SALINITY MITIGATION THROUGH VOLUNTARY DONATION IN A DEVELOPING COUNTRY: THE CASE OF BANGLADESH

By

JASIA TAHZEEDA
18275010

A thesis submitted to the Department of Economics and Social Sciences in partial fulfillment of the requirements for the degree of
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Department of Economics and Social Sciences
Brac University
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Declaration

It is hereby declared that

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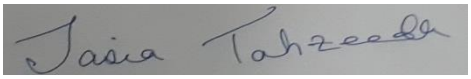

JASIA TAHZEEDA

18275010

Approval

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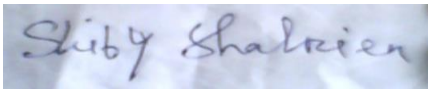
Examining Committee:

Supervisor:
(Member)



Dr Shibly Shahrier
Assistant Professor, Department of Economics and Social Sciences
Brac University

Program Coordinator:
(Member)

Dr Salma Begum
Associate Professor and Program Coordinator,
Department of Economics and Social Sciences, Brac University

External Expert Examiner:
(Member)

Anindita Bhattacharjee
Senior Research Associate
Brac Institute of Governance and Development

Departmental Head:
(Chair)

Philippe Forêt
Dean, School of Humanities and Social Sciences,
Brac University

Ethics Statement

I declare that there is no conflict of interest related to this thesis.

Abstract

This research paper concentrates on the role of voluntary donations in Bangladesh for salinity mitigation. Therefore, questionnaire survey was conducted on 1000 respondents, where their willingness to donate labor and money to collective water and/or land salinity mitigation were elicited. The relationships between the labor and money donations were analyzed in relation to socioeconomic variables such as income, education, family structure, and occupation using bivariate probit and tobit regressions. The analysis finds that income and occupation are the most important determinants to decide between labor and money donations as well as their respective amount for local Bangladeshi people who are impacted by salinity intrusion resulting from cyclone AILA. Education has found to have a negative impact on the labor donation, whereas it was found the fixed occupation has a positive impact on labor donation. Poor and the less educated people with more natural dependence are found to donate more labor. The rich people with less natural dependence are more willing to donate money, whereas the magnitude of donations is quite significant. Labor and money donations demonstrate the relation of substitutability with respect to most socioeconomic variables. The finding of the research exhibits that labor donation is a vital channel to mitigate land and/or water salinity which should be utilized for ensuring sustainable development in developing countries.

Keywords: Salinity mitigation; willingness to donate labor; willingness to donate money; substitutability; complementarity

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List of Acronyms

WDL: Willingness to Donate Labour

WTP: Willingness to Pay

Glossary

Mean	Average of the value
Median:	Median is the value separating the higher half from the lower half of a data sample, a population or a probability distribution
Geographical Cluster sampling	Geographical Cluster sampling is a technique in which clusters of participants that represent the population are identified and included in the sample

Chapter 1

Introduction

Salinity is a world-wide growing concern. Both water salinity and land salinity are not new concepts and they have prevailed for over centuries. Land salinity is gradually spreading globally in over 100 countries, whereas the existence of soil salinization has been reported in all continents (Shahid et al, 2018). The main identified causes of both soil and water salinization include flooding, over-irrigation, using poor quality ground water for irrigation, seepage, silting, rise in water table rise, climate change etc.(Mahmuduzzaman*et al*., 2014,Shahid et al, 2018).Bangladesh being a flood prone country is highly vulnerable to natural disasters and salinity intrusion. Salinity intrusion is a crucial issue in this country as it affects both the quality of the water and agricultural land. Therefore, it directly impacts on the livelihood of the people, as the fresh water supply declines and productivity of the land decreases. Studies have shown that few major reasons which are responsible for salinity intrusion in this country includes its critical geographical location, low flow of the river resulting from the barrage in the upstream neighboring country, inefficient management of coastal polders and climatic reasons such as sea level rise, cyclone and storm surge, heavy precipitation and other unsustainable human induced activities such as aggressive shrimp culture (Mahmuduzzaman*et al*., 2014). Bangladesh, which is a developing country, is highly vulnerable to the natural disaster and people of that area are used to being engaged in voluntary activities for mitigating disaster. However, due to impact of climate change, both the severity and number of natural disasters are increasing in manifold in this country and the salinity intrusion is burgeoning (Mahmuduzzaman*et al*., 2014).The salinity problem is further intensified due to cyclonic storms. For instance, the effect of cyclone Aila has caused salinity intrusion in the affected area (Jakariya et al., 2016). Therefore, to take countermeasures against salinity problems resulting from cyclone Aila, voluntary contribution and

participation from the local people might be an important aspect. Thus, in this research, we address voluntary contributionof the local people. The research analyzes the Willingness to Pay (WTP) and Willingness to Donate Labour (WDL) for mitigating water salinity and land salinity given the fact that without the voluntary contribution of the local people mitigation measure might not be successful.

Voluntary donation by community people for implementing counter measure against water salinity and land salinity can be used as an effective tool. For provisioning public goods and environmental goods, voluntary donation is applied worldwide. Therefore, numerous studies have been accomplished related to the voluntary donation and analyze the pattern of the donation in developed countries, particularly focusing on environmental or public goods (Lazaridou*et al.*, 2019; Zaiton, 2008; Brown and Lankford, 1992; Wright, 2001; Wilhelm et al., 2008; Wiepking 2009; Bauer et al. 2013; Wiepkinget al. 2014; Beldad et al. 2015). Additionally, many previous works have focused on the voluntary donation behaviors in developed countries, where labor and money donations were acknowledged as two major channels (e.g.,Menchik and Weisbrod 1987; Brown and Lankford 1992; Duncan 1999; Feldman 2010; Cappellari et al. 2011; Bauer et al. 2013). All these mentioned studies have analyzed different socio economic variables with the tendency of voluntary donation, from which a positive relationship was discovered between income and money/labor donation. The overall donation is recognized to augment in developed countries when household income rises (Fiorillo 2009; Freeman, 1997). It was also found from these studies that there is a positive relationship between the years of education with the labor and money donation. Additionally, the paper of Shahrier and Kotani (2018) revealed a relationship between WTP and WDL for mitigating natural disaster with respect to other socio economic variables such as household income,age, family structure and occupation of the household head in Bangladesh, which is a developing country. Although, only few studies have been conducted

in developing countries related to voluntary donation particularly focusing on provisioning public goods and environmental goods; voluntary donation both in terms of willingness to pay and willingness to donate labor are acknowledged to be vital measures to understand people's cooperation for preserving environmental goods (Shahrier & Kotani, 2018). Nevertheless, as conducting research in developing country is very important (Henrich et al., 2010) and no single study has been found which evaluated the willingness to donate labor in mitigating water and land salinity in developing countries. Hence, it is important to address the issue of voluntary donation for mitigating salinity through money and labor donation in developing countries to fill up the knowledge gap in the literature. Moreover, Bangladesh, being a developing country with high population and low income, it can be assumed that labor donation can be significant in the country. Furthermore, the socio economic structure of the study area, whereas the income of the inhabitant is quite low and the nature of their occupations led them to donate labor for both livelihood purpose and mitigating disaster in the area. It is expected that labor donation can be considered as a major source of contribution from the local people to mitigate salinity problem in the study area. Past studies have shown that local dweller's participation is needed for ensuring sustainable planning and implementing mitigation activities, as local people voluntarily participate and donate to mitigate the negative consequences resulting from natural disasters (Mileti, 1999; Dorcey and cDaniels, 2001;Godschalk et al. 2003; Pearce, 2003). Cyclone Aila has hampered the livelihood of the people mostly due to salinity intrusion (Jakariya et al., 2016). Therefore, the collective salinity mitigation in local level has become a crucial part for ensuring the sustainability of the livelihood of the people of the area. Thus one of the major objectives of the research is to analyze Willingness to pay and Willingness to donate labor for avoiding land and/or water salinity with respect to occupations of the locals. Additionally, a significant aspect of the paper is that it analyzes substitutability and complementarity relationship

between the labor and money donations. However, there are some previous literatures which focus on the relationship between the labor and money donations by taking the account the price of donations. The relationship found from the previous studies is ambiguous. As some studies revealed the complementarity relationship between money and labor donation in developed countries (Brown &Lankford,1992; Duncan, 1999; Cappellari et al., 2011) whereas other studies revealed that labor and money donations are substitutes (Feldman,2010; Bauer et al.,2013; Shahrier & Kotani, 2018) .

