Vol. 47, No. 1, pp 81-86, 2019
Indian Journal of Soil Conservation
Online URL : http://indianjournals.com/ijor.aspx?target=ijor:ijsc&type=home

Adoption determinants of soil and water conservation measures in Bay Islands: An analysis of farmer's perceptions for investment

Subhash Chand[1,*], Shrawan Singh[2] and R.C. Srivastava[3]

[1]ICAR-National Institute of Agricultural Economics and Policy Research, Pusa, New Delhi; [2]ICAR-Indian Agricultural Research Institute, New Delhi; [3]Central Agriculture University, Samstipur, Bihar.

**Corresponding author:*
E-mail: scchand46@gmail.com (Subhash Chand)

ARTICLE INFO

Article history:
Received : August, 2018
Revised : March, 2019
Accepted : March, 2019

Key words:
Determinants,
Farmers perception,
Gender,
SWC technologies

ABSTRACT

The determinants for perception of farmers towards adoption of soil and water conservation (SWC) were studied in Andaman and Nicobar Islands, Port Blair during 2011-13. The rate of adoption of SWC was largely affected by socio-economic condition of the farmers and biophysical factors. About 50% farmers have adopted SWC practices. The average landholding size was 2.5 ha households^{-1} and family size 6-7 people. The logistic regression model indicates that age of head and family size had the negative influence on adoption but family headed by the female members found to be inclined toward adoption of adopt of soil and conservation measures. The level of education for head of family was significantly positive towards the adoption on conservation practices. The participation and trainings of farmers in different schemes of SWC had positive influence on their perception towards SWC likely to adopt. The study will be helpful in policy input to enhance the adoption rate of SWC in these Islands.

1. INTRODUCTION

Andaman and Nicobar Islands is having a fragile islands eco-system due heavy precipitation with high intensity leads to high soil erosion. The UT government is taking and suggesting various programmes to counter the ill effect climate change. The conservation of soil of individual land holdings on 50% loan-cum-subsidy / shramdhan-cum-subsidy schemes are in force. The conservation work on watershed basis is being taken up for comprehensive conservation of soil, development of land and sustainable management of natural resources with holistic approach. Due to the land surrounded by sea and other various limiting factors like intrusion of Saline Water in the allotted cultivable land causing soil salinity, stagnation and water logging in the low lying paddy areas, deposition of gravels carried from different gullies and nallahs and its deposition on the flat agriculture land in the foothills (Singh, 1988). Therefore, to reduce soil loss, land cover and management practices need to be promoted.

The rate of adoption of SWC measures affected by numerous of socio-economic attributes of the farmers, topography of lands, climatic conditions and several other bio-physical factors. The several studies conducted in India and abroad to quantify the adoption rate of SWC measures. Still we have limited information on the determining factors perceived by the farmers to invest in conservation measures. Various studies conducted in India and abroad have indicated that the awareness level of farmers about the SWC (Thiranjangowda, 2005; Gupta *et al.,* 2009; Ihekea and Onyenorah, 2010; Mohammad *et al.,* 2002; Bagdi *et al.,* 2001) varies from 50 to 76%. While, adoption rate studied by Chandra Charan *et al.,* 2007; Hurd, 2009; Kulshrestha *et al.,* 2010 and reported at 65% to 77% in different areas. The studies on perception about SWC technologies effectiveness indicate higher perception rate and willingness to adopt the SWCs (Gang Lian *et al.,* 2007; Mansur *et al.,* 2007). Pandey and Chaudhary, 2010 studied soil and nutrients loss due to water erosion from five major land use of Andaman and Nicobar Islands. The soil loss in vegetables cultivation went up to 124 t ha^{-1}. The erodibility also was found to be very high (0.26) in vegetables fields.

Therefore, this study was planned with the specific objectives to understand the socio-economic characteristics of the farmers who have attitudes to adopt the SWC practices. To identify the determinants of farmers perception on expenditure in SWC practices. The study will add the

information in understanding farmer's perception on adoption of SWC particularly in vegetables cultivated areas in these islands. Therefore, we have planned this study to address these aspects in details.

