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Characterizing voluntary donations for natural disaster mitigation in a third world country: A case of Bangladesh

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Characterizing voluntary donations for natural disaster mitigation in a third world country: A case of Bangladesh

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Abstract

Voluntary donation is a major source of public goods provision in the developed countries. Likewise, voluntary donations may be able to contribute to public problems in third world countries such as natural disaster mitigation. However, voluntary sector in third world countries has not been studied, and thus this paper addresses voluntary donations in Bangladesh with a specific eye on natural disaster mitigation. To this end, we conducted a questionnaire survey of 1000 respondents and elicited (i) a willingness to donate their labor (labor donation) and (ii) a willingness to pay (money donation) to collective countermeasures for avoiding the damages from cyclones and associated disasters. With this data, we analyze labor and money donations in relation to socio-economic variables such as income, education, family structure, and occupation using bivariate probit and Tobit regressions. The analysis finds that age, family structure, education, income and occupation are important determinants for Bangladeshi people to decide between labor and money donations as well as their respective amount. The poor and less educated households with the occupations of higher natural resource dependence are identified to contribute a large portion of overall donations via labor. The rich and more educated people are willing to donate money and little labor, but the magnitude of donations is rather small. In summary, labor and money donations exhibit the relation of substitutability with respect to most socio-economic variables, and education and income do not positively affect overall donations in Bangladesh. This finding is in sharp contrast with the studies in USA or Europe, and illustrates a possibility that labor donation is an important channel to natural disaster mitigation that should be utilized for public betterment in third world countries.

Key Words: Voluntary donation; natural disaster; third world country

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1 Introduction

Voluntary donation is regarded as one of the major sources for public goods provision in many developed countries. For instance, in USA, the government has yielded complacent tax policy to voluntary donation for promoting philanthropy since 1917. This illustrates that philanthropy is an important activity in USA and has played a vital role to provide various social needs along with the government (Brown and Lankford, 1992, Beldad et al., 2015). Likewise, in Europe, many types of charities have been organized to meet diverse social challenges (Wright, 2001, Wiepking, 2009, Bauer et al., 2013, Beldad et al., 2015). Voluntary donation activities have taken different forms in developed countries, and a number of researches have analyzed various voluntary donations in USA and Europe. However, no papers have studied the voluntary donation behaviors in developing countries.¹

It is important to characterize voluntary donations in third world countries mainly for two reasons. First, it adds some extra knowledge in the literature of voluntary donation behavior since the donation behavior in developing countries could be different from those of the developed countries. For instance, the necessity for this type of research focusing on developing countries is pointed out by Henrich et al. (2010). Second, it might contribute to some imperative public problems in third world countries. For instance, natural disaster and climatic changes are the major threats for many developing countries and collective disaster mitigation plan is claimed to be urgent (Emanuel, 2005, Schiermeier, 2011b,a). In the process of mitigation planning and implementation, local people's cooperation is essential, and disaster mitigation cannot be sustainable without their voluntary donation (Mileti, 1999, Dorsey and McDaniels, 2001, Godschalk et al., 2003, Pearce, 2003). Therefore, we address the issue of characterizing the voluntary donation behavior in a third world country, Bangladesh, for natural disaster mitigation.

In any voluntary activities, the two channels of labor and money donations are the most conventional practices (Bauer et al., 2013). These two are important measures for people's cooperation to disaster mitigation activities. Moreover, voluntary labor donation is expected to be high con-

¹In this paper, developing countries are interchangeably used as third world countries.

27 sidering an economic structure in the disaster-susceptible areas of Bangladesh. This expectation
28 is in line with other disaster-mitigation or -recovery cases in other countries. For instance, labor
29 donation was a major force for the recovery of the 2011 earthquake off the Pacific coast of Tohoku,
30 Japan and the 2004 Tsunami of the west coast of Sumatra, Indonesia. Despite its importance, labor
31 donation for natural disaster mitigation has not been addressed in the literature. Thus, we address
32 the labor donation in addition to money donation.

33 A notable number of past works characterize the voluntary donation behavior in USA and
34 Europe considering labor and money donations as the two major channels (see, e.g., Menchik
35 and Weisbrod, 1987, Brown and Lankford, 1992, Duncan, 1999, Feldman, 2010, Cappellari et al.,
36 2011, Bauer et al., 2013). These studies generally find a positive relationship between income
37 and money donation as well as between income and labor donation. Consequently, the overall
38 donation is identified to increase in USA and Europe when household income rises. The same
39 tendency applies to education in the sense that more educated people donate more of both labor
40 and money for charitable activities.

41 Another focus in the literature on labor and money donations is the effect of price of donations.
42 Brown and Lankford (1992) discover a complementary relationship between money and labor
43 donations with respect to the price of money giving (opportunity cost for time or money giving
44 such as wage) in USA. Duncan (1999) develops a theoretical model in which labor and money
45 donations are perfectly substitute with respect to the price of money giving in the equilibrium,
46 whereas his empirical result shows that labor and money donations change in the same direction,
47 i.e, complementarity. On the other hand, Feldman (2010) has found that labor and money donations
48 are substitute. In European contexts, Cappellari et al. (2011) find complementary relation between
49 labor and money donations, whereas Bauer et al. (2013) establish substitutability relation. In
50 summary, labor and money donations have a tendency to change in the same direction with respect
51 to income and education, but not necessarily with respect to the price of money giving in USA or
52 European countries.

53 In the context of natural disaster mitigation, there are only a few works that analyze voluntary

54 donations toward collective disaster mitigation. Markantonis et al. (2013) elicit willingness to pay
55 for avoiding the damage of severe flooding in Greece, and find that experts and hunters are willing
56 to pay more than farmers. Luo and Levi (2013) analyze the determinants to induce participation
57 for collective disaster mitigation programs in China. They report that farmers usually pay a lot of
58 attention to the non-engineering practices of mitigation, but not to engineering practices. Actual
59 willingness to participate is identified to be quite low, although education and professional skills
60 can positively influence the decision to participate. Similarly to Markantonis et al. (2013), Ghan-
61 barpour et al. (2014) elicit and analyze people's willingness to pay toward flood management in
62 relation to risk perception and socio-economic factors in Iran. They conclude that the willingness
63 to pay is higher for those who have high income and high level of risk perception.

64 No past literature has addressed voluntary donations to natural disaster mitigation, considering
65 both labor and money donations within a single framework. Also there is no previous research to
66 characterize voluntary donations toward disaster mitigation in the third world countries, such as
67 Bangladesh. Nevertheless, given the increased threats of natural disasters and climatic changes,
68 organizing a collective countermeasure by means of voluntary donation is urgent and an important
69 policy agenda. Given this state of affairs, we examine voluntary donation behavior in the third
70 world countries, and characterize both labor and money donations with a specific eye on natural
71 disaster mitigation.