For this study labor and money donations have been analyzed by considering major socioeconomic variables which include as income, education, number of family members, family structure, age and occupation. For this study open-ended contingent valuation (CVM) survey of 1000 households has been applied to comprehend; (1) willingness to pay money and (2) willingness to donate labor to mitigate the land salinity and water salinity of the study area resulting from Cyclone Aila. This study has thoroughly examined the willingness to pay and willingness to donate labor with respect to avoiding land and water salinity in the study area. It also focuses on comprehending the relationship between willingness to donate labor and willingness to pay money in the area by analyzing their substitutability and complementarity. The analysis of the study is done by using bivariate probit and tobit regressions.

Chapter 2

Study Region

Bangladesh is the most vulnerable country to cyclones and tropical storms (Governmentof Bangladesh 2010). Dasgupta et al. (2010) stated that the coastal belt of Bangladesh is the most fatal region among the top ten cyclone prone regions of the entire globe due to cyclonic storm hazards. Cyclone causes huge amount of damages both monetarily and non-monetarily. Bangladesh has historically suffered a lot due to cyclone. Total of 159 cyclones hit Bangladesh from 1877 to 2009, whereas among which 48 were very severe (Government of Bangladesh, 2010). Cyclone AILA which hit the coast of Bangladesh on May, 2009 is the latest severe cyclonic storm. The speed of the storm wind was 65–75 mph, which was formed in the Bay of Bengal (Kumar et al. 2010).

The environmental and economic damage resulting from Cyclone Aila was extremely high which led towards prolonged detrimental living standard of people. According to United Nation (2010), cyclone AILA caused tremendous human suffering as it caused 190 deaths and 7100 injuries, and it devastated the livelihood of the people by washing away livestock, households, agricultural crops, shrimp gher and other means of livelihood such as fishing boats along with damaging latrines and sanitation systems, educational facilities,additionally hampered the overall communication systems such as roads and highways. The most severely Cyclone Aila affected areas include of four Upazilas of Khulna and Satkhira districts, specifically Dacope, Koyra, Shyamnagar and Asasuni (United Nation, 2010). For this research, the chosen study area is Dacope.

Both land salinity and water salinity are considered to be one of the most significant long term effects of cyclone AILA. Inundation and stagnation of saline water caused by demolition of the entire embankment system on the cultivable land has created prolonged land salinity. It was found that one year after the hit of cyclone AILA, only a negligible

segment of the arable land is useable for cultivation, which resulted around 80 % loss of agricultural productivity and reduced the shrimp cultivation productivity by 1880 kg ha−1 (United Nation 2010). During the study, farmers mentioned that only after 4 years of the hit of cyclone AILA during 2013,rice was successfully cultivated for the first time in the area. The survey was conducted during the harvesting period of farmer's first cultivation in the study area where the farmers have mentioned that the level of land salinity was significantly higher comparing to that of before cyclone AILA. The study area has shown significant land salinity and water salinity crisis even after 4 years of the cyclone's hit.

Two most severely affected unions of DacopeUpazila in Khulna district, namely Kamarkhola and Sutarkhali, respectively are chosen as study regions for this research (Figs. 1, 2).

DacopeUpazila is located between 22◦24' and 22◦40' north latitudes and in between 89◦24' and 89◦35' east longitudes. The total land area of DacopeUpazila is 992 km2 where total land area of Kamarkhola and Sutarkhali are 7214 acre and 12,092 acre, respectively (Bangladesh Bureau of Statistics 2011). These two unions are surrounded by rivers Shibsa and Dhaki in the west and north, in the east Sutarkhali, Chunkuri, and Bhadra (Bangladesh Water Development Board 2013).

Figure 1:Geography of study regions of Dacope where "Sunderban" indicates mangrove forest area (Shahrier & Kotani, 2018)

Figure 2: Segregation of the study area, Kamarkhola and Sutarkhali in Dacope, for randomization(Shahrier & Kotani, 2018)

Chapter 3

Data and methodology

For this study open-ended CVM method has been used. For valuing environmental goods and public goods, CVM is widely used. CVM is broadly applied in environmental economics for the purpose of valuation the demand of environmental and public goods when real data do not exist or inadequate (Lazaridou*et al.*, 2019; Zaiton, 2008;Cooper et al. 2004). However, salinity both in terms of land and water are considered to be public bad. Whereas, the collective countermeasure used for avoiding the salinity is non-excludable and non-rival. Thus in this research, environmental economics is applied for valuation of the public goods.

Open-ended CVM is appropriate for those researches where respondents have enough knowledge or experience about the good (Ghanbarpouret et al. 2014; Hamed et al.,2016; Proufoun et al. 2016;Verbic et al. 2016; Sun et al. 2016;Alberini and Kahn, 2009).

In the study area, all the respondents are severe and direct victims of cyclone AILA. Respondents of the area have lots of previous experience related to cyclonic hazards as the area is considered to be one of the most vulnerable areas to storm hazards and cyclones. Additionally, in this research area all the respondents have familiarity about the short term or long term impact of cyclonic hit, such as salinity resulting from cyclone Aila. Therefore, an open-ended CVM questionnaire survey of 1000 respondents in the study area was conducted between the period of November 25, 2013 and January 5, 2014. The household heads were targeted as the respondent of the survey. Through the research, per household willingness to donate money and/or willingness to donate labor for avoiding land salinity and water salinity resulting from cyclone AILA was successfully identified.

In this research a pilot survey was carried out where 70 household heads were interviewed. The questionnaires have been pretested in the first stage. In the next stage, CVM experts have provided suggestions for finalizing the methodology. Thus, the contents and wordings of the final questionnaires were revised by taken into account the result of the pilot survey and suggestions provided by the CVM experts.

In the final survey, it was asked whether the respondent is willing to donate any amount of money and/or labor for mitigating land or water salinity in the study area. In this open ended research survey, respondents are given the option to choose labor and/or money along with the opportunity to denote the corresponding quantities. Respondents are provided four options to articulate their willingness to donate. These are:

(1) labor >0 and money >0 , (2) labor >0 and money = 0 , (3) labor = 0 and money >0 , (4) labor = money = 0 . It has been assumed during developing the survey that local people may want to donate labor rather than donating money to mitigate water or land salinity. From the outcome of the pilot survey, it was revealed that giving these options were significantly useful.

Total of 1000 samples have been collected, whereas 320 and 680 samples are chosen respectively from two unions of Dacope Upazila, namely Kamarkhola and Sutarkhali (Figs. 1,2) .The number of samples has been selected based on the proportion of households in these unions. According to the data of 2011, the total number of households in Kamarkhola was 3559, which represented 32.29% of the total sample and the total number of household of Sutarkhali was 7536, which represented 67.71% of the total sample (Bangladesh Bureau of Statistics 2011).Geographic cluster sampling was used for ensuring random sampling in the area (Himelein et al. (2013, 2014). During the survey, GIS technology was used to observe

human movement and frequency of households within our study area. Both the unions were divided into five (5) subregions with the same number of households based on the household numbers (Fig. 2). By employing the information collected through field visits which were conducted before the survey began and by utilizing the GIS technology , each of the subregions were separated into some identical stratums and a starting point for initiating the survey in each stratum was chosen. In each stratum, group of two researchers were employed, one of them are trained interviewer and another one is a local expert, both of them were in charge of conducting the survey. Then the random sampling was carried out to collect equal number of samples for each stratum of a subregion. However, in the study region, people with diverse socio economics categories reside with almost equal distribution.

