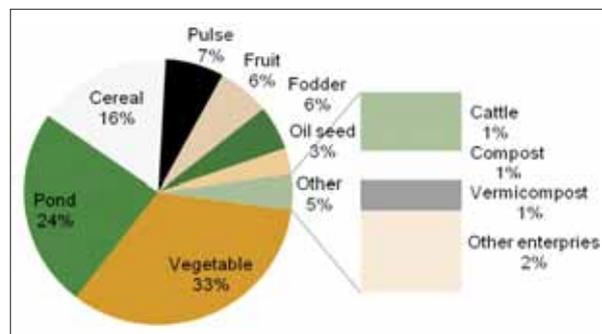




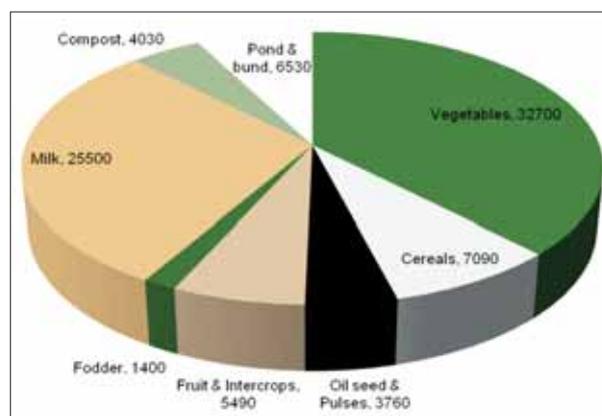
3. Farming System

Crops and livestock systems constitute the predominant land use systems in the smallholder production systems of our country. Such Integrated Farming Systems (IFS) provide a potent tool to support income, employment, livelihood and nutritional security in a sustainable manner. Integrated farming systems embodies multiple crops (cereals, legumes, tree crops, vegetables etc.) and multiple enterprises (animal farming, bee keeping, fish farming etc.) on a single farm. Vertical expansion of IFS systems by integrating appropriate farming system components requiring less space and time is a novel feature that can ensure periodic returns to the farmers. Farming system research is a powerful tool for the management of natural resources and for enhancing site productivity.

Farmers' participatory improved integrated farming systems: Location-specific integrated farming systems were designed for 192 small and marginal farm households in different states with farmers' participation. Technological interventions including primary processing/value addition of farm produce, scientific grain storage, nutritional kitchen gardens, composite fish culture, and backyard poultry with improved breeds, mushroom production and vermicomposting led to about 6.8 fold increase in net returns over variable costs. The total cost of such interventions ranged from ₹ 616 to 8,220 per household and the total net returns over variable cost of intervention ranged between ₹ 8,235 to 38,860. Household consumption of produces from within the farm and per day profit were 51.4 and 69.2% more respectively. Such interventions also generated an additional employment of 53.6 man days/year for the households.



Allocated areas (%) under 1 acre IFS model for EPHR



Layout of different components of 1 acre IFS



Buffalo component and onion in kitchen garden at Kangra (Himachal Pradesh)



A view of integrated farming system

Integrated farming system modules for rainfed ecosystem for eastern plateau and hill region: To enhance productivity and improve livelihood and

socioeconomic status of the people of eastern plateau and hill region, location-specific integrated farming system module for one acre area under rainfed ecosystem was developed. A total gross income of about ₹ 86,500 was obtained from one-acre IFS model during the first year with net monetary returns of about ₹ 45,060 per acre of land.

Melia dubia for farm and agroforestry: *Malai vembu (Melia dubia)* is a promising agroforestry tree species in the tropical region cultivated for commercial



Melia dubia block plantation at Ayalur, Erode district (Tamil Nadu)

purposes (boundary or block plantation or agroforestry systems). The rotation length (time from planting to harvest) is 10–12 years and the tree yields 0.39 to 0.42 m³ of timber per tree, which fetches a market value of ₹ 9,000/m³. The 1100 seedlings/ha were planted on the farmer's field in Ayalur model watershed, Erode district (Tamil Nadu) under the Macro Management of Agriculture (MMA)-National Watershed Development Programme for Rainfed Areas (NWDPR). The tree attained an average height of 8.5 m with 13.5 cm girth within two year after planting.

Gum/resin production from *Acacia jacquemontii*:

Acacia jacquemontii, a lesser known gum-producing species, native of Thar desert, yields gum of better quality than gum arabic, especially considering its use for edible purposes and the produce is sold at around ₹ 1,000 per kg. Very low doses of ethephon at 1 ml/stem were injected in plants growing in Nagaur district in March and April and an average gum production of 30–40 g/plant was obtained.



A plant of *Acacia jacquemontii* and gum collected from the shrub (inset)

Conservation agriculture

Pulses in rice fallows: Rice-lentil cropping system was evaluated in both upland and lowland conditions under different tillage and residue management options at Umiam, Meghalaya. Rice grown under MT-ZT (minimum tillage for rice and zero tillage for lentil)

Hydroponic fodder

Availability of green fodder is a major constraint in livestock production enterprises, especially during summer. Hydroponics technology (plant production without soil under controlled environment) is emerging as an alternative to grow fodder for farm animals. Dry matter digestibility of hydroponics maize fodder-based ration is higher than the conventional green fodder (hybrid napier)-based ration in dairy cows and heifers. However, to produce one kg of maize fodder, it would require about 1.50 l (if water is recycled) to 3.0 l (if water is not recycled and drained out) of water under Goa conditions, and the cost of production of the fresh hydroponics maize fodder is ₹ 4 to 4.50/kg. Recently, under the Rashtriya Krishi Vikas Yojana (RKVY) of Government of India, a hydroponics green fodder production unit was established at the ICAR Research Complex for Goa, for research, training, demonstration and technical guidance to the farmers.



