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Impact of farm level corruption on the food security of households in Bangladesh

Asif Reza Anik · A. V. Manjunatha · Siegfried Bauer

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Abstract In this article, we have analyzed the impact of farm level corruption on households' food security using survey data collected from 210 Bangladeshi rice farmers. Econometric results confirm that the cost of corruption adversely affects households' calorie consumption. The marginal effect of corruption is higher for the low expenditure households relative to the high expenditure households. This happens because the high expenditure households exhibit more flexibility in terms of adjusting their budgets and hence, are able to cover the cost of corruption without affecting their food consumption, whereas for the low expenditure households such flexibility is limited and hence are forced to compromise on their food budget. Variables such as the better education of women and land holding also positively contribute to food security.

Keywords Farm level corruption impacts · Calorie intake determinants · Food security · Rice farmers · Bangladesh

Introduction

Ensuring food security or adequate calorie intake for all citizens is perhaps one of the most difficult developmental hurdles for policymakers in developing countries to overcome, and Bangladesh is no exception to this. Although a fair degree of success has been achieved in improving food availability, a significant proportion of households in Bangladesh continue to have inadequate access to sufficient quantities of food. One possible cause for this is the prevalence of widespread corruption which may deny ready access to services when households are not able or willing to pay bribes. Such concerns are prominent in Bangladesh, where corruption is generally perceived as being very high. For instance, about 84.2 percent of the households in the country experience corruption while interacting with service sectors (TIB 2010). The total estimated amount of bribes paid by Bangladeshi households for accessing various services amounts to 1.4 percent of Gross Domestic Product (GDP) (TIB 2010). Additionally, several internationally available corruption indices such as Transparency International's Corruption Perception Index, Global Integrity's Global Integrity Report and World Bank Governance Indicators, reveal poor ratings for Bangladesh.

Available literature on the impact of corruption can be classified into two broad categories. One group of researchers argues that corruption is detrimental to development and growth and that countries with higher incomes and economic growth rates tend to exhibit low levels of corruption and vice versa (Treisman 2000; Paldam 2001; Chetwynd et al. 2003; Gundlach and Paldam 2009). High levels of corruption are associated with lower levels of investment and per capita GDP growth (Mauro 1995; Lambsdorff 2003; World Bank 2000a), and high income inequality (Krueger 1974; Rose-Ackerman 1978; World Bank 2000b). Corruption also reduces government revenues with the effect that relatively fewer resources are available for productive expenditures (Tanzi and Davoodi 1997).

Contrary to this group of researchers, another group claims corruption to have some beneficial effects, at least in a few situations. The most popular and common hypothesis supporting the positive role of corruption centers around 'greasing the wheels.' Investment is needed to 'speed' or 'grease' things and to overcome inefficiency in bureaucracy (Leff 1964; Leys 1965; Huntington 1968). Bribes may work as an incentive for officials to perform better and hence may promote economic growth. It may also prompt firms to evade

A. R. Anik (✉)
Department of Agricultural Economics, Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Salna, Gazipur 1706, Bangladesh
e-mail: anikbd1979@gmail.com

A. V. Manjunatha
Agricultural Development and Rural Transformation Centre, Institute for Social and Economic Change, Bangalore 560072, India

S. Bauer
Institute of Project and Regional Planning, Justus Liebig University, Giessen, Senckenbergstr. 3, 35390 Giessen, Germany

taxes leading to reduced public revenue collection. However, reduced public revenues may not always cause economic efficiency, especially when compared to the performance of government, firms or private entrepreneurs, which tend to invest less efficiently than individuals (Leff 1964). Besides, a system built on bribery may lead to an efficient process of allocating licenses and government contracts (Lui 1985), particularly when the concerned officials do not have enough information or are not competent to make decisions (Beck and Maher 1986; Lien 1986). Also through bribes, private agents can minimize the consequences of unfavorable policies i.e., those biased against entrepreneurship (Leff 1964; Bailey 1966).

The dominant trend in the literature is to analyze corruption at the macro level. Perhaps this is due to the relatively easy availability of data at the aggregate rather than the individual level (Mocan 2008). Although the available literature provides a few important insights into the implications of corruption, it hardly explains intra-country variation and is hence less useful for designing policy responses (Svensson 2003). In this paper we address these research gaps by way of analyzing the impact of farm level corruption on the food security of households in Bangladesh. Furthermore, this study explores whether impacts of corruption vary across different income groups.

The rest of the paper contains three sections: section two outlines the data collection method and conceptual models. The third section presents the results and discussion. Finally, the results are summarized in the concluding section.

