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Sustainable technological interventions in soil conservation measures for rural livelihood management

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ABSTRACT

This paper summarizes the results of a study conducted to assess rural livelihood during 2013-2014 in Angul district of mid-central table land zone of Odisha. Questionnaire identified the reasons for household adoption and distribution of adoption of interventions in the areas of study with respect to technological interventions and suitable approach for transfer of technology under rainfed and irrigated situations. A sampling of 240 respondents from 4 villages comprising both situations was taken for study. The results revealed that in adoption of soil conservation technologies, significant difference (at 1% level) is observed in adoption of natural fallows (z=6.0) followed by digging of trenches (z=4.0) with effective retention of run-off. However, mulching, construction of new terraces was found non-significant. There exists no significant relationship between socio-economic condition and adoption behaviour. Service providers (65%) and para-extension workers (46.67%) stimulate technology adoption behaviour. Compatibility (MS-3.34) and marketability (MS-3.26) attributes of innovation affects technology adoption.

Keywords: Adoption, attributes of innovation, soil conservation, stimulating approach and technological interventions

In 1992, Robert Chambers and Gordon Conway proposed the following composite definition of a sustainable rural livelihood, which is applied most commonly at the household level. A livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living: a livelihood is sustainable which can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels and in the short and long term. Social mobilization engages people's participation, institution network towards development from the grass root level (Arce, 2003). Sustainable livelihood is dynamic and ensures that needs of project activities directly addresses the household livelihoods for security needs (CARE, 1994).

Soil conservation is a set of management strategies for prevention of soil being eroded from the Earth's surface or becoming chemically altered by overuse, acidification, salinization or other chemical soil contamination. It is a component of environmental soil science. The soil conservation is a top-ranking agenda in agriculture development. Checking of soil erosion, conserving soil in terms of its content, suitability for sustainable production has been focal point for agriculture science. Taking the important components into account, the study examines their adoption dimension in rainfed and irrigated villages under study.

Angul district of Odisha lies between 20°31′ N and 21°40′ N latitude and 84°15′ E & 85° 23′ E longitude. The total geographical area of Angul is 6232 sq.kms. Odisha state has 30 districts and Angul district was selected purposively as being in the mid-central table land zone it represents the overall livelihood system as it covers parameters like rural, semi-urban, rainfed, irrigated, agriculturally dominant and moving towards industrialization and the study was conducted in 2013-14.The relevant secondary data has been collected from 2 blocks of the district selected purposively. From each block, 2 villages have been selected purposively as per diversification and livelihood strategies adopted for sustaining livelihood**.** Respondents were selected by simple random sampling with replacement and 40 respondents out of 240 were repeated. From each village, 60 households were selected taking 12 per cent of the population. A total of 240 respondents (Table 1) comprise the sample for study. The data collection was done with the help of a structured interview schedule, experts view and focused group discussion. The entire study comprised of dependent and independent variables with fair number of intervening variables.

Table 1: Sample information

District	Blocks	Villages	Total respondents
Angul	Chhendipada	Nuagaon	60
		Jaripal	60
	Atthamalik	Berham	60
		Mandarbahal	60

The entire Angul district comes under the catchments of two major river systems namely, the Mahanadi and the Brahmani. Due to hilly and sloppy terrain conditions about 40 per cent of the geographical area is affected by soil erosion. Soil conservation is a complex activity consisting of seven important components like

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Table 2: Adoption of technological interventions in soil conservation measures

Sl. No.	Interventions	Rain fed				Irrigated				Difference in
		Adopters		Non-adopters		Adopters		Non-adopters		adoption
		120	%	120	%	120	%	120	%	%
1.	Construction of new terraces	28	23.33	92	76.67	36	30.00	84	70.00	6.67
2.	Digging of trenches	67	55.83	53	44.17	24	20.00	96	80.00	35.83
3.	Mulching	78	65.00	42	35.00	81	67.50	39	32.50	2.50
4.	Use of trash lines	45	37.50	75	62.50	34	28.33	86	71.67	9.17
5.	Grass strip planting	08	6.67	112	93.33	18	15.00	102	85.00	8.33
6.	Agro-forestry	81	67.50	39	32.50	68	56.67	52	43.33	10.83
7.	Natural fallow	90	75.00	30	25.00	23	19.17	97	80.83	55.83

Note: *N= 120 in each intervention in both the farming situations (i.e. total 240)*

Table 3: Difference in adoption of interventions in soil conservation measures

Sl. No	Intervention	Rain fed	Irrigated	"z" value
		%	%	
1.	Construction of new terraces	23.33	30.00	1.0 (NS)
2.	Digging of trenches	55.83	20.00	4.0 **
3.	Mulching	65.00	67.5	1.0 (NS)
4.	Use of trash lines	37.50	28.33	1.0 (NS)
5.	Grass strip planting	6.67	15.0	2.5 *
6.	Agro-forestry	67.50	56.67	2.5 *
7.	Natural fallow	75.00	19.17	6.0 **

*Note: *Significant at 5% level of probability; ** Significant at 1% level of probability, NS – Non-significant*

Table 4: Stimulating approach for acceleration of transfer of technology (N =240)

Sl.No.	Enterprises →	Soil conservation measures
	Approaches ▼	%
1.	Multichannel information	23.33
2.	Pro-poor approach	15.83
3.	Public sector financing	32.50
4.	Service provider	65.00
5.	Feedback system	15.42
6.	Poverty reduction	26.67
7.	Competitive market	30.83
8.	NRM/ Environment security	20.00
9.	Farmers federation	31.67
10.	Vil. Extn worker/ para-extension worker	46.67

construction of new terraces, mulching, use of trash lines, grass strip planting, agro-forestry and natural fallow.

