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**Determinants of the Food Consumption Vulnerability of
the Extreme Poor- Empirical Evidence from Southern
Bangladesh**

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European Master in Agriculture,
Food and Environmental Policy Analysis
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Determinants of the Food Consumption Vulnerability of the Extreme Poor- Empirical Evidence from Southern Bangladesh

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by
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Abstract

This study determines the food consumption vulnerability of the extreme poor households in southern Bangladesh which is a natural disaster prone area where almost every year cyclone causes huge death toll and asset losses resulting permanent income loss and deprivations. Besides, this study also investigates the impact of microfinance participation and impact of cyclones on food consumption vulnerability.

In finding the determinants of vulnerability, ordered probit model is used. Moreover Heckman two-step model is applied to test the sample selection bias in the model. The impact of microfinance participation and also the impact of disaster like cyclones are analysed by using propensity score matching technique. This study finds that age of household head, years of schooling of household head and household size are the statistically significant determinants along with other variables. Age and household size both are positively related to the degree of vulnerability. It is found that wage earning households are more vulnerable than the self-employed households. On the contrary, migration can reduce 2° vulnerability by 3.4% and 1° vulnerability by 4.2%.

Safe-drinking water, access to sanitary latrine exhibit negative and distance from main road exhibits positive relationship with the degree of vulnerability. In terms of physical and financial assets, households having more owned land and availability of free land can reduce vulnerability. Having cows, poultry and savings exhibit reduction of 2° vulnerability by 0.8% point. Besides, household income, food expenditure is negatively and non-food expenditure is positively related to the degree of vulnerability. Informal loans and yearly deferred payment are found to increase the degrees of vulnerability.

Microfinance participation is found to be the significant determinant in reducing vulnerability. It can reduce both 2° and 1° vulnerability by 2.3% point. In PSM analysis, it shows much stronger impact. It shows that microfinance participation can reduce vulnerability in general by 8% point. Conversely, the impact of natural disasters on vulnerability exhibits that household being affected by cyclone causes increase in vulnerability by 8% to 14% point.

Table of Contents

List of Figures	x
List of Tables	xi
Acknowledgements.....	xii
Dedication.....	xiii
1. Chapter: Introduction.....	1
1.1 Background of the study	1
1.2 Research objectives	4
1.3 Research hypotheses	6
1.4 Methods and data	11
1.4.1 Sample.....	11
1.4.2 Methods of Data Collection and Processing:.....	15
1.5 Expected Results	15
2 Chapter: Theory and methodology	17
2.1 Literature review on theory	17
2.1.1 Consumption Smoothening Approach.....	17
2.1.2 Permanent Income Hypothesis:	17
2.1.3 Risk rationing theory.....	19
2.2 Literature review on methodology	20
2.3 Method selection	21
2.3.1 Ordered Probit Model	22
2.3.2 Heckman Probit Model	23
2.3.3 Propensity Score Matching (PSM)	26
2.3.4 Mean Difference Method.....	29
3 Chapter: Previous similar studies	30
3.1 Literature review on similar studies	30
3.2 Contribution of this study.....	33
4 Chapter: Descriptive Analysis	34
4.1 Context of the study	34
4.1.1 Identification.....	34
4.2 Data description and analysis	36
4.2.1 Overall household characteristics:	36
4.2.2 Household characteristics by participation status	38

4.2.3	Classification of land by districts:.....	40
4.2.4	Occupation	42
4.2.5	Social Safety Net Program:.....	45
4.2.6	Households' access to credit.....	46
4.2.7	Households' food consumption vulnerability	46
4.2.8	Crisis and coping.....	52
5	Chapter: Econometric Results and discussion.....	53
5.1	Regression Model.....	53
5.2	Discussion of Regression Results	53
5.2.1	Heckman Probit model- Test for selection bias	53
5.2.2	Ordered probit model.....	54
5.2.3	Propensity Score Matching (PSM)	60
6	Chapter: Conclusions and recommendations	63
6.1	Synthesis of the results	63
6.2	Policy Recommendations	65
6.3	Limitations and future research.....	67
	Bibliography	68
	Appendices.....	72
	Abbreviation	87

List of Figures

Figure 1: Tracks of Cyclones in Bangladesh	2
Figure 2: Three districts of study area in Southern Bangladesh.	12
Figure 3: A Schematic Diagram of the Sample Households.	14
Figure 4: Duration of microfinance membership in years (as of 2011).....	35
Figure 5: Distribution of households over landholding and participation status.	41
Figure 6: Seasonal Dynamics of Households' Monthly income from wage labor.	43
Figure 7: Starting and ending month of households' food deficiency.....	44
Figure 8: Percentage of household received Social Safety Net program.....	45
Figure 9: Percentage of household having consumption ordering in two periods by participation status. (N=3,924)	49
Figure 10: Percentage of household encountering the different level of vulnerability (N=3,912).	49
Figure 11: Degree of vulnerability by microfinance participation status	50
Figure A.1: Households' total unmet loss in both Sidr and Aila. (mean, in Taka).....	79

List of Tables

Table 1: Dynamics of consumption ordering of the extreme poor households.....	4
Table 2: Household Covered in the Original Census.	12
Table 3: Number of households in sample of baseline survey	14
Table 4: Microfinance membership within the study area	35
Table 5: Transition matrix of households food consumption vulnerability	47
Table 6: Percentage of households are affected by the last two major cyclones -Sidr (2007) and Aila (2009)	52
Table 7: Estimation of Average Treatment Effect for the Treated (ATT):	61
Table 8: Checking Robustness of Average Treatment Effect for the Treated (ATT):	61
Table 9: Estimation of Average Treatment Effect for the Treated (ATT):	62
Table A1.1: Summery statistics for selected variables from benchmark household survey.	72
Table A1.2: Summery statistics for selected variables from benchmark household survey. (Continued....).....	73
Table A1.3: Selected household and village characteristics by participation status.	74
Table A1.4: Comparison of economic condition by microfinance participation status.	74
Table A1.5: Types of land by districts	75
Table A1.6: Distribution of households over landholdings by districts and microfinance participation status.	76
Table A1.7: Distribution of households by char areas and by district	76
Table A1.8: Distribution of households' positions by districts and microfinance participation status.	77
Table A1.9: Distribution of households' occupation by districts.	77
Table A1.10: Percentage of households taken loans by districts.	77
Table A1.11: Comparison of consumption ordering in normal and lean time by microfinance participation status.	78
Table A1.12: Degree of vulnerability by households' characteristics and participation status.....	78
Table A1.13: Degree of vulnerability by households' characteristics and participation status (continue...).....	78
Table A1.14: Degree of vulnerability by households' characteristics and participation status (continued...).....	79
Table A1.15: Percentage of households incurred losses in two big cyclones	80
Table A1.16: Percentage of households got remedial measure from various sources in two big cyclones Sidr (2007) and Aila (2009), (%)	80
Table A1.17: Heckman two-steps estimation for selection bias conditional upon MFI membership..	81
Table A1.18: Estimation of ordered probit model and the marginal effect of the explanatory variables.	83
Table A1.19: The treatment is microfinance membership	85
Table A1.20: Estimation of the propensity score using probit model.....	85
Table A1.21: Estimated propensity score in region of common support.....	86
Table A1.22: The inferior bound, the number of treated, and the number of controls for each block .	86

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Dedication

I lovingly dedicate this thesis to my wife Trisa Khan and to my parents for their invaluable and continuous support in my life.

1. Chapter: Introduction

1.1 Background of the study

The southern region of Bangladesh suffers from natural disaster and salinity in the cropping land in every year. Besides, seasonal food deprivation occurs almost every year because of lack of income and employment. This is the lean period¹ for labor demand which implies in a sense the seasonal unemployment that affects household welfare. Sen (1981) identified this as a period when the ability of a large segment of the population is limited in acquiring food, employment and other basic necessities.

The southern part especially some districts of Barisal and Khulna divisions are vulnerable to the adverse effect of climate change and salinity in the coastal areas². Every year natural disasters like major cyclone and flood destroy the crops and homesteads of population of this area. The landless and poor households are more vulnerable to this kind of shocks. The poverty situation is worse in this region in comparison with other divisions of the country. According to the Household Income and Expenditure Survey (HIES)³ 2010, the national poverty rate is 31.5% using upper poverty line income whereas the Barisal and Khulna divisions' poverty lines are 39.4% and 32.1% respectively. Even the degree of poverty doesn't differ between rural and urban areas.

From 1877 to 1995, a total of 154 cyclones hit Bangladesh where 43 were severe cyclonic storms, 43 were cyclonic storms and 68 were tropical depression⁴. Since 1995, a total of 5 severe cyclones have hit the country's coast. According to Government of Bangladesh (GoB, 2009) report, a severe cyclone strikes the country every three years on average. The topography of Bangladesh is extremely low and flat having two-thirds of its land area less than 5m above sea level which results lives and property highly vulnerable to inundation from cyclone-induced storm surges in this lower-lying coastal districts along the Bay of Bengal. To name few major devastating cyclone in Bangladesh, Cyclone Sidr (November

¹ Lean period is households' self-nominated months when households suffer from occupational income loss.

² The United Nations Development Programme (UNDP) has ranked Bangladesh as the world's most vulnerable country to tropical cyclones (UNDP, 2004).

³ Household income and Expenditure Survey (HIES), Bangladesh Bureau of Statistics 2011

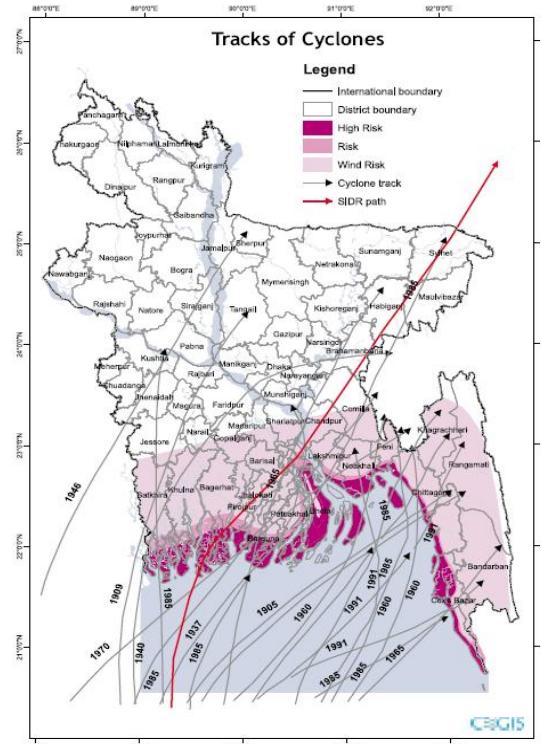
⁴ Based on the observed maximum sustained surface wind measured at a height of 10 m averaged over 3 minutes, tropical storms are classified as super cyclonic (wind speed over 220 km per hour), very severe cyclonic (119–220 km per hour), severe cyclonic (90–119 km per hour), cyclonic (60–90 km per hour), deep depression (51–59 km per hour), and depression (32–50 km per hour) (source: IMD 2013 www.imd.gov.in).

2007) and Cyclone Aila (May 2009) are to be mentioned. Cyclone Sidr (2007) with an average wind speed of 223 km per hour caused 4,234 casualties and 55,282 injuries resulting US\$1.67 billion damage of property and Cyclone Aila (2009) caused 190 deaths, 7,103 injuries and affected 3.9 million people resulting US\$ 270 million damage of assets (EMDAT, 2013). Nevertheless the inhabitants of this region are brave enough to resume their life with the existing endowment left after vandalize of nature.

Among the various coping strategies that households takes into consideration to mitigate the adverse effects of natural calamities and seasonal deprivation, the distress sale of assets (such as land), advance sale of labor and crop are pretty common. Furthermore, their resort to migration and access to social safety net programs are also very evident. Nevertheless these steps do not put them out of poverty. As a consequence, they have to starve for an extended period, which drives them to serious malnutrition and even death in extreme environments. The intensity of starving varies by households and local socio-economic characteristics; it also depends on the incidence of environmental effects like cyclone, flood and regional characteristics like distance and location. Households' vulnerability to food consumption is a failure of government policies which can't ensure food security even when the national income grows more than 6.5% rate annually.

The seasonality of the wage earning occupation is evident in the southern part of Bangladesh. Unlike the Northern Bangladesh, the seasonality varies here by occupation. Nevertheless the trend of seasonal income shock has a pattern to be mentioned. The average monthly wage income continues to fall from April to September and again continues to rise to the benchmark income of Tk. 3,000 from September to November⁶. The average income only

Figure 1: Tracks of Cyclones in Bangladesh



Source: CEGIS⁵

⁵ Centre for Environmental and Geographic Information Services.

⁶ InM report (2011) "PRIME Intervention in the Coastal Areas of South-West Bangladesh".

increases above the benchmark income from November to February. Only for 3-4 months the households have average good income in wage earning in this region (InM, 2011).

Government of Bangladesh along with other international development agencies extended their rescue and support to the affected people of this region after the cyclone Sidr and Aila. According to the MOFDM⁷ of GoB a total of US\$1.149 billion assistance were provided in the following areas of assistance- funding support for displaced people (US\$12m), Cluster houses for landless people (US\$435m), Reconstruction of houses (US\$381m), Reconstruction of Embankment (US\$62m), Restoration of livelihood (US\$56m), Reconstruction of cyclone centre (US\$200m), Restoration of water supply system (US\$3m). Besides government other Non-government Organizations (NGOs) and civil society and general people also extended their contribution to restore the life of this vulnerable people.

As microfinance set out its journey to alleviate poverty, now days it is a question whether microfinance is a mission drift or not. The challenge of the microfinance is to reach the hardcore poor of the hard-to-reach areas in one hand and on the other hand it has to be operationally self-sustained and attain financial viability. This dual objective sometimes raises questions whether the benefit of the microfinance really reaching to the poor or not. It is well established that microfinance is not a panacea to eradicate poverty. It helps to reduce the extent of poverty and vulnerability⁸. As the rural poor people are deprived of having formal credit from the formal banking institutions without collateral, microfinance extends its hand to avail this easy credit to the poor and make them active to their works and business.

It is well known in the impact evaluation of the microfinance program that the households of the geographically hard to reach areas are more vulnerable to their food consumption and less likely to have formal and semi-formal credit like microcredit. The immense severity of the informal credit interest rate which is generally 120 % per annum drives this poor people to the vicious cycle of poverty. This high interest rate informal credit is lucrative to the extreme poor in the crisis time but it becomes a bullet when they cannot pay it back. Again the geographical location also matters to determine the severity of their food consumption vulnerability. There is not much work done still to find the geographical and location impact

⁷ Ministry of Food and Disaster Management (MOFDM) of Government of Bangladesh (GoB)

⁸ Vulnerability is an economic phenomenon which may have invigorated by natural disasters but it can be eliminated by proper economic steps and interventions. Vulnerability induces risk and risk put human life into danger.

of the households on their consumption behaviour along with the other households and community characteristics.

1.2 Research objectives

The research aims at the vulnerability of the households of southern Bangladesh especially in the surveyed three districts of Barisal and Khulna division namely Khulna district, Patuakhali district and Satkhira district. All these districts were tremendously affected by both Cyclones Sidr and Aila and other tropical storms as well. The salinity in the cropping land due to upsurge of sea water is the major problem of this region. Safe drinking water is scarce resource in southern Bangladesh. Vulnerability is an ex-ante concept. Unlike conventional measure of poverty it measures the probability of falling in worse off situation in consumption ordering in future than today. The households of the targeted area reported that they have a significant variation in food consumption in the two different period of year. They termed it good time or normal time and worse time or lean period. Households⁹ reported that they can have 3 times full meal in a day in normal time with satisfaction but they are unable to take 3 times full meals in lean period due to lack of income and employments. In the lean period they have to reduce their consumption to 2 times meal daily or just only one time meal daily or even starving the whole day. Here in this study the aim is to analyse the dynamics of the changes in the consumption ordering of the household in two different periods. So the vulnerability will be the difference between the two periods which will be analysed. The transition matrix for the vulnerability can be expressed simply in the **Table 1** (below).

Table 1: Dynamics of consumption ordering of the extreme poor households

Transition matrix of vulnerability		Consumption ordering in Lean period		
		Occasional Starvation	Consumption rationing	Full 3 meals in a day
Consumption ordering in Normal period	Occasional Starvation	2°	-1°	-2°
	Consumption rationing	2°	1°	-1°
	Full 3 meals in a day	2°	1°	0°

Source: Author's calculation; Note: 2° means two degree of vulnerability.

⁹ The definition of household means the number of person usually takes food from the same oven or from a same preparation of food. The rationale for the narrow definition of household is that it is the unique unit of counting the member of household in Bangladesh. So in a family, there may be one or two households if they dine separately. So dining together is the unit of measuring the household.

This situation according to Sen (1981) can be referred to lack of entitlement of having access to food consumption. Households reported that they are vulnerable in lean period most importantly in food intake due to lack of employment and other idiosyncratic and covariate shocks. The poverty dynamics of the two periods can be assessed by various factors of the households, community and geographical incidences. Unlike the Cost of Basic Needs (CBN) method or Calorie intake method, it shows the perception of food intake and also expectation of future consumption rationing which can be a good indicator of measuring.

Seasonal unemployment is the primary reason for the instabilities in income and livelihood experiencing in the rural economy. In Bangladesh, 75% households in southern Bangladesh which is the most vulnerable area to seasonal shock, are mostly dependent on agriculture for their livelihood, more over; almost 27% of total households in the sample area are landless agricultural wage earners and about 75% of the households have less than 10 decimal of owned land which is very small to live and cultivate. Even in the lean period when there is less opportunity of agricultural works, the excess supply of labor drives down the real wage. As a result people become unemployed which results to lower purchasing power and with a seasonal increase in price of coarse rice due to supply shock. Households of these three districts are vulnerable mainly due to lack of employment and loss of fixed assets. Every three to five years big cyclones hit this region and cause huge death toll and destroy the fixed assets. We will analyse how the last two big cyclones Sidr and Aila put them into vulnerable state for food consumptions.

Microfinance¹⁰, first introduced in Bangladesh by Nobel Laureate Professor Muhammad Yunus through Grameen Bank, is a globally recognized tool for alleviating poverty and consumption smoothening. The Microfinance Institutions in Bangladesh also operating in the southern part of Bangladesh to extend their assistance to the vulnerable people. Some of the households in our sample have taken loan and deposited saving in these MFIs. Savings is an important financial instrument for smoothening consumption.

¹⁰ Microfinance operates mainly with small-scale transactions of credit and savings without collateral. The poor women are the target of microfinance institutions in Bangladesh. Microfinance institutions (MFIs) offer financial services (both savings and credit) to the poor at very low interest rates. Besides financial services, MFIs sometimes offers skill-based training to increase productivity and awareness-rising training to empower the poor. In the MFIs a minimum saving is mandatory. The other major types of savings comprise special savings, contractual savings, time deposits and daily savings. Savings is an insurance mechanism to retain and sustain the membership in the MFIs. Savings play a major role in seasonal unemployment period. Therefore, micro finance services both credit and savings will contribute to mitigating adverse effects of seasonal food deprivation in the region.

In our study we will find out the factors affecting the dynamics of consumption ordering which is defined by the number of meals in a day in normal period and in lean period. The difference is evident in our study and we will try to relate other idiosyncratic and covariate shocks along with household characteristics and village characteristics to determine the degree of vulnerability in two periods. We will also try to find out how microfinance reduces the economic hardship of poor households. Our major concern of two big cyclones Sidr and Aila and how this two major disaster contribute to put the households vulnerable is the important question of our analysis. In short the research questions can be addressed as-

1. What are the determinants of the food consumption vulnerability of these extreme poor households in the southern Bangladesh?
2. Does microfinance play any role to reduce vulnerability of the poor households?
3. What is the impact of two major natural disasters (Sidr and Aila) on food consumption vulnerability?

1.3 Research hypotheses

The dependent variable of the research is the change in number food intake per day of the household which is an ordered variable. It says how many times a household takes food in a day in normal period and how many times in lean or crisis period. Generally a household in Bangladesh takes 3 full meals (Breakfast- Lunch-Dinner) satisfactorily. Culturally lunch and dinner put more weight than breakfast. It is generally found that there is a big part of households cannot fulfil three daily meals in crisis period. They have to skip one or two meals or even starve because of their income loss. Here in this study the aim is to analyse the dynamics of the changes in the consumption ordering of the household in two different periods. So the vulnerability will be the difference between the two periods which will be analysed. We have already known that food consumption vulnerability captures effects of different shocks (idiosyncratic and covariate) on the behaviour of households. The dynamics of consumption vulnerability is caused by variations in consumption, assets and income, household characteristics, community characteristics, macro-economic changes, location point of the households, asset damaged by natural disaster like cyclone Sidr and Aila and different covariate shocks. Based on these variables the following hypothesis will be discussed throughout the study-

(1) Household head's age follows an inverted U-shaped in its relationship with food consumption pattern and participation decision¹¹ in the microfinance institutions. Younger household heads' have higher expectation for their future income which will results more borrowing in the present times and less savings as their income is relatively lower than the middle aged group. Based on Permanent Income Hypothesis by Friedman (1957), the younger group will likely to maximize utility over the life circle by borrowing when having transitory low income and by saving when having transitory high income. Middle-aged household heads', having more assets and social network, will likely to have more food and access to credit markets. But smoothen food consumption continues until a certain age and then it follows a declining trend for the rural households. Because according to the permanent income hypothesis, in the older stage the household head will have no income and have to spend from saving. But in the case of natural disaster prone area the household already spend their savings to mitigate the adverse effect of disaster and in the older age they become more vulnerable to consumption for both food and non-food. So we expect as age of household head increases the degree of vulnerability will also increase.

(2) The relationship between years of schooling and degree of vulnerability¹² to food consumption is expected to be inversed relationship. Householder with higher education level will have more access to opportunities by adapting new technology and embark on income generating activities. On the other hand, households with lower education level might lack the skills or entrepreneur abilities to carry out income generating activities.

(3) It is expected that being a female headed household can increase the probability of higher degree of vulnerability. Female, entitled to household core work and informal activities, are first affected by any shocks that hit the rural economy. So the degree of vulnerability will increase if the household head is a female.

(4) If the household size¹³ increases, it is expected that the degree of vulnerability will also increase. It is difficult to feed more family members from one person's income in lean period when the household head has to remain unemployed for several months. So the family members have to ration their food intake for twice a day or just once a day.

¹¹ Participation decision refers to borrowing loans and depositing savings in the MFIs.

