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Farming Systems

Farming/Cropping Systems Research

Mechanical transplanting of rice: Rice transplanting is a very cumbersome and labour intensive process. To overcome this problem, a mechanical transplanter was developed. It was evaluated both in on-station and on-farm locations. The rice transplanter covered 0.18–0.20 ha/hr area with a cost of Rs 1,240/ha, which provided higher rice yield (10%), cost effectiveness (25%) and energy efficiency (12%) as compared to hand transplanting.

Multi-enterprise agriculture model: A multi-enterprise model based on an integrated farming system and multiple water-use approach involving components of crops, fisheries, dairying, horticulture, vegetables, bee-keeping, poultry, duckery, *gobar* gas plant, solar heating system etc. was developed on 2.0 ha reclaimed sodic land, to provide regular income, employment and livelihood to small farmers. The preliminary results indicated that the field crops (rice and wheat) gave a net income of Rs 51,519, *berseem* Rs 45,768 and bottle gourd Rs 61,650/ha. Fish worth Rs 12,528 was sold during the year from 0.2 ha fish pond. The net income from bee-keeping was Rs 2,928 per annum with a benefit:cost ratio of 1:0.8 when 25 honey boxes were kept in the farm for honey production. Milk worth Rs 113,373 was sold from four buffaloes/cows. The studies indicated that the vegetables planted on the dykes of the pond can generate a regular income of Rs 1,000-1,500/month to meet daily cash requirements of the small farm family. The income is likely to increase manifold when fruit trees start bearing fruits. The cooking gas generated from the *gobar* gas plant was sufficient to meet energy requirement of a family of six persons throughout the year. In addition, the gas is used for lighting purpose.

Multi-entreprise agriculture model

The above model was also replicated at Sharda Sahayak Canal Command, village Kashrawan, Raibareli district, Uttar Pradesh. The area is suffering from shallow water table conditions and is not suitable for cultivation even after gypsum based reclamation. A land reclamation model based on the concept of land modifications (physical land reclamation) and pond-based integrated farming systems (bio-drainage) was conceived for this purpose. A model of one ha comprising 0.4 ha fish pond, 0.2 ha field crops, 0.2 ha fruit crop,

Farming systems modules for small farmers in drylands

Studies of the farming systems modules on micro-watershed basis conducted on Alfisols during 2005-08 indicated that a farming system module for 1.1 ha area with arable crops (0.4725 ha), agro-forestry (0.3496 ha), vegetables (0.1150 ha), grasses (0.1256 ha) and bushes (0.0890 ha) gives the highest gross income of Rs 16,080, and net income of Rs 9,793 and a benefit:cost ratio of 2.38. The individual enterprises of arable cropping, agro-forestry, vegetables, grasses and bushes contributed 38.2, 10.3, 27.2, 7.1 and 17.2%, respectively, to the total net income.

Fish production in multi-enterprise agriculture model in Sharda Sahayak Canal Command, Uttar Pradesh

0.1 ha forage and 0.1 ha vegetable crops was developed. Fish were grown in the pond after suitable initial pond treatment and raised beds were utilized for the field crops and horticultural crop without gypsum application. The slopes of embankment and the raised bed were utilized for the eucalyptus plantation, which served as bio-shield and bio-drainage purpose in the system. The preliminary data indicate that the pH of the pond water remained below 8.4 over the period under study. The pond water pH was almost same as that of canal. In the first year, 4.0 tonnes/ha of rice, 2.7 tonnes/ha of wheat was obtained without application of gypsum; green forage yield of 15.0 tonnes/ha and 15.4 tonnes/ha of sorghum and berseem was recorded in a soil where nothing could be produced before the implementation of this project. A yield of 5.5 tonnes/ha and 4.5 tonnes/ha of spinach (palak) and garlic, respectively were harvested from this integrated farming system. Fish production of 2.5 tonnes/ha was also obtained from fish farming. The benefit : cost ratio of the various components under study varied from 1.70 in fruit-based system to 2.63 in fish farming system. The whole system benefit:cost ratio comes to 2.21. Thus multi-enterprise agriculture is a better option to generate regular income and employment from small farm holdings than solely crop-based systems.

Tree root management in agri-horti system: Pearlmillet-wheat is the predominant cropping system in semi-arid region of the Indo-Gangetic plains under irrigated conditions. Agri-horti system having a fruit crop tolerant to these stress conditions opens up an opportunity for the farmer to get more assured income. It is feasible to grow pearlmillet and wheat with *ber*. The suppression effect of *ber* tree was noticed on wheat and pearlmillet. Among root management practices, tree planted in bottomless bitumen drum gave significantly higher grain yield of wheat. The yield of *ber*, pearlmillet and wheat adopting bottomless bitumen drum was 7.4, 1.73 and 3.18 tonnes/ha, respectively. Net returns of around Rs 50,000 were recorded from *ber*, pearlmillet and wheat crops.

