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Production and Profit from Different Farming System Approaches in Tripura

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ABSTRACT

Five farming system models, i.e., Agri-Horti-Duckery-Fishery, Fishery-Piggery-Horticulture, Agri-Horti-Duckery-Fishery Vermicomposting, Horti-Fishery-Poultry, and Agri-Horti-Fishery-Duckery were assessed during 2013-14 to 2014-15 for production and profit in Tripura situation. The productivity was 3-7 times higher and profit was 8-15 times higher in these models when compared with the traditional Rice-based farming. Agri-Horti-Duckery-Fishery based farming is the most profitable system with benefit-cost ratio of 4.6. Integrated farming was further found improving the soil health status through increasing the amount of organic carbon, available nitrogen, available phosphorus and potassium in the soil. Thus it is suggested as sustainable livelihood option for marginal and small farmers in Tripura and other NE States.

1. Introduction

More than 96% farmers in Tripura belong to the marginal and small category. They are financially frail, and work in diverse and risk-prone environments. Their incomes are very low (<Rs. 60000/family/annum) for sustaining the per capita daily requirement of 420g cereals, 40g pulses, 110g vegetables, 150ml milk, 65g protein and 40g fat (Dash *et al.,* 2015). Their livelihoods are on stake due to burgeoning human population, increasing demand for food and standards of living, urbanization in agricultural lands, labour crisis, escalating mechanization in the farming sectors and global climate aberration. During the recent decade, agricultural research and development on high-yielding animal and crop varieties, improved management and technologies though enabling the farmers to produce more crop per drop, but at the same time it causing overexploitation of the natural resources, deterioration of soil health, and decreasing the production, profitability and resource-use efficiency of the farm. Single farm enterprises are facing difficulties to produce adequate food, income and employment year-round for livelihood security (Dash *et al.,* 2015). Under such challenging situation, to make the agriculture more profitable and sustainable, integration of various livelihood enterprises like field crops, dairy, piggery, poultry, fishery *etc.* in an appropriate manner is a reliable mean for harmonious use of inputs and replenishment of nutrients through recycling of organic residues. Integrated farming interacts with the ecosystem without dislocating its ecological and socio-economical balance and meets the need of the farmers with multiple products (Kumar *et al.,* 2011). In this study, the production and profit from different farming system models developed by the ICAR, Tripura Centre, were evaluated over traditional farming in the agro-climatic condition of Tripura so that the information generated can be refined, up-graded and transferred to similar other locations for multiplying farmers' incomes.

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2. Materials and Methods

The study was conducted during 2013-14 to 2014-15 in the ICAR Research Complex for NEH Region, Tripura Centre, Lembucherra. Five farming system research (FSR) models, i.e., Agri-Horti-Duckery-Fishery (FSR-1), Fishery-Piggery-Horticulture (FSR-2), Agri-Horti-Duckery-Fishery-Vermicomposting (FSR-3), Horti-Fishery-Poultry (FSR-4), Agri-Horti-Fishery-Duckery (FSR-5) were evaluated for the production, profit and soil health condition. FSR 1-4 were designed keeping in view on utilization of upland/*tilla* where the productivity of crops is low and soil have the problem of low fertility, erosion *etc.* FSR 5 was designed for improving the traditional rice-based farming system in the low-lands adjoining at the confluent of the sloping areas of the *tilla* lands. The allocation of area for different crops under different FSR models is presented in Table-1 and the interventions followed in different components are presented in Table-2. The cost of cultivation and profit were calculated based on the actual market price prevailed during that period. Net benefit was calculated by subtracting the cost of cultivation from gross benefit. Benefit-cost ratio (BCR) was calculated by dividing the gross benefit with cost of cultivation. The Rice equivalent yield (REY) was calculated by dividing the system gross return by price of one tonne of rice. The available nitrogen (N), available phosphorus (P), available potassium (K) and organic carbon (OC) content of the soil in different farming systems were determined following Debnath *et al.* (2015).

Table 1. Allocation of area under different FSR models

Treatments	Area (Ha)						
	Agriculture	**Horticulture**	**Duckery**	**Fishery**	**Piggery**	**Poultry**	**Vermi-composting**
FSR-1	0.42	0.2	0.001	0.1	-	-	-
FSR-2	-	0.7	-	0.2	0.005	-	-
FSR-3	0.4	0.25	0.001	0.15	-	-	0.002
FSR-4	-	0.4	-	0.05	-	0.002	-
FSR-5	0.13	0.4	0.001	0.1	-	-	-

Table 2. The interventions followed in FSR models.

