Site Specific

Farming System Options for Rural Livelihood

- success stories from NEH Region

NAIP Bulletin No. 2

G.C. Munda, S.V. Ngachan, Anup Das
S. Malngiang and Samik Chowdhury

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ICAR Research Complex for NEH Region
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ICAR Research Complex for NEH Region,
Umroi Road, Umiam – 793 103, Meghalaya
Telephone: 0364-2570257,
Fax: 2570363,
Email : director@icar.ernet.in
svngachan@rediffmail.com

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Project Implementation Unit
National Agricultural Innovation Project (ICAR)
Krishi Anusandhan Bhavan-II, Pusa, New Delhi 110 012
Ph. 011-25848772, Fax: 011-2584303, e-mail:ndnaip@gmail.com

Dr. Bangali Baboo
National Director

Foreword

The NAIP, Component - III is entirely dedicated to Sustainable Rural Livelihood Security (SRLS) of small and marginal farmers in Disadvantaged Districts of the Country. The sponsored mega-project in NEH Region "Livelihood improvement and empowerment of rural poor through sustainable farming systems in North East India" is showcasing some of the significant innovations which have created large scale awareness in general and sustainable rural livelihood in identified areas in particular. Agricultural transformation through the enhancement in productivity, diversity and economic profitability for the farmers is very much in need to put the disadvantaged areas of the northeast India in the mainstream of agriculturally prosperous region of the country. The consortium partners of SRLS in the North East India for the last few years are relentlessly putting their efforts to bring about positive changes in the disadvantaged areas and have come out with successful technological innovations. It is high time to document such innovations and success stories for up-scaling in other areas for livelihood improvement of small and marginal farmers. Such document would serve as a guide book for the planners and other stakeholders to design and implement livelihood improvement programmes in other areas. Further, it would be a useful document for shaping and refining activities of the current project for the remaining extended period. I complement the editors and contributors of the publication *"Site specific Farming System Options for Rural Livelihood- success stories form NEH Region"* for bringing out the much needed publication for the benefit of all the stakeholders involved in livelihood programmes particularly in the north east India.

Bangali Baboo

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We are equally thankful to the administration and finance section, ICAR Research Complex for NEH Region, Umiam, Meghalaya for their cooperation and support for smooth functioning of the project. The continuous support of Shri. Victor Dkhar in expediting the coordinating activities is gracefully acknowledged.

Last but not the least, the participation and support of the members of the village institutions, youth clubs, self help groups, apex bodies and the beneficiary farmers in successful implementation of the project activities are sincerely acknowledged.

The authors are hopeful that this document will serve as resource book for the researchers, planners, development workers and stakeholders in shaping and fine tuning livelihood programmes, particularly in the North East India.

Umiam, 2012 The Editors

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Introduction

The North Eastern Region (NER) of India constitutes the states of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura. The North East of India is a region of mystic splendors and rich cultural heritage spreads over an area of 262179 sq. kms. It is stretched between 89.46° to 97.30° East longitude and 21.57° to 29.30° North latitude.

The entire North Eastern Region is at the low level of economic development although it has a tremendous potential to develop. Agriculture has been the leading sector of the economy in the region. It is playing a significant role in determining varying nature of agro-economic activities. More than 70 percent of the population in the region is involved in agricultural activities for earning their livelihood. The region is characterized by fragility, marginality and inaccessibility and the agriculture in the region is complex, diverse and risk prone. The farmers are small and marginal and about 80% of the population depends on agriculture for their livelihood. Rural population is around 82% and more than 40% of the rural population in the region lives in poverty. Shifting cultivation, acid soil, steep slopes, no or meager use of fertilizers and manure, low yielding varieties/ breeds of crop/livestock are the major constrains in agriculture. Out of 4.0 million hectares net sown area of the region, roughly 1.3 million hectares suffer from serious soil erosion problem. The basic issues facing agriculture in the region are small land holdings, low cropping intensity, low productivity, inadequate access to appropriate technologies and other external inputs, inadequate irrigation facilities, increased natural calamities etc. In order to address these issues the NAIP project (SRLS) component III "Livelihood Improvement and Empowerment of Rural Poor through Sustainable Farming Systems in North East India" is being implemented in the disadvantaged districts of North East India. The specific objective of the National Agricultural Innovation Project is to accelerate the collaborative development and application of agricultural innovations between public research organizations, NGOs, farmers, private sectors and other stakeholders to demonstrate the strength (also the need) of farming system approach at farmers field for production enhancement, natural resource conservation and livelihood improvement in a participatory mode to pave the way towards sustainable agriculture in NE region.

Implementation Progress

The project has been implemented in seven disadvantaged districts of North East India except Assam. The implemented sites (Fig. 1) are located in the most backward districts namely Upper Subansiri (Arunachal Pradesh), Tamenglong (Manipur), South Garo Hills (Meghalaya), Saiha (Mizoram), Mon (Nagaland), North Sikkim (Sikkim) and Dhalai (Tripura) with an aim to improve the livelihood of the rural poor by adopting the strategies of sustainable natural resource

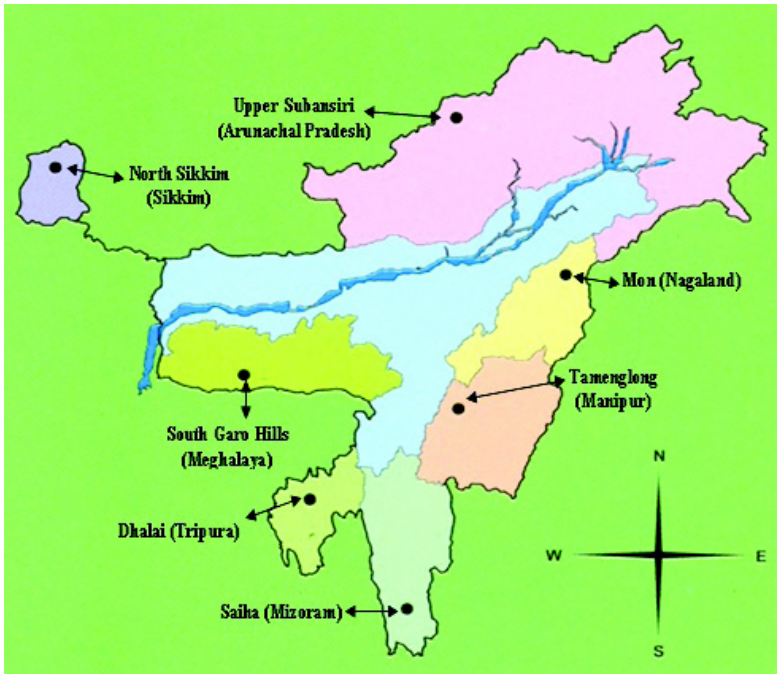

Fig. 1: Operational area of the project in North East India

management, productivity and profitability enhancement, building support systems and institutions.

Some of the significant findings of the sub-component are given below

Various site specific technological interventions such as integrated farming system for effective natural resource management, agro-forestry for rehabilitation of degraded land, resource conservation technologies viz. system of rice intensification (SRI), integrated crop management (ICM), zero tillage, poly-house technology for nursery and year round vegetables production, composite pisciculture, supplying seeds/breeds of high yielding crops/livestock breeds/fish, multiple cropping to increase cropping intensity, scientific cultivation and value addition of spices and horticultural crops, usage of farm implements, subsidiary income generation activities, etc. has been taken up during 2007-2012 as part of the project with an aim to ensure sustainable rural livelihood. Some of the site specific successful technologies identified are SRI/ICM in Dhalai and South Garo Hills where the average productivity of high yielding rice varieties under SRI/ICM has been 3.8 t/ha as against 2.4 t/ha with local variety and local practice. Farmers earned a net profit of Rs. 25,300 ha/year by adopting SRI/ICM methods of rice cultivation. In Tamenglong, zero *tillag*e toria cultivation has been a success where 172 ha area has been brought under zero tillage cultivation and the average productivity realized was 0.80 t/ha. Farmers could earn a net income of Rs 16,000/ha/yr from toria cultivation. Terracing for *panikheti* was a success in Mon where the average productivity of high yielding rice varieties (Lampnah and Shahsarang-1) was 3.9 t/ha as against 1.2 t/ha with local variety. Farmers could earn a net income of Rs 19,400/ha/yr. In North Sikkim, high value vegetables such as tomato, capsicum, cauliflower and broccoli were cultivated under polyhouse under year round vegetable production. An average yield of 23.43 t/ha was achieved as against 13.5 t/ha by farmers practice. Farmers could earn a gross income of Rs. 4,66,300/ha. Fish based integrated farming system was a success in South Garo hills where the average productivity of fish was 2.98 t/ha/yr as compared to 0.6 t/ha/yr under farmers practice. Farmers could earn a net income of Rs. 20,000/500 m^2 pond water area. Fish based farming system has been identified as profitable interventions in Dhalai too. In Upper Subansiri, under year round vegetable cultivation; vegetables such as chilli, cabbage and french bean were grown under poly house. The average yield of these vegetables was 111.5 t/ha as against 82.8 t/ha by farmers practice. In Saiha, 70 ha area was covered under turmeric cultivation and one turmeric processing unit was installed for making dry turmeric powder. Depending upon the availability of dried turmeric rhizomes for making turmeric powder, 200 – 400 kg of powder is processed per month. Turmeric powder is sold at a wholesale price of Rs. 20/100 g packet. The impact of these technologies in the identified clusters has attracted

Table 1. Operational districts profile

District	Altitude (msl)	Latitude/ Longitude	Rainfall (mm)	Area (ha)	Major crops	Nos. of adopted households
Mon	2414	26.00° N/ 94.00° E	2500	1,78,600	Rice, Maize	496
Dhalai	27	24.60° N/ 92.83° E	2200	255247	Rice, Pineapple	1100
Tamenglong	1330	24.69° N/ 93.55° E	3135	4,39,100	Rice, Maize	859
Saiha	792	22.48° N/ 92.96° E	2080	196581	Rice, Pineapple	350
Upper Subansiri	500	27.40-28.42° N/ 93.13-94.36° E	2660	7,03,200	Rice, Maize	221
North Sikkim	3000-4500	27.66° N/ 88.37° E	3250	4,22,600	Cardamom, Paddy	532
South Garo Hills	25	25.72° N/ 90.15° E	2000	1,88,700	Rice, Arecanut	505
Total			-	6,40,528	-	4063

other farmers and thereby, facilitating horizontal adoption of the technologies, thus paving the way towards marketable and proccessable surplus with associated benefit for livelihood improvement through agriculture and allied sector.

Success Stories and Up-Scalable Technologies

All the consortium partners of NAIP Component-III under the sub-project entitled "*Livelihood Improvement and Empowerment of Rural Poor through Sustainable Farming Systems in North East India*" have successfully implemented the project in their concern districts and as a result quite a few successful technologies emerged in respective areas. These technologies were widely accepted by the farmers and enhanced the livelihood of small and marginal farmers substantially. Considering the potential of such technologies for enhancing productivity, income and livelihood of small and marginal farmers, efforts were made to document such technologies for upscaling them in other disadvantaged areas for uplifting rural livelihood.

Pond based Integrated Farming System for Livelihood Improvement in South Garo Hills, Meghalaya

[1]Anup Das, [1]Syed B. Islam, [1]B.U. Choudhury, [1]Ramkrushna G.I., [1]D.P. Patel, [2]A.S. Singh, [2]Md. M. Islam, [2]T. Samajdar, [2]Amit Das and [1]S. Malngiang

[1]ICAR Research Complex for NEH Region, Umiam, Meghalaya

[2]Krishi Vigyan Kendra, Dobasipara, Tura

Introduction

Fish culture forms an integral part of the people in the 11 selected villages of Sibbari Cluster, under Gasuapara C.D Block, South Garo Hills, Meghalaya and is one of the important sources of income for the farmers in this area. Most of the farmers are having small size pond (500 to 600 m^2) where only fish were reared by conventional method before implementation of the project. The ponds were mostly unutilized/underutilized and infested with aquatic weeds. The farmers were not maintaining their fish pond scientifically which leads to low productivity of fish (500-600 kg/ha) nor they were integrating fish with any other component. Hence, the income from the fish culture was meager.

Composite fish farming with the integration of other component such as duck, pig, goat, vermi-composting and agri-horticultural crops has great scope in the cluster area to increase the water productivity/productivity of fish/animal/ agricultural crops/horticultural crops etc. thereby increasing the income of the farming community in the 11 selected villages of Sibbari cluster in particular and South Garo Hills district in general.

Rationale

Integration of aquaculture with crops, vegetables, fruits and livestock would efficiently utilize natural resources, reduce farmers risk and generate year round employment and income for sustainable livelihood improvement.

Objectives

1. To conserve the rain water in farm pond and utilize for life saving irrigation for agri-horticultural crops etc.
2. To utilize the water bodies for composite fish culture and integrate with duck, piggery, vermicomposting and agri-horticultural crops for enhancing livelihood.
3. Effective utilization of on-farm resources and their recycling to reduce cost of production.

Methodology

The Krishi Vigyan Kendra (KVK), ICAR, Tura and ICAR Research Complex for NEH Region, Umiam has made intervention on fish based farming system and selected 77 households during 2009-12. During 2012-13, another 50 ponds are planned to bring under farming system models from newly selected sites.

- ➢ Trainings were conducted on composite fish farming, integrated farming, water harvesting to develop skill of the farmers
- ➢ Dug out 35 new ponds (500 m^2) and renovated 42 shallow underutilized ponds scientifically.
- ➢ Constructed low cost pig/goat houses near the pond dykes and duck sheds over the water bodies using locally available materials like bamboo, wooden logs, thatch grass, GI sheet etc.
- ➢ Distributed 3 piglets (Hampshire), 10 ducks (Sonali), 2 goats (Black bengal) as per demand of the community restricting to maximum of two livestock components per household.
- ➢ Duck droppings were directly allowed to fall on pond water to promote plankton growth to serve as fish feed.
- ➢ Kitchen wastes, tuber crops, rice bran etc. along with limited quantity of concentrates were used as feed for pigs by the farmers.
- ➢ Installed low cost vermicomposting unit on the pond dyke and paddy straw, vegetable and other crops waste, mixed weed, etc. were used for vermicomposting.
- ➢ Planted banana, arecanut, guava, Assam lemon etc on the pond dyke and on the unused area near the pond.

Fig 1 (a). IFS site before intervention

Fig 1 (b). IFS site after intervention

- ➢ Vegetables like bottle gourd, lablab bean, laipatta etc were cultivated in the pond dyke, whereas crops like tomato, cole crops were cultivated in nearby areas.
- ➢ Lime was applied based on the pH of the water and the pond was manured before stocking the fish fingerlings.
- ➢ Fingerlings of catla, rohu, mrigal, silver carp, grass carp and common carp are stocked at 10000 nos/ha in the ratio of 1.5:1.5:1.5:2:1.5:2
- ➢ Rice variety *Ranjit* was planted under SRI in adjacent fields with 50% recommended fertilizer + pig manure 5t/ha.
- ➢ During dry season the harvested water from pond was used for life saving irrigation of crops, vegetables and fruit plants

Results

The average unit area of integrated farming system model was 1500 m^2 including pond (500 m^2), vegetables in dykes/nearby area (500m^2), rice in adjacent low land (500m^2) and fruits in pond dyke (Table 1). Farmers intensified the utilization of pond dyke by growing vegetables in the lower layer and bottle gourd in the upper layer (indigenous bamboo made structure Fig.2 & 3). Farmers net income ranged from Rs. 21, 400 (2009-10) to Rs. 37, 400 (2011-12) with B: C ratio of 2.69 to 2.83 (Table 2).

Fig 2. Vertical intensification in pond dyke

Table 1. Production from various components of pond based IFS.

Component	2009-10	2010-11	2011-12
No of Pond based farming system unit demonstrated	22	50	77
Fish production (kg/500m^2)	110	162.5	175
No of eggs/year (nos.)	250	452	510
No of piglets /year (2 female + 1 male)	7	11	14
Vegetables (tomato, bhindi, cole crops, lai pata, bottle gourd, lablab bean etc) from pond dyke/nearby areas (500 m^2)	395	350	410
Banana/Assam lemon (kg/Unit)	250	490	550
Rice (500m^2) (kg)	175	190	180

Fig 3. Cultivation of vegetables in pond dyke (A). Kongkona, (B). Batabari village, Sibbari

Table 2. Economics (Rs/unit) of pond based farming system

Component	2009-10			2010-11			2011-12		
	GR	NR	B:C	GR	NR	B:C	GR	NR	B:C
Fish	11000	8000	3.66	16250	12200	4.01	17500	13000	4.37
Egg	1250	750	2.50	2260	1700	4.03	2550	1800	3.40
Piglets	14000	8400	2.50	22000	12100	2.22	28000	15400	2.22
Vegetables	3950	2000	2.02	3500	2500	3.50	4100	2700	2.92
Fruits	2500	1500	2.50	4900	3500	3.50	5500	3700	3.05
Rice	1750	750	1.75	1900	900	1.90	1800	800	1.80
Total	**34450**	**21400**	**2.69**	**50810**	**32900**	**2.83**	**59450**	**37400**	**2.70**

GR – gross return, NR – net return

Table 3. Income and employment enhancement over farmers practice

Particulars	Farmers practice (FP)	IFS	% enhancement over FP
Income/ unit/annum (Rs)	9750	30500	213
Income/unit/day (Rs)	27	83	213
Employment/unit	30	69	130

Discussion

The number of farm family involved in pond based integrated farming system increased consistently over 2009 to 12 (Fig 4). The interventions have made great impact on farm families, and farming communities in terms of higher productivity of fish, pig, duck as well as agri-hortcultural crops which lead to higher net return and benefit cost ratio in comparison to traditional fish farming only. The livelihood of the farmers has been improved with the additional income from other components of fish based farming system. The pond dyke utilization component has got special attention of farmers in various clusters. Farmer grown banana, vegetables on pond embankment and earned a good income besides meeting their own consumption requirement. Mr. Nathan Sangma, Mandangre village sold banana worth Rs.10,000 in a single year from his system which has attracted attention of other farmers. The goat component included in IFS for the farmers (Hajong community) who are not undertaking pig husbandry started giving income. The income and employment of farm family enhanced by about 213 and 130 % respectively, over farmers practice. The people of Sibbari cluster have learned new things with integration of various components and doing things differently than they used to do earlier.

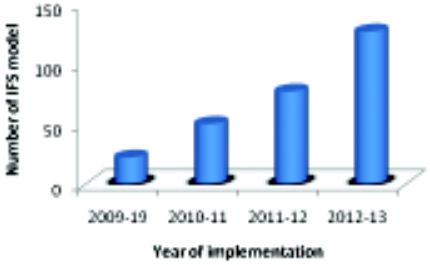

Fig 4. Growth of IFS model under NAIP-3 in Sibbari Cluster (2012-13 figure is provisional)

SRI and ICM Method of Paddy Cultivation for Higher Productivity and Livelihood Improvement in South Garo Hills, Meghalaya

[1]D.P. Patel, [2]Md. M. Islam, [1]Anup Das and [2]L. K. Nath
[1]ICAR Research Complex for NEH Region, Umiam, Meghalaya
[2]Krishi Vigyan Kendra, Dobasipara, Tura

Introduction

Soil and climatic conditions of valleys of South Garo Hills are suitable for rice cultivation but the productivity of rice was very low due to cultivation of local varieties or meager fertilizer/manure application and poor agronomic practices.

The farmers of the Sibbari cluster of 11 selected villages under Gasuapara C.D Block in the district of South Garo Hills are mostly small and marginal. Wages, agriculture and allied small scale activities were their main source of income with traditional method of cultivation before implementation of the project. The farmer was growing paddy with the seed rate of 75-80 kg/ha in traditional method of cultivation. The total area under Sali paddy in the district was 3,338 ha with the productivity of 1,053 kg/ha. However, the area under Sali paddy in Gasuapara block was 1,177/ha with the productivity of 986 kg/ha.

Rationale

By adopting System of Rice Intensification (SRI) and Integrated Crop Management (ICM) methods of rice culture, the farmers could increase the productivity of paddy, reduced the cost of cultivation thereby, earning an additional income for themselves with less effort and save seed, water, nutrient, time etc. Thus, the programme would make an excellent impact in improving the livelihood standard of the farmers in the adopted villages.

Objectives

1. To increase the rice productivity with improved method of cultivation and high yielding varieties
2. To save seed, water, nutrient, time etc
3. To increase the cropping intensity by cultivating pea/toria in rice fallows.

Fig 1. Traditional method of rice cultivation

Methodology

The Krishi Vigyan Kendra, ICAR, Tura and ICAR, Umiam through village survey, selected 35 farmers for training and demonstration on SRI and ICM cultivation technology and management. Trainings were conducted on SRI (Seed-5 kg/ha, seedling age-10 days, spacing-25 x 25 cm) and ICM (Seed-10 kg/ha, seedling age-20 days, spacing-20 x 20 cm) and demonstration on nursery bed preparation, land preparation, transplanting, weeding with cono weeder and on maintaining intermittent/shallow water level

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(Fig. 2). Integrated nutrient management with 50% NPK (40:30:20 kg/ha) + FYM 5t/ha was advocated. High yielding variety Ranjit was used as test crop. Conventionally farmers transplant 30 days seedlings, 4-5 seedlings/hill and follow random transplanting. Rice was harvested leaving 20-30 cm stubble height. Rabi crops like pea (Prakash/ Vikash) and toria (TS 36) were grown with residual soil moisture in rice fallow.