Production of hydroponic fodder

system recorded significantly higher yield (3.41 tonnes/ha) in comparison to CT-CT (conventional tillage for both rice and lentil) system (2.46 tonnes/ha). In the lowland site, two rice varieties, viz. Mendri (long duration local) and Shahsarang 1 (medium duration and HYV) were evaluated during *kharif* and two lentil varieties (early duration with high biomass, DPL 81, and medium duration with high biomass, IPL 406) were grown in the rice fallow under zero tillage under different rice residue management practices. Early duration HYV Shahsarang 1 gave higher grain yield (5.02 tonnes/ha) compared to the local variety Mendri (3.63 tonnes/ha). The lentil crop grown after Shahsarang 1 recorded better growth parameters as compared to lentil grown after long duration rice, Mendri.

There was 65% and 30.2% enhancement in seed yield of lentil in upland due to mulching and 40 cm stubble heights compared to residue removal. Under lowland conditions, mulching and 20 cm stubble heights also recorded relatively higher lentil yield compared to residue removal but the extent of yield enhancement was lower than the upland.



Organic farming

Organic production package for passion fruit based cropping system: Bio-organic inputs for passion fruit based cropping system have been standardized. Suitable intercrops were identified and both main crop (passion fruit) and different intercrops were grown organically. In terms of yield, pineapple (39.15 tonnes/ha) and ginger (22.89 tonnes/ha) were most productive. However, maximum gross returns (₹ 14.54 lakhs/ha) were recorded for passion fruit + capsicum; followed by passion fruit + ginger (₹ 9.13 lakhs/ha). Application of vermicompost (6.5 tonnes/ha) + *Azospirillum* (20 kg/ha) + phosphate-solubilizing bacteria (PSB) (20 kg/ha) + arbuscular mycorrhiza (AM) (65 kg/ha) resulted in maximum yield of passion fruit (23.63 tonnes/ha), ginger (28.45 tonnes/ha) and capsicum (9.27 tonnes/ha), as well as enhanced the quality of passion fruit (30% juice content, 16.30°B TSS, 17.50 mg/100 g ascorbic acid, 4.75% reducing sugar and 8.43% total sugar). Application of pyrethrum and *Pseudomonas fluorescens* controlled major insect-pests and diseases of passion fruit.

Rice variety RC Maniphou 12: RC Maniphou 12 (RCM 13/IET No. 22828) variety of rice was released for cultivation in Manipur. It takes 75 days to reach 50% flowering and matures in about 90 to 105 days in summer (March-April sowing) in the valleys of Manipur. The variety is suitable as the first crop of the double cropping rice production system as well as for different cropping systems and is 100 cm tall with 50–200 spikelets/panicle and with a desirable soft cooking (low amylose content-11.70%) quality preferred by the people of north-eastern hill region. It has very low amylose content and the yield potential ranges between 4.5 to 5.0 tonnes/ha.



Tomato variety RC Manikhamenashinba 1: RC Manikhamenashinba 1, was bred with the objective of developing a HYV having tolerance to biotic and abiotic stresses. The variety is suitable for the rainfed/irrigated and rice fallows (life-saving irrigation). The variety has an yield potential of 4.25 tonnes/ha under good management practices and the fruits have smooth surface, soft firmness, juicy pulp, 6.7° Brix TSS and good shelf-life if properly stored. The variety is



Tomato variety RC Manikhamenashinba 1

moderately resistant to bacterial wilt and tolerant to leaf curl disease. It is also tolerant to moisture stress and is relatively free from fruit cracking which is a major problem in tomato.

Oil palm-based cropping system: Cropping system with red ginger and *Heliconia* in grown-up oil palm gardens (under irrigated conditions) was standardized. Red ginger and *Heliconia* are shade tolerant cut flower crops which can come up well even under dense (70–80%) shade. Both the crops could be successfully cultivated as intercrops in grown-up oil palm plantations of 4–5 years. Each clump/plant produced annually 30–40 flowers (45,000 flowers/ha/year) in *Heliconia* and 15–20 flowers (22,500 flowers/ha/year) in red ginger under drip irrigation. In addition, 12–18 tonnes/ha rhizomes of red ginger were harvested after 4–5 years. The cost of cultivation varied from ₹ 15,000 to 20,000/ha/year. Red ginger and *Heliconia* provided income to farmers round-the-year with a net profit of about ₹ 40,000/ha/year.

Arecanut: Arecanut productivity improved significantly (12%) in arecanut + cacao integrated system (3,450 kg/ha) along with 291.34 kg/ha cocoa yield as compared to arecanut solo crop (3,090 kg/ha). Diverse soil microorganisms like *Funneliformis mosseae*, *F. geosporum*, *Rhizophagus fasciculatus*, *Glomus macrocarpum*, *G. aggregatum*, *G. multicaule*, *G. glomerulatum* and *Acaulospora bireticulata* were isolated from arecanut-cocoa based cropping systems under organic management practices.

Seed spices—Sustainable and profitable intercropping model: Six seed spices were beneficially integrated as intercrops within aonla or ber orchards. Seed, stover and biological yield of intercrops were more under sole cropping but coriander equivalent yield (10,269.34 kg/ha) of ber and aonla fruit proved that there was higher yield of component crops due to intercropping with ber, followed by aonla as compared with sole cropping. Among seed spices, fenugreek intercropped with ber or aonla was more beneficial with higher coriander equivalent yield.

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