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Panna Lal
Department of Agricultural Economics, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

PS Badal
Department of Agricultural Economics, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

Santosh Kumar
Department of Agricultural Economics, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

Correspondence
Panna Lal
Department of Agricultural Economics, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

Impact of Community Based Natural Resource Management on Agricultural Sustainability and Livelihood Security in Mirzapur District of Uttar Pradesh

Panna Lal, PS Badal and Santosh Kumar

Abstract
It is increasingly being realised that best approach to address natural resource problems or opportunities for ensuring livelihood security requires action at community level. The present study was conducted in Mirzapur district of the Vindhyan region of Uttar Pradesh which is highly fragile ecologically and poverty stricken. The impact of adoption of soil and water conservation programmes on agricultural sustainability and livelihood security was measured with the help of two indices namely index of risk & uncertainty and natural resource management based livelihood index.

Keywords: Natural resource management, agricultural sustainability, livelihood security

Introduction
Community based natural resource management (CBNRM) could be considered as engaging local people in resource management by incorporating their ideas, experiences, values, and capabilities and sharing management benefits (Uphoff, 1998) [6]. Community based natural resource management (CBNRM) is often promoted by governments, NGOs and donors as a means of reducing poverty in rural communities, particularly through income-generation from various natural resource-based activities. This approach envisages if rural communities have decision making authority over their natural resources and are able to benefit from the resources, they will use these more sustainably. In the past governments, development agencies and NGOs have experimented and found potential in this approach for generating income and jobs in rural communities and at the same time for promoting natural resource conservation (Braines Jones, 2006) [2].
The contribution of CBNRM programmes to combating poverty is currently more in terms of diversification of livelihood creating buffers against risk and shocks and empowering and giving a choice to local communities in terms of income generation.
At farm level, decision making with regard to soil and water conservation (SWC) technologies is the most important natural resource management intervention, since it usually affects both land use and land management, and it often requires long term investments. Adoption and continued use of long term soil water conservation measures such as terraces and stone bunds which require high initial investment and subsequently regular maintenance are not common. However, practices such as bunding, mulching and zero tillage are common in practice.
The Vindhyan plateau is situated at an altitude of between 315 m and 485 m from sea level and about 100 km South from the city of Varanasi in Uttar Pradesh. Climate is tropical monsoonal which includes a rainy season from June to September, a cool dry season (November-February) and a hot dry season (April-May). The Savanna grasslands which cover about 23 per cent of the region have been derived from tropical dry forests. Changes in land use pattern have been being observed over the past 30-40 years due to increasing anthropogenic pressure. Heavy uncontrolled grazing and intensive cultivation is now much in practice. The present study examines the impact of community based natural resource management on agricultural sustainability and livelihood Security in Vindhyan region.

Materials and Methods
In the present study multi-stage stratified random sampling technique was used for the selection of district, blocks, and villages. Vindhyan region of the Uttar Pradesh was selected for the study as it is highly prone to degradation of natural resources.

Out of three districts namely Sonebhadra, Mirzapur and Varanasi which come under Vindhyan region, Mirzapur district was randomly selected to act as a representative district of the region. Selection of blocks formed the second stage of sampling. A list of all 12 blocks in Mirzapur district was prepared and two blocks namely Narayanpur and Pahari were randomly selected. Selection of villages formed the third stage of sampling. A list of all villages of the selected blocks was obtained, and 4 villages from each block were randomly selected. Thus, the total number of villages selected for the study were eight. Selection of farmers formed the fourth and the final stage of sampling. A list of farmers in each village was prepared and 20 farmers were selected randomly. Thus a total of 80 farmers were selected from each block making the sample size 160 for the whole district. These groups were categorized as marginal farmers (less than 1ha), small farmers (1 to 2 ha), medium farmers (2 to 4 ha), and large farmers (above 4 ha).

