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Abstract

This paper aims to assess the impact of the tropical storm Milenyo on household welfare in the rural Philippines. The most important finding is that the rural households are able to cope with the disaster by changing its consumption expenditure in response to changes in commodity prices caused by the occurrence of a disaster. More specifically, the poorer households decrease their expenditure on protein and food taken outside their homes to shift their consumption towards cheaper alternative commodities such as fish. The availability of emergency informal transfers from close kins and aid from the local government in the form of food basket and house repair materials have helped the households, most importantly the poor landless households, to cope with the damages brought by Milenyo. Finally and more importantly, we found that households shifted their fuel use away from fossil fuels such as liquefied petroleum gas, kerosene, and electricity toward firewood because of the sharp decrease in shadow prices of firewood due to Milenyo. The environmental consequence of such shifts should be investigated carefully in future studies.

Keywords: Natural Disasters; Risk Coping; Poverty Dynamics

JEL Classification Numbers: D12; D92; E21; O1

1. Introduction

In both developed and developing countries, people face a wide variety of risks to their livelihood (Alderman and Paxson, 1992; Fafchamps, 2002; Dercon, ed., 2005).

Accidents, sickness, or sudden death can disable the head of a household or even an entire family (Dercon and Krishnan, 2000). Agricultural production involves a variety of price and yield risks, which appear to be prevalent especially for small-scale, poor farmers in the semi-arid tropical areas (Walker and Ryan, 1990). Urban households experience income fluctuations over time because of unemployment or underemployment resulting from contractual and price risks (Fafchamps, 2002). Macroeconomic instability or recessions, which tend to generate harsh inflation/deflation and widespread unemployment, can also significantly reduce the real value of household resources (Frankenberg, et al., 2003; Friedman and Levinsohn, 2002; Ravallion and Lokshin, 2005; Kang and Sawada, 2008a, 2008b).

However, natural disasters can generate the most serious consequences as it causes loss of lives and livelihood (Strömberg, 2007). The Centre for Research on the Epidemiology of Disasters (CRED) defines a natural disaster as an unforeseen event that causes great damage, destruction and human suffering, which overwhelms the local capacity to respond, thereby necessitating a request for national or international assistance.¹ The International Disaster Database of CRED (2008) shows an increasing

¹ The natural disasters can be divided into three subgroups (1) hydro-meteorological disasters including floods, storms, and droughts, (2) geophysical disasters including

trend from 1900 to 2006 in the occurrence of natural disasters, most specially, the hydro-meteorological disasters.

Indeed in the Philippines, the most frequently occurring natural disaster is tropical depression. The country experiences about twenty tropical storms most commonly occurring during the monsoon season from June to December every year. While there has been a remarkable progress in the theoretical and empirical literature on household behavioral responses to risks (Fafchamps, 2003; Dercon, 2005), changes in household behavior in response to a disaster have rarely been investigated in the past despite an increasing occurrence of natural disasters worldwide. Exceptions known to us are recent studies by Sawada and Shimizutani (2008), Yang (2007), and Takasaki et al. (2004) and Skoufias (2003). To bridge this gap in the existing literature, we analyze the impacts of tropical storm Milenyo in the Philippines in 2006 on rural household welfare. We have chosen the East Laguna Village because the village is located in the province of Laguna, which was one of the most badly hit provinces and, more importantly, because the village has an enormous amount of benchmark information that was collected and compiled earlier by Hayami and Kikuchi (1981), Hayami and Kikuchi (2000), and later by Fuwa et al. (2006), and Kajisa (2007).

This paper has five remaining sections. Section 2 gives an overview of Milenyo. Section 3 is the unified model of risk coping strategies of households. Section 4 gives a brief description of the study village. Section 5 assesses the damages of Milenyo and identifies the household coping strategies. Section 6 documents the changes in household expenditure pattern. Finally, Section 7 concludes this paper.

earthquakes, tsunamis and volcanic eruptions and (3) biological disasters such as epidemics and insect infestations.

2. An Overview of Milenyo

Super typhoon Milenyo hit the Philippines on September 28, 2006. Xangsane is the international code name of Milenyo, a name which was given by the Japan Meteorological Agency. The Philippine Atmospheric, Geophysical, and Astronomical Services Administration (PAGASA) reported Milenyo to have a maximum sustained winds of 130 kilometers per hour and gusts of up to 160 kilometer per hour, therefore classifying it as a severe tropical storm. Milenyo first made land contact on Samar Island, which is located east of the Philippine Visayas Region. Contrary to expectations, Milenyo did not weaken even after hitting a land mass and move further north towards the Bicol Region before hitting Cagayan Valley on its way out. As a result, it wreaked havoc on several provinces and became the strongest typhoon to directly impact Metro Manila in the last eleven years.

