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Integrated organic farming system

for livelihood and nutritional security

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A key limitation in organic farming is the insufficient availability of bulk organic inputs. This challenge can be addressed through effective recycling of both on-farm and nearby resources, along with integration of different farm components. To overcome this, an Integrated Organic Farming System (IOFS) model was designed, incorporating cereals, pulses, oilseeds, vegetables, fruits, fodder crops, dairy, fish pond, duckery, and a vermicomposting unit. The model aims to fulfill the diverse needs of farm households while conserving resources and protecting the environment. Vertical intensification was achieved by growing climbing vegetables on bamboo structures built above water bodies. Solid wastes from cattle sheds were processed into farmyard manure (FYM) and vermicompost, while wash water from dairy and duck units was channeled into fish ponds to stimulate plankton growth. Rainwater harvesting further supported critical irrigation during winter. On a 0.43 ha farm (near 1.0 acre), the IOFS model yielded a net return of ₹88,820 annually (equivalent to ₹2,06,558/ha/year), substantially higher than conventional farmer practices such as rice-fallow or rice-vegetable rotations. Nutrient recycling within the system was highly efficient, meeting about 95.4% of nitrogen, 83% of phosphorus, 98.2% of potassium, and most micronutrient demands internally. Demonstrations of this model on farmers' fields gained popularity, showing marked improvements in crop and livestock productivity under organic management compared to traditional approaches.

Keywords: Hill ecosystem, Integrated organic farming system (IOFS), Nutrient balance, System productivity

AGRICULTURE in northeast India, particularly in Meghalaya, is largely traditional, characterized by minimal use of chemical fertilizers and pesticides, reliance on local crop varieties, subsistence-oriented practices, and generally low productivity. The state's geography is predominantly hilly and mountainous, with over 70% of the area under sloping terrain, while less than one-third comprises valley lands 2019. To address these challenges, an Integrated Organic Farming System (IOFS) model was initiated in 2005 on 0.43 ha of valley land at the ICAR Research Complex for NEH Region, Umiam, Meghalaya (21.5°N–29.5°N latitude, 85.5°E–97.3°E longitude, 950 m above sea level). The IOFS concept builds upon the foundations of both organic farming and integrated farming systems. It represents a sustainable and holistic strategy that merges crop cultivation, livestock rearing, and agroforestry to establish a mutually supportive and ecologically balanced system. Central to this model is the efficient use of local resources, reduction of external inputs, and enhancement of biodiversity. Organic farming principles are applied through practices such as the use of organic manures, bio-pesticides, and crop rotations, all aimed at sustaining soil health and fertility. By adopting a circular approach to agriculture, waste generated in one component is recycled as input in another, thereby strengthening resilience, minimizing dependence on synthetic inputs, and reducing the adverse impacts often associated with conventional farming.

Development of IOFS model in institute farm

Proper farm design is essential for optimizing resource use within a production system. The IOFS model was established on 0.43 ha (1 acre), scientifically integrating field and horticultural crops with livestock units, fodder blocks, a central water body, leguminous

IOFS model developed at ICAR Research Complex, Umiam, Meghalaya

hedgerows, farmyard manure (FYM) pits, and vermicomposting structures. A 500 m² pond with an average depth of 2 m was included, serving as both an irrigation source and a site for aquaculture. Composite fish culture was followed, combining surface, column, and bottom feeders in a 40:30:30 ratio. A dairy component with one crossbred cow and a calf provided milk as well as manure for crops and the fish pond. The cowshed was strategically placed on the pond embankment so that wastewater drained directly into the pond, promoting growth of plankton that functioned as natural fish feed. To supply organic fodder, perennial grasses such as broom grass, Congo signal, hybrid napier, and guinea grass were cultivated. Solid cattle waste was processed into FYM and vermicompost.

The cropping system incorporated cereals (rice, maize), pulses (lentil, pea), oilseeds (soybean, rapeseed), vegetables (tomato, French bean, carrot, okra, brinjal, cabbage, potato, broccoli, cauliflower, chilli, coriander), spices (ginger, turmeric, chilli), and fruits (papaya, guava, banana, peach, pineapple, Assam lemon). A nutritional kitchen garden was also developed, using crop rotation, diversification, and intercropping with legumes to ensure continuous vegetable supply. In low-lying zones, raised and sunken beds were created—vegetables like tomato, carrot, and French bean were grown on raised beds, while rice-pea/lentil was cultivated in sunken beds. Crop residues were returned to the soil as mulch or compost. Hedgerows of *Tephrosia candida* were planted along bunds to supply nitrogen-rich biomass, which was used as mulch or green manure. Climbing vegetables such as pumpkin, bottle gourd, cucumber, chow-chow, and ridge gourd were trained on bamboo structures (machans) built above pond dykes and FYM pits to intensify production vertically. Nutrient supply was managed entirely through organics like FYM, vermicompost, and rock phosphate while pest and disease management relied on biological and cultural measures.

The system achieved high internal nutrient recycling, meeting about 95.4% of nitrogen, 83% of phosphorus, 98.2% of the total potassium and most of the micronutrient needs from within the farm. The 0.43 ha model generated an annual net return of ₹ 88,820 (equivalent to ₹ 2,06,558/ha), substantially higher than farmers' prevailing practices in the region.

