Research Article

A Contingent Valuation Study of Soil Conservation Program in Swat District, Khyber Pakhtunkhwa, Pakistan

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Abstract | In the Northern Areas of Pakistan, land degradation caused by soil erosion is a severe problem affecting the livelihood of local people. Agriculture and tourism, the main sources of livelihood of the inhabitants in the area, have been severely hit by this problem. Human activities, such as deforestation, overgrazing and extensive agriculture have made soil resource more vulnerable to rain and flood water. Programs at government and society level are required to control soil erosion. The objectives of this study are to seek the farm household willingness to pay (WTP) for forestation based soil conservation program on communal land in the Northern Area of Pakistan. Open-ended format of CVM is used for the elicitation of respondents' WTP. For this purpose, a contingent valuation method (CVM) was used to elicit households WTP. A sample of 109 households was randomly selected from 14 randomly selected villages two from each tehsil. The study results revealed that most of the respondents perceived the problem of soil erosion and their willingness to pay for the suggested forestation based soil conservation practices were on average Rs.4666 per year. Regression analysis revealed that slope of the land, family size, income, land size, education, age and perception, were the important factors influencing WTP of the respondents in the study area. These findings suggests that sufficient funds can be generated from local farming community to implement the suggested program, and in this direction the concerned government and non-government organizations can play key role in educating and mobilizing farmers.

Introduction

The land is a resource that provides a number of services to humans. These services include food production, biodiversity preservation, facilitation of the management of freshwater systems and carbon storage. Theseprovisions can be maintained and protected through appropriate land management.

Unfortunately due to miss management of land resource agricultural productivity is declining at an alarming rate. Around 5-7 million hectares of agricultural land is lost every year worldwide. This loss of fertile land is adversely affecting human welfare and global environment.

Land degradation in the form of soil erosion causes many onsite and offsiteeffects, which include crop yield decline, high loss of stored carbon dioxide, water quality degradation through silting and channelization throughsedimentations, increase risk flood due to stream plugging and river bed filling. Human activities responsible for land degradation are extensive agriculture, overgrazing, faulty farming practices, excessive use of fertilisers and pesticides (Shah, 2014).

In the Northern Areas of Pakistan, soil resource is more prone to water erosion. In these areas, agriculture and forest are the two main sources of food, wood and fodder of the local people. Due to the human factor in the form of deforestation, extensive and mal farming practices and overgrazing of communal pasture made the soil resource vulnerable to rain and floods/water erosion (Shah, 2014). The flood in 2010 was not less than a catastrophe caused tremendous loss to flora and fauna in the region.

Pakistan major water reservoirs located in the Northern Areas are Turbela, Warsak and Mangla Dams which are silting up due to heavy soil erosion and thus have reduced their power generating capacity. The important question in this perspective is how to deal withthe challenge of soil conservation and what will be the willingness of society for such conservation programs? That is why this research work is designed to examine that social acceptance for a soil conservation program and to investigate WTP in Swat valley of Khyber Pakhtunkhwa.

Materials and Methods

Study area

This study was carried out in district Swat Khyber Pakhtunkhwa of Pakistan. The total reported area of district Swat is around 6000 Kilometers Square (Shah et al., 2016). More than 80% of the population is residing in rural areas where agriculture is the main source of their livelihood. Based on climatic conditions and agricultural practices, the entire Swat district can be divided into lower Swat and upper Swat. Climate is more severe in winter as compared to lower Swat. The valley is famous for producing quality fruits includes peaches, apricot, apples, walnut and plumbs. Various verities of on and off-season vegetables are also grown in the study area. Wheat, rice, corn and tobacco are also produced in the study area. Due to fertile land and lush greens fields and mountains, thousands of tourists comes every year and enjoy the beauty of nature. The nickname of the valley is Switzerland of Pakistan. The average annual precipitation ranges from 1000 to 1200mm.

Sampling

For data collection, a sample of 109 households was selected through a two-stage random sampling technique. As Swat district has seven tehsils, in the first stage from each tehsil two villages were randomly selected. Thus in total 14 villages were selected from Swat district. In the second stage, a sample of 109 farm households was randomly picked from the selected villages. Yamane (1967)'s formula was used for sample size selection and the proportional allocation technique (Cochran, 1963) was adopted to decide required number of farm households from each selected village.