Fig 2. Improved technology and adoption of SRI / ICM method

Results

The yield of Ranjit variety was recorded at 4.67 t/ha and 4.24 t/ha through SRI and ICM respectively, as compared to 2.19 t/ha through farmers practice. Farmers could earn a net income of Rs. 27,200 and Rs. 23,400 with B: C ratio of 2.39 and 2.23, respectively, through SRI and ICM method of rice cultivation (Table 1 and pictorial depiction in Fig. 3 & 4)

Discussion

The interventions have made great impact on participants, families, and farming communities in terms of higher productivity of paddy, net return and benefit cost ratio in comparison to traditional practices which leads to self-sufficiency of food for sustainable livelihood improvement. The people of Sibbari cluster have learned new things and doing things differently than they used to do before.

The farmers were getting 1.5-2.2 t/ha of paddy with traditional method of cultivation which has increased to 4.2-4.3 t/ha under SRI and ICM method of cultivation. The farmers are happy with less seeds (20%), water (50-60%) and cost of inputs etc. required for SRI & ICM method of establishment compared to conventional rice culture. The new technology of SRI and ICM gave more number of tillers/hill (15-20) and higher panicle length (24-25 cm) leads to higher productivity compared to traditional farmers' practices. The significant aspect was that SRI and ICM rice matured 7 to 12 days earlier compared to same variety under farmers practice. Hence, it paved way for timely cultivation

Table 1. Production and economics of SRI & ICM method of rice cultivation vis-a-vis farmers practice

Particulars	SRI	ICM	Farmers practice
House hold, nos	35	35	-
Variety introduced	Ranjit	Ranjit	local
Area (ha)	0.15	0.15	-
Cost of cultivation (Rs/ha)	19,500	19,000	14,500
Grain yield (t/ha)	4.67	4.24	2.19
% increase in yield	113	88	-
Weed management	2 cono weeding + 1HW	2 cono weeding + 1HW	1 HW (Hand weeding)
Gross income (Rs/ha)	46,700	42,400	21,900
Net income (Rs/ha)	27,200	23,400	7,400
Income enhancement, %	267	216	-
B: C ratio	2.39	2.23	1.51

Fig 3. ICM method of rice cultivation

Fig 4. SRI method of rice cultivation

of second crops like pea, toria with residual moisture in rice field and thereby, enhancing cropping intensity. The average productivity of pea and toria was 1.8 t and 0.55 t/ha respectively, giving a net income of Rs. 20,000 and 8,500/ha, respectively.

Fish cum Vegetable Farming- A Source of Livelihood for the Farmers of South Garo Hills, Meghalaya

Cyril Tirkey, James Mani and A. Ryngkhlem
Rural Resource Training Centre (RRTC), Umran, Meghalaya

Introduction

Farmers in selected site of Meghalaya grow plantation crops in a piece of land (mixed farming) and also *jhum* farming system is prevalent. Paddy and maize are the major cereals crops and cashewnut and arecanut are the major plantation crops grown by the farmers. Vegetables are grown in a very low scale. Before RRTC interventions people in the selected clusters of South Garo Hills District used to cultivate few types of vegetable with little care which resulted in very low production which could hardly meet their family requirements.

Fishery is also another source of livelihood for the farmers in Sibbari cluster. Farmers are having small size ponds (500-600 m^2) in their backyards or near their paddy fields. However, fishes are reared in unmanaged ponds infested with weeds and economically less fish species resulting in very low water productivity. But after RRTC intervention the farmers realized the potential of fish cum vegetable farming. Now the farmers are growing at least five to seven types of vegetables round the year near in the pond dykes and the productivity of fishes has increased from a meager 500-600 kg/ha to 2.5 t/ha. They are now able to produce surplus quantity of vegetables and fishes.

Objective

The main aim is to educate the farmers about the scientific methods of fish cum vegetable farming, improve the socio-economic status of rural farmers by improving the production and income.

Methodology

Various training and demonstration on integrated farming system was conducted to sensitize the farmers about the benefits they can derive by adopting this new technology. Some of the farmers after participation in training shows great interest hence are able to achieve their goals and sets an example for the fellow farmers to adopt this modern method of farming.

Results

To achieve the desired results action plan were followed which includes awareness program of participants on productivity and effectiveness, trainings, maximum utilization of waste land for maximum profit. Mr. Welstone D Shira has realized the benefits from IFS where he could earn a net income of Rs. 15,000 from vegetables and Rs. 60,000 from fishes in a single year from his farming (Table 1). The B:C ratio was 3.30:1.

Table 1. Production and economics from IFS in Welstone D. Shira field

Particulars	Vegetables	Fishes
Area	0.26 ha	0.52 ha
Variety introduced	Cauliflower, cabbage, knol knol, tomato, radish, pumpkin, bottle gourd, carrot	Silver carp, rohu, mrigal, common carp, grass carp
Production	0.88 t	2.5 t/ha
Gross income	Rs. 17,000	Rs. 90,000
Net income	Rs. 15,000	Rs. 60,000

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Impact

Some of the main impact of the introduced technology or modern methods of farming are production, income, employment, livelihood improvement and most importantly the commercialization of the product. The farmers now begin to adopt the modern methods of farming rather than the traditional methods.

Fig 1. Fish cum vegetable farming in Welstone D. Shira field

Ginger Seed Production – a Profitable Venture at Dzongu, North Sikkim

Ashok Kumar
ICAR Research Complex for NEH Region, Sikkim Centre, Tadong, Sikkim

Introduction

Ginger is predominantly cultivated in all the districts of Sikkim in mandarin-ginger, maize-ginger, beans-ginger cropping systems. New cultivation practices were introduced and adopted by a large section of ginger growers. But at later stage, many farmers gave up ginger cultivation while others are still struggling to survive because, over the last 15-20 years, diseases severely affected the crop resulting in a decline in the yield ratio from 1 'seed' rhizome to 8-10 harvested rhizomes to only 1 to 2-3.

There is ample scope for further improvement of production and productivity of ginger for raising the income level of the farming community of the state. Yield loss under real farming condition can be attributed to several biotic and abiotic factors, important among them are improper mother rhizome selection as seed material, lack of seed treatment, poor drainage, lack of knowledge on crop rotation, faulty cultural practices and timely plant protection measures.

Ginger became the main cash crop in Dzongu area of North Sikkim after severel decline in the large cardamom area. Both the crops play a vital role in the state economy in terms of direct and indirect income and employment generation provided with immediate identification of problems and knowledge intensity.

Sikkim is among the major producer of ginger contributing to the 5 % of countries production although productivity of the ginger from the state has increased from 4.8 tonnes/ha in 2002 – 2003 to 5.3 t/ha in 2006-2007, which has not kept pace in with all India average.

Rationale

Apart from working as farm labour, farmers engages them self in different farm activities like off-season vegetable cultivation in green houses, large cardamom cultivation, small scale handloom and handicraft etc. to earn additional income.

These ventures however, were not very much profitable commensurate with the amount of labour involvement. There was a long felt need among the farmer, farmwomen and rural youth to start the production of organic ginger production in the region.

Although, farmers were aware about the cultivation and profitability of ginger crop but lacked about the improved production technology for economic viability and having the problem in procurement of quality planting materials for further multiplication, proper processing and organized marketing.

Scope of the programme

Ginger var. Bhaisey is most suitable and widely cultivated in the state owing to its simple cultivation technology, low production cost and its adaptability. It grows well in warm and humid climate up to the altitude of 2000 m above mean sea level and annual rainfall of 3000-3500 mm. However, an optimum elevation for its successful cultivation is 300-900 m with moderate climatic conditions which is at par with Dzongu region. Irrigation is not required in this region as soil has enough moisture due to regular rain. Farmers of Dzongu area were cultivating ginger in mandarin orchard for the partial shade but scientific methods were not followed. The significant aspect of the technology intervention to the farmers was the introduction of high yielding variety, crop rotation, soil treatment with trichoderma and vermi composting of on farm residues for soil health improvement.

Objectives

1. Scientific organic ginger production for higher productivity and income
2. To produce disease free quality planting material of ginger

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ICAR Research Complex for NEH Region, Umiam, Meghalaya

Methodology

Initially the ICAR Research Complex for NEH Region, Sikkim Centre, Tadong conducted PRA exercise and found that the income of the farmers decreased drastically because of the decline in large cardamom production. Selection of the beneficiary was made on the Basis of the interest of farmers and SHG, involving panchayat presidents and panchayat secretaries of the particular panchayat. In the first year of the project implementation, elite planting material of ginger was supplied from ICAR Sikkim centre along with improved production technology. In the consecutive years, the planting material produced from the selected beneficiaries were procured under the project and distributed among the newly selected beneficiaries involving local panchayat (Table 1).

Hands on training to the selected farmers were practiced after every distribution of input (Fig 1 & 2). Production technology of ginger under organic condition is disseminated and popularized through introduction of nursery technology for major horticultural crops under NAIP-III among the tribal farmers at Dzongu, North Sikkim during 2008-12.

Results

Altogether 115 households were benefitted from ginger cultivation in Dzongu area of North Sikkim. The average area per farmer under ginger cultivation was 0.10 ha. The production of ginger was 26 t/ha (Table 2).

Table 1. List of farmers and SHGs involved in ginger cultivation in different years

Year	Village	Name of Farmer/SHG
2008-09	Tingvong	Smt. Gyamit Lepcha
2009-10	Lingdong	Mr. Tenzing Lepcha
2010-11	Gor	Phuki Lepcha, LakitLepcha and Yangden Lepcha
	Sudur Hee-gyathang	Tasi Lepcha and Ugen Tshering Lepcha
	Hee-gyathang	Neromit Lepcha, Songmit Lepcha, Rigzing Lepcha, Loden Lepcha, Tasi Lepcha, Lackchung Lepcha, Samroo UgenLepcha and Tasi Loma Lepcha
	Linku Tingvong	Ongbu Lepcha and Jasmit Lepcha
	Barfok	Som Dorjee Lepcha
2011-12	Gor	Gaur Kyung SHG, Etookrip SHG, Daar Tungkung SHG, Kursong Chhu SHG, Kuchhenrip SHG, Pugurip SHG, Rumlee SHG and Ripseeng SHG
	Hee-gyathang	Sumok-rip farmers club SHG, Thing Gokmu SHG, Aadon SHG, Chumit SHG, Saknon SHG and Ghacho SHG
	Tingvong	Lingko-Lingthem (I) SHG, Lingko-Lingthem (II) SHG, Lingko-Sebim (II) SHG, Pembi Lepcha, Zangbo Lepcha, Tashi Yangzome Lepcha, Pembo Rikzing Lepcha, Dawkit Lepcha, Young Dorjee Lepcha, Sthup Lepcha, Chugmit Lepcha and Pempa Tsh. Lepcha

Fig 1. Demonstration to farmers at Lingdong

Fig 2. Ginger distribution by hon'ble minister of power and energy, Govt. of Sikkim

Table 2. Production and economics of ginger cultivation

Particulars	Before	After
House hold, nos.	-	115
Variety introduced	-	Bhaisey
Area		0.10 ha/farmer
Production	-	2.6/0.10 ha
Increase in production	-	1.4 t/0.10 ha
Cost of cultivation		Rs. 13,000/0.10 ha
Gross Income		Rs. 39,000/0.10 ha
Net income		Rs. 26,000/ 0.10 ha
Income enhancement	-	40-45 %/ farmer
Employment enhancement	-	45 man days/farmer
Adoption rate		60%

The SHGs/farmers sold their produce to private firms such as SIMFED, DST and even to government organization such as the ICAR (Table 3).

Discussion

Each farmer has gained a net income of Rs 26,000 from an area of 0.10 ha from their produce at the selling price of Rs. 15/kg. Farmers have learnt improved production technology of ginger seed production by utilizing the available unused plots and at the same time they got the opportunity to generate some extra income for improving their livelihood.

Steps for Sustainability

- ➢ Training programme on improved cultivation technique.
- ➢ Timely supply of seeds so that farmers can continues the cultivation.
- ➢ Regular visit and monitoring for confidence building of framers.
- ➢ Created linkages with marketing agencies

Table 3. Amount generated by farmers/SHGs from the sale of Ginger

Beneficiaries	Coordinator's/ facilitators	Amount generated (Rs.)	Sold to	Year
Group of SHG	1,2,3,4	3,40.000	SIMFED	2009-10
Group of SHG	1,2,3,4	40,000	DST	2009-10
Group of SHG	1,2,3,4	3,90,000	ICAR	2010-11
Group of SHG	1	88,000	SIMFED	2011-12
Group of SHG	2	1,76,000	SIMFED	2011-12
Group of SHG	3	88,000	SIMFED	2011-12
Group of SHG	4	88,000	SIMFED	2011-12
Ms. Gyamit Lepcha	2	2,00,000	SIMFED, ICAR	2009-12

[1]Ms. Anguli Lepcha (9933103222), [2]Mr. Ongda Lepcha (9800581516), [3]Mr. Shamro ugen Lepcha (9002463615) and [4]Mr. Tshering Lepcha (9800215041)

Fig 3. A happy farmer in his ginger field

Fig 4. Interaction and experience sharing of farmers with mass media of Doordarshan, Gangtok

Nucellar Seedling Production of Mandarin for Assured Income at Dzongu, North Sikkim

Ashok Kumar
ICAR Research Complex for NEH Region, Sikkim Centre, Tadong, Sikkim

Introduction

Sikkim Mandarin is similar to the Nepal or Assam or Darjeeling Mandarin. Citrus reticulate is a highly polyembryonic species, having medium sized upright trees. In Sikkim, mandarin is cultivated in an area of about 6,300 hectares, with a total average annual production of about 17,190 t. The important orange producing areas are the Tista and Rangeet river valleys within the elevation range of 600 to 1500 m above mean sea level. Tashiding, gyalshing, Omchung, Tijyah, Lingchom, Bermiok, Barthang, Rinchenpong, Chinthang, Chakung, Zoom, Timberbong, Karthok in the West; Kewsing, Lingmoo, Sangmoo, Yangang, Payong, Rateypani, Namthang, Tarku, Tokal- Bermiok, Turuk, Sumbuk in the South Nazitam, Sang, Simiklingy, Khamdong, Sirwani, Samdong in the East and Dikchu and Hee-Gyathang in the North district of Sikkim are the important orange growing areas of Sikkim. Sikkim mandarin is the leading cash crop among fruit crops in Sikkim. The productivity is comparatively lower than National productivity because of unavailability of disease free planting materials, general negligence and improper management of insect-pests and diseases. Production of quality planting materials of Sikkim Mandarin has tremendous potential in Sikkim because of its congenial climate, low cost production technology. The momentum of nursery production of orange in Sikkim is slow due to dearth of knowledge about production technology, lack of skill in nursery management, marketing, etc.

Exact scenario of clusters/villages before the project

Apart from working as farm labour, farmers engaged themselves in different farm activities like off-season vegetable cultivation in green houses, large cardamom cultivation, ginger cultivation etc. to earn additional income. These ventures however, were not very much profitable commensurate with the amount of labour involvement. Although, farmers were aware about the profitability of production of Sikkim mandarin but were ignorant about the organic means of low cost mandarin nursery technology and about organized marketing etc.

Scope of the Programme

Various aspects of nursery production and management had not received proper attention in the past. Therefore, many diseases had spread to the virgin areas bringing about economic losses in most of the citrus growing areas of Sikkim. They cause decline, loss of vigor, low yield, poor quality fruits and short commercial life of orchards which could be initially managed by the use of healthy nursery trees. Non availability of quality planting material is one of the major constraints in obtaining expected quality and productivity in fruits. The planting materials must be sourced from consistently high yielding diseased free plants. Mandarin nursery management should be invested for improvement in terms of quality seedlings production technology. Proper knowledge in management of nursery for the production of good quality seedlings is the most essential component for the establishment and development of good mandarin orchard. It germinates and grows well in warm and humid climate up to the altitude of 1500 m above mean sea level. However, an optimum elevation for its successful cultivation is 300-1500 m with moderate climatic conditions which is at par with Dzongu region. Raising of disease free elite planting materials is the foundation of any successful orchard establishment. The strategy of investment on high quality nursery tree has the greatest impact on cost ratio benefit of any orchard.

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ICAR Research Complex for NEH Region, Umiam, Meghalaya

Objectives

1. To develop skills of the farmers in nucellar seedling production
2. To produce quality planting material of mandarin for productivity and income enhancement

Methodology

Selection of the beneficiary was made on the basis of the interest of farmers and SHG, involving panchayat presidents and panchayat secretaries of the particular panchayat. The beneficiaries (Table 1) were provided all the necessary input after rigorous hands on training on the production technology of nucellar seedling production of Sikkim mandarin. Production technology of nucellar seedling (Fig 1) of mandarin is disseminated and popularized through introduction of nursery technology for major horticultural crops under NAIP-III among the tribal farmers at Dzongu, North Sikkim during 2008-12.

Fig 1. Uprooting and selection of nucellar seedling

Results

The average size of each poly house was 300 m^2 and a total no of 12 poly houses were established during 2008-2010. The cost of cultivation ranges from 60,000 to Rs. 65,000 per poly house and they earn a net income ranging from Rs. 1,35,000 to Rs. 1,40,000 (Table 2).

Fig 2. Raising of primary nursery in polyhouse

Fig 3. Ready nucellar seedlings for transplanting

Table 1. Details of beneficiaries

Year	Beneficiary	Location	Particular	Quantity
2008-09	Farmers Club SHG	Lingdong	Orange Nursery	1
2009-10	Topgey Lepcha	Shagyong	Orange Nursery	1
	Paldein Lepcha, Nima Lepcha & Samba Lepcha	Gor	Orange Nursery	1 each
	Suchuk reep SHG	Sangdong	Orange Nursery	1
2010-11	Sakchum SHG & Fongting SHG	Gor	Orange Nursery	1 each
	Samokreep farmers Cloub SHG (Ugen Tsh. Lepcha)	Hee-Gyathang	Orange Nursery	1
	Samokreep farmers Cloub SHG (Samroo Ugen Lepcha)	Hee-Gyathang	Orange Nursery	1
	Ongbu Lepcha & Lakpa Tsh. Lepcha	Tingvong	Orange Nursery	1 each

Table 2. Economics (Rs/poly house) from seedling production of mandarin under poly house

Particulars	Before	After
House hold, nos	-	12
Variety introduced	-	Sikkim Mandarin
Area (ha) /farmer		300m^2/SHG
Production/farmer	-	10000 seedling/SHG
Increase in production/yield	-	45 kg/SHG
Cost involvement/farmer		60,000-65,000/SHG
Total Income		200000/SHG
Net profit		On an average Rs 1,35,000-1,40,000/SHG
Increase in income, %	-	35-40 %/SHG
Increase in employment, %	-	60 man days/SHG

The farmers are selling their produce to other SHGs and private firms and the demand is soaring year by year. The amount generated through selling of seedlings (Table 3) is an example of few farmers who have sold their produce during 2009-2012.

Discussion

Farmers have learnt the technique of nucellar seedling production and nursery management of Sikkim mandarin. Each SHG has gained a net income of Rs 1,35,000-1,40,000/ 300 m^2 polyhouse area from the seedling production. Hence, the farmers got the opportunity to generate some extra income for improvement of their livelihood.

Steps for Sustainability

- ➢ Training programme on nursery raising techniques of Sikkim mandarin through budding and grafting.
- ➢ Timely supply of seeds and input to the farmers so that they can continues the cultivation.
- ➢ Regular visit of nursery for technical support.
- ➢ Created linkage with central and state marketing agencies

Table 3. Amount generated by SHGs from the sale of Mandarin

Beneficiaries	Amount generated (Rs.)	Enterprise	Sold to
Farmers SHG	1,60,000	Mandarin	Cincona Plantation (2009-10)
Mr. Ugen Lepcha	2,00,000	Mandarin	Farmers club, Sangthang, Kalimpong (2012-13)
Mr. Shamroo Lepcha	1,00,000	Mandarin	
Mr. Nima Tsh. Lepcha	40,000	Mandarin	
Total	5,00,000		

Clone Multiplication Units for Production of Quality Cardamom Planting Material

A. K. Biswas, T. N. Deka, Kuldeep Rai and Narayan Kumar Bhattarai
Indian Cardamom Research Institute (Spices Board), Regional Station, Tadong, Sikkim

Introduction

Area under large cardamom had come down due to various reasons like diseases, lack of quality planting material, lack of irrigation facilities and lack of scientific methods of cultivation. There is need for area expansion and gap filling. By producing quality planting material farmer can expand area under cardamom and earn income by selling additional planting material

Rationale

Quality planting materials for large cardamom is the pre requisite for area expansion as well as for livelihood improvement.