For analysis of the study, at first bivariate probit regression was applied to characterize a combination of binary choices for labor and/or money donation (Cappellari et al., 2011; Baueret al., 2013). The model is specified as follows:

$$d^{*}_{ki} = \sigma_k x_{ik} + \beta_{k1} I^2 + \beta_{k2} I^2_i + \epsilon_{k,}\ k = \{\ell, m\},\ i = \{1, \ldots, n\} \quad (1)$$

$$(\epsilon_{\ell}, \epsilon_{m}) \sim N[\mathbf{0}, \mathbf{\Omega}], \quad (2)$$

Here, $d^{*}_{li}$and $d^{*}_{mi}$are latent variables of labor and/or money donations for individual *i*, respectively, and a binary choice of observable variables for labor or/and money donations is represented by the indicator functions of $dki = 1_{[d^{*}_{ki}>0]}$. *Ii* is a household's income, $x_{ik}$is a vector of independent variables, whereas error terms are ϵ_{ℓ} and ϵ_m respectively for labor and money donation, with mean 0 where the covariance matrixis Ω and covariance ρ. Finally, $\beta_{kj} = \{\beta_{\ell j}, \beta_{m j}\}$ for j=1,2 and $\sigma_k = \{\sigma_{\ell}, \sigma_m\}$ are parameters to be estimated for each regression

of labor and money donations. A bivariate probit regression model takes account of the correlation between ϵ_{ℓ} and ϵ_m via estimating ρ.

Next for this study, Tobit regression was applied for labor and money donations to calculate the impact of independent variables on donations. Tobit model, which is pioneered by Tobin is extensively used to analyze the voluntary donation and willingness to pay for environmental goods and public goods (Bilgic&Aydogdu, 2016). In this research, same independent variables are used for Tobit regressions and bivariate probit model. Independent variables used for the regression analysis are area of the house; arable land each household owns, number of household members, occupations for household heads, house ownership, family structure, income, household heads' education and age (see Table 1.1 for details of the independent variables). In CVM, it was found that there is a strong linkage between socio economic independent variable and willingness to pay (Lazaridou et al, 2019; Shahrier & Kotani, 2018). Table 1.2 describes the details of the dependent variable. From the bivariate probit regression which elicited labor (hours⁄year) and money (BDT⁄year) donation , it was found that there were significant number of zero donations for labor and money.

Table 1.1: Description of Independent variables	
Variables	Description
Household income	Household income (in 1000 BDT per month)
Area of house	Total land area of the household (in katha)
Arable land	Total cultivable land for each household (in katha)
Age	Categories variables, 0: age 20 and 29, 1: 30 and 39, 2: 40 and 49, 3: 50 and 59, 4: 60 and 69, 5: 70 or more
Fixed occupation	Dummy variable of 1 when the household head has fixed occupation, otherwise 0
House ownership	Dummy variable of 1 when the household owns a house, otherwise 0
Single family	Dummy variable of 1 when the household consists of a joint family structure, otherwise 0 (when the household consists of a single family structure)
Education (years)	Years of schooling for the household head
Number of Family members	Number of Family members in a household
Occupation dummy variables (Reference group is “day labor”)	
Farmer	Dummy variable of 1 when the household head is a farmer, otherwise 0
Business, service and trade	Dummy variable of 1 when the household head is working in business, trade service
Natural resource dependence	Dummy variable of 1 when the household head is working as fishermen, honey hunters and so on
Shrimp gher owner	Dummy variable of 1 when the household is a shrimp gher owner, otherwise 0

Table 1.1: Description of Independent Variable

Table 1.2: Description of Dependent variables	
Variables	Description
WTP _ Land Salinity	Money donation for avoiding land salinity (in BDT/per year)
WDL_ Land Salinity	Labor donation for avoiding land salinity (in h/ per year)
Total Donation _Land Salinity	Total donation of both money and labor for avoiding land salinity (summation of Money donation and the monetary value of Labor donation for avoiding land salinity)
WTP _ Water Salinity	Money donation for avoiding water salinity (in BDT/per year)
WDL_ Water Salinity	Labor donation for avoiding water salinity (in h/ per year)
Total Donation _Water Salinity	Total donation of both money and labor for avoiding water salinity (summation of Money donation and the monetary value of Labor donation for avoiding water salinity)

Table 1.2: Description of Dependent Variables

On the other hand, Tobit model is suitable to comprehend the relationship between the set of independent variables and non-negative dependent variable. The variable *Yi* is 0 if the unobserved latent variable Yi* is smaller than or equal to zero and Yi = Yi* is positive. The latent variable Yi* can be expressed as follows:

$Yi^* = \beta Xi + \epsilon i$

Here, Xi is the set of control variable that are predictable to affect voluntary donation and ϵi is the error term.

In the model, wage rates or a proxy such as opportunity cost for time are not used unlike studies carried out in developed countries (see, e.g., Menchik and Weisbrod 1987; Brown and Lankford 1992; Cappellari et al. 2011; Bauer et al. 2013). The rationale behind this is that most of the respondents of the sample in the study region are involved into subsistence economy whereas they mostly consume whatever they harvest, as they don't have the regular wage rates. They are also mainly dependent on natural environment for their livelihood. Therefore, in the paper the proxies or wage rate could not be used. For overcoming the

limitation of the paper related to the opportunity cost, dummy variable for each occupation has been applied to control occupations (see occupation dummy variables in Table 1.1)

For this research, marginal effects of probit and tobit models are also applied to comprehend the relationship between labor and money donations when an independent variable changes. Therefore, it analyzes the substitutability or complementarity relationship through it. Furthermore, for understanding the total effect, total willingness to pay is calculated by converting the willingness to donate labor in monetary terms. For this research the conversion rate of 37.5 taka per hour of donating labor was applied (as of market price when the research was carried out).

The objective of the study of this research is to elicit willingness to provide donations of each household for mitigating land and /or water salinity through money and/or labor. The rationale for applying bivariate probit and Tobit regressions is to observe within a single framework, how money and labor donations are affected by incomes and other socioeconomic variables. The motivation of this is to recognize the substitutability or complementarity between labor and money donations when an independent variable changes. Poor and local people residing in the disaster prone coastal areas in the developing countries are highly vulnerable to natural disasters. Voluntary donations from these people to mitigate the impact of disaster are not addressed in the previous literature. Hence, this research was carried out with the intention of eliciting the willingness to pay money or donate labor from local people in the coastal and disaster-susceptible area of Bangladesh.

Chapter 4

Empirical Result

4.1Summary Statistics

Table 2.1 shows frequencies of choices for labor and money donation for avoiding water salinity.

Table 2.1: Frequencies of choices for labor and money donation for avoiding land salinity.

	Labor		Total
	0	1	
Money			
0	37 (3.70%)	294(29.40%)	331(33.10%)
1	519 (51.90%)	150(15.00%)	669(66.90%)
Total	556(55.60%)	444(44.40%)	1000(100.00%)

Table 2.1 Frequencies of choices for labor and money donation for avoiding land salinity.