72 To this end, we conducted a questionnaire survey of 1000 households and elicited willingness
73 to donate (i) labor and (ii) money to collective disaster mitigation in the disaster-susceptible ar-
74 eas of Bangladesh.² With this data, we analyze labor and money donations in relation to major

²This research differs from the previous works in another direction since we have applied the hypothetical values of labor and money donation while in previous studies the true values of money giving and labor giving has been used. Since voluntary activities have never been organized for natural disasters and such data are not available in Bangladesh, we rely on hypothetical values of labor donation and money donation. However, for valuing public goods, demand of better environmental quality, and to quantify the required compensation or damage caused by environmental deterioration, use of contingent valuation method (hereafter, CVM) has been regarded as one of the best ways (see, e.g., Mitchell and Carson, 1988, Alberini and Kahn, 2009). Several studies use CVM to computes the willingness to pay for avoiding manmade or natural disaster given the past experience of such calamities (see, e.g., Brown et al., 1996, Carson et al., 2003, Cooper et al., 2004, Martin-Ortega et al., 2011, Markantonis et al., 2013, Ghanbarpour et al., 2014). These previous works suggest that when people have enough experiences with which preferences are well established such as in the case of natural disasters, an open-ended question format in CVM method is recommended. Therefore, in this study, we have employed an open-ended question format to identify the hypothetical values of labor

75 socio-economic variables, such as income, education, family structure, age and occupation, us-
76 ing bivariate probit and Tobit regressions.³ This paper differs from the previous studies in USA
77 and European contexts, because philanthropies and charities in USA and Europe can be consid-
78 ered luxury activities in comparison to the donation activities for disaster mitigation in third world
79 countries. Natural disaster directly harms people's wealth and life and therefore, and provision
80 of natural disaster mitigation is a necessary good for the people living in the disaster-susceptible
81 areas of third world countries. Thus, our analysis provides a unique contribution to the existing lit-
82 erature by comparing how donation behavior to disaster mitigation in third world countries might
83 be different from that to charity in the developed countries and by providing policy implication of
84 how disaster mitigation should be organized by voluntary donations.

85 **2 Cyclones and our study region**

86 Bangladesh is the most vulnerable county to forceful cyclones and tropical storms (Government
87 of Bangladesh, 2010). Continental and triangular shapes at the head of Bay are found to be the
88 reasons for larger weights of storm surges in Bangladesh (Dasgupta et al., 2010). Dasgupta et al.
89 (2010) mention that due to cyclonic storm hazards, the costal belt of Bangladesh is the most deadly
90 lethal zone among the top ten cyclone prone zones in the world. Moreover, it has been predicted
91 that the intensity and frequency of cyclone will increase in future (Ali, 1996). High tidal surge
92 followed by a cyclone is another issue that is liable for a significant portion of the total damage
93 (Dasgupta et al., 2010).

94 About 10% of world's total cyclones are generated in the bay of Bengal (Ali, 1996). In between
95 1877 to 2009, 159 cyclones hit Bangladesh; 48 storms among them were very severe (Government
96 of Bangladesh, 2010). Cyclone caused 450000 deaths and huge amount of economic loss since

and money donation to collective countermeasures against cyclonic disasters, since we believe that local people have gone through enough experiences of natural disasters in our study regions.

³We also elicited risk perception to climate from the respondents in our survey following Ghanbarpour et al. (2014), but most of them simply answered "high risk perception" which do not show enough variation to be included in the analysis. Therefore, we did not include them in statistical analysis. Here, we report that almost all respondents consider natural disaster and climatic changes as high risk for their life.

97 1970. Cyclone AILA is the latest severe cyclonic storm that hit the coast of Bangladesh on May
98 25, 2009 (United Nation, 2010). The storm wind speed was 65-75 mph, which was formed in
99 the bay of Bengal on May 23, 2009 (Kumar et al., 2010). By the next two days, it had been
100 intensified to a catagoty-1 severe cyclonic storm. The AILA's timing coincided with the moonless
101 day's highest tidal water level which caused high tidal surges up to 6.5 meters (United Nation,
102 2010). Because of this high tidal wave, the economic damage and human sufferings are far higher
103 than those from any other cyclone.

104 The most severely affected areas are four upazilas of Khulna and Satkhira districts, namely,
105 Dakope, Koyra, Shyamnagar and Asasuni (United Nation, 2010).⁴ United Nation (2010) reports
106 the damages by cyclone AILA as follows; initially, it caused 190 deaths, and 7100 injuries. Due
107 to the gigantic high tidal wave followed by the storm wind, 1742km of embankment network
108 was fully destroyed which led to heavy flooding and washed away a huge number of households,
109 livestock, standing crops, homestead-vegetables and fisheries including shrimp-ghers.⁵ In four
110 severely affected unions, almost 90-100% households were fully or partially damaged. Moreover,
111 2233km and 6621km of roads were fully and partially damaged, respectively. The 445 educational
112 facilities were damaged, and 500000 students lost their opportunities of education. Among 203932
113 households in four severely affected upazilas, 201000 households faced the damage of their latrines
114 and sanitation systems. The 80% of the total livestock and almost the total arable land have been
115 destroyed. One of the main income-generating activities in the affected areas before cyclone was
116 fisheries, such as shrimp cultivation and fish hunting from natural sources. However, approxi-
117 mately 38885ha of sweet water fisheries and shrimp-ghers were destroyed during cyclone AILA.
118 Most of the fishermen lost their fishing boats and nets and many of them had to sell their boats and
119 given up their business for maintaining their daily cost of living.

120 The major prolonged effect after cyclone AILA is the increased level of land salinity. Destruc-
121 tion of the whole embankment network causes prolonged inundation and stagnation of saline water

⁴Upazila is the second lowest administrative unit in Bangladesh.

⁵“Shrimp-gher” indicates a special pond and the associated occupation for shrimp cultivation in the coastal regions of Bangladesh.

122 on the cultivable land. One year after this catastrophe, it has been found that only a minor portion
123 of the arable land is ready for cultivation (United Nation, 2010). This high level of land salinity
124 resulted in a 70-80% loss of agricultural productivity and reduces the shrimp cultivation produc-
125 tivity by $1880kg/ha$ (United Nation, 2010). It has been reported that the farmers have cultivated
126 rice for the first time in 2013 after cyclone AILA, and our survey was conducted at the harvesting
127 period of their first cultivation. During our survey, the farmers have reported that the level of land
128 salinity still remains much higher than the level of land salinity before cyclone AILA. People in the
129 affected areas still suffer from scarcity of drinking water. During the dry season in Khulna district,
130 households need to spend 16% of its monthly income only for sweet drinking water (Shaha, 2014).
131 These stories convey how the negative impacts from cyclone AILA prolong.

132 [Figure 1 about here.]

