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Full Length Research Paper

A study of factors affecting livelihood situations in the disadvantaged areas of West Bengal, India

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The present study was conducted to assess economic and social sustainability and their impact on rural livelihood of North East India. Results demonstrate that overall input self sufficiency ratio increased almost two fold (from 0.29 to 0.53). The less the index value is, the higher the cropping diversification will be, and thus, the more relatively sustainable for the farming system. The cropping diversification index (ICD) was enhanced from 36.90 to 18.73%, 40.03 to 19.72%, 34.04 to 19.90% and 43.71 to 22.33% at clusters -I, -II, -III and -IV, respectively. Due to introduction of improved agro-techniques and intensification of crop diversification through National Agricultural Innovation Project in the study areas, overall food deficiency was mitigated by 7.31, 16.97 and 24.05% for 2, 4 and 6 months, respectively, while overall food sufficiency and surplus enhancedfrom33.71to75.73%and0.38to8.07%.Overall,women'sparticipationdecreasedby40.75%inthe case of simple physical activities, whereas, it significantly increased to 417.93% in the case of knowledge and skill oriented activities, which ultimately assisted in uplifting the sustainability of farming system from low to moderate and high.

Key words: Crop diversification index (ICD), food security, input self sufficiency, sustainability.

INTRODUCTION

The concept of sustainable development has generated a great deal of debate and spawned a multitude of definitions since it was put forward by Malthus (1798) about 200 years ago. He argued that the fixed land base could not sustain the continuing growth in human population and, if people did not restrain their reproduction, the population would be controlled by war, pestilence, and starvation. The sustainable livelihoods idea was first introduced by the Brundtland Commission on Environment and Development (1987) and the 1992 United Nations Conference on Environment and Development expanded the concept, advocating for the achievement of sustainable livelihoods as a broad goal for poverty eradication. Crosson (1992) recently described a sustainable agricultural system as one "that can indefinitely meet demands for food and fibre at socially acceptable economic and environmental costs‟. Bagchi et al. (1998) use the term ―livelihood trajectories‖ to describe and explain the direction and pattern of livelihoods of individuals or groups of people (for example, households). The concept of sustainable development is social, rather than fundamentally scientific. It relates to the management of natural resources for human purpose and is therefore opened to different interpretation (Tait and Morris, 2000). Sustainable livelihoods approaches‘ (SLAs) have increasingly entered the development arena and are used by a range of organizations including the World Bank, FAO, UNDP, DFID, Oxfam and CARE (Hussein, 2002). According to Erenstein et al. (2007), the SLA is a way of looking at development in a way that is concerned

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principally with people. It may be described as ―a way of thinking about the objectives, scope and priorities for development in order to enhance progress in poverty elimination‖ (Ashley and Carney, 1999). This approach seeks to understand people's strengths, including their skills and possession, and how they use these assets to improve the quality of their lives. In this sense, the capability approach which complements the SLA is being adopted by many contemporary research and development organizations.

Employment of livelihoods approach has been considered particularly appropriate in the context of the present research proposition because the response to shocks and the ability to cope with vulnerability are very much dependent on assets (Ellis, 2000). A particular strength of this approach is that it recognizes human agencies and examines the way in which household livelihood strategies are built around protecting, substituting, increasing, and using assets to produce security and achieve other goals (Hulme and Shephard, 2003). There is a need to improve the management and use of limited land, water and other natural resources to feed the ever growing population and protect the environment in order to meet the needs of next generations (Wen and David, 1992).

With the advent of rainbow revolution era, the changed paradigm re-emphasizes the need of demand driven technological interventions for the upliftment of the disadvantaged people to mitigate the vulnerability in the rural areas of India for sustaining their livelihood status. With the help of the alternative livelihood choices and improved agro techniques skill oriented modification of existing livelihood options, the rural people can increase their self sufficiency with the access of available local natural resources with the endowment of diversified agriculture. Ultimately, the venture will increase their income, ensure food security and generate employment in the rural areas for sustaining their livelihood status. India is a low-income country, with a GDP of $ 1389 per capita in 2011 according to International Monetary Fund (IMF) 2010/2011.

