Consumption Smoothing and Climate Extremes: Evidence from a Farm Household Survey in Coastal Odisha, India

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Abstract

The farm households in India are subject to climate extremes like cyclones and floods which have negative impact on their welfare measures, such as income, consumption, productive assets, etc. They are taking up various mechanisms during ex-ante and ex-post periods in smoothening their income and consumption. From the policy perspective, it is, therefore, imperative to test the hypothesis of 'fully consumption smoothing'. Using a survey of 285 farm households affected by cyclones and floods in the coastal Odisha, the present study adopted vulnerability as uninsured risk (VER) approach to establish the relationship between households' consumption patterns (i.e., total consumption, food consumption and non-food consumption expenditure) and incidence of cyclones and floods. The aim is to identify the events for which farmers were not able to take adequate measures to hedge against their impacts. In between food and non-food consumption expenditure, both cyclones and floods have a higher negative impact on the former as compared to the latter. In fact, flood has greater negative impact on per capita food consumption than the cyclone. This underlines the fact that the farm households are not able to take sufficient adaptive measures to fully insure the food consumption. On the other hand, the evidences show that the households use existing farm financial management strategies for insuring non-food consumption expenditure. Hence, the focus should be on policy interventions that enhance farm-level adaptation measures in order to reduce potential crop loss due to these extreme events, so that farmers could smoothen their consumption.

I. Introduction

Farm households in developing nations are subject to climatic extremes like cyclones, floods and drought. These shocks have negative impact on welfare measures like

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income, consumption, productive assets, health, child schooling, occupational choice, etc (Dercon and Krishnan, 2000a and b; Datt and Hoogeveen, 2003; Dercon, 2004; Dercon et al., 2005; Hoddinott, 2006; Christiansen et al., 2007; Thomas et al., 2010; see Skoufias, 2003a). The vulnerable households are taking up various measures (i.e., farm management and technology, farm financial management, diversification beyond the farm, and government investment in health, infrastructure and education) to smoothen their consumption; these are either taken by them voluntarily or supported by the government. Therefore, assessing effectiveness of different interventions that reduce impact has relevance policy implications (Thomas et al., 2010). Though such issue was widely studied (Christiansen et al., 2007), there is a dearth of study in the context of Odisha which is prone to cyclones and floods; based on the analysis, one could suggest specific coping options for rural households.

In order to address this issue, the present study establishes a relationship between farm households' consumption patterns (i.e., total consumption, food consumption and non-food consumption expenditure) with the incidence of cyclones and floods. In this context, the research question asked as to whether the farmers succeeded in smoothing their consumption to hedge against negative impacts of past cyclones and floods, given the adaptive mechanisms to respond, i.e., cyclone and flood events require any further policy attention. The remainder of this study is structured as follows: section two outlines risk and shocks and farm households; section three explains materials and methods which include sources of household vulnerability, study area and empirical method; section four presents results of the empirical analysis and section five gives concluding remarks.

II. Risk and Shocks and Farm Households

Based on the cross-sectional survey data collected from 285 farm households during 2010/2011 production season in the coastal Odisha, Table 1 reports the details on risk and shocks that farm households came across during 2000-2009[1]. A detailed description on the sampling techniques is given in the next section.

This study has classified all the possible risk and shocks into two categories: (i) agricultural risk and shocks, and (ii) non-agricultural risk and shocks. Out of the total sample, 84.56% of farm households have experienced only cyclones (i.e., deep depression and cyclonic storms)[2]. Around 36.84% of farm households reported to be affected by floods. The percentage of farmers reporting sea/ river erosion was 37.19%. Apart from these shocks, pest and diseases affected crops (74.74%), illness of any family member (66.32%), marriage expenses (46.67%), lack of finance (61.05%) and lack of access to agricultural inputs (59.3%) negatively affected a majority of farm

[1] The risk and shocks are reported, which affect at least 10% of the sample households.

[2] As per Indian Meteorological Department (IMD), there are seven classifications of cyclonic storm based on the wind speed: (i) low pressure (< 17 knots), (ii) depression (17-27 knots), (iii) deep depression (28-33 knots), (iv) cyclonic storm (34-47 knots), (v) severe cyclonic storm (48-63 knots), (vi) very severe cyclonic storm (64-119 knots) and (vii) super cyclonic storm (>120 knots) (IMD, 2008).

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households. In total, the most commonly reported major shocks are cyclone (47.72%), flood (25.96%), and sea/river erosion (29.47%) and marriage expenses (28.42%).