133 Our study regions are the two most severely affected areas or unions of Dacope upazila in
134 Khulna district, namely, Kamarkhola, and Sutarkhali, respectively (figure 1).⁶ Dacope upazila is
135 located between $22^{\circ}24'$ and $22^{\circ}40'$ north latitudes and in-between $89^{\circ}24'$ and $89^{\circ}35'$ east longi-
136 tudes. The total land area of Dacope upazila is $992km^2$ where total land areas of Kamarkhola
137 and Sutarkhali are 7214 acre, 12092 acre, respectively (Bangladesh Bureau of Statistics, 2011). In
138 Bangladesh, the coastal areas of Khulna and Satkhira districts are divided or separated into pold-
139 ers. Polders are embankment-bounded areas and this network of embankments protects these areas
140 from storm surges. Kamarkhola and Sutarkhali unions are located in polder 32. These two unions
141 are surrounded by river Shibsra and Dhaki in the west and north, in the east Sutarkhali, Chunkuri,
142 and Bhadra (Bangladesh Water Development Board, 2013). Kamarkhola and Sutarkhali are the
143 two mostly affected unions among the seventeen cyclone affected unions of Khulna and Satkhira
144 districts. Based on United Nations Development Program (2009), in Dacope upazila, 94000 people
145 and 22000 households were affected. The 3200 households and 16000 people, 8000 households
146 and 40000 people were severely affected in Kamarkhola, and Sutarkhali, respectively. That implies
147 that in Kamarkhola, Sutarkhali and Tildanga, 90% and 100% of households were damaged.

⁶A union is the lowest administrative unit in Bangladesh.

148 **3 Data and methodology**

149 We run questionnaire surveys of 1000 respondents in the selected areas between December 25,
150 2013 and January 5, 2014. Our respondents are the household heads, and we identify per household
151 money and/or labor donations for cyclonic disaster mitigation, considering a case of cyclone AILA.
152 One might wonder that the object for valuation can be considered a private bad. However, a cyclone
153 is a public bad, and any type of cyclone disaster mitigation necessitates collective countermeasures
154 that are considered non-excludable and non-rival for avoiding the damages. Therefore, a valuation
155 problem is similar to valuing public goods in the literature of environmental economics.

156 The questionnaires have been pretested by interviewing 70 household heads in the pilot survey
157 prior to the final survey. Furthermore, for finalizing the way of valuation and several other issues,
158 we consulted CVM experts. Based on the outcomes of the pilot survey and consultation with CVM
159 experts, we refine the contents and wording of the final questionnaire. The main goal of our study
160 is to elicit donations of each household for cyclonic disaster mitigation through the two channels
161 of money and/or labor. In our final survey, we first ask the possible components of damages due to
162 natural disasters such as cyclones and whether each component has been damaged during cyclone
163 AILA. We listed twelve kinds of damages that could be considered the major ones: 1. shelters, 2.
164 schools and education, 3. roads, 4. embankment, 5. sanitation, 6. standing crop and food stock,
165 7. livestock, 8. shrimp-gher and fishery, 9. health, 10. fishing boat and net, 11. land quality
166 due to salinity intrusion (land salinity), and 12. water quality due to salinity intrusion. Next,
167 we ask whether the respondent is willing to donate any amount of money and/or labor for damage
168 mitigation, considering the possible components of damage he/she recalls in the previous question.

169 We asked respondents to think that the labor and money donations expressed in the survey
170 shall be utilized or used for the disaster mitigation such as infrastructures and publicly organized
171 programs. The vehicle for eliciting money donations (labor donations) to collective disaster mit-
172 igation is an extra fee per month or year (extra hours of voluntary labor per month or year). We
173 employ an open-ended question format, and a series of these procedures basically follows Markan-

174 tonis et al. (2013) and Ghanbarpour et al. (2014).⁷ One unique and different feature in this survey
175 from Markantonis et al. (2013) and Ghanbarpour et al. (2014) is to give respondents the options to
176 choose labor and/or money as well as to specify their corresponding quantities. Respondents have
177 four options to express their willingness to donate: (1) labor > 0 and money > 0 , (2) labor > 0
178 and money $= 0$, (3) labor $= 0$ and money > 0 , (4) labor $=$ money $= 0$. This idea is motivated by
179 the fact that many local people may want to donate labor rather than money to disaster mitigation
180 or both. In the pilot survey, we have found that giving two options of labor and money donations
181 to respondents was effective in an open-ended questionnaire format.

182 Our final questionnaire consists of three sections. In the first section, we introduce about our-
183 selves and ask questions about respondents' perceptions to a qualitative change of climate variables
184 and natural disasters, such as an increase in temperature, rainfall and frequency of cyclones. The
185 questions are asked because we are interested in the relation between people's perceptions and
186 degree of voluntary donation for disaster mitigation. The second section comprises three subsec-
187 tions. In first subsection, we ask respondents to think about the possible components of cyclone
188 damages. In the second subsection, we ask whether he/she chooses labor and/or money donations,
189 and elicits the corresponding amount of donations in an open-ended format. In the third subsec-
190 tion, we prepare the questions to clarify the motives behind their answers. The final section gathers
191 respondents' socio-economic information, such as their occupation, education, income, a number
192 of household members and so on.

193 We have collected a total of 1000 samples where 320 and 680 samples from the two unions
194 of Dacope upazila, namely Kamarkhola and Sutarkhali, respectively. The number of samples has
195 been chosen based on the proportion of number of households in these two unions. The total

⁷In fact, which elicitation formats to use can be an issue in valuing public goods especially when respondents do not have any experience of "consuming" the public goods to formulate their preference. However, in our case, respondents have sufficiently experienced cyclones, storms and related disasters, and they did not have any difficulty expressing their willingness to contribute. As mentioned earlier, in a similar type of situations, open-ended question formats have been used in previous studies (see, e.g., Markantonis et al., 2013, Ghanbarpour et al., 2014), while we could have used some other methods of CVMs such as double-bounded dichotomous choice methods. However, there are numerous previous works that justify the use of open-ended elicitation formats when people are familiar with the public goods (Mitchell and Carson, 1988, Brown et al., 1996, Carson et al., 2003, Alberini and Kahn, 2009, Martin-Ortega et al., 2011, Markantonis et al., 2013, Ghanbarpour et al., 2014). Therefore, we have determined to use the open-ended methods.

196 number of households in Kamarkhola and Sutharkhali were 3559 and 7536, respectively in 2011
197 (Bangladesh Bureau of Statistics, 2011). Therefore, 32.29% and 67.71% of the total sample has
198 been collected from Kamarkhola, and Surtarkhali, respectively.

199 To implement random sampling, we follow the procedures used in Himelein et al. (2013, 2014),
200 called geographic cluster sampling. Prior to our final survey, first we observe human movement
201 and frequency of households within our study area using GIS technology. Based on the house-
202 hold numbers, first, we divided each of the unions into five sub-regions with the same number of
203 households (figure 2). We visited the study field twice before starting our survey. In the process
204 of our field visit, we took some help from local experts since it was impossible for us to reach and
205 obtain information about frequency of households. With the help of GIS technology and informa-
206 tion obtained through field visits, we segregate each of the subregions into several equal stratum
207 and pick a starting point in each stratum for starting our survey. After the segregation, we started
208 the survey subregion by subregion (figure 2). In each stratum, we sent a group of two researchers.
209 Among them, the one were the trained interviewer, and the last one was a local expert and they
210 cover a whole stratum. From each stratum of a subregion, we randomly collect the same number
211 of samples.