According to a 2012 World Bank estimate, 37% of the total Indian population falls below the international poverty line of US$ 1.5 a day (purchasing power parity, in nominal terms ₹ 21.6 a day in urban areas and ₹ 14.3 in rural areas). With respect to material and human development, West Bengal has strong regional dimensions. This necessitates identification of an effective mix of escape routes through dove–tailing livelihood parameters with appropriate research–led technology intervention in a manner so as to develop customized livelihood models having wider replicability to similar situations. The main factors affecting livelihood situations in the disadvantaged areas of West Bengal are:

i) Enhanced deprivations and marginalization resulting out of ineffective land utilization, which again is caused due to imperfections in the soil as well as crop production environment.
ii) Limited capability of the marginal farmers and landless including women, to address the externalities and vulnerability.
iii) Absence of institutional framework to utilize development gains.

Therefore, the present research paper outlines a framework for analyzing sustainable livelihoods, defined here in relation to economic viability and social acceptability by using five key indicators namely diversification index, food security index, input self sufficiency, benefit cost ratio and women's participation in agriculture. The framework shows how, in different contexts, sustainable livelihoods are achieved through access to a range of livelihood resources (natural, economic, human and social capitals) which are combined in the pursuit of different livelihood strategies.

RESEARCH METHODOLOGY

A critical appraisal of the study on sustainability of rural livelihood furnished a good conceptual as well as structural platform for the present investigation and assisted in the use of a suitable methodology. Here, the profile of the study area, the data sources and the analytical tools, that is, methodology used to address the specific objective is presented.

The present study was carried out on the basis of both secondary and collected primary research data through field experimentation from the beneficiaries of National Agricultural Innovation Project (NAIP), Component – 3, running since 2008, covering the period up to March 2010. The sample units were scattered over ten villages of Itahar, Tapan, Manickchalk and Suti-I Block of Uttar Dinajpur, Dakshin Dinajpur, Malda and Murshidabad district of West Bengal, India respectively. The sample frame composed of 1314 beneficiaries included under sustainable livelihood empowerment sub-project of National Agricultural Innovation Project.

Profile of the study areas

Profile of the state

West Bengal is one of the important states in the eastern part of India, stretching from the Himalayas in the north to the Bay of Bengal in the South. The total geographical area of the state is 88,752 km^2 which is 2.7% of the country's geographical area, and it has a total population of 80.18 million which accounts for 7.79% of the country's population of which 72.03% of the people live in rural area. The percentage of rural population below poverty line is 31.85 against national value of 27.09% (NSS, 1999-2000). The cultivable area of West Bengal constitutes 65.48% of the total geographical area but the total cultivated area per agricultural worker is only 0.44 ha (2004 to 2005). With a very high population density of 903 persons/km^2 against the national population density of 324 persons/km^2 in 2001, the state is currently the most populated state in the country. The overall literacy rate is 68.64%, and with a human development index (HDI) value of 0.404, it stands in the rank of 20. The proportion of people living below the poverty line in 1999 to 2000 is 27%. The percentage share of Scheduled Castes (SC) and Scheduled Tribes (ST) population are 23.02 and 5.50 respectively. Agriculture is the main source of livelihood income of the rural people with 32.2% of the people providing agricultural