Objectives

To establish clone multiplication nursery of large cardamom for producing quality planting materials.

Methodology

Area covered/ No. of farmers : 10 ha. area have been covered, where 91 units planting materials been used. 1 unit can have 2500 planting materials, within 9 month 1:5 ratio planting material can be obtained, and 12500 planting material can be generated.

Step taken : Planting materials for nursery was collected locally in the nursery site for their multiplication. Trench method of sucker multiplication was adopted. Nursery for large cardamom multiplication are adopted which were not in practice before.

Target audience : Self help groups, farmer groups, youth and individual farmer.

Asked or required to do : Training and capacity building programme for SHGs member Youth groups, women's and framers learning programme Viz. Work shop training programme, group discussion, Spice Clinic, exposer tour etc. Regarding the scientific methods of large cardamom cultivation.

Results

Establishment of nurseries could address one of the most critical issues that farmers were facing. The farmers generated quality planting material during planting season. Large cardamom is a perennial crop. Stable bearing starts after 4 years. Hence, outcome of replantation and rejuvenation can be analyzed after 2012 only. However, an increase in trend productivity of capsule 14.26 kg/ ha was recorded from the rejuvenation area during the project implementation period. On an average Rs. 6,250 was earned by individual households (Table 1)

Impact

The existing situation has been changed as it was before (Fig 1) the initiation of project in the

Table 1. Production and economics of clone multiplication units

Parameter	Before	After
Household (Nos)	Nil	91
Technology introduced	Nil	Clone multiplication units
Production	Nil	1,13,7500 planting materials was produced
Cost involved	Nil	Labour charges
Gross income	Nil	Rs 56,87,500 by selling planting materials
Net income/HH	Nil	Rs. 6,250

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Fig. 1 Unmanaged large cardamom nursery

area, they started cultivating large cardamom scientifically (Fig 2). Nursery for large cardamom multiplication are adopted which were not in practice before. At the time of project initiation (year 2007) the site did not have any quality clone multiplication units. This was a main drawback for the farmers and large cardamom cultivation as a whole. They were dependent upon external sources for undertaking replanting, gap filling. An establishment of 91 clone multiplication unit with Spices Board, Development Department and NREGA produced 11,37,500 planting unit for worth Rs 56,87,500. At least 1:5 ratio could be maintained for the production of planting material within 9 months.

Steps for Sustainability

Methodology for production of planting materials has been generated as a long time asset in the project site. Planting materials production would be a continuous process and would generate income after completion of the project tenure also.

Fig. 2 Clone multiplication unit

Large Cardamom Based Farming System – a Viable Option for Income and Employment Generation in North Sikkim

T.N. Deka, U. Gupta and N.K. Bhattarai
Indian Cardamom Research Institute (Spices Board), Regional Station, Tadong, Sikkim

Introduction

National Agricultural Innovation Project (NAIP) was started w.e.f. 29/06/2007 in Dzongu area of North Sikkim under Indian Cardamom Research Institute, Regional Station,Spices Board, Tadong covering two Gram Panchayat Units (GPUs) namely Tingvong and Passingdang. The villages under these GPUs are Tingvong, Nung, Namprick, Kussong, Payal, Lingkoo, Lyngza, Mentam Laven, Passingdang, Upper Lingthem, Lower Linghtem, Sangkalang, Rukloo and Kayam. Base line survey was carried out covering 111 households and it was observed that employment potential and the income generation of the farmers were not enough to meet their requirements because of steep decline of production of large cardamom, as large cardamom was the principal cash crop for them. The major constraints for the decline of the production were identified as high pest and diseases incidence, lack of availability of quality planting materials and lack of awareness for scientific method of cultivation etc. To mitigate the problem, steps were initiated to produce large cardamom planting materials and cultivation of large cardamom in a farming system mode to maintain sustainability of income. Under the project 155 household with total population of 807 (Male- 403, Female- 404) was brought under different interventions.

Community Based Approach

Initially attempt was made to form community based organization (CBOs) for integration of various available recourses. Thirteen Self Help Group (SHGs) with 140 members and 8 Farmers Groups (FGs) with 55 members were formed. The CBOs facilitated empowerment of the farm families through collective and individual action in large cardamom and cultivation of other crops. For producing quality planting materials of large cardamom, in the beginning, 13 farmers were selected for raising large cardamom nursery. They used 19,400 numbers mother suckers of variety *Dzongu Golsey* and *Ramsey*. After one year they produced suckers at the rate of 1:5. The materials were used either for their area expansion programme, rejuvenation or selling. Thus they produced suckers with an estimated amount of worth Rs, 3,88000. With the success of this technology other farmers were motivated and within four years approximately 11, 37,500 numbers planting units were produced. They got benefit directly from NAIP or through linkage with other Departments viz., Spices Board (Dev) Manmgan and able to produce the above mentioned suckers. The value of suckers was estimated as Rs 56,87,500 and Rs 43,22,500 gross and net income respectively**.** The planting materials were used for area expansion rejuvenation as well as selling also. New innovation of irrigation through Source Modification (50 nos.), silpaulin lined later harvesting tank (48 nos), Shade Management through planting of *Alnus (*17.1 ha) and introduction of ICRI Improved Bhatti (30nos.) (Fig 1) etc, provided additional employment opportunities and generated around 108930 man days. Cost of

Fig. 1 ICRI improved bhatti

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installation ICRI bhatti was around Rs. 28,000 (2007-08) with an expected life span of 10 years. The farmers got opportunity to cure their large cardamom capsule through the ICRI Improved bhattis scientifically. The Improved bhattis cured capsules fetches higher price around Rs. 50 to 100 per kg in the auction market which was conducted by NARAMAC, Govt. of India with the help of Spices Board (Marketing). This higher price for ICRI Improved bhatti cured cardamom was achieved due to better quality of the cardamom capsule. In ICRI Improved bhatti, curing is completed through indirect heating process at a temperature ranges from 50 ± 5 ^{O}C. The cured product retained high oil content with attractive aroma, flavour and colour. Maintaining of these qualities is not possible in Traditional bhattis (Fig 2) cured product as the curing continues in a direct heating process with smoke laden heat. The cured capsule in traditional bhatti (Fig 2) imparts charred, black, unattractive colour with less aroma, flavor and low oil content. Around 100 farmers benefited from ICRI improved bhattis during 2008 -11.

Fig. 2 Traditional bhatti

Nutritional security and sustainable income

Nutritional security and income through cultivation of vegetables in homestead garden was also achieved with the innovation and introduction of drip irrigation systems (11 nos.). Farmers cultivated vegetable during winter season taking the help of drip irrigation. About 1.0 ha area was brought under the cultivation of winter vegetable in Passingdong and Tingvong , Dzongu, North Sikkim. They got input (seeds) from their own as well as from other Govt. agencies. An estimated production was near about 10 ton from where they earned a gross income of around Rs 1,00,000 and net income of Rs. 40,000 per year. Thus net income generated through cultivation of vegetables were estimated as Rs 1,60,000 in 4 years. Cultivation of garlic was started as a component with large cardamom farming system and achieved production at the ratio of 1: 6.8. Honey bee boxes (48 no) were supplied which provided nutrition security and income to farm families. The income per family per year was estimated as Rs 400/- per hive. Therefore, a total of Rs 19,200 per year was obtained by 48 families. Besides this, improvement of quality and production of all the crops grown nearby the bee colonies was noticed due to proper pollination. However, there is great scope to increase income through scientific management and or by creating awareness programme. Citrus was planted with cardamom for maintaining sustainability. Disease management programme and training on scientific cultivation of crops in the form of Spice Clinic, bio-agent production, exposure visits etc was given which empowered the farmers for maintaining sustainability of employments opportunity and income. Ten SHGs started maintain their sustainable fund.

Model farmer

Mr. Nakri Lepcha (50 yrs), Tingvong GPU, Dzongu was a farmer beneficiary of NAIP. He covered 2.1 ha under different facilities provided by NAIP. He cultivated vegetables, raised large cardamom nursery, rejuvenated and expanded large cardamom cultivation in his homestead garden (Fig 3). He utilized available water through silpaulin lined water harvesting tank constructed in upper part of his garden. An ICRI improved bhatti was constructed near his home which was being used for drying large cardamom to make good quality capsule. He was able to extend this facility to other farmers also. Mr. Lepcha was able to generate an estimated income of Rs. 2,95,500 (estimated value of planting materials and from other sources from 2.1 ha area) during 2008-2011 (Table 1). Thus his average net income per day was estimated around Rs 205.21. He got opportunities to offer work

Fig. 3 Large cardamom plantation

avenue to his 5 family members in his garden. He was able to extend large cardamom curing facility to other farmers also.

Table 1. Estimated income of Mr. Nakri Lepcha from different interventions of NAIP during 2008-11.

Sl. No.	Adopted Technology	Estimated Net Income (Rs)	
		Before Intervention	After Intervention
1	Nursery	0	47,500
2	Rejuvenation	9,000	2,00,000
3	Replantation	0	30,000
4	ICRI Improved Bhatti	0	18,000

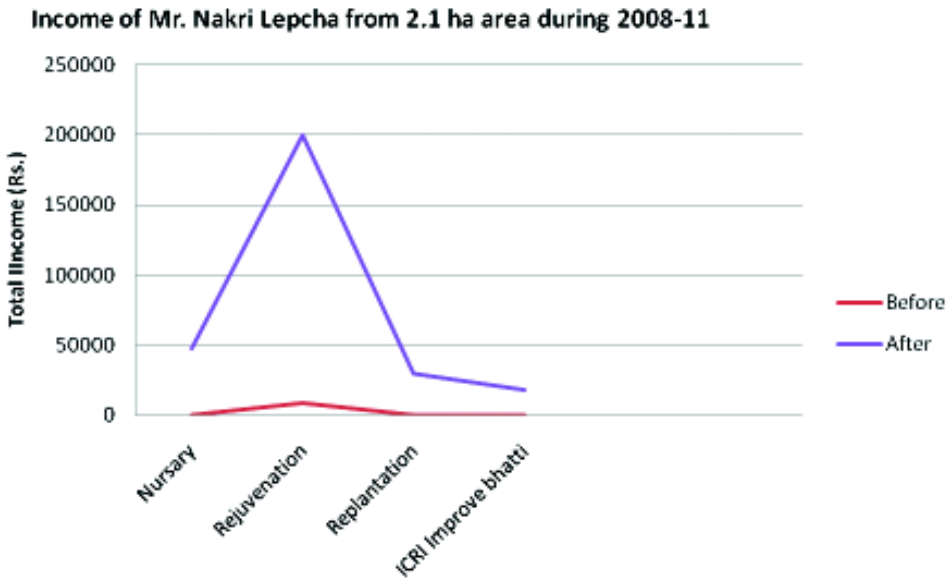

Fig 4. Comparison of income of Mr. Nakri Lepcha from different component before and after NAIP intervention

Multiple-use Water Schemes

B. Sharma
International Water Management Institute (IWMI), NASC Complex, DPS Marg, Pusa, New Delhi

Introduction

In the northeastern hilly regions of India and Nepal, women are among the main benefactors of Multiple-Use water Schemes (MUS)

The MUS are providing more controlled and reliable water supplies for household needs and more productive agricultural activities in the northeastern hilly regions of India and Nepal. In this region, only 5% of the existing water resources are used for economic activities. A surfeit of water wreaks havoc in the rainy season, while households suffer acute water shortages in the dry season. The impact of MUS on household income and the status of women has been significant.

Management innovation

Most farm households in this region grow rice, millet, corn and a few other crops using a traditional form of agriculture called *Jhum*, also known as slash and burn agriculture. Most people immediately think of the negative environmental impacts of slash and burn agriculture, but one of its main drawbacks is the very low yields. Slash and burn agriculture is also a poverty trap. Farmers would like to grow more vegetables and fruit trees but changing farming practices requires reliable supplies of water.

Several farm-level water management innovations and indigenous practices have been tried in the past, including integrated watershed management, water harvesting, multi-commodity farming systems, bamboo drips, and storing rainwater in plastic-lined ponds or ferro-cement tanks. Some of these methods have found favour among local authorities and policymakers, but most meet only agricultural water needs and even then they generally do not provide sufficient supplies during the dry season.

What smallholder farmers need is a water supply system that provides water for both domestic needs and high-value agricultural production, including livestock. Such a system needs to be flexible so that householders can switch from domestic to productive use to match seasonal demands. It has to be simple with low maintenance costs, and it must ensure equitable access. Such systems are called MUS (Fig 1).

Fig. 1 Meeting domestic water needs is the first priority of MUS

Matching MUS design with user needs

The basic designs for MUS are based on: ground water/lake water lifting and distribution; rainwater collection and distribution; spring water distributed by gravity system; and stream/river water supply after treatment (Fig. 2). Most MUS are designed to cover 10 to 40 households. In some cases, up to 80 households have been provided service from MUS. Design of an MUS accords first priority to drinking

Fig. 2 Jars and ferro-cement lined tanks for intermediate water storage, and is an important element of MUS

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water and domestic use. This is in line with the government's policy on water resources development. The design criteria assume 45 liters per person per day for domestic use, and 400-600 liters per household for productive use. The final design is decided by technicians in consultation with community users based on their local knowledge and stated needs.

Working with local authorities, researchers from the International Water Management Institute (IWMI) and International Development Enterprises (IDE) installed MUS in the hilly regions of Nepal and organized cross-learning programs between the Indian and Nepalese researchers, policymakers and farmers. A water-poverty mapping technique helped identify the best areas to target in the study villages in Nagaland and Sikkim states of India.

An evaluation of the schemes installed showed that they met the key criteria with the added benefit of low initial investment costs (approximately USD 200 per household) and short cost-recovery periods. With MUS, households can earn an additional annual income of about USD 190 through the sale of surplus produce, which means that the system has a payback period of only one year.

The MUS also have many other non-monetary benefits, especially for women. Women are the prime focus groups of all the multiple water use-related project activities. When villages adopt MUS, women generally take up key positions in MUS user committees, empowering them to lead and link with other agencies. The additional income they earn from the sale of vegetables and other produce provides financial independence and enhances financial decision making. MUS also reduces women's workload by decreasing the time needed to collect water (free labor). More vegetable consumption provides better nutrition for women and children, which translates into savings on medical care (Fig. 4).

Fig. 3 A simple, low-cost drip system in Mon, Nagaland

Fig 4. An excellent tomato crop grown with harvested water

Integrated Kitchen Garden, Potato and Poultry Farming for Food Security and Income at Mon, Nagaland

Alemla Ao, Sapu Chankija, N. Savino, L. Diaho, Amod Sharma, K. K. Jha, Pauline Alila, A.K. Singh, N.K. Patra, N.C. Sarkar, Sewak Ram, Medovi Chizo and Chingkai

SASARD, Nagaland University, Nagaland

Introduction

Agriculture (*jhum* cultivation) is the main stay of people of the villages in Mon District, Nagaland. 87% of the population is very poor. Malnutrition prevails in almost every family. Their main employment is agriculture but the field is very far, Therefore, for enhancing the productivity to get nutritional security and income generation, also to utilize the land near the households, kitchen garden concept was introduced including green leafy vegetables, ready to eat vegetables etc.

By knowing the agro-climatic condition and that the villagers popularly grow tuber crops such as tapioca and colocasia, potato was introduced for the first time to get nutrition as well as to generate income and also to use the cultivated *jhum* land after the harvest. The villagers were rearing birds but local breed which is small in size, Therefore, kroiler and vanaraja were introduced for more meat production.

Significance of interventions

1. The intervention could help them to identify the suitable varieties of vegetable crops to be grown in both summer and winter seasons in home yards.
2. It gives them additional nutrition and could earn extra amount which would empower especially the women folk.
3. Potato cultivation would enhance food security and generate additional income.
4. Inclusion of backyard poultry farming would further enhance farmers' income and provide livelihood.

Objectives

To introduce kitchen gardening, potato cultivation and back yard poultry farming for food, nutrition and liveli8hood improvement of rural farmers.

Methodology

Vegetable crops like chilli, bean, raddish, tomato, brinjal etc. were introduced in kitchen garden/homeyards. Potato varieties Kurfi Kanchan, Kurfi, Jyoti, Kurfi Giriraj was introduced, 10-15 t/ha. Application of organic manure was advocated for higher productivity. 10 nos. of broiler birds were distributed to each household.

Results

Following are the results obtained by SASARD, Nagaland University during three years livelihood projects under NAIP-3 in Mon district of Nagaland. The following table 1, 2 & 3 and pictorial depiction (Fig. 1, 2 (a & b) &3) illustrates the growers' condition that was and what they were and are getting now.

Table 1. Cost and returns from kitchen gardening

Particulars	Before	After
House hold, nos	-	120
Vegetable Varieties introduced	Nil	Beans (S. Selection) Tomato (Crystal-451) Chili (1 PHS-21) Radish (Pusao Sweta) Brinjal (Pusa HYB)
Area/HH	-	250 m^2
Production/HH	-	135 kg
Cost of cultivation (Rs/HH)	-	350
Gross Income (Rs/HH)	-	2025
Net income	-	1675
B:C ratio	-	5.78

Fig 1. Happy farmers with their produce through kitchen gardening

Fig 2 (a). Cultivation of potato at Mon

Table 2. Cost and returns from Potato cultivation

Particulars	Before	After
House hold, nos.	Nil	80 HH
Potato variety introduced	Nil	Kurfi Kanchan, Kurfi Jyoti, Kurfi Giriraj
Area/HH	Nil	1000 m^2
Production/HH	-	955
Cost of cultivation (Rs/HH)	-	4000
Gross Income (Rs/HH)	-	9550
Net Income (Rs/HH)	-	5550
B:C ratio	-	2.38

Table 3. Cost and returns from poultry birds

Particulars	Before	After
No of units	500	40
Variety introduced	Local bird	Kroiler
Nos. / Units of Poultry	2890 (whole village)	40 units @10 birds/ unit
Production/yield	X	2.5 kg/bird
Production cost (Rs.)	-	1000/unit
Gross Income (Rs.)		3750/unit
Net income (Rs.)	-	2750/unit

Fig 2 (b). Potato stored in bamboo baskets

Fig 3. Beneficiaries benefitted from poultry rearing at Mon

Discussion

The socio-economic condition of the villages before the project was very poor. Though the impact of NAIP is very clear, still it needs more time for sustainable development. However, the participants, families and community as a whole have benefited a lot. No technologies were made available earlier but through the interventions, awareness created and adoption of suitable technologies are taken up by the farmers. Their acceptance, appreciation and impact of the project is beyond doubt.

Water Harvesting and its Multiple Use for Enhancing Productivity and Livelihood in Mon, Nagaland

B. Sahoo, Moanaro and M. Krose
ICAR Research Complex for NEH Region, Nagaland Centre, Jharnapani, Nagaland

Introduction

In the NEH Region, scarcity of water particularly during the lean season is a major constraint in increasing the cropping intensity and its productivity. Due to the hilly terrain, the rain water is lost either in the form of surface water or quick sub-surface runoff leading to low soil moisture status and acute water scarcity for domestic agricultural consumption during the rainy season. By and large, monocropping is therefore, prevalent in the region. However, wherever water is available, farmers opt for second cropping. Keeping this fact in view, an attempt has been made to harvest water so as to make its judicious use for cultivation of the crops, fishery and livestock in an integrated manner.

Rationale

In Lampong Sheanghah village where the project intervention is taken place about 90% of the farmers were below poverty line as per their socio economic status. Nevertheless, agriculture is the main source of subsistence. Only upland crops were cultivated in the target area before the intervention. Upland paddy, fox tail millet, colocasia, tapioca and some seasonal vegetables were mainly cultivated by the villagers. The average productivity of rice was recorded as1.02 t/ha in *Jhum* fields. Since water harvesting structures were not available in the village, the possibility of fish rearing was ruled out. As per the baseline survey, a total of 46 nos. of non-descript type of pigs were being reared with daily weight gain of 42.5 ± 2.3 g/day. (A total of 31 nos. of goats were also being reared before intervention in the village.)

Objectives

Harvesting rainwater from roof, spring etc for life saving irrigation and multiple use to improve the livelihood of the small and marginal farmers.

Methodology

Two nos. of hillocks were selected for implementation of the activity in three-tier system. For restoration, agroforestry block was developed on both the hill tops followed by horticulture in the middle of the hillock and terracing in the lower part of the hillocks. Water was diverted from the stream through irrigation channel (Fig 1), pipes and conserved in six nos. of water harvesting structures which was used for irrigating the crops particularly during the lean season, and for fishery and livestock

Fig 1. Spring water and base flow harvesting in series of tanks

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consumption. Roof top rainwater harvesting (Fig 2) structure was also designed, fabricated and installed specially to ensure the drinking water supply during the scarcity period. A low cost modified thai jar (Fig 3) has been designed, fabricated and constructed for promoting multiple water use in Lampong shenghah village. A pig unit (2 piglets for fattening) was also integrated with small scale quaculture.