The National Disaster Coordinating Council of the Philippine government reported that Milenyo caused damages to infrastructure and agriculture worth US\$130M]. Bicol region suffered most heavily accounting for more than one half of the total damages followed by CALABARZON region including the provinces of Cavite, Laguna, Batangas, Rizal, and Quezon. The provinces that were directly hit by Milenyo are Albay and Sorsogon in Bicol region and Cavite and Laguna in CALABARZON region.

Government and non-government organizations were able to provide assistance but amounting to only US\$1.9M, which means that much of the damages were born by the households. Relief assistance included the release of sacks of rice and the distribution of food baskets (e.g. canned goods) and non-food commodities (e.g. used clothings). Medicine and clean water were also provided and public school buildings served as evacuation centers. International organizations such as the United Nations Development Program, Australian Government Overseas Aid Program and the United States Agency for International Development and France and New Zealand governments through the Philippine National Red Cross extended their contributions to the victims through domestic channels. The Catholic Church launched the “Sagip Milenyo” (Save Milenyo) drive and media personalities staged fund-raising projects. Filipino communities abroad also had their own fund raising activities.

Overall, we have seen that Milenyo inflicted enormous amount of damages to the lives and livelihoods of many Filipino households with substantial amount of damages born by the households. An important point of inquiry is how rural households are able to cope with the impacts of Milenyo. In the next section, we present a theoretical framework of household’s savings and consumption behavior given a shock to household assets in the presence of non-transfer income.

3. Theoretical framework

In order to formalize the risk coping behavior of households, we employ Zeldes' (1989) model of optimal consumer behavior under uncertain income and possible credit constraints. Suppose that a household decision maker has a concave instantaneous utility $U(\bullet)$ of household i 's consumption c_{it} . Then, the household decision is to choose the C_t that maximizes the conditional expectation of discounted lifetime utility with a subjective discount rate δ , subject to intertemporal budget constraints. Let μ represent the Lagrange multiplier associated with credit constraint where the maximum amount of credit possible for this household is represented by z . Following Zeldes (1989), we obtain a consumption Euler equation, which is augmented by the possibility of a binding credit constraint:

$$u'(c_{it}) = E_t \left[u'(c_{it+1}) \left(\frac{1+r}{1+\delta} \right) \right] + \mu_{it}. \quad (1)$$

where r represents the interest rate. We can interpret the Lagrange multiplier, μ , as an indicator of negative welfare effects arising from binding credit constraints. If the utility function is again supposed to take the form of a constant absolute risk aversion (CARA) function, then the augmented Euler equation (1) can be written as follows:

$$\Delta c_{it} = \frac{1}{\alpha} \left[\ln \left(\frac{1+r}{1+\delta} \right) + \ln(1 + e_{it}) - \ln(1 + \mu'_{it-1}) \right], \quad (2)$$

where e is a rational expectation error and μ' is the Lagrange multiplier associated with the credit constraints standardized by the marginal utility of future consumption and α is the coefficient of absolute risk aversion. From the intertemporal budget constraints, we have: $y_t^{RT} + y_t^{BT} + y_t^N - n_t = s_t + c_t$, where y_t^{RT} , y_t^{BT} , y_t^N , n_t , and s_t are private transfer income, public transfer income, non-transfer income including non-farm income, a negative shock

to the assets, and net savings, respectively. We assume that transfer income is determined endogenously, while non-transfer income and an asset shock are exogenously given. Since net saving flows are defined as gross asset accumulation minus gross borrowing, we have the following linearized version of equation (2) from the income and savings perspective [Flavin (1999); Kochar (2003); and Sawada and Shimizutani (2005)]:

$$\Delta d_{it} + \Delta b_{it} + \Delta y_{it}^{RT} + \Delta y_{it}^{BT} = -\Delta y_{it}^N + \Delta n_{it} + \frac{1}{\alpha} \left[\ln \left(\frac{1+r}{1+\delta} \right) \right] - \mu'_{it-1} + e_{it}, \quad (3)$$