Data collection analysis

Contingent Valuation Method (CVM): Contingent Valuation Method (CVM) is a survey-based economic technique and is widely used for valuation of environmental goods and services (Shah et al., 2017; Shah et al., 2016). CVM is a stated preference method used for valuation of environmental goods and services. CVM creates a hypothetical market for environmental good and directly ask individuals to state their WTP for the desired improvement/increase in its quality/quantity. The respondents are fully informed of the present situation and the suggested program for good in question. For the proposed program an open-ended elicitation questions format with a donation as payment vehicle was used to design WTP question.

The wording of the WTP question: Suppose the provincial government of Khyber Pakhtunkhwa set up a Soil Conservation Fund (SCF) and asked local households to make donations into this fund. Would you make donations into this fund?

Yes or No

If yes, then
How much moneywould you donate every year?
Rs. _____/ annum

The survey was conducted in 2018. The selected respondents were interviewed face to face. All questions were pretested prior conducting the survey and in the light of pretesting results final changes were made.

An econometric model for WTP: For estimation of WTP of sampled respondents the following regression model was used, which expressed WTP of the ith respondent as a function of their socio-economic and agricultural characteristic.
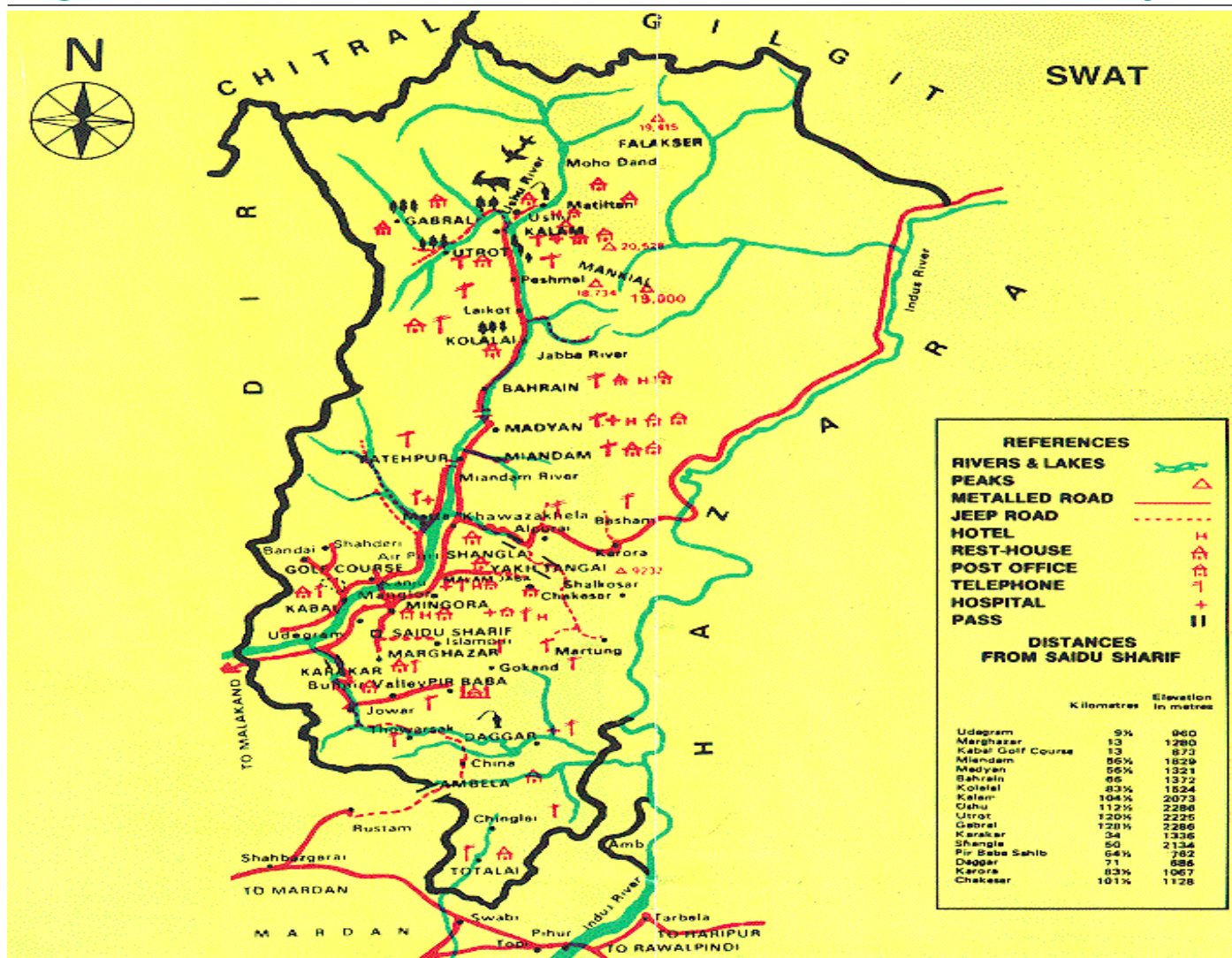
$$WTP_i = XB + \varepsilon_i \ldots(1)$$