Fig 2. Roof water harvesting from church for multiple use

Fig 3. Modified Thai jar for multiple water use

Results

- The crop productivity, particularly of rice has increased by two-folds as compared to the productivity of indigenous landrace having the productivity of 2 ton/ha (Table 1).
- Various off -season vegetables viz. radish, French bean, carrot, coriander etc. are being grown with limited irrigation facilities.
- The improved germplasm of livestock, particularly of pig, was introduced in the village and the growth performance was recorded to be 156±10.2 g/day as compared to the productivity of nondescript type of pigs, i.e. 42.5±2.3 g/day.
- Integrated fish farming (fish-cum-pig) was introduced in the village. Three exotic carps and three Indian carps species were reared and the fish productivity was recorded to be 1.4 ton/ha.
- Efforts have been made for recycling of within farm renewable resources.
- The technologies available for the Institute pertaining to recycling of the water and integrated farming system mode of food production was used for multiple livelihood option based on the water resource-based.
- Efforts have been made for recharge of the spring water flow r by planting multipurpose tree (MPTs) on abandoned *Jhum* field (Fig 4).

Fig 4. Multipurpose tree species planted on hill slopes for recharging spring water flow

Table 1. Production and economics of crop-fish-pig multiple system

Particulars	Before	After
No. of Household	35	65
Variety introduced	Local variety	Kurfi Jyoti, Arka Komal, Japanese White, Pusa Kesar.
Area (m2)	858.4	858.4
Nos./Units of animals	nil	one unit
Production	Beans -5.2 t (6.06t/ha)	Crops: French bean-0.95 t, potato-6.04 t, Radish -3.1 t, Carrot-0.12 t, Tomato- 0.72 t, Coriander-0.06 t., Total crops; 10.9 t (12.t/ha), Pig: 144 kg and Fish : 62.3 kg
Increase of production	-	109 % (Crops)
Cost of production	Rs 30,000	French bean- Rs. 4,375, potato - Rs. 29,625, Radish - Rs.1,675, Carrot - Rs.1,145, Tomato - Rs.1,150, Coriander - Rs.755, piggery- Rs. 7,500, and Fishery - Rs. 9,426, Total :Rs. 55651
Gross income	Rs.52,000	French bean – Rs. 19,000, potato – Rs. 1,20,760, Radish - Rs.3,100, Carrot - Rs. 5,265, Tomato - Rs.36,000, Coriander - Rs.3,00,00, Piggery- 12,000, & Fishery - Rs. 6,232, Total: 2,32,357
Net income	Rs. 22,000/-	Rs.1,76,706
Income enhancement	-	703 %.
Employment enhancement	**-**	***65 %***

Discussion

Since shifting cultivation was the mainstay of economy of the villagers before implementation of the project, the concept of water harvesting and its multiple use was new to them. During the implementation of the project, major thrust was given for water harvesting and its multiple use based on the lessons learnt from the past. The net monetary income of the farmers has increased significantly with the present intervention. It has open up a new avenue for increasing production and productivity not only in the target area but also in other villages of Mon district of Nagaland.

Impact

- The stake holders have gained the needful employment, food and nutritional security besides income generation with the present intervention. Integrated fish farming is becoming very much popular and farmers are trying to integrate fishery with poultry and even with cattle.
- Efforts are being made by the student union of the target area to conserve the forested areas so as to recharge the streams, which otherwise was not being followed by them before implementation of NAIP programme.

Sustainability

- Training has been imparted to the stake holders for integrated fish farming, winter vegetable cultivation and animal husbandry. Hence, local bodies have been developed to sustain the programme.
- Quality seed and planting material is being multiplied at the village level so as to make it available to other beneficiaries also.
- Quality germplasm of the livestock, i.e. Large Black pig have been introduced for increase production and integration with fishery.
- To sustain the fishery programme in the village, state government has been requested to establish either eco hatchery or to provide the fish fingerlings to the beneficiaries for sustainability of the project.

Terracing for *Panikheti* Based Farming System for Food Security and Livelihood in Mon, Nagaland

B. Sahoo. B.P. Bhatt, Moanaro and M. Krose
ICAR Research Complex for NEH Region, Nagaland Centre, Jharnapani, Nagaland

Introduction

Monocropping was practiced in the village before intervention (Fig 1) for terrace and upland paddy. Indigenous landrace, foxtail millet, colocasia, Tapioca and some seasonal vegetables were grown by the farmers in the *Jhum* fields. The productivity of upland paddy was found to be less than 1 ton/ha, likewise productivity of colocasia, tapioca, foxtail millet was recorded to be 5.97, 21.80 and 1.37 t/ha, respectively. In case of livestock, the non – descript type of pigs were reared in the village besides some goats. Prior to implementation of the project, PRA exercise was carried out besides frequent interaction with the villagers. Almost all the SHGs suggested for creating the facilities for wet-terrace cultivation (*panikheti*).

Rationale

Through wet land terrace cultivation, we intent to increase not only the rice productivity but also to introduce second cropping which otherwise were not followed by the stakeholders. The complementary role of livestock, fishery, and forestry was also proposed to harness not only to increase the food production but also to provide nutritional security to the farmers for round the year employment through agricultural practices.

Fig 1. The view of the hill slope before intervention

Objective

To harvest rain water in terraces for rice cultivation and enhance cropping intensity by cultivating *rabi* crops with conserved residual soil moisture.

Methodology

Terracing was followed in the lower part of the hillock with slope less than 30%. All the terraces were made at a vertical interval of 1m keeping intact the topmost soil there. Irrigation channels were prepared to divert water from the streams to rice field. Tomato, French bean, carrot, radish, potato and coriander are being cultivated during the winter season with limited assured irrigation facilities. For nutrient management, a thick row of leguminous hedgerow species like *Tephrosia candida* and *Crotolaria* spp were planted and the green biomass was mulched into the terraces (Fig 2). Farm pond for water harvesting, aquaculture was dug out adjacent to terraces and one unit piggery (2 no) integrated for effective utilization and recycling of on-farm resources.

Results

- The *panikheti* based IFS model demonstrated in farmers field has been depicted in Fig 3.
- Institute developed rice varieties – Shahsarang and Lampnah were cultivated which showed the productivity enhancement by 3-fold as compared to the indigenous landraces, i.e. Rakchu having the productivity of 1.2 tone/ha in wetland condition.

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Fig. 2 Hedgerow plantation on terrace risers for soil fertility management

- The cropping intensity which was recorded 104% before the intervention has increased to 146% after intervention.
- Before intervention, only upland paddy, colocasia, tapioca and fox tail millet were grown indicating the symptoms of malnutrition. However, the nutritional security was achieved at the household level only after introduction of *panikheti* system of cultivation.
- Beneficiaries have been identified for seed multiplication programme of paddy, French bean and potato.
- Efforts are being made to recharge the springs in order to obtain the perennial flow for wet land cultivation.
- Some of the villagers are making terraces on their own for sustained production.

Discussion

It has been observed that once the irrigation facilities are assured, farmers are ready to take up the second crop. Water harvesting offers the opportunities for integration of livestock and fisheries and the wet land cultivation shall be

Fig 3. The view of the IFS site after intervention

Table 1. Production and economics of *Panikheti* based IFS in Mon, Nagaland

Particulars	Before	After
House hold, nos:	01	09
Variety introduced:	Indigenous landrace- Rakchu	Lampanah and Shasharang
Area (ha)	Rice : 0.5 ha.	
Nos./Units of animals:	-	Rice : 4.9 ha (*Kharif*), Vegetables: 1 ha only (*Rabi)* Pig -02 nos, integrated with fishery
Production	Rice : 240 kg Pig/fish :Not integrated before intervention	Rice : 16,610 kg Vegetable: 6,000 kg Pig: 190 kg Fishery: 67.5 kg
Productivity enhancement, %		6821.25% (Rice)
Cost of production	Rs. 10,000/ha (Rice).	Rice: Rs. 71,050 Vegetables: Rs.19,000 Pig: Rs. 12,000 Fishery: Rs. 2,500 Total: Rs. 1,04,500
Gross income:	Rs. 2400	Rice: Rs.1,66,110 Vegetables: Rs.42,000 Pig: Rs. 19,000 Fishery: 6,750 Total :Rs.23,3860 (Rs. 47, 726/ha)
Net income	Rs.400	Rice : Rs. 95,060 Vegetables: Rs.23,000 Pig: Rs. 7,000 Fishery: Rs. 4,250 Total:1,29,310 (Rs. 26,390/ha)
Income enhancement, %:	-	984 %
Employment enhancement, %:	-	264 %

converted into farming system mode of food production. Farmers are cultivating their second crop in large scale which was not practiced before.

Impact

Terracing and assured irrigation has provided the opportunity to the beneficiaries for round the year cultivation. All the beneficiaries are also interested to increase the area under wet land terrace cultivation. The beneficiaries having terraces have significantly stopped the shifting cultivation to a great extent and a small area is being cultivated under *Jhum* by them for cultivation of some tuber crops like colocasia and tapioca, spices, sesamum and fox tail millet. Terracing is gaining popularity among the other farmers of the village and important nutritional rich crops are being cultivated by them.

Sustainability

- Stake holders are multiplying the quality seed material for transplanting of paddy.
- The seed material of the vegetables like French bean and paddy, are being multiplied by some of stakeholders in order to make it available for their uses.
- The upper catchment area is being rehabilitated by planting MPTs particularly for recharge of the spring.
- Due to integration of cereals, vegetables, livestock and fishery, there is year round employment and income to the farmers.
- Shifting cultivation has been stopped in the upper catchment of the terraced area.
- Nitrogen fixing and fast growing species like *Sesbania susben*, *Tephrosia candida* and *Crotoleria* are being planted on the field for soil fertility build up.
- Due care is being taken for insect and pests management.

Integrated Community-Based Service Delivery System for Small holders Piggery Development

R. Deka and I. Wright
International Livestock Research Institute (ILRI), South Asia Delhi Office, NASC Complex, New Delhi

Introduction

Pigs are the most common and preferred livestock species in Mon district of Nagaland. Almost 80% of households rear pigs (mostly 1 or 2 pigs), mainly for fattening purpose. The production system in the villages is very traditional, mainly based on indigenous breeds. Feeding systems are mainly based on jungle forages and kitchen waste. Housing systems are poor and unhygienic. In many areas access to veterinary services and improved farm inputs is almost nil or negligible. Pig producers have traditional knowledge and skills for management of pigs for fattening but few have the skills to successfully breed pigs. There has been no concerted effort to improve the pig production system in the project villages, leaving the whole system traditional and poorly remunerative. The poor production systems have largely failed to meet the market requirement and to deliver livelihood benefits to the majority of people. But market demand for pig meat is high, offering good scope to improve the systems and discussions with the local communities highlighted their eagerness to improve the production and marketing of pigs to improve their livelihoods.

Under the circumstances of poor financial resources to invest in the farming system, poor breed quality, labour constraints, unavailability of required feed resources and poor access to veterinary services, rapid transformation of the low-input, low-output system to a high –input, high-output system is not technically feasible nor economically viable within a short span of time. Therefore an integrated community based approach is needed to bring about incremental changes in the production system to improve productivity and efficiency. The critical need is to identify locally relevant and socially acceptable simple, cost effective interventions that best fit to the local context. The first step is to bring about attitudinal change in the mindset of the people through motivation and capacity building of the community. Strengthening of local social institutions and use of the same for putting peer pressure and for service delivery is another way forward to make the approach a success.

Interventions need to be simple, cost effective, fully community driven and highly remunerative.

Rationale

The primary source of livelihood for the people of the project villages in Mon is agriculture, mainly cultivation of rice, millet, fruits, vegetables etc. in the *Jhum* fields (slash and burn). Apart from crop cultivation, rearing of livestock especially pigs and backyard poultry, collection of fire wood, petty trading and wage labouring are secondary sources of income. Because of land fragmentation and shortening of the *Jhum*ing cycle, production & productivity of the land is gradually decreasing and villagers can hardly meet year-round requirement for staple foods from the produce of *Jhum* fields. For 3-4 months a year, they face severe food shortages and depend on non-conventional food resources like tapioca, colocacia etc. as staples. Despite poor productivity of livestock, especially pigs and poultry, the contribution of livestock to livelihoods is well recognized by the villagers because of the savings & insurance function. Indigenous pigs take about 3-4 years to achieve market weight (70-80 kg) while cross bred pigs take only 8-10 months to achieve the same weight. Selling an indigenous pig can earn Rs. 8000-10000 in three ears time, while the same amount could be earned in only one year by rearing an improved pig under improved management conditions. Income could be further increased by changing the fattening herd (to produce slaughter pigs) to a breeding herd (to produce piglets). One sow gives at least 1 farrowing per years and if 10 piglets are produced per farrowing one can earn Rs.20,000 by selling 10 piglets at Rs.2,000 piglet.

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Objectives

1. Transformation of the subsistence pig production system to a market-oriented production system through promotion of a locally suitable, innovative package of practices for increasing the productivity of smallholder pig production systems.
2. Adoption of community driven approaches that are affordable and accessible in order to ensure sustainability and self replicability.

Methodology

- ➢ Pig production and marketing systems in the project villages were assessed through participatory discussions with the community members. The need, expectation, interest and availability of resources of the community members were also assessed at the beginning of the project.
- ➢ Local best practices were identified, assessed and suitable technologies/interventions were identified in consultation with the local community members keeping in view the available financial resources and access to farm inputs, services and markets.
- ➢ Self Help Groups (SHGs) were established.
- ➢ A sensitisation programme was launched involving the local decision makers like Pastor, Chairman- Village Council, Students' body etc. It was made clear to community members that except for the capacity building programmes and some critical farm input (like piglets, planting materials of food-feed crops) all other inputs like feeding, management, construction of shed have to come from the pig producers voluntarily.
- ➢ Knowledge gaps and training need of the target group were assesed in consultation with the target beneficiaries and customized training on veterinary First Aid and Smallholder Pig Production & Management were designed and delivered. All training programmes had refresher courses after 4-5 months.
- ➢ The Hands-on-Gift Scheme was explained the SHG members and members were asked to identify the best pig producers amongst them as the first-line beneficiaries. Only the first line beneficiaries received assistance from the project in the form of improved piglets, with the pre-condition that after the first farrowing they would give one or two piglets to one or two down line beneficiaries in the SHG. SHG members were also asked to select the down line beneficiaries under each first line beneficiaries in advance in order to build the system of peer pressure.
- ➢ A system of veterinary service delivery was established by training two community-selected persons on Veterinary First Aid for pigs in each project village. After the training they were provided with a First Aid kit with all required medicine and utensils. They were also linked to government veterinary doctors, medicine suppliers, feed suppliers etc. They are provided with a small initial honorarium and encouraged to recover costs from their clients.
- ➢ The community was mobilized to invest their own resources and time for construction of pig stys, drainage systems and manure pits, cultivation of food-feed crops and to maintain clean & hygiene practices**.** They were provided with an initial supply of detergent an disinfectant.
- ➢ After building the capacity of community members, putting the veterinary service delivery system in place and completion of construction/ renovation of pig stys, each first line SHG member was provided with one good quality cross bred piglet (5 females and 1 male piglet to each SHG) to rear under improved conditions. Along with each piglet, 5 kg of concentrate feed was also offered to ensure a good initial level of nutrition.
- ➢ All first line beneficiaries were asked to cultivate food-feed crops like sweet potato, tapioca, colocacia, maize etc. as mixed crop in the backyard. ILRI collected and provided improved varieties of planting materials from several national and international organizations. Pig producers were provided with advice and guidance on the cultivation of the crops.
- ➢ Market linkages were created by organizing a Buyers-Sellers meet in the villages where all the relevant stakeholders like pig retailers, piglet traders, feed seller, medicine sellers, veterinary doctors attended.
- ➢ The First Aid Practitioners monitored and followed up the project activities and outputs with support from the project staff.

Results

Particulars	Results	
	Before the project interventions	**After the project interventions**
Households rearing pigs for breeding purpose (for piglet production)	2 households	34 households
Interest, knowledge and confidence of the community members to rear breeding herd	Very poor	Confident
Availability of good quality cross bred piglets	Unavailable	Available
Households with cross bred pigs	4 households	34 households
Households with food-feed crop cultivation in the backyard	Nil	34 households
Households with improved housing	4 households	34 households
No. of Veterinary First Aid practitioner in the village	Nil	4 practitioners
Access to veterinary medicine, vaccine	Absent	Available
Practice of cleaning pig stys, utensils, pigs etc. & hygienic disposal farm manure	Absent	Present
Mortality of pigs	10-20%	Nil
Hands on Gift scheme	No history	Successful
Component	**Before**	**After**
Households with breeding pig herd	2	34
Households with improved pigs	4	34
No. of units	34	34
Increase in production	30 kg/ annum or 4-8 piglets/ farrowing	70 kg/ annum or 8-11piglets/ farrowing
Cost of production	Rs. 1,000	Rs.3263
Gross Income:	Rs. 4,000	Rs. 20,000
Net Income	Rs. 3,000	Rs. 16,737
Income enhancement		557%
Employment enhancement		6 %

Impact

- ➢ Increased interest on pig keeping, especially for breeding purpose.
- ➢ Men were less involved in management of pigs but now they have become more interested.
- ➢ Earlier villagers used to ask for a day wage for attending training programmes but now they attend the training programmes with no request for payment, even at the cost of day wage under NREGA programme.
- ➢ Changed perception that cross bred pigs would not survive in their villages,
- ➢ Adoption of clean and hygiene practices in the pig sty have become an essential part of their daily work.
- ➢ Cultivation of food feed crops and construction of pig sty (as suggested under the project) become a priority for them. Learned the importance of feeding different feed ingredients for better productivity.

- ➢ Learned the importance of feeding a little concentrate feed along with vitamins and minerals.
- ➢ Learned about the importance of vaccination, deworming and quarantine measure to prevent diseases.
- ➢ Demonstrated activities are affordable and accessible to the community.
- ➢ Improved system is cost effective and does not put any additional burden on exiting household labour and feed resources.
- ➢ Increase in income from piggery by 557% compared to farmers practice

Steps for sustainability

- ➢ Involved community members in the decision making process and identification of beneficiaries.
- ➢ Promoted only those activities which are affordable and accessible to the community.
- ➢ Ensure market demand to stimulate interest in improving productivity.
- ➢ Built ownership of the beneficiaries by motivating them to invest on housing, feeding and healthcare management.
- ➢ Built peer pressure within the community by introducing Hands in Gift scheme (assisting only a section of the SHG members considered as first line beneficiary. Benefit to second line beneficiary depends on the performance of the first line beneficiary).
- ➢ Developed a community based service delivery system through promoting Veterinary First Aid practitioners & creating linkages of them with all relevant stakeholders for service delivery. Encouraging First Aid Practitioners to recover costs.

Integrated community based pig farming system is a successful model which needs to be up scaled in other disadvantaged areas for livelihood improvement of small and marginal farmers.

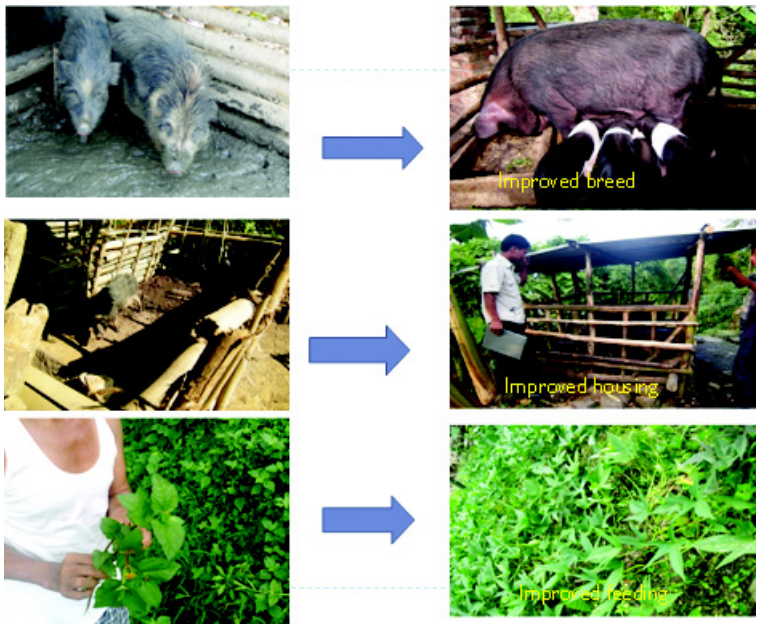

Fig 1. Transformation of subsistence production system to market oriented production system

Fish-cum-Livestock Based Integrated Farming System for Livelihood Improvement of *Jhum* Farmers in Daporijo, Arunachal Pradesh

V.K. Choudhary[1], P. Suresh Kumar[1], M. Kanwat[2], M.S. Boruah[2] and R. Bhagawati[1]
[1]ICAR Research Complex for NEH Region, Arunachal Pradesh Centre, Basar, Arunachal Pradesh
[2]Krishi Vigyan Kendra, West Siang District (ICAR), Basar, Arunachal Pradesh

Introduction

Farmers of the Daporijo, Arunachal Pradesh has been practicing *Jhum* farming from time immemorial. In the *Jhum* field generally they grow as many crops as possible to meet their daily demand. However, hardly they integrated *Jhum* farming with aquaculture and livestocks. In the valley lands of *Jhum* fields farmers can go for digging ponds or the ponds can be made by making dykes in one or two sides due to natural hillocks in other sides. Such ponds can be brought under composite pisciculture and may be integrated with livestocks like pigs, poultry etc as per the demand of the farmers. Mrs. Yalom Lida is one among the farmers who was willing to think in the way of integrated farming system.