Methodology

Data collection

Using a multi-stage sampling technique, data were collected from 210 farm households belonging to six villages spread across six different districts of the country. These were Enayetpur (Naogaon district), South Sordubi (Lalmonirhat district), Mosjidpara (Nilphamary district), Mukimpur (Sirajgong district), Rajapara (Comilla district), and Char Belabo (Narsingdi district). The reference period of the survey was from July 2008-June 2009. As rice is a major crop of the country in terms of production (33,540,320 metric tons), area coverage (75 percent of the total cropped area and over 80 percent of the total irrigated area) and contribution to national income accounts (one-half of the agricultural GDP and one-sixth of the national income) (BRRI 2012), the study focuses on rice farming. The above median rice producing districts were selected because of the occurrence of extension services for training in paddy rice production, demonstration plots and advisory services were greater in these areas. Furthermore, these areas consume a relatively high share of agricultural subsidy allotted for paddy. Based on the proportion of households experiencing corruption in service sectors, 32 districts were ranked according to TIB's corruption data base[1] and the top three and bottom three districts were chosen. From each district, the upazila[2] with the highest rice production and from the upazila, the villages with the highest rice production were selected. Finally, 35 farm households from each of the six villages were randomly selected from the list of farmers available with the local extension agents, giving the total of 210 farm households.

A semi-structured interview schedule was used for collecting information regarding the corruption experiences of farming households. Information was also collected with respect to households' interaction experiences with nine different service sectors, namely: health, education, electricity, banking, judiciary, land administration, law enforcement agencies, local government and Non-Governmental Organizations (NGOs). Several strategies were followed: for instance, in the case of bribery data, instead of asking direct questions as to the amount of bribe paid, households were asked about their paid cost or price for a given service. The difference between the price paid by a households and that announced by the service was considered as the amount of the bribe paid. Further, information regarding demographic and socio-economic characteristics of households such as education, income and expenditure patterns, land holding, relationship with different organizations and power entities was also collected. For information on calorie consumption, households were asked about the quantity of different food items consumed over the previous seven days.[3] Food quantities consumed at the household level were converted to calories using the locally available food composition table (BIRDEM 2013).

Conceptual model

We have used the number of calories consumed to represent the food security status of a household, which is perhaps the most commonly and widely used among different food security indicators (Kumar 1988; von Braun 1988; Longhurst and Lipton 1989; Garrett and Ruel 1999; Aromolaran 2004; Abdulai and Aubert 2004; Omotesho et al. 2006; Babatunde and Qaim 2009). Following Tschirley and Weber (1994),

[1] The ranking here was done using the TIB's database of 'National Household Survey 2007 on Corruption in Bangladesh.'

[2] An administrative unit in Bangladesh that is above the village level but below the district level.

[3] The dependent variable is basically a snapshot of household's annual consumption. Whereas the list of independent variables also includes two annual variables (annual expenditure and annual cost of corruption). Since establishing a relationship here denies possibilities of seasonal effects, one may argue for annual consumption data. But the accuracy of food consumption data reduces with the length of recall period (Bouis 1994) and hence we have used the seven day recall method during the survey. Use of this method is common in the literature (Garrett and Ruel 1999; Babatunde and Qaim 2009).

Subramanian and Deaton (1996), and Babatunde and Qaim (2009), a calorie consumption model was developed to determine the impact of corruption cost and other determinants of calorie consumption. The model can be expressed as follows:

$$c_i = \alpha_0 + \alpha_1 x_{1i} + \alpha_2 x_{2i} + \ldots + \alpha_k x_{ki} + \varepsilon_i \quad (1)$$

where c_i is the per-capita daily calorie intake for the *i*th household adjusted by the adult equivalent (AE) ratio (kcal); x_i's are different household and community level characteristics of the *i*th household that may influence caloric intake; and ε_i is the error term. All the household level variables were converted into adult equivalent (AE) ratios in order to obtain values that were comparable across households of different sizes.[4] The explanatory variables used in the regression models included: annual expenditure in Bangladeshi Taka divided by Adult Equivalents (BDT/AE)[5]; annual cost of corruption (BDT/AE); weighted calorie price of basic food items (BDT)[6]; two interaction variables, one was the interaction term of expenditure and cost of corruption and the other was the interaction term of calorie price and cost of corruption[7]; ratio of children to total family members[8]; household's male head or father's education (years); mother's education (years)[9]; land ownership (ha/AE); and dummy of household's economic status (1 = non-poor).[10] The selection of these variables was based on the available literature and insights gained from the field survey. Detailed descriptions of these variables and their measurement techniques are presented in Table 1. Two different models were developed, one with the linear and the other with the logarithmic form of calorie intake variable, whereas the lists of explanatory variables did not vary across the models.

