3

Farming Systems

Viability of site-specific nutrient management in rice-wheat cropping system: On an average (9 locations), site-specific nutrient management (SSNM) outyielded farmers' practice (FP) by around 2 tonnes/ha (~ 36% higher). This improvement was achieved at an average benefit: cost ratio (BCR) of 5.8, which means that every extra rupee invested in nutrients for SSNM over FP produced extra crop value of Rs 5.8 on a net basis.

NB 4- a high-yielding local cowpea selection of Goa: Field evaluation of selected local cowpea accessions in rice fallows under residual soil-moisture situations in Goa revealed that cowpea accessions NB 4 at 45 cm spacing recorded the highest cowpea seed yield (1,137 kg/ha) and biomass yield (5.68 tonnes/ha).

A new mustard variety: CS 56 (Triveni), a new raya variety, identified as CS 234-2 with higher oil content (37.4%) released for late-sown irrigated conditions of Zone II (Sriganganagar, Bathinda, Ludhiana, Hisar, Bawal, Navgaon, Delhi). The average yield of this new cultivar was recorded 1.28 tonnes/ha which was nearly 15.2, 57.8 and 17.2% higher over the national checks Vardan, Varuna and Kranti respectively.

Drought-tolerant variety of horsegram mutant: During 2009 severe drought, horsegram served as a successful contingent crop for sowing even up to September. Considering its importance in drylands, the CRIDA developed and released a drought-tolerant horsegram mutant (CRIDA 18R) for the south zone. The variety is early maturing (85–95 days) with synchronized podding, tolerant to pod shattering, yellow mosaic virus and powdery mildew. In farmers' fields, it recorded a mean grain yield of 912.0 kg/ha which was about 40% more over national checks.

Superior gonda types: *Gonda* (*Cordia myxa*) fruits constitute an important vegetable and pickling material in the desert, especially during summers when other vegetables are meager. Its wood is used in making minor agricultural implements. To select superior genotypes, evaluation of its germplasm for 3 years was carried out which resulted in selection of 3 superior accessions, namely 'G 2025' (19.7 kg/plant), 'G 2012' (17.5 kg/plant), 'G 2061' (12.1 kg/plant).

Superior *karonda* cultivars: *Karonda* (*Carissa carandus*) fruits are used for making pickles, jams and *chutneys*. Its germplasm evaluated for the last few years resulted in selection of two superior genotypes, namely pink fruits (CZK 2001-17) and purplish green fruit (CZK 2000-1).

Complementary cropping systems for high productivity and profitability: To ensure efficient resource use with high productivity and profitability, 7 cropping systems along with land configurations, *in-situ* green manuring, residue incorporation, zero/minimum tillage and intercropping approaches were evaluated. The conventional rice-wheat system generally gives rice-equivalent yield of ~ 10 tonnes/ha and profitability of Rs 166/ha/day under irrigated condition. However, by substitution of conventional rice variety with hybrid rice, an increase in yield of about 2.16 tonnes/ha could be achieved. Similarly, comparable rice-equivalent yield (15.3 tonnes/ha) could be harvested from maize cobs + cowpea - wheat (ZT)- greengram(ZT, G+R) on flat bed system with productivity of 41.8 kg/ha/year and profitability of Rs 267/ha/day. The system involving pegionpea + blackgram - wheat (ZT)-greengram was also equally better in terms of productivity (44.8 kg/ha/day) with highest benefit:cost ratio (2.24) due to low cost of cultivation.

Multi-tier cropping system in tribal dominated eastern ghats of Orissa: Papaya intercropped with ginger + pigeonpea (8:2) and boundary plantation

SUCCESS STORY

Management of seasonal waterlogged areas of coastal ecosystem

To enhance productivity of seasonal coastal waterlogged areas pond-based farming technology (deep water rice in *kharif* + watermelon, okra, spinach, chili in winter + on-dyke vegetables-fruits + fish inside pond) was conceptualized and evaluated in a representative deep waterlogged areas (1–2.5 m water depth) of Puri district, Orissa.

The pond-based farming technology enhanced the net water productivity to Rs 7.29/m^3 and net returns of Rs 26,735/ha compared to Rs 1.4/m^3 (net returns Rs 22,100) in rice. Improved deep water rice cultivar Hangseswari gave 2.4–2.5 tonnes/ha yield in *kharif* season in deep waterlogged situation which was about 200% higher than of local cultivars. This pond-based farming technology can be replicated in 3.4 m ha deep water areas of eastern India.

A MoU was signed (repatriate agreement) between Directorate of Water Management, Technology Information, Forecasting and Assessment Council (TIFAC), DST, GOI, New Delhi and a NGO (AID, Bhubaneshwar) for large-scale dissemination of the technology.

Deep water rice Hangseswari in farmer's field

Pond-based farming system to enhance productivity of seasonal deep waterlogging areas

of gliricidia, registered yield of papaya to the tune of 15.45 kg/tree with lowest runoff as well as soil loss (1.893 tonnes/ha). Among different intercrop combinations, ginger + pigeonpea showed significant superiority for different yield attributes, namely pods/plant, pod length, seeds/pod and test weight in comparison to other intercropping combinations of runnerbean + pigeonpea and *ragi* + pigeonpea. Boundary plantation of gliricidia improved various biophysical measures and yield of papaya fruits tree to the tune of 46%. Further, intercropping of fruit trees (papaya and drumstick) improved the yield of ginger up to 37%. Green leaf manuring of gliricidia improved biophysical measures like plant height, number of secondary branches of drumstick to the tune of 17.5 and 5% respectively. Similar treatment on ginger beds improved number of tillers (8.44), finger no. (6.34) and ginger yield (11,986 kg/ha).