Table 2.1 depicts respondents' choices for labor and/or money donations for avoiding land salinity. Among 1000 respondents, the 963 (96.30%) respondents are willing to donate either money or labor avoiding land salinity from cyclonic disaster AILA. Therefore, only 37 respondents (3.70%) are not willing to donate any amount of both labor and money. The 519(51.90%) respondents choose to donate only money, and 294(29.40%) respondents choose to donate only labor. Finally, the 150 (15.00%) respondents choose some amount of both labor and money to express their total donations. Table 2.2 shows thefrequencies of choices for labor and money donation for avoiding water salinity.

Table 2.2: Frequencies of choices for labor and money donation for avoiding water salinity

	Labor		Total
	0	1	
Money			
0	32 (3.20%)	295 (29.50%)	327(32.70%)
1	523 (52.30%)	150 (15.00%)	673(67.30%)
Total	555 (55.50%)	445 (44.50%)	1000(100.00%)

Table 2.2 Frequencies of choices for labor and money donation for avoiding water salinity

Table 2.2 presents respondents' choices for labor and/or money donations for avoiding water salinity. Among 1000 respondents, the 968 (96.80%) respondents are willing to donate either money or labor avoiding water salinity from cyclonic disaster AILA. Hence, the only 32 (3.20%) respondents are not willing to donate any amount of labor and/or money. Furthermore, 523(52.30%) respondents choose to donate only money, and 295(29.50%) respondents choose to donate only labor. Finally, 150 (15.00%) respondents choose some amount of both labor and money to express their total donations.

The result derived from Table 2.1 and Table 2.2 is similar from the perspective of labor and money donation. In both the cases for avoiding water salinity and labor salinity, 15.00% respondents choose some amount of both labor and money for donations. In terms of avoiding water salinity, 3.20% are not willing to donate any amount of labor and money, whereas for avoiding land salinity, 3.70% respondents are unwilling to donate any amount of labor and money. It can be derived from the result that more people are willing to donate money and/or labor on avoiding water salinity comparing to that of avoiding land salinity.

Table 2.3: Frequencies of choices for total donation for avoiding land salinity and total donation for avoiding water salinity

	Total Donation _Land Salinity		Total
	0	1	
Total Donation_ Water Salinity			
0	31(3.10%)	1(0.01%)	32(3.20%)
1	6(0.60%)	962(96.20%)	968(96.80%)
Total	37(3.70%)	963(96.30%)	1000(100%)

Table 2.3Frequencies of choices for Total Donation for avoiding Land salinity and Total Donation for avoiding Water salinity

Table 2.3 presents respondents' choices for avoiding water salinity and/ or land salinity by considering total donation of labor and/or money for cyclonic disaster AILA. Among 1000 respondents, the 969 (96.90%) respondents are willing to donate for avoiding land salinity and/ or water salinity from cyclonic disaster AILA. Only 31 respondent's (3.10%) are not willing to donate anything as a mean of money or labor for avoiding land salinity or water salinity from cyclonic disaster AILA . Furthermore, 6 respondents choose to donate for

avoiding water salinity whereas they prefer not to donateanything for avoiding land salinity. Additionally only 1 respondent (0.01%) choose to donate for avoiding land salinityonly and prefer donating nothing for avoiding water salinity. Ironically, 962 (96.20%) respondents choose to donate for both avoiding land salinity and for avoiding water salinity.

The result explains that in that area people are highly concerned about avoiding the consequences of water and land salinity as it negatively impacts their lives. Furthermore, majority of the respondents (962 people) are interested to avoid both water and land salinity. Considering people's ultimate vulnerability to cyclonic disasters in this region, it is not surprising. However, more people have expressed their willingness to pay for avoiding water salinity (968 people) than on avoiding land salinity (963 people).

Table 3 Summary statistics of the variables

Variables	Mean	Median	SD	Min	Max
WTP _ Land Salinity	97.90	50.00	261.90	0.00	5000.00
WDL_ Land Salinity	12.11	0.00	15.68	0.00	72.00
Total Donation _Land Salinity	551.95	275.00	599.58	0.00	5000.00
WTP _ Water Salinity	103.14	50.00	280.11	0.00	5000.00
WDL_ Water Salinity	12.71	0.00	16.31	0.00	90.00
Total Donation _Water Salinity	579.65	300.00	627.79	0.00	5000.00
Household income (per month/1000 BDT)	7.52	6.00	5.16	1.00	50.00
Area of the household shelter (Katha)	5.73	3.00	11.89	0.00	300.00
Household arable land (Katha)	48.10	8.00	325.17	0.00	10000.00
Age[a]	1.56	1.00	1.34	0.00	5.00
Fixed occupation (0 or 1)	.54	1.00	0.50	0.00	1.00
House ownership (0 or 1)	.212	0.00	0.41	0.00	1.00
Single family[b]	.25	0.00	0.43	0.00	1.00
Education (years)	4.75	5.00	4.14	0.00	16.00
Number of Family members	4.71	4.00	1.75	1.00	14.00

Table 3Summary statistics of the variables

- [a] Age is coded as 0, 1, 2, 3, 4, 5 when the range for the household head's age is 14–30, 31–39, 40–49, 50–59, 60–69 and more than 70, respectively. This coding is made due to the fact that most people do not care about their exact age in rural Bangladesh
- [b] It is a dummy variable. When it is a joint family, it is 1 and when it is a single family, it is 0.

Table 3 presents summary statistics of the variables. The mean and median of household labor and money donations for avoiding land salinity are 12.11 h per year, 0 h per year and 97.90 BDT per year, 50 BDT per year, respectively. The mean and median of household labor and money donations for avoiding water salinity are 12.71 h per year, 0 h per year and 103.14 BDT per year, 50 BDT per year, respectively. The mean and median of the total willingness to pay through both labor and money donations for avoiding land salinity and water salinity are 551.95 BDT per year, 275 per year and 579.65 BDT per year, 300 per year respectively.

The mean of labor donations for both avoiding water salinity and land salinity are much more, while those of money donations are lower. In the study area, monthly household incomes are relatively low compared to other areas of Bangladesh (mean of 7516 BDT and median of 6000 BDT). For instance, average household monthly income in capital city, Dhaka, is around 21,465 BDT based on our survey. This implies that relatively poor people reside in that area.

It is also clear that resident tend to donate more money and labor for avoiding water salinity than avoiding land salinity. Additionally, the total willingness to pay through household labor and money donations for avoiding water salinity is higher than that of avoiding land salinity. This implies that perhaps people of the area are more concerned about avoiding the consequences of water salinity than that of land salinity. This might be the case as most of the people of that area are farmers, day laborer or natural resource dependent;whereas they are apprehensive about encroachment of salinity into their territory and hampering their livelihood. Moreover, the inhabitants are mostly concerned about water salinity more as it would affect the fresh water supply which might hamper the quality of the livelihood of the people. Such as for farmers, the water salinity would impact their livelihood more as it would not only reduce the fresh water supply for consumption, but it would also hamper the agricultural production by constraining the irrigation.

Average education (mean 4.75 and median 5) indicates that the level of education is very low in the study area and most of the people do not attend even high school or college. In case of household arable land, high standard deviation (SD) and gap between mean and median indicate that some households in this region have significantly greater amount of arable land than the other households. With respect to age, six categories are prepared because most people in rural Bangladesh do not care about their exact age and cannot even answer it (see footnote a in Table 3). The 76% people are aged less than 50 years and the 53% people are aged less than 40 years in this region which means a significant proportion of the household heads are working-age people. In case of family structure, the number of single family is dominant over the number of joint family. However, the proportion of joint family (24.80%) is high compared with that in other areas of Bangladesh. Furthermore, number of average family member is 4.71, with the median of 4 members.

Lastly, the most notable fact in Table 3 is the mix of fixed and temporary occupations. It demonstrates that only 53% of the household heads fall under the fixed occupation which is completely an opposite scenario comparing with the occupational structure of developed countries.