III. Materials and Methods

III.1 Sources of Household Vulnerability

The shocks on households due to extreme events like cyclone and flood, affect them in multiple ways: economic effects (wealth, income and consumption as described by Dercon and Krishnan, 2000a and b; Datt and Hoogeveen, 2003; Skoufias, 2003b; Dercon, 2004; Dercon et al., 2005; Hoddinott, 2006; Christiaensen et al., 2007), psychological effects (the traumatic impact of violence: Doherty and Clayton, 2011), destruction of community assets, health effects and education effects (Tesliuc and Lindert, 2002), social capital (e.g., trust and reciprocity) (Fleming et al., 2014). The final outcome of a shock on a household will depend on the shock itself, household's sensitivity, and adaptation measures undertaken by a household to mitigate its negative externalities (McCarthy et al., 2001). In order to reduce the potential vulnerability faced by the households, it is vital to assess present welfare impact of past shocks on households with the present adaptive capacity. In other words, whether shocks can account for the observed fluctuations in consumption or the given adaptation options are enough to a perfectly smooth consumption becomes a pertinent question (Figure 1 describes the process in detail).

It is clear from the Figure 1 that the farm households experiencing shocks are more vulnerable than other farm households who are subject to no shock due to higher exposure level. In addition, vulnerability of households also depends on to what extent their asset endowments are sensitive to shocks, and the adaptation mechanisms they could undertake to reduce potential impacts. If a farm household, for instance, lives in a thatched house and/ or depends on agriculture for basic livelihoods, such household could be at a higher risk.

Households react to these shocks in two ways: ex-ante and ex-post (Morduch, 1995). The ex-ante measures are called 'income smoothing' in the development economics literature and 'pro-active' in the climate change discourse meaning, interventions are taken to protect the households from adverse income shocks before they occur (Morduch, 1995). There are three types of ex-ante strategies: (i) risk prevention or reduction (actions taken to eliminate risk events from occurring, i.e., building sea dyke and flood embankment, and increasing mangrove conservation to reduce risk of cyclone and flood), (ii) reduction of exposure to risk (given the risk, interventions are taken to lower the exposure to risk, i.e., cultivating flood tolerant and/ or traditional varieties of paddy crops and sending children to work in non-farm sources), and (iii) risk mitigation that includes both formal and informal responses to the expected loss (prior arrangement of compensation in case of loss, i.e., purchasing agricultural insurance, building farmer groups and participation in SHGs) (Morduch, 1999; Heitzmann et al., 2002).

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Table 1: Details on risk and shocks

Type of risk/ shock	% of households affected by this risk/ shock	Widespread of Risk and Shocks: % of reporting as idiosyncratic risk/ shock	Widespread of Risk and Shocks: % of reporting as covariate risk/ shock	Impact of Risk and Shocks: % reporting impact on income	Impact of Risk and Shocks: % reporting impact on income & consumption	% reporting this shock as major risk/ shock
Agricultural risk/ shock						
Cyclone	84.56	0.00	100.00	28.77	55.79	47.72
Flood	36.84	0.00	100.00	10.18	26.67	25.96
Sea/river erosion	37.19	0.00	100.00	0.00	37.19	29.47
Pests and diseases affect crops	74.74	89.70	10.30	74.74	0.00	0.00
Pests and disease affect livestock	38.60	100.00	0.00	38.60	0.00	1.40
Lack of access to agricultural inputs	59.30	36.70	63.30	59.30	0.00	3.16
Increase in agricultural input price	16.84	0.00	100.00	16.84	0.00	0.00
Decrease agricultural output price	18.25	13.50	86.50	18.25	0.00	0.00
Lack of finance	61.05	96.00	4.00	11.93	49.12	2.81
Confiscation of land	10.53	100	0.00	10.53	0.00	0.00
Non-agricultural risk/ shock						
Death of working adult members	27.37	100.00	0.00	6.67	20.70	15.09
Death of other members	18.60	100.00	0.00	7.02	11.58	7.72
Illness of any members	66.32	100.00	0.00	25.96	40.35	16.14
Marriage expenses	46.67	100.00	0.00	4.91	41.75	28.42
Separation of family members	27.72	100.00	0.00	2.81	24.91	1.40
Loss of employment	15.09	97.70	2.30	6.32	8.77	2.11

Source: Computed from primary data

The ex-post measures are referred to as 'consumption smoothing' in the development economics literature (Morduch, 1995) and 'reactive' in the climate change discourse. Examples of these measures include selling productive assets, removing children from school, claiming compensation on damage caused, reduced consumption and seasonal migration of household members etc (Morduch, 1995). In addition, the government also provides formal safety nets for the upliftment of poor households (Tesliuc and Lindert, 2002), such as formal extension, PDS (public distribution system), employment opportunity in MGNREGS (Mahatma Gandhi National Rural Employment Guarantee Scheme) and disability as well as old-age pension grants in the Indian context, which to some extent also help households to smoothen income and consumption. For example, Tiwari et al. (2011) find that MGNREGA reduced vulnerability level of farmers to