¹² Vulnerability is defined as change in frequency of daily meal intake in two periods such as normal period and crisis or lean period.

¹³ Household size is the number of people living in the same house and usually takes food from the same serving or dines together. Friends are not included here.

(5) If the occupation of the household head is wage earning, it is expected that the household will be more vulnerable towards food consumption in lean period. Wage earners lose jobs in lean period and have no income generating activities which results starvation for a while. On the contrary, household with self-employment will be less vulnerable because the trading and informal entrepreneurship will generate income even in lean period compared to the wage earners. It is also assumed that the income from service will have no impact on the food consumption vulnerability as their consumption will be the same in the both periods.

(6) Households' income, food expenditure, non-food expenditure and savings are assumed to have negative relationship with the consumption vulnerability. Income plays an important role in consumption smoothening of the household during the lean period. Food and non-food expenditure can be used as a proxy of the household wellbeing. Households those have savings with a significant amount can use to smoothen consumption during the lean period. So savings and income will show a negative relationship with the degree of vulnerability.

(7) It is expected that households' income from social safety net program from the government and non-government organization will have a negative relationship with regard to the degree of vulnerability. The households those get social safety net transfer payment in terms of old age benefit, food for work, cash for work, 100 days project, education stipends, Vulnerable Group Feeding (VGF), Vulnerable Group Development (VGD) etc. are expected to smoothen their consumption behaviour in lean period as well as normal period.

(8) In terms of physical assets it is assumed that the households those have more owned land¹⁴ will have negative relationship with degree of vulnerability. More total owned land means the possibility of cropping which might smoothen the consumption expenditure throughout the year. It is also mentioned that only total owned land is not enough to determine the vulnerability because the total land comprises also the barren land and unused lands. So we will also see the total using land and non-using lands owned by the households. We will also see the total free¹⁵ land and that can be operated by the households just like their owned land. More operative land will indicate less vulnerability of the households.

¹⁴ Total owned land means all agricultural cropping lands, homestead land, garden, ponds or ditches, lands for salt production, barren land due to salinity and other barren lands are inherited by the households.

¹⁵ Free land is the kind of land that is owned by the government but government don't pressurise them to refrain from cultivation. Households may cultivate the land but they don't have property right over the land. Those kinds of lands are usually the roadside lands or lands beside the rivers or dams.

(9) It is expected that the households those have more cows or goat or poultry will be less vulnerable in lean periods. The rationale behind is that the number of goat and poultry indicates the possibility of selling the milk or even cows in lean period to purchase their living and foods. In extreme cases the households also sell the cows at a lower price and mitigate the crisis. So it is assumed that if the increased number of cows or goats or poultry in the household, then the degree of vulnerability will be decreased.

(10) In terms of coping intensity of natural disaster such as cyclone Sidr and Aila, it is assumed that the households those have more unmet loss¹⁶ are supposed to have higher degree of vulnerability. There are two unmet loss here- unmet loss in for Cyclone Sidr and for Cyclone Aila. The gap between two losses is 2 years. So our assumption is that the households with higher degree of recovery or less unmet loss will show a lower degree of vulnerability.

(11) In terms of loan aspects, the households those who have taken formal¹⁷ loans are supposed to have lower degree of vulnerability than who have taken informal¹⁸ loan. The rationale behind this hypothesis is that formal loan receiving households have to pay lower interest rates (varies from 10% to 17% flat rate per annum) set by the institute or by the regulatory authority, but informal loan receiving households will have to pay a lot more (usually 120% per annum). When a household takes informal loan, it becomes a victim of paying very high interest rates and sometimes it has to lose fixed assets to repay the loan. So the logic behind is that the households having informal loan will be more vulnerable than the households with formal loans.

(12) Duration of microfinance membership is assumed to have negative impact on the degree of vulnerability. If any household being a member of Microfinance Institutions (MFIs) for more than one year and have taken loans from the MFIs at least once, then it is assumed to have less vulnerable than those who haven't taken loans.

¹⁶ Unmet loss refers to the loss that has not been recovered from any kind of assistance. Some households have got financial assistance from government and non-government organization after the cyclones. Some households could mitigate their loss with that money but still they have some other unmet loss that can't be recovered in that time, some direct loss and some economic loss.

¹⁷ Formal loans are defined as the loans from banks, Microfinance Institutions, co-operatives etc.

¹⁸ Informal loan refers to the borrowing from the professional money lenders, neighbours charging interest rates, powerful person in the village who lends money with interest rates. There are some borrowings from the friends and relatives with zero interest rates.

(13) Migration is an important factor also. It is expected that in the crisis or lean period when there is no employment in the rural economy, members of the households will migrate to the place where jobs are available at least for a short period of time. By this they can mitigate the risk of losing consumption and employment. So the households especially the head of the households or any member of the household who moves to another place for job are assumed to perform better to mitigate vulnerability. Migrating households will show a less degree of vulnerability than those who didn't migrate.

(14) In terms of infrastructure facility- electricity, safe-drinking water and sanitary latrine, the households those have access to these facilities will likely to have less degree of vulnerability. The rationale behind is that having electricity is one step forward to initiate income generating activity and work at night. The refugees those who lost their houses and still living in the roadside and dam sides are less likely to have electricity in their house. As a result they have less scope for initiating any enterprise. Besides, safe-drinking water is also very essential improvement of the rural life. As the study area is salinity prone area and safe-drinking water is a scare resource for the households, having safe-drinking water reduces the degree of vulnerability as it reduces the cost of illness throughout the year. The same logic applies to the access to sanitary latrine also.

(15) The distance factor is also very important to determine the vulnerability. It is assumed that the households locating far distant from the roads or highways, markets and even microfinance branch office is expected to have high degree of vulnerability. The rationale behind is that transaction cost is higher to access any service or selling products. Even the access to infrastructure facility provided by the government doesn't reach those households. As a result the opportunity to employment and entrepreneurship become smaller which results the degree of food consumption vulnerability.

(16) *Char*¹⁹ factor- *Char* lands are geographically inaccessible areas of the region. People in this region have limited access to the mainland and have less opportunity to work in mainland. In this area, they have their own market system and sometimes they are ill-paid. As a result the opportunity to improve the lifestyle is very limited due to geographical

¹⁹ *Char* refers low-lying lands that are very close to river basin (even in the middle of the river) or sea shore which are often flooded during the monsoon. Usually char lands are not suitable for all kind of productions. There are some specific crops that can be cultivated in this area. In *char*, it is usually found that the households don't have permanent house like the mainlanders. The homesteads are very vulnerable to flood and upsurge of the sea tides. These areas are less connected to the main land by roads and highways. The main vehicles in these areas are boats, three wheeler pooling vans, cattle cart etc.

remoteness and local landlords. So our hypothesis is that being a household in a *char* area, will likely to have less access to food in lean period and becomes more vulnerable.

1.4 Methods and data

The study is based on the data provided jointly by the Institute of Microfinance (InM) and Palli Karma Sahayak Foundation (PKSF), Bangladesh. PKSF with the help of its Partner Organizations (POs) made a census survey with the aim of providing microfinance through a program named PRIME (Programmed Initiatives for Monga Eradication) funded by DFID (Department for International Development), UKaid. PRIME had been operating in the Northern Part of Bangladesh since 2006 and it is going to extend to the southern part of Bangladesh as well. As such PRIME would be carried out in five districts of South-western coastal region of Bangladesh initially stepping into six Upazilas (sub-district) in three of these districts in 2011. These three districts are- Khulna, Patuakhali and Satkhira. Afterwards, the program will be extended to five more Upazilas by 2012.

1.4.1 Sample

1.4.1.1 *Census survey:*

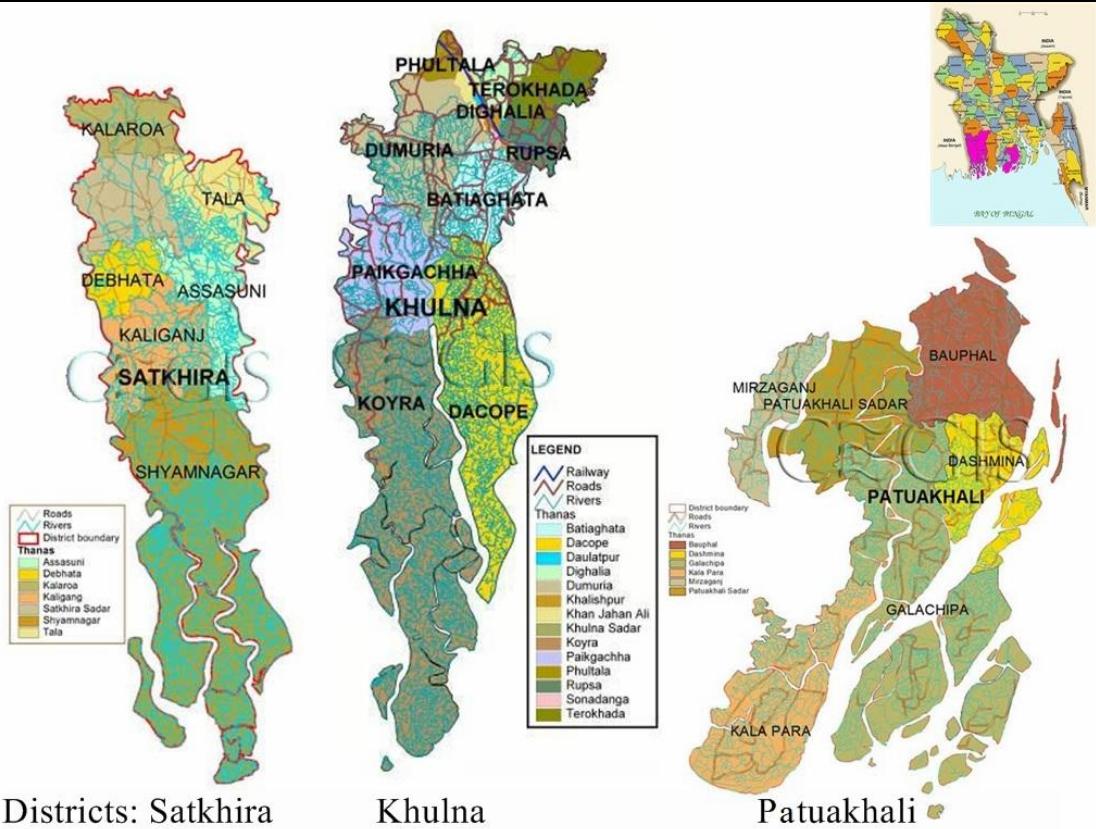
By selecting Partner Organizations²⁰ (POs) for the program, PKSF has gone through an extensive census in the above region shown in the Figure 2. The POs are distributed by Union²¹ basis where only one PO is assigned for a Union. Hence there is no PO overlap for the program purpose in the same union. Census included some of the socio-economic indicators with a set of predefined determinants of selecting ultra-poor people. The criteria for selecting ultra-poor households are as follows-

- (1) Monthly income less than or equal to 3,000 Taka (equivalent to EUR 30) per household during lean period; or
- (2) Primary occupation of the household head is daily wage earning (in farming, fishing, logging, honey collection or other activities); or
- (3) Having less than or equal to 50 decimal cultivable land.

²⁰ There are nine Partner Organisations (POs) were selected for the microfinance operations in the three districts. These are Ad-Din (5), Codek (3), Heed (3), JCF (9), NGF (4), Sangram (6), SUS (8), Uddipan (5), Unnayan (3). In the parenthesis the numbers of branches are shown.

²¹ Unions are the lowest level administrative areas of operation in Bangladesh.

Figure 2: Three districts of study area in Southern Bangladesh.



Source: Maps are generated by CEGIS. Maps are assembled by Author. Map of Bangladesh (upper captioned) is from PKSF.

With the help of POs, PKSF conducted the census survey covering over one hundred thousand households those reported about seventy percentage of them having no or minimal involvement with microfinance industry as of 2010-11. The study is covered in the original census 60,000 of these households (see Table 2) and sample for the baseline survey has been taken from these households.

Table 2: Household Covered in the Original Census.

District	Upazilla	Total household targeted for PRIME
Khulna	Dacope	7,588
	Koyra	13,632
Patuakhali	Golachipa	13,543
	Kolapara	5,745
Satkhira	Kaliganj	11,201
	Shaymnagar	8,344
Total		60,053

Source: InM report (2011) & PKSF Household Census for PRIME South.

1.4.1.2 Sample size:

The data for this study has been taken from a designed survey aiming at to evaluate a program intervention. The data has been structured in two sample groups- treatment group and control group. As program still is in the inception stage and very few operations or interventions have been initiated, we would rather call the two groups as program area and the control area. It is very important to identify these two groups for the purpose of program evaluation. But in this stage we will focus on cross sectional differences between our own identified unit of analysis- microfinance participants and non-participants. A total of 4,000 sample size had been target to cover for the study of baseline condition. Finally the working data set for the cross sectional analysis will be 3,977 households.

1.4.1.3 Baseline Survey:

Institute of Microfinance (InM) was assigned to conduct the baseline survey on June- July 2011 and InM research team decided to collect detailed information of 4,000 households from the study area. The selection of treatment²² group and control²³ group was *ex ante* and as such 4,500 household had been chosen randomly from a list of 9,415 households²⁴ of which some basic information had already been collected in order to properly target households for the treatment. These households were chosen from 153 villages, 14 Unions and 5 Upazilas of three districts of southern Bangladesh (for details see Table 3 below). It is mentioned that it didn't include all unions in the baseline survey. The rationale for deliberate exclusion of four Unions in the baseline survey was to have almost equal size identifying groups- treatment and control for the sake of impact evaluation. In terms of geographical proximity, some socio-economic characteristics of the households are found to be similar before the interventions.

²² “Treatment” group only consists of households which, as confirmed by PKSF, satisfy the precondition of enlistment and who are going to receive the treatment within next couple of months. For the treatment the all the targeted households of a Union- the administrative area are covered. Households in the treatment group actually receive the intervention in the first place or at least one and half year before the control group.

²³ “Control” group consists of households which are similar to the treatment households (i.e. the program intervention) living in the unions with small number of targeted households is less likely to receive the treatment within the next year and half. To determine the sample households for “control” group, in consultation with PKSF, PRIME program was withheld temporarily without affecting the overall program. These areas were either remote or there were just too few ultra-poor households for a viable MFI branch establishment.

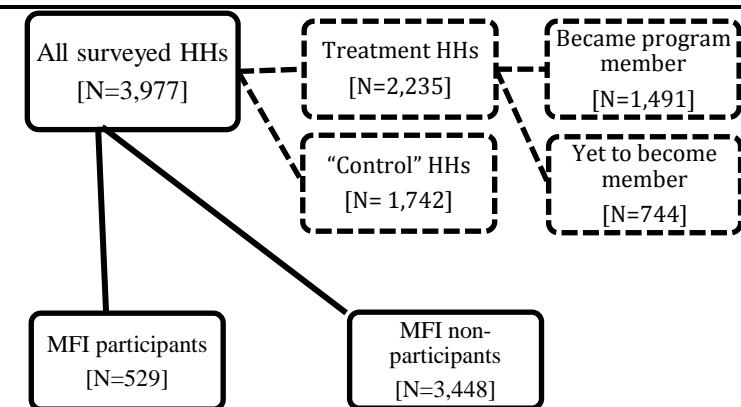
²⁴ 9,415 ultra-poor households correspond to the total number of targeted households in the treatment union. Treatment unions and control unions were chosen to be located in the same Upazila to control for geographic variation.

Table 3: Number of households in sample of baseline survey

District	Upazila	Union	Assigned PO	N	n	Status	Upazilla Total	District Total
Khulna	Dacope	Dacope	Heed	234	234	Control	234	820
	Koyra	Moharajpur	SUS	275	275	Treatment		
		Moheshwaripur	NGF	311	311	Treatment	586	
Patuakhali	Golachipa	Aamkhola	CODEC	199	199	Treatment		
		Borobaisdia	UDDIPAN	746	746	Control		
		Dakua	CODEC	131	131	Treatment		
		Gojalia	CODEC	155	0	Treatment	1526	1526
		Golachipa pouroshova	SONGRAM	145	145	Control		
		Golachipa union	SONGRAM	305	305	Treatment		
		Golkhali	CODEC	169	0	Treatment		
		Kolapara	SONGRAM	275	0	Treatment	0	
		Bisnopur	UNNAYAN	178	178	Treatment		
Satkhira	Kaliganj	Champaful	JCF	120	120	Treatment		
		Krishno Nagar	UNNAYAN	157	157	Treatment	1439	1703
		Kushulia	UNNAYAN	312	312	Treatment		
		Ratanpur	NGF	672	672	Control		
		Tarali	JCF	63	0	Treatment		
		Shayamnagar	Gabura	264	264	Treatment	264	

Source: InM report for PRIME South, 2011. Note: ‘N’ is the number of households provided by the Assigned PO’s (Partner organizations) and ‘n’ is the number of households are chosen for baseline survey.

Figure 3: A Schematic Diagram of the Sample Households.



Source: InM PRIME South report, 2011; bold line represents the unit of analysis.

After the baseline survey, the working data set for the evaluation remains to 3,977 households. Among them the “Treatment Area” consists of 2,235 households and the “Control Area” consists of 1,742 households. In terms of previous MFI participation, 529 households are participants and 3,448 households are non-participants (Figure 3).

1.4.2 Methods of Data Collection and Processing:

As the baseline survey is the collection of primary data of the sampled households, InM with the help of PKSF conducted the survey. InM hired 33 Enumerators and 5 Supervisors to conduct the survey. Educational attainment (minimum Graduate), maturity, effectiveness in training, experience in other survey and ability to spend at least two weeks in the field were the criteria for selecting the Enumerators and the Supervisors. Besides, InM research team was in-charge of overall supervision of the data collection process and the data capturing process. The Enumerators and the Supervisors went through a weeklong extensive training before going to their designated areas. Enumerators personally communicated with the respondents to fill up the questionnaire. The questionnaire is a digital format questionnaire named ICR (Intelligent Character Recognition) format. The filled up data can be captured by the machine automatically and hence less possibility of wrong data entry.

To motivate the households to take part in the survey, InM compensate each household BDT 50 (half-day labor wage in the local market) for their working time. For ensuring the data quality and validity, each questionnaire has been cross-checked by the Enumerators and Supervisors as well. After the field work, all questionnaires were sent to machine to get the data in digital format. Unique bar code identification was used in the questionnaire so that there is no duplicate questionnaire or losing any section of the data. Finally the data converted into Stata and SPSS format. Also the questionnaires were scanned for keeping it in digital format.

The 23 page ICR questionnaire consists of household characteristics and both idiosyncratic and covariate shocks. The questionnaire asked question about the following variables- Household roster, household characteristics, occupation, physical and financial assets, income, expenditure, loan information, microfinance membership, disaster and remedies information.

1.5 Expected Results

First, the study aims at to find out the determinants of the vulnerability of the extreme poor. It is expected that the household head characteristics, some household characteristics and natural catastrophe can be found as determinants of the food consumption vulnerability. Household head's age is positively related to the degree of vulnerability whereas the education of the household head will tend to decrease the vulnerability. Female headed

households are also expected to show positive relationship with degree of vulnerability. The same is also true for household size. If household size increases the degree of vulnerability will also increase.

Occupation is an important factor determining the food consumption vulnerability in two period of time. Wage earners are more vulnerable than the self-employed persons. Wage earners lose jobs in the lean period and become destitute. Service holder position is better than the wage earning group. On the other hand, having more yearly income can be found an important determinant of the poverty. Beside, food and non-food expenditure are also important variables to determine poverty situation.

Financial assets like savings, loans and membership duration could be found as vital factor. On the other hand, having informal loan can deteriorate the situation of poverty and vulnerability. Social safety net program from government and non-government organization can be found improving the condition of vulnerability. Households' physical assets such as owned land and operational land can be found significant determinants to define vulnerability. Households having more cows, goat, poultry, trees and farming will be less vulnerable than the other group.

If the unmet loss from Sidr and Aila are higher, the degree of vulnerability will increase significantly. Migration households are expected to be less vulnerable. Infrastructure facility such as electricity, safe-drinking water and sanitary latrine can improve the chance of income generating which indirectly will reduce the consumption vulnerability. If the distance increases from main road, market place increases, vulnerability also increases. Being a household in the *char* areas- remote inaccessible areas, the probability of being vulnerable is very high.

Second, microfinance participants with loans will be less vulnerable than the non-participants. Here we will control the microfinance participation with loans. Though the percentage of this group of households is not much bigger, still produces significant differences among the participants and non-participants.

Third, the unmet loss in two big cyclones such as Sidr and Aila are very important factors to determine food consumption vulnerability. More unmet loss will cause more vulnerability.

2 Chapter: Theory and methodology

2.1 Literature review on theory

The vulnerability of the food consumption is rooted in the economic theory Permanent Income Hypothesis where households' consumption behaviour has been analysed with the credit demand. The prime question of this research- the determinants of the food consumption vulnerability will be analysed by the *Permanent Income Hypothesis (PIH)* and the participation in microfinance will be analysed by *Credit constraint hypothesis*.

2.1.1 Consumption Smoothening Approach

Consumption smoothening means having the consistent level of consumption in terms of both food and non-food throughout the year no matter the income level is. The present research deals with the change number of food intake per day between two periods of a year. The justification of using the measure of vulnerability of the meal consumption is that it is a perception based and also exhibits the expectation for the future consumption where the households have adequate information but they have nothing to do without coping with the satiation.

2.1.2 Permanent Income Hypothesis:

Consumption smoothening approach can be defined by the Permanent Income hypothesis (PIH) - a theory of consumption which was developed by American Economist Milton Friedman in 1957. The theory tells that both household income and consumption consist of two components- permanent and transitory components. The permanent components of consumption and income are positively related, there is no correlation between transitory components. Permanent income is determined by household's assets both physical and human. Physical assets consist of property, bonds and shares whereas human assets consist of education and experience. These two assets influence households' ability to earn income. The consumer then can make an estimation of anticipated lifetime income. Transitory income is the difference between the permanent income and the measured income.

According to Friedman (1957), any change in consumption caused by shocks to income (transitory income) could be smoothed sufficiently by perfect capital market borrowing as the household would try to maximize utility. Household will borrow from market when it has transitory low income and by saving when having transitory high income. Hence the consumption patterns of households are largely determined by the change in permanent

income, rather than the change in temporary income. The transitory or the temporary change or fluctuation in income have little effect on consumer spending behaviour but the permanent change can have large effect on consumption behaviour. So any change in permanent income- such as physical and human assets can shift the consumption pattern of the households- may increase or decrease the level of consumption.