Table 4: Household income, labor, money and total donation per occupation

Statistics	Occupations					Overall
	Day labor	Natural resource dependence	Farmers	Business	Shrimp gher	
No of Respondents	184	191	421	182	22	1000
Average years of schooling	2.26	3.48	5.09	7.68	5.68	4.74
Household income (BDT/month)						
Average	5168	6126	7902	8850	20,795	7516
Median	5000	6000	7000	8000	20000	6000
SD	1924	2416	4984	4676	15038	5158
Min	2000	2000	1500	2000	1000	1000
Max	12000	20000	35000	25000	50000	50000
WTP _ Land Salinity						
Average	12.67	79.60	118.17	143.51	204.09	97.89
Median	0.00	50.00	50.00	100.00	100.00	50.00
SD	24.50	363.01	250.61	268.10	291.70	261.90
Min	0.00	0.00	0.00	0.00	0.00	0.00
Max	150.00	5000.00	2500.00	2500.00	1000.00	5000.00
WDL_ Land Salinity						
Average	19.45	8.75	14.19	4.52	2.73	12.11
Median	20.00	0.00	0.00	0.00	0.00	0.00
SD	15.26	13.98	16.63	10.95	9.02	15.68
Min	0.00	0.00	0.00	0.00	0.00	0.00
Max	64.00	60.00	72.00	60.00	36.00	72.00
Total Donation _Land Salinity						
Average	742.25	407.87	650.12	313.29	306.36	551.95
Median	750.00	100.00	500.00	100.00	100.00	275.00
SD	562.40	613.99	618.45	460.79	445.66	599.58
Min	0.00	0.00	0.00	0.00	20.00	0.00
Max	2400	5000	3200	2500	1400	5000
WTP _ Water Salinity						
Average	13.77	89.58	117.93	159.36	220.00	103.139
Median	0.00	50.00	50.00	100.00	100.00	50.00
SD	28.20	363.75	270.99	314.72	297.28	280.11
Min	0.00	0.00	0.00	0.00	0.00	0.00
Max	200.00	5000.00	3000.00	3000.00	1000.00	5000.00
WDL_ Water Salinity						
Average	20.95	9.35	14.59	4.81	2.18	12.71
Median	24.00	0.00	0.00	0.00	0.00	0.00
SD	15.81	14.55	17.04	12.11	7.06	16.31
Min	0.00	0.00	0.00	0.00	0.00	0.00
Max	64.00	64.00	90.00	60.00	24.00	90.00
Total Donation _Water Salinity						
Average	799.22	440.43	665.02	339.86	301.82	579.65
Median	900	100	500	100	100	300
SD	584.28	627.26	645.34	527.33	404.54	627.79
Min	0	0	0	0	20	0
Max	2400	5000	3500	3000	1400	5000

Table 4 Household income, labor, and money donation per occupation

Table 4 presents the statistics of labor donation, money donations along with total donation for avoiding land salinity and water salinity with respect to years of education/per occupation and household income per occupation. These statistics have been separately shown across occupations since the features of occupational structure are different from those of developed countries or urban area, and it is expected that occupations explain a significant portion of the total variation in our final result. The nature of our study region is characterized by the high degree of vulnerability due to the uncertainty to natural disasters, low income of the inhabitants along with proximity and dependence on natural resources such as mangrove forests.

Occupations of the inhabitants are categorized into (0) day labor, (1) natural resource dependence, (2) farmer, (3) business, trade and service, and (4) shrimp gher owner (see Table 1 for occupation categories). “Day labor” respondents mainly work in construction or small-scale industries, depending on society’s ongoing needs. They also work under the sea boat owners to collect wood, honey and crabs from the nearby forests. During rice cultivation seasons, they work as agricultural labor. Respondents at “natural resource dependence” comprise the fishermen, crab hunters, honey collectors, beekeepers and wood collectors. Respondents at “farmer” include those who engage in large, medium, or small-scale farming activities as their main job. They own land or borrow it from others for cultivation. Respondents at “business, trade and service” include all the businessmen, government and non-government service holders, middlemen in fishing business and fishing boat owners. “Shrimp-gher owners” are those who cultivate shrimp in their own ponds which are called “gher”.

Table 4 reveals that businessmen and the shrimp-gher owners are relatively high-income people, while day laborers, farmers and natural resource dependents are low-income people in this region. In particular, the shrimp-gher owners are the highest income people followed

by business and service, farmer, natural resource dependents and day labor categories. Table 4 shows that people with high-income occupations tend to be more educated with exception that shrimp-gher owners (5.68 years of schooling) are less educated than businessmen (7.68 years of schooling).

Table 4 also demonstrates the summary statistics of labor and money donations across occupations. They show that households with high-income occupations (highly educated) tend to choose more money donation, whereas households with low-income occupations (less educated) choose more labor donation. For instance, labor donation is the highest and money donation is lowest for day labor. Additionally, labor donation is second highest and money donation is second lowest for farmers. However, shrimp-gher owners donate the lowest amount of labor and the highest amount of money followed by businessmen. Nevertheless, when total willingness to pay is considered by incorporating monetary value of willingness to donate labor, the result is quite interesting. It is found that total willingness to pay is the highest for daily labor followed by farmers, whereas that total willingness to pay is the lowest for shrimp-gher owners followed by businessmen. All these results are consistent in both the cases of avoiding water and avoiding land salinity.

4.2 Labor and money donations in relation to socioeconomic factors

The estimations reflecting bivariate probit and tobit regressions for labor and money donations for avoiding land salinity have been presented in Table 5.1. Additionally, the estimations of bivariate probit and tobit regressions for labor and money donations for avoiding water salinity have been presented in Table 5.2.

Based on the results in Table 5.1 and Table 5.2, the marginal effects of independent variables are reported respectively in Table 6.1 and Table 6.2 under the assumption that the other explanatory variables are at their means.

The marginal effects of independent variables for both bivariate probit and tobit regressions in Table 6.1 and Table 6.2 were analyzed to measure the impact of independent variables on labor and money donations. Finally, in Table 6.3 marginal effects of independent variables through bivariate probit regression on avoiding land salinity and avoiding water salinity are analyzed by measuring two situations where the respondents have both the willingness to pay money and willingness to donate labour vs. respondents neither have the willingness to pay money nor have any willingness to donate labour.

Table 5.1: Bivariate and Tobit Regression for Avoiding Land Salinity

	Bivariate probit		Tobit		
	Money	Labor	Money	Labor	Total WTP
Household income(1000 BDT)	0.15*** (0.04)	-0.07*** (0.03)	54.68*** (5.42)	-1.78*** (0.62)	15.06 (9.91)
Household income squared	-0.00 (0.00)	0.00 (0.00)	-0.77*** (0.15)	0.03 (0.02)	-0.05 (0.29)
Area of house (katha)	0.00 (0.01)	0.02 (0.00)	-1.16 (0.90)	0.15 (0.10)	0.83 (1.72)
Arable land(katha)	0.00 (0.01)	-0.00 (0.00)	-0.06* (0.03)	-0.02 (0.02)	-0.06 (0.06)
Age	-0.01 (0.03)	-0.07** (0.03)	-12.56 (8.00)	-1.30*(0.78)	-26.87** (14.32)
Fixed occupation (ref. temporary)	-0.49*** (0.11)	0.67*** (0.10)	-29.76 (23.60)	16.35*** (2.35)	288.32*** (42.59)
House ownership (ref no ownership)	0.10 (0.12)	-0.06 (0.12)	-10.71 (29.43)	-3.35 (2.73)	-82.55 (51.50)
Joint family (ref single family)	-0.26* (0.13)	0.04 (0.12)	-58.82** (30.01)	1.297 (2.88)	-16.41 (53.68)
Education (years)	0.06*** (0.01)	-0.04*** (0.01)	4.32 (2.88)	-0.88*** (0.29)	-14.56*** (5.24)
Number of Family members	-0.03 (0.03)	0.01 (0.03)	-7.84 (7.35)	0.01 (0.73)	-10.78 (13.30)
Occupation (ref daily labour)					
Farmer	0.54*** (0.13)	-0.34** (0.13)	156.80 *** (34.70)	-4.27 (2.81)	-49.94 (56.09)
Business, service and trade	0.89*** (0.18)	-0.84*** (0.18)	160.18*** (42.20)	-17.58*** (4.00)	-205.19***(72.83)
Natural resource dependence	0.86*** (0.14)	-0.71*** (0.14)	197.05*** (38.18)	-13.33 ***(3.23)	-200.51*** (63.18)
Shrimp gher owner	1.70*** (0.49)	-1.65*** (0.47)	92.79 (80.72)	-35.61*** (10.67)	-463.05*** (149.77)
ρ	-0.82***				
Log likelihood	-909.32			255.79	
Wald λ^2	324.26				

