RESEARCH NOTE

Enhancing Livelihood of Tribal Farmers of Sikkim Through Integrated Organic Farming System: A Case Study

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ABSTRACT

Sustainable agriculture means an integrated approach to increasing farm yield and managing resources in order to address all three critical aspects of sustainability: economic, environmental and social. ICAR-KVK, East Sikkim adopted the Integrated Organic Farming Systems (IOFS) approach to stabilize income streams through natural resource management and livelihood diversification in tribal village, Timpyem, East Sikkim. The salient features of IOFS included – innovation in farming for maximizing production through optimal use of local resources, effective recycling of farm waste for productive purposes, community-led local systems for water conservation, organic farming, and developing a judicious mix of income-generating activities such as dairy, poultry, piggery, vermicomposting and others. ICAR-KVK, East Sikkim built farmer capacities for adoption of productive, remunerative, eco-friendly and self-sustaining integrated farming in the village. The economic indicators clearly showed that the net returns from the recommended practices were substantially higher than the farmers' practices during the demonstration period. Average yield enhancement by the recommended technological interventions under IOFS was 26.9 per cent for agricultural and horticultural crops over the pre-intervention yield resulting in average B:C ratio of technology at 2.1 whereas farmers' practice paved only 1.4. Similarly, average yield enhancement was recorded at 33.2 per cent from livestock enterprises consequently an average B:C ratio of technology was 2.6 as compared to only 1.4 with farmers' practice.

Key word: *B:C ratio; Economic; Enterprise; Organic farming; Sustainability; Yield;*

The economy of Sikkim is linked with agriculture that serves as the source of livelihood and economic security for sizeable native population. The growth, however, has been restricted because of biotic and abiotic factors. It is estimated that over 80 per cent of the rural population of Sikkim depends on agriculture and allied sectors for economic, food, and nutritional security. The agricultural systems practiced in Sikkim are integrated with nature that evolved through years of experimentation by the farmers. A marginal improvement in the lifestyle of the farmers has been witnessed with the adoption of modern technologies. Sikkim has some inherent strengths that largely supports organic farming. The policies and programmes on organic farming, in tune with our natural endowments envisages making Sikkim a Model Organic State. The march towards organic farming has led to substantial departmental interventions. Large number of initiatives was under taken by the Agriculture and Horticulture Departments of the state. Major crops grown are maize, rice, wheat, millet, buckwheat, pulses, barley and oilseeds. No single crop or variety of crop suits all the elevations. Even though agriculture is crucial to the economy of the state it is largely rain-fed with traditional system of cultivation and low level inputs. Although rainfall in the state is quite high but due to inadequate effort in harnessing the available resources the area under the irrigation is hardly about 11 per cent. The

productivity in Sikkim is lower than both the regional and national averages for all the major field crops. Increasing per unit productivity will be the key in bridging this gap which can be achieved with area expansion under high yielding varieties along with proper package of practices that will exploit the inherent production potential of varieties designed for organic farming from the local gene pool; soil-test values based nutrient management and appropriate plant protection measures. Low cropping intensity in Sikkim is primarily due to low available soil moisture after the cessation of long rainy season from mid February to October end, low awareness of technological options to utilize residual soil moisture and utilization of harvested, stored rain water using micro irrigation systems and persistence with conventional practices resulting in low yielding production systems. As per the Human Development Report – 2001, in Sikkim, diversification in the land use pattern has to be taken into account for both food security and livelihood sustainability. The limitations of terraced farming in terms of productivity and the dearth of land for cultivation highlight the constraints faced by the farming community for livelihood security. Under these conditions innovative scientific technologies in the potential sectors like horticulture and livestock can be identified by exploring the most pressing constraints for the best possible opportunities for growth of the farming sector.

East District is the main economic district of Sikkim with geographical area of 954 sq. km. The total population of the district is 2,44,790 (*Census 2011*). It is estimated that more than 70 per cent of rural population depends on agriculture and allied sectors for economic, food and nutritional security. The majority of the farmers of the district fall in the small and marginal category. The farmers of the district practice mixed farming. Farmers depend on agriculture, horticulture and animal husbandry for their livelihood.