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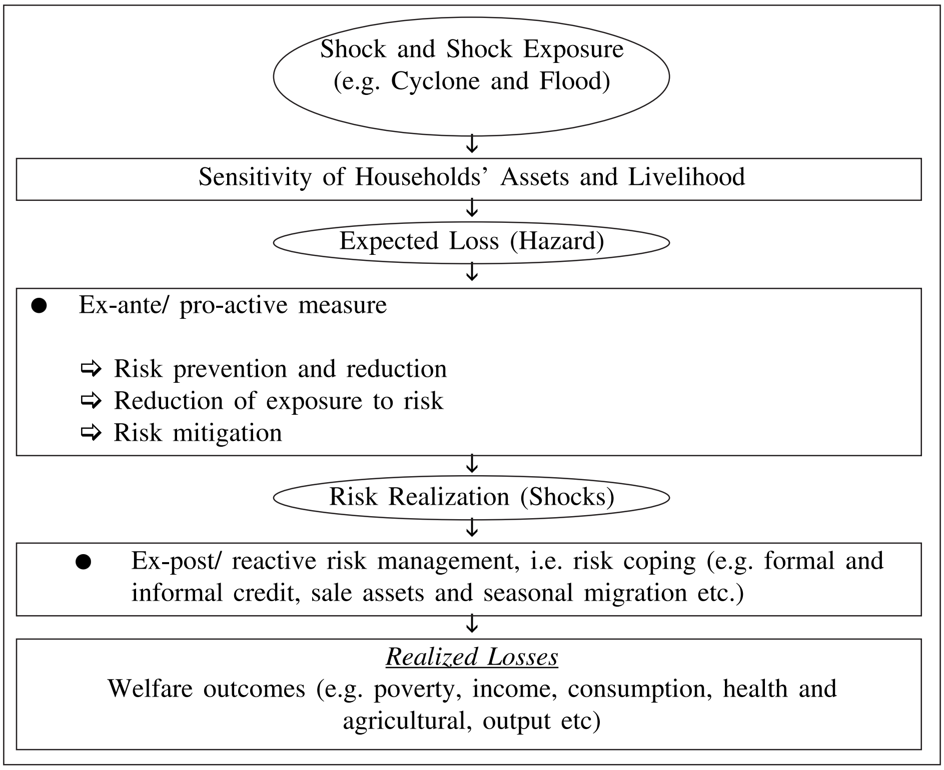
uncertain rainfall in the Chitradurga district of Karnataka state, India. Similarly, Esteves et al. (2013) report that the works generated through MGNREGA reduce vulnerability of agricultural production and livelihoods of the beneficiaries in four states of India, e.g. Andhra Pradesh, Karnataka, Madhya Pradesh and Rajasthan.

Figure 1: The risk chain



Source: Adopted from Heitzmann et al. (2002)

III.2 Study Area and Data

The state of Odisha, geographically located at the eastern coast of India and at the head of the Bay of Bengal, is prone to both cyclonic storms and floods (IMD, 2008; Bahinipati, 2014). For example, IMD (2008) reports that 48.19% (387 out of 803 cyclones) of the total number of cyclones were occurred in Odisha during 1891-2007 (see Bahinipati, 2014). As per BMTPC (Building Materials and Technology Promotion Council) vulnerability atlas, Odisha's 35.8%, 2.4% and 61.7% of the total area are at risk under a wind velocity of 55 m/s (meter per second) and 50m/s, 47m/s and 44 m/s, and 39m/s, respectively (BMTPC, 2006). On the other hand, 21% (i.e., 3340 thousand ha) of the state's total area is considered as flood prone (World Bank, 2008). Out of them, 75% is spread across eight districts, including six coastal districts, namely, Balasore, Bhadrak, Kendrapada, Jagatsinghpur, Puri and Ganjam, and two non-coastal districts, such as

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Cuttack and Jajpur (World Bank, 2008). Bahinipati (2014) finds that eight districts of Odisha, e.g., Balasore, Bhadrak, Jajpur, Kendrapada, Malkangiri, Nabarangpur, Nuapada and Rayagada, are found as more vulnerable as compared to other districts of Odisha.

It is observed that the frequency and intensity of cyclones and floods have increased (Mohanty et al., 2008; Pasupalak, 2010; Guhathakurta et al., 2012) and are likely to increase in the years to come (Unnikrishnan et al., 2011). For instance, a positive increasing trend was reported for both reported damage costs and normalised economic losses, which controls the influence of socio-economic factors (Bahinipati and Venkatachalam, 2014; Bahinipati and Patnaik, 2015). Further, an average of 0.33 million ha agricultural land damaged in the state due to flood during 1953-2011 that converts into an economic loss of Rs. 316.2 million per year (GoO, 2013a). The occurrence of unseasonal cyclonic rainfall in 2010 caused major crop loss across 24 districts in Odisha, i.e. the value of crop loss was around Rs 60,000 million (GoO, 2011). Again, flood in September 2011 caused damages around Rs 326.6 million in the state (Samal, 2011). Further, the occurrence of very severe cyclonic storm 'Phailin' in 2013 caused crop loss across 18 districts, which is calculated as Rs 23,000 million, and an estimates loss to house, crops and public properties as Rs 1,43,734.7 million (GoO, 2013b).