Table 5.1 Bivariate and Tobit Regression for Avoiding Land Salinity

The analysis on avoiding land salinity as in Table 5.1 and Table 6.1 strongly shows that rich people tend to choose more money and less labor donations, whereas poor people donate more labor and less money. The bivariateprobit regression estimates a 3.00% increase and a 3.00% decline in the probability of choosing money and labor, respectively, when income increases by 1000 BDT per month. Similarly, Tobit regression estimates that a 1000 BDT increase in per month household income is associated with a 42.86 BDT rise and a 1.30-h decline peryear in money and labor, respectively. Tobit regression also expresses that a 1000 BDT increase in per month household income is associated with a 14.23 BDT rise in total willingness to pay for avoiding salinity. This result comes from the fact that a fall in

“monetized” labor is less significant than an increase in money donation with respect to an increase of 1000 BDT in household income. This indicates that there is a positive correlation with income and total willingness to pay for avoiding land salinity. The effect of household income on the willingness to pay money and willingness to donate labor shows that the willingness to donate labor and willingness to donate money are substitutes.

Regarding education, it appears that less educated people donate more labor than more educated people, while money donation becomes less as education increases. (Bivariate Probit Regression in Table 6.1). It can be interpreted that as education of the respondent increases by 1 (one) year, the willingness to donate labor decreases by 1.00% and from the Tobit regression it is found that 1 (one) year of additional education is associated with average decrease of 0.88 h of labor donation. Overall, our results suggest that income and education affect both labor and money donations in a negative direction. From the Tobit regression it was found that Total willingness to pay decreases as education level increases.

Concerning the effect of family structure, the Tobit regression shows that single family is more likely to donate money than joint family. In this research it is found that single family is willing to pay 58.82 BDT more comparing to joint family.

The bivariate probit estimation demonstrates that households with fixed occupation household heads are more likely to choose labor than that of the households with temporary occupation by 2.00%. Tobit regression estimates that fixed occupation households donate more labor per year on the average by 16.35 h, relative to the temporary occupation. This result reflects the fact that household with fixed occupation can easily allocate specific amount of time to donation activities since he/she has less uncertainty over income and regular working hours.

In terms of avoiding land salinity occupation dummies are recognized as very important predictors. Relative to day labor households, all other occupation holders tend to donate more money and less labor for avoiding land salinity. Bivariate probit regression shows that farmer, business and service, natural resource dependent and shrimp-gher owner are more likely to choose money by 13.00%, 27.00%, 24.00% and 53.00% respectively. While possibility of choosing labor is lower by 13.00%, 24.00%, 22.00% and 45.00% respectively for farmer, business and service, natural resource dependent and shrimp gher owner than that of the day labor. Tobit estimation identifies an increase in money donation by 156.80, 160.18, 197.05 and 92.79 BDT on the average by the farmer, business and service, natural resource dependent households and shrimp gher owner respectively, compared to that of the day labor. On the other hand, farmer, business, and service, natural resource dependent, and shrimp-gher owner households donate 4.27,17.58, 13.34 and 35.60h less labor than that of the day labor households, respectively. While comparing the Total willingness to pay for avoiding land salinity, Tobit estimation identifies a decrease in donation for business and service, natural resource dependent households and shrimp gher owner by 49.94 BDT, 205.19 BDT, 200.51 BDT and 463.05 BDT, respectively, compared to that of the day labor.

Overall, with fewer exceptions, the bivariate probit and Tobit regressions show the consistent results with each other. The estimated p value of -0.82 (significant at 1% level in Table 5.1) in the bivariate probit regression indicates a significant and negative association between labor and money donations, implying the overall relation of substitutability between the two. More specifically, the effect of income and most other explanatory variables on labor and money donations in regression analysis demonstrates the substitutability between labor and money donations.

Table 5.2: Bivariate and Tobit Regression for Avoiding Water Salinity

	Bivariate probit		Tobit		
	Money	Labor	Money	Labor	Total WTP
Household income(1000 BDT)	0.17*** (0.04)	-0.08*** (0.03)	56.42*** (5.85)	-1.90*** (0.61)	13.13 (10.36)
Household income squared	-0.00 (0.00)	0.00 (0 .00)	-0.83*** (0.17)	0.03 (0.02)	-0.04 (0.30)
Area of house (katha)	0.00 (0.01)	0.01 (0.01)	-0.58*** (0.97)	0.15 (0.10)	1.34 (1.79)
Arable land(katha)	0.00 (.00)	-.000 (0.00)	-0.06* (0.03)	-0.02 (0.02)	-0.06 (0.07)
Age	0.01(0.03)	-0.09***(0.04)	-10.49 (8.60)	-1.27 (0.80)	-22.11 (14.94)
Fixed occupation (ref. temporary)	-0.48*** (0.11)	0 .691*** (0.10)	-31.28 (25.41)	17.17*** (2.44)	306.80*** (44.52)
House ownership (ref no ownership)	0.09 (0.12)	-0.06 (0.12)	-0.78 (31.63)	-3.84 (2.82)	-89.11 *(53.80)
Joint family (ref single family)	-0.03** (0.13)	0.04 (0.13)	-76.25** (32.34)	1.78 (2.98)	-16.19 (56.07)
Education (years)	0.06*** (0.01)	-0.04*** (0.01)	4.00 (3.10)	-0.83*** (0.30)	-13.50**(5.47)
Number of Family members	-0.02 (0.03)	0.02 (0.03)	-3.68 (7.92)	-0.04 (0.76)	-7.87 (13.90)
Occupation (ref daily labour)					
Farmer	0.52*** (0.13)	-0.33** (0 .13)	163.75*** (37.39)	-5.59* (2.90)	-93.95 (58.64)
Business, service and trade	0.89*** (0.18)	-0.86*** (0.18)	190.56*** (45.42)	-19.59*** (4.25)	-225.02*** (76.12)
Natural resource dependence	0.95*** (0.15)	-0.67*** (0.14)	222.03*** (41.06)	-13.90 *** (3.32)	-207.88*** (65.97)
Shrimp gher owner	1.69*** (0.49)	-1.65*** (0.47)	124.09 (86.91)	-39.69 *** (11.25)	-514.91*** (156.62)
ρ	-0.85				
Log likelihood	-889.55				
Wald λ^2	189.91				

Table 5.2 Bivariate and Tobit Regression for Avoiding Water Salinity

This analysis on avoiding water salinity as in Table 5.2 strongly apparently demonstrate that rich people tend to choose more money and less labor donations, whereas poor people donate more labor and less money. The bivariateprobit regression estimates a 2.00% increase and a 3.00% decline in the probability of choosing money and labor, respectively, when income increases by 1000 BDT per month. Similarly, Tobit regression estimates that a 1000 BDT increase in per month household income is associated with a 43.88 BDT rise and a 1.39-h decline per year in money and labor donation, respectively. Tobit regression also expresses that a 1000 BDT increase in per month household income is associated with a 12.59 BDT rise in total willingness to pay for avoiding water salinity. This result comes from the fact that a fall in "monetized" labor is less significant than an increase in money donation with respect to an increase of 1000 BDT in household income. This indicates that there is a positive

correlation with income and total willingness to pay for avoiding land salinity. The result also shows that the relationship between willingness to donate labor and willingness to donate money are substitute.