Hence households' access to credit market is derived from the demand for smoothening consumption against income shocks. The assumption of the perfect capital market is violated in the developing countries because of the asymmetric information. The financial markets are heavily distorted and there is principal-agent problem in the market, which could be a reason to justify the credit constraints and credit rationing according to Conning & Udry (2007) and Morduch (1995). Therefore, households consumption is not completely smoothed if imperfect financial market prevails (Dercon & Krishnan, & Studiën, 2000; Duflo & Udry, 2004; Goldstein, 2004). According to Morduch, (1995) households are credit constrained if they are not able to fill the income gap by borrowing sufficiently while experiencing income shock. Not only the credit constraint but also the household precautionary behaviour could result violation of permanent income hypothesis (Deaton, 1991; Morduch, 1990; Paxson, 1992). According to Deaton (1991) and Kurosaki (2006), the characteristics such as household savings, other accumulated assets, external assistance and remittances or cash transfer could play the role of absorbers of the income shocks keeping consumption smoothed even if household facing credit constrained for financial market. The poor households' credit constraint becomes more persistent when they can't generate sufficient saving for the future because their average propensity to consume is higher than the rich (Armendariz & Morduch, 2005). If there is no savings then there is no accumulated asset. So a savings constraint is another form of credit constraints. In many developing countries like Bangladesh, the significant number of population is not insured or inadequately insured by health insurance policy. Social safety-net is also not adequately available for the poor people. So adverse health shock of any member of the household may not directly affect income but creates a demand for credit to mitigate the shock if the household have insufficient saving to pay the healthcare bills (Kochhar, 1995).

In developing and least developed countries with the existence of imperfect market, demand for credit is not only for coping with income shock but also financing households' income generating activities and investment decision. Sudden shock in production activities such as death of domestic or faming animal, harvest lost, drought, flood, natural disaster like cyclone

and tsunami, the demand of external financing especially from the credit market become essential to restore the production technology.

So the permanent income hypothesis is the theory behind to find out the determinants of the food consumption vulnerability of the extreme-poor households in Southern Bangladesh. According to our study, more than 70% households reported that they have credit constraint and only 13% are having loans for more than one year. Many households have become member of the MFIs recently and didn't experience any loan until now. Still the microfinance market in Bangladesh is not perfect though thousands of Microfinance Institutions and Commercial banks as well are providing microfinance. A large segment of the poor households demand for credit but unfortunately they are not provided the credit. There are both supply side constraints and also demand side constraints for this phenomenon.

Townsend (1995) argues about risk sharing besides the idiosyncratic income shock. He found that the households in Thailand have more risk sharing in rural areas than in the Capital city. Beside the credit market constraints the risk sharing or pooling among the community is another tool for smoothening consumption. Even in better-functioning society, idiosyncratic shocks can be lessened by risk sharing. But in the developing countries households coping mechanism against crisis usually are the sale of assets, advanced sale of labor, advanced sale of crops, land mortgage, migration, informal loans etc.

2.1.3 Risk rationing theory

According to Boucher & Carter (2001), risk rationing shifts the significant contractual risk to the borrowers when lenders are constrained by asymmetric information resulting voluntary withdrawal of the borrowers from the credit market even though they have the necessary collateral to qualify the loan contract. The risk is from the both sides, supply side and the demand side. When lenders don't have sufficient information and capability of repaying the loan, then they wouldn't allow the incumbent borrowers to take loan. Microfinance Institutions operating in the remote areas don't have perfect information about the very poor and vulnerable households and their repayment capability. Again the modalities of the MFIs for making group lending are also very difficult to form a group in some locality. So both asymmetric information and group formation modalities are kinds of constraint to offer loans to these poor households.

On the contrary, prospective borrowers also face self-constraints in getting the loans. Households' are sometimes afraid of timely repayment the instalment, peer pressure from the group members, losing the entrance fee, losing the deposited savings and any collateral they had in the MFIs. All these are the contractual risk for the borrowers. Three kinds of credit constraints may take form according to Boucher et al (2006) - quantity rationing, transaction cost rationing and risk rationing. Quantity rationing is the threshold rationing where borrowers are incapable of deposit minimum amount of savings or collateral or assurance and involuntarily excluded from the credit market. Transaction cost rating is associated with the cost and distance. MFIs don't necessarily go to the very remote areas to provide loans and group formation as their screening costs are so high. On the other hand prospective borrowers are unmotivated to take loan from distant MFIs as they don't trust them and reluctant to pay the conveyance and necessary cost to make a loan. So both suppliers and the demanders are voluntarily withdrawn from the market. The other constraint is the risk rationing constraint. The self-constraints households' are afraid of timely repayment the instalment, peer pressure from the group members, losing the entrance fee, losing option for future credit from the same institution, losing the deposited savings and any collateral they had in the MFIs. As a result the households are voluntarily excluded from formal credit participation. On the other hand the households are sometimes fond of taking informal loan (personal loan) from the money lenders (with interest rate) or friends or relatives (without interest rate). It is empirically found that the money lenders' interest rates are so high (usually 120% annually) that the borrowers lose everything repaying the loan. But informal loans are popular sometimes as it has more flexibility than the formal credit.

2.2 Literature review on methodology

As consumption ordering is a natural ordering and the definition of vulnerability is also naturally ordered, hence we will use ordered probit model to find the determinants of vulnerability. As we are concerned about the microfinance participation, so we will compare the mean difference of the two groups –participants and nonparticipants. To see the microfinance participation effect, we will use the Propensity Score Matching technique.

Khandker et al. (2010) used this approach of food consumption ordering to find out the impact of other factors in poverty. As the vulnerability is an ordered index which we will use dependent variable of the regression model, an ordered probit model can help us to find out the determinants that causes it.

Jalan and Ravallion (1998) defined vulnerability to consumption analogous to '*transient poverty*', which is the time-mean consumption poverty at the household level that is directly related to variable consumption. They found that both chronic and transient poverty are reduced by greater access of physical capital. They argue that variability in the availability of physical capital, and adverse geographic conditions do influence transient poverty and hence vulnerability.

Propensity score matching is a useful approach to construct a statistical comparison group which is based on a model of probability of participating in a specific program using observed characteristics where participants are matched on the basis of propensity score to non-participants (Khandker, Koolwal and Samad, 2010). This approach is also used by Godtland et al (2004), Khandker et al (2010), Heckman, Ichimura, and Todd (1998) and Caliendo and Kopeinig (2008).

2.3 Method selection

The regression model deals with the change in the frequency of the meal consumption as dependent variable. Households speculate the shock in the coming months but they hardly can do anything against this phenomenon. The speculative behaviour such as savings, assets, contracts are sometimes less effective because of their life style and their low income during the whole year. They can't guarantee themselves of having three full meals throughout the year due to income shocks. Precautionary measures are insufficient to meet this phenomenon and as a result the household has to cope with the lean period's shock. They can't switch their job sometimes because of the adaptable risk to the new job and potential threat from the existing labor market. The coping mechanism incorporates advanced sale of labor, sale of assets, advanced sale of crops, contracting out the lands and migration. The most popular way of coping is the occasional starvation during the whole period (taking only one meal a day or starve the whole day) or consumption rationing (taking two meals or three meals with unsatisfactory amount of food).

The traditional way of calculating the poverty and vulnerability by calorie intake is not followed here. Rather what reflects the households' perception about their economic situation especially their first basic need "food intake" is used. They address themselves as vulnerable in their consumption expenditure for both food and non-food because of their income shock.

So in our analysis we have chosen the frequency of their normal time meal consumption and lean time meal consumption. The difference from normal time consumption frequency minus the lean time consumption frequency is defined as vulnerability. The vulnerability matrix can be seen in Table 1, where the degree measures the extent of vulnerability. The bench mark is three times meal in a day for every household with full satisfaction. Whenever a household consumes 3 meals in normal time and only 2 meals in lean time then it is calculated the vulnerability of degree 1. So changes from 3 times to 1 time, 2 times to 1 time or remaining 1 time in both periods are defined as 2° vulnerability. Similarly 3 times to 2 times or 2 times in both periods are defined as 1° vulnerability. On the other hand, some households reported that they are better off during the lean period of their occupational income. As a result, they showed a better number of consumption frequencies during their self-nominated lean period. So -1° and -2° are the degree of well off where -2° is better than -1° . Again there are some households having 0° of vulnerability meaning their consumption frequencies do not change in any period.

Before using ordered probit model, Heckman two step sample selection model will be used to check whether any sample selection biasness exists in the analysis due to some missing values. Again as we are concerned about the potential impact of existing microfinance in that area (before PRIME intervention), we will use Propensity Score Matching (PSM) technique to find out the impact of being a long time member of microfinance. We will also do it for victims of natural disasters. Besides in the descriptive analysis we will follow the Mean Difference approach to compare the mean values of the two groups- microfinance participants and non-participants.

2.3.1 Ordered Probit Model

Ordered Probit model deals with the dependent variable which is ordered in nature. It can be from like lowest to highest or vice versa. Since our dependent variable vulnerability is an ordered variable we will have to use ordered probit model for the estimation. According to Cameron and Trivedi (2005), the starting point is an index model, with single latent variable

In the equation (1), x doesn't include intercept. As y^* crosses a series of increasing unknown thresholds we move up the ordering of alternatives. As for example, for a very low y^* health status is poor, for $y^* > \alpha_1$ health status improves to fair, for $y^* > \alpha_2$ it improves further to good, and so on.

In general for an m -alternative ordered model we define

$$y_i = j \quad \text{if} \quad \alpha_{j-1} < y^* \leq \alpha_j \quad \dots \quad (2)$$

Where $\alpha_0 = -\infty$ and $\alpha_m = \infty$. Then

$$\begin{aligned} \Pr[y_i = j] &= \Pr[\alpha_{j-1} < y_i^* \leq \alpha_j] \\ &= \Pr[\alpha_{j-1} < x_i' \beta + u_i \leq \alpha_j] \\ &= \Pr[\alpha_{j-1} - x_i' \beta < u_i \leq \alpha_j - x_i' \beta] \\ &= F(\alpha_j - x_i' \beta) - F(\alpha_{j-1} - x_i' \beta), \quad \dots \quad (3) \end{aligned}$$

Where, F is the Cumulative Density Function (cdf) of u_i . The regression parameters β and the $(m-1)$ threshold parameters $\alpha_1, \dots, \alpha_{m-1}$ are obtained by maximizing the log likelihood function

$$L = \ln L_N = \sum_{i=1}^N \sum_{j=1}^M y_{ij} \ln p_{ij} \quad \dots \quad (4)$$

Where $p_{ij} = F_j(x_i, \beta)$ is a function of parameters β and regressors.

If we maximize the log likelihood function of (4) with respect to p_{ij} defined in (3) we will obtain the parameters $\alpha_1, \dots, \alpha_{m-1}$.

For the **ordered probit model** u is standard normal distributed and $F(\cdot)$ is the standard normal cumulative density function.

The sign of the regression parameters β can be immediately interpreted as determining whether or not the latent variable y^* increases with the regressors. For marginal effect in the probabilities

$$\frac{\partial \Pr[y_i = j]}{\partial x_i} = \{F'(\alpha_{j-i} - x_i' \beta) - F'(\alpha_j - x_i' \beta)\} \beta \quad \dots \quad (5)$$

Where F' denotes the derivative of F . Cameron and Trivedi (1986) used the ordered probit model to number of doctor consultations. Hausman, Lo, and MacKinley (1992) applied the ordered probit to data on changes in a count, which can be negative.

2.3.2 Heckman Probit Model

Our aim is to analyze the impact of microfinance program on the food consumption vulnerability. Besides the finding the determinants of the vulnerability, we will also analyze the possible impact of microfinance membership over the economic hardship like

vulnerability. We will encounter two endogenous variables- microfinance and the vulnerability with the other exogenous variables like household characteristics, community characteristics and some covariate shocks. As we will measure the vulnerability as conditional upon microfinance where conditionality may usually divulge the correlation between the errors of two endogenous variables and may produce potential risk of sample selectivity bias. As the dataset encounters some missing values for the important variables frequency of meal consumption, we will check whether it produces any potential risk towards sample selectivity bias or not. If it is found that there is not sample selection bias, then we can follow the ordered probit model to estimate the determinants of the vulnerability.

According to Cameron, A. C., and P. K. Trivedi (2005), the sample selection model which is bivariate comprises a participant or selection equation that

$$y_1 = \begin{cases} 1 & \text{if } y_1^* > 0 \\ 0 & \text{if } y_1^* \leq 0 \end{cases}$$

And a resultant outcome equation that

$$y_2 = \begin{cases} y_2^* & \text{if } y_1^* > 0 \\ 0 & \text{if } y_1^* \leq 0 \end{cases}$$

It specifies that y_2 is observed when $y_1^* > 0$, whereas y_2 doesn't need to take on any meaningful value when $y_1^* \leq 0$. The standard model identifies a linear model with additive errors for the latent variables, so

$$y_1^* = x_1' \beta_1 + \varepsilon_1 \text{ where } \varepsilon_1 \sim N(0,1)$$

$$y_2^* = x_2' \beta_2 + \varepsilon_2 \text{ where } \varepsilon_2 \sim N(0,1)$$

Where y_1^* and y_2^* represent the unobservable variable for an individual and this is linearly determined. The problem of estimating β_2 arises if the two errors ε_1 and ε_2 are correlated.

A binomial Probit models can be constructed for the objective purposes to test for the determinants of vulnerability (*vul*) and participation in microfinance program (*mfmember*), as follows-

According to Cameron, A. C., and P. K. Trivedi (2005), to avoid the potential problem of sample selectivity bias, a two-step probit selection model is applied. Given (6) and (7), for $y_1^* > 0$ we observe y_2^* , with probability equal to the probability that $y_1^* > 0$ times the conditional probability of y_2^* provided that $y_1^* > 0$. Hence for positive y_2 the density of the observables is $f^*(y_2^* | y_1^* > 0) \times \Pr[y_1^* > 0]$. For $y_1^* \leq 0$ all that is observed is that this event has occurred, and the density is the probability if this event occurring. The bivariate sample selection model therefore has likelihood function

$$L = \prod_{i=1}^n \{ \Pr[y_{1i}^* \leq 0] \}^{1-y_{1i}} \{ f(y_{2i} | y_{1i}^* > 0) \times \Pr[y_{1i}^* > 0] \}^{y_{1i}} \dots \dots \dots \quad (8)$$

Where the first term is discrete contribution when $y_{1i}^* \leq 0$, since then $y_{1i} = 0$, and the second term is the continuous contribution when $y_{1i}^* > 0$. This likelihood function is applicable to quite general models, not just linear models with joint normal errors, Cameron, A. C., and P. K. Trivedi (2005).

It is considered only the truncated mean in the sample selectivity model as positive values of y_2 are used. Consequently, with the assumption of correlation between the error terms as per bivariate standard normal distribution with correlation coefficient ρ , the probability model is expressed, in general, as:

$$\begin{aligned} E[y_2 | x, y_1^* > 0] &= E[x'_2 \beta_2 + \varepsilon_2 | x'_1 \beta_1 + \varepsilon_1 > 0] \\ &= x'_2 \beta_2 + E[\varepsilon_2 | \varepsilon_1 > -x'_1 \beta_1] \end{aligned} \quad \dots \dots \dots \quad (9)$$

Here x represents the vector of all explanatory variables in the outcome and selection equations. If there is no correlation between the errors ε_1 and ε_2 , then the last term of the expression (9) simplifies to $E[\varepsilon_2] = 0$. On the other hand, any correlation between the two errors meaning the truncated mean is no longer $x'_2 \beta_2$ and we are to account for selection bias. To obtain $E[\varepsilon_2 | \varepsilon_1 > -x'_1 \beta_1]$ when ε_1 and ε_2 are correlated, Heckman (1979) ascribed that if the errors are normal, then we have

$$\varepsilon_2 = \sigma_{12} \varepsilon_1 + \xi \quad \dots \dots \dots \quad (10)$$

Here the random variable ξ is independent of ε_1 .

By using (10), the truncated mean of equation (9) becomes

$$\begin{aligned} E[y_2 | x, y_1^* > 0] &= x'_2 \beta_2 + E[\sigma_{12} \varepsilon_1 + \xi | \varepsilon_1 > -x'_1 \beta_1] \\ &= x'_2 \beta_2 + \sigma_{12} E[\varepsilon_1 | \varepsilon_1 > -x'_1 \beta_1] \end{aligned} \quad \dots \dots \dots \quad (11)$$

The selection term is similar to Tobit model and then we can write

$$E[y_2 | x, y_1^* > 0] = x'_2 \beta_2 + \sigma_{12} \lambda(x'_1 \beta_1)$$

Where $\lambda = \frac{\phi(\bullet)}{\Phi(\bullet)}$ and ϕ and Φ characterize the density and cumulative functions of the standard normal distribution, respectively.

Equation (11) is the original probit model including a selection correction term $\lambda(\bullet)$ with coefficient value σ_{12} , to adjust for the non-random sample. According to Greene (2003), this selection term permits the changes in the independent variables to affect both the probability that the household is affected by vulnerability and probability that they receive Microfinance. If σ_{12} is significantly different from zero i.e. the error terms are correlated, a regression base on only observed data for y_1 and y_2 would create an omitted-variable problem (Greene 2003).

The value of ρ ($= \frac{\sigma_{12}}{\sigma_2^2}$) is used to evaluate the risk of selection bias and evaluates whether it is required to incorporate the selection model. If ρ is non-significant, we can say that there is no evidence of selection bias and no reason for applying the two-step selection model. In this situation, the standard Probit model will deliver the more consistent and unbiased estimates. In the output, the values of both ρ and λ will be estimated and their significance level can be assessed.

2.3.3 Propensity Score Matching (PSM)

The Propensity Score Matching (PSM) is sophisticated and increasingly used tool for program evaluation. The assumption is that selection can be explained purely in terms of observable characteristics. For each individual in the treatment group a matching individual is found on the basis of observable characteristics with an identical individual in the non-treatment group. What is required is to match each individual in the treatment group with individuals sharing similar characteristics in the non-treatment group. Then mean effect of treatment can be calculated as the average difference of outcomes of two groups. According to Khandker, Koolwal and Samad (2010) PSM matches each participant with an identical nonparticipant and then measures the average difference in the outcome variable between the participants and the nonparticipants. It tries to capture the effects of different observed covariates X on participation in a single propensity score. Then, to obtain the program effect, outcomes of participating and nonparticipating households with similar propensity scores are

compared. If there is no match found, households are dropped as no basis exists for comparison.

Here we will describe how PSM works to estimate the impact of a program. As we are concerned about the impact of microfinance membership to determine the vulnerability of the household in the southern part of Bangladesh, we will use the microfinance membership which is of more than one year and have at least one loan during individual's membership period. It is mentioned that in the study area a newly sophisticated program is going to begin and the targeted households are offered membership now-a-days. In the impact of microfinance loan aspects, we are not considering all the new members of the program rather we will concentrate on the existing members of the area before the program. When the survey took place, the amount of loan of the new program was minimal and almost insignificant, so there is no possibility of ignoring the loans with valid membership. The definition of the membership will be discussed later on with specification.

In order to apply PSM, we define the individual who participate in microfinance program as treatment group so that we might estimate average treatment effect on the probability of being vulnerable by comparing with participants and non-participants. Our goal is to estimate the effect of microfinance program on food consumption vulnerability. Let us define

$$y_i = \text{mfmember} = \begin{cases} 1 & \text{if households participate in microfinance program} \\ 0 & \text{if household doesn't participate in microfinance program} \end{cases}$$

Here we define the outcome of microfinance membership as y_1 and the outcome of non-membership of microfinance programs ($\text{mfmember} = 0$) as y_0 . The goal is to ascertain the average treatment effect on the treated (ATT). The average treatment effect on the treated is defined as benefits

$$\text{ATT} = E(y_1 - y_0 / \text{mfmember} = 1) = E(y_1 / \text{mfmember} = 1) - E(y_0 / \text{mfmember} = 0) \dots\dots\dots (5)$$

The first term of the equation (5) is observable whereas the second term is not observable because it is not impossible to observe the same individuals as recipient as well as non-recipient simultaneously. The use of propensity score matching can eliminate this problem to estimate $E(y_0 / \text{mfmember} = 0)$.

It is an observational study to estimate ATT but problem remains in the non-randomness of the selection of the treatment and control and therefore the estimation of ATT suffers from biasedness. The use of PSM can fix this problem which summarizes the pre-treatment characteristics of subject into a single index variable (the propensity score) which is then used to generate the matching. PSM is used to reduce the biasedness by comparing two groups based on observable characteristics. The validity of the propensity score matching depends on two conditions- (1) conditional independence (unobserved factors don't affect participation) and (2) sizable common support or overlap in propensity score across the participant and non-participants.

Estimating the propensity score, any standard model such as Logit or Probit can be applied. The role of propensity score is only to reduce the dimensions of the conditioning; as such, it possesses no behavioral assumptions. For the purpose of estimation we will use Probit model as follows-

$$\begin{aligned}
 P(y_i = 1|x) &= P(y_i^* > 0|x) \\
 &= p(x_i' \beta + \varepsilon_i > 0|x) \\
 &= P(\varepsilon_i > -x_i' \beta | x) \\
 &= 1 - F(-x_i' \beta) \dots \dots \dots \quad (6)
 \end{aligned}$$

Assuming the error terms are independently and normally distributed:

$$\begin{aligned}
 P(y_i = 1|x) &= 1 - \Phi\left(-\frac{x_i' \beta}{\sigma}\right), \sigma \equiv 1 \\
 &= \Phi(x_i' \beta) \dots \dots \dots \quad (7)
 \end{aligned}$$

The application of the PSM method occurs in three steps- (1) Estimating a model of program participation, (2) defining the region of common support and balancing tests, (3) Matching participants to non-participants. Matching participants and non-participants can occur in various ways such as (1) Nearest-neighbor matching, (2) Caliper or radius matching, (3) Stratification or interval matching, (4) Kernel and local linear matching, (5) Difference-in-difference matching etc.

In PSM, the first step is to determine the propensity score and satisfy the balancing property. The propensity score which is within the range of lowest and highest estimated values for households in the treatment group, is called area of common support. With the propensity

score generated, the outcome of interest between treatment group and matched control group will be compared to see whether microfinance program affect the outcome of interest or not.