Within the state, three cyclone and flood prone districts, namely Balasore, Kendrapada and Jajpur (see Patnaik et al., 2013; Bahinipati, 2014) were selected to conduct farm household-level survey. While Bahinipati (2014) finds these districts are highly vulnerable to cyclones and floods as compared to the other districts of the state, Mohapatra et al. (2012) report these districts as prone to cyclones. For instance, these three districts come across at least 20 cyclonic storms and floods during 1994-2010, and among them, Balasore experienced a higher number of these events, i.e., 30 times (GoO, 2011). While the total area of Balasore and Kendrapada (i.e., 100%) is prone to cyclonic storms, 46.3% and 35.5% of total area in Balasore and Kendrapada are prone to floods, respectively (BMTPC, 2006). During 1994-2008, an average of 0.95 million people were affected and 72.06 thousand ha land got damaged in Balasore, 0.82 million people were affected and 52.5 thousand ha land got damaged in Kendrapada, and 0.63 million were people affected and 54.21 thousand ha land got damaged in Jajpur due to cyclones and floods (GoO, 2011).

The farm household-level survey was conducted in the randomly selected seven disaster prone villages in these three districts (see Figure 2) during November 2010 to March 2011. A stratified random sampling method was used to select farm households with an aim to cover households representing different categories of land ownership. In doing so, a two step sampling procedure was followed. Firstly, all the households at village-level were stratified into five categories on the basis of land ownership: landless (0 ha), marginal (< 1 ha), small (1-2 ha), medium (2-10 ha) and large (> 10 ha). Secondly, with following a simple random sampling method 10% of the farm households have been drawn in proportion to the total households within each 'strata'. In total, 285 farm households were interviewed.

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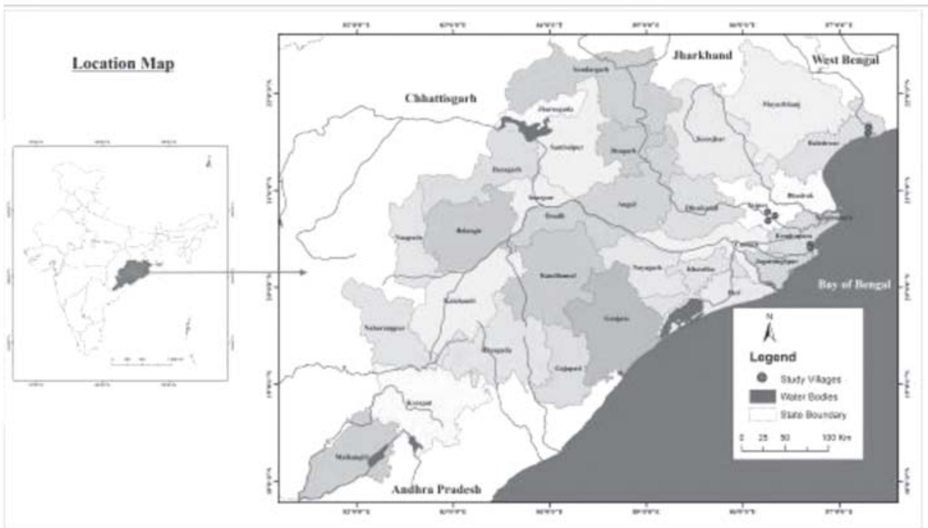
To answer our research question, this study has followed 'shock module' developed by Hoddinott and Quisumbing (2003b), which was tested in the villages studied and refined to meet the specificities of these villages. Since the data is 'cross-sectional' in nature, the present study developed a retrospective module to obtain a history of risk and shocks and also responses (Hoddinott and Quisumbing, 2003b). This module asks farm households to list out possible negative risk and shocks, e.g., climatic, health, lifecycle, social, economic and environment (Hoogeveen et al., 2004) that occurred in the last decade, and their frequency (high, moderate and low)[3], impact (i.e., loss of income, and loss of both income and consumption) and geographical coverage (covariate or idiosyncratic). The data for cyclone and flood frequency was collected either through village-level survey or secondary sources (e.g., 'Panchayat office' of the respective village), and the information related to other risks and shocks ware self-reported[4]. These questions help us to assess the extent to which these shocks have negative implication on farm households' living standard.

Figure 2: Map of the Study Region



Source: Author's Figure

[3] Low frequency: shocks with a frequency of one in ten years; medium frequency: shocks with a frequency of more than one in ten years; and high frequency: shocks with a frequency of more than one in one year (Heitzmann et al., 2002).

[4] As the collection of shock data through the recall process involves error such as either under or over reported (Dercon and Krishnan, 2000a), the present study gathers information related to covariate shocks from the published disaster reports and panchayat office. However, it is not possible to collect information on idiosyncratic shocks from the secondary sources. Moreover, Dercon and Krishnan (2000a) outline that error involved in reporting health shocks is minimal.