Rationale

Integration of *Jhum* farming with fishery and livestock would enhance farmers' income and employment beside effectively utilizing the land and improving food and nutritional security of tribal farmers.

Methodology

Mrs. Yalom Lida of Lida village of Gusar circle of Daporijo district of Arunachal Pradesh had land area of 1.2 ha under *Jhum* and her earnings were just enough to feed her family. Considering the potentiality of fish farming she developed a fish unit on her farm, but the pond remained underutilized.

Under NAIP intervention it was targeted to convert her *Jhum* land to settled cultivation by integrating livestock and crops with fish farming. Before starting the IFS activity she was provided trainings at ICAR, Basar. Due to her exposure to practical trainings and demonstrations on IFS, she gained confidence and adopted the technology. The pond was renovated during dry season and some terraces were constructed at mid hill slopes, while keeping forest area intact on top hills. From the forest area water was diverted to her field by forming ditches. Low cost pig shed and poultry units were constructed on the pond dyke and the poultry droppings and pig shed washing were diverted to fish pond to promote growth of zoo plankton and phyto-plankton to serve as fish feed. Additional pig excreta were collected in a near by pit and composted for manuring vegetables. Similarly, the waste of vegetables was used as feed for the pig. Damaged and low quality maize seeds were used as feed for poultry. Farmers also brought their kitchen waste for feeding pigs and poultry.

Results

With her own cultivation practices she was harvesting the cereals (1.14t/ha), vegetables (3.45 t/ha) and tuber crops (5 t/ha) with the respective area given in table. The total return from her traditional way of cultivation was Rs. 13896/- only. However, after integrating the various components she has increased her production and productivity of cereals by 2.71t/ha, vegetables 5.25 t/ha and started earning Rs. 73, 800/- from the above said area and components. She mostly earned the said amount from livestock and fish. By seeing the performance and profit of animal components she is now converting her agricultural land to fish pond. The basic data are given in table 1 and 2.

Another farmer Mr. Pugo Digbak of Digbak village is a beneficiary of the activity. He has the *Jhum* area of 1.0 ha and wet land of 1.5 ha. Before implementing IFS he was growing more no. of crops on *Jhum* and rice on wet land. After getting exposed with trainings at ICAR Basar, he was

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Fig. 1. a) Integration of fruit-fish–pig, b) Integration of fish –pig-poultry, c) Monitoring of poultry unit and d) Integration of crop

Table 1. Production and economics of activity site

Components	Area (ha)	Production (kg)	Cost (Rs)	Gross income (Rs)	Net income (Rs)	B:C ratio
Before						
Cereals	0.70	800	5,500	9,500	4,000	0.42
Vegetables	0.40	1380	6,500	12,500	6,000	0.92
Tubers*	0.10	5000	3,000	6,896	3,896	1.30
Total	1.20		15,000	28,896	13,896	
After						
Cereals**	0.70	1900	6,000	13,200	7,200	1.20
Vegetables	0.40	2100	9,000	21,000	12,000	1.33
Tuber crops	0.10	5000	3,000	-	-	
Poultry***	10 x5 (0.005)	240	10,500	28,800	18,300	1.74
Pig***	10 x 3 (0.003)	200	12,400	32,000	19,600	1.58
Fish	30 x 15 m (0.045)	252	8,500	25,200	16,700	1.96
Total	˜1.20		49,400	1,20,200	73,800	

* Tuber crops (*colocasia* and tapioca) were used for livestock feed instead of selling.
**Cereal mostly maize was used as feed for livestock
*** Pig and poultry were given place pond embankment

Table 2: Economic assessment of fish cum livestock based farming system

Particulars	Before	After
Cost of cultivation (Rs/ha)	12,500	41,160*
Gross return (Rs/ha)	24,080	1,00,160
Net return (Rs/ha)	11,580	61,500
Additional income (Rs/ha)	-	49,920
B:C ratio	0.93	1.49
Man days required (man-days/ha/year)	220	405
Employment enhancement (%)	-	84.1
Cropping intensity (%)	100	250
Land use (days)	260	340
Land use efficiency (land use/365) (%)	71.2	93.1

*cost of cultivation includes construction of poultry and pig shed

confident to take up the activity on his land with possible integration. As his farm is away from home, he was not convinced to integrate livestock because of the unavailability of labour and possibility of theft. Therefore, he kept the livestock like pig and poultry on his home and crops on field. Manures were recycled to field after composting at site. The cost of cultivation was Rs. 13,000/- before and Rs. 21000/- after imposing the activity. The cost includes construction of poultry and pig shed. Before integration his earning was about Rs. 16,100/ annum/ha but after integration his earnings increased to Rs. 39,000/annum/ha. The B: C was 1.24 before and 1.86 after the activity. By integrating the livestock and by growing sequential crops he used his family labour throughout the year. Neighboring farmers were also convinced by seeing the performance of Mr. Pugo and hopefully they will also integrate the components in best possible manner.

Farmers Innovation

Water was collected from the spring sources, she placed stones to avoid the loss of water from sources and made the channel to collect the water from small spring sources and collected water was diverted to field by forming shallow ditches. She has distributed the water throughout the field by covering almost all the components. Hence, she was getting the water throughout the year.

Impact of the activity

By seeing the performance of integration of the various components on unit area and by judicious use of resources of farm more farmers are enthusiastic to take up the activity on their respective field. But the real impact yet to see.

Steps for sustainability

- Group meetings and trainings were given to the farmers and explained about the advantages of integrated farming system.
- The farmers were trained on seed conservation of HYVs of different crops for next season.
- Farmers were trained about preparation of low cost feed for livestock and judicious use of resources available at site.
- Farmers were advised to grow the sequential crops on their land to harvest additional crops.
- They were also advocated to follow the soil and water conservation measures on their land wherever possible. It was advised to include leguminous crops at least once in two year for maintaining soil fertility.
- Suggested to utilize the free flowing water from nearby area by growing sequential high value crops (vegetables) and also for livestock unit.

Soil Conservation and Cropping System for Sustainable *jhum* Farming in Daporijo, Arunachal Pradesh

V.K. Choudhary and R. Bhagawati
ICAR Research Complex for NEH Region, Arunachal Pradesh Centre, Basar, Arunachal Pradesh

Introduction

Daporijo district is one of the most disadvantageous areas in Arunachal Pradesh. The farmers here do not have much of livelihood options other than the agriculture, but the productivity of most of the crops is lower than the state and national average. There are three different land forms those are *jhum*, wet land and terrace land. Out of these most of the farmers go for *jhum* cultivation and they grow the crops as per their household requirements by selecting traditional local varieties. The uses of foreign varieties (HYVs and hybrids) are considerably low in this area. Therefore, the *jhum* area is targeted due to the importance of this as the way of life for them. Mr. Tapuk Digbak is one of the *jhum* growers who hardly take crops during rainy season without following any row proportion and topo sequencing. Therefore, soil and water erosion and productivity was low in his *jhum* area. Keeping all these problems in mind *Jhum* improvement activity was initiated in his *jhum* land (Fig 1).

Methodology

For developing sustainable *jhum* farming model the field of Sri Tapuk Digbak, of Digbak village,

Fig 1. ***jhum*** **field before intervention**

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Daporijo, Arunachal Pradesh was selected. The family size of Mr. Digbak was five and land holding was 2.55 ha. Out of his land 2.05 ha is *jhum* land and 0.50 ha is wet land. The *jhum* land was targeted for developing sustainable land use model under NAIP-3. Improved varieties of cereals, pulses, oilseeds and vegetables were included in the system with appropriate soil and water conservation measures such as mulching, contour planting, cover cropping etc.

The residues of crops and weeds were used for mulching. Across the slope planting was advocated instead of along the slope as practiced by the farmers. The top hill portion was kept under intact forest for enhancing water infiltration to recharge water level in down hills. In-situ nutrient management in *jhum* by composting weed biomass and field waste on farm pit and recycled to crop plant

Fig 2 a. Contour bunding, b. grasses across the slope for soil and moisture conservation in *jhum* fields

Fig 3 a. Cereals + vegetables across the slopes, b. crops in topo-sequence in *jhum*

Results

Before intervention of ICAR, the farmers was using almost 88% local seeds, whereas, after intervention it reduced to 30% only (Fig 4).

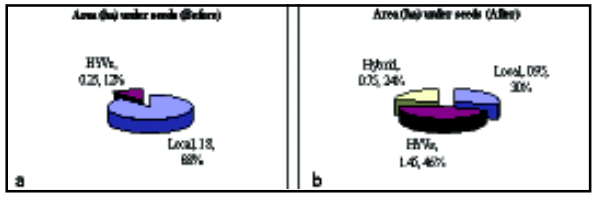

Fig 4. Use of different kinds of seeds in *jhum* land a) before and b) after

Another farmer Mrs. Yapu Riddi is a farmer of Riddi village. Before implementing the activity on here *Jhum* land she was earning only Rs 17,400/- annum and she was keeping her land fallow after

Table 1. Area, production & productivity of different crops from *jhum* land

Name of crops	Area (ha)	Production (tones)		Productivity (tones/ha)	
		Before	After	Before	After
Cereal					
Rice	0.70	0.77	1.12	1.10	1.60
Maize	0.30	0.48	0.73	1.60	2.42
Pulses					
Black gram	0.15	-	0.10	-	0.67
Frenchbean	0.15	-	0.93	-	6.20
Pea	0.30	-	0.38	-	1.28
Soybean	0.25	-	0.18	-	0.72
Oilseeds					
Sesame	0.10	0.02	0.04	0.22	0.40
Vegetables					
Okra	0.30 (0.15 M and 0.15 PM)	0.75	2.34	5.00	7.80
Tomato	0.15	0.90	1.61	6.00	10.70
Brinjal	0.10	0.55	0.76	5.50	7.60
Chilli	0.20 (0.1M and 0.1PM)	0.19	0.56	1.90	2.80
Cucurbits					
Pumpkin	0.10	1.20	1.58	12.00	15.80
Cucumber	0.10	0.53	0.74	5.30	7.40
Ridge gourd	0.10	0.47	0.68	4.70	6.80
Bitter gourd	0.10	0.21	0.34	2.10	3.40
Ash gourd	0.05	0.52	0.73	10.40	14.50

- M: monsoon, PM: post monsoon
- 0.95 ha area is under second crop (0.15 ha frenchbean, 0.30 ha pea and 0.25 ha soybean, 0.1 ha chilli and 0.15 ha okra)
- Total area under cultivation before intervention was 2.05 ha and after gross cultivation area increased up to 3.15 ha.

Table 2. Economic assessment of *jhum* cultivation

Particulars	Before	After
Total area (ha)	2.05 (monsoon)	3.15 (monsoon and post monsoon)
Cost of cultivation (Rs/ha)	12,195 (25000)*	14,127 (44500)
Gross return (Rs/ha)	19,512 (40000)	40,120 (126377)
Net return (Rs/ha)	7,317	25,993
Additional income (Rs/ha)	-	20557
B:C ratio	0.60	1.46
Area under cultivation during post rainy season (ha)	-	0.95
Man days required (man-days/ha/year)	230	315
Employment generation (%)	-	37.0
Cropping intensity (%)	100.0	153.6
Land use (days)	210	330
Land use efficiency (land use/365) (%)	58.30	90.40

*Figures in parenthesis are from total area

- Increase in cost of cultivation is due to more labour, high seed requirement, use of agrochemicals etc.
- Land used: 32.1% more

Fig 5. Scientist with *jhum* farmer Mrs. Yapu Riddi

harvesting of rainy season crop. She was doing nothing after the crop harvest. But once after the intervention the activity on *Jhum* land improved her earning about (Rs.67787/annum) with B: C ratio of 2.42, was engaged in farm activity for about 39.9% more (263 man-days/annum from 188 man-days/annum). Her personal experience is that during fallow period land was infested by weeds but by growing sequential crops weed population was reduced with additional crop and the yield of rainy season crops also increase because of improvement of soil health. The land use was increased about 82.2% (300 days). Other farmers should fallow the improved practice and earn even more than the Mrs. Yapu Riddi, there are great possibilities to use the natural resources in judicious manner.

Steps for sustainability

- Group meetings were conducted and convinced the farmers about the advantages of the improved *Jhum* cultivation including beneficiary.
- Adequate trainings were conducted to build their confidence and demonstrated the technologies in research farm and field of progressive farmers.
- The farmers were trained on seed conservation of HYVs of different crops for next season.
- Farmers were advised to grow the sequential crops on their *Jhum* land to harvest some more crops and also suggested to select leguminous crops with high vegetative growth, so that fertility of *Jhum* site improved along with reduction in weed growth and proper soil and moisture conservation.

Year Round Vegetables Production under Polyhouse for enhanced productivity and income in Upper Subansiri, Arunachal Pradesh

Rupankar Bhagawati and P. Suresh Kumar
ICAR Research Complex for NEH Region, Arunachal Pradesh Centre, Basar, Arunachal Pradesh

Introduction

Utilization of land effectively by growing assorted vegetables all through the year will increase the farm income and sustain the soil health. Unevenly distributed and heavy rainfall in the Lenyi and Digbak villages of Upper Subansiri hindering the farmers to take sequential crop after rice. Farmers normally cultivate rice as mono crop in single season and keep the land fallow rest of the year. The rice grown will be sufficient only to the farmers need. As the population in majority is the non-vegetarian grows vegetable in the backyard to meet the home need. They never realized the fact that huge amount of vegetables are coming to market from other nearby states like Assam, Meghalaya & other districts of Arunachal Pradesh.

Rationale

Low cost polyhouse technology will increase the farm income by growing vegetables round the year. The microclimate can be manipulated by covering the crops with polyethylene. This shelter provides opportunity to schedule the production programme as per grower need.

Objectives

1. To demonstrate the poly house technology FOR raising vegetables throughout the year.
2. Demonstrating the scientific cultivation practices for various vegetables to generate year round income.

Methodology

The Project was sanctioned during Feb 2009. Thereafter series of exposure visits, trainings were conducted to interested farmers to sensitize them about the technology and created awareness about the easy avenue of income generation during off season. One to one contact and group meetings were organized in their villages and home to make them friendly with the project. The technology was then given to chosen farmers. In the first phase the technology was given to two farmers namely M.Yinyo of Belo village and Mrs. Yella Reddi of Lenyi village. Accordingly procurement of critical inputs like polythene, vegetable seeds was distributed to them. Skilled labourers who know the construction of low cost polyhouse were involved during construction and they taught the

Fig. Cultivation of vegetables under poly house

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others the nuances of this simple technology. Likewise, after seeing success, two other low cost polyhouse were constructed in the farmer's field (Mr. Potam Digbak & Mr. Yapa Digbak) of the project site.

Results

Due to adoption of low cot poly house cultivation, farmer is getting year round income. The productivity of crops also enhanced substantially. The net income from a single poly house (100 m2) was Rs. 11,125 in a single year compared to hardly about 750 from open cultivation (Table 1).

Discussion

Year round production of vegetables under polyhouse is the great and simple technology in the high rainfall zone areas where growing second crop in the open field is very difficult. However, as the farmers are mostly poor, subsidies may be given to the farmers who are interested in adoption of this technology. As polyhouse is the costly business, growing crops under huge area is pre-requisite to get the yield advantage all through the year and making profit. Impact is very positive and overwhelming. Many farmers are coming forward to adopt this technology.

Sustainability

Policy interventions, creating markets, easy availability of all the critical inputs are essential to sustain this technology in the long run.

Table 1. Economics of vegetable cultivation in low cost poly house

Particulars	Before	After
No of house holds	0	4
Variety introduced	Chilli (local)	Chilli (Tejawini), French bean (Anupam), Cabbage (Rare ball)
Area	-	100 m^2/poly huse
Production	Chilli (82.75 kg/100 m^2) of green chilli	Chilli: 132.4 kg/100 m^2, French bean: 64 kg/100 m^2, Cabbage: 150 kg/100 m^2
Increase in production		The increase in production was observed in absolute terms. As the crop rotation and sequential cropping is new technology to the farmers expressing the yield increase will give wrong data.
Cost of cultivation	Rs. 1,050/100 m^2	Rs. 16,500/100 m^2
Gross income	Rs. 1800/100 m^2	Rs. 27,625/100 m^2
Net income	Rs. 750/100 m^2	Rs. 11125/100 m^2
Income enhancement (%)	-	As the intervention is new introduction to the place, so there is absolute increase in income.
Employment enhancement (%)	-	43% increase in employment

Low Cost Polyhouse Technology for cultivation of Tomato and Capsicum in Upper Subansiri, Arunachal Pradesh

Rupankar Bhagawati and Pranabjyoti Sarma
ICAR Research Complex for NEH Region, Arunachal Pradesh Centre, Basar, Arunachal Pradesh

Introduction

Cultivation of high value crops under protected condition is recognized as a useful tool to augment the productivity. Low cost polyhouse cum rain shelter has the potential to promote production of high value crops like tomato and capsicum. High rainfall prevailing in the project site of Upper Subansiri district has the potential for adoption of the low cost polyhouse technology.

Rationale

Low cost polyhouse technology has immense scope to promote production of high value low volume vegetables like tomato, capsicum, and cucumber *etc*. along with multiplication of quality planting materials of fruits, vegetables and flowers.

Objectives

1. To create awareness about low cost polyhouse technology among the farmers and rural youths.
2. To demonstrate the technology for raising of vegetable seedlings and cultivation of high value crops like tomato, capsicum, cucumber *etc*.

Methodology

After sanctioning the project in January, 2009, a meeting was conducted among the farmers of the project site and they were made aware about the low cost polyhouse technology thorough training and exposure visit. Few farmers came forward to adopt the technology. Accordingly procurement of critical inputs like polythene, vegetable seeds were done. One training programme on "Construction and utilization of low cost polyhouse" was conducted (Fig 1) for the beneficiaries and other farmers and rural youths for general awareness during the construction of one polyhouse in the farmers' field. Likewise two other low cost

Fig. 1 Construction of low cost poly house at Lida village

polyhouse were constructed in the farmers field of the project site. Critical inputs like polythene and other construction materials, vegetable seeds *etc.* were given to the beneficiaries free of cost from the project. Mrs.Yapu Doyom from Linnye villages had been provided one polyhouse from which she is getting some subsidiary income by growing tomato and capsicum. The polyhouses have been utilized for cultivation of tomato, capsicum, cucumber, frenchbean, chilli and for rising of orange seedlings.

Results

Mrs. Yella Reddi of Lida village, Upper Subansiri district, Arunachal Pradesh used to follow the mono cropping of rice from her childhood. She used to leave the land fallow and didn't know the way to increase her farm income. ICAR AP Centre, Basar has given her number of training on nursery management of vegetables, off season production of vegetables under polyhouse and scientific vegetable cultivation of vegetables. She has grown vegetables and raise nursery in the backyard of her house which is not utilized in the past for any purpose. We advised her to raise the nursery under polyhouse and transplanted the vegetables into main field at right time. All the scientific cultivation practices were followed under the supervision of

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Fig 2. Beneficiary farmer Mrs. Yella Riddi

our dedicated team. After seeing the profit and daily income through vegetables, she allotted part of her farm land only for production of vegetables all through the year. She being the ASM and has much influence to her society is now disseminating the importance of growing vegetables to other farmers and asking them to adopt vegetable cultivation for sustainable farming. The following Table 1 shows the economics of vegetable cultivation in polyhouse.

Discussion

Vegetable crops are occupying an important place in diversification of agriculture, playing a pivotal role in food and nutritional security, livelihood security besides environmental protection in NE Region. Use of improved hybrids/ varieties and adoption of improved packages under protected condition has potential to increase the yield by 3-5 times.

Impact

Low cost polyhouse technology is a new intervention in the project site. It has significant impact by increasing the productivity and off season availability of the produces and improved seeds of vegetable.