2.3.4 Mean Difference Method

It is a very useful tool to compare the mean of two groups. Usually t-test is used to compare whether the groups are statistically different from each other. Mean comparison test is appropriate for comparing the means of two groups in the randomized experimental design. If we only look at the mean it doesn't say anything of the variability of the score. To overcome this problem t-test is appropriate to judge the difference between the means relative to the spread or variability of the scores.

The formula for t-test can be described below-

$$t = \frac{\bar{X}_T - \bar{X}_C}{\sqrt{\frac{Var_T}{n_T} + \frac{Var_C}{n_C}}}$$

Where T represents treatment group and C represents control group. This formula can also be used as for microfinance participants (P) and non-participants (NP). Such as-

$$t = \frac{\bar{X}_P - \bar{X}_{NP}}{\sqrt{\frac{Var_P}{n_P} + \frac{Var_{NP}}{n_{NP}}}}$$

In the t-test it assumes in the null hypothesis that there is no difference between the means of two groups. If the p-value of the t-test is significant then we have to reject null, i.e. the means are statistically different from each other.

It is mentioned here that all the data files, regression models and estimations have been done using the statistical software- "Stata".

3 Chapter: Previous similar studies

3.1 Literature review on similar studies

Vulnerability to poverty or consumption ordering of food is associated with economic structure. In the subsistence economy, poor were not necessarily considered as vulnerable as the impacts of shocks were minimal due to their self-sufficiency. With the diversifying economic structure and skewed distribution of economic opportunities, the poor are more exposed to uncertainty and risks. Similarly the non-poor with limited wealth and income might as well be subject to risks and uncertainty due to their limited capability to cope with shocks. In the earlier literature, the poor that faces a more average decline in welfare due to shock was considered vulnerable. The non-poor that could face a substantial decline in welfare were also disregarded (Glwee and Hall, 1997).

In recent literature, vulnerability is often used to report poverty dynamics that a poor household is not only faced with low income and low consumption but also fluctuations in its consumption. Different authors have defined vulnerability in different methods. Chambers (1989) describes vulnerability as “defencelessness, insecurity and exposure to risk, shocks and stress”. Ligon and Schechter (2004) define it as a “loss in forward looking welfare due to low expected consumption, high variability of consumption or both”. Also there are other literatures that address vulnerability as a probability. Vulnerability, expressed as a probability, will show us greater or lower extent of poverty, and the probability of risk will increase as time horizon extends. Chaudhuri *et al.* (2002) extends the definition as “the ex-ante risk – which a household would fall below the poverty line, or if the household is currently poor will remain poor”. He argues that “*the main difference between poverty and vulnerability is risk*” – the uncertain future well-being, which households face from different sources such as – failed harvest, increased food prices, illness of main income earner etc. If such risks were absent the ex-post (poverty) and ex-ante will be the same. Therefore, vulnerability in essence has three distinguishable characteristics; they are: (i), vulnerability is measured as probability; the higher probability means higher vulnerability. Second, vulnerability is a one-dimensional measure of welfare; it measures welfare to certain benchmark level. Third, in vulnerability assessment we need to clearly define the future as, the longer the time period the higher the vulnerability.

Quite a number of studies have been conducted on vulnerability and its determinants. Glewee and Hall (1995, 1997) were among the pioneers to analyse vulnerability. They found

that, in Peru, households with better education were less vulnerable as they could easily adapt to changing economic conditions; households with more children were more vulnerable. They found that Peru's transfer network was inefficient and the social security program was ill-targeted towards the poorest and vulnerable.

Chaudhuri et al. (2002) used cross-section data from Indonesia to assess vulnerability. They show that, *first*, while 22% of the population is poor but 45% of population has the possibility to face the risks of becoming poor and are vulnerable to poverty; and *second*, low expected mean consumption is the prime source of vulnerability of rural and less educated households, and consumption volatility is the major source for the urban and educated households. Del Ninno and Marini (2005) conducted analysis of vulnerability to shocks in Zambia. They found that about 20 percent of the households were vulnerable whilst almost 40 percent were chronically poor.

Hoddinott and Quisumbing (2003) did quite an extensive survey of the vulnerability literature and identified the characteristics of the households that are more vulnerable than others. Chaudhuri and Christiaensen (2002) showed that the characteristics of the poor were remarkably consistent with the characteristics of the vulnerable: large family sizes, high dependency ratios, illiteracy, location in counties with low provision of public services and poorer regions of the country. Ligon and Schechter (2002) showed that households headed by an employed, educated male were less vulnerable to aggregate shocks than other households. They also found that the correlates of vulnerability were extremely similar to the correlates of poverty; moreover, the correlates of aggregate risk were the same as the correlates of poverty. Using longitudinal data from Russia, Skoufias (2002) found that households having younger children were found to be less vulnerable (perhaps as a consequence of the child allowances they receive) while female headed households were more vulnerable. Harrower and Hoddinott (2002) found that income shocks had larger effects on consumption amongst the households those did not have access to irrigation infrastructure.

These evidences suggest that household characteristics do explain vulnerability. The important characteristics are family size, occupation, dependency ratio, education and assets. Larger the family size higher is the degree of vulnerability. Similarly higher dependency ratio reflects high intensity of consumption.

Identifying the causes of vulnerability would enable policymakers to distinguish between those who are not vulnerable and those who are structurally poor. For the former group,

interventions that reduce consumption volatility by reducing their exposure to risk or by enhancing their ex post coping capacity could be sufficient. However, for the latter, risk reducing interventions alone may be inadequate, and must be accompanied by interventions to increase mean consumption. Negative shocks combined with poor risk management are a principal source of vulnerability. This suggests that combining the enumeration of shocks with characterizing vulnerability as welfare losses arising from uninsured exposure to risk—represents one method for identifying sources of vulnerability.

Tesliuc and Lindert (2004) classified the sources of shocks into five categories: i) agricultural shocks (droughts, pest infestations, bad harvests, and worsening terms of trade); ii) idiosyncratic economic shocks (a job loss, a bankruptcy, an accident to or death of the breadwinner, and lost remittances); iii) social / violent shocks (family or land disputes and criminal offenses); iv) covariate economic shocks (enterprise closures and mass lay-offs); and v) Natural shocks (earthquake, floods, storms, hurricane, land slide or forest fires). Because of the use of cross-sectional data the shock profile of the year in concern was a poor predictor of future shocks except for natural shocks, which is usually dominated by locations. They found that economic shocks are more severe on household consumption, income and wealth; in majority of the cases households were able to manage the shocks using coping mechanisms; only over a quarter of the households experienced wealth and consumption losses.

Chaudhuri and Paxson (2002) found that households run by agricultural income on an average earn 75% of their annual income in just a three-month period. According to Sahn (1989); Paxson (1993); Dercon and Krishnan (2000) food consumption levels also vary by seasons in rural economies just like income. It is frequently stated that the detected seasonality in consumption is generated largely by the seasonal variation in income, and partly by the lack of appropriate credit markets. However, according to Chaudhuri and Paxson (2002), “seasonality in consumption can also be due to non-credit factors, such as seasonal variation in prices, preferences, labor efforts and precautionary savings motives”. Yet credit constraint could be an important potential determinant in seasonal consumption, especially for the very poor of rural economies (Townsend, 1995). Pitt and Khandker (2002) showed that micro-credit helps to smooth consumption by effectively diversifying agricultural income and employment.

Dercon and Krishnan (2000), by applying fixed effects regressions model, examined the effects of idiosyncratic shocks (self-reported at the household level: rainfall, crop damage, livestock disease and problems with access to grazing or water for livestock) and covariate shocks (village level rainfall, prices and wages). They find that both idiosyncratic and covariate shocks matter. Village level rainfall, the crop damage assessment, and the livestock disease variables are strongly significant and negative (positive) shocks have negative (positive) effects on consumption. Günther and Harttgen (2005) found that rural vulnerability were caused by both covariate and idiosyncratic shocks; whereas, urban vulnerability is largely determined by idiosyncratic shocks. Fluctuations and only 8% of urban households are vulnerable due to low consumption.

In brief, the short review of literature on empirical analysis of vulnerability provides several key findings. First, the vulnerability is a forward-looking concept. It captures effects of different shocks (idiosyncratic and covariate) on the behaviour of households. Second, vulnerability is caused by variations in consumption and income. Third, household characteristics, community characteristics, macro-economic changes, and different covariate shocks explains vulnerability.

3.2 Contribution of this study

This study is a relatively new approach to see the poverty situation of any specific area. Generally poverty is analysed by Cost of Basic needs (CBN) method, Calorie Intake Method etc. But this approach directly hit into the perception of poverty expressed by the households themselves. The calorie intake method deals with the body requirement of a person but this approach of meal frequencies expresses the economic phenomenon of consumption degradation reported by the household themselves.

This study will contribute to the literature of the empirical studies of poverty and microfinance by revealing the true nature of the vulnerability. The natural disaster like cyclone, flood and uprising sea water can cause huge disruption in this region and the impact of these disasters can be found in this analysis. Besides, the microfinance practitioners can be benefited by learning the result of the impact of microfinance for reducing vulnerability in that particular region. So this analysis can benefit Policy makers from home and abroad, researchers, academicians, development agencies, practitioners of NGOs, MFIs and Banks.

4 Chapter: Descriptive Analysis

4.1 Context of the study

The context of the study is to analyse determinants of the food consumption vulnerability of the extreme poor households in the southern region of Bangladesh. The analysed three districts – Khulna, Patuakhali and Satkhira are the most affected region of the natural disaster like cyclones and salinity in the cropping fields. The frequent natural calamities cannot let the households to get out of poverty. Besides, the seasonal income shock and unemployment also push them into poverty. The insufficient savings and access to flexible credit also a major hindrance to get out of poverty. In our analysis we will try to look into the detail of the vulnerability of food consumption and how the access to microcredit loans can make a difference in their life and generating sufficient income to consume food. Besides, we will also see the impact of natural disaster specially the last two big cyclones Sidr in 2007 and Aila in 2009 on the food consumption vulnerability.

4.1.1 Identification

In finding the determinants of the degree of vulnerability and finding the impact of a specific program, it is necessary to identify the analysing unit for conducting the whole research. Based on the identified groups, the program's impact can be analysed. In our analysis, the predefined “treatment” and “control” groups are not sufficient enough to capture the impact of microfinance in the study area as the new program “PRIME” is in the initiating phase and it is too early to analyse the program impact. Hence, we have selected our identifiers based on the existing microfinance member and non-members. Within the study regions regular microfinance operation are being conducted for decades and lots of households are experienced with this financial system in the rural areas. So we have identified two groups of households those who are having membership with an MFI and also taking loans or at least have taken one loan. We have called this group as participants and the households that are not having any membership with any MFIs or became member of a MFI very recently without taking any loan can be called as non-participants in the microfinance program. So unlike the usual definition of participants, the definition of this analysis is quite narrow and specified. It can be said that the participants are the long term members with having loans and non-participants are not members or very new members without loans. On the basis of these two groups the whole research analysis is organized and described.

Table 4: Microfinance membership within the study area

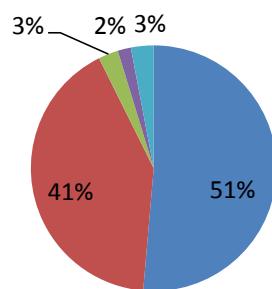
	Control area	Treatment area	Total
Microfinance non-participants	1,418 (41.13) (81.4)	2,030 (58.87) (90.83)	3,448 (100) (86.7)
Microfinance participants	324 (61.25) (18.6)	205 (38.75) (9.17)	529 (100) (13.3)
Total	1,742 (43.8) (100)	2,235 (56.2) (100)	3,977 (100) (100)
Pearson χ^2	<0.01		

Source: Author's calculation

In Table 4(above) it is clear that the microfinance participants are the 13.3% and non-participants are 86.7% of the total sample of 3,977. These participants and the non-participants are spread over the whole sample area like "treatment area" and the "control area". Among the participants, almost 61% live in the control area and 29% live in the treatment area whereas among the non-participants, 41% live in control area and 59% live in treatment area. But in terms of our analysis, the grouping of treatment and control has no importance, but can be used for further research. We have also applied the Pearson's Chi-square (χ^2) test to see if there any functional relationship within the two types of groups. The chi-square test is significance which implies that the two groups are independent of each other.

Figure 4: Duration of microfinance membership in years (as of 2011).

■ non-member ■ 1 ■ 2 ■ 3 ■ 4+



Source: Author's calculation

Note: This figure comprises the memberships irrespective of microfinance loans.

As we have already said the current members of the microfinance institutes are also considered as non-participants if there is no loan has been taken. So the statistics of the duration of membership in Figure 4 can be different as we observe. It is absolutely clear that the number of non-members are 51% and 41% of the sampled households have already got membership having loans or without loans. We have split this group in two parts, the households with loans are counted as participants and households without loans are counted as non-participants. Obviously, the number of non-participants becomes 86.7%. Among the

participants, 3% households are having membership of 2 years, 2% having membership of 3 years and 3% having more than 4 years. It is mentioned that the participants became member of the MFIs by their self-decision, so there is no imposed program over them. It is the self-selecting decision of the households in participating and non-participating.

4.2 Data description and analysis

In the present section we will focus on the descriptive analysis of the households' characteristics, socio-economic characteristics, community characteristics in terms of overall sample and by participation status as well.

4.2.1 Overall household characteristics:

In Table A1.1 (shown in the appendix) we have presented the summery statistics of the total sampled households. We have grouped the characteristics in terms of household head's characteristics, occupation, households' characteristics, infrastructure facilities, households' distance information, village characteristics, physical and financial assets, households' income and expenditure, households' loan information and households' coping mechanism with natural disaster. We will analyse these grouped characteristics by overall households and also by participants and non-participants.

Households' head characteristics: The average age of household head is 42 years and their average years of schooling are 2 years. Among the household heads, 85% are currently married. It is founded that 14% of the household heads are female (Table A1.1).

Occupation: About 53% of the households are wage earners or day labourer. They are paid in daily basis and their work mainly in the agriculture and non-agricultural sectors. About 10% of the households are self-employed in agriculture mainly doing agricultural works in their own or rented lands (Table A1.1). Agriculture also includes poultry and livestock. About 22% of the households are self-employed in non-agriculture which is mainly small traders, vendors, rickshaw puller, van puller etc. About 13% of the household heads' migrates for some months to look for jobs in other cities. This is one of the coping mechanisms of the households those who face a seasonal income shock during the specific period of a year.

Household characteristics: Household characteristics means household is a unit of analysis, not the individual. It is evident from the table that the average household size is four and sex ratio (number of female/number of male) is 1.2. The maximum years of schooling in the

households are 4.9 years and the migration of any household member to another place is about 18% (Table A1.1).

Infrastructure facilities: Almost 11% of the households have access to electricity, 79% of the households have access to safe-water from tube-well or tap water and 63% of the households have access to sanitary latrine (Table A1.1). These facilities are important because the safe water is a major concern in that region. Although the other parts of the country have safe drinking water, this part of the country suffers from salinity in the water is not potable. Usually the household has to collect safe water from distance or has to collect rain water in the monsoon.

Households distance information: Households' average distance from the main road is 8 kilometres and distance from small and big markets are 1.9 and 3.9 respectively. The distance from the nearest branch of MFI is about 3 kilometres. About 25% of the households remain in the *char* land (Table A1.1). *Char* land is the geographically inaccessible areas which are the mainly deltaic land in the sea or in the rivers.

Physical and financial asset: The physical and financial asset comprises lands, livestock and household savings. As in Table A1.2, Households' average landholding is 13 decimals and among them 4.9 decimals are for agriculture. Total using land is 11.7 decimals and non-using land is 0.5 decimals. Households also used some land that is not owned by them but they can use to cultivate those lands. These lands are called *khas* land (government property). It is about 5.7 decimals in average. The average number of cows and goats are 0.4 and 0.6 respectively and numbers of poultry are four. The average asset value of the households is about BDT 59,000 and the total saving of the households in the financial institutions is BDT 1,334.

Household income and expenditure: Average yearly income of households is BDT 49,903. Among them BDT 39,409 is the food expenditure and BDT 13,271 is the non-food expenditure described in Table A1.2.

Households' loan information: Households' average formal loan is BDT 1,234 and informal loan is BDT 1,643. Households' average yearly deferred payment amount is BDT 8,662.

Households' coping mechanism with disaster: Every year households in the sample area fall in natural disasters. Households experienced two major cyclone in past 4 years- Sidr in 2007 and Aila in 2009. The average of total unmet loss (loss that is not recovered) of households in

Sidr is BDT 5,404 and in Aila is BDT 9,260. Households' average loss in cyclone Sidr and Aila are BDT 7,452 and BDT 12,841 respectively. Average loss in last year crisis is BDT 1,700 and among the unmet loss is BDT 1,100. The average amount of social safety net received by the households is BDT 3,350 in last year (Table A1.2).

4.2.2 Household characteristics by participation status

Household heads' characteristics: The average age of household heads is 41.4 for the participants and 42.8 for the non-participants. The p-value is statistically significant at 5% level shown in Table A1.3 in the appendix. The means comparison test (t-test) is used to compare whether the groups are statistically different from each other. If the p-values are statistically significant then we can say that the mean of participants are statistically different from that of non-participants. The years of schooling of the household head is also statistically significantly different for participants (2.2) and for non-participants (1.9). The percentage of female headed household is 7.75% for the participants and 15.2% for the non-participants. This difference is also statistically significant at 1% level. It is found that 92% of the participant household heads migrates to another place whereas it is 83% for the non-participants. The difference is statistically significant at 1% level.

Occupation: The percentage of wage earning households doesn't significantly differ between participants and the non-participants which are shown at Table A1.3 in the appendix. About 52% of the wage earning households is participants and about 53.5% is non-participants. In the agricultural self-employment, about 12% is from participants and 10% from non-participants which is statistically significantly different from each other. In non-agricultural self-employment, 27% of the participants are employed whereas only 21% from the non-participants which is at 1% level of significance. Households migrating for works don't differ statistically significantly between participants and non-participants.

Household characteristics: The years of schooling are higher for the participants than that of non-participants. Participants possess 5.4 years of schooling on average than 4.9 years of non-participants where the difference is at 1% level of significance. Besides participants household size (4.4) is also statistically significantly different than the non-participants (4.0) at 1% level. Sex-ratio is same for both participants and the non-participants. The migration of any household member for work is also not significant here (Table A1.3).

Infrastructure facility: Participants have higher access to electricity and safe-drinking water than the non-participants. 17.2% of participants and 10.4% of non-participants have access to electricity which is statistically significantly different at 1% level. In case of tube-well or tap water, participants (89%) have higher access than non-participants (78%) at 1% level of significance. Both participants and the non-participants have access to sanitary latrine which is 64% of households (Table A1.3).

Households' distance Information: According to Table A1.3 in the appendix, the average distance from main road is 13.5 kilometres for the participants and 7 kilometres for the non-participants which is statistically significant at 1% level. Though participants' live in distant areas than the non-participants, the distance from small market, big market and the MFI braches are smaller for them than the non-participants. The average distance from big market is 3.5 kilometres for the participants than 4 kilometres of non-participants which is at 1% level of significance. MFI branch is 2.8 kilometres distant for the participants than 3.1 kilometres for non-participants. This distance differs statistically significantly at 1% level. About 40% of the participants and about 23% of the non-participants live in char area which is statistically significant at 1% level.

Physical and financial assets: The average of owned land is 15.2 and 12.7 for the participants and the non-participants respectively which don't differ statistically. The same is also true for the average agricultural land that has been shown in Table A1.4 in the appendix. On the other hand, the average using land statistically significantly differs between participants and the non-participants at 5% level. Participants have average using land of 14.6 decimal whereas non-participants have 11.3 decimal. The average occupied free land is higher in case of participants (10.7 decimals) than the non-participants (5 decimals) which is statistically significant at 1% level. It signifies that participants' uses more land for their cultivation. Participants have more poultry and livestock than the non-participants which are significant at 1% level shown in Table A1.4. The average asset value of the participants is higher than the non-participants. Participants possess average assets of BDT 68,184 which is higher than the non-participants' BDT 57,522 at 1% level of significance. Average savings of the participants (BDT 1,831) is also higher than the non-participants' (BDT 1,258) at 1% level of significance.

Household income and expenditure: Participants have more income and hence more food and non-food expenditure than that of non-participants. The average income of participants is

BDT 57,314 which is higher than the BDT 48,766 of non-participants' at 1% level of significance. Participants' food expenditure and non-food expenditure of BDT 45,616 and BDT 16,962 respectively are higher than BDT 38,456 and BDT 12,704 respectively of non-participants at 1% level of significance (Table A1.4).

Households' loan information: Participants have formal loans but non-participants don't have which is obviously statistically significant at 1% level. On the other hand, both participants and non-participants take informal loans which are shown in Table A1.4 in the appendix. The average informal loan amount of the participants is higher than the non-participants because participating households have more self-employment than the non-participants. Participants take informal loan of BDT 2,581 and non-participants takes BDT 1500 which are statistically significant at 5% level. Participants' entrepreneurship behaviour can be observed in the amount of deferred payment. On average, participants take BDT 13,410 of goods from deferred payment than BDT 7,934 of non-participants which is statistically significant at 1% level.

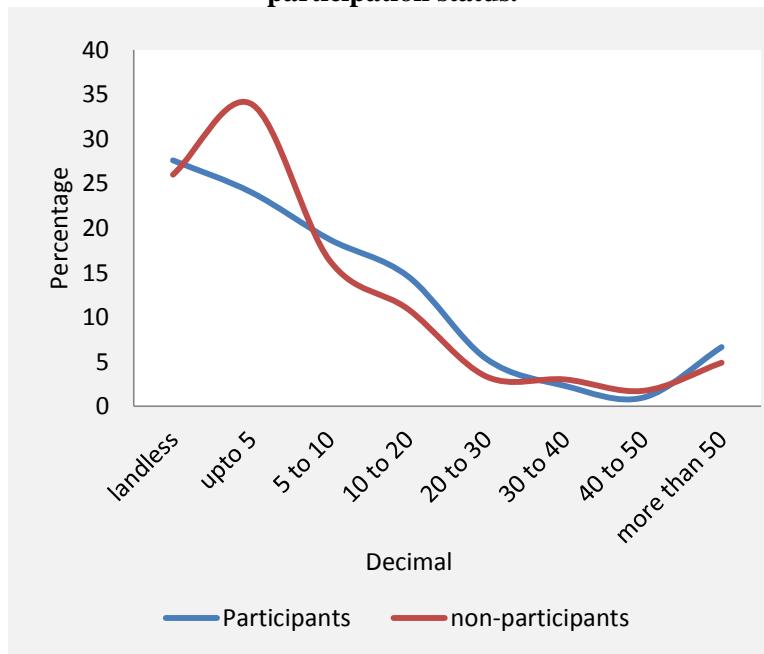
Households' coping in disaster: It is evident from the Table A1.4 that the loss in disaster and crisis is always higher than the non-participants. Participants lose more and they can also recover quickly with their entrepreneurship activities and live better than the non-participants. The average loss in cyclone Sidr (BDT 12,212) for participants is statistically significantly higher than BDT 6,721 of non-participants at 1% level of significance. As cyclone Side hit in 2007 and within this four years the recovery of the participants are better than the non-participants. On the other hand, cyclone Aila causes almost same amount of loss for both participant and the non-participants. Participants lost significantly higher than the non-participants in the last year's crisis. According to Table A1.4 the unmet loss in Sidr is significantly higher for participants (BDT 8,986) than the non-participants' (BDT 4,855) at 1% level of significance. Similarly, the unmet loss in last year crisis is also higher for participants than the non-participants at 1% level of significance. Interestingly, participants received less amount of social safety net amount than the non-participants. Participants got average amount of BDT 2,739 than BDT 3,445 of non-participants which is at 5% level of significance.