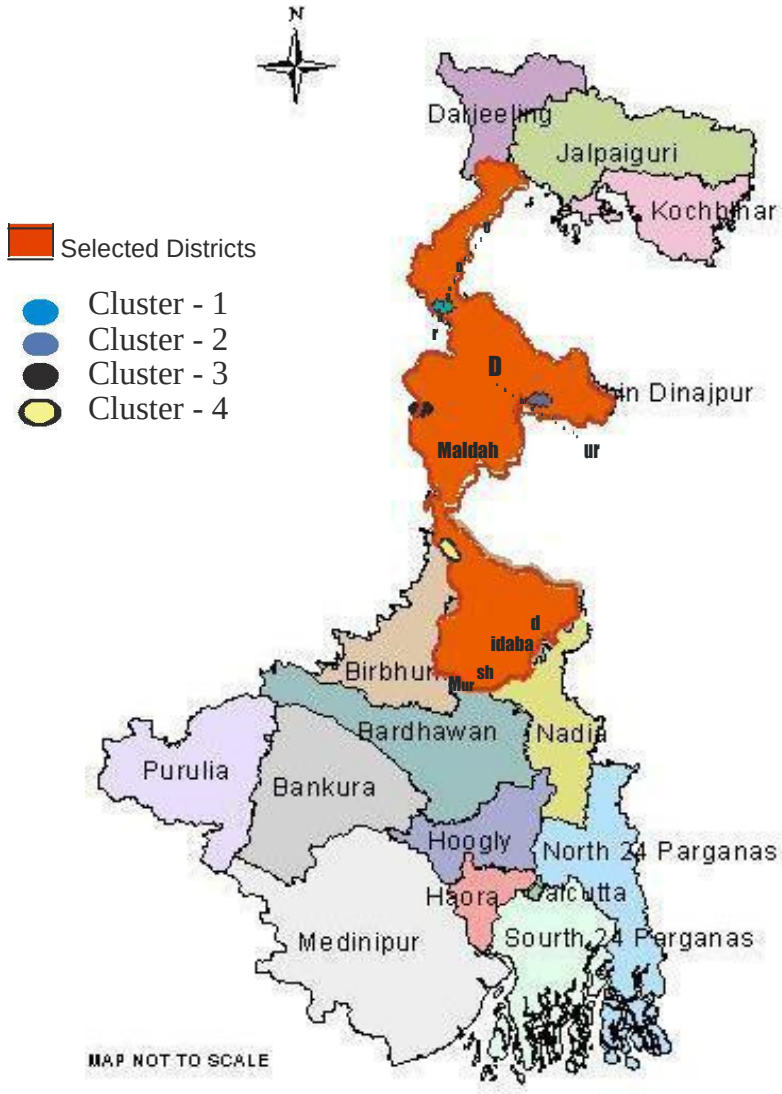

Figure 1. Study area.

labour and 11.8% marginal labour.

Profile of the study area

Four backward districts of the state West Bengal (Uttar Dinajpur, Dakshin Dinajpur, Malda and Murshidabad) were brought under sustainable livelihood empowerment sub-project of National Agricultural Innovation Project (Figure 1). The backwardness is characterized by low per capita income, low yield per acre of land, backwardness in industrialization, shortage of capital and entrepreneurship, and also the lack of infrastructure and large labour surplus. The West Bengal Human Development Report (2004) is clearly indicative of the prevalence of very poor health index, gender development index, and high degree of infant mortality rate (IMR) and low HDI values across all these districts. A highly semi-humid atmosphere and medium rains characterized the climate of these districts. The average annual rainfall is 1487.32 mm and January to February is the coldest period with temperature varying between 7.4 and 20.3°C, April is the hottest month with mean daily maximum temperature of 38.5°C and mean daily minimum temperature of 22.2°C. The economy of these backward areas mostly depends upon the primitive agriculture and its allied activities. The total agricultural lands of these four districts are 86.41, 79.29, 76.09 and 76.15%, respectively (Census, 2001). The districts have abundance natural resources like bamboo, palms, creepers, fruit trees, etc., and agricultural produce like rice, jute, potato, wheat and maize and mustard in some pockets. So, by making proper planning like introducing short gestation vegetables, improved varieties of field crops, utilizing homestead area, creation of small scale village handicrafts through self help groups (SHGs), there is a wide scope for the development of these districts.

Data collection

Secondary data

An extensive survey instrument has been designed for the purpose of conducting the baseline survey. The instrument had been pre-tested and fine tuned on the basis of pre-testing feedback. The survey instrument has two components – participatory rural

Table 1. Analysis of Input self-sufficiency ratio.

Score index	Variables values	Sustainable classifications
1	0.00-0.20	Very low sustainability
2	0.21-0.40	low sustainability
3	0.41-0.60	Moderate sustainability
4	0.61-0.80	High sustainability
5	0.81-1.00	Very high sustainability

Table 2. Analysis of benefit-cost ratio.

Score index	Variables values	Sustainable classifications
1	<0.5	Very low sustainability
2	0.51-1.00	low sustainability
3	1.01-1.50	Moderate sustainability
4	1.51-2.00	High sustainability
5	>2.01	Very high sustainability

Table 3. Analysis of cropping diversification.

Score index	ICD values (%)	Sustainable classifications
1	81-100	Very low sustainability
2	61-80	low sustainability
3	41-60	Moderate sustainability
4	21-40	High sustainability
5	0-20	Very high sustainability

appraisal (PRAs) and focus group discussion (FGD). Besides that, a sample check had also been conducted to estimate the extent of data sanitization. Field investigators had primarily been selected from the same locality living in close vicinity of the identified villages. The selection criteria to choose the investigator was done through knowledge and understanding of conducting surveys on local areas. The program coordinators of respective KVKs were involved in the selection process.