III. 3 Households' Vulnerability to Cyclones and Floods: An Econometric Assessment

There are three methods available in the literature to assess vulnerability, namely, 'vulnerability as expected to poverty' (VEP) (Chaudhuri et al., 2002; Sarris and Karfakis, 2007; Shewmake, 2008; Deressa et al., 2009; Gunther and Harttgen, 2009; Azam and Imai, 2009; Milcher, 2010), 'vulnerability as low expected utility' (VEU) (Ligon and Schechter, 2003) and 'vulnerability as uninsured to risk' (VER) (Dercon and Krishnan, 2000a and b; Tesliuc and Lindert, 2002; Skoufias, 2003a; Skoufias and Quisumbing, 2003; Christiaensen et al., 2007; Gerry and Li, 2010; Thomas et al., 2010). Mostly these three methods are applied to estimate vulnerability at the household-level (Hoddinott and Quisumbing, 2003a and b). While both VEP and VEU measure ex-ante vulnerability, VER estimates welfare loss due to the observed shocks. In particular, VER is an ex-post assessment that estimates the extent to which a negative observed shock caused welfare loss, given the risk management mechanisms to mitigate impact of such shock.

The VER approach was adopted in the present study to develop an econometric model for estimating the extent to which cyclone and flood have caused welfare loss, given the risk management mechanisms to mitigate impact of such shocks. In this context, the present analysis used cross-sectional variability as a proxy for inter-temporal variability (Hoddinott and Quisumbing, 2003b). This is due to the lack of availability of data for longer period. Farm households' welfare, measured by their per capita consumption expenditure, depends on household characteristics, including characteristics of the household head, access to formal and informal institutions, observed negative shocks and district-level unobserved characteristics. While the observed negative shocks drive the exposure of a farm household, the household characteristics, access to formal and informal institutions and district-level unobserved characteristics represent the sensitivity as well as the adaptive capacity of a farm household. The variables were chosen in the present analysis based on the previous vulnerability studies (e.g., Datt and Hoogeveen, 2003) and field experience. In practice, this study estimates the following model (which is similar to the model described in Datt and Hoogeveen, 2003):

$$\textit{Model}\ 1: \ln C_h = \beta_0 + \beta_1 X_h + \beta_2 S_h + \beta_3 I_h + \beta_4 D_h + e_h \ldots\ldots(1)$$

Where C_h is the per capita consumption expenditure (total, food and non-food consumption expenditure) in household h, X_h is a set of the variables denoting the characteristics of the household and the household head, S_h is a binary variable indicating if the farm household experienced cyclone (i.e. deep depression and cyclonic storm) and flood during 2000-2009, I_h is a vector of access to formal and informal institutions, D_h is a set of binary variables identifying households living in each district separately to capture unobserved heterogeneity effect at district-level and e_h is a random error term. The random error term captures measurement error of consumption expenditure (since dependent variable is consumption measured in logarithm) as well as effect of idiosyncratic shocks. In the present model, it is assumed that there is no correlation between idiosyncratic shocks that are captured by the random error term and farm household characteristics (Hoddinott and Quisumbing, 2003a)[5].

The vector X_h includes a number of variables associated with the demographic characteristics of the farm household (e.g., size of household and size of household square) as well as asset ownership (e.g., log per capita asset value) and characteristics of the household head (e.g. age of household head, household head age square, years of education by household head, agriculture as major source of income). As observed in the literature (Datt and Hoogeveen, 2003; Christiaensen and Subbarao, 2004; Dercon et al., 2005; Christiaensen et al., 2007), the variables associated with demography, agriculture and economic capacity are the potential determinants of vulnerability, which have either positive or negative association with level of vulnerability. The above variables are also considered to control the taste and preferences of a farm household. The square term of the size of household and household head's age are taken to capture the non-linear effects of the respective variables. The vector S_h includes dummy variables for cyclone and flood, i.e., whether a farm household experiences at least one cyclone or flood during 2000-2009. If farm households are insured against cyclone and flood, the coefficient values of β_2 are either zero or close to zero; it means, shocks to current consumption should have no effect.

In addition, a set of access to formal and informal institutions I_h includes variables like access to formal credit, employment opportunity in MGNREGA, informal credit and if the household receives remittances. These variables capture the role of formal and informal institutions as these indicators are to some extent assist farm households to mitigate potential impacts of cyclone and flood. The vector D_h includes dummy variables for two study districts, i.e. Balasore, and Jajpur. These variables are taken to capture some of the variation in consumption arising from district-level unobserved heterogeneity. While taking dummy variables for cyclone and flood, the functional form adopted in equation 1 assumes that each farm household experienced similar number of cyclone and flood. However, some farm households might have experienced more number of cyclones and floods, and obviously, these households could be more vulnerable as compared to the other households in the study region. This consideration leads to an augmented version of the model (1), i.e. the cyclone and flood frequency variables (SF_h) are considered instead of cyclone and flood dummy variables, which is represented in equation 2.

$$Model\ 2: \ln C_h = \beta_0 + \beta_1 X_h + \beta_2 SF_h + \beta_3 I_h + \beta_4 D_h + e_h \cdots\cdots (2)$$

Ordinary least square (OLS) regression analysis was performed to estimate the above models. A robust standard error was calculated to address the possibility of heteroskedasticity in both the models. While Appendix 1 presents the description of variables and their construction procedure, and Table 2 reports basic descriptive statistics of these variables used in the regression model.