4.2.3 Classification of land by districts:

In Khulna district participants possess more owned land than the non-participants. This is also true for the districts Patuakhali and Satkhira (Table A1.5). In Khulna, participants have

17.3 decimals of owned lands which are greater than the 12.6 decimals of non-participants. In Satkhira, the average land holding for both participants and the non-participants is lower than district Khulna and Patuakhali. On the other hand in Patuakhali, the average agricultural land is higher than the other two districts. The participants of Patuakhali possess 7.8 decimals of agricultural land than the participants of the Khulna and Satkhira possessing 3.8 decimals and 3.5 decimal respectively. Surprisingly, the households in the Patuakhali districts use all of their land and they don't have any non-using land. The total operational land is higher in Patuakhali because it has more occupied free land (mainly *char* land) than the other two districts (Table A1.5).

Figure 5: Distribution of households over landholding and participation status.



Source: Author's calculation.

Distribution of households over land holdings: If we look at Table A1.6, we see that around 27% of the sampled households are landless. The highest percentage of landless households remains in Patuakhali district which is about 40% from participants and 33% from non-participants. On the other hand in Khulna and Satkhira, the percentage of landless households is smaller than the non-participants. In Khulna, the percentage of landless is 9.86% for participants which are smaller than 21.34% of non-participants. The Pearson chi-square value is statistically significant for this group- participants and non-participants in Khulna, Patuakhali districts and overall sample as well at 1% level (Table A1.6). The distribution of households over the landholding is more skewed to the landholding up to 15 decimals. The

majority of the households have less owned land and the participants possess more land holdings in each category than the non-participants (Figure 5). The skewness of the distribution of landholdings can be viewed in Figure 5 for both participants and non-participants.

Char characteristics: The distribution of households living in the *char* area is skewed to Patuakhali as 77% of the char living households live in this district and remaining 13% live in Khulna and 10% in Satkhira (Table A1.7). In the mainland, 53% lives in Satkhira and only 23% in Khulna in the total sample. The Pearson Chi-square is statistically significant at 1% level for mainland and char area group.

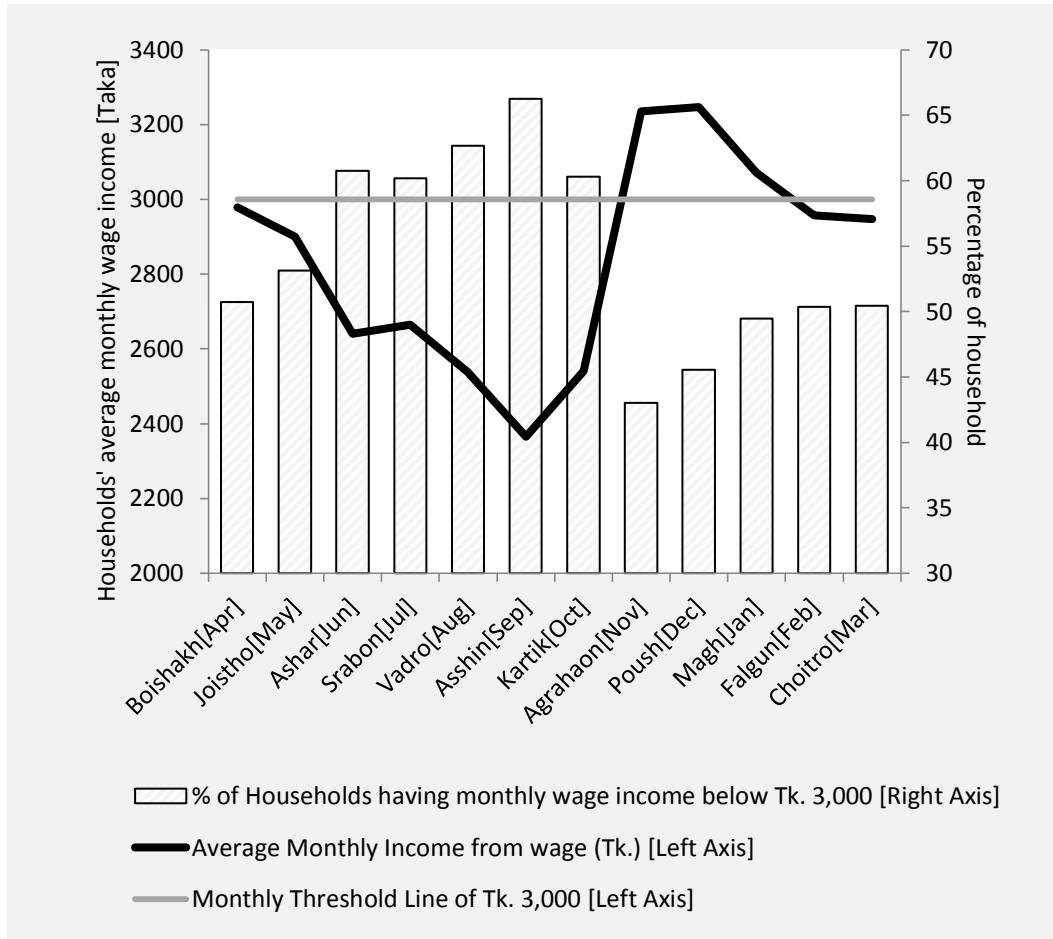
Now if we look at Table A1.8 in the appendix, we see 40% of the participating households live in *char* area whereas 23% of non-participants live in *char* area. The overall percentage of char living participants is higher because 77% of participating households live in *char* area in Patuakhali which is much higher than the other two districts. The Pearson chi-square value is statistically significant at 1% level for Khulna, Satkhira and overall as well.

4.2.4 Occupation

We have classified the diverse occupation of the sample area into 3 major categories- wage worker, self-employed in agriculture and self-employed in non-agriculture. We have also identified migration for work is an important characteristic for evaluating the vulnerability. It is evident that in Table A1.9, for each categories of occupation the difference within the group is statistically significant which is shown by Pearson chi-square test and it shows at 1% level of significance. The percentage of wage-earning households is higher in Satkhira (42%) than Patuakhali (33%) and Khulna (25%). About 47% of the household those who are self-employed in agriculture live in Patuakhali and Satkhira districts. The percentage of self-employed in non-agriculture is also higher in Satkhira district (51%) than the other two districts. The percentage of migration for work is almost equally distributed in the three districts (Table A1.9).

Seasonal dynamics of wage labor: In the southern part of Bangladesh the seasonality of occupations of the households doesn't follow any specific pattern. The lean period varies by occupations. In Figure 6, we have tried to focus on the dynamic of seasonality in the study area. The bold black line represents the average monthly wage income and the fade straight line represents the threshold level of household income at BDT 3,000.

Figure 6: Seasonal Dynamics of Households' Monthly income from wage labor.



Source: Author's calculation.

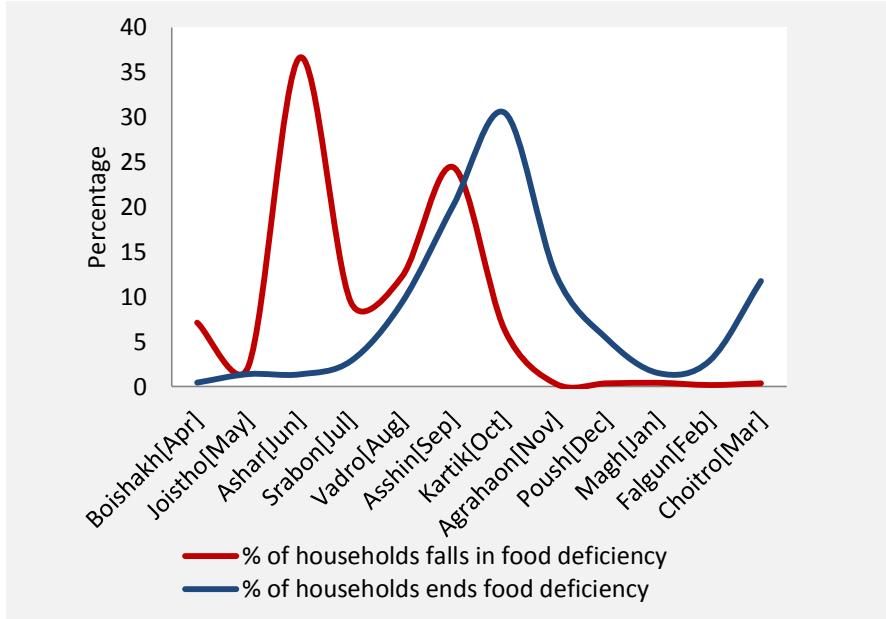
The shaded bar-diagram represents the percentage of households having monthly wage income below threshold standard level BDT 3,000. In the figure the seasonality is clearly evident. Average monthly income starts to fall from Bengali month *Boishakh* [April] and continues to fall until *Asshin* [September]. The mean income of the households fall in this months and the percentage of households living below BDT 3,000 also increases which can be observed by the bar diagram. The bar chart of these months is higher than the other months. This is the lean periods reported by the households. The average month of crisis period is 3.5 reported by the households. This period is the monsoon period in Bangladesh when the majority of the crop cultivation is hampered by flood and monsoon rain and even by salinity. The wage earning households have to lose their daily income because of unavailability of jobs.

After the month of *Asshin* [September], the wage income starts to rise again as it starts for cropping in the field and the beginning of autumn and winter seasons. Farmers start to crop their cultivation and they employed the seasonal labor in their fields. Hence the wage income

starts to rise until the end of *Poush* [December]. Again the wage income starts to decline from *Falgun* [February] and the same process repeats every year. In this period of September to February, households earn good income (more than BDT 3,000) to consume food and non-food expenditure. We can see from the bar chart that the percentage of households having monthly wage less than BDT 3,000 is lowest in *Agrahaon* [November] and it is about 43% which is lower than the highest 67% in the month of *Asshin* [September]. It is evident from the figure that households have good income for four months and percentage of households earning more than BDT 3,000 is for only five months. Seasonality is not a problem if they could have savings enough to ensure food security in lean periods. But in the study area, the households can't make enough savings and loans to make them better off in the lean periods.

The seasonality in wage-earning also induces the food consumption pattern of the households. They have reported that the starting month and the ending month of their food consumption changing pattern. Figure 7 clearly depicts the diverse pattern of starting and ending month of the food deficiencies of the households.

Figure 7: Starting and ending month of households' food deficiency



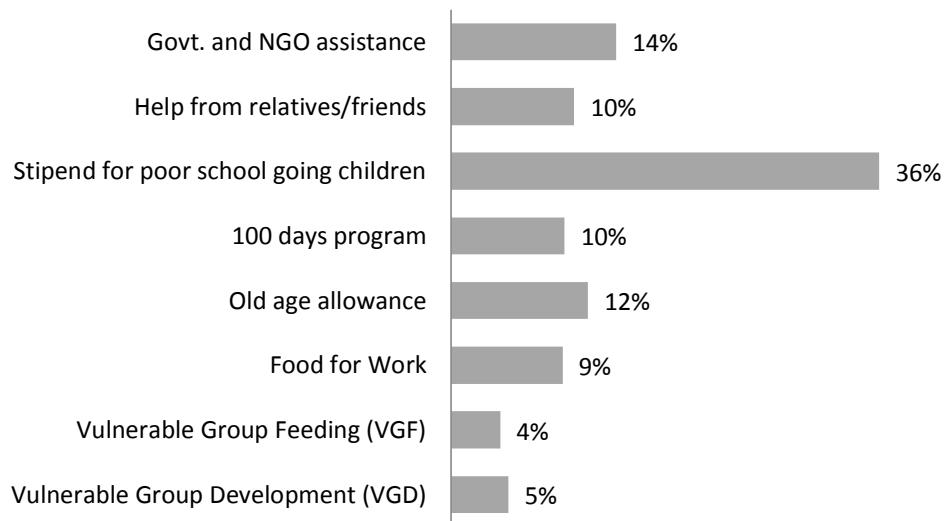
Source: Author's calculation.

More than 35% of the households reports that their deficiencies start on *Ashar* [June] and 25% reported on *Asshin* [September]. On the other hand almost 32% of the households reported that they end food deficiencies on *Kartik* [October]. The average length of food consumption deficiency is 3.5 months. From the figure, it can be said that from October to March most of the households end their food consumption deficiency and it starts again from

April and continues until September. Though households have prior knowledge about this cycle, they can hardly do anything against this shock.

4.2.5 Social Safety Net Program:

Figure 8: Percentage of household received Social Safety Net program in 2010-11.(N=2771)



Source: Author's calculation.

Social safety net program is the assistance program to alleviate poverty in the country. Generally it is given by the government authorities to the households those who are very poor and have no earning sources. In Figure 8, we can see the percentage of households receiving social safety net program in year 2010-11. It is found that 14% of the households have received Government and Non-government assistance in the study area. It is mentioned that the percentage of household receiving the safety net are not mutually exclusive i.e. any household can receive more than one program. It is clear from the figure that 10% of the households received 100 days program, 12% households received old age allowances, 9% received food for work, 4% received VGF and 5% received VGD program. VGD and VGF and 100 days program are offered aiming at to help the destitute people by providing some temporary works in the respective areas. 36% households receiving the students' stipend is the government's step to educational assistance to the school going poor households who have high chance of dropping out due to poverty. Some households also got assistance from their friends and relatives. About 10% of the households received relatives' help to mitigate their crisis situation in last year 2010-11.

4.2.6 Households' access to credit

Access to credit is the important instrument to smoothen consumption and investment. According to Friedman (1957), the change in consumption caused by shocks to income could be smoothed sufficiently by perfect capital market borrowing as the household would try to maximize utility. According to the theory, households will borrow from capital market when they have low transitory income. So if we look at the capital market, it is evident that the market is not perfect and the households possess asymmetric information to get into the credit market. Again, the credit constraint – quantity constraint, transaction cost constraint and risk rationing all these struck the household not to participate in the credit market. However, the credit is obvious and households seek for credit when they are in need either from formal credit market or informal credit market. Formal credit market comprises with banks, microfinance institutions, co-operatives etc. On the other hand, informal credit market comprises with money lenders with high interest rate, relatives etc. Table A1.10 highlights the percentage of households those who experienced credit from different sources. It is found that about 75% of the households couldn't avail any loans either formal or informal. Only 9% households have taken loans from the formal credit market and 14% households from the informal market. On an average 3% households have taken loans from both formal and informal market. It is mentioned that Table A1.10 represents the percentages that are mutually exclusive.

If we observe the district-wise loan information, we see that access to formal credit didn't increase more than 10% in any districts. On the other hand, the informal credit reached up to 18% in Satkhira. It is also evident from the table that households in Khulna district have experienced less credit from either formal or informal market relative to Patuakhali district.

4.2.7 Households' food consumption vulnerability

The prime aim of this study is to analyse the food consumption vulnerability. Households reported that they have changes in their food consumption frequencies due to the seasonal income shock. Households find themselves capable enough to buy their daily food in normal period but they ration their consumption in lean period. Table 5 represents the distribution of households having frequencies of food consumption in both normal and lean period. It shows that in normal time, about 0.28% of total households suffer from occasional starvation, 19% experience consumption rationing and more than 80% of the households enjoy full 3 meals in

a day. But in lean period, about 9.46% of households fall in occasional starvation, 73% suffer from consumption rationing and only 17.46% can consume full 3 meals in a day.

Table 5: Transition matrix of households food consumption vulnerability

Consumption ordering in normal time	Consumption ordering in lean time			Total
	Occasional Starvation	Consumption rationing	Full 3 meals in a day	
Occasional Starvation	6 (54.55) (1.62)	3 (27.27) (0.1)	2 (18.18) (0.29)	11 (100) (0.28)
Consumption rationing	232 (31.02) (62.7)	508 (67.91) (17.77)	8 (1.07) (1.17)	748 (100) (19.12)
Full 3 meals in a day	132 (4.19) (35.68)	2,348 (74.47) (82.13)	673 (21.34) (98.54)	3,153 (100) (80.6)
Total	370 (9.46) (100)	2,859 (73.08) (100)	683 (17.46) (100)	3,912 (100) (100)
Pearson χ^2	<0.01			

Source: Author's calculation, Note: Normal time represents when households earn more than BDT 3,000 and lean period represents when they earn less than this amount. For details, see Figure 6 and Figure 7.

In Table 5, the red shaded cells represent the number of households fall in occasional starvation in lean period from normal period. This group of households are vulnerable of degree 2, because the benchmark is full 3 meals in a day. The pink shaded cells represent vulnerability of degree 1, as these households degrade one degree from the benchmark level and previous level. The green shades show the number of households become better off in their mentioned lean period. Though they don't have sufficient income and employment, they can consume full 3 meals or at least consumption rationing which are better than their normal period consumptions. They actually gain some benefit of seasonality. But the households those gain are very insignificant in number and not an important criterion for the analysis. The majority of this group comes from the previous full 3 meals group and they continue it during their lean period also meaning they have sufficient saving and income source to maintain a consistent consumption frequencies.

The households those were in starving occasionally in normal period have switched to consumption rationing and full 3 meals categories in lean period. About 27% of them switched to consumption rationing and 18% to full 3 meals category in lean period. But in absolute term, the numbers of households are only 3 and 2 respectively. On the other hand,

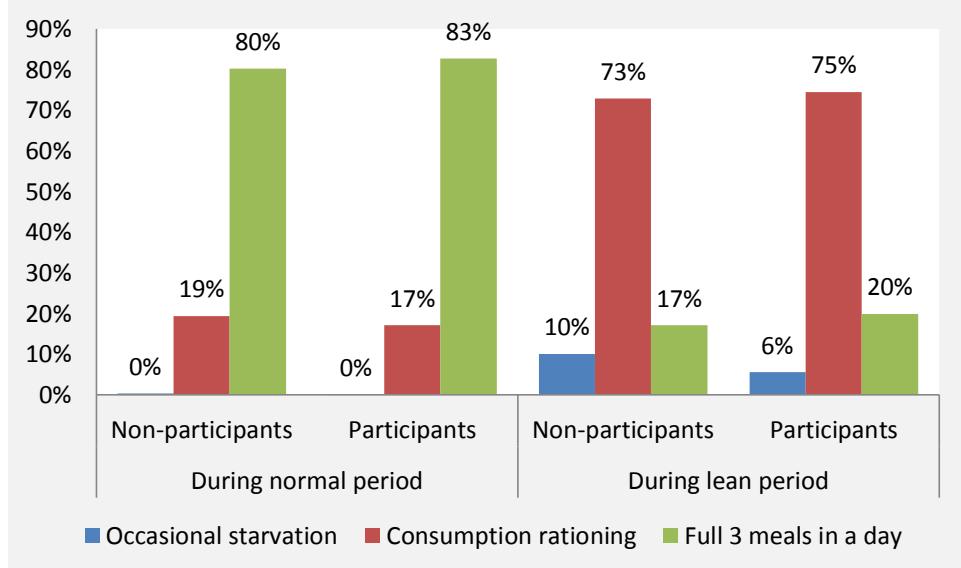
households those who were experiencing rationing their consumption, about 31% of them fall in occasional starvation, 68% remain in the same group in lean period. It is also clear from Table 5 that the households who were enjoying full 3 meals in normal time, about 4.19% of them fall in occasional starvation, 74% fall in consumption rationing and only 21% could continue their regular full 3 meals in lean time. In this table we are interested in the red and pink shaded cells where the most vulnerable households belong to.

Vulnerability by microfinance participation status: To find out who are most vulnerable in lean period, we are interested to look at microfinance participation status of the households. We have classified the distribution of households for food consumption frequencies by participants and non-participants. It is evident from Table A1.11 that the microfinance participating households are better off in lean period than the non-participants. Only 5.6% of the participants fall in occasional starvation during lean period which is smaller in comparison with the 10.04% of non-participants. About 75% of the participating households ration their consumption during lean period in comparison with 73% of non-participants. So consumption rationing doesn't differ much between participants and the non-participants. However, in full 3 meals category, participants are better off than the non-participants. About 20% of the households enjoy full 3 meals in lean period whereas only 17% non-participants enjoy it in lean period (Figure 9). It is important to know that the Pearson chi-square value in lean period for participants and non-participants is statistically significant at 1% level. However, this chi-square test for these two groups is not significant in normal period. The significance of chi-square value in lean period demonstrates the impact of microfinance in lean period food consumption and it makes a difference between participants and non-participants.