where a and b are dissaving such as sales of assets and borrowing, respectively. The last two terms on the right-hand side represent the effects of credit constraints and the mean zero independent expectation error. It should be noted that μ' is a negative function of initial income and assets. Therefore, for example, those who own assets or are less credit-constrained can achieve a smaller amount of left-hand side variables, indicating that they do not need to rely much on risk-coping. Equation (3) formally shows that there are several possible risk-coping strategies against realized negative shocks, whose absolute values are represented by $-\Delta y_{it}^N + \Delta n_{it}$. First, cutting back consumption and/or switching consumption to own produce is a way to weather the negative impact of the absolute value of realized negative shocks, $-\Delta y_{it}^N + \Delta n_{it}$. Other coping strategies can be captured by the left-hand side of equation (3), including sales of valuable items, emergency borrowing, received remittances and aid from government and NGOs, and participating in nonfarm employment opportunities.

4. The Study Village

The study village is located about 70 kilometers southeast of Manila, facing the east coast of Laguna de Bay in the province of Laguna. The village, called the East Laguna village, has been surveyed repeatedly since 1966 (Hayami and Kikuchi, 2000). Surveys of all households in the village were conducted in 1966, 1974, 1976, 1980, 1983, 1987, 1995, 1997, 2001, 2003 and 2006. To our knowledge, the dataset that was collected in this village represents the most comprehensive household panel data set in the Philippines. Historical data show that rice farming is the most important agricultural activity in the village. In earlier years, the village was largely covered by coconut trees, which was then one of the more important nonrice crop.

The village economic and social structure has changed dramatically since 1966 because of the influx of commercialization and the spread of new rice technology- the so-called modernization forces. In addition to these two modernization forces, major forces that caused economic and social changes are: (1) continued population pressure on limited land resources; (2) implementation of land reform programs; (3) public investments in infrastructure such as irrigation systems, roads, and schools; and (4) growing urban influences accelerated by improvements in transportation and communication systems (Hayami and Kikuchi, 2000, p.13).

In the 1990s, the development of industrial parks along Laguna de Bay increased non-farm job opportunities to the villagers. Non-farm income has become an important household income component, not only among non-farm households, but also among farm households, whose children tend to work in the non-farm sectors (Kajisa, 2007). As we discuss later in this paper, non-farm employment is one of the more important

coping strategies of households when there is a calamity. This is particularly true for a non-farm employment that gives a regular stream of income flow that is independent of agricultural cycle. The ability of household members to engage in nonfarm employment, on the other hand, is a result of household decision to invest in children's schooling in earlier years.

Furthermore, in more recent years with high population pressure rice fields and coconut lands have been increasingly transformed into residential areas resulting to a more diversified village population. In-migrant households consisting mainly of nonfarm households from nearby villages and provinces have started to purchase residential plots in a section in the village which was converted into residential subdivision plots. And with the influx of commercialization, some of the rice fields and coconut lands have been planted with high value crops or converted into commercial fish pens. Given this development, household income has become much more diversified.

Our team conducted the Milenyo survey in January 20 to February 15, 2007- barely three months after Milenyo hit the village. A total of 399 households reside in the village at the time of the survey consisting of farmer households (10%), landless households (37%), and nonagricultural households (53%) (Table 1). Farmer households included those households that were currently cultivating land such as owner cultivators and leaseholders. Landless households included those households that were not currently cultivating land such as owners, who were renting-out their entire land and agricultural worker households. Nonagricultural households are those that were purely dependent on nonagricultural wage employment or self employment.

The questionnaire consists of five modules: (1) household characteristics such as landholding and characteristics of each household members such as age, schooling, gender, occupation, and membership in an organization; (2) damages of Milenyo to households' physical and human assets including farm endowments and human lives; (3) household coping mechanisms in the aftermath of Milenyo; (4) detailed expenditure on food and nonfood items as well as on utilities and tobacco; and (5) prices of basic goods such as rice, chicken, pork, sugar, bread, and fish one week before the survey and one week before and after Milenyo. We believe that recall data on expenditures are quite accurate owing to the proximity of our survey to the time Milenyo hit to the village.