The variable cost of corruption broadly included:

(i) Cost of corruption in service sectors (BDT/AE): The total annual amount of bribe paid by households to all service sectors, and

(ii) Cost of corruption in the agricultural sector (BDT/AE): We have considered farmers' paddy cultivation experiences. The following three components were incorporated into the cost of corruption variable for the agricultural sector: First, excess payment in the agricultural input market (BDT) was calculated as the difference between government fixed retailer price and the actual price paid by the farmer for the subsidized inputs. In addition, bribes paid by irrigation pump owners for collecting irrigation subsidy was also included; Second, the monetary value of time wasted and excess transportation cost incurred (BDT). A farmer may experience time wastage while waiting in a queue and incur additional transportation costs due to repeated visits to the dealers and separate transportation of small quantities instead of a common large one. Time wasted was measured in person-days and then multiplied by the specific wage rate available at the time of collecting that specific input. The excess transportation cost included cost of vehicles and labour. These two cost components were incorporated into the cost of corruption only in the context of no supply shortage in the market, and farmers having enough capital and willingness to purchase a given input. To ensure that there was no supply shortage, secondary data about fertilizer and seed supply in the local market were checked; and the third component was the cost of corruption in government extension services (BDT). Some of the demonstration plot organizers have reported not receiving adequate quantities of inputs from the extension office while organizing demonstration plots. The monetary value of these inputs that the extension office was supposed to supply but did not, constituted the final part of cost of corruption in the agricultural sector.

Econometric considerations: problem of endogeneity

Due to a simultaneous causality between expenditure and a household's calorie intake, we suspect a potential endogeneity problem in the structural equation model (Eq.1). It is the expenditure that determines the caloric intake, but the reverse is also possible. As food expenditure was included in the expenditure variable, the level of calorie intake will have a direct influence on a households' expenditure. Another reason for endogeneity is that a starving person cannot work as productively as a healthy one. Thus calorie intake can affect

[4] Nutritional (calorie) based Equivalence Scales have been sourced from Dercon and Krishnan (1998).

[5] To deal with seasonality and to obtain a high response rate during interview, expenditure was used instead of income (Thomas 1993; Subramanian and Deaton 1996; Garrett and Ruel 1999; Aguiar and Hurst 2003).

[6] This variable was included to describe the relationship between calorie intake and price. Rice, potato and lentil were considered as these three accounted for more than 81 percent of our sample households' calorie intake. It is the ratio of a household's total expenditure for calories to the total calories obtained from the three selected food items. Expenditure for a food item was estimated by multiplying calorie price by total calories obtained from that particular food item.

[7] The variables here were included in order to ascertain whether expenditure and calorie price have a stronger effect on calorie regression for households with higher costs of corruption, and *vice versa*.

[8] Household members, who were below seven years of age, were considered as children.

[9] For households, where the mother was absent, the education of women (in most cases, the grandmother or elder sister) who carried out the responsibility of the mother was used.

[10] Based on a household's per-capita annual expenditure, households were classified as poor or non-poor. The area specific poverty lines available in HIES (2010) were used (BBS 2010). The poverty lines were estimated using the Cost of Basic Needs (CBN) method.

Table 1 Summary statistics and description of the variables used in econometric models

Variables	Description	Mean (S.D.)
Dependent variable		
Calorie intake (kcal/day/AE)	Household's per AE daily calorie consumption	2693.1 (682.9)
Explanatory variables		
Annual expenditure (BDT/AE)[a]	Household's per AE annual expenditure	29614.1 (23127.2)
Annual cost of corruption (BDT/AE)	Household's per AE annual cost of corruption	757.5 (878.0)
Interaction term of expenditures and cost of corruption	Cross term of expenditure and cost of corruption	2,245,711 (4,078,359)
Weighted calorie price of basic food items (BDT)	Per unit calorie price of rice, potato and lentil	0.010 (0.003)
Interaction term of calorie price and cost of corruption	Cross term of weighted calorie price of basic food items (BDT) and annual cost of corruption (BDT)	7.83 (10.45)
Ratio of children	Ratio of children to total members	0.07 (0.11)
Mother's education (years)	Years of formal schooling	3.80 (4.00)
Household's male head or father's education (years)	Years of formal schooling	4.89 (4.68)
Land holding (ha/AE)	Household's total land ownership	0.17 (0.18)
Dummy for household's economic status (1=non-poor)	1 for households above poverty level; and 0 for households living below poverty line.	0.60 (0.49)

[a] 1 US$ is approximately 79.55 BDT and 1 Euro is approximately 105.87 BDT (Bangladesh Bank 2012)

income and ultimately expenditure of a given household.[11] Endogeneity of the expenditure variable in calorie regression analysis is also found in the works of Behrman and Deolalikar (1987), Garrett and Ruel (1999), Levin et al. (1999), Rashid et al. (2006) and Razzaque and Toufique (2007).

