm height were produced.

In the next stage, planting of 13-15 days old single seedlings at 22.5x 22.5cm squares were done. This was achieved by moving one marked rope over the parallel fixed ropes or base line planted. The field staff helped in training the labourers in holding the seedlings and moving the ropes. The labourers opined that this method of planting saves lots of time and in lesser time and labour, more area could be planted.

After 10-12 days of planting, cono weeders were used and each farmer was advised to use conoweeder twice or thrice at 7-10 days interval. For more efficient use with less strain, skill development sessions were handled by highlighting holding position of the weeder and push& pull techniques. The operation of conoweeder incorporate the weeds as manures, stirs the soil into colloids, aerates the soil, prunes the roots partially and heaps the soil around clumps. All these practices induced more vigourous root system in turn efficient nutrient uptake resulting a burst in tillering, more yield attributes and yield.

Cono weeding in SRI

All the farmers were helped to apply nutrients as per the team's complete supervision. Similarly, the irrigation was done by ponding water to a depth of 2.5cm each time immediately after the disappearance of ponded water. In total, the 60 farmers had SRI over an area of 21 ha. During harvest, the yield was compared with the conventional planted crop. The mean yield of SRI crop of the trial farmers was 7350 kg/ha whereas the conventional crop yielded only 5470 kg/ha.

The data recorded for labour requirement showed that for SRI, 155 number of labourers were used/ha whereas for conventional planting 225 were used. Here also, a saving of 31.1% which worked out to Rs.10500/ha. The mean cost of cultivation for SRI was Rs. 64770/ha compared with Rs. 72920/ha for conventional. The net returns was also higher for SRI which worked out to Rs. 60840/ha whereas the same was only Rs. 48880/ha for conventional. Though, water saved was not measured, the farmers themselves accepted that water saving could be to the tune of 20-25% than the conventional.

Now, by seeing the results visibly, the fellow farmers are also started cultivating rice under SRI and during 2014-15 the SRI area of the village- was 400 ha during *kharif* and 425 ha in *rabi* which is equivalent to more than 80% of total rice area. The community accepted the interventions and worked in harmony to save water, labour and inputs and also realising higher profits.

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TELANGANA

Critical low cost farming system interventions improves net returns

GPS Location

Latitude	Longitude	Altitude (m)
17⁰53'40'' N	079⁰28'36''	103.0

Warangal district is situated in North Telangana Plateau. The normal annual rainfall of the district is 1059 mm with 63 rainy days per annum. The net sown area

Interventions in crop and livestock components

Integrated farming system approach at Dharmapuram village of Dharmasagar mandal of Warangal district

of the district is 4,71,000 ha with cropping intensity of 129%. The major soil is shallow red chalka soils which contributes 50% of the area followed by black soils (25%) and deep red chalk soils (20%). The major source of irrigations is bore wells and open wells which contributes 69% of the total irrigated area followed by tanks (17%). The major crops are rice, cotton, maize, greengram, redgram and groundnut. Mango is the major fruit crop of the district followed by orange and banana. Chillies and turmeric are major vegetable and spice crops respectively. The local low yielding cattle population are 7,85,000 nos. The non descriptive buffaloes comprises of 7,48,800 and cross bred cattle population are 12,400 nos. Sheep (19,60,000 nos) goats are 5,46,200 nos also present. Back yard poultry comprises 3383927 nos and commercial birds are 12,74,547 nos.

Shri Gardas Saraih residing in Dharmapuram village (130 km of Hyderabad) of Dharma sagar mandal of Warangal district of Telangana is having 1.8 ha with six member family. He used to grow rice, cotton, maize during *kharif* and rice-maize during *rabi*. He also had 3 numbers of local buffaloes. The total net income was Rs 66420 only.

OFR centre of AICRP-IFS, Warangal identified the G. Saraiah for conducting the "On-Farm Evaluation of Farming System Modules for improving profitability and livelihood of small and marginal farmers" experiment in participatory mode. The low cost interventions were done as per farmer's willingness and market demand in crop, livestock, and product diversification-value addition and optional modules by identifying the constraints.

In existing system, farmer used to grow in 1 ha rice-rice system with production of 4171kg/ha during *kharif* and 6250 kg/ha during *rabi*. The milk yield from 2 buffalo was only 1260 litres excluding home consumption. In crop modules the low yielding factors were identified as imbalanced fertilization and growing of cold susceptible varieties whcih are addressed with balanced fertilizer application during *kharif* and introduction of sheethal variety of rice during *rabi*. Similarly in livestock module, low milk yield and low fat content in milk were addressed with supply of nutritious feed and azolla growing and feeding to cattle. Vanaraaja birds were distributed to the farmers to generate additional income.

In rice-rice system, 29% yield advantage was noticed after interventions. In buffalo, the increased in milk yield was found to be 11%.

The total additional cost due to interventions aws only Rs 5060 which resulted in additional income of Rs 32320 within a year for the farmer.

Impact : A field day was conducted at Dharmapuram village of Dharmasagar mandal of Warangal district to create awareness among the farming community regarding success story of farming system approach at G.Saraiah. Nearby farmers are showing interest to purchase the vanaraaja birds for their back yards and to cultivate cold tolerant sheethal variety and construction of azolla tanks for feeding to their milch cattle.

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Diversification in crop and livestock boosts income of marginal farmers

GPS Location

Latitude	Longitude	Altitude (m)
18^{0}00'04'' N	079^{0}59'05'' E	101.2

Shri Narendar Reddy is a marginal farmer from Tekulagudem village (130 km of Hyderabad) of Hanamkonda mandal of Warangal district of Telangana state. He is having 1 ha of land and survives with four family members. The normal annual rainfall of the district is 1059 mm. The main crops are rice, cotton and maize during *kharif* and maize and rice during *rabi*. The farmer gets annual income of Rs 51840.

The farmer was identified for on-farm research under diversification of existing farming systems. In rice-fallow system, the yield limiting factors are imbalanced fertilizer application to rice during *kharif* and maize was grown during *rabi* under crop diversification. In livestock component, region specific low cost vanaraaja birds were distributed to the farmer to sustain the income. The annual income generation from rice-fallow from 1 ha was Rs 51840 with a cost of Rs 34000. The net income per year was Rs 17840.

The critical interventions of fertilizer and maize seed were supplied during *kharif* and *rabi* respectively. The gross income increased to Rs 95150 due to intervention of balanced fertliser application and introduction of maize with a additional cost of only Rs 9900.

The farmer was given with the five numbers of 3 weeks chicks. The five chicks produced 150 eggs up to 300 days. He used to give his farm waste products like maize flour, broken rice and other farm by products to chicks. He sold 60 eggs to neighbour farmers @ Rs 5/egg. 50 eggs were consumed in home. 40 eggs were kept for brooding with country birds through which 30 chicks were generated. The four parent birds were sold in the market after attaining 3.5 kg weight bird at the the rate of Rs 180/kg of chicken. He earned Rs 2520 from chicken and Rs 300 from

Vanaraaja birds rearing at Tekulagudem village and other OFR mandated villages

sale of eggs. Now he is planning to multiply the birds from existing 21 birds on large scale with a cost of only Rs 500, the farmer got net income of Rs 2820 in 10 months.