Figure 1: *Map of District Swat.*

Table 1: *Variables used in the model.*

List of variables	Nature of variables	Measurement unit	Expected effect
Age of the head	Continuous	In years	_
Education of the head	Continuous	Year of schooling	+
Head's farming experience	Continuous	Number of years	+
Slope of the land	Categorical	"1" if steeper; 0 otherwise	+
Monthly Income	Continuous	PKR	+
Household size	Discrete	Individuals	+/-
Perception of soil erosion as a threat to farm productivity	Dummy	1 if Perceive, 0 otherwise	+ (Ajmal et al., 2018)
Extension contact	Dummy	1 if Perceive, 0 otherwise	+
Cultivated land size	Discrete	In Kanals	+
Soil erosion intensity	Dummy	1 if intense, 0 otherwise	+
Farm location	Dummy	1 if located in flood zone, 0 otherwise	+

Where;
WTP is expressing ith farm household willingness to pay a donation in the fund; X is a vector of socioeconomic and agriculture characteristic of the ith farm household; B is parameter vector, and ε is the error term with 0 mean and constant σ^2. The model was estimated by using ordinarily least square (OLS) method.

The explanatory variables that were hypothesized to effect WTP for soil conservation measures are described in the given Table 1.

Results and Discussion

Household Socio-Economic Characteristics

Table 1 depicts the socio-economic characteristics of the selected households. Traditionally they were headed by male individuals, and their meanage, education and farming experience were 47, 8 and 26 years respectively. Average family size was 7.00 individuals, and theirtotal monthly income was on average Rs.69880. Farm size on average was 1 acre. Their most common crops were rice, maize and wheat. Peaches, Apples and Walnuts were popular fruits. Onion, potato, tomato and some ofthe vegetables are also grown in the study area.

Table 1: *Household socio-economic characteristics.*

Characteristics	Mean/per-centage	Standard deviation
Heads gender (Male %)	100	0.00
Heads age (years)	47.12	12.77
Heads education (years)	8.17	4.45
Heads farming experience (years)	26.39	11.20
Household size (individual)	7.00	2.10
Monthly income (Pak Rs)	69880.73	88119.31
Farm land size	8.9	5.97

1 Pakistani Rupees = 0.0096/U$

Farmers Perception of Soil Erosion

For the purpose to know whether the respondents have observed soil erosion on their farmland and to quantify their/its frequency and intensity level different questions were asked from selected households. Out of the 109 households, 25% reported less frequent and more intense erosion, while 20% of households experienced more frequent and more severe on-farm soil erosion. This erosion occurs due to rain and flood water in the form of land sliding and surface soil runoff. Another question was asked about their perception of the impact of soil erosion on their agricultural productivity. Around 90% of the households said that soil erosion couldreduce crop yield significantly and 55% of the sampled households considered soil erosion as a severe threat to their future agricultural production and returns. Most of them (96%) were willing to pay on average Rs. 4666/- for the suggested soil conservation program on communal land.

Table 2: *Frequency and intensity of on-farm soil erosion.*

	Less frequent erosion		More frequent erosion		Total
	Less intense	More intense	Less intense	More intense	
Selected farm households	35%	25%	29%	20%	100

(less frequent:once a year, more frequent: more than once a year)

Estimated WTP model for soil conservation: The linear WTP model was estimated using Ordinary Least Square (OLS) method. Post estimation tests were conducted to check for the violation of linear regression model. The Breush Peghan test detected the hetroscadasticity problem in the estimated model. This problem was corrected with robust estimation of the the model.

The robust estimated model (given in Table 3) show that important determinants of farm household's WTP for soil conservation were land size, the slope of the land, education, age, monthly income of the heads of the households and family size.