Primary data

To accomplish the objective of this investigation, data on yield, net sown area and cost of cultivation was collected from the experimental fields from the clusters of the study areas while the data on food security and women participation in maintaining livelihood were collected through focus group discussion and personal interview of the beneficiaries. Here, cluster represents the groups of adjacent villages, selected for the study. The information were also collected from government officials and staff in agricultural agencies for cross verification.

Analytical tools

Although quite a good number of indicators have been developed and used in different countries, these do not cover all aspects of sustainability. In this study, the sustainability of rural livelihood was examined in terms of economical and social aspects of sustainability. Moreover, due to bio physical and socio-economic variations, indicators used by others may not be directly used in this study. The results were interpreted by using scoring system.

Economic viability

It is one of the important goals that sustainable agriculture pursues. Three indicators were used to evaluate the economic sustainability.

Input self sufficiency ratio: Input self sufficiency ratio is the ratio of costs of local inputs to the total inputs for each household (Tisdell, 1996). Local inputs are labour, draught power, local varieties of seed, organic manures and natural pesticides. So, the scoring systems for each site are given in Table 1.

Benefit-cost ratio: The benefit-cost ratio (BCR) is an indicator used in the formal discipline of cost-benefit analysis, attempts to summarize the overall value for money of a project or proposal. A BCR is the ratio of the benefits of a project or proposal, expressed in monetary terms, relative to its costs, also expressed in monetary terms. Benefit cost ratio (BCR) takes into account the amount of monetary gain realized by performing a project versus the amount it costs to execute the project. The higher the BCR, value the better the investment. Benefit-cost ratio = total return of crop production/total variable cost (Zhen and Routray, 2003). The score system is as shown in Table 2.

Cropping diversification: One of the goals of sustainable agriculture is to minimize the farmer‘s risk. Cropping diversification can reflect this point when one crop fails, it can be compensated from another crop. To see the differences in crop diversification among the study area, the following formula was used (Thapa, 1990):

$$ICD = \frac{Pa + Pb + Pc + ...+ Pn}{Nc} \quad (\%)$$

Where ICD = index of crop diversification; Pa = proportion of sown area under crop a (%); Pb = proportion of sown area under crop b (%); Pc = proportion of sown area under crop c (%); Pn = proportion of sown area under crop n (%); Nc = number of crops

Relevant analysis can be arrived based on the Table 3. 100% means that farmers grow only one crop. Less ICD value means less risk to farmers.

Social acceptability

It is also a non separate component of sustainable farming system. Two indicators were chosen for the study.

Adequacy of food grain production: Producing enough food for consumption is the primary goal of agriculture. To compare the food adequacy more precisely, the index of food security was constructed to measure the variations of food security at the farmers‘ level among four clusters (Chen, 2000):

$$IFS = \frac{fd1*1 + fd2*2 + fd3*3 + f0*4 + fs*5}{N}$$

Where IFS = index of food security; fd1= frequency of responses indicating deficit for 2 months; fd2= frequency of responses indicating deficit for 4 months; fd3 = frequency of responses

Table 4. Input self sufficiency in annual crop production before and after introduction of NAIP.

Sites	Farm size	Avg. cost of total input for each HH (a)		Average cost of local input (b)		Input self sufficiency ratio (c=a/b)		Sustainability classification	
	(ha.)	Before	After	Before	After	Before	After	Before	After
Cluster-I	0.60	155025	134658	43701	79525	0.28	0.59	Low	Moderate
Cluster-II	0.82	211868	183749	51428	95018	0.24	0.52	Low	Moderate
Cluster-III	0.36	91025	79000	21221	41715	0.23	0.53	Low	Moderate
Cluster-IV	1.20	289345	273856	98402	138500	0.34	0.51	Low	Moderate
Overall	0.75	186816	167816	53688	88690	0.29	0.53	Low	Moderate

indicating deficit for 6 months; f0= frequency of responses indicating no deficit and no surplus; fs= frequency of responses indicating surplus; N= sample size; C= coefficients of different adequate food grains. 1 indicating deficit for 2 months, 2 indicating deficit for 4 months, 3 indicating deficit for 6 months, 4 indicating no deficit and no surplus and 5 indicating surplus.

