

Integrated farming system models

for livelihood security and doubling the farmers' income
– A case study in Meghalaya

U K Behera^{1*} and P P Mohapatra²

College of Agriculture (Central Agricultural University, Imphal), Kyrdemkulai, Meghalaya 793 105

Integrated farming is a sustainable and effective tool for improving rural economy due to its cost effectiveness, low investment and higher profitability. It optimises the farm productivity per unit area through recycling wastes, by-product and crop residues from one enterprise to the other with due environmental consideration. Rice-based Integrated Farming systems involving crops (rice and vegetables) and livestock (piggery, poultry and goatry) generated a gross and net returns of ₹325,800 and ₹205,018, respectively with generation of employment equivalent of 318 mandays from 1 ha area in a year (2020-21). Such model can help in attracting rural youth towards agriculture as an entrepreneur venture and livelihood security to small-and marginal-farmers.

Keywords: Employment, Farmer, Income, Integrated Farming System, Meghalaya

AN integrated farming system (IFS) represents multiple crops (cereals, legumes, tree crops, vegetables etc.) and multiple enterprises (livestock, bee keeping, fish farming etc.) in a single farm in an integrated manner. For the small and marginal farmers of India, who constitute more than 85% of the total farming community, IFS plays a vital role for enhancing their income and livelihood. Integrated farming systems is a multidisciplinary whole-farm approach and very effective in solving the problems of small and marginal farmers. The approach aims at increasing income and employment from small-holdings by integrating various farm enterprises and recycling wastes and by-products within the farm itself. Under the gradual shrinking of land holding, it is necessary to integrate land-based enterprises like dairy, fishery, poultry, duckery, apiary, field and horticultural crops, mushroom, agroforestry etc. within the bio-physical and socio-economic environment of the farmers to make farming more profitable and dependable. No single farm

enterprise is likely to be able to sustain the small and marginal farmers without resorting to integrated farming systems for the generation of adequate income and gainful employment year round.

Farming systems in Meghalaya

Hill and mountain agro-ecosystem has severe soil erosion, very less irrigated area, limited land resources and unscientific land management and crop cultivation, erosion of biodiversity, high population of low yielding animals. In the hill and mountain agro-ecosystem, the land holding is much smaller than that in the plains. Therefore, for making hill farming sustainable and ensuring livelihood securities judicious use of the resources and technologies is imperative. Mountain eco-systems are generally fragile; physiographic and biophysical characteristics of mountain areas leads to farming on terraced and sloppy land masses with in-appropriate land use pattern; traditional farm practices with more impetus on human labour rather mechanization; small and marginal

land holdings with scattered arable land in hilly terrains, exploitation of natural resource base is limited, socio-agro-economic environment is highly vulnerable to external pressure; steep slopes and harsh conditions challenge mobility; transport costs to mountain areas are higher; market access and agri-market infrastructure is poor; inaccessibility is common in mountain areas leading to poor physical access to improved agricultural inputs and farm technological advancement; flow of farm technology dissemination is poor; establishment and maintenance of infrastructure is difficult and expensive.

Agriculture is the prime livelihood options for the people in Meghalaya. Around 80% of the total population of Meghalaya depends upon agriculture for their living. It is the wettest state in India. The rainfall is not evenly spread in all regions but overall, the state receives a large amount (2,818 mm/annum) of rainfall. Shifting cultivation is a popular traditional practice in Meghalaya commonly called the



Fig. 1. Integrated Farming System Model at College of Agriculture (CAU, Imphal), Kyrdemkulai, Meghalaya: A view.

Jhum cultivation. Under jhum land situations, acid soils are dominated. The productivity of jhum land is poor due to acidity and low nutrient supply capacity of the soil. Under the situation, monocropping of rice and other few crops grown results in less income to the farmers. The farmers of the area hardly able to generate income meeting the cost of production or sometimes with a marginal income. Integrated farming system is a potential option to boost the income of the farmers in jhum land.