Table 3: *OLS estimated WTP model for soil conservation.*

Variable	Linear Model		
	Coefficient	T. Value	P>T
Age	-38.46626	-3.58	0.001
Family Size	8.056907	0.15	0.879
Education Level	69.10827	2.26	0.026
Farming Experience	143.5533	7.92	0.000
Extension	127.5726	0.56	0.578
HHS Expenditure Month	.0060969	3.00	0.003
Land Area (Acres)	1368.26	5.24	0.000
Cultivated Land Slope	491.7309	2.04	0.044
Perception	608.8247	1.90	0.061
Constant	-652.0663	-0.90	0.371

$F_{(9,99)} = 110.94$; Prob> F = 0.0000; R squared =0.9091; adjusted R squared = 1032.5

Age of the household head: The age of the farmer's household head have shown negative effect on WTP of households for the conservation of soil in the study area. Its negative and significant effect on the explained variable (WTP) at 0.05 percent probability level maybe because the older the farmers, the shorten will be their planning horizon, which reduces their WTP for soil conservation practices. The expectation of aged farmers that they will be less benefit from such investment makes them reluctant to pay for soil

conservation practices and thus their WTP reduced with the increase of their age.

The education level of the household head: Education showed a positive and significant relationship with the dependent variable (WTP) in this research study which means that the increase of education level of a household increases their WTP for soil conservation practices. The reason might be the increased level of environmental awareness, and its value in the minds of farmers injected by education. Similar results has been shown by this independent variable on WTP in the studies of Gebrelibanos (2012) and Ajmal et al. (2018).

Family size: This variable showed a positive but statistically insignificant relationship with the dependent variable in the econometric model at 0.05 percent probability level. This might be the reason that as soil conservation practices and its maintenance is a labour intensive task, so the larger family size would like to contribute more than smaller family size.

Farming experience in years: The estimated coefficient for this explanatory variable is positive and significant at 5 percent probability level. It means keeping others variables constant in the model, a one year increased in the farming experience will lead to increase WTP of the household up to 143 Rs. The result is in line with Shah et al. (2016) and Ajmal et al. (2018).

Agriculture training(extension): The effect of extension in this study is positive but not significant which is not similar to most studies result for the same variable Gebrelibanos (2012) and Ajmal et al. (2018), this might be the results of farmers passive attitude which resist change by large, or it may be the non convincing powers of extension agent as lacking of skilled apparatus.

Household monthly income: the respondents' monthly income showed a positive and significant relationship with the household WTP for soil conservation at 5 percent probability level the increase in income of household increase there WTP for natural resource conservation keeping others variables constant in the model.

Land area: The estimated coefficient for this independent variable has a positive and significant relationship with WTP in the model. Keeping others

variable constant at the given probability level, a 1 acre increase in the farmland area will increase WTP of farm household by 1368 rupees. It might be the reason that more cultivated land area may have the problem of erosion and the farmer would like to pay more for its conservation to cope with the problem. The results are similar toprevious studies conducted by Balay (2015) and Ajmal et al. (2018).

Land slope: In this study,an attempt has been made to know the role of physical characteristics of the household farmland. Thus the degree of steepness of the farmland which is the slope of the farmland is considered, and its effect on WTP of farm household has been analysed. The slope of cultivated land showed a positive and significant effect on WTP of the selected respondent. The more the land is steep, the more is WTP of farmers for soil conservation. Perception: The WTP of farm household was positively and significantly affected by this explanatory variable in the model at the 5 percent probability level. Thathousehold who perceived soil erosion problem in their farmland iswilling to pay more for the conservation of their soil than those who did not perceive this problem. This result is in line with the findings of Gebrelibanos (2012).

Conclusions and Recommendations

Data reveals that 25 and 20 percent of the sample farm households reported less frequent and frequent severe erosion on their farm.Most of the farm households were willing to pay for forestation based soil conservation program on communal land, and their mean annual WTP was Rs.4666. Regression analysis shows that the important determinants of WTP of household in the study area were farm size, education, cultivated land slope, household income, farming experience and perception. Age a hasnegative but significant effect on WTP, while extension a hasa positive but insignificant effect on WTP of farm household in the study area. The findings of this research work show that any plan for intervention in the soil conservation should know the existing heterogeneity in household characteristic, perception and soil erosion, physical factors, institutional and demographic factors. The policy makers must take on board farm household in decision making. Afforestation, agroforestry, fencing and terracing farming practices are recommended for controlling soil erosion in the study area. Sufficient funds can be generated bylocal people to finance such

projects.

Novelty Statement

This study used contingent valuation method, which is a non-marketed valuation technique for measuring WPT. In Pakistan, very few studies have conducted to use this method to estimate demand for environmental goods and services.

Author's Contribution

Ayub Khan: Conducted the research and collected the data, did analysis and wrote the manuscript.
Ghaffar Ali: Supervised the study and guided thoughout the project.

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