The two-stage least squares (2SLS) estimation technique was followed in order to adequately address the endogeneity problem (Hahn et al. 2004; Murray 2006; Bascle 2008). In the reduced form of the equation, the expenditure variable was regressed on the instrument(s) and other exogenous regressor(s). Then in the second stage, instead of the observed value of the expenditure variable, the resulting fitted value from the first stage regression was used.

If suspected endogeneity existed, the error term ε_i would be correlated with the expenditure variable and hence would produce inconsistent coefficients. To address this problem, we had to introduce some new variables in the form of instruments in the structural equation. The instruments should satisfy two major properties: instruments should not be correlated to ε_i but correlated with the endogenous variable (Wooldridge 2002; Baum et al. 2003; Bascle 2008). Hence, instruments are variables which are directly related to the endogenous variable (expenditure) and may not have a direct influence on the dependent variable (calorie intake). Expenditure is likely to be influenced by income sources and expenditure patterns. We introduced a household's own land holding (ha/AE) and off-farm income (BDT/AE)[12] to represent a farm household's income from farming and other off-farming activities, respectively. Additionally we introduce the dummy for peri-urban location (1=peri-urban) as we assumed, depending on location, a household's income sources and hence expenditure, may vary.

In the Instrumental Variable method, the structural equation takes on the following form:

$$c_i = \alpha_0 + \alpha_1 \widehat{x}_{1i} + \alpha_2 x_{2i} + \ldots + \alpha_k x_{ki} + \varepsilon_i \qquad (2)$$

where $\widehat{x}_{1i}$ is the predicted value of the endogenous variable from the first stage regression; x_i's are the vectors of exogenous explanatory variables; and ε_i is the error term. While the predicted value of $\widehat{x}_{1i}$ is generated by the following regression, which is the first stage of the 2SLS:

$$\widehat{x}_{1i} = \beta_0 + \beta_1 x_{2i} + \ldots + \beta_k x_{ki} + \gamma_1 z_{1i} + \gamma_2 z_{2i} + \gamma_3 z_{3i} + u_i \qquad (3)$$

here z_{1i} is the land holding (ha/AE) for the ith household; z_{2i} is the ith household's income (BDT/AE) from non-farming activities; z_{3i} is the dummy for ith household's location; x_i's are the vectors of exogenous explanatory variables; and u_i is the error term.

[11] One can also be suspicious of the interaction term being endogenous. We have conducted Durbin-Wu-Hausman χ^2 test for the cross term, accepting endogeneity for the expenditure variable. The test statistics for both models were insignificant, suggesting that the cross term is exogenous.

[12] The variable, off-farm income, can also be endogenous due to its simultaneous causality with the expenditure variable. To be sure of this, the Durbin-Wu-Hausman χ^2 test was conducted. Five variables were selected as instruments here. These were: dummy of location, age of the household head, dummy of membership in NGOs, number of active adult members in the family and distance from the nearest market. The test statistics here weere non-significant, suggesting that off-farm income does not exhibit an endogeneity problem.

Testing the relevance and validity of instruments

The test statistics generated for checking the relevance and endogeneity of instruments and the regressors are presented in Table 2.[13] As the estimated Cragg-Donald F statistics for both the models are above the value of 10, this implies that the chosen instruments are relevant and sufficiently strong. In both the models, Sargan and Hansen test statistics are insignificant meaning that the orthogonality conditions are satisfied and that our instruments are valid. Furthermore as the Durbin-Wu-Hausman test statistics for both the models are significant, we reject the null hypothesis and conclude that the instrumented variable is endogenous.

