Post -Adoption Behavior of Farmers for Soil and Water Conservation Technologies –A Case of Ravine Watershed in Southeastern Rajasthan

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ABSTRACT

The study examined the post-adoption behavior of beneficiary farmers who have adopted different soil and water conservation technologies in Badakhera, a typical rainfed ravine watershed developed by Indian Institute of soil and water conservation during 1997-2003 in Bundi District of Rajasthan. The results revealed 68 per cent of the farmers adopted land levelling followed by summer ploughing (64%), bunding technology (60%), and masonry check dams (60%). Intercropping was only the crop based technology which was discontinued completely (100%) by farmers at the time of the study. Reduction in soil loss & runoff, conserving soil moisture and better application of water in fields were some of the reasons for continuing adoption of various technologies as perceived by the selected farmers. The results further indicate that 64.7 per cent and 100per cent of sample farmers adopted land levelling and gully plug technology with a technological gap. The values for a set of behavioral indices such as Technology Continue-Adoption Index (TCAI), Discontinuance Technology Index (DTI), *Technological Gap Index (TGI) and* Technology Diffusion Index (TDI) *was worked out for Badakhera watershed sample households and found 86.44, 13.56, 7.70 and 82.59 per cent respectively. Farm size, mechanical power, farm implements, scientific orientation, innovativeness, and risk were identified as factors which determine the extent of adoption of soil and water conservation technologies. The study suggested that any technological intervention for soil and water conservation in an area ought, to begin with, understanding farmer specific characteristics and behaviour. Over and above, developmental agencies should encourage location specific cost-effective technologies which required low investment and efforts for higher adoption in view of farmer's poor socio-economic status and uncertain returns from rain-fed agriculture in ravine areas.*

Key words: *Water conservation; Technologies; Summer ploughing; Adoption; Diffusion; Attitude; Index;*

Agriculture plays a unique role in reducing poverty through the use of new technologies. Dissemination of information related to technology is important. In general, farmers have conservative attitudes and need more time and information to be persuaded to adopt new technologies. Important pockets of poverty remain in areas characterized by rain-fed agriculture or fragile soils and which affects close to 60 per cent of the geographical area in the country. To reduce rural poverty and hunger government of India initiated a number of programmes, among them watershed development programme is a prominent one. A number of soil and water conservation technologies or interventions are being taken up to increase productivity and reduction in soil erosion. However, the success of the Soil and water conservation (SWC) intervention depends on the extent to which the introduced conservation technologies were accepted and adopted by the farmers after withdrawal of these watershed developmental programmes. Over and above, adoption of soil and water conservation interventions does not automatically guarantee long-term use especially when these measures have been established with considerable project assistance. However, *Rogers,1995* found that when the farmers are satisfied with whatever new technology they have adopted, they are likely to hold on to it, but if they feel that it does not meet their requirements they will discard it. About 60 per cent of total arable land (142 million ha) in India is rain-fed and watershed development projects in the country has been sponsored and implemented by Government of India from early 1970s onwards in one way or other to address the problem of soil erosion by executing various soil and water conservation interventions for holistic development of the rainfed areas, where erratic precipitation often results in low crop yields or crop failure as well as encourage land degradation.

The Indian Institute of soil and water conservation (IISWC) and its research centres have developed successful model watersheds across the country. Many evaluation studies were conducted on these projects in the past. However, assessment of post adoption status of soil and water conservation technologies over a longer period was lacking. It is evident that adoption of conservation practices alone may not lead to sustained land rehabilitation unless the technologies are utilized continuously by the beneficiary households. Keeping in view the above facts the present study was undertaken to measure the extent of post-adoption behaviour (i.e. continue-adoption, dis-adoption, technological gap, diffusion, and infusion) of farmers regarding adopted SWC technologies executed in Badakhera watershed which is a typical ravine watershed and developed under Integrated wasteland development programme (IWDP) during 1997-2003.