A small tribal village Timpyem of 44 farming families with total population 161 persons (male: 54.03%, female: 45.96%) was identified in East district located at 27°33’94" N Lat. and 88°60’29" E Long. to assess the technologies developed by ICAR Sikkim Centre (now ICAR-NOFRI). Participatory rural appraisal revealed that the village was approximately 87 per cent literate and farming was the only income for 32 farm families under marginal category and 3 landless farm families. Maize/rice based cropping systems with traditional methods were practiced. Livestock *viz*., cattle, pig, goat and poultry with a population of cattle 45 nos., pig 22 nos., goat 27 nos., and poultry 397 nos. provided supplementary income. The net income from the agriculture produce and livestock in the village was around Rs 12,750 per household per annum. The farmers of the village suffered from the acute shortage of marketing linkage and ultimately sold their produces at low price through middlemen. The village faced deficient of organic farming inputs including quality seeds. Insect pest and diseases infestation were the most common problems. Therefore, in order to enhance the cropping intensity the best possible resource conserving technologies and other suitable technological interventions through Integrated Organic Farming System under Tribal Support Plan were demonstrated in participatory mode by the ICAR-NOFRI and KVK-East Sikkim, Ranipool, East Sikkim during 2014-16.

METHODOLOGY

Considering the physical, social and economic limitations of Sikkim, an integrated farming system model was demonstrated in Timpyem village, East district of Sikkim during 2014-15. Various technologies for increasing the productivity of the existing conventional farming system were introduced to 44 nos. of farming families in 5.55 ha cultivable land. With the assistance of Tribal Sub-Plan, technological interventions were detailed by providing training, on field demonstrations and input support. Various inputs/interventions were provided under the project with the purpose of reorienting their traditional farming into integrated organic farming system (IOFS) to increase the farm income. Major technologies included low cost water storage structure, *Jalkund* using silpaulin (250 GSM), low cost plastic tunnels (transparent UV stabilized sheet of 45 GSM) for sequential vegetable cultivation, zero till vegetable pea, mustard, cole crops, buckwheat were introduced in the village. Strengthening backyard poultry production with Vanaraja, scientific method of piggery and dairying, hybrid Napier cultivation as fodder grass on terrace risers were also mediated. High yielding varieties of cereal crops like maize (Vivek Sankul-31) and rice (VL Dhan-86) were introduced. Similarly, high yielding varieties of vegetables *viz*., cabbage var. Rare Ball, cauliflower var. Suhasini, broccoli var. tomato var. Arka Samrat, coriander var. Super Midori, spinach var. All Green, radish var.

Chinese White were sequentially cultivated under low cost plastic tunnels. *Jalkund*, micro water harvesting structure, was designed with dimensions of 5 m × 4 m × 1.5 m (capacity of 30,000 L) and introduced to meet the water requirement of crops through gravitational sprinkler irrigation system and encouraged the farmer to opt for diversification of the integrated organic farming system. Marketing of farm produce was linked with the Farmers' Produce Organization of the district through the intervention of the Institute.

RESULTS AND DISCUSSION

Capacity building of the farmers through institutional intervention changed the farmers' attitude and motivated the farming community to adopt improved technological options developed by ICAR-NOFRI (Formerly ICAR Sikkim Centre). Interventions raised the productivity of maize and rice to 3260 kg/ha and 2470 kg/ha as compared to 2435 kg/ha and 1920 kg/ha, respectively which ultimately increased maize yield by 25.3 per cent and rice yield by 22.3 cent during 2016-17. Demonstration on buckwheat under scientific management practices paved higher net income of Rs.41,020.00 per ha in the village. Average productivity of Kharif vegetable crops was 6825 kg/ha after intervention while, it was only 4538 kg/ha during 2015-16. Rabi vegetable cultivation with improved production technology recorded higher productivity (6950 kg/ha) as compared to conventional practices (4650 kg/ha). The benefit: cost ratio of the recommended practice for Rabi vegetables was 2.3 as compared with 1.6 of pre-intervention which was 1.6 before the intervention. Vegetable crops were cultivated in sequence (Broccoli-Radish-Fenugreek-Coriander-Spinach) under low cost poly tunnel system with a benefit cost ratio of 4:1. Eight numbers of low cost micro water harvesting structures (Jalkund) were demonstrated in the village which encouraged the farmers to opt for diversification with the cultivation of cole crops, potato, vegetable pea, fenugreek, coriander etc. during Rabi season. The overall performance on crops production under recommended technology was superior to the conventional methods which overlaid the average net income of Rs. 43,074.00 with 26.9 per cent yield increase resulting in B:C ratio of 2.1 from the technology (Table 1).