Table 2 Instrumental variable testing

Tests	Model 1 (Dependent variable: calories/day/AE)	Model 2 (Dependent variable: log of calories/day/AE)
Cragg-Donald Wald F statistic	10.08	10.08
Sargan statistic (p-value)	0.454	0.335
Hansen *J* statistic (p-value)	0.368	0.220
Durbin-Wu-Hausman χ^2 test (p-value)	0.007	0.040

Results and discussion

Summary statistics

Table 1 shows summary statistics of the variables used in the calorie regressions. Average calorie intake for the sample households was 2,693 kcal/day/AE, whereas the national average for 2005 is 2,238 kcal/day/person (Government of Bangladesh 2011). Our data relates to 2008–09 and hence it is not surprising that we have observed a higher average than the national estimates for 2005. Annual average expenditure of the households is 29614 BDT/AE. Around two out of every five households (40 percent) lives below the poverty level. The most recent Household Income and Expenditure Survey estimated that 31.5 percent (35.2 percent in rural area and 21.3 percent in urban area) of Bangladeshi households live above the poverty line (BBS 2010). The average ratio of children was 0.07 meaning that among every 100 household members there were 7 members who were below 7 years of age. As compared to mothers, household heads possess better educational attainments. However, the average years of schooling for both males and females were lower than primary level. Average land holdings of households were less than a hectare: small farm sizes are a common feature in Bangladesh. Annual cost of corruption for the sample households was 757.5 BDT/AE, demonstrating that, on average, corruption costs each household 2.56 percent of their total expenditure.

Determinants of food security: results from an econometric analysis

Using linear (Tschirley and Weber 1994; Garrett and Ruel 1999; Rashid et al. 2006; Babatunde and Qaim 2009; Babatunde et al. 2010) and logarithmic (Levin et al. 1999; Hoddinott and Yohannes 2002; Abdulai and Aubert 2004; Akramov et al. 2010) forms of the dependent variable (caloric intake), two different models were estimated with the same set of explanatory variables. These models were estimated through the 2SLS procedure,[14] and the results are presented in Table 3.

Both the models produced similar results in terms of direction of influence and the level of significance associated with the explanatory variables. In the models, corruption negatively affected calorie intake, whereas, the cross term of corruption and expenditure, dummy of household's economic status, mother's education, and land quantity positively influenced calorie intake. A significant negative impact of the cost of corruption variable on calorie intake implies that with an increasing cost of corruption, households consume fewer calories. In other words, households have to reduce their food consumption so as to accommodate the increased cost of corruption.

The average estimated marginal effect of the cost of corruption on calorie intake in Model 1 is −0.118, suggesting that a decrease in the annual cost of corruption by 1,000 BDT/AE would result in an average consumption improvement to the extent of 118 kcal/day/AE. However, going by Model 2, a similar degree of decrease in the cost of corruption would have much less impact on calorie intake. Here a 1,000 BDT/AE increase in the annual cost of corruption amounts to a reduction in a household's daily calorie intake of 48 kcal/AE.

The marginal effect of cost of corruption on calorie intake was estimated for each household under Model 1, and is presented in Figs. 1 to 3. Figure 1 shows 46 households with positive marginal effects, whereas the other two figures represent the remaining households with negative marginal effects. We have separated the households with positive marginal effects in Fig. 1 in order to know if low expenditure or high expenditure households experience higher negative marginal effects of the cost of corruption. The households with negative marginal effect were divided into two equal

[13] The output of the 1st stage regression is presented in Appendix Table 4.

[14] Baum et al. (2007) wrote the *ivreg2* command for STATA, and it is used here.

Table 3 Regression results on household-level determinants of calorie intake (2SLS)

	Model 1		Model 2	
	Dependent variable: calorie intake (kcal/day/AE)		Dependent variable: log of calorie intake (kcal/day/AE)	
Regressors	Coeff.	Marginal effect	Coeff.	Marginal effect[c]
Expenditure (BDT/AE)[a]	−0.295 (0.186)	−0.141	−0.000080 (0.000061)	−0.0998
Cost of corruption (BDT/AE)	−0.747**(0.345)	−0.118	−0.000196**(0.000110)	−0.0479
Interaction term of expenditure and cost of corruption[b]	0.0002** (0.0001)		0.00000006** (0.00000003)	
Weighted calorie price of basic food items (BDT)	−9224.19 (30633.38)	−10361.79	−4.49 (10.14)	−5236.05
Interaction term of calorie price and cost of corruption	13.05 (22.16)		0.003 (0.007)	
Ratio of children	256.21 (452.24)		0.090 (0.153)	
Education of the mother (years)	47.44* (25.68)		0.015** (0.008)	
Education of the household head (years)	−28.28 (17.78)		−0.009 (0.006)	
Land holding (ha/AE)	794.84* (459.29)		0.272** (0.148)	
Dummy for household's economic status (1 = non-poor)	474.34** (219.88)		0.136** (0.072)	
Constant	3042.51*** (263.16)		7.96*** (0.09)	
R-squared (1st stage)	0.793		0.793	
Prob > F	0.0134		0.014	