The higher index value indicates relatively higher food security. The scoring systems maybe: < 1: very low sustainability; 1 – 2: low sustainability; 2-3: moderate sustainability; 3-4: high sustainability and > 4: very high sustainability.

Women's participation in agriculture: According to Miah (1993), to compare the degree of participation of women in agricultural activities among the four clusters, the index was built as:

$$IDP = \frac{\Sigma Wi * fi}{N}$$

Where IDP = index of degree of participation; Wi = weight on the ith activities, which are variable according to the importance of the activities, from simple physical activities to mental activities, the values are gradually bigger and bigger ranging from 0.1 to 1.0; fi= frequency of i^{th} activities; N = total number of observations.

When interpreting into scoring system, each level maybe like this, < 0.2: very low; 0.2-0.4: low; 0.4-0.6: moderate; 0.6-0.8: high and > 0.8: very high.

RESULTS AND DISCUSSION

Evaluation of economic viability

This study assesses the comparative economic sustainability of the farming system before and after introduction of technological intervention through National Agricultural Innovation Project, Component-3. It involves benefits of crop production which includes input self-sufficiency and benefit-cost ratio and index of cropping diversification.

Input self-sufficiency

Farmers use both local and external inputs. Local inputs are labour, drought power, local varieties of seed and organic manures. External inputs include chemical fertilizers, pesticide, hybrid seed, biofertilizer and fuels. The high dependency on external inputs increases farm vulnerability due to the fact that farmers cannot control its supply and price. Lockeretz (1984) has observed "reduced use of purchased inputs, especially toxic or non-renewable ones, less damage to the environment, better protection of water, soil, and wildlife‘‘.

Among the clusters, input self sufficiency ratio was found to be highest at cluster-I (0.59) followed by cluster-III (0.53), cluster-II (0.52) and cluster-IV (0.51) after the introduction of NAIP project. This was due to the building of awareness and confidence among the beneficiaries on using their available local resources in farming through the training and demonstrations. The overall input self sufficiency ratio increased almost two fold (from 0.29 to 0.53), due to reduction of consumption of external inputs namely biofertilizer, chemical fertilizer and pesticides, as because farmers of the study area producing vermicompost, enrich-compost, biofertilizer and botanical pesticides which substitute chemical fertilizer and pesticides after introduction of NAIP project (Table 4). Pretty et al. (2008a) suggested that best use of locally available resources increased the sustainability of the agriculture system. Lockeretz (1984) also suggested that shifts to low-input farming on environmental grounds may suggest a 'sustainable' interest in changing agricultural practices to ride out the high costs of inputs. Hence, based on the scoring systems, the sustainability of input self sufficiency enhanced from low to moderate standards in all the clusters.

Benefit-cost ratio

Benefit- cost ratio was calculated on the basis of average yields of major field crops of the study areas. Among the crops, lentil (1.31) and maize (1.87) fetched highest benefit-cost ratio before and after introduction of the project, respectively. It was observed from Table 5 that benefit-cost ratio of all the crops increased more than previous situation due to improved crop husbandry leading to higher productivity and higher net return. In terms of percentage, benefit-cost ratio increased significantly for black gram (245.71), sesame (200), mustard (80.00) and maize (78.13). Highest net return to

Table 5. Overall benefit: Cost ratio of major field crops.

Name of the crops	Productivity (t ha^{-1})		Total variable cost (Rs. ha^{-1})		Gross return (Rs. ha^{-1})		Net return (Rs. ha^{-1})		Benefit: Cost ratio	
	Before	After	Before	After	Before	After	Before	After	Before	After
Rice	1.42	2.2	18150	20075	13888	21516	-4262	1441	-0.23	0.07
Wheat	2.14	2.9	20625	23549	27285	36975	6660	13426	0.32	0.57
Maize	2.84	4.5	13868	17230	31240	49500	17372	32270	1.25	1.87
Jute	1.75	2.2	31272	35412	49000	61600	17728	26188	0.57	0.74
Potato	32.5	40.25	102456	111450	162500	201250	60044	89800	0.59	0.81
Lentil	0.72	0.95	14785	16569	34218	45149	19433	28580	1.31	1.72
Mustard	0.67	0.9	19104	23217	21943	29475	2839	6258	0.15	0.27
Groundnut	1.26	1.85	18292	21890	40320	59200	22028	37310	1.20	1.70
Green gram	0.56	0.875	15707	19788	25200	39375	9493	19587	0.60	0.99
Black gram	0.4	0.75	12457	14321	16848	31590	4391	17269	0.35	1.21
Sesame	0.382	0.565	11250	13749	12606	18645	1356	4896	0.12	0.36