212 One might wonder that a particular group of people, such as rich people, in these regions live
213 only in a specific area. For example, rich and educated people might tend to live in some specific
214 districts or residential areas such as in Europe, USA or Japan. However, this is not the case in the
215 study regions. All types of people are well mixed and almost equally distributed over the districts
216 where figure 2 confirms our argument. It shows that most of the households are situated adjacent
217 to embankment networks, and the middle areas surrounded by the households boundary are arable
218 lands. In this light, we can say that natural disasters, such as cyclone AILA, are equally likely to
219 affect people as a “public bad” in the study region.

220 [Figure 2 about here.]

Following the previous research such as in Cappellari et al. (2011) and Bauer et al. (2013), we
apply a bivariate probit regression to characterize a combination of binary choices for labor and/or

money. The model is specified as follows:

$$d_{ki} = \boldsymbol{\delta}_k \mathbf{x}_{ik} + \beta_{k1} I_i + \beta_{k2} I_i^2 + \epsilon_k, \quad k = \{\ell, m\}, i = \{1, \dots, n\}, \quad (1)$$

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

221 where $d_{\ell i}$ and $d_{m i}$ are binary choice variables of labor or/and money donations for individual i ,
 222 respectively, I_i is a household's income, \mathbf{x}_{ik} is a vector of independent variables and ϵ_ℓ and ϵ_m
 223 are error terms for labor and money donations, respectively, with mean 0 and covariance matrix $\boldsymbol{\Omega}$
 224 with covariance ρ . Finally, $\beta_{kj} = \{\beta_{\ell j}, \beta_{m j}\}$ for $j = 1, 2$ and $\boldsymbol{\delta}_k = \{\boldsymbol{\delta}_\ell, \boldsymbol{\delta}_m\}$ are parameters to be
 225 estimated for each regression of labor and money donations. A bivariate probit regression model
 226 takes account of the correlation between ϵ_ℓ and ϵ_m via estimating ρ .

227 In addition to the bivariate regressions, we also apply Tobit regressions for labor and money
 228 donations to quantify the impact of independent variables on donations. The Tobit regressions
 229 employ the same independent variables as in the bivariate probit regression, and the dependent
 230 variables are the quantity of labor and money donations where zero donations for labor and money
 231 occupy some considerable portion. A set of independent variables included in the regression anal-
 232 ysis contains area of the house, arable land each household owns, occupations for household heads,
 233 house ownership, family structure, income, household heads' education and age.

234 The difference between the other models and our model is inclusion of wage rate for labor.
 235 Most of empirical studies include wage rates as a proxy of opportunity cost for time (price of money
 236 giving) (see, e.g., Menchik and Weisbrod, 1987, Brown and Lankford, 1992, Cappellari et al., 2011,
 237 Bauer et al., 2013). Our model does not contain the variable because many people of our sample
 238 in the study region are indigenous in the sense that their life is autonomous (simply harvest and
 239 eat) and largely dependent on the degree of uncertainty associated with natural environment and
 240 disasters. In that sense, many respondents do not have "regular" wage and thus, we cannot quantify
 241 wage rates in the same way other papers do in the developed countries. What we can do best is
 242 to control occupations by putting a dummy variable for each. In this way, the opportunity cost for

243 time is somewhat controlled.

244 The intent of running bivariate probit and Tobit regressions is to see how incomes and other
245 explanatory variables affect money and labor donations within a single framework. For example,
246 when income increases, how does it affect money and labor donations at the same time? That
247 is to identify the substitutability or complementarity between labor and money donation when an
248 independent variable changes. Most vulnerable people against natural disasters in the third world
249 countries are indigenous. Voluntary donations from such people have neither been organized, it
250 is nor addressed about how indigenous and vulnerable people seek to cooperate against natural
251 disasters. Therefore, we do this research through eliciting the donations from local people in the
252 coastal areas of Bangladesh.

253 **4 Empirical results**

254 **4.1 Summary statistics**

255 Table 1 presents respondents' choices for labor and/or money donations for cyclonic disas-
256 ter mitigation. Among 1000 respondents, 938 (98.3%) respondents are willing to donate either
257 money or labor to the collective countermeasures against cyclonic and associated disaster mitiga-
258 tion. Hence, the only 17 respondents (1.7%) are not willing to donate any amount of both labor and
259 money. The 452 respondents choose to donate only money, and 109 respondents choose to donate
260 only labor. Finally, 422 respondents choose some amount of both labor and money to express their
261 total donations. Compared with other studies that elicit labor and/or money donations for public
262 goods, the response rate of nonzero donations in our study is high (see, e.g., Alberini and Kahn,
263 2009).

264 [Table 1 about here.]

265 Table 2 presents summary statistics of the variables. The mean and median of household labor
266 and money donations are 112.21 hours/year, 64.00 hours/year and BDT 1,099.51/year, 600.00/year,

267 respectively. The mean and median of labor donations are much more than our expectation, while
268 those of money donations are lower. In the study areas, monthly household incomes are relatively
269 low compared to other areas of Bangladesh (mean of BDT 7516 and median of BDT 6000). For
270 instance, average household monthly income in capital city, Dhaka, is reported to be BDT 35000.
271 This implies that relatively poor people reside in our study areas and is vulnerable to natural dis-
272 asters.

273 [Table 2 about here.]

274 Average education (mean 4.746 and median 5) indicates that the level of education is very low
275 in our study region and most of the people do not go to college or university. In case of household
276 arable land, high standard deviation (SD) and gap between mean and median indicate that some
277 households in this region have significantly greater amount of arable land than the other house-
278 holds. With respect to age, six categories are prepared because most people in rural Bangladesh
279 do not care about their exact age and cannot even answer it (See footnote 2 in table 2). The 76%
280 people are aged less than 50 years and 53% people are aged less than 40 years in this region which
281 means a significant proportion of the household heads are working-age people. In case of fam-
282 ily structure, the number of single family is dominant over the number of joint family. However,
283 the proportion of joint family (24.80%) is high compared with that in other areas of Bangladesh.
284 Finally, the most notable fact in table 2 is the mix of fixed and temporary occupations. It shows
285 that only 53% of the household heads fall in fixed occupation where they are hired as a fixed po-
286 sition. It is in sharp contrast with the occupational structure of developed countries or urban areas
287 of Bangladesh.