METHODOLOGY

The study was carried out in a typical ravenous watershed namely Badakhera in district Bundi of Rajasthan state. This watershed having 682.5 ha area and represents about 0.4m ha ravenous infested area of the state located along the river and its tributaries. This watershed was developed by Indian Institute of Soil and water conservation, Research centre, Kota under the scheme IWDP during 1997 2003. The watershed was treated with different soil and water conservation interventions and improved crop based management practices. A sample of 50 beneficiary farmer households, who possessed fields treated with soil and water conservation technologies under the watershed management project was selected randomly. Qualitative and quantitative data regarding personal, psychological and post-adoption behavior variables collected on specially designed and pre-tested questionnaire by interviewing the respondents personally during the year 2013-14. Field visits for verifying soil and water conservation technologies adopted on selected sample households was also conducted in order to ensure the validity of information obtained from the respondents. The values for a set of behavioral indices such as *Technology Continue-Adoption Index (TCAI), Discontinuance Technology Index (DTI)*, Technological Gap Index (TGI) and *Technology Diffusion Index (TDI)* was worked out as reported by *Bagdi, et al., 2015*. The data were analyzed using MS Excel and determinants of the extent of adoption of soil and water conservation technologies were identified using multiple linear regression analysis.

RESULTS AND DISCUSSION

Sample Characteristics : The sample profile of farmers understudies given in Table 1 which shows that 58 per cent of them were between the ages of 50-75 yrs with mean about 52 yrs hence, all of them having vast experience of farming. The average family size was recorded as 7 persons. It was noted that none of the houses was headed by a female. A good number of sample households were literate. On an average, the land area cultivated was 3.58 hectares (SD=2.58) by the sample households. The majority (68%) of the households had farms that were below 4 ha while 4 per cent had more than 8 ha of cultivated area. Except for few marginal farmers, all the households supplement their income by rearing animals. The average numbers of animals in standard livestock unit (SLU) maintained by the farmers was found to be 2.98 (SD=2.37).

The extent of technology adoption : The success of the implemented watershed projects can be measured in terms of the extent to which the implemented soil and water conservation technologies were adopted by the individual farmer. Distribution of respondents by the extent of technology adoption presented in Table 2. The results revealed that an average number of technologies adopted in Badakhera watershed was 3.18 (SD=1.53). The study further indicates that the majority (50%) of the sample respondents adopted between 3-4 technologies while 30 per cent adopted 1-2 technologies introduced. Only 2 per cent of farmers adopted more than 7 technologies. The variation in the number of technology between farmers may be due to the facts that some of the soil conservation technologies may effective only when executed or adopted in combinations.

Table 1. Socio-economic profile of the respondents

Socio-economic characteristics		No.	%
Age	<25 Years	0	0.0
	25-50 year	21	42.0
	50-75 years	29	58.0
	Mean	51.84	
	SD	12.06	
Family size	<3	3	6.0
	3-6	27	54.0
	7-9	16	32.0
	>9	4	8.0
	Mean	6.54	
	SD	3.36	
Education	Illiterate	12	24.0
	Primary	18	36.0
	Middle	6	12.0
	Sec. & above	14	28.0
	Mean	2.26	
	SD	1.90	
Holding size (ha)	0-1 ha	2	4.0
	1-2 ha	19	38.0
	2-4 ha	13	26.0
	4-8 ha	14	28.0
	>8 ha	2	4.0
	Mean	3.58	
	SD	2.58	
No.of animals (SAU)	<2	15	30.0
	2-4	13	26.0
	4-6	14	28.0
	>6	8	16.0
	Mean	2.98	
	SD	2.37	

SAU= Standard livestock unit (SAU= 1 animal= 1buffalo, 0.7 cow, 1 bullock, 0.08 (sheep / Goat)

Table 2. Distribution of respondents by numbers of technologies adopted under the program

No. of Technology adopted	No.	%
1-2	15	30
3-4	25	50
5-6	9	18
7-8	1	2
Mean	3.18	
SD	1.53	