Table 2 contains analysis of adoption of seven important components beneficial for soil conservation. In rainfed areas, natural fallow (75.00%) tops the list followed by agro forestry, mulching, digging of trenches, use of trash lines and construction of new terraces, natural fallow and grass strip planting are observed in order. The significant difference in adoption is observed in case of natural fallow (55.83%) and digging of trenches (35.83%) while other variables do not exhibit significant difference. Natural fallow is more in rain fed villages because of erratic and insufficient rainfall and digging of trenches follow the same route in rain fed area when compared to irrigated area. Other factors being non-significant indicating no remarkable difference need explanation as case remain similar in case of irrigated area. Grass strip planting is also a better technology for soil conservation but not widely adopted due to cost intensive.

Management of soil and water resulting soil conservation of two selected areas were examined to

Table 5: Soil conservation technologies and stimulating approaches for adoption

Sl. No.	Stimulating approaches	"z_r" value (transformed 'z' score)	"t" value
1.	Multichannel Information	0.299	4.70 (**)
2.	Pro-poor approach	0.811	12.50 (**)
3.	Public sector financing	0.661	10.5 (**)
4.	Service provider	0.064	0.93 (NS)
5.	Feedback system	0.005	0.061 (NS)
6.	Poverty reduction	0.280	3.51 (**)
7.	Competitive market	0.333	5.11 (**)
8.	NRM/ Environment Security	0.230	3.51 (**)
9.	Farmers federation	0.660	10.5(**)
10.	Vil. extn. worker/ para-extension worker	0.436	7.35 (**)

*Note: *Significant at 5% level of probability; **Significant at 1 % level of probability, NS – Non-significant*

Table 6: Attributes of innovation for successful adoption

Sl. No.	Attributes	Soil conservation measures (n=29)	
		Mean score	Rank
1.	Relative Advantage	2.89	IV
2.	Affordability	2.77	VI
3.	Social Acceptability	2.99	III
4.	Timely Availability	2.87	V
5.	Marketability	3.26	II
6.	Compatibility	3.34	I

find out difference between adopters in adopting selected interventions. Results reveal that construction of new terraces, mulching and use of trash lines are not influenced in adoption status because of irrigation whereas digging of trenches, grass strip planting, agro-forestry and natural fallow exhibit significant differences. The inference is that adoption of soil conservation methods has variation in both the cases in four important components as discussed in table 3.

The socio-economic variable invariably influences adoption behaviour of the farmers. The research funding have clearly established that higher the SE status greater is the rate of adoption. In order to find out existing relationship between socio-economic status and adoption behaviour, with respect to technological interventions in the enterprise was analysed.

The calculated score on socio-economic variable obtained by an individual and score obtained for adopting components of different interventions were tested under zero order correlation and the results obtained in terms of 'z' and 't' values. The 't' in rainfed condition is 1.40 and in irrigated condition is 1.54. The sample adopting particular technology was taken in to consideration leaving out non-adopters. Soil conservation management practices reflect non-significant correlation in both the situations *i.e*. rainfed and irrigated.

Adoption of an innovation according to a recent review of a meta level analysis undertaken by Prokopy *et al*. (2008) shows that education levels, capital, income, farm size, access to information, positive environmental attitudes, environmental awareness and utilisation of social networks are generally positively, associated with the adoption of best management practices. This is principally influenced by the characteristics and circumstances of the farmer, and the characteristics of the practices, especially its relative advantage over existing practices and landholder's ability to trial the practice. Farmers adopt an innovation if they expect that the practice will help them achieve their goals, which may include economic, social and environmental goals.

Table 4 reveals that in an attempt to conserve soil fertility, revolution is towards organic farming for sustainable agriculture development. Under the study, soil conservation measures involve technologies like construction of new terraces, digging of trenches, mulching, use of trash lines, grass strip planting, agro-forestry and natural fallow. The stimulating approach for promoting soil conservation technologies is found highest with service provider (65.00%) followed by para-extension workers (46.67%). The preference of market, environment and multi-channel information is not found to be very much effective as major factor is farmers group

approach and subsidy under poverty reduction (26.67%) programmes.

Table 5 reveals the stimulating approaches which provoke farmers to adopt or reject certain technologies. Adoption of soil conservation measures was influenced maximum by pro-poor approach (t = 12.50), farmers' federation (t = 10.50) and public sector finance. Role of service provider and feed-back system is not found to be non-significant.

Technology armed with certain useful attributes and useful to increase income of farmers has been focal point of adoption. Taking review of literature into consideration and experts in the field of transfer of technology, six important attributes of all the enterprises were taken in to consideration. These are relative advantage, affordability, social acceptability, timely availability, marketability and compatibility.

Table 6 reflects that in case of soil conservation the stimulating attributes are compatibility followed by marketability, social acceptability and relative advantage. However, affordability is found to play minimum role because in case of soil conservation major input are supplied by Government. Compatibility refers to both farming as well social system which favour soil conservation measures to increase fertility of soil or arrest degradation of soil. This also holds good in the district condition as 75per cent of the soils are acidic in nature.

This study examined the adoption status of technological interventions in rainfed and irrigated areas for soil conservation. Personal characteristics of farmers such as age and experiences are likely to affect the adoption of best crop management practices (Mariano *et al*., 2012). Based on the results, following policy recommendations are that in the livelihood sector, grass strip planting should be emphasized and farmers need to get government support for the same. Agriculture land needs to be conserved (Singh and Narasimhan, 2017). Farmers need to be motivated for soil conservation measure primarily with public finance support.

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