Additonal income of Rs 53610 was obtained by farmer with the investment of Rs 10400 as cost of interventions in his farming system.

Impact : By seeing his prosperity with vanaraaja birds 10 more farmers consulted with reference of the above farmers for supply of vanaraaja birds. AICRP IFS Centre, Warangal suggested them to bring birds from Assistant Director, Vanaraja Multiplication Farm, Live stock centre, Mamnur, Warangal district – 506 166 Telangana. They approached on above address and got vaccinated chicks from farm. These farmers are happy with these birds giving additional income from vanaraaja birds.

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Climate resilient step in farming systems : Sheethal – cold tolerant rice variety is boon for Northern Telangana farmers

GPS Location

Latitude	Longitude	Altitude (m)
17^{0}53'48'' N	079^{0}28'40'' E	104

Shri G. Sanjeeva from Dharmapuram village (130 km of Hyderabad) of Dharma sagar mandal of Warangal district of Telangana. He is a small farmer having 1.2 ha to support two member family. He used to grow rice-rice system with 2 buffaloes. The annual income of the farmer was Rs 90,000 and net income was Rs 70,000/ year. The main yield limiting factors of rice are imbalanced fertilizer application and cold injury during *rabi* winter. These problems are addressed by balanced fertilizer application and introduction of cold tolerant sheethal variety during *rabi* rice. In buffaloes, improved feed and azolla were given as feed to address the low milk yield and low fat content.

Farmers used to grow MTU 1010 rice variety in *rabi* season. It is predominant rice variety during rabi season. In northern telangana region, the minimum temperature goes up to 6-7^{o}C during nights in winter months. Due to this, germination is low and seedlings becomes reddish in colour. Farmers was facing severe problems with cold injury in nursery. There are few technologies to combat the cold effect on nursery. Only few varieties are there in rice to tolerate cold effect. One of the variety is recently developed and released from RARS, Warangal (sheethal). Due to cold injury farmers could not get reasonable yield in rice during *rabi* season.

Sheethal variety introduced as one of the intervention in crop module under OFR-3 during *rabi* 2013-14 at Shri G. Sanjeeva farm. Breeder seed was distributed to farmer to cultivate it as seed as well as to overcome the cold effect. This variety also tolerant to salinity, less susceptible to stem borer and leaf folder attack. It comes to harvest in 125-

Performance of cold tolerant variety Sheethal in farmers field

135 days with a yield potential of 5.5 to 6.5 t/ha. Additional yield of 16 % was obtained by farmer due to Sheethal variety.

Impact : OFR Centre, Warangal conducted the field day to create awareness on sheethal variety under crop module and feeding of azolla and improved feed to the buffaloes. All the nearby farmers purchased seeds from Shri G. Sanjeeva and because of that he got additional income of Rs 200/quintal.

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UTTAR PRADESH

Farm profitability realization through farming system approach

GPS Location

Latitude	Longitude	Altitude (m)
26^{0}30'501'' N	079^{0}52'577'' E	127

Shri Ashwani Kumar, a marginal farmer residing in a village Bharat Singh ka purwa located in Akbarpur block of Kanpur Dehat district of Uttar Pradesh was selected for diversification of existing farming systems by OFR-Centre, Kanpur Dehat.

Crop diversification with mustard, berseem and fodder sorghum

Five member family was deriving livelihood from 1 ha land. The prevalent farming system was crop + livestock with average annual rainfall of 801 mm.

During the bench mark survey in May, 2013, it was found that Sri. Ashwani Kumar was growing rice (0.8 ha), maize (0.2 ha) in *kharif* and wheat (0.8 ha), gram (0.2 ha) in *rabi*. The productivity of all crop was low as compared to potential yield. The major constraints for low productivity were identified as no application of potassium and Zinc, higher dose of nitrogenous fertilizers; higher seed rate and weed infestation. In addition to crop production, he had maintained one local buffalo and one cross bred cow. Total milk production of both the animal was 1815 litre / year which was very low as compared to potential milk production. The major constraints for low milk yield were poor nutrition, imbalance feeding, improper health care and poor shelter. At the time of bench mark, he was getting total annual income of Rs. 73825 only from crop and livestock for their family.

Shri Ashwani Kumar was selected during *kharif* 2013 for conducting on–farm experiment titled "Diversification of existing farming system under marginal household conditions". The constraints in crops were addressed by applying low cost and knowledge based interventions with supplying Muriate of Potash (MOP) and Zn, recommended dose of N, recommended seed rate, weed management and timely sowing. For year round green fodder availability, crop diversification with fodder sorghum and berseem in 0.1 ha was done. Diversification of mustard in 0.1 ha was also practiced to meet the requirement of family. In fallow area of summer, green gram in 0.1 ha was introduced to fulfil the family's pulses requirement. Additional income of Rs. 7315 was realized after interventions and diversification in crops.

Mineral mixture as intervention for livestock

Similarly, in livestock component, the main constraints were addressed by making availability of green fodder by growing fodder sorghum and berseem, supply of 20 kg mineral mixture and Penacure dewormer. In addition to this,

Farming systems improvement through diversification and technological interventions

Particular of House hold	Farmers practices	Improve practices (after intervention)
	Kharif	
Paddy	0.8 ha	0.8 ha
Yield (kg)	4500	4550
Gross income (Rs)	49500	54600
Cost of cultivation (Rs)	25400	26500
Net income (Rs)	24100	28100
Maize	0.2 ha	0.1 ha
Yield (kg)	350	210
Gross income (Rs)	2800	2310
Cost of cultivation (Rs)	1500	1700
Net income (Rs)	1300	610
Diversification	NIL	3500
Fodder sorghum yield for fodder	0.1 ha	
	Rabi	
Wheat	0.8 ha	0.7 ha
Yield (kg)	3500	3020
Gross income (Rs)	42000	42280
Cost of cultivation (Rs)	17900	19500
Net income (Rs)	24100	22780
Chickpea	0.2 ha	0.2 ha
Yield (kg)	160	200
Gross income (Rs)	4000	6400
Cost of cultivation (Rs)	1550	3100
Net income (Rs)	2450	3300
	Diversification	
Mustard	-	0.1 ha
Yield (kg)	-	145
Gross income (Rs)	-	5075
Cost of cultivation (Rs)	-	2100
Net income (Rs)	-	2975
Berseem for Green fodder yield	0.1 ha	6500

Particular of House hold	Farmers practices	Improve practices (after intervention)
	Summer	
Green Gram	-	0.1 ha
Yield (kg)	-	80
Gross income (Rs)	-	3200
Cost of cultivation (Rs)	-	1700
Net income (Rs)	-	1500
Livestock (Cow)		
Milk yield (litres)	915.00	1100
Gross income (Rs) @ Rs. 30/litre	22875.00	27500.00
Rearing cost (Rs)	13000.00	16600
Net income (Rs)	9875.00	10900.00
Livestock(Buffalo)		
Milk yield (litres)	900	1200
Gross income (Rs) @ Rs. 30/litre	27000	36000
Rearing cost (Rs)	15000	20200
Net income (Rs)	12000	15800
Total net income (Rs)	73825	85965

Nutritional kitchen garden

knowledge on clean milking, sanitation of shelter and timing of proper feeding schedule was imparted. These interventions resulted in additional milk yield of 485 litres/ year. The total milk production was increased from 1815 litre to 2300 litre which recorded 26.8 % additional benefits over benchmark.