[5] There may be a possibility that measurement error of idiosyncratic shocks could be correlated with farm households' characteristics. In order to overcome this problem, Datt and Hoogeveen (2003) apply the instrumental variable regression model. However, a suitable instrumental variable was not found in the present sample.

IV. Results and Discussion

The estimated models of the welfare impact of cyclone and flood on farm households' consumption level are shown in Table 3. The results from this Table are described below. In these models, the goodness of fit (R^2) varies in between 0.203 to 0.339, i.e. these models explain 20-34 percent of the total variation in log consumption expenditure (total, food and non-food consumption expenditure). Further, the estimated coefficients of variables taken in the models are consistent with those reported in the earlier literature (e.g. Datt and Hoogeveen, 2003; Dercon et al., 2005; Christiaensen et al., 2007).

Table 2: Descriptive statistics of variables used in the econometric model

Variables	Mean	SD	Min	Max
Dependent variables				
Log(per capita consumption expenditure)	3.73	0.14	3.05	4.14
Log(per capita food consumption expenditure)	3.59	0.15	2.30	3.89
Log(per capita non-food consumption expenditure)	3.11	0.26	2.26	4
Independent variables				
Household characteristics				
Size of household	5.89	2.52	1	18
Size of household square/100	0.41	0.42	0.01	3.24
Age of household Head	49.23	13.69	25	82
Age of household Head square/100	26.10	14.03	6.25	67.24
Years of education of household head	1.57	2.70	0	14
Agriculture as major source of income	0.71	0.46	0	1
Log(Per capita asset value)	4.11	0.47	2.95	5.36
Climatic shocks				
Cyclone	0.85	0.36	0	1
Flood	0.37	0.48	0	1
Cyclone frequency	4.17	2.94	0	7
Flood frequency	2.11	3.09	0	8
Access to formal and informal institutions				
Access to formal credit	0.38	0.48	0	1
Employment opportunity in MGNREGA	0.48	0.50	0	1
Access to informal credit	0.84	0.37	0	1
Remittances received	0.67	0.47	0	1
District				
Balasore	0.35	0.48	0	1
Jajpur	0.16	0.39	0	1

Source: computed from primary data

Note: SD- standard deviation, Min- minimum value and Max- maximum value

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Among the household characteristics, the variables like size of household, square of size of household, years of education by household head and log per capita asset value are found to be significant in both the models. While size of household has negative relationship with total, food and non-food consumption expenditures, square of size of household has a positive association with these variables. This suggests that size of household has a negative as well as a non-linear impact on farm households' consumption pattern. In other words, the per capita consumption expenditure declines marginally for larger household size due to non-diversification of income sources. This is similar to the results obtained by Datt and Hoogeveen (2003), Christiaensen and Subbarao (2004), Dercon et al. (2005) and Christiaensen et al. (2007). Further, the variable representing years of education of the household head has a positive relationship with the farm households' level of consumption per capita. For example, an additional year of education is likely to enhance per capita consumption expenditure (total, food and non-food) within a range of 0.6% to 0.9%. This could be due to two reasons: i) the likelihood that literate farm household head and his/ her children could have access to non-farm income sources, and ii) high probability that a literate farm household could undertake adaptation measures to mitigate potential impacts. Our findings are similar to the findings of Dercon et al. (2005), Blankespoor et al. (2010), Wamsler et al. (2012) and Sharma et al. (2013) whereby they establish that access to education is one of the major factors in the context of reducing vulnerability. The farm household with higher per capita asset value tends to be richer. Such household is able to smoothen consumption through dissaving and/ or depleting the existing assets as the presence of higher level of assets in a household facilitates faster recovery. On similar lines, Datt and Hoogeveen (2003) also find a positive association between land ownership and household consumption pattern. In the present analysis, it is found that the coefficient of log per capita asset value is positive (i.e., this can increase level of consumption expenditure within the range of 8.3% to 30.1%) with a significance at 1% level.