Table 1: Details of the selected villages under different size groups

S.No.	Blocks	Name of villages	Size groups				
			Marginal	Small	Medium	Large	Total
1.	Narayanpur	Gurahupur	7	5	4	4	80
		Gharwaspur	5	6	4	5	
		Garaudhi	6	5	4	5	
		Gopalpur	8	5	3	4	
2.	Pahari	Newaria	8	4	5	3	80
		Hinauti	7	5	4	4	
		Sindhaura	6	4	6	4	
		Shivgarh	5	7	5	3	

Primary as well as secondary data were collected from different sources. Primary data were collected through personal interview using structured questionnaires developed specifically for the purpose. Pretesting of schedules and questionnaires were done and suitable modifications were made. After the preparation of schedules, actual field work was started and data were collected. Special care was taken to contact the respondents in their leisure hours and when they were alone. It ensured the supply of reliable data with minimum personal and social biases. The data pertains to period from April 2010 to June 2011. In order to examine impact of CBNRM on agricultural sustainability and livelihood security in the area, a set of indices were used.

Ecological sustainability is the process of development which is compatible with quality and security of food supplies (Smith and McDonald, 1998) [4]. Agricultural sustainability would be enhanced with the conservation of soil fertility, improved productivity and the reduction of risk and uncertainty in agriculture production. In this study the index of risks and uncertainties was examined based on cropping diversification in agriculture and stability of crop yield Crop diversification was measured through the index of crop diversification (lCD) using the following formula (Rasul and Thapa, 2003) [3]:

$ICD= l/[(R_1+R_2+... +R_n)/N_c]$

Where ICD is the index of crop diversification, R_1 the ratio of sown area under crop 1, R_2 the ratio of sown area under crop 2, R_n the ratio of sown area under crop n, N the number of crops. Crops occupying less than 1 % of the cropped area were excluded from the analysis. The five major crops: paddy, maize, millet, wheat and mustard, were taken into consideration. The stability of crop yield was examined by constructing an index based on farmer's subjective responses to a question related to yield trend. The index was constructed based on the following formula:

$IPS= (F_i* 1 + F_c * 0.5 + F_d * 0) / N$

Where, IPS is the index of production stability, F_i the frequency of responses indicating increasing yield, F_c the frequency of responses indicating constant yield, F_d the frequency of responses indicating decreasing yield, N the total number of responses.

The risk and uncertainties index was constructed based on the following formula (Rasul and Thapa, 2003) [3]:

IPS = log (ICD + IPS) / 2

Where IRU is the index of risk and uncertainties, ICD the index of crop diversification, IPS the index of production stability. A higher absolute value of the risk and uncertainties index indicates higher risk and uncertainties in agricultural production.

The computation of livelihood security for adopters and non-adopters was done with the help of following index which was modified form of one given by Sullivan *et al*. (2008) [1].

$$NRMLI = \frac{\sum W_i X_i}{\sum W_i}$$

Where,

NRMLI = NRM based livelihood security

X_i = Livelihood variables from 1 to 10

X_1 = Index of risk and uncertainty (IRU)

X_2 = Adoption of soil and water conservation (Yes = 1, No = 0)

X_3 = Access to credit (Yes = 1, No = 0)

X_4 = Access to market (Yes = 1, No = 0)

X_5 = Source of off farm income (Yes = 1, No = 0)

X_6 = Owned land (Yes = 1, No = 0)

X_7 = Owned livestock (Yes = 1, No = 0)

X_8 = Access to irrigation facilities (Yes = 1, No = 0)

X_9 = Literacy level (Literate = 1, Illiterate = 0)

X_{10} = Extension contact (Yes = 1, No = 0)

$\sum W_i$ = Sum of weight given to individual variables.

Weights were classified into three groups depending upon their importance with subjective judgment. Following weights were given to different variables.