Capacity building

Under product diversification, a nutritional kitchen gardening was promoted to fulfil fruit and vegetable requirement of family. Organic kitchen garden was established in 200 m^2. Vegetable seeds of okra, bittergourd, palak, and pumpkin, cucumber alongwith saplings of lemon, karonda, papaya and banana were planted. A total of 65 kg of vegetables were produced and consumed by family.

Under the capacity building programme, trainings on improved practices of *kharif* and *rabi* crops, rearing of animal, goat and organic kitchen garden were conducted to enrich practical knowledge of the farmer. After interventions in crop, live stock, nutritional kitchen gardening, product diversification and capacity building the farmer obtained annual income of Rs. 85,965/year. Additional income of Rs. 12,140 was obtained due to interventions which is 16% higher in the first year.

Many of the households in village Bharat Singh Ka Purwa, Sarva, Ambarpur, and Jaitpur are using potassium application in their crop which they did not use earlier. Many households are also giving mineral mixture, dewormer (Penacure) and vaccination to their animal for obtaining higher milk.

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Diversification of farming system components doubles income of marginal farm holder

GPS Location

Latitude	Longitude	Altitude (m)
26^{0}36'385'' N	80^{0}00'034'' E	129

Shri Roshan Lal, a marginal farmer residing in a village Jaitpur located in Maitha block of Kanpur Dehat district in Uttar Pradesh was selected for experiment by OFR Centre, Daleep Nagar, Kanpur. He is alone in his family during livelihood from 0.6 ha. Prevalent farming system was crop + livestock with rainfall of 801 mm.

Diversification of rice and wheat with maize and pulses

Integration of goat in existing system

During bench mark survey in May, 2013, it was found that Shri Roshan Lal was growing only rice in *kharif* and wheat in *rabi*. The productivity of rice and wheat was low compared to potential yield. The major constraints for low productivity were identified as no application of potassium and zinc, higher dose of nitrogenous fertilizers and higher seed rate. In addition to crop production, he had maintained one local buffalo. Total milk production of buffalo was 490 litre / year which was very low. The major constraints for low milk yield were poor nutrition, imbalanced feeding, improper health care and poor shelter. At the time of bench mark, he was getting total annual income of Rs 28150 only from crops and livestock.

Shri Roshan Lal was selected during *kharif* 2013 for conducting OFR experiment titled "Diversification of existing farming system under marginal household conditions" by OFR Centre, Daleep Nagar, Kanpur Dehat under C.S. Azad University of Agriculture and Technology, Kanpur.

The major constraints in crop were addressed by applying low cost and knowledge based interventions like supplying Muriate of Potash (MOP) and Zn, recommended dose of N, recommended seed rate, weed management and timely sowing. For year round green fodder availability, diversification with maize in 0.1 ha was done. Diversification with gram in 0.1 ha was also done to save market expenditure on pulses. In fallow area of summer, Mentha in 0.1 ha was grown to get more income. Additional income of Rs. 18990 was gained after interventions and diversification from crops.

In livestock component, the main constraints were addressed by making availability of green fodder as maize stalk and 10 kg concentrate. In addition to this, knowledge on clean milking, sanitation of shelter and proper feeding schedule was

Farming system improvement through interventions

Particular of House hold	Farmers practices	Improve practices (after intervention)
	Kharif	
Paddy	0.5 ha	0.5 ha
Yield (kg)	2200	2450
Cost of cultivation (Rs)	14500	15500
Net income (Rs)	9700	13900
Diversification with Maize		
Maize	0.1 ha	-
Yield	-	200 kg
Cost of cultivation (Rs)	-	1500
Net income (Rs)	-	700
	Rabi	
Wheat	0.5 ha	0.5 ha
Yield (kg)	2150	2315
Cost of cultivation (Rs)	12500	15000
Net income (Rs)	13300	17410
	Diversification with chickpea	
Chickpea	0.1 ha	0.1 ha
Yield (kg)	-	140
Cost of cultivation (Rs)	-	1750
Net income (Rs)	-	2730
	Summer	
Mentha	0.1 ha	0.1 ha
Oil yield (litre)	-	15
Cost of cultivation (Rs)	-	4000
Net income (Rs)	-	7250
	Livestock (Buffalo)	
Milk yield (litre)	490	600
Rearing cost (Rs)	9550	9800
Net income (Rs)	5150	8200
Total net income (Rs)	28150	50890

Okra in nutritional kitchen garden

Capacity building

adopted. These interventions resulted in additional milk yield of 110 litres. A three month goat kid was provided to supplement his household income.

Under product diversification, a nutritional kitchen garden of 200 m^2 was promoted to fulfil the fruit and vegetable requirement. Vegetable seeds of okra, bittergourd, palak, pumpkin, cucumber along with saplings of lemon, karonda, papaya and banana. Total of 52 kg of vegetables/year were produced in a year.

Under the capacity building, trainings on improved practices of *kharif* and *rabi* crops, rearing of buffalo, goat and nutritional kitchen garden were imparted to enrich practical knowledge of the farmer. After interventions in crop, live stock, nutritional kitchen garden and capacity building, the farmer obtained Rs. 50890 per year. Additional income of Rs. 22740 was obtained due to interventions in different farming system components which resulted in 78 % higher income with in a year.

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Crop diversification in farming systems results in improved crop and livestock productivity

GPS Location

Latitude	Longitude	Altitude (m)
$26^0$030'446'' N	$79^0$54''051' E	128

Shri Dharam Pal Singh, a marginal farmer residing in Sarwa village located in Akbarpur block of Kanpur Dehat district of Uttar Pradesh was selected for OFR experiment by OFR Centre, Daleep Nagar, Kanpur. He was deriving his livelihood for his 4 member family from 1 ha area by growing arhar (0.1 ha) and maize (0.8 ha) in *kharif* and wheat (0.9 ha) in *rabi*. The major constraints for low productivity were identified as no application of potassium and zinc, higher dose of nitrogenous fertilizers, higher seed rate and weed infestation. He had maintained one local buffalo and two cross bred cows. Total milk production of both the animal was 4015 litres/ year. The major constraints for low milk yield were poor nutrition, imbalance feeding, improper health care and poor shelter. The farmer was getting only Rs. 95730/year from the existing farming system.