288 Table 3 presents the statistics of household income, labor and money donations per occupation.
289 These statistics have been separately shown across occupations since the features of occupational
290 structure are different from those of developed countries or urban areas, and it is expected that
291 occupations explain a significant portion of the total variation in our final result. The nature of
292 our study region is characterized by the high degree of vulnerability, the uncertainty to natural
293 disasters, close vicinity and dependence on natural resources such as mangrove forests.

[Table 3 about here.]

294

295 In this research, we categorize subjects' occupations into (0) day labor, (1) natural resource
296 dependence, (2) farmer, (3) business, trade and service, and (4) shrimp-gher owner. "Day labor"
297 respondents mainly work in construction or small scale industries, depending on society's current
298 needs. They also work under the sea boat owners to collect wood, honey and crabs from the
299 nearby forests. During rice cultivation seasons, they work as agricultural labor. Respondents at
300 "natural resource dependence" comprise the fishermen, crab hunters, honey collectors, beekeepers
301 and wood collectors as their main job. Respondents at "farmer" include those who engage in large,
302 medium, or small scale farming activities as their main job. They own land or borrow it from
303 others for cultivation. Respondents at "business, trade and service" include all the businessmen,
304 government and non-government service holders, middlemen in fishing business and fishing boat
305 owners. "Shrimp-gher owners" are those who cultivate shrimp in their own ponds which are called
306 "gher." The third row in table 3 shows the number of respondents that belong to each category of
307 occupations.

308 Table 3 reveal that businessmen and the shrimp-gher owners are relatively high-income people,
309 while day labors, farmers and natural resource dependents are low-income people in this region.
310 In particular, the shrimp-gher owners are the highest-income people followed by business and
311 service, farmer, natural resource dependents and day labor categories. The third row in table 3
312 shows that people with high-income occupations tend to be more educated with exception that
313 shrimp-gher owners (5.68 years of schooling) are less-educated than businessmen (7.68 years of
314 schooling). Table 3 also demonstrates the summary statistics of labor and money donations across
315 occupations. They show that households with high-income occupations (highly educated) tend to
316 choose more money donation, whereas households with low-income occupations (less educated)
317 choose more labor donation. For instance, labor donation is the highest and money donation is
318 lowest for day labor. However, shrimp-gher owners donate the lowest amount of labor and the
319 highest amount of money.

320 **4.2 Labor and money donation in relation to socio-economic factors**

321 [Table 4 about here.]

322 [Table 5 about here.]

323 The estimations of bivariate probit and Tobit regressions for labor and money donations have
324 been presented in table 4. Based on the results in table 4, the marginal effects of independent
325 variables are reported in table 5 under the assumption that the other explanatory variables are at
326 their means.⁸ Since our interest is on the impact of independent variables on labor and money
327 donations, we focus on reporting the marginal effects of independent variables for both bivariate
328 probit and Tobit regressions in table 5. Overall, table 5 reveals that household income, age, family
329 structure, and occupation dummies (categories) are the significant predictors of both labor and
330 money donations, while education and occupation types are significant only in labor donation.

331 Our analysis shows that rich people tend to choose more money and less labor donations,
332 whereas poor people donate more labor and less money. The bivariate probit regression estimates
333 a 1.6% increase and a 2.7% decline in the probability of choosing money and labor, respectively,
334 when income increases by BDT 1,000 per month. Similarly, Tobit regression estimates that a BDT
335 1,000 increase in per month household income is associated with a BDT 312.99 rise and a 10.49-
336 hours decline per year in money and labor, respectively. Regarding education, it appears that less
337 educated people donate more labor than more educated people, while money donation does not
338 show any strong association with respect to education (Tobit regression result in table 5).

339 Overall, our results suggest that income and education does not affect both labor and money
340 donations in a positive direction. The effects of income and education on labor and money dona-
341 tions in our regression results are different from the studies in USA or Europe that find an increase

⁸We use the command “c.income##c.income” in Stata 13 to incorporate the nonlinear effect of income on dependent variable both for bivariate probit and Tobit regression. Furthermore, in our regression, we include both of occupation type and occupation category as independent variables since for every occupational category, fixed-occupation and temporary-occupation holders are mixed up due to special structures of a labor market in our study region. For instance, many businessmen fall in the category of temporary occupation since their business is a seasonal business. On the other hand, many of the semi-skilled day labor are considered “fixed occupation” because they sell their physical labor in a specific sector such as shrimp cultivation without seasonality.

342 in both labor and money donations with respect to income and education (see, e.g., Menchik and
343 Weisbrod, 1987, Brown and Lankford, 1992, Freeman, 1997, Fiorillo, 2009, Cappellari et al., 2011,
344 Bauer et al., 2013). However, our result is not surprising when we consider special contextual is-
345 sues, socioeconomic and cultural situations in Bangladesh. We provide more detailed explanations
346 for this later.

347 Concerning the effect of family structure, the bivariate probit regression shows that joint-family
348 households are likely to choose more labor and less money. Tobit regression also confirms the
349 same tendency that, on the average, single-family households' money donation is higher and labor
350 donation is less than that of joint-family households' by BDT 611.44 and by 27.00 hours per year,
351 respectively. Joint-family households usually have more working-age members in a house and
352 therefore, they have a tendency to donate more labor. On the other hand, single-family households
353 have less working-age members and thus they have a tendency to donate less labor and more
354 money.

355 With respect to age, our analysis shows that people donate more in their early ages. A 4.7% fall
356 in the likelihood of choosing labor has been estimated when one category in household heads' age
357 increases. Tobit estimation also implies 13.05 hours and BDT 99.38 reductions per year in labor
358 and money donations, respectively, in relation to a one-category rise in household heads' age. Yet
359 again, this finding is not in line with past literature in Europe or USA showing that both of labor
360 and money donations increases in ages (Cappellari et al., 2011, Bauer et al., 2013). However, our
361 result could be intuitively interpreted by considering the donations to natural disaster mitigation as
362 investments. For instance, the respondents in our study are potential victims of natural disasters.
363 Therefore, younger respondents have stronger incentives to make investments by donating labor
364 and/or money to natural disaster mitigation, because they can maximize the long-run return from
365 such early investments (Menchik and Weisbrod, 1987). In this sense, our result with respect to age
366 is quite plausible.

367 The bivariate probit estimation demonstrates that households with fixed occupation household
368 heads are more likely to choose labor than that of the households with temporary occupation by

369 25.8%. Tobit regression estimates that fixed occupation households donate more labor per year on
370 the average by 104.69 hours, relative to the temporary occupation. This result reflects the fact that
371 household with fixed occupation can easily allocate specific amount of time to donation activities
372 since he/she has less uncertainty over income and regular working hours.