5. Damages of Milenyo and Household Coping Mechanisms

5.1 Damages of Milenyo

Table 2 shows the damages to households in terms of assets and income lost. As to human losses, there were no reported dead or seriously injured household members, thanks to an extensive television and radio broadcast on the severity of the intensity of Milenyo that made the households aware of its possible damages. Indeed, 24% of farmer households, 42% of landless households, and 50% of nonagricultural households reported to have experienced no damages. Milenyo hit the village during rice harvesting season and the major damage to rice crop was water logging. The availability of portable water pumps enabled some farmers to evade the destruction of Milenyo, as they were able to plant and harvest early before the typhoon hit the village. Even among the farmers who

had not finished harvesting, the water logging damage was generally location specific. This means that there is a wide degree of heterogeneity in damages caused by Milenyo even within the same village, thus, enabling us to identify the risk coping strategies quantitatively.

The most common form is house roofing damage because of sustained heavy winds and low-standard roofing. A total of 108 households (27 percent) encountered serious damages to their house: typically, they completely lost their roofing and so the local government distributed galvanized iron sheets to these households to allow them to renovate their roofs.

Including the cases of multiple damages, fifty four percent among the farmer and twenty seven percent among the landless reported to have had experienced a decline in income especially because of damages to the standing rice crop. Notably, the income decline was combined with other damages such as damages to houses, productive assets, and standing crops. Interestingly, crop damage, which was mostly to fruit crops, appears to be common even among the nonagricultural households.

The trees contribute to household income because those trees are high value crops. The more common trees are avocado, banana, jackfruit, mango, and rambutan. Table 3 shows that banana trees have the largest damage in terms of number completely lost and number heavily damaged. Yet the value of the damages to mango trees is sixteen times larger because mango trees have longer productive lifespan and mango fruits are more expensive than bananas. Rambutan trees also suffered from damages, which is second largest after that of mangos. Damages to chickens and pigs are much lower compared to those of standing trees.

The total amount of paddy harvest in the village was only 151,160 kg while the expected harvest was 222,966 kg thereby falling short by 71,806 kg, i.e., a decline by 32% . Villagers had expected before Milenyo that they would receive PHP8.89 per kg of paddy, but they actually received only PHP7.44 per kg (i.e., 16% reduction). According to the villagers, the decline in the unit value received was due to the fact that their paddy got wet when the fields were submerged in water and wet paddy commands a lower price in the market. The loss in paddy production due to Milenyo was on the average PHP260 per household, which is almost equivalent to the minimum wage rate of PHP277 per day (US\$5.29 at US\$1=PHP52.35). In contrast, the total lost in mango tree was PHP680 per household, which is 2.72 times the minimum wage rate per day. These figures show the seriousness of Milenyo in terms of the degree of aggregated or average shock, while there was heterogeneity in Milenyo-induced effects depending on the ownership of fruit trees and paddy fields.

While typhoons occur in most parts of the Philippines almost regularly during monsoon months, the extent of the damage caused by Milenyo in our study village was by far exceptionally large. In fact, typhoon damage with severe economic consequences appears to occur relatively infrequently, at least in the East Laguna village. The 2003 survey conducted in the village, for example, reveals that only 2% of the households experienced crop damage due to typhoon and 8% reported property damage in the past ten years (i.e., 1994-2003), while 27% reported of serious illness and 8% reported of death among income earning household members during the same period (Fuwa et al. 2006). This suggests that the damage caused by Milenyo was largely an unexpected shock. In addition, during our informal interviews, a few of the long time residents

compared Milenyo with a legendary typhoon, named “Rosing”, which hit the village in the 1970s.

5.2 Households’ risk coping mechanisms

How did households cope with the damages caused by Milenyo? Based on the model framework shown in Section 2, we can investigate a variety of risk coping strategies. As is summarized in Table 4, households in the village were able to cope with Milenyo by adopting six important strategies out of ten possibilities, that is, by (1) reducing their food consumption, i.e., reducing protein intake and food taken outside; (2) switching consumption from purchased food to own produce; (3) obtaining emergency loans from relatives and village moneylenders; (4) receiving remittances; (5) receiving aid from local government and private individuals; and (6) engaging in nonfarm employment. Coping strategy (1) and (2) is c_t , in our theoretical framework in Section 2, (3) is b , (4) is y_t^{RT} , (5) is y_t^{BT} and (6) can be considered as y_t^N .

In the East Laguna Village, we find that nonfarm employment played a very important role, which is consistent with past studies in India (Walker and Ryan, 1990; Kochar, 1999) and in Indonesia (Frankenberg, Smith, and Thomas, 2003). Nonfarm employment serves as an effective insurance mechanism for rural households because nonfarm income to a large extent is not associated with fluctuations in farm income.