Diversification with mustard and fodder sorghum

The major constraints in crops were addressed by applying low cost and knowledge based interventions like supplying Muriate of Potash (MOP), recommended dose of N, recommended seed rate, weed management and timely sowing. For year round green fodder availability, diversification with fodder sorghum in 0.1 ha was done. Diversification with mustard in 0.1 ha was also practiced to save market expenditure on oil for the family. In fallow area of summer, green gram in 0.2 ha was grown to fulfil pulse requirement.

In livestock component, the main constraints were addressed by making availability of green fodder by supplying fodder sorghum, mineral mixture (25 kg), vaccination for FMD, and Haemorrhagic Septicaemia diseases and dewormer. In addition to this, knowledge on clean milking, sanitation of shelter and timing of proper feeding schedule was also imparted. These interventions resulted in additional milk yield of 385 litres/year.

Under product diversification, a nutritional kitchen garden in 150 m^2 was promoted to fulfil fruit and vegetables requirement. Vegetable seeds of okra, bittergourd, palak, pumpkin, cucumber alongwith saplings of lemon, karonda, papaya and banana were planted. Total 50 kg of vegetables were produced and consumed by family. The fruits plants in kitchen garden is also expected to additional benefit in the long term.


Interventions of mineral mixture and vaccination for livestock

Particulars	Farmers practices	Improve practices (after intervention)
	Kharif	
Maize	0.8 ha	0.8 ha
Yield (kg)	2350	2480
Gross income (Rs)	23500	27280
Cost of cultivation (Rs)	11350	13090
Net income (Rs)	12150	14190
Arhar (Pigeonpea)	0.1 ha	0.1 ha
Yield (kg)	150	170
Gross income (Rs)	5250	5950
Cost of cultivation (Rs)	2050	2580
Net income (Rs)	3200	3370
Diversification (0.1 ha)	-	3200
	Rabi	
Wheat	0.8 ha	0.9 ha
Yield (kg)	3515	3580
Gross income (Rs)	42180	50120
Cost of cultivation (Rs)	20150	23600
Net income (Rs)	22030	26520
	Diversification Mustard (0.1 ha)	
Yield (kg)	-	145
Gross income (Rs)	-	5220
Cost of cultivation (Rs)	-	2350
Net income (Rs)	-	2870
Diversification Summer crop		
Greengram		0.1 ha
Yield (kg)	-	150
Gross income (Rs)	-	6300
Cost of cultivation (Rs)	-	2400
Net income (Rs)	-	3900
Livestock (Cow-02)		
Milk yield (litres)	2800	3000
Gross income (Rs)	70000	75000
Rearing cost (Rs)	29750	32750
Net income (Rs)	40250	42250
Livestock(Buffalo-01)		
Milk yield (Litres)	1215	1400
Gross income (Rs)	36450	42000
Rearing cost (Rs)	18350	21200
Net income (Rs)	18100	20800
Total net income (Rs)	95730	113900

After interventions in crops, live stock, nutritional kitchen garden and capacity building, the farmer obtained annual income of Rs. 1,13,900/year. Additional income of Rs. 18,170 was obtained due to intervention in different farming system components.

Nutritional kitchen garden for meeting household vegetables and fruits

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Farming system interventions gives additional income to marginal holder

GPS Location

Latitude	Longitude	Altitude (m)
26^{0}29'970'' N	079^{0}54'790'' E	125 m

Shri Radha Krishna, a marginal farmer residing in Amberpur located in Akbarpur block of Kanpur Dehat district in Uttar Pradesh was selected for adopting OFR experiment by OFR centre, Daleep Nagar, Kanpur Dehat. Six member family was living with 0.7 ha area by growing rice (0.3 ha), maize (0.4 ha), in *kharif* and wheat (0.3 ha) and mustard (0.4 ha) in *rabi*. The family also maintained one murrah buffalo. Total milk production of one buffalo was 900 litre/year which was very low as compared to potential milk production. The major constraints for low milk yield were poor nutrition, imbalance feeding, improper health care and poor shelter. Family was earning only Rs. 39500 from agriculture.

Shri Radha Krishna was selected during Kharif 2013 for on–farm experiment titled "Diversification of existing farming system under marginal household conditions" by OFR centre, Daleep Nagar, Kanpur Dehat under C.S. Azad University of Agriculture and Technology, Kanpur. As new integration, backyard poultry was introduced to increase household income. 10 no. of 10 days old chicks (100gm) were integrated and after nine month birds gained 1kg weight.

Diversification with fodder sorghum and chickpea

Farming system interventions and benefit

Particular	Farmers practices	Improve practices (after intervention)
	Kharif	
Paddy	0.3 ha	0.3 ha
Yield (kg)	1500	1620
Gross income (Rs)	16500	19440
Cost of cultivation (Rs)	7400	9000
Net income (Rs)	9100	10440
Maize	0.4 ha	0.3 ha
Yield (kg)	300	280
Gross income (Rs)	3000	3080
Cost of cultivation (Rs)	1500	3060
Net income (Rs)	1500	20
Diversification Fodder sorghum (0.1ha)		
Yield (kg)	-	2500
	Rabi	
Wheat	0.3 ha	0.4 ha
Yield (kg)	1000	1800
Gross income (Rs)	12000	25200
Cost of cultivation (Rs)	7200	12000
Net income (Rs)	4800	13200
Mustard	0.4 ha	0.2 ha
Yield (kg)	300	250
Gross income (Rs)	9000	7500
Cost of cultivation (Rs)	2450	2000
Net income (Rs)	6550	5500
Diversification Chickpea		0.1 ha
Yield (kg)	-	130
Gross income (Rs)	-	3900
Cost of cultivation (Rs)	-	1700
Net income (Rs)	-	2200
	Diversification (Summer)	
Green gram	-	0.2 ha
Yield (kg)	-	150
Gross income (Rs)	-	6300
Cost of cultivation (Rs)	-	2150
Net income (Rs)	-	4150
Livestock (Buffalo-01)		
Milk yield (Litres)	900	1080
Gross income (Rs)	27000	32400
Rearing cost (Rs)	9500	9800
Net income (Rs)	17500	22870
Total net income (Rs)	39320	58480

Under product diversification, a nutritional kitchen garden of 100 m^2 was promoted to fulfil fruit and vegetable requirement of family. Total of 57 kg of vegetables were produced and consumed by family.

Intervention of mineral mixture, vaccination and deworming in livestock

Nutritional kitchen garden

After interventions in crop, livestock, nutritional kitchen garden and capacity building, the farmer obtained Rs 58480. Additional income of Rs 19160 was obtained due to interventions in different farming system modules.