373 Occupation dummies are also identified to perform as vital predictors. Relative to day labor
374 households, natural resource-dependent households and farmers are more likely to choose money
375 by 10.2% and 4.0%, respectively. While possibility of choosing labor is lower by 15.8%, 35.9%,
376 28.9% and 67.87%, respectively, for farmer, business and service, natural resource dependent and
377 shrimp-gher owner than that of the day labor. Tobit estimation identifies an increase in money
378 donation by BDT 774.15, BDT 772.05 and BDT 1249.08 on the average by the farmer, business
379 and service, natural resource dependent households, respectively, compared to that of the day
380 labor. On the other hand, farmer, business, and service, natural resource dependent, and shrimp-
381 gher owner households donate 34.57, 130.85, 72.76, and 255.27 hours less labor than that of the
382 day labor households, respectively.

383 The regression results associated with occupation dummies confirm that households of oc-
384 cupations with less natural resource dependence tend to choose more money, and households of
385 occupations with high natural resource dependence donate more labor. Day labor households do-
386 nate the highest amount of labor per year, while shrimp-gher owners and business and service
387 households donate less labor. Therefore, the degree of natural resource dependence in occupations
388 is another key for people to choose labor and/or money donations. Day labor, farmer and natural
389 resource dependent households heavily depend on the availability of natural resources and prone
390 to natural uncertainty for their livelihood, implying that their income fluctuate due to natural and
391 climate events.

392 Among the occupations, day labor occupation is the most physical labor intensive followed
393 by the natural resource dependent and farmer, while it does not mean that each occupation is un-
394 der labor-time constraint. Households with these occupation donate more labor than that of the
395 business, and service, and shrimp-gher owner households. This predisposition comes from the

396 nature of the occupations, for instance, day labors, natural resource dependents, and farmers are
397 habituated with hard physical labor for their livelihood and do not hesitate to donate labor. On the
398 other hand, businessmen, service holders and shrimp-gher owners are comparatively highly edu-
399 cated and are not habituated with heavy physical labor. In addition, they consider labor donation
400 to natural disaster mitigation as low-class types of works on the basis of Bangladeshi culture or
401 customs. Due to these reasons, rich and more educated people choose to donate more money and
402 little money, while poor and less educated people choose to donate more labor and less money.

403 Overall, with fewer exceptions, the bivariate probit and Tobit regressions show the consistent
404 results each other. The estimated ρ value of -0.384 (significant at 1% level) in the bivariate pro-
405 bit regression indicates a significant and negative association between labor and money donations.
406 Similarly, the effect of income and other explanatory variables on labor and money donations
407 implies the substitutability between labor and money donations as well. Finally, to see the sub-
408 stitutability effect of independent variables on labor and money donations on the same basis, we
409 convert labor donation to monetary term and compare it with money donation based on the regres-
410 sion results. For this, we use the conversion rate of BDT 37.50 per labor hour and compare the
411 “monetary labor donation” with money donation. The BDT 37.50 is the minimum wage in the
412 study region and the lowest conversion rate.

413 The conversion computation based on our Tobit regressions finds that a BDT 1000 rise in per
414 month household income leads to a BDT 80.57/year decline in total donation. A fall in “mone-
415 tized” labor is more significant than an increase in money donation with respect to the income.
416 This finding is striking and in contrast with the studies in Europe and USA since they find a pos-
417 itive association between the income and the overall donation. Our results clarify that the labor
418 is an important channel and significant for total donation. Overall, the poor and less educated
419 households with the occupations of higher natural resource dependence are identified to contribute
420 a large portion of overall donations via labor. The rich and more educated people are willing to do-
421 nate money and little labor, but the magnitude of donations is rather small. In summary, labor and
422 money donations exhibit the relation of substitutability with respect to most socio-economic vari-

423 ables, and education and income do not positively affect overall donations for disaster mitigation
424 in Bangladesh.

425 There are several important factors to explain the results of donation behavior to natural disaster
426 mitigation in Bangladesh. Donation for charities in USA and Europe is qualitatively different from
427 donation to disaster mitigation in our study areas. Natural disasters directly harm local people's
428 wealth and earning. Thus, local people are the direct victims of natural disasters and their donation
429 to natural disaster mitigation is considered "investments" and directed toward the reduction of
430 future losses from disasters. Donation behaviors are based on people's strong desire to improve
431 or to stabilize their future life and it is a main motivation. In USA or Europe, philanthropies and
432 charities are considered important social contributions and luxury goods, inducing the rich and
433 educated people to donate more of both labor and money (Andreoni, 2006).

434 In the study region, people who are the most vulnerable to climatic changes and associated
435 disasters are poor and less educated people with high natural resource dependence, whereas rich
436 and educated people with less natural resource dependence are not so vulnerable because their life
437 does not depend on nature. Poor and less educated people with high natural resource dependence
438 are those who do not have any option to migrate, and are required to cooperate with neighboring
439 people for survival through the activities of fishing, hunting and harvesting foods on a daily basis.
440 In other words, the best practice for such people to survive is to cooperate with others in the
441 neighborhood. Our data analysis confirms that poor and less educated people with high natural
442 resource dependence contribute a large portion of total donation via labor, reflecting their best
443 strategy of cooperation in their daily life even for natural disaster mitigation.

444 The rich and educated people with less natural resource dependence in the study regions usually
445 consider labor donations to natural disaster mitigation as low-class types of works and thus are not
446 willing to do so. They even have an option to migrate to other areas because their skills and wealth
447 enable to do so. In addition, they are not required to cooperate with "neighboring" people, because
448 they earn income through their own business and office works. This type of differences in their
449 daily life appears to reflect our result that rich and more educated people with low natural resource

450 dependence donate only money, but the magnitude is small, compared to poor and less educated
451 people with high natural dependence. Those who are likely to suffer from natural disasters in more
452 serious ways are motivated to donate more, that is, poor and less educated people with high natural
453 dependence. These types of contextual differences in natural resource dependence, income and
454 education could be considered the main logic behind our result.

455 **5 Conclusion**

456 This paper analyzes people's labor and money donations in relation to socio-economic factors
457 in third world countries with a specific eye on cyclonic disaster mitigation. Moreover, it examines
458 the substitutability or complementarity between labor and money donations in relation to income
459 and other socio-economic factors. We are motivated to do so since collective countermeasures
460 to protect the coastal people of Bangladesh from cyclonic disasters is urgent, and in the process
461 of mitigation planning and implementation, it is important to identify how disaster-susceptible
462 people are willing to donate. To analyze the donation behavior of local people to natural disaster
463 mitigation, we conducted surveys of 1000 households and analyzed the data through bivariate
464 probit and Tobit regressions to see how labor and money donations are related to socio-economic
465 factors compared to the donation behaviors observed in USA and Europe.

466 The analysis finds that age, family structure, education, income and occupation are important
467 determinants for Bangladeshi people to decide between labor and money donations as well as
468 their respective amount. The poor and less educated households with the occupations of higher
469 natural resource dependence are identified to contribute a large portion of overall donations via
470 labor. The rich and more educated people are willing to donate money and little labor, but the
471 magnitude of donations is rather small. In summary, labor and money donations exhibit the relation
472 of substitutability with respect to most socio-economic variables, and education and income do not
473 positively affect overall donations in Bangladesh. This finding is in sharp contrast with the studies
474 in USA or Europe.