2. MATERIALS AND METHODS

Study Area

This study was conducted in the Andaman and Nicobar Islands in the Bay of Bengal (6-14 N latitude and 92-94 E longitude. The archipelago is divided, geographically, into five groups of Islands, namely North Andaman, Middle Andaman, South Andaman, Car Nicobar, Nancowry and Campbell Bay. These islands, a group of 572 Islands of which only 38 are inhabited, are spread on 0.825 M ha of geographical area. It has a population of 3,79,994. The soils are loose, well drained, generally gravely loamy to sandy loamy in texture, mostly slightly acidic in reaction and low to moderate in nutrients. The climate is equatorial humid tropical and temperature varies from 18 to 35°C and average annual rainfall is 3000 mm, distributed over 8 to 9 months. Humidity ranges from 71 to 85%. Forest cover (87%), home garden (4.6%) and rice fields (1.3%; Basic Statistics, 2016). Cyclones occur during the Monsoons, accompanied by very strong winds, mainly during May and November and in some years during mid-April. The Andaman Islands were home to several groups of Negrito, hunter-gatherer indigenous tribes. Settlement has also resulted in the loss of most of the lowland evergreen forest, and small freshwater riverine habitats, which include most of the Andaman teal and crocodile nesting habitats in the Andaman. The islands being a popular tourist destination is visited by 1,95,396 tourists (includes 14,615 foreign tourists) during 2010-11 (Chand *et al.,* 2015).

Data Source and Data

We have collected data from primary and secondary sources and used STATA 14.0 to compute the descriptive statistics and other analyses purposes. The specification of the variables and expected sign is given in Table 1.

Logit Function

To understand the determinants of SWC practices adoption perception a logistic statistics model was used. In the logistic model, the coefficients are compared with the probability of an event occurring or not occurring and bounded between 0 and 1. The dependent variable becomes the natural logarithm of the odds when a positive choice is made. The odds ratio and predicted probability of the independent variables indicate the influence of these variables on the likelihood of adoption of improved technology if other variables remain the same. Hence, if the estimated values of these variables are positive and significant, it implies that the farmers with higher values for these variables are more likely to adopt SWC technology.

The model is specified as : ln (Px/(1 Px)) = _0 + _1_X1i + _2_X2i + . . . + _k_Xki ...(1)

Where, the subscript i is the i_{th} observation in the sample, Px is the probability of an event occurring for an observed set of variables Xi, *i.e.* the probability that the farmer adopts the improved technology and (1 Px) is the probability of non-adoption. 0 is the intercept term and 1, 2, . . . ,k are the coefficients of the explanatory variables X1, X2, . . . , Xk.

The dependent variable for the adoption model indicates whether or not a household has adopted improved soil conservation technology. Adoption of SWC technology was defined as a binary variable with a value of "1" for farmers who adopted soil and water control technology or adopters; a household who has adopted at least one improved soil conservation technology, either as recommended by extension workers or with some modification, was defined as adopter. These technologies include adoption of broad bed furrow (BBF) system, vegetative barrier (*Glaricidiea* on bund/periphery), Kuccha wall with wood plunks, Water harvesting structure, half-moon trench, stone strips, bunds, wind break, mulching include "0" was assigned to households "non-adopters" who do not use any SWC technologies. SWC technology is

Table: 1
Specification of variables

Name of variable	Type of variable	Unit of measures measurement	Probable Sign
SWC perception	Dummy	1 for yes soil and water can be conserved otherwise 0	
Age Head of family	Continuous	Years	-+
Family size	Continuous	Numbers	-+
Gender head of family	Dummy	Male=1 otherwise 0	+
Schooling years	Continuous	No. of years school attended	+
Landholding size in ha	Continuous	In hectare	-+
Participation in SWC	Dummy	1 for adopter otherwise 0	+
Type of land (Sloppy, valley	Dummy	If sloppy lands=1 otherwise 0	+
Trainings in SWC	Dummy	If farmer attended any SWC training yes=1 otherwise 0	+
Land security	Dummy	If farmers had land own name yes=1 otherwise 0	-+
Member of social groups	Dummy	If farmer is member of any social groups yes=1 otherwise 0	-+

influenced by personal, social, economic and, institutional factors. These variables were considered as explanatory variables for analysis.