The yield enhancement by the recommended technological interventions was higher by 30.6 per cent in Rabi vegetables and 30.0 per cent in Kharif vegetables than the pre-intervention yield. Various economic indicators like gross expenditure, gross return, net returns and benefit: cost ratios of the demonstrations are also presented in Table 1. The economic indicators clearly show that the net returns from the recommended practices were substantially higher than the farmers'

Table 1. Economics of the crops under IOFS in Timpyem village

Crops/Enterprise	Average yield (q/ha)		% incr-ease	Gross cost (Rs./ha)		Gross income (Rs./ha)		Net income (Rs./ha)		B:C ratio	
	PI^1	PI^2		PI^1	PI^2	PI^1	PI^2	PI^1	PI^2	PI^1	PI^2
Maize	24.35	32.60	25.3	28100	30250	36525	48900	8425	18650	1.3	1.6
Rice	19.20	24.70	22.3	32560	33050	38400	49400	5840	16350	1.2	1.5
Buck wheat	10.50	14.32	26.7	29560	30580	52500	71600	22940	41020	1.8	2.3
Kharif vegetable	45.38	68.25	30.6	54590	44650	68070	102375	13480	57725	1.3	2.3
Rabi vegetable	46.50	69.50	30.0	58250	60850	95325	142475	37075	81625	1.6	2.3
Average	29.2	41.9	26.9	40612	39876	58164	82950	17552	43074	1.4	2.1

Table 2. Economics of livestock and poultry under IOFS in Timpyem village

Crops/Enterprise	Average yield (q/ha)		% incr-ease	Gross cost (Rs./ha)		Gross income (Rs./ha)		Net income (Rs./ha)		B:C ratio	
	PI^1	PI^2		PI^1	PI^2	PI^1	PI^2	PI^1	PI^2	PI^1	PI^2
Back yard poultry	6.55	26.28	75.1	95695	165800	163750	657000	68055	491200	1.7	3.9
Dairy cattle (lit.)	8665	10510	11.1	195450	201250	303275	367850	107825	166600	1.5	1.8
Piggery (Hampshire)	13.68	16.80	13.4	161250	165280	273600	336000	112350	170720	1.7	2.0
Average	-	-	33.2	150798	177443	246875	453617	96077	276174	1.6	2.6

PI^1 = Pre -intervention; PI^2 = Post - intervention

practices during the demonstration period. *Mukherjee (2003)* reported that the innovative interventions had superior implications in enhancing productivity. The average net returns of Kharif vegetables and Rabi vegetables from the recommended practices were much higher than the income before intervention *viz.*, Rs. 57,725/- (pre-intervention Rs. 13,480/-) and Rs. 81,625/- (pre-intervention Rs. 37,075/-), respectively. The benefit : cost ratio of the recommended practices for Buckwheat, Kharif vegetables and Rabi vegetables was 2.3 each as compared to 1.8, 1.3 and 1.6 respectively, prior to intervention. *Mishra et al. (2009)* in potato, *Sharma (2003)* in moth bean and *Gurumukhi and Mishra (2003)* in sorghum have reported similar findings.

Similarly, the overall performance of backyard poultry (6.55 q meat), dairy cattle (8665 lit. milk), piggery (13.68 q meat) in the whole village was recorded before the intervention of technologies (Table 2) and the incremental changes were recorded in backyard poultry (75.0%), dairy cattle (11.1%) and piggery (16.8%) after the technological intervention. Accordingly, the economic indicators like gross expenditure, gross returns, net returns and benefit: cost ratios of demonstrations also improved over farmers' practice (Table 2). It is also revealed that gross income was calculated Rs. 1,65,800.00 under backyard poultry production which was much higher the pre-intervention (Rs.95695/-). Farmers earned net profit of Rs.4, 91,200.00 from backyard poultry farming resulting in B:C ratio of 3.9 during the study period. Data also showed that scientific dairy and piggery farming proved to be much more profitable venture in the village. The benefit: cost ratio of the recommended practice for scientific dairy and piggery farming was 1.8 (1.5 B:C ratio during pre-intervention) and 2.0 (1.7 B:C ratio during pre-intervention), respectively (Table 2).

The village is now developed as Integrated Organic Farming System model for the entire farming community of East Sikkim district as well as whole Sikkim. Farmers from other villages are motivated by the success of this village and headmen of neighboring villages are encouraging farmers to implement similar models in their villages. These interventions have the potential to create positive impact on the utilization of scarce resources under the fragile mountain ecosystem benefitting the farmers at large. The economic indicators clearly showed that the net returns from the recommended practices were substantially higher than the farmers' practices during the demonstration period. Average yield enhancement by the recommended technological intervention under IOFS was 26.9 per cent for agricultural and horticultural crops over the pre-intervention yield resulting in average B:C ratio of technology at 2.1 whereas the farmers' practice provided only 1.4. Similarly, average yield enhancement was 33.2 per cent from livestock enterprises consequently an average B:C ratio of the technology was 2.6 whereas it was only 1.4 in farmers' practice.

CONCLUSION

High benefit: cost ratio also advocated the economic viability of the demonstration and motivated the farmers towards adoption of interventions demonstrated. Identification of suitable technologies for enhancing the productivity of all possible components of Integrated Organic Farming System, and conduct of such demonstrations have the potential to bring economic improvement and empowerment of farmers under organic conditions. It will also provide impetus to the diversification programme of the state government, besides increasing the cropping intensity in the state.

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