Status of technologies adoption: The most common soil and water conservation interventions/technologies adopted by farmers under the watershed program was bunding, land leveling and summer plowing (Table 3). The reason of the adoption of these technologies on large scale was due to the fact that majority of farmers were acquainted about the practices as a traditional practice but not sure about the expected benefits prior to implementation of watershed projects.The data show that maximum farmers (68%) preferred to adopted land leveling followed by summer plowing (64%) bunding (60%) and masonry check dams (60%). The reason acknowledged for the adoption of technologies under the programme and thereafter continuation of the majority of practices by the farmers was that the technologies executed under the programme was a good blending of mechanical as well as biological measures which were effective in controlling soil erosion, improved soil moisture which enhanced the soil productivity. The results also indicate the present status of technology dis-adopted and found that crop-based technology namely intercropping discontinued completely (100%) by farmers. The reason behind discontinuation of the

Table 3. Status of technology adoption, continuation, and adoption with technological gap

Name of technologies implemented during watershed development	Farmers adopted technology(%)	Farmers continued technology (%)	Farmers discontinued technology (%)	Farmers adoptedtech with technological gap (%)
Contour farming	2.0	0	100	0
Inter cropping	30.0	0	100	0
Land levelling	68.0	68.0	0	44.0
Check dam (Masonry)	60.0	60.0	0	0
Summer ploughing	64.0	64.0	0	0
Gully plugs	6.0	6.0	0	100
Loose Boulder check dam	2.0	2.0	0	100
Grassed water way	4.0	0.0	100	
Bunding	60.0	60.0	6.6	0
Well recharge	2.0	0.0	100	0
Pond	6.0	6.0	0	0
Anicut	12.0	12.0	0	0
Plantation (agri-horti)	2.0	2.0	0	0

intercropping system was i) changing cropping pattern over time in favor of more remunerative pure crop especially soybean ii) problem in farm operations and the difference in crop durations of intercrop iii) increased water availability in watershed converted long duration rainfed monocropping system into double cropping. Therefore, it is clear that farmers adopted and sustained only those soil and water conservation technologies which they perceived as economically beneficial besides controlling soil erosion.

The extent of the post-adoption behaviour of farmers : Table 4 presented the indices value of the extent of the post-adoption behaviour of farmers. The table indicates that as per the TCAI values more than 86per cent of SWC technologies were continue adopted by farmers in the watershed. The Discontinuance of Technology Index (DTI) values indicate that 14 per cent of SWC technologies were discontinued or dis-adopted by farmers. The overall Technological Gap Index (TGI) data also revealed that on an average 7.7 per cent technology gap was assessed in adopted SWC technologies out of the total continue adopted technologies by the farmers in the Badakhera watershed. Diffusion of SWC technologies was also evaluated using the Technology Diffusion Index (TDI) and it was found that more than 82 per cent of farmers diffused SWC technologies to other farmers' fields in nearby areas. The reason for higher diffusion may be attributed with the fact that this watershed gained wide publicity due to the good impact of SWC interventions in this ravine watershed which motivate non-beneficiary of Badakhera watershed as well as nearby villagers who frequently visited the project sites and replicate technologies on their fields.No case of technology infusion was found in the watershed.

Table 4. Indices values of the Post-adoption behavior of farmers in selected watersheds

Post-adoption behavior indices	Indices Value (%)
Continue adoption (TCAI)	86.44
Dis-adoption (DTI)	13.56
Technological gap (TGI)	7.70
Diffusion (TDI)	82.58
Infusion(mean no. of technologies) TII	Nil

Reasons for continue adoption : The study further ascertains the technology-based reasons for adoption and its continuation over time and presented in Table 5. The continuation of technology adoption was explained by the fact that farmers perceived improved production of crops after execution of technologies in their fields over time besides reduction in land degradation and improved water conservation. The result presented in table indicate technology based some of the reasons perceived by the farmers justifying continuation of technology in use Viz destroy harmful soil microbes (summer ploughing), conservation of soil and water (Land levelling), Conservation of water and reduction in soil loss (Masonry Check dams), reduction in soil loss & runoff (Bunding), Regular employment &More profit (plantation).