Regarding education, it appears that less educated people donate more labor than more educated people, while money donation becomes less as education increases, on the other hand (bivariate probit regression in Table 6). It can be interpreted that as education of the respondent increases by 1 (one) year, the willingness to donate labor decreases by 1.00% and from the Tobit regression it is found that 1 (one) year of additional education is associated with average decrease of 0.83 h of labor donation. Overall, our results suggest that income and education do not affect both labor and money donations in a positive direction. Rather it shows that as education decreases, there is a decrease in the willingness to donate labor. From the Tobit regression it was found that Total willingness to pay decreases as education level increases.

Concerning the effect of family structure, the Tobit regression shows that single family is more likely to donate money than joint family. In this research it is found that single family is willing to pay 76.25 BDT more comparing to joint family.

The bivariate probit estimation demonstrates that households with fixed occupation household heads are more likely to choose labor than that of the households with temporary occupation by 14.00%. Tobit regression estimates that fixed occupation households donate more labor per year on the average by 17.17h, relative to the temporary occupation. This result reflects the fact that household with fixed occupation can easily allocate specific amount of time to donation activities since he/she has less uncertainty over income and regular working hours.

In terms of avoiding land salinity, occupation dummies are recognized as very important predictors. Relative to day labor households, all other occupation holders tend to donate more

money for avoiding water salinity (bivariate probit). Farmer, business and service, natural resource dependent and shrimp-gher owner are more likely to choose money by 12.00%, 28.00%, 23.00% and 52.00% respectively. While possibility of choosing labor is lower by 12.00%, 23.00%, 23.00% and 45.00% respectively for farmer, business and service, natural resource dependent and shrimp gher owner than that of the day labor. Tobit estimation identifies an increase in money donation by 163.75, 190.56, 222.03 and 124.10 BDT on the average by the farmer, business and service, natural resource dependent households and shrimp gher owner respectively, compared to that of the day labor. On the other hand, farmers, business, and service, natural resource dependent, and shrimp-gher owner households donate 5.59, 19.59, 13.90 and 39.69h less labor than that of the day labor households, respectively. While comparing the total willingness to pay for avoiding water salinity, Tobit estimation identifies a decrease in donation for business and service, natural resource dependent households and shrimp gher owner by 93.95 BDT, 225.02 BDT, 207.88 and 514.91 BDT, respectively, compared to that of the day labor.

Overall, with fewer exceptions, the bivariate probit and Tobit regressions show the consistent results each other. The estimated *p* value of −0.85 (significant at 1% level in Table 5.2) in the bivariate probit regression indicates a significant and negative association between labor and money donations, implying the overall relation of substitutability between the two. More specifically, the effect of income and most other explanatory variables on labor and money donations in regression analysis demonstrates the substitutability between labor and money donations.

Table 6.1: Marginal effects of Bivariate and Tobit Regression for avoiding Land Salinity

	Bivariate probit		Tobit		
	Money	Labor	Money	Labor	Total WTP
Household income (1000 BDT)	0.03*** (0.01)	-0.03*** (0.01)	42.86*** (3.56)	-1.30*** (0.40)	14.23** (6.47)
Area of house(katha)	-0.00 (0.00)	0.00 (0.00)	-1.16 (0.90)	0.15(0.10)	0.83(1.72)
Arable land(katha)	0.00 (0.00)	-0.00 (0.00)	-0.06 *(0.03)	-0.02 (0.02)	-0.06(0.06)
Age	0.02* (0.10)	-0.01 (0.01)	-12.56 (8.0)	-1.30* (0.78)	-26.87* (14.31)
Fixed occupation (ref. temporary)	-0.20*** (0.03)	0.02*** (0.02)	-29.76(23.60)	16.35 *** (2.36)	288.32*** (42.59)
House ownership (ref no ownership)	0.02(0.03)	-0.02(0.03)	-10.71(29.43)	-3.36(2.73)	-82.55 (51.51)
Joint family (ref single family)	-0.03(0.04)	0.05(0.03)	-58.82**(30.02)	1.29(2.88)	-16.41 (53.67)
Education (years)	0.01*** (0.00)	-0.01*** (0.00)	4.32 (2.89)	-0.88*** (0.29)	-14.56(5.24)
Number of Family members	-0.01 (0.01)	0.01 (0.00)	-7.84 (7.356)	0.01(0.73)	-10.78(13.30)
Occupation (ref daily labour)					
Farmer	0.13*** (0.04)	-0.13*** (0.03)	156.80***(34.71)	-4.26(2.81)	-49.95(56.09)
Business, service and trade	0.27*** (0.05)	-0.24***(0.04)	160.18*** (42.204)	-17.58*** (4.09)	-205.19*** (72.82)
Natural resource dependence	0.24*** (0.04)	-0.22*** (0.03)	197.05*** (38.18)	-13.34*** (3.22)	-200.51*** (63.18)
Shrimp gher owner	0.53*** (0.15)	-0.45***(0.13)	92.79 (80.72)	-35.60*** (10.67)	-463.05*** (149.77)

Table 6.1 Marginal effects of Bivariate and Tobit Regression for avoiding Land Salinity

***Significant at the 1 percent level, **at the 5 percent level and *at the 10 percent level.

Table 6.2: Marginal effects of Bivariate and Tobit Regression for avoiding Water Salinity

	Bivariate probit		Tobit		
	Money	Labor	Money	Labor	Total WTP
Household income(1000 BDT)	0.02*** (0.01)	-0.03*** (0.00)	43.88*** (3.84)	-1.39*** (0.41)	12.59* (6.76)
Area of house (katha)	-0.00 (0.00)	-0.00 (0.00)	-0.58(0.97)	0.15 (0.10)	1.34 (1.80)
Arable land(katha)	0.00 (0.00)	-0.00 (0.00)	-0.06*(0.03)	-0.02 (0.02)	-0.06 (0.07)
Age	0.02** (0.01)	-0.01 (0.01)	-10.49 (8.59)	-1.27 (0.80)	-22.11 (14.94)
Fixed occupation (ref. temporary)	-0.20*** (0.03)	0.14*** (0.02)	-31.28 (25.41)	17.17*** (2.44)	306.80*** (44.52)
House ownership (ref no ownership)	0.02 (0.03)	-0.02 (0.03)	-0.78 (31.63)	-3.842488 (2.83)	-89.11* (53.80)
Joint family (ref single family)	-0.04 (0.04)	0.06 **(0.03)	-76.25** (32.34)	1.78 (2.98)	-16.19 (56.07)
Education (years)	0.01 *** (0.00)	-0.01*** (0.00)	4.00 (3.10)	-0.83*** (0.30)	-13.50* (5.47)
Number of Family members	-0.01 (0.01)	0.01 (0.01)	-3.68 (7.92)	-0.04 (0.76)	-7.87 (13.91)
Occupation (ref daily labour)					
Farmer	0.12*** (0.04)	-0.12*** (0.032)	163.75*** (37.39)	-5.59* (2.91)	-93.95 (58.64)
Business, service and trade	0.28*** (0.05)	-0.23*** (0.04)	190.56*** (45.42)	-19.59*** (4.25)	-225.02*** (76.12)
Natural resource dependence	0.23*** (0.04)	-0.23*** (0.03)	222.03*** (41.06)	-13.90*** (3.33)	-207.88*** (65.97)
Shrimp gher owner	0.52*** (0.15)	-0.45*** (0.12)	124.10(86.92)	-39.69*** (11.25)	-514.91*** (156.62)