3. RESULTS AND DISCUSSION

General Features of A&N Islands

The general features of A&N islands analysed based on secondary data. This is evident from the table that South Andaman district harbour majority of population being capital located in the district. All the business activities take place in this district and agriculture infrastructure like markets, cold storage, transport, banks, education institutions etc. and government offices are located at Port Blair. However, local offices of line departments are also located in respective districts. These districts are different in terms of communities residing and land use followed as summarised in Table 2.

The loss due to land degradations were documented by various authors (Joshi and Agnihotri, 1984; Parikh and Ghosh, 1995; Joshi *et al.,* 1996; Srinivasarao, 2013) in terms of declining crop productivity, land use intensity, changing cropping patterns, high input use and declining profit. In general, the island soils with humus on top have 0.20-0.95% organic carbon and in coastal areas prone to tidal floods, acid sulphate and saline soils are found. The island soils in general show deficiency nitrogen, phosphorous (owing to fixation), calcium, magnesium, and sulphur. The T-sunami of December 26, 2004 that has resulted in tilting these islands by 1.2 meter north to south and has resulted in accelerated and altered shoreline erosion (Gangaiah *et al.,* 2015).

Socio-economic Characteristics of Respondents

The data on socio economic attributes of 284 respondents belong to entire islands were analysed and presented in the Table 3. The average family size was about 6-7 person in the family. Though average family looks to be higher size for the pooled data but it was about 4-5 person in the family for south, north and middle Andaman while more than 9 persons for Nicobar groups of Island. The reasons being higher family size for Nicobar Islands was due to tribal are following the joint family system. Only about 12%

Table: 3
Socio-economic characteristics of selected farmers

Particulars	Frequency (N=284)	%
Average Family size	6.61	100.00
Small	4.26 (105)	36.97
Medium	5.86 (67)	23.59
Large	9.00>(112)	39.44
Gender Head of family		
Male	250	
Female	34	80.03
Annual income (No.)	284	19.97
Low 20000-35000	98	34.50
Medium 35001-50000	106	37.32
High >50001	80	28.18
Land holding size (ha)	2.5	
Member of any social group (%)	190	67.02
SWC measures adopted (Included if any one)	141	49.8
Slope of land cultivated (Whether land possessed is sloppy or not? If yes than)		
Mild slope	168	59.15
Steep slope	116	40.85
Livestock no.	1-4	
Distance from market (km)	7.8	
Distance from school (km)	6.4	
Source of information	TV, Press, Mobile phone	

Figures in parenthesis indicate the number of respondents, Authors calculation based on survey

Table: 2
General features of A&N Islands

S.No.	Particulars	A&N Islands	Name of District		
			South Andaman	North and Middle	Nicobar
1.	Total geographical area (sq km)	8249	3106	3302	1841
	Per capita Geographical area (ha)	2.17	1.31	3.13	5.00
2.	Total forest area (sq km)	6629	2673	2956	1542
	Per capita forest area (ha.)	1.74	1.13	2.80	4.19
3.	Total population (0000 no.)	37.99	23.76	10.56	3.68
4.	Area under home gardens (% total agriculture area)	9.43	7.82	8.91	11.54
5.	Home gardens (% to Total no. of farmers)	82.59	62.43	93.27	95.12
6.	Literacy rate (%)	86.27	88.49	84.25	77.5
7.	SC/ST Population (%)	7.05	11.24	10.29	78.51
8.	Total No. of land holdings (000)	11.35	5.07	5.85	0.67
9.	Operational holdings in ha (000)	22.69	7.96	13.09	1.64
10.	Total No. of livestock (0000)	17.56	5.53	7.48	4.37
11.	Total Milk production (00 mt annum^{-1})	157.02	75.52	74.90	6.60
12.	Total meat production (0000 kg annum^{1})	33.88	18.51	12.26	3.12
13.	Total Eggs production (00000 no)	989.55	525.915	372.93	90.712

