3. Farming Systems

Integrated farming systems

Integrated farming systems for marginal and small farmers: An integrated farming system (IFS) model for marginal and small farmers of western Uttar Pradesh was developed for an average farm family of 7 members. The IFS model, besides producing all the required domestic food and feed items including cereals, pulses, oilseeds, vegetables, fruits, meat and milk etc. for daily consumption, also produced green and dry fodders for their animals in sufficient quantities and generated an additional revenue of Rs 130,622/year to meet the other liabilities. The system besides being profitable in term of net return of Rs 75,211/ha/year, also generated 347 additional man-days as compared to crops alone (182 man-days/year), offering increased employment opportunities to the rural youth. Not only this, all the farm-wastes, crop residues, animal urine and dung etc. were properly collected, composted and recycled in production process of different enterprises, viz preparation of vermicompost (3.2 tonnes FYM), fish meal and fruits and crop production etc.

Rainwater harvesting and multiple water use: A rainwater harvesting tank was constructed on the mid-land of the plateau region lined by LDPE film. Multi-tier horticulture system comprising litchi as main crop, guava as filler crop was planted in the command area with vegetables (including pea, French bean, cucumber and tomato) on about 1,000 m^2 area as per water availability. With the supplementary irrigation from the harvested rainwater, rice and cowpea were sown in an area of 1,210 m^2 and 456 m^2 respectively. On bunds, bottle gourd, pointed gourd, and maize cobs were grown. In all, the total income from vegetables, rice and fish was Rs 18,690 in the very first year.

Multiple-enterprise agriculture for livelihood security in reclaimed sodic lands: The traditional rice–wheat cropping system gives income to farmers only twice at the harvest time, though regular income is needed throughout the year. A multi-enterprise farming system model is being developed to increase water productivity, farmers' income and year-round employment generation relevant for small land-holding farmers. The model involves components of crops, fisheries, animal husbandry, horticulture, vegetables, bee keeping, *gobar* gas plant, solar heating system etc. for a 2 ha reclaimed sodic soils area. The initial first year

Multiple uses of harvested rainwater in Jharkhand

Multiple enterprise agriculture-based integrated farming system

results indicated that rice–wheat rotation provides an annual return of Rs 39,400/ha, vegetable (bottle gourd–cauliflower)-based crop rotation Rs 80,000/ha, and the forage-based crop rotations like maize– maize–berseem and sorghum–berseem/ oat Rs 59,000 and Rs 40,000/ha respectively. About Rs 35,000 were earned in 3 months through the sale of milk from 4 buffaloes. The vegetables cultivated on the dikes of fish pond are generating weekly income of Rs 200–300. Sale of fish from 0.2 ha fish pond generated a revenue of Rs 15,000. The cowdung was utilized in the *gobar* gas plant to generate cooking gas to meet energy requirement of 6–8 people. After generating energy, the cow-dung slurry was poured into fishpond as fish feed.

Enhancing productivity of waterlogged area through optimizing micro-water resources design and integrated farming system: Micro-level water resources design was optimized in waterlogged area using water balance simulation model. The design dimension of on-farm ponds were decided from field level water balance. As a part of reclamation, an integrated farming system was developed with integration of bio-drainage and cultivation of water-loving co-existing crops.

The waterlogged wasteland was converted into alternate elevated platforms on which bio-drainage vegetation of *Acacia* and *Casuarina* was planted at 2 m × 2 m spacing with an objective to lower the rising water-table. In the 2nd year of planting the water-table was below 2.75 m under bio-drainage vegetation, while in other experimental plots it was within 0.75 m during summer. Intercrops like pineapple, arrowroot, turmeric have also been successfully raised inside bio-drainage vegetation.

Crop diversification

Alternate cropping systems to rice–wheat system for different agro-climatic zones of northern India

- In mid-high altitude intermediate zone of Jammu and Kashmir a system involving rice–potato–wheat was found to be more efficient in terms of production (13.9 tonnes/ha/year), giving about 51% higher yield than the existing rice–wheat system. But in economic terms, rice–wheat–sorghum+cowpea (fodder) was better than other systems and gave highest profitability of Rs 121/ha/day, resulting in relative gain of 38% higher over the existing rice–wheat system.
- In terms of wheat-equivalent yields, rice–potato–sunflower (18.30 tonnes/ha/annum) and rice–potato–wheat (15.50 tonnes/ha/annum) and sugarcane–ratoon–wheat (14.40 tonnes/ha/annum) have emerged as potential alternatives to existing rice–wheat system (9.00 tonnes/ha) under north-western plain region.
- In central plain zone of Punjab, system involving rice–potato–groundnut was identified to be more productive with highest productivity of 54.5 kg grain/ha/day and profitability of Rs 96/ha/day. This system was more productive with relative production efficiency of 82% and relative economic efficiency of 191% than rice–wheat system.
- In *bhabar* and *tarai* zone of Uttarakhand, rice–vegetable pea–rice system was more productive (14.0 tonnes/ha/year) with highest productivity (38.4 kg rice- equivalent yield/ ha/day) and profitability of Rs 112/ha/day.
- In central plain zone of Uttar Pradesh, maize–potato–wheat was more productive (15.8 tonnes/ha/year) with highest productivity of 43.2 kg grain/ha/day. But, in terms of economics, maize–pea–sunflower was found to be more economical which gave highest profitability of Rs 78/ha/day. It was 114% higher than the existing rice–wheat system.
- In Vindhayan plain zone of Uttar Pradesh, rice–potato–greengram system was more productive (14.3 tonnes/ha/year) with highest productivity (39.2 kg grain/ha/day) and profitability (Rs 58.2/ha/day). This system was superior to the tune of 69% in terms of relative production efficiency and 80% in terms of relative economic efficiency compared to the existing rice–wheat system.
- In south alluvial zone of Bihar, rice–potato–onion was found better with highest system yield of 18.1 tonnes/ha/year in terms of rice-equivalent yield, productivity of 49.7 kg/ day/year and relative production efficiency of 135% compared to existing rice–wheat system. But in terms of economics, rice–berseem–maize+cowpea (fodder) system was more remunerative which gave highest net return of Rs 45,624/ha/year, profitability of Rs 125/ha/day and relative economic efficiency of Rs 224% compared to existing rice–wheat system.
- In plain zone of Chhattisgarh, rice–tomato system was superior to existing rice–wheat system which gave highest yield (15.2 tonnes/ ha/year) with productivity of 41.6 kg/ha/day and profitability of Rs 168/ha/day.
- In Keymore plateau and Satpura hill zone of Madhya Pradesh, system involving black-gram–potato+wheat was better for production (11.8 tonnes/ha/year) and productivity (32.3 kg rice grain-equivalent/ha/day).
- In Vindhyan plateau zone of Madhya Pradesh, soybean–wheat system was found better in terms of rice-equivalent yield (7.1 tonnes/ ha/year), productivity (19.6 kg grain/ha/day) and profitability (Rs 62/ha/day).

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