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UTTARAKHAND

Adoption of IFS approach increases profits

GPS Location

Latitude	Longitude	Altitude (m)
29^{0}19'174'' N	79^{0}31'272'' E	692

Sri Bhuwan Singh Jeena having 1 ha area with family size of 4 was living in Dogra village of Bhimtal in Nainital district. The area was receiving 1246 mm. Rice-wheat-maize is the predominant cropping system in the region while crop + livestock + horticulture is the pre-dominant farming system. Farmer's annual gross income from agriculture before intervention was Rs. 108200. The study started from *kharif* 2011-12 and continued for three years. After three years (2013-14) the net income has increased from Rs. 36127 to Rs 76352.

Shri Bhuwan Singh Jeena and his family member at the time of start of study (2011-12)

Before intervention the farmer was having rice- wheat- fodder as major cropping system. In livestock, he had one cow, one buffalo, two bullock and two calves. The productivity of rice, wheat and maize were 3000, 2400 and 2500 kg/ha, respectively. He was getting the net income of Rs. 13936, Rs. 7691 and Rs. -379 from the rice, wheat and maize, respectively. From the livestock component, he was earning only Rs. 455 as net income.

In field crops major constraints identified were random transplanting in rice (un even planting (25-30 hills/m^2), broadcast sowing in wheat and imbalanced

Wheat crop sown in lines at proper spacing with recommended fertilization

Vegetable pea crop introduced for higher returns

fertilization in rice and wheat [low or no use of phosphorus (20-30 kg/ha) and potassium (10-20 kg/ha)]. Besides that no high value crop was there in the cropping system to provide more returns. Sufficient fodder was not available round the year for livestock. Milk productivity was very low due to malnutrition of milching animal particularly the multi nutrient deficiency. Animals were also suffering from the abdominal worms. This farmer had a lot of left over unutilized space. He was willing to take backyard poultry as a new enterprise, but he did not know how to proceed without any experience and availability of quality chicks. He also had a pucca water storage tank exclusively for the irrigation purpose which can also be used for fish production.

Good quality papaya plantation for additional returns

Fisheris started in the Pucca structure (water storage tank for supplemental irrigation)

For the above constraints, the module wise interventions were made. In crop component, rice and wheat crops were transplanted/sown at proper spacing (40-50 hills/m^2 for rice and line sowing in case of wheat), and fertilized with recommended dose (60 kg P & 40 kg K/ha). Vegetable pea crop was introduced into the cropping system. The farmer was also provided with the knowledge and management measures to control the pest and diseases in the newly introduced pea crop.

Backyard poultry introduced with dual purpose breed (croiler)

For round the year fodder availability, farmer planted Napier grass on the bunds. For getting the sufficient fodder during summer, he cultivated maize with cowpea. Milking buffalo was provided with the mineral mixture and de-worming drug (Albendazol) to overcome the malnutrition problem.

Good quality papaya plantation (Royale F 1 variety) was done on unutilized left over space of the farm to get additional returns. The leftover/ unutilized space was also used for the nutritional kitchen garden and cucurbits production. Seedlings of mango, guava, citrus, litchi & jack fruit were also planted on unutilized space for the additional returns. Backyard poultry was also started with 30 chicks of dual purpose breed (Croiler) for additional returns. Fisheries were started in the pucca structure being used for water storage tank for supplemental irrigation. Coriander and chilli crops were taken during the rainy season to get better price (off season).

After three years (2013-14) besides the traditional rice-wheat cropping system, Bhuwan Singh is also following the rice- vegetable pea-okra and rice-onion-maize + cowpea (for fodder) cropping system on his farm. He is growing the rice and wheat crops at proper spacing and applying recommended fertilizers to these crops. For these interventions in field crops he is additionally spending Rs. 1590 and getting additional returns of Rs. 37330 from the field crop component.

Under the livestock component, previously he was having one cow, one buffalo, two bullocks and two calves (2011-12), now he owns only two buffalos. He is

spending additional amount of Rs. 980/year/milking animal (Rs. 700 on mineral mixture, Rs. 80 on de-worming drug and Rs. 200 on fodder seed cowpea) and getting additional benefit of Rs. 31260 due to increased milk production and milk quality.

Onion, okra and coriander are sold in the market after grading & packing, in this process he spends only Rs. 2400 in the form of human labour but he manages to get additional return of Rs. 7600 due to better price of onion production from papaya, cucurbits, chili, coriander and other vegetables along with backyard poultry and fisheries on the left over unutilized space around his home gives additional return of Rs. 34040 with investment of only Rs. 8440. Fruiting is yet to be started in fruit plants which was planted one year ago and it will further augment the returns. Fisheries too started one year back would provide additional returns in years to come.

Economics of the household before and after the interventions

Parameters	Pre intervention (2011-12)	Post intervention (2013-14)
Gross in come (Rs.)	108200	218430
Cost (Rs)	72073	142078
Net income (Rs)	36127	76352

Interventional cost and additional net returns from interventions

Components of FS	Intervention cost (Rs.)	Net benefit due to intervention (Rs.)
Crop component	1590	37330
Livestock component	1960	31260
Processing and value addition (grading)	2400	7600
Other components (Papaya, cucurbits, Vegetables, Backyard Poultry, fisheries, fruit trees)	8400	34040
Total	14350	110230

Documented by: Dinesh Kumar Singh and Virendra Singh, GBPUA&T, Pantnagar Horticultre Research & Extension Centre, Jeolikote, Nainital under G.B. Pant University of Agriculture and Technology (Uttarakhand)

IFS benefits marginal farmer

GPS Location

Latitude	Longitude	Altitude (m)
29^{0}18'597'' N	79^{0}31'783'' E	654

Shri Bhuwan Singh Bisht in Dogra village of Bhimtal in Nainital district was having an area of only 0.5 ha to support his family of 4. The mean annual rainfall of region was 1246 mm. Farmer's gross annual income from agriculture before intervention was Rs. 132250. The study started from *kharif* 2011-12 and continued for three years.

Shri Bhuwan Singh Bisht's family at the time of start of study (2011-12)

Constraints were addressed through module wise interventions. In crop component, the rice and wheat crops were transplanted/sown at proper spacing (40-50 hills/ sq m for rice and line sowing in case of wheat), and fertilized with recommended dose (60 kg P & 40 kg K/ha). High value vegetable pea crop was introduced into the cropping system. The farmer was also provided with the knowledge and management practices to control the pest and diseases in the newly introduced pea crop.

Good quality papaya plantation (Royale F 1 variety) was done on unutilized left over space of the farm to get additional returns. The leftover/ unutilized space was also used for the nutritional kitchen garden and cucurbits production. New mango orchard was introduced by planting mango plants on unutilized space for the additional returns. Backyard poultry was also started with 30 chicks of dual purpose breed (Croiler) for additional returns. Coriander and chilli crops were taken during the rainy season to get better price (off season).

Backyard poultry introduced with dual purpose breed (croiler)

Cowpea fodder during summer provided better nutrition to milking cow

After three years (2013-14) besides the traditional rice-wheat cropping system, Shri Bhuwan Singh Bisht is also adopting the rice-wheat-maize, black gram-wheat-Okra and rice-pea-coriander cropping system on his farm. He is also growing coriander and chilli near his home in rainy season for selling in market. For these interventions in field crops he is additionally spending Rs. 1665 and getting additional returns of Rs. 14470 from the field crop component.