Figures in parentheses are robust standard errors. AE = Adult equivalent; *, **, and *** indicate significance levels at 10 %, 5 %, and 1 %, respectively; [a] Endogenous regressor, instrumented by: land holding (ha/AE), dummy for peri-urban location (1 = peri-urban areas), and off-farm income (BDT/AE). [b] Joint significance tests of the cross term with expenditures and cost of corruption in both models have been conducted. The tests results argue that in both the models the variables are significantly different from zero. [c] As the impact on log is not descriptive, the marginal impacts were calculated on the absolute term and reported here

groups based on their expenditure. The average monthly expenditure for the low expenditure group was 1,178 BDT/AE, whereas it was 2,213 BDT/AE for the upper expenditure group. The monthly expenditure threshold separating the lower group from the upper group here is 1,712 BDT/AE. Figure 2 presents households belonging to the low expenditure group, whereas Fig. 3 shows households with a relatively high expenditure.[15]

Compared to Fig. 2 (low expenditure group), Fig. 3 (high expenditure group) shows a high share of households with relatively low negative marginal effects. The calculated average marginal effect for the low income households was −0.413, whereas it was −0.181 for the high expenditure group. An increase in the annual cost of corruption by 1,000 BDT would reduce the low expenditure households' daily calorie intake by 413 kcal/AE. A similar increase in the cost of corruption would negatively affect high expenditure households daily calorie intake by the lower figure of 181 kcal/AE..

The positive sign associated with the dummy variable representing household's economic status means that households living above the poverty level consume more calories than their counterparts who live below the poverty level. Our result is consistent with the literature (Behrman and Deolalikar 1987; Bouis and Haddad 1992; Subramanian and Deaton 1996; Dawson and Tiffin 1998; Garrett and Ruel 1999; Aguiar and Hurst 2003; Abdulai and Aubert, 2004) – households with better economic status have higher consumption levels or improved food security status.

The educational attainment of women has a significant positive impact on a household's calorie intake as reflected in the existing literature (Smith and Haddad 2000; Smith et al. 2003; Rashid et al. 2006). Women's education can positively contribute to a household's food security in several ways: educated mothers have a better idea of the nutritional requirements of their family members in addition to their being generally capable of managing household resources; along with their traditional duties such as food preparation and taking care of children, women are now becoming more involved in income generating activities. Such opportunities are more likely to be explored by educated mothers.

The estimated coefficient of the variable land holding in the linear model (Model 1) shows that with each additional hectare of land, a household's daily calorie consumption increases by 795 kcal/AE. On the other hand, according to estimates based on Model 2, a one hectare increase in land ownership will result in a 27.2 percent increase in a

[15] Marginal effect is also calculated for Model 2, but as the results from both models were similar, only those from Model 1 are presented here due to space constraints.

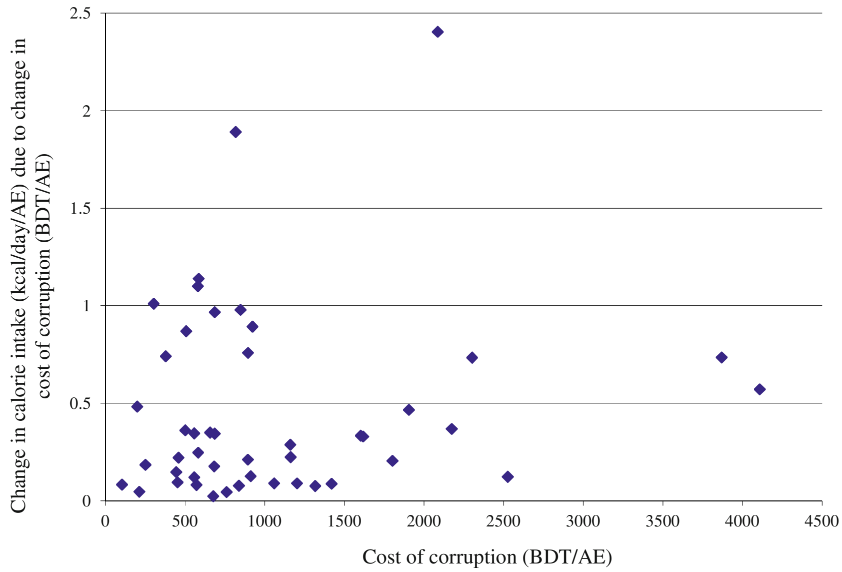

Fig. 1 Marginal effect of the cost of corruption on calorie intake against cost of corruption for households with a positive marginal effect, derived from Model 1