Source: Basic statistics A&N administrations, 2016

families were headed by the women and that to in tribal dominate areas. About 28% households had higher income > ₹ 50001/- in the study area while more than 70% had low to medium level of income. The SWC measures were followed by almost 50% farmers. It is worth to mention that we have considered as adopter to those farmers who have practiced at least one SWC measure. The hill slopes are moderate to steep and rugged and susceptible to heavy soil erosion. Flat lands are comparatively scarce (District Census Handbook, 2011). The land holding size was about 2.5 ha households^{-1} and this land comprising of mild sloppy by 59% farmers to steep sloppy by 41% farmers. The main source of information on SWC measures and technologies was tv, newspapers, department advisory services and mobile phones.

Farmer's Perception on SWC Technologies Investment Considerations

The perceptions of the farmers on SWC technologies were obtained and analysed. We have considered the SWC measures adopted by the farmers and possible impact attributes as given in the Table 4. It was observed that 12% respondents have adopted BBF system and perceived that BBF conserve the water to the extent of 90%. Farmer's response to improve farming was 82%, retain the moisture (77%) and increase the agriculture farm production by 78% of adopters. Bunding was considered by the respondents to protect their lands from erosion. About 27% respondents have cultivated vegetative barriers which act as bio fence. Similarly, about 40% farmers have their lands with kuccha bunds. The mulching was also practiced and about 30% farmers perceived that it was beneficial in moisture conservation and our crops are protected during the sun strokes and water stresses. About 5% farmers have their own water harvesting structures like small ponds at their fields. These ponds are used for storing rains and used during water shortage particularly in dry month in these islands. Though perceptions of the farmers on the benefits of SWC measure were not uniform but the findings give an idea that policy interventions needed to increase the agriculture production. The enhanced local agriculture production will reduce the dependency on imports from main lands.

Determinants of SWC Measures Investment in A&N Islands

We have analysed the perceptions of the respondents on SWC measures assuming that farmers socio-economic, bio-physical and their involvement with community institutions may leads to better adoption. We used the logistic regression model and calculated the extent of perceptions explained by the model (R^2 = 0.38). We regressed the independent variables like age of head of family, education, income land slope, land security, trainings on SWC technologies, and institutions participation etc. with SWC measures adopted. We assume that if estimated coefficients in the model are having positive sign and are significant, it implies that the farmer's perception for adoption of SWC measures increased. While negative sign of the explanatory variables indicate the reverse implication on adoption of SWC measures. We have identified the ten attributes of socio-economic characteristics of respondents and used as explanatory variables in the model. The logistic regression model indicates that age of head and family size hade the negative signs of respective coefficients but was not significant (Table 5). The gender of family has indicated the negatively influence on the perception of the farmers in adoption of SWC measure. It means if family is headed by the female members likely to adopt the conservation measures since, variable was dummy (male = 1, female = 0). The level of education for head of family had the positive and significant at 5% level of significance. This implies that educated farmers are more likely to adopt and invest in conservation measures as their perception had positive sign. Similarly, participation in SWC works undertaken though different schemes and it had positive sign implies to influence of the perception of the farmers. The trainings on SWC had positive and significant influence on farmer's

Table: 4
Details of farmer's perception about soil and water conservation technologies

Soil and water conservation technologies adopted	Frequency N=284	Perception of the farmers on adoption of soil and water conservation technologies (%)					
		Improve farming system	Control erosion	Protect land	Water conservation	Moisture conservation	Increase production
Broad bed furrow system	36	82	19	10	90	77	78
Bunding	45	56	67	68	18	63	48
Vegetative barrier on bund/periphery	78	52	43	51	0	9	35
Stonewall	28	24	62	38	8	8	54
Kuccha wall with wood plunk	115						
Terracing	45	32	25	69	12	13	55
Drains	63						
Mulching	86	41	11	6	49	68	72
Water harvesting	13	38	10	9	100	97	67

perception toward SWC adoption. Other, attributes like land security and participation in community intuitions activities did not turned to be significant though their sign was positive. Sahoo *et al.,* 2017 also studied the behavioural factors for adoption of SWC and our finding is conformity in the same line. Therefore, study has indicated that education, trainings and slope of lands possessed by the farmers are the deterring attributes for higher perception on adoption of SWC technologies in the study area.