Previous studies find that the shocks negatively influence households' welfare (e.g., Dercon and Krishnan, 2000a; Datt and Hoogeveen, 2003; Ninno and Marini, 2005; Christiaensen et al., 2007; Thomas et al., 2010; Skoufias, 2003b). With reference to the present analysis, it is observed that cyclone and flood have negatively influenced total and food consumption per capita. This ascertains that both cyclone and flood have a negative impact on farm household's welfare, i.e., farm households are not fully recovered from the impacts of past cyclones and floods at the time of survey. In other words, the given adaptation measures are not sufficient to fully mitigate the potential impacts of these events. However, flood has greater impact on total consumption expenditure than that of a cyclone. For example, flood has a 4.9% (significant at 5% level) negative impact on per capita total consumption expenditure of farm households affected by this shock alone. Similarly, cyclone reduces the consumption of those affected by 4.1%, which is significant at 10% level.

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Table 3: Impact of cyclone and flood on (log) per capita household consumption expenditure

	Model 1			Model 2		
	Log(per capita consumption expenditure)	Log(per capita food consumption expenditure)	Log(per capita non-food consumption expenditure)	Log(per capita consumption expenditure)	Log(per capita food consumption expenditure)	Log(per capita non-food consumption expenditure)
Household characteristics						
Size of household	-0.051*** (0.012)	-0.042*** (0.014)	-0.059*** (0.020)	-0.052*** (0.012)	-0.043*** (0.014)	-0.061*** (0.019)
Size of household square/100	0.258*** (0.075)	0.216** (0.086)	0.319*** (0.116)	0.256*** (0.074)	0.209** (0.083)	0.331*** (0.114)
Age of household head	-0.0004 (0.004)	-0.004 (0.004)	0.004 (0.009)	0.001 (0.004)	-0.003 (0.005)	0.003 (0.009)
Age of household head square/100	0.001 (0.004)	0.005 (0.004)	-0.004 (0.009)	-0.0001 (0.005)	0.003 (0.005)	-0.004 (0.009)
Years of education of HH head	0.007*** (0.003)	0.007*** (0.003)	0.009* (0.005)	0.006** (0.003)	0.006** (0.003)	0.009* (0.005)
Agriculture as major source of income	0.003 (0.015)	0.015 (0.017)	-0.011 (0.033)	-0.0001 (0.016)	0.010 (0.017)	-0.013 (0.033)
Log(Per capita asset value)	0.147*** (0.026)	0.092*** (0.026)	0.301*** (0.046)	0.139*** (0.027)	0.081*** (0.026)	0.296*** (0.046)
Climatic shocks						
Cyclone	-0.041* (0.021)	-0.054*** (0.019)	-0.040 (0.048)			
Flood	-0.049** (0.022)	-0.082*** (0.024)	0.057 (0.051)			
Cyclone frequency				0.001 (0.005)	0.001 (0.008)	0.008 (0.009)
Flood frequency				-0.007* (0.004)	-0.013*** (0.005)	0.015 (0.009)
Access to formal and informal institutions						
Access to formal credit	0.022 (0.015)	0.024 (0.016)	0.009 (0.031)	0.026* (0.016)	0.029* (0.018)	0.012 (0.031)
Employment in MGNREGA	0.009 (0.016)	0.012 (0.018)	0.024* (0.031)	0.003 (0.017)	0.006 (0.017)	0.011 (0.031)
Access to informal credit	0.038 (0.025)	0.024 (0.037)	0.081** (0.040)	0.042* (0.025)	0.031 (0.037)	0.082** (0.040)
Remittances received	0.033** (0.017)	0.014 (0.019)	0.064** (0.032)	0.034** (0.016)	0.015 (0.019)	0.069** (0.032)

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District						
Balasore	-0.016	0.037	-0.199***	-0.012	0.038	-0.171***
	(0.024)	(0.025)	(0.052)	(0.027)	(0.037)	(0.053)
Jajpur	-0.019	0.009	-0.159**	0.014	0.054	-0.145
	(0.034)	(0.034)	(0.076)	(0.05)	(0.057)	(0.101)
Constant	3.298***	3.440***	1.997***	3.260***	3.389***	1.959***
	(0.141)	(0.139)	(0.259)	(0.140)	(0.139)	(0.253)
No. of observations	285	285	285	285	285	285
R^2	0.339	0.216	0.271	0.331	0.203	0.270
F(13, 271)	8.43	6.45	5.61	8.26	5.83	5.58
Prob. > F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Source: computed from primary data;

Note: i) The figures in the parentheses are robust standard error
ii) *** p<0.01, ** p<0.05 and * p<0.1 respectively

In the case of impact on food and non-food consumption expenditure, the cyclone and flood dummy variables have higher negative impact on the former in comparison to the latter, and the coefficient is also significant. It is inferred that both cyclone and flood have a higher negative impact on food consumption than that of non-food consumption. But, the flood has a higher negative impact on food consumption expenditure than cyclone. For instance, flood reduces food consumption by 8.2% (significant at 1% level), whereas cyclone cuts down food consumption by 5.4% (significant at 1% level). This underlines that the farm households, especially the flood affected farmers, are not able to take sufficient adaptive measures to hedge against food consumption loss than the non-food consumption loss. This could be attributed to the continuous damage of agricultural crops due to cyclones and floods, which are the major source of income for the farm households. In spite of this, most of the existing risk management policies (e.g., employment opportunity through MGNREGA, formal credit and agricultural insurance etc.) are dealing with farm financial management, and therefore, these measures could have helped the households to reduce the negative impacts on non-food consumption expenditure.