Under the livestock component, he owns one cross bred cow and two cross bred buffalos. He is spending additional amount of Rs. 980/year (on every milking animal Rs. 700 on mineral mixture, Rs. 80 on de-worming drug and Rs. 200 on

Mineral mixture and de-worming drugs increased milk yield and quality

New mango orchard introduced

fodder seed cowpea) and getting additional income of Rs. 85710 due to increased milk production and milk quality.

Economis of the household before and after the interventions

Parameters	Pre intervention (2011-12)	Post intervention (2013-14)
Gross in come (Rs.)	132250	264800
Cost (Rs)	129408	171705
Net income (Rs)	2842	93095

Interventions cost and additional net returns from interventions

Components of FS	Intervention cost (Rs.)	Net benefit due to intervention (Rs.)
Crop component	1665	14470
Livestock component	2940	85710
Processing and value addition (grading)	2100	8940
Other components (Papaya, cucurbits, Vegetables, Backyard Poultry, fisheries, fruit trees)	6820	23430
Total	12545	132550

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IFS approach increases profit

GPS Location

Latitude	Longitude	Altitude (m)
29^{0}19'410'' N	79^{0}31'568'' E	817

Shri Raghuwar Singh Patalia in Suryajala village of Bhimtal (Nainital) has 0.5 ha area to support 7 member family size. The area is receiving rainfall of 1246 mm. Farmer's annual gross income from agriculture before intervention was Rs. 137950. The study started from *kharif* 2011-12 and continued for three years.

Shri Raghuwar Singh Patalia'sfamily at the time of start of study (2011-12)

Good quality papaya plantation (Royale F 1 variety) was done on unutilized left over space of the farm to get additional returns. The leftover/ unutilized space was also used for the nutritional kitchen garden and cucurbits production. New orchard was established by planting

Backyard poultry introduced with dual purpose breed (croiler)

Hybrid napier grass on bunds provided better nutrition to milking cow

Mineral mixture and de-worming drugs increased milk yield and quality

Cucurbits cultivation around home provided additional returns

mango, citrus, jackfruit, gooseberry and litchi plants on unutilized space for the additional returns. Backyard poultry was also started with 20 chicks of dual purpose breed (Croiler) for additional returns. Coriander and chilli crops were taken during the rainy season to get better price (off season).

Good quality papaya plantation benefited the farmer to earn more

After three years (2013-14) besides the traditional rice-wheat cropping system, Shri Raghuwar Singh Patalia is following the rice-wheat-maize and Colocacia-onion-coriander cropping system on his farm. He is also growing coriander and chilli near his home in rainy season for selling in market. He is growing the rice and wheat crops at proper spacing and applying recommended fertilizers to these crops. Critical interventions costing only Rs. 14385 resulted in additional income of Rs. 196725.

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Increased profit from IFS

GPS Location

Latitude	Longitude	Altitude (m)
29^{0}19'492'' N	79^{0}31'265'' E	747

Shri Dhirendra Singh from Suryajala village of Bhimtal, Nainital has 1 ha area to support family of 6. Constraints were addressed through the module wise interventions. In crop component, the rice and wheat crops were transplanted/sown at proper spacing (40-50 hills/ sq m for rice and line sowing in case of wheat), these crops were fertilized as per the recommendation ((60 kg P & 40 kg K/ha)). High value vegetable pea crop was introduced into the cropping system.

Shri Dhirendra Singh'sfamily at the time of start of study (2011-12)

Mineral mixture and de-worming drugs increased milk yield and quality

For round the year fodder availability this farmer planted Napier grass on the bunds. For getting the sufficient fodder during summer he cultivated cowpea along with the maize crop. Milking cow was provided with the mineral mixture and de-worming drug (Albendazol) to overcome the malnutrition problem. For getting the higher price of coriander a before marketing packing was done.

Wheat crop before intervention

Wheat crop after intervention

After three years (2013-14) besides the traditional rice-wheat-maize cropping system, Dhirendra Singh is also following the soybean-pea-coriander and black gram-gram-maize cropping system on his farm. He is also growing coriander near his home in rainy season for selling in market. He is growing the rice and wheat crops at proper spacing and applying recommended fertilizers to these crops. For these interventions in field crops he is additionally spending Rs. 1650 and getting additional returns of Rs. 61000 from the field crop component. In total he is spending additional Rs. 17345 on critical inputs and getting now additional income of Rs. 188465 over the base year.

Rice crop sown after interventions (proper spacing and recommended fertilization)

Vegetable pea crop introduced in the cropping system to increase returns

Before intervention : fallow land

After intervention : Gooseberry plantation

Documented by: Dinesh Kumar Singh and Gaurav Deep Singh, GBPUA&T, Pantnagar Horticultre Research & Extension Centre, Jeolikote, Nainital under G.B. Pant University of Agriculture and Technology (Uttarakhand)

WEST BENGAL

Integrated farming system with vegetable in bund and homestead become boon for 0.12 ha marginal farmer

GPS Location

Latitude	Longitude
21^{0}50.045' N	88^{0}13.425' E

Shri Kamal Kar, a marginal farmer residing at Vishalaxmipur of Kakdwip Block in South 24 Parganas district of West Bengal was fighting his life everyday to fullfill the need of his 4 member family and survived with gross income of Rs. 13966 from his 0.12 ha area. The area is dominated by rice-greengram and rice-fallow system, whereas crop + dairy + fishery is the predominant farming system.

Azola cultivation in integrated farming

Growing of vegetable in homestead area

Shri Kamal Kar used to grow rice during *kharif* in his 0.12 ha of land and obtains a yield of 345 kg with the return of just Rs.3275/- and by growing greengram in the same area during summer he gets an yield of 80 kg with a return of Rs. 4000/-. He has a *deshi* cow with low yield (was dry at the time of characterization) and an unmanaged pond yielding just 40 kg of fish giving income of Rs. 4000/- per year.

Growing of vegetable on bunds during rainy season

Integration of poultry in farming system

Yield and season economics of IFS interventions in 0.12 ha

Component	Pre-intervention				Post-intervention				
	Yield (kg)	GR (Rs)	COC (Rs)	NR (Rs)	Yield (kg)	GR (Rs)	COC (Rs)	NR (Rs)	COI (Rs)
Rice	345	3276	2260	1016	432	5616	4690	926	456
Greengram	80	4000	1850	2150	106	5300	2985	2315	550
Onion	-	-	-	-	575	6900	1570	5330	540
Vegetable (Bund+Homestead)	-	-	-	-	-	24533	7330	17203	900
Dairy	-	3330	4250	-920	-	16110	7583	8527	994
Poultry	-				-	2256	3901	-1645	906
Fishery	42	3360	1100	2260	109	9840	3500	6340	718
Total		13966	9460	4506		70555	31559	38996	5064

COC- Cost of cultivation, GR- Gross return, NR- Net return and COI- Cost of intervention

He was not concerned about the balanced fertilization of rice and greengram and also did not have the knowledge of crop diversification for increasing the profit. Due to continuous submergence during *kharif,* he was unable to take other crop than

rice. He was not having any know how about better nutrition and vaccination for his dairy animal. He used to purchase fingerlings from the local suppliers and rear in his hand and not at all accustomed with poultry.