Table 6.2 Marginal effects of Bivariate and Tobit Regression for avoiding Water Salinity

****Significant at the 1 percent level, **at the 5 percent level and *at the 10 percent level.*

Table 6.3: Marginal effects of Bivariate Probit Regression on Avoiding land salinity and Avoiding Water Salinity

	Donation for Land Salinity		Donation for Water Salinity	
	No Money & No labor	Both money and labor	No Money & No labor	Both money and labor
Household income(1000 BDT)	-0.01*** (0.00)	0.01*** (0.00)	-0.01*** (0.02)	0.01*** (0.00)
Area of house (in katha)	-0.00 (0.00)	0.00 (0.00)	-0.00 (0.00)	0.00 (0.00)
Arable land (in katha)	-0.00 (0.00)	0.00 (0.00)	-0.00 (0.00)	0.00 (0.00)
Age	0.00** (0.00)	-0.02*** (0.01)	0.01 ** (0.00)	-0.02** (0.01)
Fixed occupation (ref. temporary)	-0.01* (0.01)	0.07*** (0.02)	-0.02** (0.01)	0.07*** (0.02)
House ownership (ref no ownership)	-0.00 (0.01)	0.01 (0.03)	-0.00 (0.01)	0.00 (0.02)
Joint family (ref single family)	0.02* (0.01)	-0.04 (0.03)	0.02 (0.01)	0.05** (0.02)
Education (years)	-0.00 (0.00)	0.00 (0.00)	-0.00* (0.00)	0.00 (0.00)
Number of Family members	0.00 (0.00)	-0.00 (0.01)	0.00 (0.00)	0.00 (0.01)
Occupation (ref daily labour)				
Farmer	-0.02* (0.01)	0.02 (0.03)	-0.01 (0.01)	0.02 (0.03)
Business, service and trade	-0.01 (0.01)	-0.03 (0.03)	-0.00 (0.01)	-0.04 (0.03)
Natural resource dependence	-0.02 (0.01)	-0.01 (0.03)	-0.02** (0.01)	0.02 (0.03)
Shrimp gher owner	-0.01 (0.02)	-0.07 (0.06)	-0.01 (0.02)	-0.07 (0.06)

Table 6.3 Marginal effects of Bivariate Probit Regression on Avoiding land salinity and Avoiding Water Salinity

****Significant at the 1 percent level, **at the 5 percent level and *at the 10 percent level.*

Table 6.3 also validates that as household income increases by 1000 BDT, the probability that respondent would deny to donate both donate money and labour decreases by 1 % and probability that the respondent would be willing to donate both money and labour increases by 1 %. This result is same for both avoiding land salinity and for avoiding water salinity.

It can be interpreted that the probability that the respondent would deny to both donate money and labour ,as their occupation status get changed from temporary to fixed would decrease by 1 % and 2 % for avoiding land salinity and water salinity respectively. It also shows that the probability that the respondent would donate both money and labour increase by 7 % for both the cases of avoiding land salinity and for avoiding water salinity ,as their occupation status get changed from temporary to fixed. It is also found that as age increases by 1 year, the probability that the respondent would donate both money and labour decreases by 2 %, the result is evident in both the cases for avoiding land and water salinity. On the

other hand, the result of willingness to pay money or donate labor related to water salinity vividly reflected that the probability that the respondent would deny to contribute both labor and money increases by 1 % as age increases. This result is not surprising as when people's age increases the tendency to donate more money increases (Table 6.1 and Table 6.2); whereas with increased age people usually tend to donate less labour due to lack of physical capacity and better financial condition.

Chapter 5Discussion and Conclusion

This study examine local people's behavior related to labor and money donations in relation to socioeconomic factors in a developing for country mitigating land and/or water salinity. Furthermore, it scrutinizes the relationship between the willingness to pay money and willingness to donate labour with respect to income and other socioeconomic factors. Therefore the substitutability or complementarity between labor and money donations is analyzed in the paper. The paper is very significant in terms of comprehending the behavior of the disaster-susceptible and salinity affected people of the coastal area and consequently measuring the willingness to donate labor and willingness to donate money. Furthermore, it is very important to put emphasis on collective countermeasures to mitigate salinity resulting from disasters in the coastal area of Bangladesh. Therefore, to analyze the donation behavior of local people to mitigate the salinity after the cyclone AILA, for this study a surveys focusing on 1000 households were done. The analysis of the date was done through using bivariate probit and Tobit regressions and marginal effects of it.

The analysis of the paper depict that the people suffering from salinity induced by AILA in Bangladeshi decide between labor and money donations along with their respective amount depending on some major determinants which are the nature of the occupation whether it is fixed or temporary, education, household income, age and occupation type. The poor households tend to donate more labor and less money comparing to that of rich household in

the area. However, as income increases, there is an increase total donation as the magnitude of donating money is quite significant. Furthermore, less educated households are recognized to considerably contribute to overall donations via labor. The rich people with less natural dependence are more willing to donate money, whereas poor people with more natural dependence are found to donate more labor. It was also found that people with fixed occupation also tend to provide more labor comparing to those with temporary occupation. This result does align with our expectation as the people with fixed occupation are more likely to be impacted from the salinity in their livelihood, as shifting their work is not viable. Precisely, labor and money donations demonstrate the relation of substitutability with respect to most socioeconomic variables. Unlike the previous studies conducted in developed countries, in our studies it was revealed that education does not positively affect overall donations in Bangladesh as there is a tendency to drop in donating labor as people get more educated. The result is not surprising as in the socio cultural context of Bangladesh providing manual labor and getting compensation by an hourly wage is considered as a low tier job which is less respected. The study further suggests that the poor and less educated people with high natural resource dependence are highly motivated to avoid salinity as it impacts on their livelihood, thus they donate labor. The difference in the result is predictable, since the motivation of donation of people in developing country is very different from that of the developed countries. The people of the developed countries tend to consider donation as a luxury good, as it is the culture of their society to donate more in charities as they become more educated and rich. (Andreoni,2006). On the other hand, in developing countries, salinity intrusion is directly impacting the livelihood of the people, thus the donation for mitigating the salinity can be considered as necessary good.

In our research, as it was not viable to monitor and accumulate the data for the “actual” labor and money donation behaviors, therefore “elicited labor and money donations” in the study

area was used to conduct the study. Therefore, there might be some biases as elicited labor and money is used, which is a major limitation in the study. However, the respondents are the victim of salinity resulting of cyclone AILA in the area, so the result derived are more likely to be consistent. So we assume that the bias is insignificant, and the result attained in this research is considerably precise to provide insights for such cases.

However, like many other developing countries, study regions of Bangladesh, there are no well established public mitigation programs that organize labor and money donations from people. Thus such program can be implemented in the study region, as the people of the area have shown to donate both labor and money for mitigating the salinity. Therefore, it is feasible to organize programs which focus on mitigating land and water salinity through labor donations of the local people. Such programs will help them to generate more income. Moreover, as most of the people with high natural resource dependence transfer their occupational knowledge to the future generation, thus once salinity mitigation programs are successfully established through labor donations from local people, the skill will be developed and the donations from the current generation to the next generation will be continued, therefore sustainable development could be achieved. The paper disseminate message that labor donation could be a major channel of the donations for many disaster mitigations especially in developing countries.

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