IOFS models developed at farmers' fields of Meghalaya

The dissemination of IOFS technology was carried out through a cluster-based approach with the objective of enhancing the livelihoods of tribal farming communities. Priority was given to areas where farmers either avoided or used very limited amounts of synthetic fertilizers and pesticides. The central premise was that integrating IOFS with scientific organic practices would not only sustain yields but also enhance productivity. The programme was first implemented in three villages of Ri-Bhoi district, Meghalaya—Mynsain, Pynthor, and Umden Umbathiang, covering about 340 households, of which more than 95% belonged to tribal communities. Building on the initial success, organic farming initiatives were later expanded to other districts of Meghalaya through projects such as the Network Project on Organic Farming, the Tribal Sub-Plan, and the National Mission on Sustainable Agriculture for Hill Regions. A large-scale effort was subsequently launched in partnership with the Government of Meghalaya and the School of Livelihood and Rural Development (SLRD) to bring nearly 200,000 ha under organic certification. To formalize collaboration, aMoU was signed with SLRD, Shillong, focusing on organic farming promotion and certification processes.Water management interventions were a major component of the programme. Numerous farm ponds were either established or renovated, and low-cost rainwater harvesting structures known as Jalkunds were introduced. These structures, constructed using 250 GSM silpaulin sheets, enabled collection of monsoon rainwater for supplemental irrigation of high-value crops during dry spells. The use of Jalkunds significantly enhanced crop productivity, facilitated diversification into more profitable crops and livestock systems, and contributed to food and livelihood security throughout the year. To reduce drudgery and improve efficiency, small-scale mechanization was promoted, and farmers were trained in organic farming techniques, including recycling of crop residues. Additional enterprises such as mushroom cultivation and apiculture (beekeeping) were introduced to diversify income sources. These activities not only supported nutritional security but also generated supplementary

income, ensuring better utilization of available on-farm resources.

Flow chart/ steps of technology

Site selection: Identify suitable land close to the homestead for establishing an Integrated Organic Farming System (IOFS)

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Water management: Construct rainwater harvesting structures such as jalkunds or small farm ponds to ensure water availability

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Animal husbandry: Establish units for dairy, piggery, or poultry to provide income, nutrition, and organic manure

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Nutrient recycling: Build compost pits and vermicomposting units to recycle animal dung, kitchen waste, crop residues, and weeds into organic manure

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Kitchen garden: Develop a nutritional garden with year-round vegetables of high demand

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Field crops: Grow maize followed by French bean to maintain crop diversity and soil fertility

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Fruit cultivation: Plant fruit crops like pineapple, Assam lemon, papaya, banana, and guava along field boundaries and corners

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Vertical intensification: Construct bamboo machans over jalkunds and cultivate climbing vegetables such as pumpkin and bottle gourd

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Fodder and multipurpose trees: Promote the cultivation of fodder grasses and multipurpose tree species for livestock and ecological benefits

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Market linkage: Develop strategies for marketing surplus farm produce to strengthen farm income and promote entrepreneurship

Impact

The economic benefits of IOFS were evaluated over a five-year period in Meghalaya to assess their impact on farmers' livelihoods. It was observed that IOFS substantially enhanced productivity and farm income by integrating multiple enterprises such as crop cultivation, livestock, fisheries, and on-farm nutrient recycling through composting and vermicomposting. Crop and vegetable yields showed notable improvements compared to traditional practices (use of local varieties, low inputs, and limited recycling). Productivity gains were recorded at 20–30% in maize, 40–45% in French bean, 33–40% in ginger, 45–50% in tomato, 37–50% in carrot, and 27–30% in chilli. Livestock contributed 41–49% to the total farm income, while fishery added 3.5–9.5%. Farmers also recycled large volumes of biomass, producing 0.4–1.25 tonnes of quality vermicompost, annually.

Case studies further highlighted the model's profitability. For example, Mr. Jrill Makroh and Mrs. Skola Kurbah achieved net annual returns of ₹ 46,695 from 0.27 ha (equivalent to ₹ 1,73,702/ha) and ₹ 31,100 from 0.21 ha (₹1,48,946/ha), respectively. These figures were considerably higher than the prevailing farmer practices of maize-fallow or maize followed by vegetables in partial areas during the winter season. Nutrient self-sufficiency within the IOFS was also remarkable, meeting 76–95.1% of nitrogen, 68.6–82% of phosphorus, and 85.5–96% of potassium requirements through internal recycling. Additionally, about 70% of seed needs were fulfilled from farm-saved seed. With organic certification, both income levels and livelihood security are expected to improve further. The successful demonstration of IOFS in Meghalaya has gained international recognition, with the initiative featured in the Compendium of Country Case Studies presented at the United Nations Climate Change Conference of the Parties (COP26) in Glasgow, United Kingdom, in November 2021.

IOFS models developed in different villages of Meghalaya

SUMMARY

Integrated Organic Farming System (IOFS) represents a sustainable and eco-friendly farming model that promotes entrepreneurship, particularly for small and marginal farmers. By combining crops, livestock, water management, and composting, the system diversifies farm income sources and reduces dependence on a single enterprise. The integration of high-value crops, vegetables, spices, fruits, and livestock enables farmers to respond to market demands, minimize risks linked with monocropping, and create new opportunities for agribusiness development. Field demonstrations of IOFS have shown that, under organic management, both crop and livestock productivity improved considerably compared to traditional practices. The models also generate a substantial proportion of nutrients internally, ensuring long-term sustainability while enhancing farm income and strengthening rural livelihoods.

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