Gmelina-turmeric-based agroforestry for humid and sub-humid zone: *Gmelina arborea*, a fast-growing N-fixing tree species is suitable for rainfed uplands of humid and sub-humid regions. The species can ameliorate soil physical condition and improve soil productivity, besides providing timber. It attains a height of 25–30 m and dbh of 40–45 cm within 10 years of growth and is of good timber value. Turmeric as a shade-tolerant crop can be successfully grown with a yield recovery of 80% and with a benefit:cost ratio of 2.16. A farmer can generate net returns of timber worth Rs 3,000–4,000 after 10 years of growth and 7–8 tonnes/ha of turmeric from 5 years of tree growth.

Gmelina with turmeric, sapota, teak-based agroforestry system for hilly zone of Karnataka: This technology is suitable for adoption in transitional and hilly zone with medium/deep soils under irrigated condition. Sapota was planted at a recommended spacing of 10 m × 10 m. Three teak plants planted in between two sapota plants across the slope. The first teak at 3 m from sapota and subsequent two teak trees at 2 m, thus leaving 3 m again between last tree and sapota. On either side of sapota and teak, guinea grass was planted in a strip of 1 m width. In between two rows of sapota+trees, field crop was grown for initial 8–10 years based on canopy coverage. Initially paddy was grown for 6 years, South African maize for

SUCCESS STORY

Farming system model for small and marginal farmers of eastern India

Rainwater harvesting system was designed and agricultural diversification model (on-dyke horticulture, fisheries, cultivation of diversified field crops, short-term fruits like papaya, banana, floriculture like marigold, tuberose etc.) with harvested rainwater was developed for small and marginal farmers through multiple use of water. The same model was implemented in Bahasuni watershed of Dhenkanal, Orissa and by adopting the technology farmers are earning Rs 22,810–35,000/ha. Owing to harvesting of spring and rainwater, irrigated areas of 2 villages of the watershed increased from 3.2 ha (2002–03) to 26.5 ha (2008–09) where 55 tribal families were benefited. The technology has been recommended for inclusion in the 'National Rural Employment Guarantee Act (NREGA) for implementation in watersheds of eastern Indian states.

Agricultural diversification with harvested rainwater

3 years and sunhemp for next 3 years until crown coverage was observed. The space available for agricultural crops was reduced gradually depending upon growth of sapota and tree species. Cultivation of arable crops became difficult after 13 years. At the end of 17 years teak planted adjoining sapota were harvested for pole purpose. The teak was retained for timber purpose up to 28 years. The technology will help for commercial entrepreneurship for higher income with net returns of around Rs 22,000/ha/year after 28 years. It also acts as green cover conserving soil, moisture and fertility, besides generating employment during the off-season.

Thornless cactus– an unconventional feed source for arid region livestock: Cactus has 8% dry matter (DM) and 26.55% mineral rich ash, comprising 9.42% acid insoluble ash (AIA) and 90.52% acid soluble ash (ASA). Animals, namely cattle, sheep and goat, had shown fairly good acceptability, palatability and dry matter intake for chaffed cactus cladodes with conventional grasses/ straw. Animals have registered significantly higher body weight gains against the grasses/straw control. Besides, the water requirement of animals on cactus + grass/straw feed was considerably reduced, making the cactus a feed admixture of choice in the water scarcity desert. Also the mineral deficiencies in desert animals will be corrected by feeding the mineral rich cactus + grass/straw mixture.

SUCCESS STORY

Fish farming in harvested water system

Shri Manabendra Moharata, a farmer at Bhataparagarh village, Khurda district of Orissa, produced about 11 crore carp spawn, 1.7 crore fry, 8 lakh fingerlings and 3 tonnes of yearlings in harvested rain water from the catchment areas of the hilly terrains. The IARI National Award for 2009 was presented to him for this innovative activity. The technical advice for the same was provided by the CIFA, Bhubaneshwar.

Feeding of mineral rich resource-thornless cactus to Tharparkar cattle (*inset:* thornless cactus)

Lobster farming in open sea: Lobsters were cultured in floating cages in open sea along Vizhinjam coast. The lobsters attained weight of 200–350 g in 4½ months with 85% survival rate and yielded 200 kg produce.

Organic shrimp farming: A low-input shrimp farming technology with low stocking density of 6 nos/m^2 using organic principles was developed, with a production of 1.2 tonnes/ha. In organic farming of *Penaeus monodon*, low fish meal feed was applied in the ponds along with yeast-based organic preparations and vermicompost as other organic inputs. The shrimps so produced were healthy and free from WSV, IHHNV, YHV and GAV diseases. Substantial gain in the production level (15%) and improvement in size at harvest (10%) with better FCR (6.57%) by following organic principles were achieved.

Inland saline resource utilization for aquaculture: *Penaeus monodon* culture technology was refined successfully with a stocking density of 6 PL/m^2 in inland saline farm at Rohtak Centre, Haryana using groundwater with 10% salinity. The production achieved was 1.3 tonnes/ha with the survival rate of 85%, food conversion ratio (FCR) of 1:1.2, within a period of 110 days. ❑