Table 1. Economics of vegetable cultivation in low cost poly house

Particulars	Before	After
House hold nos.	0	5
Variety introduced	Tomato (Local varieties) Capsicum net grown earlier.	Tomato (Avinash-2, Lehar) Capsicum (California Wonder)
Area	-	100 m^2 /poly house
Productivity	Tomato (Local variety) 172.75 kg/100 m^2	Tomato (Avinash-2) 399.5 kg/100 m^2
Capsicum (California Wonder)	189.75 kg/100 m^2	
Productivity enhancement	-	Tomato 131.26 % increase in yield Capsicum absolute increase in yield
Cost of production	Rs. 1,250/- per 100 m^2	Rs. 15,500/- per 100 m^2
Gross income	Rs. 2,600/- per 100 m^2	Rs. 36,750/- per 100 m^2
Net income	Rs. 1,350/- profit per 100 m^2	Rs. 21,250/- profit per 100 m^2
Income enhancement, %	-	As the intervention is new introduction to the place, so there is absolute increase in income.
Employment enhancement, %	-	35% increase in employment

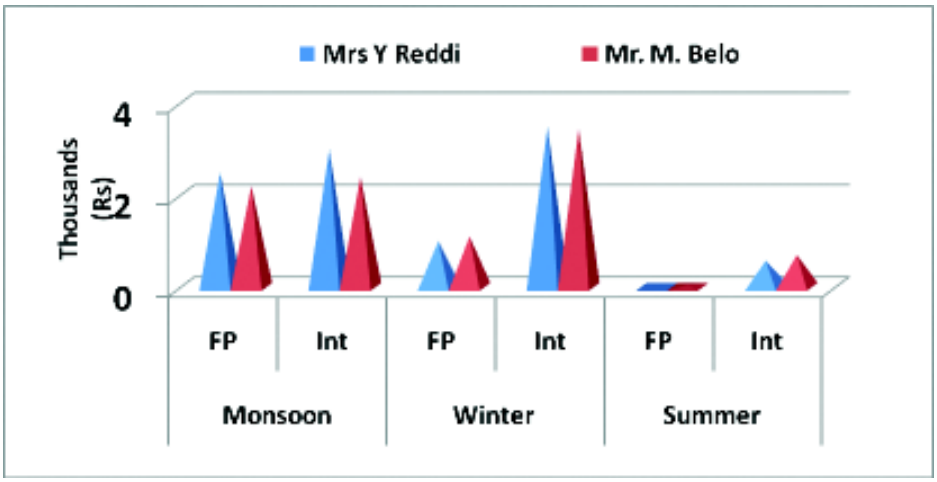

Fig 3. Income from farmers practice (FP) and improved practice (Int) in farmers field

Nutritional Kitchen Garden for Empowering Woman and Children in Dhalai, Tripura

M. Datta, Anup Das, S.P. Das, Ripan Sarkar and Randhir Sarma
ICAR Research Complex for NEH Region, Tripura Centre, Lembucherra, Tripura

Introduction

For a balanced diet, an adult should have an intake of 85 g of fruits and 300 g of vegetables per day as per the dietary recommendation of nutrition specialists. But the present level of production of vegetables in our country can permit a per capita consumption of only 140 g of vegetables per day. One should consume 40% leafy vegetables, 30% root vegetables and 30% other vegetables. Balanced nutritional is incomplete without vegetables as these are the major and the only source of nutritional vitamins and minerals required by human body besides being rich source of carbohydrates and protein. Vegetables are the source to increase not only the family income but also nutritive values of foods and its palatability. So production of vegetables in backyards using the available fresh water as well as the kitchen and bathroom wastewater. This will not only facilitate the utilization of unused water which otherwise will be hazardous to our health through environmental pollution, but can be useful for successful production of vegetables. Since kitchen gardening is done in a small area, it facilitates the methods of controlling pests and diseases through the removal of affected parts and non-use of chemicals.

Two crops of paddy in a year, rearing live stock and growing vegetable on marginal scale is the main source of income in the selected clusters of Balaram and Maracherra. Before the intervention of nutritional kitchen garden people of these two clusters used to cultivate very few types of vegetable with little care which could hardly meet their family requirements. The practice of sowing vegetables was not a continuous process. But with this intervention they are growing at least five to seven types of vegetables round the year. They are now able to produce surplus quantity of vegetables and fruits.

Rationale

There is an ample scope for sustainability of the programme in the selected clusters as farmers are not utilizing the available land in their back yard round the year. More over vegetable production of Balaram and Maracherra are not sufficient to meet the requirement of local markets. The woman and children would get fresh including ready to eat vegetables in their door step and hence, dependence on market would reduce. This in turn would empower woman and children in project area of Dhalai.

Objectives

1. To ensure dual benefits of food and income generation.
2. Continuous supply of , all the year round.
3. Kitchen garden is a good source to meet the nutritive demand of family members.
4. Kitchen gardens also provide fodder for household animals.

What actions are being put into place to ensure your desired results?

- ➢ Training programme on cultivation technique of vegetable.
- ➢ Supply of quality seeds.
- ➢ Regular monitoring of cultivating farmers.
- ➢ Marketing of garden produce and is an important source of income for women

Methodology

To execute the programme 200 nos of farmer was selected (100 farmers from each cluster) from Balaram and Maracherra cluster during 2009-11. They were supplied with quality vegetable seeds. For kitchen garden, vegetable crops with high nutritive value and short period of growth was selected. Beneficiaries were instructed to establish

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kitchen garden near their residence for ensuring proper attention. The garden must receive adequate sunlight. The backyard of the house was selected for nutritional kitchen garden as it is convenient as the members of the family can give a constant care to the vegetables during leisure and the wastewater from the bathrooms and kitchen can easily be diverted to the vegetable beds. Well rotten farm yard manure or compost was applied as it is a rich source of nutrients. Need based little supplement of fertilizer was given for crops like maize, bhindi etc. Composting was encouraged in the corner of home garden for nutrient supplementation of crops.

Fig 1. Awareness programme cum seed distribution for nutritional kitchen garden

What actions are being put into place to ensure your desired results?

- ➢ Training programme on cultivation technique of vegetable.
- ➢ Supply of quality seeds.
- ➢ Regular monitoring of cultivating farmers.
- ➢ Application of farmyard manure/composts etc.
- ➢ For pest management organic approach/ ITKs were promoted

Results

The average area per farmer before NAIP intervention was only about 200 m^2 which rose to about 500 m^2 per farmer with ICAR intervention. Farmers were earlier growing only few crops like pumpkin, lablab bean, chilli etc. whereas, after intervention, they started growing multiple vegetable crops including leafy vegetables and ready to eat vegetables like cucumber. Farmers were producing only about 85 kg vegetable before intervention with no marketable surplus, whereas they were harvesting about 425 kg vegetable from their kitchen garden after NAIP intervention (Table 1). The farmers could sale about 50% of their produce (200 kg) after scientific kitchen gardening even after meeting their own consumption. This income is expected to be with woman as woman

Table 1. Production, income and employment from nutritional kitchen garden

House hold, nos.	Before intervention	After intervention
No of farmers involved in kitchen gardening	70	200 (100 each in Balaram and Moracherra cluster)
Area /farmer:	200 m^2	500 m^2
Crops grown	Pumpkin, cowpea, lablab bean, etc.	Brinjal, Cucumber, Basella alba/rubra (Poi sak), Okra, Pumpkin, Amaranthus (Data sak), Maize (green cob), Chilly, Cowpea / Yard-long bean (Barbati) and Reddish
Production/farmer:	85 kg	**i.** Brinjal, Cucumber, okra, cowpea, lablab bean, yard long bean, reddish, pumpkin etc (350 m^2/farmer)- 310- kg **ii.** Leafy vegetables (rubra (Poi sak), Amaranthus, lai patta, coriander etc) (150 m2)- 115 kg Total: 425 kg.
Cost involvement/farmer	350.00	1,800
Gross income (Rs.)	1275.00	6,375
Net income(Rs.)	925.00	4,575
Productivity enhancement		400%
Income enhancement	-	394 %
Increase in employment	5 man-days	2605 (18 man days)

and children mostly looked after the kitchen gardening leaving the man for field works, daily labour etc.

Each farmer has gained a net income of Rs. 4,575 from an area of 500 m^2 from their produce. People have learnt to utilize the available unused plots in their backyard through year round vegetable cultivation (Fig.2). At the same time they got the opportunity to generate some extra income for improvement of their livelihood. Due to availability of fresh vegetables/fruits in doorsteps, the vegetable consumption of farmers especially the women and children increased which resulted into better nutrition and health of the people.

Fig 2. Vegetables under Nutritional Kitchen Gardening at Dhalai, Tripura

Mushroom as Component of Farming System for Nutrition and Livelihood Improvement in Dhalai, Tripura

Subrata Biswas, M. Datta, Ripon Sarkar and Ranadhir Sarma
ICAR Research Complex for NEH Region Tripura Centre, Lembucherra, Tripura

Introduction

The farmers in the selected cluster viz. Balaram and Maracherra of Dhalai district of Tripura are mainly dependent on agriculture as their source of livelihood. In those areas, paddy is the main staple crop which is cultivated twice in a year. Besides, some vegetable crops are also grown which is not enough for their need and to meet the demand of the local markets. The main hurdle for the area is the scarcity of irrigation water leading to low cropping intensity. Therefore to improve the livelihood of the community certain additional source of income is most important. Mushroom cultivation is such a practice which can significantly serve the purpose. Through mushroom cultivation, people can easily generate some decent amount of extra income with least investment.

Rationale

As the selected clusters are rice growing areas, producing sufficient amount of paddy straw and its remnants that kept as wastes in fields, as well as the inhabitants are mushroom eater, hence there is ample scope to flourish the mushroom cultivation technologies amongst the farmers**.**

Objectives

To improve livelihood of poor farmers by mushroom cultivation and to produce protein rich food like mushroom for their nourishment.

Methodology

Mushroom cultivation is a new practice in the areas of Balaram and Maracherra villages. At initial stage, the mushroom cultivation was introduced by giving training and demonstration to popularize this venture. The spawn and other requisite materials were either supplied from ICAR or by purchasing from the Government laboratories. Then the farmers cultivated oyster mushroom on intact straw with steam disinfection method. They were kept under close supervision by the ICAR personal in giving necessary directions and other inputs from time to time to combat diseases, pests and adverse climatic conditions. In this way considerable number of farmers learned the cultivation techniques and produced mushroom for the first time in their houses. Several steps were taken towards commercialization of the venture. In doing so, the interested farmers, who were able to produce mushroom, were selected for the construction of mushroom units. The low cost mushroom sheds were prepared in the houses of the progressive farmers (Fig. 1). The farmers earned profit from selling of fresh mushroom @ Rs.80/- per kg in the local markets. Now the process of mushroom cultivation is a regular practice at Balaram and Maracherra. Total nine (9) units have been established and nine (9) more units are about to complete.

Fig 1. Newly constructed mushroom sheds

Results

In all 216 farmers cultivated mushroom during the period starting from June, 2008 to December, 2010 (Table 1). They produced 2062 kg of fresh

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oyster mushroom. Total expenditure was calculated as Rs. 46,492 @ Rs. 12 for a poly bag filling. The farmers sold their produce @ Rs. 80 per kg fresh mushroom to the local markets and earned Rs. 1,65,045, which resulted Rs. 1,18,509 as net profit (Table 2).

Discussion

A number of framers have learnt a new technique to enhance their income. Mushroom cultivation is a totally new technique for Balaram and Maracherra cluster. They learned the mushroom

Table 1. Year wise mushroom production and profit observed in Balaram and Marcherra clusters

Name of the cluster.	No. of Farmers	No. Spawn bag used (150 g each)	Total expenditure (Rs.)	Production of mushroom (kg)	Gross income (Rs.)	Net income (Rs.)
Balaram (April 2008 to March, 2009)	139	750	9,000	361.90	28,952	19,952
Maracherra (April 2008 to March, 2009)	133	370	4,440	101.85	8,253	3,813
Balaram (April 2009 to March, 2010)	107	882	10,584	560.30	44,824	34,396
Maracherra (April 2010 to March, 2011)	77	889	10,668	559.00	44,720	34,052
Balaram (April 2010 to Dec, 2010)	125	600	7,200	296.20	23,696	16,496
Maracherra (April 2009 to Dec, 2010)	75	400	4,800	182.50	14,600	9,800

Table 2. Cumulative production and income generated from mushroom cultivation

Particulars	Before	After
No. of house hold	Nil	216
Variety introduced	Nil	Oyster mushroom
Production	Nil	2061.75 kg from 3871 no of spawn packets @ 532 gms /packet.
Increase in production	Nil	100 %
Total cost involvement (Rs.)	-	46492 @ Rs 12/packet of spawn.
Gross Income (Rs.)	-	165045 @ 80 / kg of mushroom.
Net income (Rs.)	-	118509 @ 80/ kg of mushroom
Income enhancement %	-	118509 @ 80/- / kg of mushroom.
Employment enhancement %	-	1185 man days

Fig 2. Farmers displaying their produce

cultivation technologies after participating in training. "Mushrooms cultivation ensured enhancement of family income at cost of less investment. Waste materials easily deposed into food materials enriching with nutrition is the extra benefits at farmers' hand.

Sustainability

Sustainability depends upon regular construction of new sheds in order to increase mushrooms production amongst interested beneficiaries, however continuous mushrooms spawns supply poses a challenge that can sufficiently manage through improved techniques of spawn (seeds) production.

Tuber Crop Based Farming System for Food Security and Livelihood Improvement in Dhalai, Tripura

M. Datta, M. Sankaran, Ripon Sarkar and Ranadhir Sarma
ICAR Research Complex for NEH Region Tripura Centre, Lembucherra, Tripura

Introduction

The *tilla* land of tripura is suitable for cultivation of tuber crops. Inclusion of tuber crops in farming system would enhance the productivity per unit area besides improving food security for small and marginal farmers. Before intervention, the self help group *Abachanga* had 0.48 ha of *tilla* land (moderate hillock upland) which was kept fallow with full of weeds and shrubs (Fig 1). As the portion of the land was *tilla* and without any source of irrigation, it was selected for cultivation of tuber crops viz Dioscorea, Elephant foot yam, Tapioca, Ginger, Sweet Potato etc. After clearing, the land was divided into small plots of about 800m^2 each for the individual tuber crops. Boundary of each plot was planted with Banana Suckers. The materials were planted at 90cm ×90cm (Dioscorea, Elephant foot yam, Tapioca), 60cm ×20cm (sweet potato) and ginger which was planted @ 1.5 ton/ha. One unit pig (2 piglets) was integrated for fattening by utilizing tapioca, sweet potato etc as feed. Farmers provided kitchen waste, some concentrate for better growth of pigs.

Before intervention **Tuber Crop based farming system** was completely a new concept for the farmers in the selected villages of Dhalai District, because there was no such type of tuber crops cultivation. The farmers do not have any idea to utilize the fallow land. They would consume the tuber crops during the monsoon season while the food availability used to be less due to continuous rain and also during working in *Jhum* land after collecting from adjacent jungle. As per their concept it is very highly energetic and durable items. They were using tapioca (*Kathaloo*) as fencing materials. The tuber crops were also used as pig feed.

Fig 1. IFS site before intervention

Rationale

- Transfer of unproductive land to productive one.
- Extensive use for family nutrition purpose
- Source of feeds (Tapioca, sweet potato), sweet potato for pigs
- Surplus is sold in the market which generated revenue thus added to the livelihood of the SHG group
- Tuber crops became more popular in the area as source of livelihood

Results

The productivity of discorea, elephant foot yam, tapioca, ginger and sweet potato was 5.63t/ha, 3.75 t/ha, 1.9 t/ha, 2 t/ha and 4.25 t/ha, respectively (Fig. 2 & 3). Farmers could earn a net income of Rs. 20950 from 0.48 ha area area with a B:C of 2.15 (Table 1).

Impact

The net income from crop component was 14,150 and that of from pig was Rs. 6,200, thereby, giving a total net income of Rs. 20,950 in a single year from a piece of 0.48 ha land area. There was effective utilization of land and various waste materials for maintaining soil health. Steps have been initiated to replicate the model in other areas for horizontal spread.

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Fig. 2 Tapioca at early vegetative stage

Fig. 3 Tuber crop based farming system model

Table 1. Productivity and BC ratio from traditional and improved practices

Cost / Economics	Traditional Practice	Improved practice	
1. Productivity	Traditionally the farmer group never used to cultivate these crops viz. dioscorea, elephant foot yam, tapioca, ginger etc. They used to gather such crops from jungles for their consumption and access collection they used to sale in the market.	Dioscorea Elephant foot yam Tapioca Ginger Sweet Potato Banana (on boundaries) Piggery (2 nos)	5.63 t/ha (Production-450 kg/800 m^2) 3.75 t/ha (Production-330 kg/800 m^2) 1.9 t/ha (Production-150 kg/800 m^2) 2 t/ha (Production-160 kg/800 m^2) 4.25 t/ha (Production-320 kg/800 m^2) 10 bunches/annum (100 kg) 180 kg (fattening purpose)
2. Cost of production (Rs.)	Since the crops were collected from natural jungles so cost is almost nil	Rs. 3250/0.48 ha for cultural practices & Rs. 5100/0.48 ha for planting material. The cost of pig rearing including piglet, feed etc was Rs. 9800. Thus, total cost of production was Rs Rs.18,150.00	
3. Income (Rs.)	Minimal	Gross income *i.Crop component* Rs. 23,100/0.48 ha or Rs. 4,8125/ha *ii. Livestock* Rs.16,000.00 *iii. Total = 39,100.00*	Net Income Rs. 14,150/0.48 ha or Rs. 29,479/ha Rs. 6200.00 *Rs.20,950.00*
4. Employment (man days)	Collection by the farmer himself	40 man days/0.48 ha or 83 man days/ha	
5. B:C ratio	Not available (Waste land before intervention)	1:2.15	

Fish-Rice-Vegetable-Fruit Based Farming System in Dhalai, Tripura

Ratan K. Saha and Dillip Nath
College of Fisheries, Central Agricultural University, Lembucherra, Tripura

Introduction

Rice and fish are the major food items for the people of Tripura. Vegetables are grown in upland and kitchen gardens. However, the productivity of fish in most cases are very low (600 kg/ha) due to non adoption of scientific approach. The ponds are mostly underutilized and farmers can hardly meet their daily needs. There is ample scope for enhancing fish and crop productivity by scientifically integrating them. Keeping this in mind the present success intervention "Evaluation and validation of indigenous and improved fish based farming system models for enhancing production in agro-ecosystem of disadvantageous areas of Dhalai district of Tripura" were implemented for sustainability, profitability and competitiveness.

Rationale

Integration of fish farming with rice, vegetables and fruits would result efficient utilization and recycling of farmers available resources. At any point of time, one or other component would give income and there will be year round employment due to diversified activities. During drought, the water from farm pond can be used for life saving irrigation of vegetables.

Objectives

1. To utilize the traditional paddy cum fish culture system for enhancement of productivity and profitability.
2. To improve the livelihood of poor/ marginal farmers through location specific sustainable scientific intervention.
3. To impart the knowledge about the best utilization of land through business module of fish based farming system options.

Methodology

The present technology intervention is a location specific scientific modification of traditional paddy-cum-fish culture which gives low fish production and one crop of paddy only. In the traditional fish farming system they only practiced the fish culture in an unscientific way. They did not maintain proper methodology of fish farming. The adjacent plain land near the fish pond was used for rice culture only. No vegetable and fruit farming was practiced by them. A scientific layout of the available land has been planned in such a way that farmer can grow fish, rice, vegetable and fruits simultaneously. For fish culture we have renovated channels and main reservoir and also made use of water throughout the season for rice, fruit or vegetable farming on the adjacent land.

To perform such activities various training programme were organized on location specific fish based farming system modules and also provided different input such as quality fish seed, balanced fish feed, lime, vegetable seeds and different planting materials etc. The stocking ratio of fish species was maintained as 5 species @ catla (3): silver carp (1): rohu (3): mrigal/ prawn (1.5): common/ amur carp (1.5). Initial stocking density was @ 12,000 nos. /ha and periodical stocking @ 8,000 nos./ha. Rice (Gumoti variety) farming was practiced on plain land of that system. The vegetable cultivation (bottle guard, potato, ridge gourd, string bean, local bean) was done on pond embankment as well as adjacent plain land whereas the fruit crops like banana and papaya were planted on pond embankment.

The monitoring and maintenance of fish pond, rice field, fruit field, vegetable field, pest management, and soil and water quality were followed regularly for better production. The success story of Sri Suryasen Satnami, Maracherra

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is documented and indicated below. The total land area of Mr. Satnami is 0.36 ha along with water area of 0.12 ha.

Outcome

The significant outcomes of the technology during 2011-12 are furnished below in the table 1. In the traditional paddy-cum-fish culture the production of fish is only 600- 800 kg/ ha but in IFS system fish productivity of 1,250 kg/ ha of fishes. Sri Surjasen Satnami of Maracherra earned a net income of Rs. 27,700 from his IFS model involving fish-rice-vegetable and fruit farming from an area of 0.36 ha in a single year (Table 1).

Table 1. Production and economics of fish-rice-vegetable-fruit farming based framing system

Particulars	Net Income (in Rs) Before intervention	Production after intervention	Net Income (in Rs) After intervention (2011-12)
Land Area= 0.24 ha	0	Vegetables (Bottle guard, Potato, Ridge gourd, String bean, Local bean) = 3550 kg	13,700.00
	1,500.00	Rice = 280 kg	4,000.00
Water area= 0.08 ha (Before intervention)	1,500.00	Fish= 150kg	10,000.00
Water area= 0.12 ha (After intervention			
Total net income*	3,000.00		27,700.00
Cost of production	2,200.00		18,500,00
B:C Ratio	2.36		2.49
Employment (man-days)	33		65

*Fruit cultivation: Banana sucker has been planted during 2011-12, the fruiting will be started during the 2012-13 and due to that reason the income of fruits have not been given in the table.