Considering the above and importance of IFS in NEH region, projects entitled “Development of Model IFS village for livelihood security of tribal and resource poor farmers in Meghalaya” in collaboration with ICAR-CRIJAF, Barrackpore (W.B.) and ICAR-CIRC, Meerut (U.P.) and “Development of Model fruit and vegetable villages in Meghalaya” in collaboration with ICAR-IIVR, Varanasi (U.P.) operated in few adopted villages of Meghalaya. In this project integrated farming systems models were promoted with the objectives to double the farmers’ income and enhance livelihood security of the farmers.

Benefits of IFS

The advantages of IFS include pooling and sharing of resources/inputs, efficient use of family labour, conservation, preservation and utilization of farm biomass including non-conventional feed and fodder resources, effective use of manure/animal waste, regulation of soil

fertility and health, income and employment generation for many people and increase economic resources. It improves space utilization and provides diversified products for better family nutrition. IFS is a part of the strategy to ensure sustainable use of the natural resources for the benefit of present and future generations.

- **Productivity:** IFS provides an opportunity to increase economic yield per unit area per unit time by virtue of intensification of crop and allied enterprises. By adopting IFS, the system productivity can be enhanced to varying degrees depending upon the composition of farming systems.
- **Profitability:** Improved profitability by reducing production cost through recycling wastes/ by-products of one enterprise as input of other enterprise.
- **Sustainability:** Organic supplementation through effective utilization of by-products of linked component is done, thus providing an opportunity to sustain the potentiality of production base for much longer periods. It gives emphasis on achieving agro-ecological equilibrium through the reduction in build-up of pests and diseases and recycling the nutrient and energy within the system.
- **Balanced food:** Components of varied nature are linked to produce different variety of products/ produces (cereals, pulses, oilseeds, fruits, vegetables, milk, meat egg etc.) , which serve as balanced diet for the farm families.
- **Environmental safety:** In IFS

waste materials are effectively recycled by linking appropriate enterprises/components, thus minimize environment pollution.

- **Resource recycling:** IFS results in effective recycling of waste materials/by-products (crop residues and livestock wastes) in the system. Therefore, there is less reliance to outside inputs-fertilizers, agrochemicals, feeds, energy, etc. This leads to stable production system and reduction in production cost.
- **Income rounds the year:** IFS provides flow of money to the farmers round the year by way of sale of farm produces (milk, egg, mushroom, vegetables, fruits, food grains etc.).
- **Risk minimization:** IFS provides a stable and sustainable production systems through diversified crops and enterprises. This helps in risk minimization and resilience to climate change.

Integrated Farming Systems in Meghalaya: A case study

For implementation of IFS projects in adopted villages in Meghalaya, IFS model developed at the research station for hilly ecology (Figure 1) was disseminated to the farmers with suitable modification depending upon the farming situations with respect to resource availability, farm constraints and market opportunity. We present here the case studies of a farmer, who was awarded as the best farmer of the Meghalaya by Central Agricultural University, Imphal in Agri Fair during 6-8 March, 2021. The study was carried out with the farmer Mr. Drosing Kyrasian, village : Lummyrri, Block: Umsning of RiBhoi district of Meghalaya who could adopt an improved IFS model involving Piggery, Poultry, Goatry, Horticulture, Field Crops and Agro-forestry. The objective of the holistic intervention was to double and stabilize the farmers’ income.

Crop enterprises

Rice

Rice is the main crop for the farmers of the area in order to meet

the food requirement round the year. During monsoon (June to November) of the study year 2019-20, the farmer grew lowland rice in 8000 m² area. High yielding rice (Ranjit) and local rice varieties having 145-150 days duration were grown under transplanting. During field preparation, FYM was incorporated @ 5.0 t/ha. Nursery of rice crop was sown in the last week of May and transplanting was done in 1st week of July. No chemical fertilizer was applied to the crop. There were no pest problems and hence, plant protection measure was not required. After harvest of rice, the land was partly utilized for vegetables.

Vegetables

In upland/jhum land near to homestead, vegetables such as brinjal (*Solanum melongena*), tomato (*Lycopersicon esculentum* Mill), cucumber (*Cucumis sativus*), pumpkin (*Cucurbita moschata*), capsicum (*Capsicum annuum*), and king chilli (*Capsicum chinense*) and green vegetables mustard were grown in an area of 1420 m². Vegetables were grown with recommended practices and plant nutrition was met from FYM only @ 10 t/ha. Thus, the crops were grown organically without using chemical fertilizer.