475 This study demonstrates that people's donation behaviors for the case of natural disaster mitiga-
476 tion in a developing country could be considered different from those for the charities in developed
477 countries. We confirm an importance of labor donations from our statistical analysis, which is
478 quite consistent with disaster mitigation activities for other cases all over the world. Public mitiga-
479 tion programs that organize labor and money donations from people are not well established in the
480 study regions of Bangladesh and many third world countries, whereas such collective countermea-
481 sures against climatic change and associated disasters are urgent. Considering our finding in this
482 research, there should be some possibility of successful development for sustainable and collective
483 disaster mitigation practices by fully utilizing labor donations in each locality.

484 It is our belief that the qualitative result in this research gives some insights to more general
485 cases. As our result suggests, labor could be identified as a major channel of the donation for
486 many disaster mitigation. For instance, planting trees, green belting and community forest projects
487 can be well organized beforehand through labor donations as cyclonic disaster mitigation in both
488 developing countries. Such projects require constant donation from the local community when
489 local people are motivated to donate to such mitigation projects that stabilize or improve their life
490 in communities.

491 We relied on elicited labor and money donations to analyze the behavior since it is impossible
492 to observe the "actual" labor and money donation behaviors in our study areas. Considering this
493 nature of elicited labor and money, there might be hypothetical biases that could be considered one
494 limitation in our study. However, our respondents are those who have experienced frequent natural
495 disasters, in particular, cyclones and storms, and could answer the labor and money donations
496 effectively without any incentive to tell a lie.⁹ Hence, the hypothetical biases for labor and money
497 donations are expected to be rather small.

⁹More specifically, the possible bias could have been upward. However, such an upward bias (i.e., concerns for overestimation) for labor donations and money donations shall not be a serious concern in this research, because reported values of labor donations and money donations elicited especially from poor people appear to be quite plausible and understandable on the basis of their daily life styles and price levels in that region.

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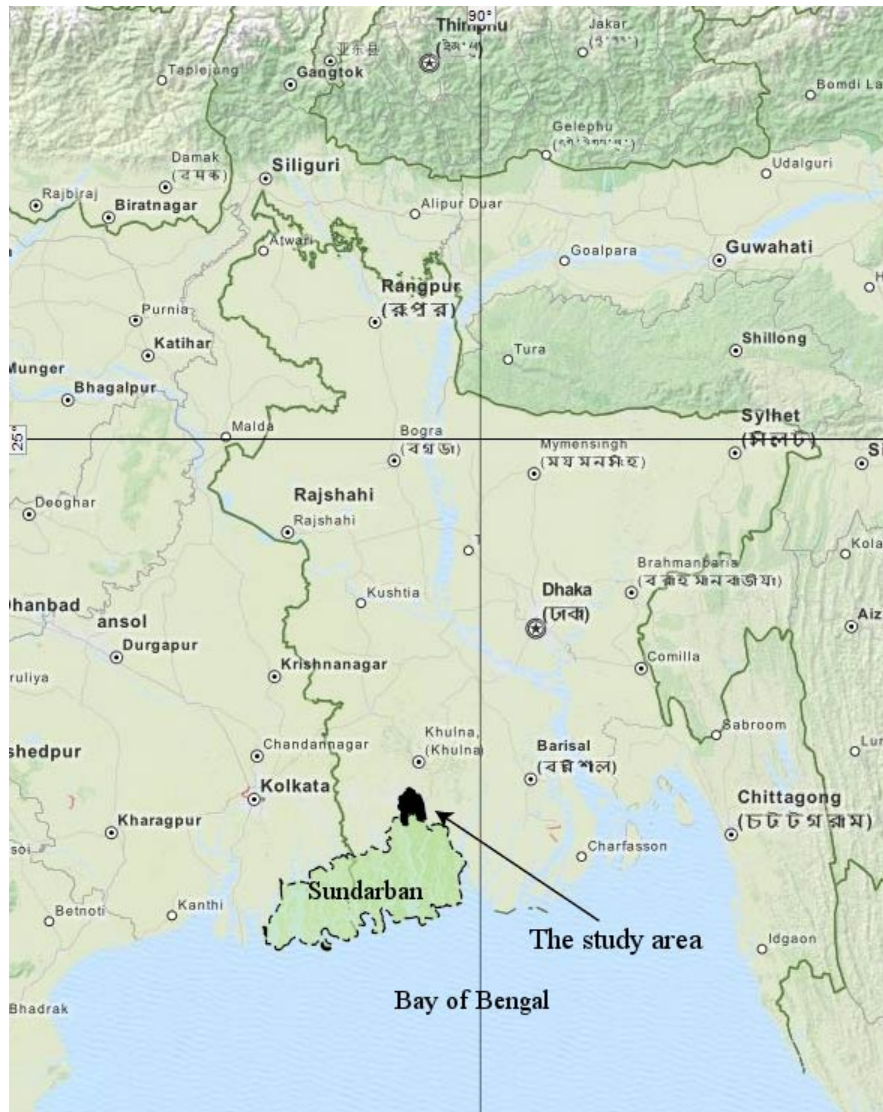


Figure 1: Geography of study regions where “sunderban” indicates mangrove forest areas