He was convinced to build up a bund (106.5 m in length X 1.5 m in width X 0.75 m) around his field and also at the middle of rice field for growing vegetables round the year. In the field bund, he was also suggested to grow vegetables round the year. He was also suggested to show vegetables in his homestead area. *Dhaincha* as green manuring was grown before rice. Balanced nutrition was recommended for rice and greengram. Instead of growing greengram alone during summer, he was advocated to diversify the system with onion. Vaccination, deworming and mineral mixture was practiced for his dairy animal. In addition to the dairy, his system was diversified with *vanaraja* poultry bird with proper vaccination and *azola* cultivation for feed. Indian Major Carps (IMC) with proper carp ratio, proper rationing and liming was advised for fishery component.

After interventions, the yield for rice and greengram were enhanced by 25 and 32% respectively. Miracle results were noticed with introduction of onion and vegetable in bund and homestead and farm family got a net return of Rs. 5330 and Rs.17203, respectively. There was a steady progress in net income of the farmer after interventions both in dairy (Rs. 8527) and fishery (Rs. 6340). The poultry componant was just introduced and expected to give good returns. Overall, only with the intervention cost of just Rs. 5064 the net income reached to the level of Rs. 38996 in comparison with previous year's Rs. 4506 only. Seven time increase in returns over investment was observed.

Documented by: M. Ray, U. Mandal and C. Mandal, OFR Centre, Kakdwip, South 24 Parganas, AICRP on Integrated Farming Systems, Bidhan Chandra Krishi Vishwavidyalaya, Kalyani, Nadia, West Bengal

Integrated farming system approach of interventions provides six times returns over cost of interventions

GPS Location

Latitude	Longitude
$22^0$50'030'' N	$88^0$13'470'' E

Shri Narayan Manna a marginal farmer in Vishalaxmipur village of Kakdwip Block in South 24 Parganas district, West Bengal living with his parents and earning an amount of Rs.74,742/- as net return from 0.67 ha, which was not sufficient for an enthuastic young man like him and always thinking about innovativeness in his farming. His area was dominated by rice-greengram and rice-fallow system with crop + dairy + fishery as the predominant farming system.

He has grown *kharif* rice (0.67 ha), greengram (0.066 ha), sunflower (0.667 ha), lady's finger (0.033 ha) and beetlevine (0.066 ha) in his small farm and obtained yield of 2158 kg, 65 kg, 70 kg, 750 kg and 20500 numbers respectively. He was earning Rs.68907/- from crop component as net return, out of which contribution of beetle vine alone was Rs.63750/-. One *desi* cow gave yield of 380 kg of milk with a net return of Rs.2700/- only, whereas from poultry (7 local birds) and fishery (1 poorly

Vermicomposting for resource recycling

Growing of beetlevine with vermicompost

Use of sticky trap in lady's finger

Maize as border crop in lady's finger

managed pond) he earned a net return of Rs. 945/- and Rs. 2190/-, respectively with a yield 576 number of eggs and 75 kg of fish harvest.

In beetlevine, about 50% cost was for supplying plant nutrients (both organic and inorganic) and plant protection. The lady's finger crop was suffering from heavy infestation of yellow vein mosaic disease and yield becomes less. He has no idea about the scientific rearing and health management for dairy, poultry and fishery.

At the very beginning to recycle the crop residues and cowdung he was advised to build a low cost vermicomposting structure. Vermicompost mixing with azotobacter, trichoderma and pseudomonas was used extensively in beetle vine. Some vermicompost was also used in lady's finger. Before sowing lady's finger, hybrid maize was sown in double row with a aim to create a fence around the lady's finger field to check the entry of white fly into field. Along with this, a pre-tested insecticide schedule and sticky trap was practiced to control yellow vein mosaic. To enhance the yield of crops like rice, greengram, sunflower, a balanced dose of nutrient was practiced. To improve the milk productivity, cow was given mineral mixture. Improved bird (*Vanaraja*) along with vaccination was practiced for poultry. In fishery, Indian Major Carps (IMC) were introduced with a scheduled ration and health care management.

Vermicompost of about 500 kg was produced with a market value of Rs. 10000, with production expenditure of only Rs. 300. Out of 500 kg, 400 kg was used for beetlevine and rest for lady's finger, which led to saving of 50% cost (oil cakes @

Growing of vegetable in roof

Rs. 25 per kg and 30% of inorganic fertilizer) without compromising of beetlevine yield. Due to use of bio-agents, the crop was very healthy and did not require any plant protection, except prophylactive spray. Due to use of maize as a border crop, sticky trap and vermicmpost in lady's finger, the crop performance was very good and 10 days extra harvesting was done which brought extra yield of 105 kg with extra earning yield of Rs.1880. Improvement in other crops like rice, greengram and sunflower was also observed due to interventions. He also observed significant increase in yield and income from dairy, poultry and fishery. Thus, with the total intervention cost of Rs. 9372, net return of Rs. 59787. Interventions in farming system approach led to 6 times increase in net returns over invetment.

Component	Before intervention			After intervention			Additional benefit	
	COC (Rs)	GR (Rs)	NR (Rs)	COC (Rs)	GR (Rs)	NR (Rs)	COI (Rs)	Additional NR (Rs)
Crop (except beetle vine)	28222	33380	5158	44788	76660	31872	4390	26714
Beetlevine	90000	153750	63750	70124	157500	87376	2700	23626
Dairy	4900	7600	2700	7310	12420	5110	580	2410
Poultry	783	1728	945	4350	5664	1314	1050	369
Fishery	6810	9000	2190	4342	13200	8858	652	668
Total	130715	205458	74743	130914	265444	134530	9372	59787

COC- Cost of cultivation, GR- Gross return, NR- Net return and COI- Cost of intervention

Documented by: M. Ray, U. Mandal and C. Mandal, OFR Centre, Kakdwip, South 24 Parganas, AICRP on Integrated Farming Systems, Bidhan Chandra Krishi Vishwavidyalaya, Kalyani, Nadia, West Bengal

Success Story of OFR-AICRP on IFS published in ICAR website and DARE report

http://www.icar.org.in/en/node/5783

http://www.icar.org.in/en/node/6780

DARE/ICAR Annual Report 2014-15 (Page 17)