household's calorie intake. A significant positive impact of land holding or farm size on a household's food security is well documented in studies of Bangladesh (Mallick and Rafi 2010; Kazal et al. 2010) as well as studies around the world (Tschirley and Weber 1994; Aromolaran 2010; Babatunde and Qaim 2009; Babatunde et al. 2010). Households with large land holdings are likely to register substantial agricultural production and hence greater food supply. However, such possibilities are less likely to hold true in urban settings but more so in an agricultural and higher levels of rural settings. Possession of additional land by itself does not contribute to food security if the land is of poor quality and also if people look for employment opportunities or hold jobs outside agriculture. In such situations a farmer may find it wiser to work outside agriculture rather than holding on to farming activities on less fertile land.

Contrary to the existing literature (Behrman and Deolalikar 1987; Bouis and Haddad 1992; Subramanian and Deaton 1996; Dawson and Tiffin 1998; Abdulai and Aubert, 2004; Rashid et al. 2006) and our expectations, the average estimated marginal effects of the expenditure variable in both the models were negative (Table 3), but the effect being insignificant, we may not worry much about the relationship. However, one should bear in mind that results concerning expenditure are not necessarily the best representation of the real world scenario and hence should be interpreted cautiously.

Conclusion

This study has analyzed corruption related experiences of 210 Bangladeshi rice farmers in order to explore the relationship between corruption and a household's food security. The empirical results show that the cost of corruption negatively affects a household's food security forcing them to sacrifice money which could otherwise be used for food.

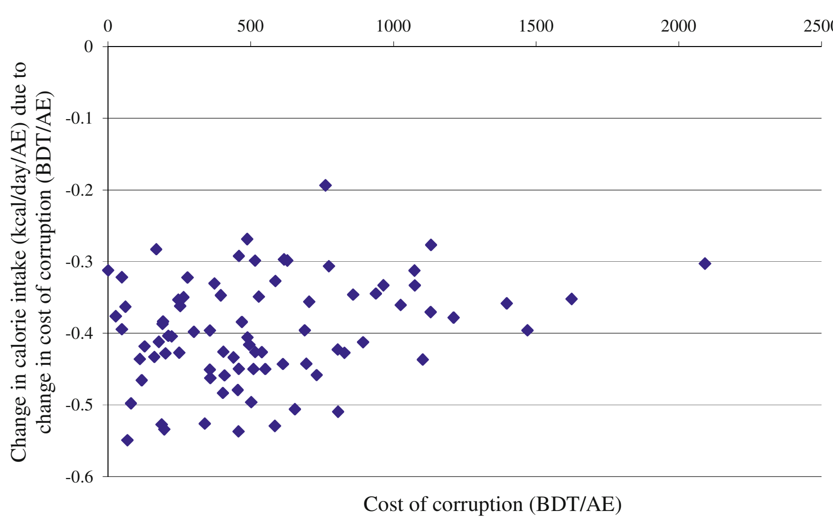

Fig. 2 Marginal effect of the cost of corruption on calorie intake against the cost of corruption for the households with a negative marginal effect in Model 1 (lower expenditure group)

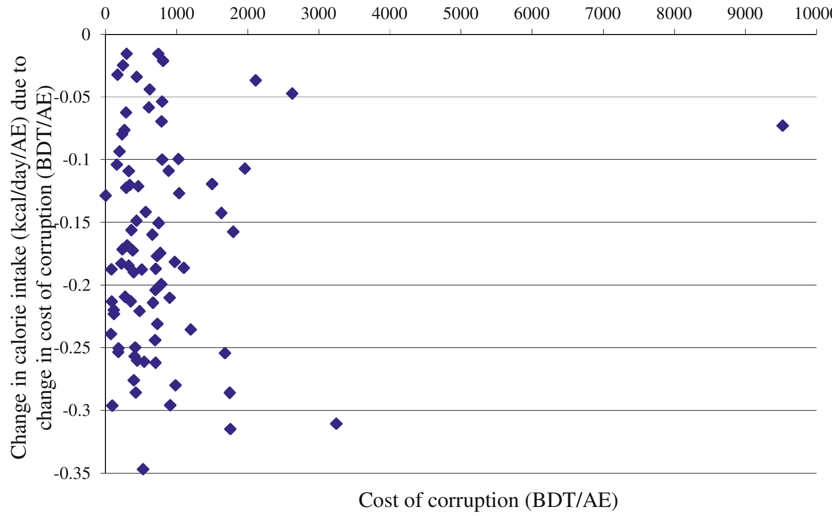

Fig. 3 Marginal effect of the cost of corruption on calorie intake against the cost of corruption for the households with a negative marginal effect in Model 1 (high expenditure group)