Degree of vulnerability: As we have already discussed the definition of the degree of food consumption vulnerability in Table 1 and in Table 5, we can see the percentage of households experiencing the degree of vulnerability in Figure 10. The change in consumption ordering from normal period to lean period that we call vulnerability is highest for the consumption rationing group. Households from full 3 meals and also remaining rationing group comprise this new group in lean period and this constitutes about 73% of the total households. Only 17% of the sample households are not affected by this kind of vulnerability in food consumption. The worst case i.e. the 2 degree of vulnerability is about 9.46% of households. These 9.46% of the households have to starve occasionally during the lean period which is driven by the seasonal income shock. The -1 and -2 degree of vulnerability which actually

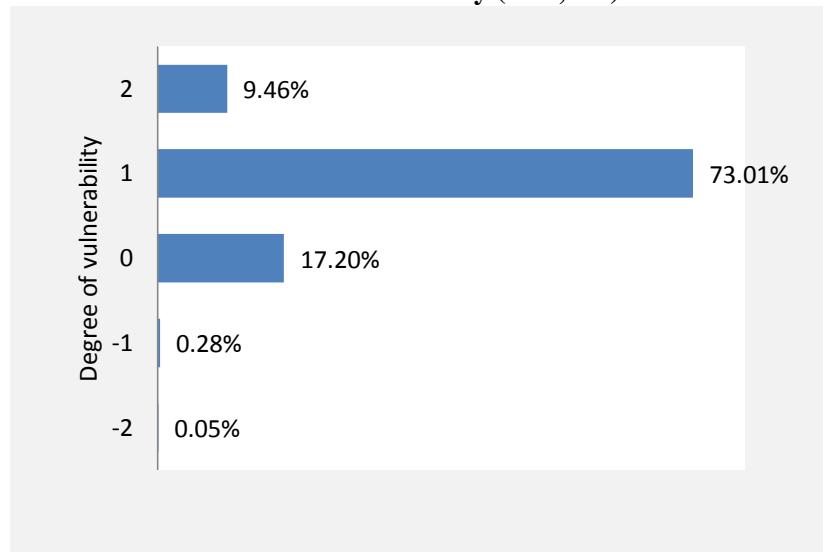
represent the better off situation in lean period are very insignificant in number, only 0.28% and 0.05% of the households.

Figure 9: Percentage of household having consumption ordering in two periods by participation status. (N=3,924)



Source: Author's calculation

Figure 10: Percentage of household encountering the different level of vulnerability (N=3,912)

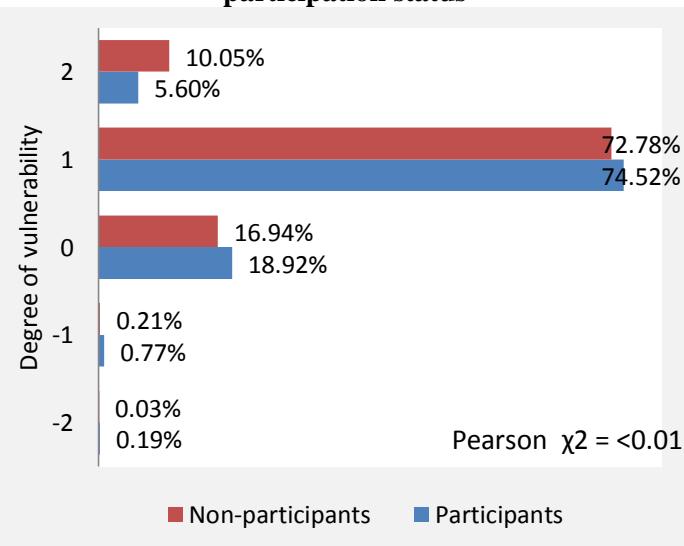


Source: Author's calculation.

Note: Degree of vulnerability ranges from +2 to -2, where +2 represents the highest level of vulnerability; 0 represents there is no vulnerability in food consumption between normal period and lean period; -2 represents the negative vulnerability which actually represents the better off situation between two periods. Some households are found to be better off during the lean period by increasing their number of meal consumption per day. The definition of degree of vulnerability has been discussed in Table 1.

If we observe the degree of vulnerability with respect to participant and non-participant in Figure 11, we see participants are in better off position than the non-participants. In 2 degree of vulnerability, participants are only 5.6% whereas non-participants are 10.05%. For one degree of vulnerability, both participant and non-participants are very close to each other. And obviously for zero degree of vulnerability, participants have higher percentage in share than the non-participants. Again, for -1 and -2 degree though insignificant, participants possess higher percentage in share than the non-participants. So it can be said that participants are better off than the non-participants.

Figure 11: Degree of vulnerability by microfinance participation status



Source: Author's calculation.

Degree of vulnerability by selected household characteristics:

It is very important to know about the households characteristics with respect to degree of vulnerability. Years of schooling in term of degree of vulnerability, the participants have more schooling years than the non-participants. It is also noted that the participant and non-participants those who have more years of schooling are less vulnerable to food consumption. For 2 degree of vulnerability, the participants have on average 2.3 years of schooling which is higher than the 1.4 years of non-participants. The size of households don't make any significant difference between participants and non-participants but they show a trend that if the size of household increases, degree of vulnerability also increases (Table A1.12). In case of migration for works, the higher the percentage of migration the less vulnerable they are. For both participants and non-participants, the percentage of migration is lower for 2 degree of vulnerable group than zero degree of vulnerability group. For almost all degrees of

vulnerability, the participants migrated more than the non-participants (Table A1.12). It is evident from Table A1.12 that participating households have more owned land than the non-participants. The more the land they have the less vulnerable they are. For participants, land ownership is higher for zero degree than the two degree of vulnerability. Participants have 26.31 decimal of land those who remain in zero degree vulnerability. On the other hand, participants have only 9.53 decimal of land and remain in two degree of vulnerability.

Being a wage-earner increases the degree of vulnerability (Table A1.13). In most vulnerable group 72% participants and 54% non-participants are wage earners. Conversely, for zero degree of vulnerability group 35% participants and 40% non-participants are wage earners. It is also noted non-participants possess higher percentage in wage-earning activities than the participants. Income is an important determinant of defining vulnerability. Participants have more income than the non-participants in all vulnerability level. The mean income of participants in zero degree vulnerability is BDT 69,733 which is higher than BDT 53,799 of one degree of vulnerability. Conversely, income for participants for zero degree is BDT 69,733 which is higher than BDT 61,962 of non-participants (Table A1.13). Same comparison is also true for other degree of vulnerability. According to Table A1.13 food and non-food expenditure for participants are higher than the non-participants. And obviously the more expenditure on food and non-food the less vulnerable the household is which is clearly evident in Table A1.13.

For formal credit it is only the participant's takes loans by default. For informal credit, the more they receive the more vulnerable they are (Table A1.14). Informal loan shows a positive trend with the degree of vulnerability which can be analysed by vulnerability 0 and 1 degree in Table A1.14. In zero degree vulnerability group, participants received social safety net of BDT 4,082 which is higher than BDT 2,952 of non-participants (table). Participants have higher savings than non-participants in all level of vulnerability. The more savings they have, the less vulnerable they are. Participants with two degree of vulnerability have savings of BDT 1,588 which is clearly lower than saving of BDT 3,132 of zero degree vulnerability group (Table A1.14).

In case of unmet loss in cyclone Sidr and Aila, it is clear from Figure A.1 that participants have more unmet loss than non-participants. It is evident from the Figure A.1 that participants lost more and they also get recovered quickly and made them better off in term of food consumption vulnerability.

4.2.8 Crisis and coping

The disaster like cyclones and tsunamis generating from the Indian Ocean and also from the Bay of Bengal first hit in this region and cause massive devastation of properties and human lives. The people in this region possess the courage to fight with disaster and refurbish again. According to Table 6, 23% of the sample households were affected only by cyclone Sidr (2007), 38% by only cyclone Aila (2009) and about 75% were affected by any one of these two. 14% of the households reported that they were affected by the both cyclones and about 25% reported that they were not affected by any of these two cyclones.

Table 6: Percentage of households are affected by the last two major cyclones -Sidr (2007) and Aila (2009)

Households affected by	(N=3,977)
Only Sidr	23%
Only Aila	38%
At least one of these cyclones	75%
Both cyclones	14%
Not affected by any of these two	25%

Source: Author's calculation

Households incur different types of losses in last two big cyclones Sidr and Aila. Most of the households reported that their house had been broken, death of livestock, damage of trees and garden. About 47% households reported broken of houses in Aila and 55% reported in Sidr (Table A1.15). About 19% of the households lost their livestock in each of the cyclone. Aila also destroyed the trees of 20% of households. Conversely it was only 12% in Sidr. Table A1.15 describes the all types of losses that incurred by the households.

Among the various remedial measures the first one that comes to hand is savings (22% households used it). Besides savings other assistances like- from government and non-governmental organization, relatives are worth to mention (Table A1.16). Almost 9% of households received government assistance in both cyclones and about 6 to 8 percentage of households received non-government assistances. Moreover 9% households in Aila and 11% in Sidr seek assistance from relatives. The other remedial measures such as formal credit, informal credit, advanced sale of crops, advanced sale of labor, insurance, land leasing, selling of land, animal and assets are also to be mentioned. It is also remarkable from Table A1.16 that almost 45% households in Aila and 40% in Sidr couldn't attempt any remedial measure which drives them to more vulnerable state.

5 Chapter: Econometric Results and discussion

5.1 Regression Model

As the dependent variable “vulnerability” is an ordered variable and we want to regress it on the other continuous and dummy variables, we will use ordered probit model to estimate the determinants of vulnerability. The ordered probit model for regression analysis can be defined very simply as-

$$V_i^* = \mathbf{X}'_i \boldsymbol{\beta} + \delta \mathbf{D}_i + \varepsilon_i$$

Where,

V_i^* = Food consumption vulnerability for individual i (ordered from -2 to +2)

\mathbf{X}_i = vector of observed continuous variables like household and family characteristics, infrastructure facilities, occupation, physical and financial assets, household income, expenditure and consumption of individual i .

D_i = Dummy of some idiosyncratic and covariate shocks, effect of cyclones, occupations, infrastructure facilities, member of microfinance etc.

5.2 Discussion of Regression Results

Based on our hypothesis and descriptive analysis, the determinants of the food consumption vulnerability are shown in this section. Though the descriptive analysis of the previous section showed important distinction for the microfinance participation and the determinants of the food consumption vulnerability, the econometric estimations are needed to see the causal relationships among the variables. Here the regression results consist of three parts- *Heckman test for selection bias*, *Ordered Probit estimation*, and *Propensity score matching* estimation. The regression results of these three models are shown below-

5.2.1 Heckman Probit model- Test for selection bias

Econometric analysis based on non-randomly selected samples may lead to erroneous results which may end up with poor policies. The Heckman correction which is a two-step statistical approach provides the solution of this problem. Heckman's correction involves a normality assumption and provides test for sample selection bias. Before we proceed to our main regression estimation of ordered probit model, it is necessary to check the sample selectivity biasness in the sample data. As we have encountered some genuine missing values (65 missing values) in our dependent variable, it is a must to check for selectivity biasness.

Heckman's two-step model is a solution to check our dataset. If there is no selection biasness is found then we can directly use ordered probit model for our estimation.

In the Heckman two-step model we have used microfinance membership which may create endogeneity problem with another dependent variable - degree of vulnerability. As the method of this model is already discussed in the section 2.3.2, we will directly focus on the result of the model. Table A1.17 exhibits the Maximum Likelihood estimation and also for Heckman two-step estimation. It is apparent from the ML estimation that the most of the explanatory variables are significant as we expected in our hypothesis. To test for biasness in our model, we examine the relationship between the residuals for the two stages (stage 1 for microfinance membership and stage 2: degree of vulnerability). If the unobserved variables in the selection model are correlated with the unobserved variables in the stage 2 model, then we have encountered biased estimates which implies that unobservable in selection of microfinance membership are affecting the determinants of the degree of vulnerability.

Nevertheless, it is important to observe the rho (ρ) and lambda for the sample selectivity biasness. In Table A1.17, both athrho (transformation of rho) and lnsigma (transformation of sigma) are significant at 5% and 1% level respectively. However, the Chi-square value for LR test of independent equations (rho = 0) is 1.16 which is not statistically significant. This result signifies that though rho is negative i.e unobservables are negatively correlated to each other but they are not statistically significant as the p-value is 0.28. This result pronounces that there is no selection bias in our model. According to Heckman two-step model, if ρ is non-significant, we can say that there is no evidence of selection bias and no reason for applying the two-step selection model. The same conclusion can also be drawn from Mills lambda. If Mills lambda is insignificant then we can say that there is no selection bias. In our analysis we have found Mills lambda of -7.94 and p-value 0.88 which is not significant at all. So we can definitely say that there is no selection bias in our model and we can use ordered probit model directly to estimate our determinants of vulnerability.

5.2.2 Ordered probit model

Unlike the ordinary regression setting, the interpretation of the coefficient in the ordered probit model is more complicated and direct analysis of the estimated coefficients would be ambiguous. One should look at the marginal effect of the each ordered dependent variables and can compare how much per unit change in independent variables likely cause the change in dependent variable. In our analysis of Table A1.18, we have showed both estimated

coefficient of the ordered probit model and the marginal effects as well. The normal coefficient represents that a one unit increase in explanatory variable changes the Z-score by β unit. So β coefficient shifts the Z-score by that amount which may or may not change the prediction of dependent variable. So only the coefficient of the ordered probit model is not sufficient to predict the results. For example, for one year increase in *years of schooling* of household head can decrease the Z-score by 0.023 units at 1% level of significance but this doesn't tell us how much it reduces the food consumption vulnerability. So we merely focus on marginal effect of the explanatory variables to each ordered choice. Here will discuss the results according to the characteristics.

Household head characteristics

Age of household head exhibits positive sign to the degree of vulnerability. For one year increase of age escalate the chance of reporting 2° as well as 1° vulnerability by 0.0001% point at 10% level of significance (Table A1.18). Conversely, increasing age reduces the likelihood of being in zero degree vulnerability by 0.001% at 10% level of significance. So we can say that though the marginal effect of age on 2 and 1 degree of vulnerability are very minimal, it exhibit a positive trend which is obvious in empirical research and very important determinant of vulnerability.

The variable *Years of schooling* exhibits reduction of the degree of vulnerability. For one year increase in the *years of schooling*, decrease the chance of reporting 2° vulnerability by 0.3% and 1° vulnerability by 0.2% at 1% level of significance. Conversely, it improves the chance of being 0° vulnerability by 0.5% at 1% level of significance. Hence, *years of schooling* of the household head is very important determinant of the food consumption vulnerability. Being a *female headed household* doesn't statistically significantly affect the degrees of vulnerability at any level (Table A1.18).

Household heads' Occupation

Occupation of household head as determinant of vulnerability is very important characteristics. *Wage earners* are 2.5% point more likely to report 2° vulnerability at 1% significance level and 2% more likely to report 1° vulnerability at 5% significance level (Table A1.18). Conversely, being wage earner households' report 4.4% less likely to remain in the zero degree vulnerability at 5% significance level and 0.1% less likely to remain in the -1°

vulnerability at 10% level of significance. So *wage earners* are more vulnerable to food consumption vulnerability.

Being *self-employed* improves the situation. Self-employed households are more likely to report the decrease of 2° vulnerability by 1.8% point and 1° vulnerability by 1.4% point both at 5% level of significance. Conversely being self-employed households report 3.1% point more likely to remain in the zero degree vulnerability at 5% level of significance and remaining in the -1° vulnerability by 0.1% point at 10% level of significance (Table A1.18). In all cases, the -2° degree vulnerability are statistically insignificant because of less sample size for this group.

Self-employment in agriculture statistically significantly affects the 1° vulnerability as it cause an increase of 1° vulnerability by 1.2% point at 1% level of significance. This results implies that self-employment in agriculture is a risky business in this region where the natural calamities are more frequent to hit. Conversely it reduces the likelihood of being in the zero degree vulnerability by 3.6% point at 10% level and -1° vulnerability by 0.1% point at 10% level of significance. Besides, *self-employment in non-agriculture* is not significantly impacting the degrees of vulnerability at any level according to the Table A1.18.

Migrations for work are also important determinants for the food consumption vulnerability. A migrating household can reduce the 2° vulnerability by 3.4% point at 1% level of significance and 1° vulnerability by 4.2% point at 1% level of significance (Table A1.18). Conversely, Migrating household are more likely to report being in the zero degree and -1° vulnerability by 7.3% point at 1% level and 0.2% point at 5% level of significance respectively. So impact of migration for reducing vulnerability is enormous and very effect determinant as well.

Household Characteristics

Household size is an important determinant of vulnerability. According to Table A1.18 a one unit increase in the household size will more likely to increase the 2° vulnerability by 1.3% point and 1° vulnerability by 0.9% point both at 1% level of significance. On the contrary, it also reduces the likelihood of being in the zero degree vulnerability by 2.1% point at 1% level of significance.

Sex-ratio doesn't have any statistically significant impact on the degrees of vulnerability at any level (Table A1.18).

Infrastructure facilities

Access to electricity doesn't have any statistically significant impact on the degrees of vulnerability at any level. On the contrary access to safe water and sanitary latrine possess significant impact for degrees of vulnerability.

Having *tube-well water* reduces the 2° vulnerability by 2.2% point at 5% level and 1° vulnerability by 1.3% point at 1% level of significance (Table A1.18). Conversely having safe water increases the likelihood of being in the zero degree vulnerability by 3.4% point at 1% level and -1° vulnerability by 0.1% point at 5% level of significance.

Having *sanitary latrine* reduces the 2° vulnerability by 1.3% point at 5% level and 1° vulnerability by 0.9% point at 5% level of significance. Conversely having *sanitary latrine* increases the likelihood of being in the zero degree vulnerability by 2.2% point at 5% level of significance (Table A1.18).

Households' distance Information

In the households' distance information the important significant variables are distance from main road, distance from small market and distance from nearest microfinance branch. According to Table A1.18, household's position being one kilometre distant from main road increases the chance of 2° vulnerability and 1° vulnerability by 0.2% point each at 1% level of significance. On the contrary it reduces also the chance of being in the zero degree of vulnerability by 0.4% at 1% level of significance. So *distance from main road* is an important determinant.

Surprisingly, the increased *distance from small market* place reduces the degree of vulnerability. This signifies that the people those who are in the sample are much far away from the nearest small market and big market. Though the sign is opposite of our expectation, it basically depicts the importance of consumption pattern than the trading pattern. So the degrees of vulnerability may not decline if a household remains very close to market place. It may increase the trading behaviour of the particular households but without the surplus production participating in the small market trading isn't sufficient enough to reduce the food consumption vulnerability, especially in the region where wage earners are already vulnerable. So it may be logical that market place can less likely to change the food consumption vulnerability. In Table A1.18 it says that being a household in the distant from

small market place can reduce the 2° vulnerability by 0.6% point at 1% level and 1° vulnerability by 0.4% point each at 1% level of significance.

Distance from big market place and households' position in the *char area* doesn't statistically significantly impact the degrees of vulnerability in our analysis.

Distance from nearest microfinance branch also exhibits the same relationship like *distance from small market place*. It postulates as distance increases households become less vulnerable. One explanation of this phenomenon is that less participation status in the microfinance institutions. Participants sometimes collect loans from distant MFI branches as households' self-inclusion in the microfinance program clearly exhibits the demand driven phenomenon. For one kilometre distance from the nearest microfinance branch reduces 2° vulnerability by 0.8% point and 1° vulnerability by 0.6% point each at 1% level of significance. Conversely it exhibits the likelihood of being in the zero degree vulnerability by 1.3% point at 1% level of significance (Table A1.18).

Physical and financial asset

Household physical and financial assets such as land, livestock and savings are very important determinants in our analysis. Having *own land* and *free lands* exhibit decline of vulnerability, but in the marginal effects are close to zero. On the contrary, having *owned cow* exhibits the significant reduction in the vulnerability. For each cow the likelihood of reducing 2° vulnerability by 0.8% point and 1° vulnerability by 0.6% point at 1% level of significance each (Table A1.18). Conversely, having each cow increase the likelihood of being in the zero degree vulnerability by 1.4% at 1% level of significance. So, cows are more responsive than other assets for the household because they can sell the milk every day and purchase better food. *Poultry* significantly exhibits the same trend like cows but *goats* don't.

On the contrary, savings is the key determinant to reduce vulnerability. For yearly savings of BDT 10,000 the likelihood of reducing the 2° vulnerability by 0.8% point and 1° vulnerability by 0.6% point at 5% level of significance each (Table A1.18). Conversely, having savings also improves the condition of being in the zero vulnerability by 1.4% point at 5% level of significance.

Household income and expenditure (Yearly)

Household *income* and *food expenditure* exhibit the same trend in reducing vulnerability. For the yearly income of BDT 10,000 reduces the likelihood of 2° vulnerability by 0.5% point

and 1° vulnerability by 0.3% point at 1% level of significance (Table A1.18). Conversely having income of this amount also improves the possibility of remaining in the zero vulnerability state by 0.8% point at 1% level of significance. For food expenditure of BDT 10,000 will reduce the likelihood of 2° vulnerability by 1.8% point and 1° vulnerability by 1.3% point at 1% level of significance. On the contrary, *non-food expenditure* of BDT 10,000 will increase the likelihood of 2° vulnerability by 1.3% point and 1° vulnerability by 1.0% point at 1% level of significance. Conversely it also reduces the possibility of remaining in the zero degree vulnerability by 2.2% point at 1% level of significance (Table A1.18).

Households' loan information

Households' *formal loan* doesn't exhibit any marginal impact on the food consumption vulnerability in the regression analysis. Rationale behind such result is that the number of households taken formal loan is limited in number. However, *informal loan and purchase on deferred payment* exhibit statistically significant impact on vulnerability. For each BDT 10,000 amount of informal loan increases the likelihood of 1° vulnerability by 0.4% point and 1° vulnerability by 0.3% point at 10% level of significance (Table A1.18). The same result is true for *purchase on deferred payment*.

Households' coping in disaster

Households' *unmet loss in Sidr* in 2007 exhibits negative relationship with the degree of vulnerability. It exhibits for BDT 10,000 unmet loss in Sidr reduces the likelihood of 2° vulnerability by 0.7% point and 1° vulnerability by 0.5% point at 1% level of significance each. The rationale behind such result is that unmet loss in long past doesn't impact the current consumption of the households. It shows households can bear their livings though their losses are not recovered yet. The *unmet loss in Aila* (2009) and *unmet loss in last year crisis* (2010-11) do not exhibit any marginal impact on vulnerability (Table A1.18).

Social safety net programs don't improve vulnerability situation, rather worsen it. For BDT 10,000 social safety net amount the likelihood of increasing the 2° vulnerability by 0.8% point and 1° vulnerability by 0.6% point at 10% level of significance. Rationale behind of this result is that social safety net amount is very small amount relative to their needs and it creates dependency on aid rather than income generating activities.

Microfinance membership

Microfinance membership reduces the degrees of vulnerability in each level. For being participants in the microfinance program reduces the likelihood of 2° vulnerability by 2.3% point at 5% level of significance and 1° vulnerability by 2.3% point at 10% level of significance (Table A1.18). Being participants also improves the possibility of being in the zero degree vulnerability by 4.5% point 10% level of significance. So microfinance participation is very responsive to the reduction of food consumption vulnerability.