Livestock

Farmers reared pigs, goat and backyard poultry (layer) in his farm with the objective to earn profit. The poultry bird “Vanaraja” was reared by the farmer. The available byproducts from the farm, viz. rice bran, kitchen wastes, water from fermented rice, and green grass/weeds (from the cropped area) were fed. No additional feed or any supplement was purchased from outside source for these livestock.

The produces of the farm and their sale proceed were recorded. At the beginning of the study, the income of the farmer from different crops and enterprise and total farm income were assessed for the previous year (2018-19). This was compared with the study year (2019-20) in which integrated farming system was

adopted by the farmer. To estimate the productivity of a component and compare with the crop component expressed in terms of equivalent crop yield (Rice equivalent yield, REY). Further the production estimation itself varies among the interlinked allied components in integrated farming systems. Productivity of allied components was worked out based on their economic products' on the local market prices.

Economics of IFS model

The performance of the IFS model in farmers field was commendable with a gross and net income of ₹ 325,800 and ₹ 205,018 per ha per year from 1.1 ha area with an investment of ₹ 121,782. The net profit was increased by 2.5 times with the adoption of intensive IFS than the conventional farmer's practice. The maximum system productivity in terms of rice equivalent yield was obtained with tomato and Chili (normal green and king chili). The king chili is a high value crop and sold at a higher price in the market. A total system productivity of 10.86 was obtained from 1.09 ha area. Benefit cost ratio in rice was low with 1.76 and it was maximum with piggery, tomato and Chili with 4.0, 3.59 and 3.26, respectively. Overall benefit cost ratio of 2.68 was obtained from the system compared to previous year 2.03. In this model the local resources, by-products and wastes were recycled making the farm self-sufficient and reducing the production cost. Initially the farmers were growing rice only with few vegetable crops from which his income was around ₹ 82,110 from an investment of ₹ 79,910. However with the diversification of the enterprise and inclusion of high value crops like king chilli, capsicum, tomato, broccoli, brinjal etc. their income was doubled/enhanced significantly (Table 1). Besides the production of egg, meat, fruits and vegetables helped in better nourishment of the farm family. Such a diversification and IFS approach resulted higher productivity (2.0 times in terms of REY), profitability (2.5 times compared to previous year), stability and resilience

Among the different enterprises, the king chilli and tomato contributed mostly for the farm income. However rice crop occupied major area (80%) of total area, but the income from the rice crop is only 16%. Though the income from rice is less but farmers are having no other option during rainy except rice due to heavy rain and valley lowland situations. After rice harvest, the land could be utilized for raising potato, tomato and other vegetables during *rabi* season. However, under the jhum land situations, vegetables like capsicum, brinjal, mustard (green leaf) along with enterprises like backyard poultry, piggery, goatry supplement their income to great extent.

Employment generation in IFS model

The IFS generated an employment opportunity of 318 man days from 1.09 ha area. The intensification of farming with vegetables is one of the reasons for additional employment generation. Due to poor mechanization opportunities, most of the farmers in the region go for manual plowing of land. There is need to popularize light farm machineries suitable under hill ecologies in order to reduce drudgery. The maximum engagement in the farming was from cultivation of rice, which engaged 38% of the total labour requirement. Generation of additional employment opportunities under farming system approach is due to diversification and integration of crops, livestock and horticulture. IFS approach to generate additional employment is very important in the area, where almost 5-6 months of farm families are unemployed. In general employment opportunities are higher and well distributed around the year in IFS compared to that of monoculture or commodity oriented agriculture. There was additional 51% higher employment generation leading to effective engagement of the farm family members in IFS compared to earlier farmers practice.