Treatments/ Farming systems	**Components and interventions**
FSR-1	**Agriculture and vegetable-** *Kharif*- bhindi (Kashi Pragati), cowpea (Kashi Kanchan), cucumber, upland rice (direct seeded rice, sahabagi) and maize (minimum tillage maize with hybrids-HQPM-1, VQPM-9) *Rabi*- broccoli (Punjab *Broccoli*-1), cabbage (Golden Acre), cauliflower (Kashi Kunwari), tomato (Arka Sourav) and capsicum (Arka Gaurav) **Fruit crops-** Mango (Amrapali), Litchi (Shahi), Banana (Sabri) **Duckery-** Khaki Campbell **Fishery-** Composite culture
FSR-2	**Fishery-** Composite culture **Piggery-** Cross-bed (Hampshire X Ghungroo) **Tuber crops-** *Kharif*- tapioca, colocasia, elephant foot yam, dioscorea *Rabi*- potato, sweet potato **Fruit crops-** Guava (Lalit), Mango (Amrapali), Ber (Gola), Pineapple (Queen), Papaya (Tripura Papita), Citrus, Areca nut **Fodder-** Hybrid Napier
FSR-3	**Agriculture and vegetables-** *Kharif*- maize (HQPM-1), cowpea (Kashi Kanchan), brinjal (TRC Bholanath amd Singhnath), dolichos (TRC D1), bhindi (Arka Anamika) *Rabi*- tomato (Arka Rakshak), capsicum (Arka Gaurav), cabbage (Pusa Drum head), cauliflower (Arka Kanti), radish (Pusa Chetaki), carrot (Pusa Kesar) **Fruit crops-** Papaya, Banana, Pineapple, Citrus- **Duckery-** Khaki Campbell **Fishery-** Composite culture **Vermicomposting**

FSR-4	**Fruit crops**- Litchi, Papaya, Citrus **Fishery-** Composite culture **Poultry-** Gramapriya
FSR-5	**Agriculture and vegetable crops-** *Kharif*- lowland rice (Gomati dhan), groundnut (ICGS-76) *Rabi*- boro rice (Naveen), mustard (Pusa Mustard 26), potato (Kufri Jyoti) **Fruit crops-** Papaya, Banana, Citrus, Karonda **Fishery-** Composite culture **Duckery-** Khaki Campbell

3. Results and Discussion

The production and profit from different FSR models are presented in Table: 2-6. The net benefit was highest in the FSR-2 (Figure 2), then in FSR-1 (Figure 1), FSR-5 (Figure 4), FSR-4 and FSR-3 (Figure 3). BCR was highest in the FSR-1 and it was superseded FSR-2 due to the involvement of higher cost in cultivation in the FSR-2. The net benefit was lowest in the FSR-3 due to organic approach in the system. Overall, the production was 3-7 times higher and net benefit was 8-10 times higher in the demonstrated models when compared with the traditional rice-based farming (Table 7) which was due to recycling of more volume of crop residues/wastes and proper utilization of by-products from different components through integration (Kumar *et al.,* 2011). Yadav *et al.* (2013) has also opined that integrated farming systems with improved management practices are productive and profitable over traditional farming. The soil nutrients, i.e., available N, P, K and OC content were improved through integrated farming (Table-7) because of recycling of nutrients from the animal and plant wastes (Kumar *et al.,* 2012).

From this study, it can be said that integrated farming system approaches are productive and profitable over conventional farming. It improves the soil health condition and promotes sustainability in farming. It is recommended in the agro-climatic conditions of Tripura and other NE States through location-specific modifications for strengthening the livelihood of the poor farmers and doubling their income. Further studies are advised on the possible incorporation of more crops into the fold of integrated system to make the system more viable and climate-resilient.

Table 3. Production and profit from FSR-1

Components	**Cost of cultivation (Rs.)**	**Production**	**Sale price (Rs.)**	**Total benefit (Rs.)**	**Net benefit (Rs.)**	**BCR**
Paddy	5000	Grain-600 kg Straw- 900 kg	12/ kg 1/ kg	7200 900	3100	1.6
Maize	2500	Cob- 620 kg Fodder- 4000 kg	10/ kg 1/ kg	6200 4000	7700	4.0
Vegetable	26800	11800 kg	10/kg	118000	91200	4.4
Fruit	2000	1000 kg	20/kg	20000	18000	10
Duck	3000	Egg- 1800 nos. Ducks-11 nos.	6/ egg 200/ piece	10800 2200	10000	4.3
Fishery	6000	Fish-200 kg	100/kg	20000	14000	3.3
Total	45300			189300	144000	4.6