5.2.3 Propensity Score Matching (PSM)

Propensity Score Matching (PSM) technique is a sophisticated tool for program evaluation. It deals with treatment and control groups. For each individual in the treatment group a matching individual is found on the basis of observable characteristics with an identical individual in the non-treatment group. What is required is to match each individual in the treatment group with individuals sharing similar characteristics in the non-treatment group. In this study we will analyze the impact of microfinance for reducing vulnerability and the impact of cyclone in causing vulnerability.

Impact of microfinance participation: Microfinance is used as panacea for poverty reduction and in our study it proves so. Table A1.19, Table A1.20, Table A1.21 and Table A1.22 show how we got the PSM and the matching results for microfinance participation.

In the process of getting propensity score, first it estimates probit regression for the treatment group over the explanatory variables. Then it looks for the region of common support. In our analysis the region of common support is [.03028738, .74013679]. Then it exhibits the estimated propensity score in the region of common support. The first step is to identify the optimum number of blocks. In our analysis the number of block is 6. Then it searches for balancing property to be satisfied. If balancing property is not satisfied, then the process has to run again by changing some variables. So the balancing property needs to be satisfied. After the balancing property is satisfies, then the matching technique can be applied.

The impact of microfinance participation can be seen by several matching techniques. Here we have applied Nearest Neighbour, Stratification and Kernel matching techniques. The results of the matching techniques are shown Table 7. In all cases Microfinance participation exhibits statistically significant reduction in the degree of vulnerability. For Nearest Neighbour method, 522 households are found to be treated and 431 are control. This result

signifies a 7% reduction in the degree of vulnerability because of microfinance participation. The t- value is 2.041 which is 5% level of significance. It implies the average treatment of the treated (ATT) on vulnerability for microfinance participation is 7%. For Stratification matching method, it shows a 6% reduction in the degree of vulnerability because of microfinance participation at 5% level of significance as t-value is 2.326. Kernel matching method also supports for microfinance impact on vulnerability. It also shows 6% reduction in the vulnerability due to microfinance participation at 5% level of significance. All three matching techniques exhibit the statistically significant results for microfinance in reducing vulnerability.

Table 7: Estimation of Average Treatment Effect for the Treated (ATT): Impact of MFI participation on vulnerability

Matching Methods	Number of treated	Number of control	ATT	Standard Error	t-value
Nearest Neighbour method	522	431	-0.07**	0.035	-2.041
Stratification method	522	3141	-0.06**	0.026	-2.326
Kernel Matching method	522	3141	-0.061**	0.026	-2.358

Source: Author's calculation. Note: *** p<0.01, ** p<0.05, * p<0.1

The robustness of the Average Treatment Effect for the Treated (ATT) can be checked by another technique which is shown in the Table 8. It directly applies the matching technique instead of estimating the propensity score first. In this table we see that the matching technique is also statistically significant at 5% level. This result exhibits that 8% reduction in the degree of vulnerability because of microfinance participation which is similar to the other matching techniques. We can now definitely say that microfinance participation is a strong tool for alleviating the degree of food consumption vulnerability.

Table 8: Checking Robustness of Average Treatment Effect for the Treated (ATT): Impact of MFI participation on vulnerability

Degree of vulnerability	Coefficient	Standard Error	z	P>z	[95% Confidence Interval]
SATT	-.0800781	.0316686	-2.53	0.011	-.1421475 -.0180087

Source: Author's calculation

Impact of cyclone on vulnerability: The impact of last two big cyclones – Sidr (2007) and Aila (2009) have also significant impact on food consumption vulnerability. As PSM satisfies the matching techniques, it provides the robust results. The treatment variable is a dummy

variable of disaster affected households in any of last two cyclones. After estimating the propensity score we apply the matching methods to get the ATT estimation. Table 9 postulates the all matching results which are statistically significant. In Nearest Neighbour matching method, 14% increase in the degree of vulnerability for a household being affected by disaster. The t-value is statistically significant at 5% level. In Stratification method, 8.7% increase in the degree of vulnerability due to being disaster affected which is 10% level of significant (t-value is 1.848). In the Kernel matching technique, a 9.6% increase in the vulnerability due to affected by the disaster which is significant at 5% level.

**Table 9: Estimation of Average Treatment Effect for the Treated (ATT):
Impact of cyclone on vulnerability**

Matching Methods	Number of treated	Number of control	ATT	Standard Error	t-value
Nearest Neighbour method	171	130	0.140**	0.071	1.984
Stratification method	170	909	0.087*	0.047	1.848
Kernel Matching method	171	908	0.096**	0.043	2.227

Source: Author's calculation. Note: *** p<0.01, ** p<0.05, * p<0.1

It is evident from Table 9 that the disaster affected household are more vulnerable than the households that are not affected by disaster. The technique matches each individual in the treatment group with individuals sharing similar characteristics in the non-treatment group.

6 Chapter: Conclusions and recommendations

6.1 Synthesis of the results

The results are relevant to the theory of permanent income hypothesis where it says the transient income doesn't determine the reduction of consumption level in the presence of perfect capital market. However, with the presence of imperfect credit market and persistent credit constraint faced by the households, transient income does influence the consumption pattern. The seasonal shock resulting lower transient income reduces the meal consumption frequencies and hence increases vulnerability which in a sense violates the PIH. Besides the permanent asset and savings losses which impact the permanent income causes the change in permanent consumption. Risk rationing theory is also got relevant for this study.

Determinants of food consumption vulnerability: Food consumption vulnerability is an economic downturn of the households. In the southern part of Bangladesh, household suffers from serious income shock and cut down their first basic consumption of food. Our study has find out some determinant of this food consumption vulnerability. It is observed that most of hypotheses are significant in our study. Here we will discuss the determinants that we have found in our study.

In terms of household characteristics, *Age of household head*, *years of schooling of household head* and *household size* are the important statistically significant determinants in our analysis. As age increases the degree of vulnerability also increases. Households with older household heads are more vulnerable than households with younger household heads. If years of schooling increase by one year the 2° of vulnerability will decrease by 0.3% at 1% level of significance. The marginal effect for 1° vulnerability is 0.2% at 1% level of significance. Besides, if the size of households increases, the degree of vulnerability will also increase.

In terms of household occupation, *wage earning* households are more vulnerable than the other households. The marginal impact is statistically significant for all degrees of vulnerability. Being *self-employed household* head can reduce the likelihood of being vulnerable. This result is significant in all level of vulnerability. On the contrary, being *safe-employed in agriculture* may increase the 1° and zero degree vulnerability as natural disaster and salinity cause a huge damage of crops in this region. Normally self-employment in agriculture can reduce vulnerability but the geographic location of the households in the study areas are showing opposite result in our study. Household heads' migration for work is

statistically significant determinant in our study. It shows if a household head migrates, the 2° vulnerability reduced by 3.4% and 1° vulnerability by 4.2% and being in the zero degree vulnerability increased by 7.3% at 1% level of significance in all cases.

In terms of infrastructural facility, if the households are provided with *safe-drinking water* and access to *sanitary latrine*, the degree of vulnerability will be reduced by statistically significant amount. Hence these two are also important determinants in our study.

Household distance criteria also plays important role in defining the degrees of vulnerability. More *distance from main road* exhibits more vulnerability in our study. Though the *distance from small market* and *microfinance branch* show opposite results as we expected, the rationale of this result is the inaccessibility of the financial market in that region and less microfinance memberships in numbers. The households are less access to credit and the MFIs is less likely to operate in those inaccessible areas.

In terms of physical and financial assets, *households owned land* and availability of *free land* can reduce vulnerability, but the extent of reduction is very small. On the contrary, the degree of reduction is higher if the households have *cows* and *poultry*. Having cows exhibit 0.8% and having poultry exhibits 0.1% reduction of 2° vulnerability. Conversely, *savings* of the households also plays important role in reducing vulnerability. It can reduce 0.8% of 2° vulnerability at 5% level of significance.

In terms of households' income, expenditure and loans, Household *total income* and *food expenditure* significantly reduce the degree of vulnerability. Income can reduce 2° vulnerability by 0.5% and 1° vulnerability by 0.3%. Conversely food expenditure can reduce 2° vulnerability by 1.8% and 1° vulnerability by 1.3%. On the contrary, the *non-food expenditure* increases the degree of vulnerability. As the households are extremely poor, expenditure on non-food cuts the share of food. The more a household takes *informal loan*, the more likely the increase of vulnerability it has. Both *informal loans* and *yearly deferred payment* amount increase the degrees of vulnerability of the households. Microfinance loans can improves the vulnerability situation a lot. For being a microfinance member and actively taking loans can reduce the 2° vulnerability by 2.3% and 1° vulnerability by 2.3% at 5% and 10% level of significance respectively. Conversely, being *microfinance participants* increases the likelihood of being in the zero degree vulnerability by 4.5% point at 10% level of significance. So microfinance participation is a very strong and important determinant of the food consumption vulnerability.

In terms of households' coping with disaster, *the unmet loss in Sidr* (2007) doesn't show any significant increase in vulnerability, rather it shows the opposite. The rationale behind this result is that the 4 years past incidence doesn't impact recent food consumption vulnerability. Households revived their income earnings. *Social safety net program* exhibits increasing trend in the degree of vulnerability. Program receiving households became more dependent on program and couldn't improve their situation of income generating activities.

Impact of microfinance on vulnerability: Impact of microfinance in reducing vulnerability is enormous and it can be seen as a very strong and important tool in the rural life of southern Bangladesh. We have found in our study that microfinance participants can reduce the 2° vulnerability by 2.3% and 1° vulnerability by 2.3% as well at 5% and 10% level of significance respectively. Conversely, being *microfinance participants* increases the likelihood of being in the zero degree vulnerability by 4.5% point at 10% level of significance.

Again from PSM analysis, it shows much stronger impact. It shows that participation in the microfinance program can reduce vulnerability in general by 8% point at 5% level of significance (Table 8). Almost same results are found in the three matching techniques as well (Table 7). So we can strongly claim that microfinance is obviously a strong tool to reduce vulnerability.

Impact of cyclone on vulnerability: The last two cyclones significantly affect the vulnerability status of the households. Though we didn't find any significant causality in the ordered probit model and in the marginal impact, we have found significant impact from PSM technique. In PSM analysis (Table 9), it exhibits that 8% to 14% increase in the degree of vulnerability for being affected by the any of these two disasters. PSM matches the households with similar characteristics and draws the results. So we can state that falling in to the cyclone like disaster can increase the degree of food consumption vulnerability by 8% to 14%.

6.2 Policy Recommendations

Vulnerability is an economic term and hence it can be resisted. Seasonal unemployment isn't a serious shock in human life but permanent seasonal unemployment with assets loss is a serious phenomenon. The vulnerability can be reduced by implementing some steps in that region. The region is natural disaster prone area and it is impossible to resist cyclones and

storms. People in this region are courageous enough to live against the adverse natural calamities and refurbish their life again if they have some help from the government and non-government organisations.

Short term solution

As study shows education, safe water and sanitary latrine can reduce vulnerability; government should at least ensure these three things for all the households in that region. Safe water is a serious matter in these three districts and if these are ensured then it is expected that the health prone vulnerability will be reduced significantly in future.

For coping with the seasonal shocks, household should move to places where there are works. Households are needed to be provided with relevant information from the localities about their job searching in other areas. Government can take any development project aiming to employ these unemployed household for temporary basis for the construction of roads, dams, and cannels. These are the short term solution. Wage earners are most vulnerable in our study. Government can introduce saline resistant cropping technique in this region which can be cultivated all the year round which can hire more wage labor.

Even in the short term plan, household with seasonal unemployment can be offered credit to implement income generating activities. Lots of households are in need of credit to start their entrepreneurship. MFIs as well as government banks can offer microcredit for this people with flexible repayment scheme. MFIs in the northern part of Bangladesh have already proved to be successful. So implementing flexible credit, emergency loan, income generating training activities and some basic health service can really improve the life of southern households. These households have potential but they don't know how to use it. The increased microfinance penetration along with government intervention with infrastructural facilities can improve the situation.

Long term solution:

Government should implement some major steps in improving the lives of these areas. Government needs to establish more cyclone shelters, ensure safe drinking water and sanitation, enhance the primary school enrolment and retain them up to class 8, establish more community health clinic, more roads and highways, invigorate the local government by reducing corruption. Government should also increase the social safety net budget for the destitute households. Introducing more income generating activities by invigorating the local economy, the seasonal shock can be eliminated which can reduce the vulnerability. Beside

government, NGOs and humanitarian organisation should come forward with new ideas to invigorate the local economy where the poor households can get jobs and earn their livings. As we have got in our analysis that having cows and poultry reduces vulnerability, so income generating activity like cow rearing and poultry business can be good options.

6.3 Limitations and future research

The design of the study and the baseline data set are wonderful and very good quality. But the full data set was not available for doing this research. As a result income and assets in disaggregated level are not available in our analysis. Households' investment in the entrepreneurship projects is missing in our analysis because of the data restriction.

This is a demand side analysis in the three districts of the southern Bangladesh. To get the clear picture of the food consumption vulnerability, other variables are needed to be considered. Besides the demand side analysis, the supply side analysis (MFIs, government program) is also important. It is also important to know the exact geographic location of the households which can give us the spatial correlation analysis and can relate with the degrees of vulnerability. So GIS data can help us a lot in this regard. Conversely, the GIS data of salinity, cropping intensity, roads and highways etc. are also important variables to improve the results. The quality of the government infrastructure such as road and highways, government administrative units, control of corruption and government effectiveness in running programs in this region are also equally important variables to be incorporated. From the supply side, the amount of loan disbursed, loan outstanding and the number of microfinance members per NGO field worker are important to analyse the penetration of microfinance in this region. So only demand side analysis can give us the picture but other information is needed to initiate the any program in this region and to help the vulnerable households to get rid of poverty situation. All these variables are preferred to be incorporated in the future research.

Again, this study analyses the baseline data of the household. So the impact of any program can be observed after two or three years later. We have found the previous microfinance participation has already got benefit out of it. So after 2 or 3 years of the baseline survey, impact assessment can be taken into consideration.

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Appendices

Table A1.1: Summary statistics for selected variables from benchmark household survey.

	Mean	Standard Deviation
Household head characteristics		
Female	14.2%	34.9%
Age (Years)	42.6	13.8
Years of schooling	2.0	3.1
Household head currently married	84.59%	36%
Occupation		
Wage worker	53.33%	49.90%
Self-employed in agriculture	9.88%	29.85%
Self-employed in non-agriculture	22.08%	41.48%
Live outside the household for work	12.75%	33.36%
Household characteristics		
Maximum Years of schooling(Years)	4.9	3.46
Household size(Number)	4.0	1.46
Sex Ratio (Number of female/Number of male)	1.2	0.90
Any household member live outside for work	17.68%	38%
Infrastructure facilities		
Access to electricity	11.34%	31.71%
Access to tube-well or tap water	79.16%	40.62%
Access to sanitary latrine	63.16%	48.24%
Households' distance Information		
Distance from main road (kilometer)	8.0	14.3
Distance from small market place (kilometer)	1.9	1.6
Distance from big market place (kilometer)	3.9	2.5
Distance from nearest microfinance branch (kilometer)	3.1	2.0
Village characteristics		
Household in <i>char</i> areas	24.74%	43.15%

Source: Author's calculation.

Table A1.2: Summery statistics for selected variables from benchmark household survey.
(Continued....)

	Mean	Standard Deviation
Physical and financial asset		
Total owned land (Decimal)	13.0	35.9
Total agricultural land (Decimal)	4.9	27.6
Total using land (Decimal)	11.7	33.3
Total non-using land (Decimal)	0.5	5.9
Total free land occupied (Decimal)	5.7	31.9
Number of cows	0.4	1.0
Number of goats	0.6	1.5
Number of poultry	4.0	5.5
Total asset value including land (Taka)	58,940.68	123,666.60
Savings (Taka)	1,334.86	7,129.00
Household income and expenditure (Yearly)		
Total Income (Taka)	49,903.13	38,268.86
Expenditure on food (Taka)	39,409.01	15,110.89
Non-foods expenditure (Taka)	13,271.18	9,965.57
Households' loan information		
Total formal loan (Taka)	1,234.10	4,475.37
Total informal loan (Taka)	1,643.63	12,216.71
Total purchase on deferred payment (in 2010-11) (Taka)	8,662.78	12,776.29
Households' coping in disaster		
Total loss in Cyclone Sidr (Taka)	7,452.28	17,634.17
Total loss in Cyclone Aila (Taka)	12,841.48	29,815.04
Total loss in crisis last year (2010-11) (Taka)	1,699.58	7,228.77
Total unmet loss in Cyclone Sidr (2007) (Taka)	5,404.71	14,634.80
Total unmet loss in Cyclone Aila (2009) (Taka)	9,259.75	26,666.24
Total unmet crisis in 2010-11 (Taka)	1,105.04	5,417.67
Total amount from Social Safety Net program (Taka)	3,351.57	7,121.52

Source: Author's calculation.

Table A1.3: Selected household and village characteristics by participation status.

	Participants [N=529] (mean)	Non- participants [N=3448] (mean)	p- value
Household head characteristics			
Female	7.75%	15.20%	<0.01
Age (Years)	41.4	42.8	=0.02
Years of schooling	2.2	1.9	=0.07
Household head currently married	92.06%	83%	<0.01
Occupation			
Wage worker	51.80%	53.57%	=0.44
Self-employed in agriculture	11.91%	9.57%	=0.09
Self-employed in non-agriculture	26.65%	21.37%	<0.01
Live outside the household for work	10.96%	13.02%	=0.18
Household characteristics			
Maximum Years of schooling(Years)	5.4	4.9	<0.01
Household size(Number)	4.4	4.0	<0.01
Sex Ratio (Number of female/Number of male)	1.2	1.2	=0.2
Any household member live outside for work	16.45%	18%	=0.42
Infrastructure facilities			
Access to electricity	17.20%	10.44%	<0.01
Access to tube-well or tap water	88.85%	77.67%	<0.01
Access to sanitary latrine	64.65%	62.94%	=0.44
Households' distance Information			
Distance from main road (kilometre)	13.5	7.1	<0.01
Distance from small market place (kilometre)	1.8	1.9	=0.05
Distance from big market place (kilometre)	3.5	4.0	<0.01
Distance from nearest microfinance branch (kilometre)	2.8	3.1	<0.01
Village characteristics			
Household in <i>char</i> areas	39.70%	22.45%	<0.01

Source: Author's calculation.

Table A1.4: Comparison of economic condition by microfinance participation status.

	Participants [N=529] (mean)	Non- participants [N=3448] (mean)	p- value
Physical and financial asset			
Total owned land (Decimal)	15.2	12.7	=0.13
Total agricultural land (Decimal)	5.6	4.8	=0.5
Total using land (Decimal)	14.6	11.3	=0.03
Total non-using land (Decimal)	0.4	0.5	=0.81
Total free land occupied (Decimal)	10.7	5.0	<0.01
Number of cows	0.5	0.4	<0.01

Number of goats	0.7	0.6	=0.41
Number of poultry	5.2	3.8	<0.01
Total asset value including land (Taka)	68,184.5	57,522.5	=0.06
Savings (Taka)	1,831.2	1,258.7	=0.08
Household income and expenditure (Yearly)			
Total Income (Taka)	57,314.0	48,766.1	<0.01
Expenditure on food (Taka)	45,616.7	38,456.6	<0.01
Non-food expenditure (Taka)	16,962.0	12,704.9	<0.01
Households' loan information			
Total formal loan (Taka)	9,223.1	0.0	<0.01
Total informal loan (Taka)	2,581.7	1,499.7	=0.05
Purchase on deferred payment (in 2010-11) (Taka)	13,410.7	7,934.3	<0.01
Households' coping in disaster			
Total loss in Cyclone Sidr (Taka)	12,212.9	6,721.9	<0.01
Total loss in Cyclone Aila (Taka)	12,557.4	12,885.1	=0.81
Total loss in crisis last year (2010-11) (Taka)	3,297.0	1,454.5	<0.01
Total unmet loss in Cyclone Sidr (2007) (Taka)	8,986.7	4,855.1	<0.01
Total unmet loss in Cyclone Aila (2009) (Taka)	9,023.3	9,296.0	=0.82
Total unmet crisis in 2010-11 (Taka)	2,078.1	955.8	<0.01
Total amount from Social Safety Net program (Taka)	2,739.4	3,445.5	=0.03

Source: Author's calculation.

Table A1.5: Types of land by districts

Types of land (mean, in Decimal)	Khulna [N=816]		Patuakhali [N=1471]		Satkhira [N=1690]	
	P [N=71]	NP [N=745]	P [N=255]	NP [N=1216]	P [N=203]	NP [N=1487]
	(33.6)	(29.9)	(39.7)	(49.2)	(28.0)	(23.8)
Total owned land	17.3 (33.6)	12.6 (29.9)	18.1 (39.7)	15.9 (49.2)	10.7 (28.0)	10.1 (23.8)
Total agricultural land	3.8 (18.9)	1.2 (7.1)	7.8 (31.4)	8.8 (43.1)	3.5 (21.4)	3.2 (15.2)
Total using land	13.4 (30.3)	6.8 (14.0)	18.1 (39.7)	15.7 (47.6)	10.7 (28.0)	10.0 (23.7)
Total non-using land	3.2 (16.7)	2.1 (12.1)	0.0 (0.0)	0.0 (0.3)	0.0 (0.0)	0.1 (2.3)
Total operational land	0.5 (3.9)	0.9 (7.5)	21.7 (56.8)	16.1 (61.8)	11.1 (32.0)	5.4 (21.7)
Total free land occupied	0.4 (1.8)	0.8 (2.3)	20.9 (44.6)	11.8 (52.3)	1.5 (4.9)	1.5 (6.0)

Source: Author's calculation; Note: P denotes microfinance participants; NP denotes non-participants. Values in the parenthesis represent standard deviation.

Table A1.6: Distribution of households over landholdings by districts and microfinance participation status.