Weight	Variables
0.05	X_2, X_5, X_{10}
0.10	X_3, X_4, X_6, X_7
0.15	X_1, X_8, X_9

Results and Discussion

Cropping intensity was computed for all size groups of farms and presented in Table 2. The maximum cropping intensity was observed to be 212.31 per cent in case of marginal farms, followed by small, medium and large farms corresponding 203.16, 190.82 and 182.42 per cent respectively with an

overall average of 189.20 per cent.

Table 2: Cropping Intensity of Sample Farms

Size of groups (ha)	Total cropped area	Net area	Cropping intensity %
<1	0.65	1.38	212.31
1-2	1.58	3.21	203.16
2-4	3.05	5.82	190.82
4 and above	6.2	11.31	182.42
Total	11.48	21.72	189.20

Adopted Practices for Sustainable Farming

Table 3 presents the different components of sustainable farming practices adopted at farms. It can be observed that 85 per cent of farmers adopted some form of SWC measure. Surprisingly, drip irrigation and sprinkler irrigation was adopted by none of the farmers. This is despite the fact Mirzapur is a water scarce region. Most common adopted practices were found to be bunding, mulching, zero tillage and leveling.

Table 3: Adopted Practices for Sustainable Farming

Particulars	Number of farmers	Its percentage
Bunding	144	90
Mulching	32	20
Sprinkler irrigation	-	-
Drip irrigation	-	-
Organic farming	-	-
Zero tillage	88	55
Levelling	137	85.5

Agricultural Sustainability

Agricultural sustainability in the area was examined with the help of computation of index of risk and uncertainty (IRU) comprising of index of diversification (ICD) and index of production stability. Higher value of both the ICD and IPS implied a desirable condition whereas a lower value was not a desirable condition. In case of IRU a lower absolute value was desirable as it showed lower level of risk and uncertainty. Results of the analysis are presented in Table 4.

Table 4: Agricultural Sustainability in Mirzapur District

Blocks	Adopters			Non-adopters		
	ICD	IPS	IRU	ICD	IPS	IRU
Narayanpur	0.33	0.68	0.29	0.27	0.57	0.39
Pahari	0.25	0.64	0.35	0.23	0.51	0.44
Total Mirzapur	0.27	0.65	0.33	0.25	0.54	0.41

It can be seen from the Table 4 that in Narayanpur block the level of diversification was higher in case of soil and water conservation (SWC) adopters (0.33) as compared to non-adopters (0.27). Similar trend was observed in case of Pahari Block. Further production stability was also found higher in case of adopters of SWC measures as compared to non-adopters in both the blocks. Consequently, the risk and certainty was found to be lower in case of adopters as compared to non-adopters in both the blocks and Mirzapur as a whole. This implies that as market access, credit support and input availability combined with other institutional supports improves, the agricultural sustainability improves. Similar observations were made by Rasul and Thapa (2003) [3] and Bhandari and Grant (2004) [5].

Impact of CNBRM

Livelihood security was examined with the help of 10 variables including index of risk and uncertainty. The index varied between 0 and 1, being the higher level of livelihood security. Results of the computation of livelihood security are given in Table 5.

Table 5: Impact of CNBRM in Livelihood Security

Block	Adopters	Non-adopters
Narayanpur	0.7025	0.4541
Pahari	0.6025	0.4041
Mirzapur	0.6523	0.4291

It can be seen from the table that adopters in the Narayanpur block obtained an index of 0.7025 which was more than non-adopters (0.4541). Similar trend was obtained in Pahari block. Thus it can be concluded that community based natural resource management coupled with institutional support is capable of providing better livelihood security to farmers.

Conclusion and Policy Implications

The study revealed that cropping intensity was higher at smaller holdings compared to large holdings. More than 85 per cent of farmers were adopting one or the other form of soil and water conservation measures either in the form of bunding, mulching, leveling or zero tillage. Index of agricultural sustainability was higher on the farms of adopters of soil and water conservation programmes as compared to non-adopters. Adoption of soil and water conservation practices also resulted in a higher level of livelihood security on these farms.

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