Table 4. Production and profit from FSR-2

Components	**Cost of cultivation (Rs.)**	**Production**	**Sale price (Rs.)**	**Total benefit (Rs.)**	**Net benefit (Rs.)**	**BCR**
Fishery	10000	Fish-500 kg	100/ kg	50000	40000	4.0
Piggery	18000	Piglets- 24	3000/ piglet	72000	54000	4.0
Tuber crops	92000	17000 kg	10/kg	170000	78000	1.6
Fruit crops	2000	500 kg	20/ kg	10000	8000	5.0
Fodder	500	1000 kg	1/ kg	1000	500	2.0
Total	122500			303000	180500	3.3

Table 5. Production and profit from FSR-3

Components	Cost of cultivation (Rs.)	Production	Sale price (Rs.)	Total benefit (Rs.)	Net benefit (Rs.)	BCR
Maize	10000	Cob- 1800 kg Fodder- 10000 kg	15/kg 1/kg	27000 10000	27000	2.8
Vegetable	10000	1400 kg	15/kg	21000	11000	2.1
Fruit crops	4000	1000 kg	10/kg	10000	6000	2.5
Duckery	3000	Eggs- 1800 nos. Ducks-11 nos.	6/ kg 200/ kg	10800 2200	10000	4.3
Fishery	10000	Fish-375 kg	100/ kg	37500	27500	3.7
Vermicomposting	5000	Manure-2500 kg	6/ kg	15000	10000	3.0
Total	42000			133500	91500	3.1

Table 6. Production and profit from FSR-4

Components	Cost of cultivation (Rs.)	Production	Sale price (Rs.)	Total benefit (Rs.)	Net benefit (Rs.)	BCR
Fruit crops	19000	3400 kg	20/ kg	68000	49000	3.5
Fishery	2000	Fish-75 kg	100/ kg	7500.00	5500	3.7
Poultry	25000	Meat-600 kg	120/ kg	72000.00	47000	2.8
Total	46000			147500.00	101500	3.3

Table 7. Production and profit from FSR-5

Components	Cost of cultivation (Rs.)	Production	Sale price (Rs.)	Total benefit (Rs.)	Net benefit (Rs.)	BCR
Paddy	12000	Rice- 1500 kg; Straw- 2300 kg	12/ kg 1/ kg	18000 2300	8300	1.7
Groundnut	4000	200 kg	60/kg	12000	8000	3.0
Potato	7000	2000 kg	10/ kg	20000	13000	2.8
Mustard	3000	200 kg	50/ kg	10000	7000	3.3
Fruit crops	30000	8000 kg	10/ kg	80000	50000	2.6
Fishery	7000	Fish-250 kg	100/kg	25000	18000	3.5
Duckery	3000	Eggs-1800 nos. Sale of old ducks	6/ egg 200/ piece	10800 2200	10000	4.3
Total	66000			180300	114300	2.7

Table 8. Extrapolated production and profit from different FSR models

Farming systems	Production (REY t/ha)	Cost of cultivation (Rs./ha)	Gross return (Rs./ha)	Net return (Rs/ha)	BCR
Traditional low land rice	4.0	40000	54000	14000	1.35
Upland rice	2.5	25000	34000	9000	1.36
FSR-1	21.9	62829	262552	199723	4.18
FSR-2	28.5	138418	342372	203954	2.47
FSR-3	13.8	52303	166251	113948	3.18
FSR-4	18.8	82500	225375	142875	2.73
FSR-5	27.3	102222	327777	225555	3.21

Table 9. Soil health under different farming system

Farming systems	Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)	OC (%)
Traditional low-land paddy	340	12	200	0.62
Upland paddy	280	8	180	0.53
FSR-1	390	20	210	0.82
FSR-2	400	21	240	0.81
FSR-3	420	23	220	0.93
FSR-4	395	20	215	0.83
FSR-5	380	18	210	0.85

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Agri-horti-duckery-fishery-based farming system (FSR-1)

Figure 1. FSR -1

Fishery-piggery-horticulture- based farming system (FSR-2)

Figure 2. FSR – 2

Agri-horti-duckery-fishery-vermicomposting-based farming system (FSR-3)

Figure 3. FSR – 3

Agri-horti-fishery-duckery-based farming system (FSR-5)

Figure 4. FSR