Fig 1 . Pond site of SrI. Surjasen Satnami (A)- before intervention and (B)- after IFS

Fish-Vegetable-Fruit Based Farming System in Dhalai, Tripura

Ratan K. Saha and Dillip Nath
College of Fisheries, Central Agricultural University, Lembucherra, Tripura

Introduction

Rice and fish are the major food items for the people of Tripura. Vegetables are grown in upland and kitchen gardens. Very less importance is given to fruits by the farmers and cultivated under no input condition. However, the productivity of fish in most cases are very low (600 kg/ha) due to non adoption of scientific approach. The ponds are mostly underutilized and farmers can hardly meet their daily needs. There is ample scope for enhancing fish and crop productivity by scientifically integrating them. Keeping this in mind the present success intervention "Evaluation and validation of indigenous and improved fish based farming system models for enhancing production in agro-ecosystem of disadvantageous areas of Dhalai district of Tripura were implemented for sustainability, profitability and competitiveness".

Rationale

Integration of fish farming with vegetables and fruits would result efficient utilization and recycling of farmers available resources. Addition of horticultural component enhances farmers income and provide nutrition to poor people. At any point of time, one or other component would give income and there will be year round employment due to diversified activities.

Objectives

1. To modify the traditional fish culture system along with fruit and vegetable farming for enhancement of productivity and profitability.
2. To improve the livelihood of poor/ marginal farmers through location specific sustainable scientific intervention.
3. To impart the knowledge about the best utilization of land through business module of fish based farming system options.

Technology Intervention

The fish-vegetable-fruit farming intervention is a location specific scientific modification of traditional fish culture which gives low fish production for the farmers. In the traditional fish farming system they only practice the fish culture in an unscientific way. They did not follow proper methodology of fish farming. The adjacent land near the fish pond remains fallow and unutilized for year after year. No vegetable and fruit farming was practiced by them along with fish culture in the adjacent plain land and in the pond dyke. Hence, technology for proper utilization of land as well as water in an integrated with fish-vegetable-fruit farming was introduced. A scientific layout of the available land has been planned in such a way that farmer can grow fish, vegetable and fruits simultaneously. The farm pond was renovated which can retain water throughout the year for fish culture and also utilize for fruit or vegetable farming on the adjacent land and pond dyke to minimize soil erosion.

To perform such activities various training programme was organized on location specific fish based farming system modules and also provided different input such as quality fish seed, balanced fish feed, lime, vegetable seeds and different planting materials etc. The stocking ratio of fish species was maintained as 6 species @ catla (2.5): silver carp (1): rohu (3): grass carp (0.5): mrigal (1.5): common/ amur carp (1.5). Initial stocking density was @ 12,000 nos. /ha and periodical stocking @ 8,000 nos./ha. The vegetable (bottle guard, pumpkin, brinjal, local bean) cultivation was done on pond embankment as well as adjacent plain land and dyke whereas the fruit crops like banana, papaya and amropalli were planted on pond embankment. The monitoring and maintenance of fish pond, fruit field, vegetable field, pest management, soil and water quality were followed regularly for better production. Present intervention

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was undertaken by Santineer SHG, Balaram in an land area of 0.16 ha + Water area of 0.32 ha (total 0.48 ha)

Outcome

The significant outcomes of the technology during 2011-12 are furnished below in the table 1.

Table 1. Production and income from fish-vegetable-fruit farming

Particulars	Net Income (in Rs.) Before intervention	Component and production after intervention	Net Income (in Rs.) After intervention (2011-12)
Land Area= 0.16 ha	1,500.00	Vegetables (Bottle gourd, Pumpkin, Brinjal, Local bean on dyke and adjacent areas) = 2450 kg	12,500.00
Water area= 0.32 ha	15,000.00	Fish = 835kg	52,200.00
Net income (total)*	16,500.00		64,700.00
Cost of Production	7,000.00		43,500.00
B:C ratio	3.35		2.48
Employment	29		56

*Fruit cultivation: Banana sucker has been planted during 2011-12, the fruiting will be started during the 2012-13 and due to that reason the income of fruits have not been given in the table.

Fig 1 . Pond site of Santineer SHG (A)- before intervention and (B)- after IFS

Fish-Fruit-Vegetable-Pig Farming System in Dhalai, Tripura

Ratan K. Saha and Dillip Nath
College of Fisheries, Central Agricultural University, Lembucherra, Tripura

Introduction

The main source of income of the farmers from agriculture is from rice cultivation. They were practicing fish culture but not in a scientific way and hardly any integration of the fish culture with the crop and animal component, which can give a better profit for the farmers and improve their livelihood. Therefore, it is very important to integrate the fish culture activity along with the different crop (fruit and vegetable) and livestock (pig) according to specific area, location and topography.

Before intervention the productivity from fish culture was hardly 0.3 to 0.6 t/ha. The income from vegetable and fruits were also minimum. Farmers hardly thought to integrate pig farming with fish culture.

Rationale

The Dhalai district of Tripura possesses vast potential for the development of fisheries, agriculture and animal husbandry. The farmers can improve the productivity of fish as well as the fruits and vegetables depending upon the specific area and location. Despite high demand of fish, vegetable, fruit and meat in the local market, the farmers are not able to meet the demand. Hence through this programme, there is a good scope to develop fish based farming system with integration of different crop (vegetable and fruits) and livestock (pig) components to increase the livelihood of the local poor.

Objectives

Evaluation and validation of indigenous and improved fish based farming system models for enhancing production in agro-ecosystem of disadvantageous areas of Dhalai district of Tripura for sustainability, profitability and competitiveness.

Methodology

Organization of various training programme on fish based farming system, supply of input of quality fish seed, fish feed and lime. Monitoring of fish pond and its water quality. Preparation of pig shed and distribution of piglets etc.

Results

The average income per farmer ranged from 25,572 to 83800 compared to 9500 per farmer before intervention. The significant findings/results of the technology demonstration are furnished in table 1.

Table 1. Economics of Fish + vegetable + pig farming system in farmer's field

Name of Beneficiary	Name of the cluster	Before Intervention		After Intervention (2008-09)		After Intervention (2009-10)		After Intervention (2010-11)	
		Exp. (Rs.)	Return (Rs.)	Exp. (Rs.)	Return (Rs.)	Exp. (Rs.)	Return (Rs.)	Exp. (Rs.)	Return (Rs.)
Mr. Uttam Debnath	Balaram	8000	13000	12844	25700	16701	53500	23200	63800
Mr. Bimal Debnath	Balaram	7000	11000	7,184	16010	16804	34000	19200	44000
Mr. Bhagirath Debbarma	Maracherra	1500	2000	2500	6390	2670	6850	6550	24950
Total (Rs.)		16500	26000	22528	48100	36175	94350	48950	132750
Net return (Rs)			9500		25572		58175		83800
B: C ratio			1.57		2.13		2.60		2.71

Discussion

The farmer's economic status enhanced substantially by adopting the fish based farming system. The benefit cost ratio before intervention was recorded at 1.57, whereas it was raised upto 2.71 during the year 2010-2011 after intervention. From the pig rearing practices the farmers received Rs. 10,000 to Rs. 14,000 during the year 2010-2011. Mr. Uttam Debnath deposited an amount of Rs. 20,000 in LIC annually from the income of fish based farming system. They are able to maintain their farm by themselves without any financial help from the 2nd year.

Impact

The farmers are going to enhance their economic status by adopting the fish based farming system. Out of nine interventions Fish-fruit-vegetable-pig farming was found as more effective as compared to others. The productivity of fish per ha increased to 2.7 to 3.1 t/ha after intervention as compared to the initial status of 0.3 to 0.6 t/ha. The people have learned about the scientific integration of fish, vegetable, fruits and pigs for better economic development. They have learned about the integrated farming system and management in proper ways. The other farmers are now very much interested to follow fish based farming system after releasing the potential economic benefit of fish based farming system.

Fig 1. Pond site of Mr. Uttam Debnath (A)- before intervention and (B)- after IFS intervention

Fish-Fruit-Vegetable-Pig-Fish Spawn Farming System in Dhalai, Tripura

Ratan K. Saha and Dillip Nath
College of Fisheries, Central Agricultural University, Lembucherra, Tripura

Introduction

In Dhalai district of Tripura, the main source of income of the farmers from agriculture is from rice cultivation. Fish culture is being practiced, but not in a scientific way and hardly any integration of the fish culture with the crop and animal component, which can give a better profit for the farmers and improve their livelihood. Therefore, it is very important to integrate the fish culture activity along with different crops (fruits, vegetables) and livestock (pig) according to specific area, location and topography. Before intervention the productivity of fish culture was hardly 0.5 t/ha. The income from vegetable and fruits were also meager. Farmers hardly thought to practice pig farming with fish culture.

Rationale

The fish farmers will be benefited from the programme in a different way. The productivity of fish and crops can be increased according to the specific area and location. Fish fingerlings can be produced from the spawn that were reared in small ditches. There is a good demand of fish, vegetable, fruit and meat in the local market. Therefore, there is a good scope to develop fish based farming system with integration of different crop (vegetable and fruits) and livestock (pig) components with spawn rearing and composite fish culture activities to improve the livelihood of the local poor.

Objectives

Evaluation and validation of indigenous and improved fish based farming system models for enhancing production in agro-ecosystem of disadvantageous areas of Dhalai district of Tripura for sustainability, profitability and competitiveness.

Methodology

For improving and renovating the existing pond based system training programmes on fish based

Fig 1. Pond site of Shri. Bhagirath Debbarma (before intervention)

farming system were organized, supply of inputs like quality fish seed, fish feed, lime, spawn, preparation of pig sheds, supply of piglets and different planting materials etc. were undertaken. Monitoring the maintenance of fish pond its water quality.

Results

The average net return of the farmer was Rs. 10,061 and Rs. 17,800 during 2008-09 and 2009-10, respectively. The significant findings/results of the technology/product are furnished in table 1.

Discussion

The farmers economic status is enhanced by adopting the fish based farming system (Fig 2). The B: C ratio was recorded as 1.66 before intervention whereas, after intervention i.e. in the year 2008-09 and 2009-10 the benefit cost ratio was recorded as

Fig 2. Pond site of Shri. Baghirath Debbarma (After Intervention)

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Table 1. Economics of Fish + fruit + vegetable + pig + fish spawn farming in farmers field

Name of Beneficiary	Name of the cluster	Before Intervention		After Intervention (2008-09)		After Intervention (2009-10)	
		Exp. (Rs.)	Return (Rs.)	Exp. (Rs.)	Return (Rs.)	Exp. (Rs.)	Return (Rs.)
Biswakumar Debbarma	Balaram	300	500	2000	7066	3500	9300
Santineer SHG	Balaram	0	0	2300	7295	6000	18000
Total (Rs.)		200	500	4300	14361	9500	27300
Net return (Rs/Unit)			500		10,061		17,800
B: C ratio			**2.50**		**3.33**		**2.87**

3.33 and 2.87, respectively. The productivity of fish, crop and livestock was increased substantially. Farmers would be able to maintain their farm by themselves without any financial help from the next year.

Impact

The productivity of fish per ha increased to 2.1 t/ha after intervention as compared to the initial status of 0.3 to 0.6 t/ha and productivity of horticultural crops (vegetables and fruits) was 1.25 t/ha/y. The people have learned about the scientific integration of fish, vegetable, fruits and pigs for better economic development. They have learned about the integrated farming system and management in proper ways. The other farmers are now very much interested to follow fish based farming system after releasing the potential economic benefit of fish based farming system.

Fish Breeding- Spawn Rearing- Fruit Based Farming System in Dhalai, Tripura

Ratan K. Saha and Dillip Nath
College of Fisheries, Central Agricultural University, Lembucherra, Tripura

Introduction

Balaram and Maracherra cluster of the Dhalai District of Tripura are rich in water resources, however there is limited availability of quality fish and the farmers have to collect the fish seeds from the locally available water bodies or they have to depend on the local traders for the fish seeds for stocking their ponds. Therefore, it is very important to develop a fish breeding unit so as to ensure the availability of quality fish seed for stocking the ponds. In this context proper training and demonstration on fish breeding and spawn rearing is required. Inclusion of fruits like banana would further enhance farmers income and provide sustainability to the farming system.

Before intervention no income was recorded from fish spawn rearing. The only source of income was from agriculture (mainly from rice) and traditional method of production of fishes was followed.

Rationale

The fish farmers will be benefited from the programme in a different way. Under this programme the farmers can produce quality fish seed at their own farm. For the farmers who have difficulty in producing fish spawn in their farm, they can procure the fish spawn from the local farmers and rear in their farm upto fingerlings stage and they can be sold again locally. By this way the economic status of farmers could be enhanced and this would also ensure the availability of spawn as well as fingerlings for scientific fish culture practices.

Objectives

Addressing the constraints of deliverables to facilitate the community/people to harness optimum benefit from fishery and agriculture sector.

Methodology

Organized training and undertaken demonstration programme on fish breeding and spawn rearing by utilizing small ditches for spawn rearing for the farmers. Manuring, liming, netting and other cultural practices were followed as recommended.

Results

Sri Baburam Satnami of Maracherra cluster has undergone training during 10-12th July, 2008 at College of Fisheries. During the training programme he learnt about the breeding technique of fishes and subsequently he has started the production of fish seed at his own pond and has earned Rs.17, 550 by selling the fish seed during the year 2008-09 and Rs. 13,000/- during the year 2009-10. The average net income from a 2000 m^2 pond area was Rs. 21,850/annum and farmers income enhanced by 173% over traditional practice (Table 1).

Table 1. Economics of fish + fruit farming in Dhalai, Tripura.

Total pond area (ha)	**0.20 (nursery= 0.04 ha, Rearing = 0.16 ha)**
Total expenditure (Rs.)	13,200
Income from fish (Rs.)	30,550
Income from banana (Rs.)	4,500
Gross income (Rs)	35,050
Net income (Rs)	21,850
B:C Ratio	2.65
Income from farmers practice (Rs)	8000
Income enhancement (%)	173

Discussion

Mr. Baburam Satnami is the only farmer who has started the fish breeding in his own pond after

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taking the breeding training organized by College of Fisheries, Tripura. He has earned a good amount by selling fingerlings during the year 2008-09 and 2009-10 where no income was recorded earlier from such activities. He is able to develop nursery and rearing activities in his own pond. At the same time, he is earning a good income from banana (Fig 1).

Fig 1. Fish +fruit farming of Mr. Babunam Satnami, Dhalai

Impact

After intervention of fish breeding and spawn rearing practice the participant has increased his income by selling the fingerlings and due to this reason the local farmers got quality fish seed. The other farmers were also interested to learn the new technology of fish breeding and rearing. A number of farmers have participated in such training programme and learnt about the techniques of fish breeding. Some of the farmers from both the clusters have started spawn rearing during the year 2010-11 and their income was enhanced. Now, the trend of spawn rearing has started in such localities from which they have increased their economic level by cultivating and selling the quality fish seed.

The breeding and spawn rearing technique is totally a new intervention for this region. People thought earlier that fish culture in a pond is possible easily without any scientific knowledge. But now they have come to know there are so many interesting and profitable processes to be learned which in turn could enhanced their income.

Agri + Horti + Piggery + Fishery Integrated Farming System in Unused *Tilla* Land of Dhalai, Tripura

Pankaj Chakraborty, Shitangsu Saha and Chaiwafru Mog
Zilla Parishad, Dhalai, Tripura

Introduction

The *tilla* lands (small hillocks with gentle slope) in the selected clusters (Balaram and Maracherra) of Dhalai district of Tripura are suitable for cultivating agricultural as well as horticultural crops however it is left fallow by the farmers nad the land generally remains infested with weeds and unproductive shrubs. Hardly a few farmers are using their *tilla* land for cultivation of tuber crops, banana, assam lemon, pineapple etc. and even if some farmers are cultivating they are mostly growing local varieties. They are not aware of the high yielding varieties that are available in the market, hence the productivity of crops is very low and the income derived is minimal.

Fish culture is also a common practice among the farmers of Dhalai District of Tripura where they would culture fishes in small size ponds of 400-500 m^2, but most of the ponds are constructed in plain areas mostly near paddy fields. But fish culture is not practiced near theses *tilla* lands may be due to scarcity of water or the water source is not available. However, there is ample scope for integrating crops with aquaculture and animal husbandry in these *tilla* lands by conserving rain water during monsoon season and using it for irrigating crops and for fish culture.

Objectives

1. Transformation of unproductive or low productive *tilla* land to productive one.
2. To conserve the rain water in farm pond and utilize for fish culture and for irrigating agri-horticultural crops.

Materials and methods

Integrated farming system is a completely new concept for the farmers in the selected clusters of Dhalai district, so steps were taken to create awareness and to promote integrated farming system among the farmers.

- ➢ Various training programmes were organized on agri- and horticultural crops cultivation, animal husbandry and composite fish culture.
- ➢ High yielding varieties of agri and horti crops were supplied to the farmers.
- ➢ Fish fingerlings of Indian Major Carps (IMCs) and exotic carps were distributed to the farmers.
- ➢ Arecanut saplings were supplied for planting along the boundary of the land.
- ➢ Pig shed were constructed on the pond dyke and cross bred pigs were opted for rearing.

Results

The gross income of two farmers i.e. Mr. Ramendra Marak and Mr. Durga Marak was Rs.

Fig 1 (a). IFS site of Shri. Durga Marak before intervention

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400235 and Rs. 333625/- from 3 and 2.5 ha land area respectively (Table 1 & 2). The two farmers are now happy with this IF and are able to get year round income and employment.

Impact

Before Dhalai Zilla Parishad intervention of Agri + Horti + Pig + Fish farmers are not using their *tilla* land but after intervention they have realised the benefits that they can derived from their unused land by practicing integrated farming system. Farmers are now self sufficient and they are using the produce not only at house hold level but they are selling the surplus amount thereby enhancing their income and livelihood substantially.

Fig 1 (b). IFS site of Shri. Durga Marak after intervention

Table 1. Production and economics of IFS in Ramendra Marak field

Name of Beneficiary	Name of cultivation	Area (ha)	Before Intervention		After Intervention	
			Production (kg)	Gross Income (Rs.)	Production (kg)	Gross Income (Rs.)
Ramendra Marak	Pineapple (kew)	3	Nil	Nil	Growing stage	Nil
	Tapioca		Nil	Nil	24000 kg	1,50,000
	Ar-har (local language)		Nil	Nil	175 kg	7,000
	Banana (Sapri, Champa)		Nil	Nil	225 banch	16,875
	Arecanut		Nil	Nil	Growing stage	Nil
	Pisciculture		1200 kg	1,44,000	1728 kg	2,07,360
	Pig		Nil	Nil	6 nos. piglets born	19,000
	Total			**1,44,000/**		**4,00,235**
	Net Income/ha					**1,33,411**

Table 2. Production and economics of IFS in Durga Marak field

Name of Beneficiary	Name of cultivation	Area (ha)	Before Intervention		After Intervention	
			Production (kg)	Gross Income (Rs.)	Production (kg)	Gross Income (Rs.)
Durga Marak	Pineapple (kew)	2.5	25,000 nos.	1,25,000	35,000 nos.	1,75,000
	Arecanut		Nil	Nil	Growing stage	Nil
	Lemon		500 nos.	1,000	1,500 nos	3,000
	Banana (Sapri, Champa)		125 banch	9,375	275 banch	20,625
	Pisciculture		700 kg.	8,400	1125 kg.	1,35,000
	Total			**1,43,775**		**3,33,625**
	Net Income/ha					**1,33,450**

Fig 2 (a). IFS site of Shri. Ramendra Marak before intervention

Fig 2(b). IFS site of Shri. Ramendra Marak after intervention

Production to Processing of Turmeric: An Innovative Approach for Livelihood Improvement in Saiha, Mizoram

[1]Lalchhuanawmi Pachuau*, [2]K. Vanlalhriatpuia, [2]Lanbir Singh, [2]U.K. Sahoo, [2]Lalnilawma and [2]K. Upadhyaya

[1]Krishi Vigyan Kendra, Lawngtlai district, Mizoram; [2]Mizoram University, Aizawl-796004, Mizoram

Introduction

Turmeric is one of the important spice crops of Mizoram and the quality of turmeric of Northeast is very good due to its high curcumin content. However, the productivity of turmeric is very low due to poor management practices and lack of value addition. Besides post harvest losses, lack of proper market are the issues of concern in Saiha district of Mizoram. Most of the farmers sale their produce (marketable surplus) immediately after harvesting. The agricultural produce is either sold in local market or the farmers have to take the pain to transport their produce to Saiha market which is 45 km away from the selected villages viz. East Kalcho and Maubawk. Regarding the post harvest activities, the farmers adopted drying, cleaning and grading only. They were not involved in other technology like value addition. Some farmers have reported low receipt of price due to the quality deterioration affected by insect and pest attack. Farmers from time to time have expressed the need of warehousing and cold storage facilities from government so that they can store their high value commodities for a longer period of time.