We now discuss about the results when the 'frequency' of cyclone and flood is included instead of just cyclone and flood, in model 2. The flood frequency is negatively associated with total and food consumption expenditure. This means, on an average farm household experiencing more number of floods have lower level of total consumption and food consumption expenditure. While the flood frequency reduced food consumption expenditure by 1.3% (significant at 1% level), total consumption declined by 0.7% (significant at 10% level). From model 1 and 2, it can be inferred that the flood had a higher negative impact on farm households' consumption pattern as compared to cyclone, particularly on their food consumption expenditure.

Access to formal and informal institutions help farm households to smoothen income and consumption (Morduch, 1999; Skoufias, 2003a; Sumarto et al., 2003), and this also reflects the adaptive capacity of a farm household. The time required to fully recover from the impact of cyclone and flood is less for those households with access to formal institutions; because, they are able to avail formal credit as well as formal safety net measures to smoothen their consumption (as observed by Skoufias, 2003a; Sumarto et al., 2003). In the present analysis, both the variables of formal institutions, e.g. access to formal credit and employment opportunity in MGNREGA, show a positive relationship with farm households' consumption pattern. For instance, employment opportunity in MGNREGA increases purchasing power of farm households, and reduces the 'recovery' period after a cyclone or flood. In addition, the development based activities undertaken through MGNREGA reduce the level of vulnerability of farmers (Tiwari et al., 2011). Further, farm households are better off if they have access to informal institutions like informal credit (borrowing from money lender, friends and neighbourers) and receive remittances (Morduch, 1999); but the informal credit makes a household more susceptible in the long-run due to a higher interest rate on borrowing. In the present analysis, both the variables are found to be positively influencing farm households' consumption expenditure. In both the models, variables representing access to informal credit and remittances are statistically significant in the case of both total and non-food consumption expenditure. It means the farm households in the study region are using informal sources to smoothen non-food consumption expenditure.

V. Concluding Observations

The present study assesses the impact of cyclone and flood on farm households' consumption behaviour. In doing so, this identifies particular climatic extreme events to which the farmers are not able to take adequate measures to hedge against their impacts.

Adopting VER approach, this study ascertains that both cyclone and flood have a negative impact on the farm households' consumption pattern, but flood has higher impact compared to the cyclone. In the case of impact on food and non-food consumption expenditure per capita, both cyclone and flood have higher negative impact on the former as compared to the latter. However, flood has greater negative impact on per capita food consumption than the cyclone. This underlines the fact that the farm households are not able to take sufficient adaptive measures to fully insure the food consumption; however, evidences show that the households use existing farm financial management strategies for insuring non-food consumption expenditure. The farm households might have partially insured food consumption. Hence, the focus should be on policy interventions that enhance farm-level adaptation measures in order to reduce potential crop loss due to these extreme events.

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Appendix 1: Description of the variables and their construction procedure

Variables	Definition of the Variables
Dependent variables	
Log(per capita consumption expenditure)	Log of per capita consumption expenditure
Log(per capita food consumption expenditure)	Log of per capita food consumption expenditure
Log(per capita non-food consumption expenditure)	Log of per capita non-food consumption expenditure
Independent variables	
Household characteristics	
Size of household	Total number of members in a household
Size of household square/100	Square of size of household divided by 100
Age of household head	Number of years household head completed
Age of household head square/100	Square of number of years household head completed divided by 100
Years of education of household head	Number of years formal education completed by the household head
Agriculture as major source of income	Dummy=1, if a farm household earns more than 50 percent of their income from agriculture; 0, otherwise
Log(Per capita asset value)	Log of per capita asset value
Climatic shocks	
Cyclone	Dummy =1, if a farm household experienced at least one cyclone during 2000-2009; 0, otherwise
Flood	Dummy =1, if a farm household experienced at least one flood during 2000-2009; 0, otherwise
Cyclone frequency	Number of cyclonic storms experienced by the farm households during 2000-2009
Flood frequency	Number of floods experienced by the farm households during 2000-2009
Access to formal and informal institutions	
Access to formal credit	Dummy=1, if a farm household has access to formal credit sources; 0, otherwise
Employment opportunity in MGNREGA	Dummy=1, if any members of the farm household is employed under MGNREGA activities; 0, otherwise
Access to informal credit	Dummy=1, if a farm household has access to informal credit sources; 0, otherwise
Remittances received	Dummy=1, if a farm household receives remittances; 0, otherwise
District	
Balasore	Dummy=1, if a farm household belongs to Balasore district; 0, otherwise
Jajpur	Dummy=1, if a farm household belongs to Jajpur district; 0, otherwise

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