FARMING SYSTEM

Success story

Realizing respectable revenue through farming system approach

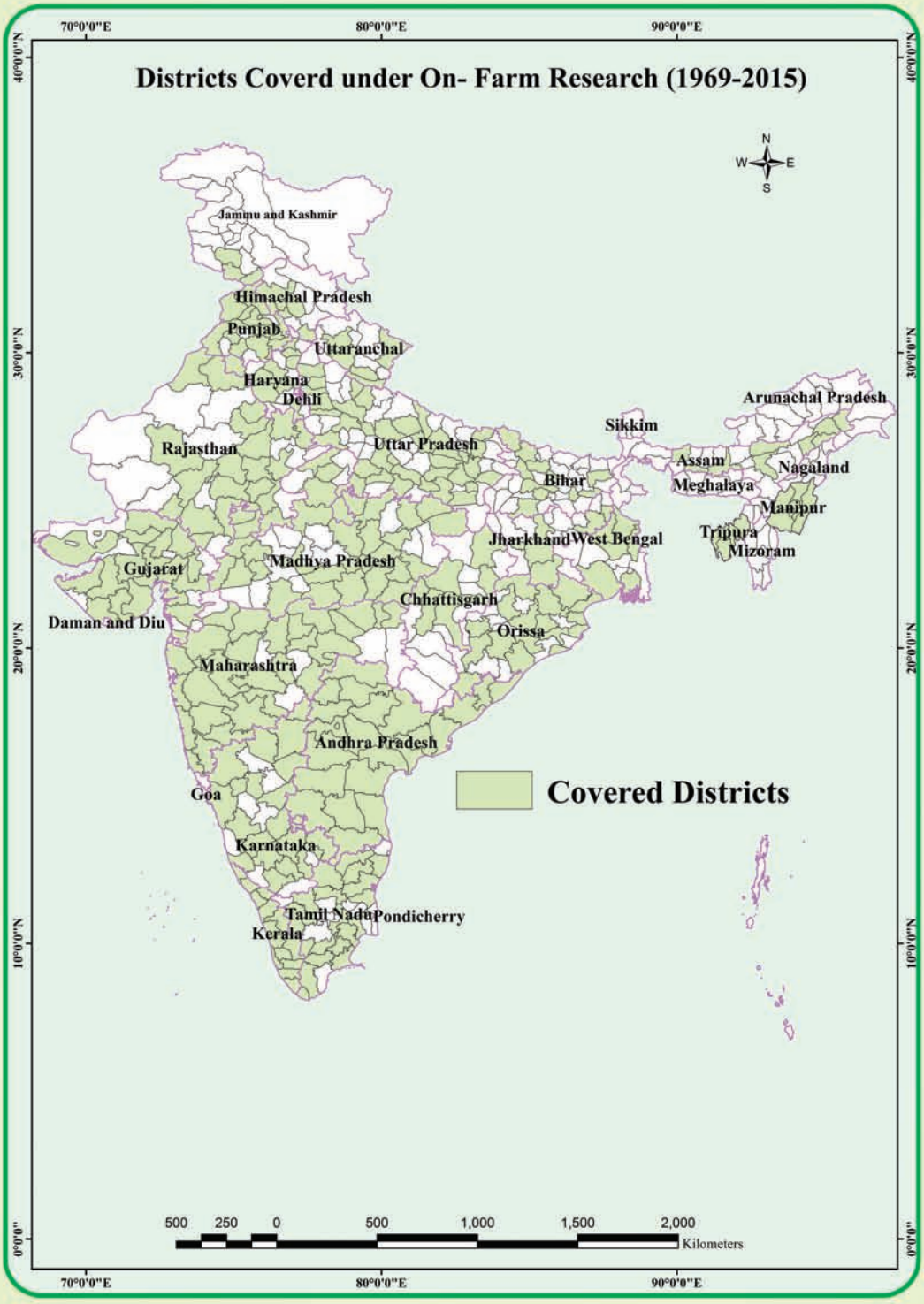
The AICRP on Integrated Farming Systems at the Dryland Agricultural Research Station, Chettinad (Tamil Nadu Agricultural University) adopted 60 farm households in Sivagangai district of Tamil Nadu for on-farm farmer participatory research in farming systems involving low and no cost interventions. The average annual rainfall in the area is 940 mm with rice–rice as the predominant cropping system. Shri Francis Pritto, a marginal farmer who hails from a small hamlet (Ammayenthal) located in Thirupathur block, deriving livelihood from 1 ha land for his six member family (2 adults and 4 children), was one of the beneficiaries. He used to grow rice during the monsoon season followed by blackgram, groundnut and vegetables (okra) during summer and maintained two crossbred cows and a calf, besides desi poultry birds in the backyard. The annual net income obtained from marketable surplus of all components was only ₹ 75,230/ year with a net return of ₹ 1 per rupee invested.

Seed drill sowing of groundnut to maintain spacing

Improvement in yield of grain and milk due to constraint specific interventions

Post-intervention contribution of components of farming system to net income

Production constraints were identified by the AICRP staff and improved system based packages were advocated to resolve them, which included introducing high yielding varieties and hybrids (MDU 5 rice, VBN 5 blackgram, VRI 7 groundnut), soil test crop response (STCR)-based fertilizer application for all crops including foliar nutrition with 'TNAU 7 groundnut consortia' and 'TNAU pulse wonder' during 50% flowering stage, and pest surveillance based IPM strategies which include traps and bionoculants. Seed drill sowing of rice (direct seeded rice against transplanted rice), cultivation of blackgram and groundnut and early post-emergence herbicides such as Bispyribac Sodium and Azimsulfuron, Imazethapyr and Quizalfop-ethyl in rice and pulses were demonstrated. Year round supply of green fodder for livestock with bajra Napier Hybrid CO 5, supplementation of area and species-specific mineral mixture, artificial insemination (AI) with Jersey and HF semen, and deworming at regular intervals resulted in additional milk yield of 0.9 L/animal/day, increased the lactation period (224 days) and reduced inter-calving intervals considerably (339 days). Dual purpose chicks, NKL (Namakkal) 1 and Giriraja with proper vaccination, resulted in additional income of ₹ 2,800 for the family. Azolla and vermicompost production with low cost portable Silpaulin bags were also integrated as additional options. Yield improvement in crops and dairy was in the range of 18 to 80%. The household earned net income of ₹ 119,470/ year with a net return of ₹ 1.61 per rupee invested. Crops contributed bulk of the income (82%).


Districts Coverd under On- Farm Research (1969-2015)
70°0'0"E
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Himachal Pradesh
Punjab
Uttaranchal
Haryana
Dehli
Rajasthan
Uttar Pradesh
Sikkim
Arunachal Pradesh
Assam
Nagaland
Meghalaya
Bihar
Manipur
Tripura
Mizoram
JharkhandWest Bengal
Madhya Pradesh
Gujarat
Chhattisgarh
Daman and Diu
Orissa
Maharashtra
Andhra Pradesh
Goa
Karnataka
Tamil NaduPondicherry
Kerala
Covered Districts
500 250 0 500 1,000 1,500 2,000
Kilometers