Table 5. Reasons perceived by the sample households for continue adoption in Badakhera ravine watershed (N=50)

Technology	Reason	%*
Summer plowing	To destroy harmful soil microbes	18
	Better physical properties	18
	Proper aeration	02
Land leveling	Better agricultural practices	04
	uniform application of water	24
	moisture conservation	06
	To conserve soil & water loss	50
	Better crop yield	-
Bunding	To reduce soil loss & runoff	52
	To conserve soil moisture	06
	Higher yield due to moisture conservation	-
	To check runoff	-
Grassed waterway	To reduce soil loss and runoff	02
Check Dam	To reduce soil loss	64
	To conserve water	64
Gully plug	To reduce soil loss	08
Well Recharge	To conserve water	02
Ani cut	To conserve soil & water	08
Pond	To conserve water	02
	Well recharge	06
Lose Boulder	To conserve soil	02
Plantation	Subsidy by Govt.	-
	Regular employment &More profit	04
	To conserve soil & water	-

*Multiple responses

Determinants of the extent of adoption: The stepwise linear regression model was used to identify the factors influencing the extent of adoption of soil and water conservation technologies at the household level. The analysis hypothesized twenty explanatory variables and included in the model. Farm size, mechanical power, farm implements, scientific orientation, innovativeness,

Table 6. Stepwise multiple linear regression results showing determinants affecting extent of technology adoption

Parameter	Estimate	SE	T-statistic	P-value
Constant	5.70294	1.95548	2.91639	0.0056
Farm size	0.152943*	0.0711755	2.14881	0.0372
Mechanical power	0.283719**	0.0976236	2.90625	0.0057
Farm Implements'	-0.230934**	0.081661	-2.82796	0.0070
Scientific Orient.	0.271863**	0.060409	4.50038	0.0000
Innovativeness	-0.245163**	0.0821145	-2.98562	0.0046
Risk	-0.175449**	0.04037	-4.34602	0.0001
R^2	63.153%			
R^2 (adjusted)	58.2648%			
Standard Error of Est.	0.983089			
Mean absolute error	0.754034			

*Significant at 0.05 level of significance

**Significant at 0.01 level of significance

and risk were identified as factors which determine the extent of adoption of soil and water conservation technologies (Table 6). Almost all the explanatory variables in the model had the correct sign as hypothesized with the exception of farm implements and innovativeness. The R^2 statistics indicate that the model fitted explains 63 per cent of the variability independent variable and four variable namely farm size, scientific orientation, mechanical power, and risk variables have greater effect in making decision about the number of soil and water conservation practices adoption as these variables explain 79 per cent of the total variation (63.15%) while other three variables namely farm implements, innovativeness, and risk taken together contributed only 21 per cent of the total variation. Factors affecting the extent of adoption suggested that any technological intervention for soil and water conservation in an area ought to, to begin with, understanding farmers' behavior apart from local factors which may influence technology adoption

CONCLUSION

The study showed that 86 per cent of the SWC technologies were continued adoption by the beneficiary farmers, while, 14 per cent of the SWC technologies discontinued by the farmers due to change in cropping pattern, the ineffectiveness of technology in improving yield and moisture conservation and operational difficulties. It was also found on an average 7.7 per cent technological gap was assessed in adopted technologies. The diffusion of adopted SWC technologies indicates that 82 per cent of farmers diffused the technology in nearby areas for the conservation of natural resources. No case of technology infusion was observed despite the fact that this watershed execution work was completed at least a decade back. Farm size, Mechanical power, scientific orientation, and Risk were the major factors which affect the extent of SWC technologies adoption. Therefore, the study suggests that any technological intervention for soil and water conservation in an area ought, to begin with, understand farmer specific characteristics and behaviour. Over and above, developmental agencies should encourage location specific cost-effective technologies which required low investment and efforts for higher adoption in view of farmer's small size of land holdings, poor socioeconomic status and uncertain returns from rain-fed agriculture in ravine areas.

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