the tune of Rs. 89800.00 ha^{-1} was obtained from potato cultivation, followed by groundnut (Rs. 37310.00 ha^{-1}), maize (Rs. 32270.00 ha^{-1}) and lentil (Rs. 28580.00 ha^{-1}). So, the return was found to be higher for cash crop. The finding is also similar with the study of Brown and Kennedy (2005) who also reported that cultivation of vegetable-based cash crops increased farm income over cereal crops. Among the crops, rice fetched negative net return which became positive after the intervention of SRI technology as well as introduction of high yielding short duration varieties. As per sustainability, rice, sesame and mustard was found to be very low, while moderate and high sustainability could be achieved for black gram, maize, lentil and groundnut.

Crop diversification index

Cropping diversification was used to explain the risk of farming. Crop diversification indicates increasing numbers of crops or production enterprises per farm, which helps insure the crops against various types of risk (Beets, 1990). The value of index starts from 100 (when only one crop is grown) and goes to the tendency of zero (when as many as crops are grown). The less the index value is, the higher the cropping diversification will be, and thus, the more relatively sustainable for the farming system as the relatively high degree of cropping diversification in this type of system is conducive to making efficient use of different types of nutrients available in soil and to increasing bio-diversity (Dahal, 1996). In this study, the cropping diversification index (ICD) was enhanced from 36.90 to 18.73%, 40.03 to 19.72%, 34.04 to 19.90% and 43.71 to 22.33% at clusters -I, -II, -III and -IV, respectively (Table 6). This was due to more area brought under cultivation, introduction of high yielding short duration varieties and substitution of rice, jute and potato growing area to some extent with other profitable field crops like groundnut, maize, lentil, green gram and black gram. So, based on the scoring system, the degree of sustainability raised from high to very high at clusters I and III, moderate to high at cluster-IV and moderate to very high at cluster-II. The study of Edwards and Grove (1991) and Hossain and Kashem (1997) also reported that there is a higher chance of agricultural sustainability with increasing cropping diversification, mixed cropping and use of organic fertilizers.

Evaluation of social acceptability

One of the major objectives of agriculture is to meet the basic demands of food to sustain the livelihood of poor people. Thus, an agriculture which fails to provide an adequate supply of required food at a reasonable cost is not sustainable. This study assessed social sustainability using two indicator viz. index of food security and index of women‘s participation in agriculture.

Food security

The study of Pretty (1995) and Rasul and Thapa (2003) suggested that the assessment of variables such as equity, and food security, are highly relevant for agriculture sustainability and livelihood security in rural areas. Adequacy of food production is a crucial factor for food security. In this study, farmers were asked whether or not their food supply all year round was enough. Due to the introduction of improved agro-techniques and intensification of crop diversification through NAIP in the study areas, overall food deficiency was mitigated by 7.31, 16.97 and 24.05% for 2, 4 and 6 months respectively, while overall food sufficiency and surplus was enhanced from 33.71 to 75.73% and 0.38 to 8.07%,

Table 6. Analysis of crop diversification Index before and after NAIP intervention.

Name of the crops	Net sown area (ha)							
	Cluster-I		Cluster-II		Cluster-III		Cluster-IV	
	Before	After	Before	After	Before	After	Before	After
Rice	78.66	69.23	79.81	71.00	74.01	66.50	84.15	69.25
Jute	47.21	44.33	51.45	41.35	55.72	47.75	58.50	55.23
Potato	34.43	26.72	31.90	28.56	36.05	31.05	38.08	34.50
Wheat	21.28	28.25	23.75	31.50	19.00	23.74	14.79	21.81
Mustard	-	9.25	13.22	10.48	15.27	9.33	23.01	16.33
lentil	-	7.27	-	7.98	-	6.58	-	9.78
Black gram	-	2.93	-	5.44	4.17	13.25	-	3.22
Groundnut	-	5.23	-	6.52	-	7.19	-	10.42
Green gram	-	3.12	-	4.05	-	4.95	-	13.11
Maize	2.94	7.25	-	8.26	-	2.75	-	6.37
Sesame	-	2.50	-	1.74	-	3.86	-	5.59
Gross cropped area in ha	298.20	298.20	185.00	185.00	183.00	183.00	798.00	798.00
Cropping diversification index	36.90	18.73	40.03	19.72	34.04	19.90	43.71	22.33
Type of sustainability	High	Very high	Moderate	Very high	High	Very high	Moderate	High

Table 7. Analysis of food security index before and after NAIP intervention.