Land owned by households (decimal)	Overall		Khulna		Patuakhali		Satkhira	
	P	NP	P	NP	P	NP	P	NP
landless	146 (27.6)	896 (25.99)	7 (9.86)	159 (21.34)	101 (39.61)	401 (32.98)	38 (18.72)	336 (22.6)
up to 5	127 (24.01)	1,170 (33.93)	18 (25)	296 (40)	21 (8)	262 (22)	88 (43.35)	612 (41)
5 to 10	99 (18.71)	563 (16.33)	14 (19.72)	110 (14.77)	48 (18.82)	230 (18.91)	37 (18.23)	223 (15)
10 to 20	77 (14.56)	375 (10.88)	19 (26.76)	76 (10.2)	36 (14.12)	137 (11.27)	22 (10.84)	162 (10.89)
20 to 30	28 (5.29)	114 (3.31)	7 (9.86)	21 (2.82)	15 (5.88)	56 (4.61)	6 (2.96)	37 (2.49)
30 to 40	12 (2.27)	103 (2.99)	2 (2.82)	29 (3.89)	7 (2.75)	38 (3.13)	3 (1.48)	36 (2.42)
40 to 50	5 (0.95)	59 (1.71)	0 (0)	16 (2.15)	3 (1.18)	18 (1.48)	2 (0.99)	25 (1.68)
> 50	35 (6.62)	168 (4.87)	4 (5.63)	38 (5.1)	24 (9.41)	74 (6.09)	7 (3.45)	56 (3.77)
Total	529 (100)	3,448 (100)	71 (100)	745 (100)	255 (100)	1,216 (100)	203 (100)	1,487 (100)
Pearson χ^2	<0.01		<0.01		<0.01		0.77	

Source: Author's calculation. Note: P denotes microfinance participants; NP denotes non-participants. Values in the parenthesis represent column percentage.

Table A1.7: Distribution of households by char areas and by district

District	Mainland	Char areas	Total
Khulna	687 (22.95)	129 (13.11)	816 (20.52)
Patuakhali	714 (23.86)	757 (76.93)	1,471 (36.99)
Satkhira	1,592 (53.19)	98 (9.96)	1,690 (42.49)
Total	2,993 (100)	984 (100)	3,977 (100)
Pearson χ^2	<0.01		

Source: Author's calculation. Values in the parenthesis represent column percentage.

Table A1.8: Distribution of households' positions by districts and microfinance participation status.

Position of households	Overall		Khulna		Patuakhali		Satkhira	
	NP	P	NP	P	NP	P	NP	P
Mainland areas	2,674 (77.55)	319 (60.3)	624 (83.76)	63 (88.73)	655 (53.87)	59 (23.14)	1,395 (93.81)	197 (97.04)
Char areas	774 (22.45)	210 (39.7)	121 (16.24)	8 (11.27)	561 (46.13)	196 (76.86)	92 (6.19)	6 (2.96)
Total	3,448 (100)	529 (100)	745 (100)	71 (100)	1,216 (100)	255 (100)	1,487 (100)	203 (100)
Pearson χ^2	<0.01		0.272		<0.01		<0.01	

Source: Author's calculation; values in parenthesis represent column percentage.

Table A1.9: Distribution of households' occupation by districts.

District	Wage worker		Self-employed in Agriculture		Self-employed in non-agriculture		Live outside of house for work		Total
	No	Yes	No	Yes	No	Yes	No	Yes	
Khulna	280 (15.09)	536 (25.27)	787 (21.96)	29 (7.38)	668 (21.56)	148 (16.86)	631 (18.18)	185 (36)	816 (20.52)
Patuakhali	774 (41.7)	697 (32.86)	1,286 (35.88)	185 (47.07)	1,191 (38.43)	280 (31.89)	1,361 (39.22)	110 (22)	1,471 (36.99)
Satkhira	802 (43.21)	888 (41.87)	1,511 (42.16)	179 (45.55)	1,240 (40.01)	450 (51.25)	1,478 (42.59)	212 (42)	1,690 (42.49)
Total	1,856 (100)	2,121 (100)	3,584 (100)	393 (100)	3,099 (100)	878 (100)	3,470 (100)	507 (100)	3,977 (100)
Pearson χ^2	<0.01		<0.01		<0.01		<0.01		

Source: Author's calculation; Note: Values in parenthesis represent column percentage.

Table A1.10: Percentage of households taken loans by districts.

Loan classification	Overall (N=3,977)	Khulna (N=816)	Patuakhali (N=1,471)	Satkhira (N=1,690)
No loan taken	75%	87%	72%	72%
Formal credit only	9%	7%	10%	8%
Informal credit only	14%	6%	13%	18%
Both formal and informal loans	3%	0%	5%	2%

Source: Author's calculation.

Table A1.11: Comparison of consumption ordering in normal and lean time by microfinance participation status.

Consumption ordering	During normal time			During lean time		
	Non-participants	Participants	Total	Non-participants	Participants	Total
Occasional Starvation	10 (90.91) (0.29)	1 (9.09) (0.19)	11 (100) (0.28)	341 (92.16) (10.04)	29 (7.84) (5.6)	370 (100) (9.45)
	661 (88.13) (19.42)	89 (11.87) (17.08)	750 (100) (19.11)	2,475 (86.51) (72.88)	386 (13.49) (74.52)	2,861 (100) (73.1)
	2,732 (86.37) (80.28)	431 (13.63) (82.73)	3,163 (100) (80.61)	580 (84.92) (17.08)	103 (15.08) (19.88)	683 (100) (17.45)
Total	3,403 (86.72) (100)	521 (13.28) (100)	3,924 (100) (100)	3,396 (86.77) (100)	518 (13.23) (100)	3,914 (100) (100)
	Pearson χ^2	0.407				<0.01

Source: Author's calculation; Values in parenthesis represent percentage.

Table A1.12: Degree of vulnerability by households' characteristics and participation status.

Degree of vulnerability	Years of schooling of household head (mean)		Household size (mean)		Migration of household head (%)		Household land ownership (mean in decimal)	
	NP	P	NP	P	NP	P	NP	P
-2	0.00	0.00	7.00	2.00	0%	0%	0.00	9.00
-1	3.86	3.50	3.57	4.50	0%	25%	10.71	4.25
0	2.68	3.00	4.03	4.20	15%	18%	23.25	26.31
1	1.83	1.96	3.96	4.45	14%	9%	10.97	13.08
2	1.40	2.31	3.74	4.48	6%	10%	7.57	9.53

Source: Author's calculation. Note: NP = Non-participants; P = Participants.

Table A1.13: Degree of vulnerability by households' characteristics and participation status (continue...)

Degree of vulnerability	Household head is wage earner (percentage)		Household income (mean, Taka)		Household food expenditure (mean, Taka)		Household non-food expenditure (mean, Taka)	
	NP	P	NP	P	NP	P	NP	P
-2	0%	0%	18565	84200	33904	19864	18230	15110
-1	57%	75%	35174	42785	32619	45344	7646	14127
0	40%	35%	61962	69733	41881	48344	14177	17119
1	57%	55%	46316	53799	38200	44809	12293	16741
2	54%	72%	42230	63013	34127	46606	13170	17534

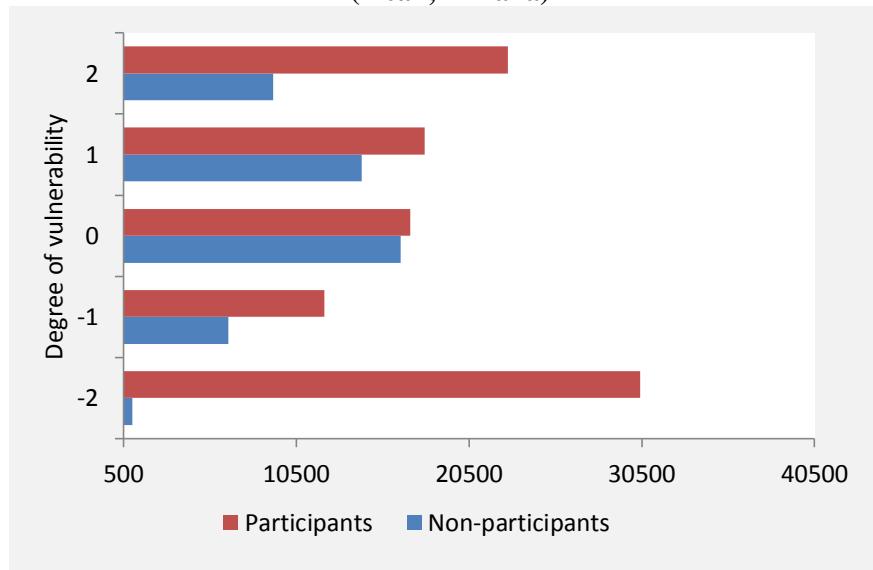
Source: Author's calculation. Note: NP = Non-participants; P = Participants.

**Table A1.14: Degree of vulnerability by households' characteristics and participation status
(continued...)**

Degree of Vulnerability	Households' formal loan (mean, Taka)		Households' informal loan (mean, Taka)		Households received Social Safety Net program (mean, Taka)		Households' savings (mean, Taka)	
	NP	P	NP	P	NP	P	NP	P
-2	0	10000	0	0	0	20000	118	1200
-1	0	9750	2857	3000	1043	900	412	394
0	0	9214	1192	1046	2952	4082	2112	3132
1	0	9197	1668	3096	3545	2245	1162	1496
2	0	9103	952	552	3490	4901	569	1588

Source: Author's calculation. Note: NP = Non-participants; P = Participants.

**Figure A.1: Households' total unmet loss in both Sidr and Aila.
(mean, in Taka)**



Source: Author's calculation.

Table A1.15: Percentage of households incurred losses in two big cyclones Sidr (2007) and Aila (2009) (%)

Types of losses	Aila (N=3,741)	Sidr (2,452)
Land Erased	0.45	0.04
House Broken	47.02	55.18
Livestock's Death	19.25	19.58
Trees/Garden Destroyed	20.29	12.77
Crops Destroyed	1.5	1.71
Shrimp/crab/Fish flown away	2.83	2.20
Loss of others Assets	2.81	7.46
Death of Family member	0.11	0.04
Disease of family members	4.38	0.49
Fertility decrease of land	0.48	0.00
Others	0.88	0.53

Source: Author's calculation.

Table A1.16: Percentage of households got remedial measure from various sources in two big cyclones Sidr (2007) and Aila (2009), (%)

Types of remedies	Aila (N=3,695)	Sidr (N= 2,403)
From own savings	21.52	22.89
Relatives' help	8.61	10.94
Government help	9.01	9.49
Non-government help	5.79	7.99
Informal credit	3.6	3.12
Microcredit	0.24	0.75
Advanced sale of crop	0.08	0.00
Advanced sale of labor	1.43	0.37
Insurance	0.03	0.00
Lease of land	0.03	0.04
Selling of land	0.05	0.29
Selling of animal	0.24	0.79
Selling of asset	0.14	0.54
Almost nothing	3.92	3.12
No remedial measure	45.3	39.62

Source: Author's calculation

Regression results:

Table A1.17: Heckman two-steps estimation for selection bias conditional upon MFI membership.

Explanatory variables	Max. Likelihood estimates	Heckman's two-step estimates
	Coefficient	Coefficient
Household head characteristics		
Age (years)	0.001*	0.001
Years of schooling	-0.010***	-0.010
Female (dummy)	-0.020	-0.020
Household heads' Occupation		
Wage earning	0.073**	0.074
Self-employment (dummy)	-0.051**	-0.049
Self-employed in agriculture (dummy)	0.062	0.061
Self-employed in non-agriculture (dummy)	-0.009	-0.009
Live outside the household for work (dummy)	-0.109***	-0.109
Household Characteristics		
Household size	0.037***	0.037
Sex Ratio (Number of female/Number of male)	0.013	0.013
Infrastructure facilities		
Access to electricity (dummy)	-0.034	-0.035
Access to tube-well or tap water (dummy)	-0.063***	-0.062
Access to sanitary latrine (dummy)	-0.035**	-0.036
Households' distance Information		
Distance from main road (kilometre)	0.006***	0.007
Distance from small market place (kilometre)	-0.017***	-0.017
Distance from big market place (kilometre)	0.004	0.004
Distance from nearest microfinance branch (kilometre)	-0.022***	-0.023
Household in char areas	-0.027	-0.028
Physical and financial asset		
Total owned land (Decimal)	-0.001***	-0.001
Total free land occupied (Decimal)	-0.001***	-0.001
Total number of owned cow	-0.023***	-0.023
Total number of owned goat	0.008	0.008
Total number of owned poultry	-0.003**	-0.003
Total Savings (Taka)	-0.000**	-0.000
Household income and expenditure (Yearly)		
Total Income (Taka)	-0.000***	-0.000
Expenditure on food (Taka)	-0.000***	-0.000
Non-food expenditure (Taka)	0.000***	0.000
Households' loan information		
Total formal loan (Taka)	-0.000*	0.000
Total informal loan (Taka)	0.000**	0.000
Total purchase on deferred payment (in 2010-11) (Taka)	0.000	0.000
Households' coping in disaster		
Total unmet loss in Cyclone Sidr (2007) (Taka)	-0.000***	-0.000
Total unmet loss in Cyclone Aila (2009) (Taka)	0.000	0.000
Total unmet crisis in 2010-11 (Taka)	0.000	0.000
Total amount from Social Safety Net program (Taka)	0.000*	0.000
Constant term of the regression model	1.099***	1.429
Microfinance membership (select)	-0.120	-0.093
Constant (select)	2.126***	2.125***

/athrho (transformation of rho)	-0.422**	
/Insigma (transformation of sigma)	-0.697***	
LR test of independent equations (rho = 0): chi2(1)	1.16	
Mills lambda		-7.945
Number of observation	3742	3742
Censored observation	65	65
Uncensored observation	3677	3677
Wald chi2(34)	430.42	1.83
Prob > chi2	0.0000	1.0000

note: *** p<0.01, ** p<0.05, * p<0.1

Table A1.18: Estimation of ordered probit model and the marginal effect of the explanatory variables.

Explanatory variables	co-efficient	Marginal effect of degrees of vulnerability				
		2	1	0	-1	-2
Household head characteristics						
Age (years)	0.003*	0.000*	0.000*	-0.001*	-0.000	-0.0000
Years of schooling	-0.023***	-0.003***	-0.002***	0.005***	0.000**	0.0000
Female (dummy)	-0.045	-0.006	-0.005	0.011	0.000	0.0001
Household heads' Occupation						
Wage earning (dummy)	0.182**	0.025***	0.020**	-0.044**	-0.001*	-0.0002
Self-employment (dummy)	-0.128**	-0.018**	-0.014**	0.031**	0.001*	0.0002
Self-employed in agriculture (dummy)	0.162	0.025	0.012***	-0.036*	-0.001*	-0.0001
Self-employed in non-agriculture (dummy)	-0.019	-0.003	-0.002	0.005	0.000	0.0000
Live outside the household for work (dummy)	-0.281***	-0.034***	-0.042***	0.073***	0.002**	0.0005
Household Characteristics						
Household size	0.089***	0.013***	0.009***	-0.021***	-0.000***	-0.0001
Sex Ratio (Number of female/Number of male)	0.034	0.005	0.003	-0.008	-0.000	-0.0000
Infrastructure facilities						
Access to electricity (dummy)	-0.076	-0.010	-0.009	0.019	0.000	0.0001
Access to tube-well or tap water (dummy)	-0.150***	-0.022**	-0.013***	0.034***	0.001**	0.0001
Access to sanitary latrine (dummy)	-0.094**	-0.013**	-0.009**	0.022**	0.000**	0.0001
Households' distance Information						
Distance from main road (kilometre)	0.016***	0.002***	0.002***	-0.004***	-0.000***	-0.0000
Distance from small market place (kilometre)	-0.043***	-0.006***	-0.004***	0.010***	0.000**	0.0000
Distance from big market place (kilometre)	0.008	0.001	0.001	-0.002	-0.000	-0.0000
Distance from nearest microfinance branch (kilometre)	-0.056***	-0.008***	-0.006***	0.013***	0.000**	0.0001
Household in char areas (dummy)	-0.083	-0.011	-0.009	0.020	0.000	0.0001
Physical and financial asset						
Total owned land (Decimal)	-0.003***	-0.000***	-0.000***	0.001***	0.000***	0.0000
Total free land occupied (Decimal)	-0.002***	-0.000***	-0.000***	0.000***	0.000**	0.0000
Total number of owned cow	-0.059***	-0.008***	-0.006***	0.014***	0.000**	0.0001

Total number of owned goat	0.019	0.003	0.002	-0.005	-0.000	-0.0000
Total number of owned poultry	-0.008**	-0.001**	-0.001**	0.002**	0.000*	0.0000
Total Savings ^a (Taka)	-0.059**	-0.008**	-0.006**	0.014**	0.000*	0.0001
Household income and expenditure (Yearly)						
Total Income ^a (Taka)	-0.033***	-0.005***	-0.003***	0.008***	0.000***	0.0000
Expenditure on food ^a (Taka)	-0.128***	-0.018***	-0.013***	0.030***	0.001***	0.0001
Non-food expenditure ^a (Taka)	0.093***	0.013***	0.010***	-0.022***	-0.000**	-0.0001
Households' loan information						
Total formal loan ^a (Taka)	0.008	0.001	0.001	-0.002	-0.000	-0.0000
Total informal loan ^a (Taka)	0.031*	0.004*	0.003*	-0.007*	-0.000	-0.0000
Total purchase on deferred payment ^a (in 2010-11) (Taka)	0.029*	0.004*	0.003*	-0.007*	-0.000	-0.0000
Households' coping in disaster						
Total unmet loss in Cyclone Sidr ^a (2007) (Taka)	-0.047***	-0.007***	-0.005***	0.011***	0.000**	0.0001
Total unmet loss in Cyclone Aila ^a (2009) (Taka)	0.008	0.001	0.001	-0.002	-0.000	-0.0000
Total unmet crisis in 2010-11 ^a (Taka)	0.007	0.001	0.001	-0.002	-0.000	-0.0000
Total amount from Social Safety Net program ^a (Taka)	0.056*	0.008*	0.006*	-0.013*	-0.000	-0.0001
Microfinance membership (dummy)	-0.177**	-0.023**	-0.023*	0.045*	0.001	0.0003
/cut1	-3.877***					
/cut2	-3.393***					
/cut3	-1.446***					
/cut4	0.993***					
LR chi2(35)	406.62					
Prob > chi2	0					
Pseudo R2	0.0716					
Number of observations	3677					

Note: *** p<0.01, ** p<0.05, * p<0.1; here superscript 'a' represent the amount of the variable in per 10,000 BDT.

*****Algorithm to estimate the propensity score***

Table A1.19: The treatment is microfinance membership

Microfinance membership	N	Percentage
Non-participants	3,448	86.7
Participants	529	13.3
Total	3,977	100

Table A1.20: Estimation of the propensity score using probit model

Treatment is microfinance participant	Coefficient	P-value
Age (years)	-0.005	0.02
Years of schooling	0.003	0.76
Female (dummy)	-0.063	0.55
Wage earning (dummy)	0.063	0.41
Self-employment (dummy)	0.336	0.00
Self-employed in agriculture (dummy)	-0.150	0.13
Live outside the household for work (dummy)	0.002	0.98
Household size	-0.015	0.55
Sex Ratio (Number of female/Number of male)	-0.033	0.28
Access to electricity (dummy)	0.095	0.23
Access to tube-well or tap water (dummy)	0.217	0.01
Access to sanitary latrine (dummy)	0.044	0.46
Distance from main road (kilometre)	0.014	0.00
Distance from big market place (kilometre)	-0.047	0.00
Household in char areas (dummy)	-0.028	0.79
Total owned land (Decimal)	-0.001	0.23
Total number of owned cow	-0.005	0.86
Total number of owned goat	-0.007	0.70
Total number of owned poultry	0.003	0.54
Total Savings ^a (Taka)	0.024	0.45
Total Income ^a (Taka)	0.003	0.74
Total income from service ^a (Taka)	0.003	0.92
Income from wage warning ^a (Taka)	0.032	0.06
Expenditure on food ^a (Taka)	0.100	0.00
Non-food expenditure ^a (Taka)	0.087	0.00
Total informal loan ^a (Taka)	-0.012	0.57
Total unmet loss in Cyclone Sidr ^a (2007) (Taka)	0.018	0.27
Total unmet loss in Cyclone Aila ^a (2009) (Taka)	-0.005	0.69
Total unmet crisis in 2010-11 ^a (Taka)	0.058	0.17
Total amount from Social Safety Net program ^a (Taka)	0.038	0.33
constant term	-1.781	0.00
LR chi2(30)	228.04	
Prob > chi2	0.0000	
Pseudo R2	0.0754	

Number of observation

3738

Note: the common support option has been selected. Here superscript ‘a’ represents the amount of the variable in per 10,000 BDT.

The region of common support is [.03028738, .74013679]

Table A1.21: Estimated propensity score in region of common support

Estimated propensity score				
	Percentiles	Smallest		
1%	0.034139	0.030287		
5%	0.044804	0.030297		
10%	0.055148	0.030638	Observation	3663
25%	0.078577	0.03067	Sum of Wgt.	3663
50%	0.119433		Mean	0.141623
		Largest	Std. Dev.	0.089095
75%	0.17912	0.620086		
90%	0.26487	0.700994	Variance	0.007938
95%	0.315554	0.728062	Skewness	1.697125
99%	0.456126	0.740137	Kurtosis	7.24505

Step 1: Identification of the optimal number of blocks

The final number of blocks is 6: This number of blocks ensures that the mean propensity score is not different for treated and controls in each blocks.

Step 2: Test of balancing property of the propensity score

The balancing property is satisfied

Table A1.22: The inferior bound, the number of treated, and the number of controls for each block

Inferior of block of propensity score	Microfinance membership		
	Non-participants	Participants	Total
0.030287	1,324	95	1,419
0.1	868	123	991
0.15	432	94	526
0.2	486	181	667
0.4	28	26	54
0.6	3	3	6
Total	3,141	522	3,663

Note: the common support option has been selected

****End of the algorithm to estimate the propensity score****

Abbreviation

ATT	Average Treatment Effect for the Treated
BDT	Bangladeshi Taka
CBN	Cost of Basic Need
CEGIS	Center for Environmental and Geographic Information Services
DFID	Department for International Development
EMDAT	International Disaster Database
GIS	Geographic Information System
GoB	Government of Bangladesh
HIES	Household Income and Expenditure Survey
IMD	India Meteorological Department
InM	Institute of Microfinance
MFI	Microfinance Institute
MOFDM	Ministry of Food and Disaster Management
NGO	Non-Government Organisation
PKSF	Palli Karma-Sahayak Foundation
PO	Partner Organisation
PRIME	Programmed Initiatives for Monga Eradication
PSM	Propensity Score Matching
Taka	Bangladeshi Currency
VGD	Vulnerable Group Development
VGF	Vulnerable Group Feeding

Declaration

I declare, that this Master Thesis is of my own composition. I have not used any additional means beside of the mentioned auxiliaries. The parts of the Thesis, where I cited word-for-word or in the same sense are marked.

This Thesis was neither in the same nor in a similar form handed over to another Examination Office.

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(Name of the Candidate)

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