Hence, it is felt that improved technology of agricultural practices would help the farmers to increase the production of their crop followed by post harvest activities (turmeric powder) such as value addition of their produce would fetch them a higher price thereby improving their livelihood.

Methodology

In the selected cluster of Saiha district, 148 no of farmers of the two villages viz. East Kalcho and Maubawk were selected for cultivating turmeric covering an area of 70 ha with an average of 0.5 ha/house hold (HH). High yielding variety of turmeric (Lakadong) was cultivated organically under rain fed conditions (Fig.1). For nutrient management, FYM @ 15 t/ha was applied and organic mulching (green leaves, subabul leaves, weeds etc @ 10 tonnes/ha, paddy straw @ 2 tonnes/ha) was practiced for soil and moisture conservation.

Disease free whole rhizome pre-treated with DM-45 (for 30 min) were grown in the month of April to May by dibbling method. About 2 t/ha of the rhizomes are used for planting at a spacing of 30 cm between rows and 20 cm between plants. The crop is raised under rain-fed condition. 2-3 hand weeding are carried out. The crop is raised either as sole crop or as mixed cropping with maize, common bean, or along with *Jatropha*, mango and pineapple.

Results

The crops are harvested within 8-9 months time during January - February by digging using a spade. The average yield under sole crop is about 10.5 t/ha (without mulches) and under mixed cropping 12.5 t/ha (approx.) and with mulches about 13.7 t/ha.

Fig 1. Official inspecting turmeric crop at farmer's field

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Table 1. Economics of turmeric cultivation/ha

(A) Input costs:	:	Amount (Rs)
Land tilling including bed preparation	:	8000
Cost of rhizome 2 t @8/kg	:	16,000
Treatment before sowing	:	2,000
Seed sowing/labour cost*	:	4,600
Application of FYM (15 t/ha @ Rs.:3/kg)	:	45,000
Application of green mulches:**	:	Nil
Cost of paddy straw (2 t/ha @ Rs)	:	4,000
Hoeing/weeding**	:	3,000
Cost of digging/labour charge**:	:	6,000
Transportation cost:	:	1,400
Total	:	**90,000**
(B) Output costs		
Yield	:	10.5-13.7 t/ha (varies with cropping type)
Local market price for freshly harvested turmeric @ Rs. 8/kg	:	Rs. 109600.00
Net Benefit from cultivation of turmeric from 01 ha of land	:	Rs. 19600.00/ha

* partly borne by the farmers, ** available around the field; labour towards collection of mulch materials are borne by the farmers

Value Addition/Processing cost of Turmeric

One kg of freshly harvested turmeric after curing and drying gives about to 230g, which after processing it comes to nearly 200 g in powdered form.

10% of the total benefit gets deposited in the revolving fund/sustainability fund i.e Rs. 20360

90% of the profit is equally distributed among the 148 HHs which comes to Rs 12390/year. The net income generation from raw turmeric from 0.5 ha land holding to each HH: Rs 9800

The net income generation from the processed turmeric to each household Rs. 12,390.

Achievements

Before installation of the processing unit, the turmeric growers in the project site had not been harvesting the crops regularly owing to low market demand for the raw turmeric product, however, now the scenario is quite change.

- Processing of turmeric provides **36.63**% more income than selling of the raw materials.
- Use of organic mulches and intercropping with maize and other crops provides **30-35%** more yield than the traditional practice of sole crop.

Table 2. Economics of turmeric processing

The cost for processing 1 kg of fresh turmeric (i.e roughly 200 g powder)	Rs 40
Packaging cost per 1000g of powdered turmeric	Rs. 80
Total cost of processing of 1000 g powdered turmeric	Rs. 120
Cost of processing of a 100g packet	Rs. 12
Total weight of processed powdered from 1 ha of land (from the site):	Rs. 2670 kg
The total cost of processing @ Rs. 120/kg	Rs. 3,20,400
No. of 100 g packets/pieces	26700 nos.
The selling price @ Rs. 20/100g pack in local market	Rs. 20
Total processed & packed turmeric from 1 ha	Rs. 5,34,000
Net benefit (Rs. 53,400.00-Rs. 320400)	Rs. 2,13,600

- ➢ Use of machinery reduces drudgery by 30.0 %. However, this needs further confirmation.
- ➢ The intervention of scientific cultivation of turmeric with value addition provides 25-30 %

Management

The processing unit is managed by the Apex body, M/s Paradise Valley Development Committee, East Kalcho, Saiha district (Mizoram). The Secretary, Mr. Z. Chhapai is the overall I/c for coordinating between the farmers groups on processing of turmeric at the project site.

Constraints

Although, the processing unit has started with a good beginning, the farmers have shown more enthusiasm in taking up turmeric cultivation at a bigger scale, frequent failure of power supply to the village is a major constraint in the sustainability of the project.

Fig 2. Turmeric processing unit

Land Development for Integrated Farming System in Jhum Lands for Livelihood Improvement at Saiha, Mizoram

Y. Ramkrishna, S.B. Singh, T. Bhoopati, B.K. Singh, L.H. Puii and Chinlampianga
ICAR Research Complex for NEH Region, Mizoram Centre, Kolasib, Mizoram

Introduction

Theiva village is resource poor village of Saiha district at Mizoram state. Most of the villagers of Theiva depends upon the Jhuming (Fig 1). Adoption of new technologies is negligible due to lack of knowledge regarding the resource management in and out of field. Annual crops like maize, upland rice *kharif* vegetables etc were grown during the *kharif* season only. Animals mainly local breed of pig are reared in 2-5 numbers and some local birds are raised at the backyard. The village is under food deficit condition where 85 % of food grains were received through PDS or imported from other state. For animals protein villager use to go for hunting till day. The average income of the farmer were about Rupees 25,000 per annum.

The soil of Theiva village is acidic with pH rangeing from 5-6, loamy-sand to sandy-loam in texture, rich in organic matter and total hill topography. The intervention site lies at an altitude of 320 m MSL to 1100 m MSL with slope angle of 30 to 70°. Soil erosion is common due to high rainfall of about 2000-3000 mm per annum, out of this 80-90 percent of rainfall were received during five month of kharif season. In the later months onward soil become dry in the absence of rainfall.

Fig 1. Practice of *jhum* cultivation at IFS site before intervention

The top soil moisture remains near to the permanent wilting point or less with visible cracks. Under the livelihood improvement project of NAIP-III, on the "Introduction and Development of Integrated Farming System Technology" Mr. N. Thulanga, resident of Theiva village, Siaha district of Mizoram, a typical farmer with an annual income of Rs 32000 from his two 0.8 hectare piece of land. The income received from cultivation of maize and rice were Rs 9000 and Rs 21000 from rearing of local pig (Burmese breed).

Methodology

For the sustainable growth of the farmers, the intervention should meet both long-term and short-term goal. The resource can be utilized when the relationship between components are symbiotic or complimentary type. So his land was partitioned into annual crops 0.3ha (maize and rice), vegetable crop 0.2 ha (okra, french beans cabbage, chinese mustard) fruits tree 0.4 ha (Banana: 700, Lemon: 5, khasi mandarin 20, pineapple 200, mango: 25) forest tree 0.8 (teak) and intercropped with tuber crops (sweet potato, tapioca and colacasia). The remaining land used for construction of water storage structure, piggery unit, poultry unit, vermicompost unit. To develop an integrated farming system model, some investment on water harvesting structure (Rs 45,000), shade house (Rs 35,000,) pigsty(Rs 10,000), poultry house (Rs 5,000) and planting of economically important perennial tree or fruit tree were made. Terracing was undertaken in an area of 4.5 ha for demonstrating settled agriculture in the cluster village. During first year soybean (variety JS 335) and rice bean were grown for fertility build up. The crop and weed residues were used for mulching and manure**.** During the sbsequent year maize and rice was grown in the same plots were pulses were grown.

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Results

Maize variety RCM 76 was given to the farmers for cultivation in the terraced land. The RCM-76 variety can be harvested at 90-95 DAS (dough stage) and accommodate more plant per unit area to produce higher yield. The famers fetch higher price due to early availability of maize cobs in market beside their own consumption. After the maize crop farmer grow a second crop of soyabean (JS 335), during month of late July and August. Previously farmers were practicing mix cropping of maize with vegetable like pumpkin, chinese mustard etc. Out of the area, about 2600 numbers of cobs and 550 kg of rice were harvested. About 2500 maize cobs were sold to market and rest were consumed at household level. All rice grain was milled and 300 kg of rice was kept for self-consumption. Bran weight about 250 kg used as feed for poultry and pig. Soyabean production was 350 kg grain, out of which 30 kg was preserved for seed purpose, 50 kg was utilized for family consumption and rest was used as feed for poultry and pig.

Vegetable crops were grown in an area of about 1600 m^2. Ginger, okra, pumpkin, cowpea, french bean, bird eye chili were cultivated in the field while coriander and tomato in low cost shade net were grown during the *kharif* season. In the *rabi* season nursery of cole crop were raised in shade house for sell and remaining plant were subsequently transplanted in terraced land. Green coriander fetches higher and regular income than any other crop under shade house. The coriander required 45-55 days to give economic yield, so five crops per year were taken under shade house. The gross income generated by the vegetable cultivation has been Rs 32,000. The net income from the vegetable was Rs 25,000 with benefit cost ratio of 1.79.

Improved breed of Hamshire cross (4 female: 1 male) for fattening and dual purpose birds Vanaraja birds (25 No's) were distributed to the farmer. The Vanaraja birds with similar management of local bird gained a body weight of 2.79±0.51kg female and 3.82±0.84kg male, while the local folk weighed 1.25 ±0.46 kg female and 2.5±0.53 kg male after 6 months. To boost the body weight in addition to local feed supplement mineral mixture, deworming, vaccination etc were advocated. Supplements feed for vanaraja consisted of mainly broken rice, grass and some weeds, vegetable waste and kitchen waste.

The Hamshire cross produced 30 to 40 per cent more body mass compared to local Burmese breed which could able to gain body mass of 75-80 kg. The Hamshire cross-recorded a body weight of 129±5.8 kg under the IFS condition. The pig feed consisted of cooked little rice, bran, tuber or leaves of plants, damage vegetable etc.

About 600 kg of vermi cast from vermicompost produced within the system was utilized for the vegetable production mainly under shade house. An additional 1.0 ton of manure generated from piggery and poultry unit, utilized for terraced land fruit crops. So fertility of the farm maintain by the utilization of local resources.

Due to all the above interventions, Mr. N. Thulanga could earn a net income of Rs 1,38,500 (Table 1). The man-days were also increased from 120 days to 305 days. The farmers of Theiva village realized the importance of cereals, horticulture crops and animal component for higher productivity and income generation. With all this integration of component (Fig 2-5), income from the farming can be improved for sustainable economic development of the backwards peoples of Saiha district.

Fig 2. View of water harvesting structure of IFS model

Fig 3. Farmers grading farm produce at IFS model

Table 1. Economics of IFS in Theiva village, Saiha (Farmer- Mr. N Thluanga)

Component	Area (ha)	Cost of production (Rs)	Net income 2nd year onwards (Rs)	Benefit : cost ratio
Silvi-pastoral crops	0.064	1200	500	0.42
Fruits	0.30	11000	15000	1.36
Vegetable	0.16	14000	25000	1.79
Cereals	0.26	6000	9000	1.50
Other	0.016	-	-	-
Poultry		2000	6000	3.00
Piggery	4 female + 1 male	21000	80000	3.81
Vermicompost	2X3X1 m	1000	3000	3.00
Total	0.80	56200	138500	2.46

Fig 4. Pig feed preparation by farmers

Fig 5. Back yard poultry in IFS

Zero Tillage Toria Cultivation in Rice Fallow for Crop Intensification and Resource Conservation in Tamenglong, Manipur

I.M. Singh, Narendra Prakash, N.J. Singh and L.S. Singh
ICAR Research Complex for NEH Region, Manipur Centre, Lamphelpat, Manipur

Introduction

Rice is predominant crop (60%) and monocropping of rice is a commonly system practiced by the farmers in Tamenglong during the *kharif* season, keeping the remaining period of the years as fallow resulting in low cropping intensity of about 110 % which is the major problem in the cluster villages viz. Noney, Reangkhong, Awangkhul and Tupul Charoi Chagotlong. The productivity of rice in Tameglong is very low due to cultivation of local varieties and non adoption of improved cultural practices. In some pockets the farmers are cultivating mustard but the productivity is low due to poor agronomic practices, use of local variety and meager fertilizer/manure application. By adopting zero tillage for toria, the farmers could increase the productivity of toria, reduced the cost of cultivation thereby increasing the cropping intensity and earning an additional income for themselves with less effort. Zero tillage also helps in timely sowing of toria (October-November), conserve soil moisture and require less water, saves tillage cost and the soil is protected from erosion due to the retention of surface residues and reduce organic matter depletion.

Objectives

1. To enhance rice and toria productivity by improved cultural practice including varietal interventions
2. To conserve natural resource and reduce the cost of cultivation
3. To intensify cropping intensity and enhance farmers income

Methodology

The ICAR Research Complex for NEH Region, Manipur Centre selected 21 to 235 ha rice farmers with total area ranging from 5 to 63 ha. Similarly, 43 nos., 56 nos., 40 nos. 165 nos. and 172 nos. of farmers were selected during 2007-08, 2008-09, 2009-10 and 2010-11, respectively for training and demonstration on zero tillage cultivation of toria (Variety M-27). High yielding variety RC Maniphou 10 was demonstrated in farmers' field (Fig. 1). Trainings were conducted on zero tillage cultivation of toria

- ➢ A seed rate of 6-7 kg/ ha (sow the seeds after soaking 24 hours) and row to row spacing of 6-8 inches were advocated to the farmers.
- ➢ To facilitate row planting of toria and use of row marker and other small implements, transplanting of rice with wider spacing (20 x 20 cm) or SRI/ICM practice was suggested.
- ➢ Fertilizer dose of 80:60:40 NPK/ha + FYM 5 t/ha was recommended for rice. Half dose of N is used (86.8 kg) and remaining half 2 splits (43.4 kg each) doses at tillering and panicle initiation stage was advocated. Fertilizers dose of 60:30:30 NPK/ha (Urea-130 kg, SSP-188 kg/ha and MOP-50 kg/ ha). Half dose urea as basal and remaining half dose at 45 DAS was recommended.

Fig 1. A good crop of rice in farmers' field

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- ➢ Life saving Irrigation at 45 DAS and 60 DAS was advocated wherever possible for higher productivity.
- ➢ For managing aphids Spray spray of Monocrotophos (1 ml/lit water) at 10 days interval was recommended.
- ➢ When more than 75% of the pods matured, harvesting was undertaken during morning hours to avoid shattering losses.
- ➢ About 30 cm stubble height was retained in the field for resource conservation and fertility enhancement.

Fig 2. Introduction of Bee hives in toria field

- ➢ 50 bee hives were included in the toria field to generate additional income (Fig 2).

Results

Beneficiary farmers found that in the riverside foothills the improved blast resistant variety RC Maniphou-10 was superior to the local varieties not only in yield attributes but also in quality parameters. The productivity of RC Maniphou 10 ranged from 3.5 t/ha during 2007-08 to 3.87 t/ha during 2010-11 compared to low average productivity of 2.2 t/ha of local variety (Moirangphou) Table 1. Zero *tilla*ge rapeseed mustard production technology (*var*.M-27) could utilize the residual moisture to harvest a good crop (Fig 3).

The yield of toria was recorded at 0.64 t/ha, 0.73 t/ha, 0.75 t/ha and 0.88 t/ha during 2007-08, 2008-09, 2009-10 and 2010-11 respectively. The farmers' number has also increased from 43 HH in the year 2007-08 to 172 HH in the year 2011-12. Farmers could earn a net income of Rs. 17, 500 with B: C ratio of 2.30 (Table 1 and Fig 4).

Table 1. Adopted farmers, area covered and yield of rice in the four adopted villages

Noney Village								
Variety		Maniphou-6				RC Maniphou-10		
Year	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2008-09**	**2009-10**	**2010-11**	**2011-12**
Adopted farmers (nos.)	17	-	40	-	36	6	40	35
Area covered (ha)	4	-	10	-	12.5	1.8	10	12
Yield (t/ha)	3.69	-	3.8	-	3.94	3.8	4.2	4
Reangkhong village								
Variety		Maniphou-6				RC Maniphou-10		
Year	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2008-09**	**2009-10**	**2010-11**	**2011-12**
Adopted farmers (nos.)	12	-	35	-	5	10	25	15
Area covered (ha)	5.2	-	10	-	1.8	2.0	8	6
Yield (t/ha)	3.88	-	3.9	-	4.3	3.78	4.1	3.90
Awangkhul village								
Variety		Maniphou-6				RC Maniphou-10		
Year	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2008-09**	**2009-10**	**2010-11**	**2011-12**
Adopted farmers (nos.)	4	-	30	-	8	5	15	22
Area covered (ha)	0.25	-	10	-	2.2	1.2	5	4
Yield (t/ha)	3.75	-	3.7	-	2.04	2.88	3.2	3
Tupul village								
Variety		Maniphou-6				RC Maniphou-10		
Year	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2008-09**	**2009-10**	**2010-11**	**2011-12**
Adopted farmers (nos.)	4	-	20	-	8	-	30	-
Area covered (ha)	0.25	-	5	-	2.2	-	5	-
Yield (t/ha)	3.4	-	3.6	-	3.94	-	4.5	-

Table 2. Area, production and economics of rice-toria system

Particulars	Crop	2007-08	2008-09	2009-10	2010-11	2011-12
House hold, nos:	Rice	50	94	21	235	172
	Toria	43	56	40	165	172
Area (ha)	Rice	10	28	5	63	46
	Toria	14	23	12.8	65	95
Cost of cultivation (Rs/ha)	Rice	19,500	19,500	20,500	20,500	21000
	Toria	9,000/-	9,000	9,500	9,500	9,500
Grain yield (t/ha)	Rice	3.50	3.62	3.82	3.87	3.80
	Toria	0.64	0.73	0.75	0.88	0.85
% increase in yield	Rice	59	64	74	76	73
	Toria					
Gross income (Rs/ha):	Rice	70,000	72,400	76,400	77,400	76,000
	Toria	19,200	21,900	22,500	26,400	25,500
Net income (Rs/ha)	Rice	50,500	52,900	55,900	56,900	55,000
	Toria	10,200	12,900	13,000	16,900	16,000

Variety introduced - Rice: RC Maniphou -6 & RC Maniphou -6, Toria : M27

Fig 3. Zero tillage mustard at Tamenglong

Discussion

Due to adoption of HYV and improved agricultural practice, the rice productivity was enhanced by 59 to 76 %. Farmers started saving their own seed for next season and recovering higher price by selling seeds to other farmers. Zero *tilla*ge technique allows farmers to plant 15 days earlier than usual. Since the cost of land preparation was minimum, it also generates higher net income. This approach also reduced weed problems - because the soil is disturbed less under zero *tilla*ge, fewer weed seeds are exposed and fewer germinate. At present the area under zero *tilla*ge rapeseed mustard is being expanded rapidly. A total no of 204 farmers have benefitted from zero *tilla*ge toria cultivation covering an area of 114.8 ha. Farmers have also started to extract the oil from mustard in the oil expeller unit provided by ICAR-RC-NEH, Manipur Centre thereby enhancing their income from zero *tilla*ge mustard cultivation (Fig 6). Seeing the achievement by fellow farmers under zero *tilla*ge more numbers of farmers are showing their willingness to adopt this new technology of mustard cultivation.

Farmers earned an additional income of Rs. 600-700/- from the bee hives.

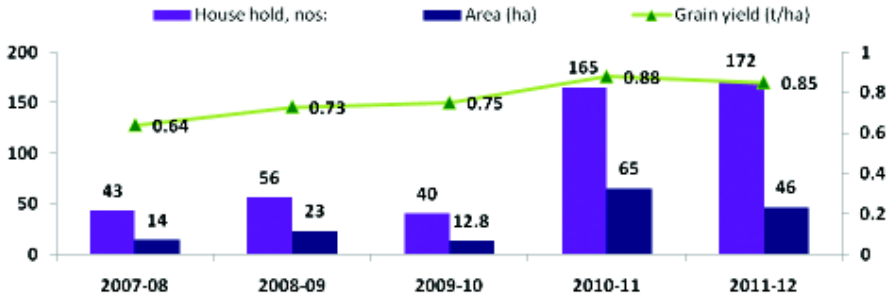

Fig 4. Growth of zero tillage mustard in Tamenglong

Fig. 6 Oil expeller unit at Tupul Village

Steps for sustainability

- ➢ To sustain the project activities, a concept of Sustainability Fund is still to be created in the sub project and the success of various interventions in the operational area in the post project can be judged by sustainability fund.
- ➢ Formation of farmer's interest groups at village level for marketing of farm surplus is taken up in marketing their surplus produce.
- ➢ The programmes was covered by different print and electronic media for wider dissimination (Fig 7)

Fig. 7 Scientist interacting with DD Reporters