4. CONCLUSIONS

The study investigates the socio-economic, biophysical and institutions that influence the adoption perception of the farmers towards SWC technologies in the Island ecosystem of India. The level of education for head of family had the positive and significant indicated that educated farmers are more likely to adopt the conservation measures. Similarly, participation in SWC works undertaken though different schemes and it have positive sign implies the influence of the perception of the farmers. The trainings on SWC had positive and significant influence on farmer's perception toward SWC adoption. Since, A&N Islands is a fragile-agri -ecosystem needs more efforts to sustain its natural resource base and to be conserved for future generation (Ambast *et al.,* 2010). Therefore, study indicated that education, trainings and slope of lands possessed by the farmers are the deterring attributes for higher perception on adoption of SWC technologies in the study area. The farmers have exhibited low and medium perception about positive impact of the SWC practices and believe that SWC practices are the management aspects. There is need for appropriate interventions in realizing the consequences of land degradation and motivate farmers for adoption of SWCs technologies. This emphasised the need of policy interventions for providing skill training and timely adequate input and services to motivate and attract the farmers towards higher adoption rate.

Table: 5
Brief summary of logistic model used for analysis of farmer's perception

Logistic regression	Number of obs	=	284
LRchi2(10)		=	12.89
Prob> chi2		=	0.0448
Pseudo R^2		=	0.3838
Dependent variable if SWC adopted			
=1 otherwise 0|	Coef.	Std. Err.	P>|z|
Age Head of family|	-0.05696	0.00965	0.271
Family size|	-0.03766	0.01353	0.161
Gender head of family|	-1.27250*	0.48165	0.008
Schooling years|	0.12685**	0.03271	0.012
Landholding size in ha|	-0.00132	0.00021	0.136
Participation in SWC|	0.29818*	0.02916	0.001
Sloppy land (yes=1 otherwise =0)|	0.08685***	0.03271	0.012
Trainings in SWC|	0.09766***	0.03353	0.041
Land security|	0.05375	0.04021	0.136
Member of social groups|	0.76432	0.00021	0.136
_cons|	1.04163	0.79660	0.191

*Model Chi-square= 12.89 and log likelihood function 184.16318, Number of observations 284 and level of significance * significant at p< 0.001, ** p< 0.005, ****p< 0.01*

ACKNOWLEDGEMENTS

Authors are thankful to anonymous referees for their valuable suggestions improve this paper.

REFERENCES

Ambast, S.K., Subramani, T., Ravisankar, N. and Swarnam, T.P. 2010. Salt-water-nutrient dynamics in broad bed and furrow system. pp. 18-19. In: Annual Report, 2009-10, Central Agricultural Research Institute, Port Blair.

Kulshrestha, A., Kushwaha, T.S., Singh, Y.K. and Rai, D.P. 2010. Adoption of watershed technologies by the farmers in Morena district of Madhya Pradesh, Chitrakoot, Madhya Pradesh. *Indian Res. J. Extn. Edu.,* 10(2): 58-60.

Bagdi, G.L., Samra, J.S. and Kumar, V. 2001. Adoption of soil and water conservation technologies by the farmers of *Sardar Sarovar* project catchment in Gujarat state. *Indian J. Soil Cons.,* 29(1): 65-68.

Gangaiah, B., Dam Roy, S., Subramani, T., Swain, S. and Velmurgan, A. 2015. Status and strategies for conservation of natural resources in Andaman and Nicobar Islands, National Seminar on 'Sustaining Hill Agriculture in Changing Climate', Agartala, Tripura.