Items	Wi	Number of responded									
		Cluster-I		Cluster-II		Cluster-III		Cluster-IV		Overall	
		Before	After	Before	After	Before	After	Before	After	Before	After
2 months food deficiency	1	29	0	25	2	33	4	15	0	102	6
4 months food deficiency	2	70	7	66	11	79	8	39	5	254	31
6 months food deficiency	3	137	44	91	37	148	66	120	33	496	180
No food deficiency	4	140	308	109	208	132	291	62	184	443	991
Surplus	5	2	27	2	35	1	24	0	20	5	106
Total sample size	-	386	386	293	293	393	393	242	242	1314	1314
Index of food security	-	2.98	3.92	2.99	3.90	2.97	3.82	2.90	3.90	2.96	3.88
Type of sustainability		Moderate	High	Moderate	High	Moderate	High	Moderate	High	Moderate	High

(Table 7). It was from the study that there was an intra-region difference in food sufficiency. Among the clusters, highest food sufficiency and food surplus were achieved at cluster-IV (50.41%) and cluster-II (11.26%), respectively. According to sustainability classification, food security which was moderate, augmented to the level of high standards in all clusters. The report of Altieri (1987) and World Commission on Environment and Development (1987) also highlighted that inequitable or inefficient food distribution mechanisms have been blamed widely for the persistence of hunger in the world today.

Women's participation in agriculture

The mode of female participation in agricultural production varies with the land-owning status of farm households. Women's direct involvement in agricultural and allied activities is not only important in the perspective of women's empowerment but also essential for agricultural and overall socio-economic development of the rural area. It can facilitate the mobility of labour community from one sector to another sector and particularly the small and marginal farmers can fill up the labour shortage during the peak seasons. It the study area, women's participation in agricultural activities was divided into 10 items for evaluating sustainability of farming systems. These items cover different levels of agricultural production (Table 8). After 3 years study, it was observed that women's participation shifted from simple physical works (land preparation, sowing, intercultural operations, harvesting and threshing) to knowledge and skill oriented activities like raising livestock, kitchen gardening,

Table 8. Women's participation in agriculture.

Activities	Wi	Number of responded									
		Cluster-I		Cluster-II		Cluster-III		Cluster-IV		Overall	
		Before	After	Before	After	Before	After	Before	After	Before	After
Land preparation	0.1	97	48	76	38	116	36	107	22	396	144
Sowing	0.2	155	104	93	40	146	102	139	73	533	319
Intercultural operation	0.3	167	112	136	83	159	78	106	82	568	355
Harvesting	0.4	79	61	83	63	84	33	78	59	324	216
Threshing	0.5	88	65	58	32	75	68	61	47	282	212
Raising livestock	0.6	53	107	69	89	44	150	36	137	202	483
Kitchen gardening	0.7	9	43	5	56	12	133	0	38	26	270
PPHT	0.8	12	26	16	38	14	99	0	24	42	187
Micro-entrepreneurship	0.9	0	54	3	96	7	148	3	83	13	381
Decision making	1	0	68	1	27	6	59	0	27	7	181
Total		660	668	540	562	663	906	530	592	2393	2748
IWP		0.32	0.51	0.35	0.56	0.33	0.61	0.29	0.54	0.33	0.56
Type of sustainability		Low	Moderate	Low	Moderate	lOw	High	Low	Moderate	Low	Moderate

processing and post harvest technological activities, micro entrepreneurship development in group approach and decision making in all the clusters. It was revealed from Table 8 that overall women's participation decreased by 40.75% in case of simple physical activities, whereas, it significantly increased to 417.93% in case of knowledge and skill oriented activities, which ultimately assisted in uplifting the sustainability of farming system from low to moderate and high at cluster-III. Total women's involvement in agriculture and allied activities was also increased by 14.83% due to awareness building through extensive training and demonstration of skill oriented income and self employment generating activities.

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