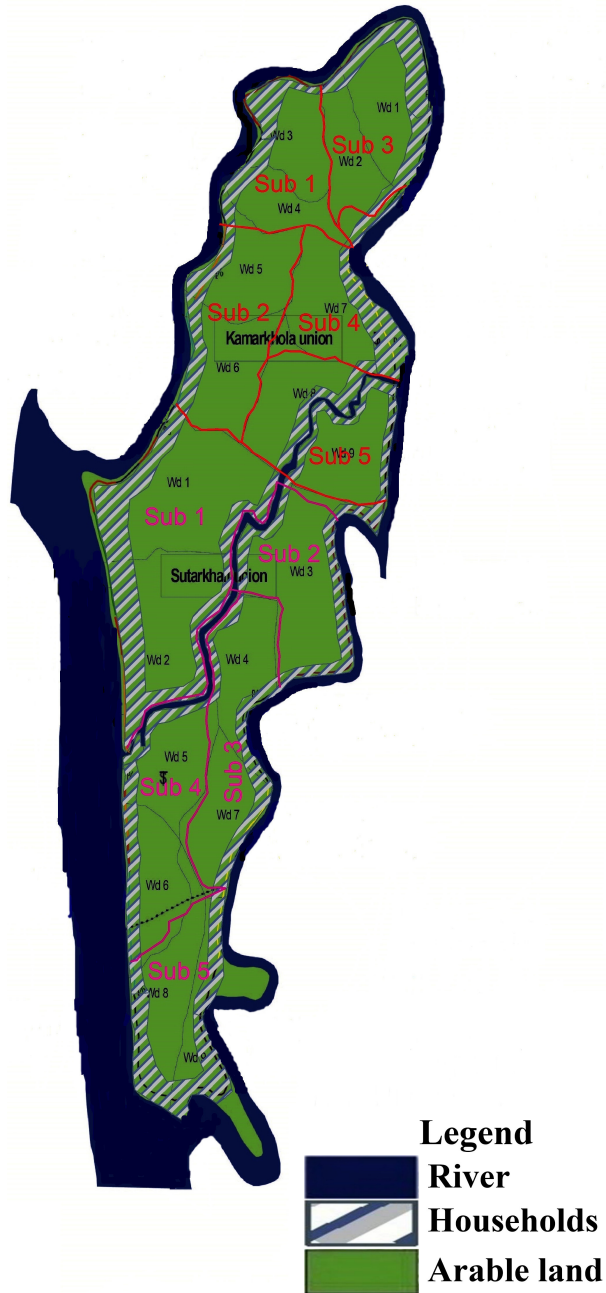


Figure 2: Segregation of the study area for randomization

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Table 1: Frequencies of choices for labor and/or money donations

		Labor		Total
		0	1	
Money	0	17	109	126
	1	452	422	874
Total		469	531	1000

Table 2: Summary statistics of the variables

Variables	Mean	Median	SD	Min	Max
Money donation (BDT/year)	1099.51	600.00	1835.74	0.00	19000
Labor donation (hours/year)	112.21	64.00	122.33	0.00	440.00
Household income per month (1000 BDT)	7.51	6.00	5.16	1.00	50.00
Area of the household shelter (Katha)	5.72	3.00	11.88	0.00	300.00
Arable land for a household (Katha)	48.10	8.00	325.17	0.00	10000.00
Age ¹	1.56	1.00	1.34	0.00	5.00
Fixed occupation (0 or 1)	0.53	1.00	0.49	0.00	1.00
House ownership (0 or 1)	0.78	1.00	0.41	0.00	1.00
Single family ²	0.75	1.00	0.43	0.00	1.00
Education (years)	4.75	5.00	4.14	0.00	16.00

¹ 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.

² It is a dummy variable taking 1 with a single family. When it is a joint family, it is 0.

Table 3: Household income, labor and money donation per occupation

Statistics	Occupations					Overall
	Day labor	Natural resource dependence	Farmers	Business	Shrimp-gher	
# 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	20795	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
Labor donation (hours/year)						
Average	179	98	125	38	25	112
Median	200	0	128	0	0	64
SD	101	127	124	85	75	122
Min	0	0	0	0	0	0
Max	368	440	405	385	312	440
Money donation (BDT/year)						
Average	153	1158	1186	1538	3210	1099
Median	50	1000	545	1000	2350	600
SD	213	1509	2017	2030	2828	1835
Min	0	0	0	0	0	0
Max	1050	19000	16500	15700	10500	19000

Table 4: Bivariate and Tobit regressions

	Bivariate probit		Tobit	
	Money	Labor	Money	Labor
Household income (BDT 1000)	0.27*** (0.059)	-0.11*** (0.026)	386.73*** (44.32)	-16.10*** (3.84)
Household income squared	-0.0050* (0.0030)	0.0030*** (0.0010)	-4.91*** (1.24)	0.37*** (0.11)
Area of the house (katha)	-0.012* (0.0060)	0.0050 (0.0050)	-4.08 (4.75)	0.86 (0.84)
Arable land (katha)	-0.000 (0.0020)	-0.0020** (0.0010)	0.32** (0.166)	-0.22 (0.17)
Age	-0.10** (0.045)	-0.12*** (0.034)	-99.38*** (40.85)	-13.05*** (5.05)
Fixed occupation (ref. temporary)	-0.318** (0.16)	0.647*** (0.099)	17.36 (111.29)	104.69*** (15.56)
House ownership (ref. no ownership)	0.27* (0.15)	0.071 (0.13)	-14.06 (137.39)	27.43* (16.94)
Single family (ref. joint)	0.59*** (0.16)	-0.20* (0.11)	611.44*** (144.49)	-27.00* (16.38)
Education	0.035* (0.019)	-0.041*** (0.013)	18.14 (13.22)	-7.29*** (1.87)
Occupation (ref. day labor)				
Farmer	0.86*** (0.15)	-0.40*** (0.14)	774.15*** (120.97)	-34.57** (15.47)
Business & service	0.82*** (0.22)	-0.90*** (0.18)	772.05*** (163.85)	-130.85*** (25.63)
Natural resource dependence	1.29*** (0.21)	-0.72*** (0.15)	1249.08*** (184.48)	-72.76*** (19.83)
Shrimp-gher owner	5.89 (14.69)	-1.70*** (0.413)	586.15 (515.78)	-255.27*** (75.70)
Constant	-1.29*** (0.39)	1.36*** (0.24)	-2668.82*** (345.43)	187.44*** (32.75)
ρ		-0.38***		
Log likelihood		-814.47		
F -statistics			25.29	27.59
Wald χ^2		643.79		

***significant at the 1 percent level, **at the 5 percent level and *at the 1 percent level.

Table 5: Marginal effects of bivariate and Tobit regressions

	Bivariate probit		Tobit	
	Money	Labor	Money	Labor
Household income (BDT 1000)	0.016* (0.0090)	-0.027*** (0.0070)	312.98*** (31.86)	-10.49*** (2.73)
Area of the house (katha)	-0.0010 (0.0010)	0.0020 (0.0020)	-4.08 (4.75)	0.86 (0.84)
Arable land (katha)	-0.000 (0.000)	-0.001* (0.000)	0.32** (0.166)	-0.22 (0.17)
Age	-0.0080 (0.0060)	-0.047*** (0.014)	-99.38*** (40.85)	-13.05*** (5.05)
Fixed occupation (ref. temporary)	-0.025 (0.18)	0.26*** (0.039)	17.36 (111.29)	104.69*** (15.56)
House ownership (ref. no ownership)	0.21 (0.16)	0.028 (0.050)	-14.06 (137.39)	27.43* (16.94)
Single family (ref. joint)	0.047* (0.027)	-0.080* (0.044)	611.44*** (144.49)	-27.00* (16.38)
Education	0.003 (0.002)	-0.017*** (0.005)	18.14 (13.22)	-7.29*** (1.87)
Occupation (ref. day labor)				
Farmer	0.067* (0.040)	-0.158*** (0.058)	774.15*** (120.97)	-34.57** (15.47)
Business & service	0.064 (0.044)	-0.36*** (0.071)	772.05*** (163.85)	-130.85*** (25.63)
Natural resource dependence	0.102* (0.062)	-0.29*** (0.061)	1249.08*** (184.48)	-72.76*** (19.83)
Shrimp-gher owner	0.46 (0.89)	-0.68*** (0.16)	586.15 (515.78)	-255.27*** (75.70)

***significant at the 1 percent level, **at the 5 percent level and *at the 1 percent level.