Reducing calorie consumption is one strategy to pay the cost of corruption. The positive significant impact of the dummy introduced to represent a household's economic status shows that households below the poverty level consume fewer calories compared to their counterparts who are not poor. The effect of corruption on households' food security largely depends on their economic status. Statistically 'significant' impact of the dummy for a household's economic status and the cross term of expenditure and cost of corruption are also supportive of this finding. As a household's consumption level is determined by its economic status, any increase in cost of corruption will have a much higher impact on calorie consumption of the poor. The positive impact of the interaction term of calorie price and cost of corruption, though not insignificant, is noteworthy. Anik and Alam (2011) found that the amount of bribe paid by Bangladeshi farm households mainly depended on their economic status with the rich being able to pay more than the poor.

Empirical findings also point towards the better education of women as a factor in the improvement of a households' food security. Educated mothers have a higher probability of earning a greater income. They are also likely to be better managers of household resources and more capable of taking care of household members. Along with formal education, awareness building programs regarding food and nutrition requirements, especially targeting women, should be launched by both the government and NGOs. A farmer's own land has a significant role to play in a household's food security. One's own land serves as a stable and reliable source of food and thus increased calorie intake.

In order to improve households' food security, due attention needs to be given to improve households' economic status, controlling the leakage of households' income by reducing corruption, and improving the level of education. Controlling corruption is imperative as this will enable households to enjoy a better level of food security owing to being able to spend more on food.

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Appendix

Table 4 First stage regression results of the 2SLS (Dependent variable: Expenditure (BDT/AE))

Regressors	Coefficient (standard error)
Cost of corruption (BDT/AE)	−1.48*** (0.30)
Interaction term of expenditure and cost of corruption	0.00046*** (0.00003)
Weighted calorie price of basic food items (BDT)	45702.54 (30279.17)
Interaction term of calorie price and cost of corruption	11.35 (24.00)
Ratio of children	−443.85 (610.79)
Education of the mother (years)	27.21 (25.28)
Education of the household head (years)	−17.46 (21.76)
Land holding (ha/AE)	2009.81*** (374.25)
Off-farm income (BDT/AE)	0.0094** (0.0045)
Dummy for peri-urban location (1=peri-urban)	508.47*** (138.52)
Dummy for household's economic status (1=non-poor)	783.98*** (184.14)
Constant	964.53*** (306.26)
R-squared	0.793
Prob > F	0.000

First stage regression is same for both the models. AE = Adult equivalent; *, **, and *** indicate significance levels at 10 %, 5 %, and 1 %, respectively;

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Asif Reza Anik is a member of the academic staff of the Department of Agricultural Economics at Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Bangladesh. Prior to this he was a member of Patuakhali Science and Technology University (PSTU), Bangladesh. He holds a doctoral degree from Justus-Liebig-Universität, Giessen, Germany and a Master's degree from the Bangladesh Agricultural University, Bangladesh. In his PhD research he focused on the impact of corruption on farm households in Bangladesh. His research interests include production economics, agricultural governance, rural development and livelihoods of farm households.

A.V. Manjunatha obtained his MSc in Agricultural Economics from the University of Agricultural Sciences, Bangalore, India and an International MSc in Rural Development from the University of Gent, Belgium. He holds a doctoral degree in Agricultural Economics from Justus Liebig University, Giessen, Germany. From his research, he has been able to publish scholarly papers in reputable journals and present his findings at conferences. His research interests encompass efficiency, equity and sustainability of natural resources, agricultural water management and water markets, energy and climate change, agricultural markets and rural development. Currently he is serving on the faculty of the Agricultural Development and Rural Transformation centre of the Institute for Social and Economic Change, Bangalore, India, as assistant professor.

Siegfried Bauer obtained his Ph.D. in 1977 and habilitation in the subject of agricultural policy and agrarian economics in the year 1984. From 1985 to 1987 he held a professorship for agricultural policy at the University of Kiel and at the University of Bonn. Since 1991 he has been professor of project and regional planning at the faculty of Agriculture and Environmental Management at Justus Liebig University Giessen, Germany. He has contributed to various studies and projects in developing countries.