Agroforestry system in coastal salt-affected soils: The cropping pattern in the high rainfall coastal region of the country is entirely monocropped with rice in the *kharif*. Due to heavy rainfall in monsoon, flat topography, low infiltration rate and lack of proper drainage facility, most of the cultivated fields are deeply waterlogged in the *kharif* season. Under the situation, there is hardly a choice for alternate crops other than poor yielding and long duration tall *indica* type traditional rice varieties in the *kharif* season. Due to increase in salinity in dry months with no irrigation facility, the land remains almost fallow throughout the year after *kharif*. Alternate farming in the salt-affected coastal areas has become essential. Agroforestry system could be an alternative and sustainable farming system for the low-lying salt-affected coastal land. Low-lying agricultural lands in the coastal region suffer from severe drainage congestion in the *kharif* and acute shortage of freshwater during *rabi* season. Studies were conducted to develop appropriate agroforestry system for such situations. Evaluation of various tree species revealed that *Eucalyptus* sp., *Acacia auriculiformis*, *Casuarina* sp., *Heritiera fomes*, *Brugeria gymnorhiza* and *Xylocarpus mekongensis* can be grown after suitable land shaping under this situation.

Economic fortification of existing forest and horti-land use system

Aloe vera was cultivated in the interspaces of matured *ber* trees that were planted in 8 m × 4 m spacings. Planting distance of *Aloe vera* was 0.5 m × 0.5 m and 1 m space was left out after every two rows of *Aloe vera*. When raised as an intercrop with *ber*, the growth and yield parameters such as plant height, spread and yield of *Aloe vera* were 68 cm, 70 cm and 47 tonnes/ha/year, respectively, and yield of *ber* fruits was around 7.5 tonnes/ha/year. As a result, gross and net income from the *ber* – *Aloe* system was estimated to be Rs 123,000 and Rs 73,000, respectively.

A new rust bio-agent, *Puccinia* sp. for management of exotic weed, *Lagascea mollis*: A new rust fungus, a species of *Puccinia* (Isotype NRCWSR-3 and holotype HCIO 48,126) identified for management of velvet bush or silk leaf (*Lagascea mollis*), a fast-spreading weed in cropped and non-cropped areas in India. It also serves as an alternate host for some insect pests of legume crops and diseases of rice, French bean, chilli, tomato etc. Inoculation of fungus under micro-plot experiment caused drastic reduction in the seed production/plant (91.68%) compared to fungicide-protected control plants of *L. mollis*.

Seed weight (1,000 seed) and germination (%) as observed from inoculated plants also showed remarkable reduction by 68.20% and 77.78% respectively. In another field trial of host specificity testing on about 150 crop species and resident weeds the bioagent was found safe to the tested plants and restricted only to the *L. mollis*. This heavy damage potential of this safe rust bioagent is being tested for further bio-intensified management of this exotic weed.

New varieties/hybrids: A new tomato hybrid namely Swarna Vijaya was recommended for commercial cultivation in Zone I (Uttarakhand, Himachal Pradesh and Jammu and Kashmir). The plants are of medium height (50-60 cm). It takes 25-30 days to flower after transplanting. It is resistant to bacterial wilt under normal field condition and is suitable for winter and summer season cultivation. The mean yield potential in winter crop is 90-100 tonnes/ha.

A promising hybrid brinjal Swarna Neelima has been recommended for commercial cultivation in Zone IV (Jharkhand, Bihar, Uttar Pradesh and Punjab). The plants are of medium height (80-100 cm), prostrate growth habit with broad plant spread. It takes 55-60 days to flower after transplanting. The fruits become ready for first harvest after 65-75 days of transplanting. The variety is resistant to bacterial wilt under normal field conditions and is suitable for winter and summer season cultivation. The mean yield potential in *rabi* is 70-80 tonnes/ha.

CS 234-2, a new salt-tolerant raya variety identified for late-sown irrigated conditions of Zone II (Sriganganagar, Bathinda, Ludhiana, Hisar, Bawal, Navgaon, Delhi) with an yield potential of around 1.28 tonnes/ha, which was nearly 15.2, 57.8 and 17.2% higher over the national checks, viz. Vardan, Varuna and Kranti, respectively.

KRL 119, a salt-tolerant new wheat genotype has been identified, which can be grown up to pH 9.3. Its plant type is semi-dwarf, resistant to lodging and has dense ears, easy threshability and bold grains. The genotype is resistant to all the three rusts and other diseases, viz. leaf blight, Karnal bunt, flag smut, head scab and foot rot.