Chandra Charan, V., Syed Sadaqath and Hirevenkanagoudar, L.V. 2007. Adoption of watershed practices by the respondents of Sujala watershed. *Karnataka J. Agric. Sci.,* 20(1): 176-177.

District Census Handbook. 2011. Directorate of census Andaman and Nicobar Islands.

Gang Lian, Xu-Dong Guo., Bo-Jie Fu., Jing Wang and Ting, He. 2007. Farmer's perception and response towards land policy and eco-environment based on participatory rural appraisal: A case study in the Loess hilly area, China. *Int. J. Sust. Dev. World Ecol.,* 14(2): 182-191.

Hurd, J. 2009. Perception of watershed restoration political economy of watershed restoration series, Missoula, MT: Wildlands (www.Wildlandscpr.org/politicaleconomy/perceptions:2-11).

Ihekea, O.R. and Onyenorah, C.O. 2010. Awareness, preferences and adoption of soil conservation practices among farmers in Ohafia Agricultural Zone of Abia State, Nigeria. *J. Sustain. Agric. Environ.,* 13(1):1-8.

Joshi, P.K. and Agnihotri, A.K. 1984. An assessment of the adverse effects of canal irrigation in India. *Indian J. Agric. Ecol.,* 39: 528-536.

Joshi, P.K., Wani, S.P., Chopde, V.K., Foster, J. 1996. Farmers perception of land degradation: A case study. *Econ. Polit. Wkly.,* 31: 89-92.

Mansur, C.P., Kubsad, V.S. and Manjunath, L. 2007. A study on farmers' perception about contour bunding. *Karnataka J. Agric. Sci.,* 20(2): 228-229.

Mohammad, C., Saeed, K. and James, R.L. 2002. A needs assessment of soil conservation competencies for farmers in the Markazi province of Iran. *Int. J. Environ. Rural Dev.,* 30(2): 75-85.

Pandey, C.B. and Chaudhary, S.K. 2010. Soil and nutrient losses from different land uses and vegetative methods for their control on hilly terrain of South Andaman. *Indian J. Agr. Sci.,* 80(5): 399-404.

Parikh, K. and Ghosh, U. 1995. Natural Resource Accounting for Soil: Towards and Empirical Estimate of Costs of Soil Degradation for India; Discussion Paper No. 48; Indira Gandhi Institute of Development Research, IDEAS: Mumbai, India.

Sahoo, D.C., Madhu, M., Adhikary, P.P., Dash, Ch. Jyotiprava, Subha, S.S. and Devi, S. 2017. Adoption behaviour of different soil and water conservation measures among tribal farmers of Gajapati, Odisha, *Indian J. Soil Cons.,* 45(1): 112-116.

Singh, N.T., Mongia, A.D. and Ganeshmurthy, A.N. 1988. Soils of Andaman and Nicobar Islands. Technical Bulletin No.1. Central Agricultural Research Institute, Port Blair, 63p.

Srinivasarao, Ch., Venkateswarlu, B., Ratan, Lal, Singh, A.K. and Kundu, 2013. Sustainable management of soils of dry land ecosystems in India for enchaining productivity and sequestering carbon. *Advan. Agron.,* 121: 253-329, doi: 10.1016/B978-0-12-407685-3.00005-0.

Chand, S., Singh, S., Shinoj, P., Dam Roya, S. and Kumar, A. 2015. Explaining the status and scope of eco-tourism development for livelihood security: Andaman and Nicobar Islands, India. *Int. J. Sustain. Dev. World Ecol.,* doi: 10.1080/13504509.2015.1050478.

Thiranjangowda, B. 2005. A study on cultivation and marketing pattern selected cut flower in Belgaum district of Karnataka. M.Sc. (Agri.) Thesis, University of Agricultural Sciences, Dharwad.

Gupta, Vinod, Rai, P.K. and Nanda, Rakesh. 2009. Soil conservation competencies of the farmers in the watershed area of Vijaypur block of Jammu, India. *Indian Res. J. Extn. Edu.,* 9(2): 125-128.