In eastern Himalayas, where shifting cultivation is the dominant practice of farmers, has put pressure on natural resources affecting the

Table 1. Income and employment generation by the marginal farmer through adoption of integrated farming system model by farmer in Lummyinri village (Ri-bhoi district) in Meghalaya during 2020-21

Crop/enterprise	Area (ha)	Sowing/planting time	Gross returns (₹)	Production cost (₹)	Net returns (₹)	Labour requirement (Mandays)	Rice equivalent yield (Tonne)	B:C ratio
X1 Paddy	0.80	June/July to November	75000	42550	32450	120	2.50	1.76
X2 Tomato	0.10	January/February to May	80000	22250	57750	60	2.67	3.59
X3 Chili (King Chili, normal green chili)	0.10	January/February to May	70000	21450	48550	57	2.33	3.26
X4 Other vegetables	0.08	June to May	16800	7532	9268	21	0.56	2.23
X5 Pig	0.0025 (3 number)	Round the year	40000	10000	30000	20	1.33	4.0
X6 Poultry	0.005 (20 birds)	Round the year	26000	10500	15500	25	0.87	2.48
X7 Goat	0.0025 (3 number)	Round the year	18000	7500	11500	15	0.6	2.40
Total	1.09 ha		325,800	121,782	205,018	318	10.86	2.68

productivity of land caused by land degradation, increased level of soil erosion, hydrological imbalance and forest degradation. Our studies revealed that farming system approach of land use through integration of agriculture of agri-horti crops, livestock, fishery, agroforestry etc has been found most suitable for livelihood security of tribal farmers and scientific management of the shifting/jhum land of the region.

Impact of IFS model

Under the project 'Development of model IFS and model fruits and vegetable villages' in Meghalaya more than 500 farmers were given training on IFS. They were exposed to the live demonstration on IFS at the instructional farm of College of Agriculture, Kyrdekulai, Meghalaya. Besides, technical guidance and input supports were given for establishing an IFS model at the farming systems level. As a result, farmers could establish multi-enterprise IFS model in their area, which helped in doubling the farm income.

Integration of technology involving piggyery, poultry, goatry, horticulture, field crops and agroforestry served as an ideal approach for developing rural bio-

entrepreneurship, which was adopted by rural youth and progressive farmers. Few farmers got training on value aided dairy products and scientific dairy farming as business model. As a result it helped in promotion of dairy farming. Later, the farmers were also supported with inputs, viz. mineral mixture, dairy feed, milk cane, medicines etc. those who started dairy farming. Adoption of dairy farming helped in production of cow dung/ manure at the farm level which could be recycled for crop production. Cultivation of high value vegetable crops, viz. capsicum, king chilli, brinjal, tomato, broccoli, potato, ginger, turmeric, cucumber etc. by the farmer under the support of the projects helped in enhancing the income of farmers. Promotion of kitchen garden in the area through the training programs and support of kitchen garden kits to around 1000 farmers in Ri-bhoi and West Khasi Hills district of Meghalaya through these projects helped many farmers in meeting their vegetables requirement from the own kitchen garden during the lockdown period expressing their satisfaction regarding our program. Besides, many farmers were benefitted through supply of chicken (4 weeks old birds) and piglets under the project, and could generate additional income from

the farming.

SUMMARY

Integrated farming system proved potential for doubling farmers' income, livelihood security and higher resource use efficiency. Such an approach is climate resilient. There should be efforts by the line department, scientists, NGOs and policy makers to promote IFS in the region for the sustainable development of small and marginal farmers. The entire philosophy of integrated farming system revolves round better utilization of time, money, resources and family labourers of farm families. The farm family gets scope for gainful employment round the year, thereby ensuring good income and better standard of living. It is high time that the scientists, administrators and planners should think on such lines and provide adequate facilities and encouragement to the small and marginal farmers and rural youth to go ahead with the integrated farming systems with a sense of commitment for the rural development in totality.

¹Dean, ²Assistant Professor, College of Agriculture, Central Agricultural University, Kyrdekulai, Ri-Bhoi, Meghalaya. *Corresponding author's e-mail: ukb2008@gmail.com

Know Krishi Unnati Yojana

The *Krishi Unnati Yojana*, a central sector scheme, is envisaged as umbrella programme for focusing on food security, by merging schemes on Soil-health Card, Integrated Scheme on Agricultural Co-operation and Agricultural Marketing, National Mission on Agriculture Extension, Horticulture Development, Price Stabilization Fund, National Mission on Sustainable Agriculture and other programmes.