Occupation

Table 5 shows the primary occupation of economically active household members (15 to 65 years old who are not in school at the time of the survey) before and after Milenyo. A large number of the population were in agricultural work, casual work, transportation sector, carpentry and electrical works, and factory work. Thirty two percent reported to be fulltime housekeepers for women and no primary occupation for men. It is interesting to observe a relatively large number of overseas workers, which are the major source of remittances to the villagers particularly so after Milenyo.

In Table 5, we cannot identify major changes in the primary occupation after Milenyo, which indicates that it is the long-term employment in the nonfarm sector that enabled the households to insure against the disaster. With respect to secondary occupation we find a relatively larger number in carpentry and construction work *among those who were employed even after Milenyo* perhaps because of the greater demand for house repair after the typhoon. There were also a larger number of those engaged in fishing as secondary occupation perhaps because many fish pens in Laguna Lake were destroyed by the typhoon thus making open fishing a profitable venture. Interestingly, the number of unemployed, i.e., those workers who reported “none” in the primary occupation, rose from 57 to 67 people indicating an increase in unemployment rate by 18%.

Public transfers

As shown in Table 4, a large proportion of households – the proportion is higher for the landless households - have received aid from the local government and a political

candidate in the form of grocery bags containing rice, noodles, and canned goods valued at about US\$2 per household. These food bags were distributed to the households through the office of the village chieftain purposely to effectively identify the poor and the severely affected households. The food aid was distributed in addition to the galvanized iron sheets given to 16 households whose houses lost their roofs and to additional 8 households that received cash aid amounting to about US\$50, thanks to the provincial governor, who run and won in the May 2007 local elections barely seven months after Milenyo.

Borrowing and private transfers

There are studies showing that borrowing commonly from close relatives is one of the more important coping strategies during disaster time (Glewwe and Hall, 1998; Shoji, 2006; Sawada and Shimizutani, 2008). Interestingly, moneylenders played an important role as sources of emergency funds in the study village. A major question is whether those moneylenders charge usurious interest rates during the calamity. For the landless, nearby *sari-sari* (village variety) stores provided either on credit or cash purchase the most basic needs such as rice, canned goods, candles, and kerosene, evidence that village stores do not hoard basic goods during calamity perhaps because of intricate close associations among the village people that prohibit opportunistic behavior.

As reported in earlier studies (Estudillo, Sawada and Otsuka, 2008), remittances have become an important source of income in the rural Philippines as a result of the increasing number of OFWs. As in Table 5, there were 31 OFWs in our study village.

25% of the farmer households, 16% of the landless households, and 21% of the nonagricultural households reported to have received remittances after Milenyo (Table 4). In brief, the availability of emergency borrowing and remittances indicate the importance of personal network in surviving a crisis.

Consumption reallocation

A larger proportion (76%) of the landless households compared to farmer (27%) and nonagricultural households (47%) reported to have decreased their food consumption (Table 4). The landless households reported the lowest total expenditure on food one week after Milenyo (PHP984) compared to farmer (PHP1,412) and nonagricultural households (PHP1,023). Reducing protein intake was the more common coping strategy among the landless while about one-fourth of the farmer households have reduced their consumption of food taken outside, which is more expensive than home prepared food.

Switching consumption to own produce, which is cheaper than those bought in the market, is another coping strategy for 34% of the landless, 22% of the nonagricultural, and 12% of the farmer households. Perishable fruits of backyard trees such as mangos, banana, and rambutan, which were fallen by Milenyo became substitute to fruits bought in the market shortly after Milenyo. Because fish prices went down sharply, many households were able to shift to own fish catch (or given by relatives) to fill up their daily protein requirements.

Role of the local government

The local government through the village chieftain immediately responded to the disaster by opening the village meeting hall as a temporal shelter to households that lost their roofs or were affected by flash floods. In addition, the local government and a political candidate for a local post released food baskets to the affected families. The village chieftain had been able to identify the badly affected families because of his many years of association with the village people and his immediate effort to assess the devastation of the typhoon to be able to report to and get aid from the local town mayor. Indeed, during our survey we found that the relatively better off households in the village did not receive the food baskets even if they were equally affected by Milenyo. There was also strict food price and supply monitoring undertaken by the local government in the local public market in order to avoid unnecessary price hikes and disruption of local food supply maneuvered by opportunistic businessmen.

Our data clearly show that the role of the local government is particularly effective during disaster because households in our study village identified the food basket as one of their more important coping mechanisms. The food basket is particularly important to the poor landless households (Table 4). Indeed, disaster management undertaken by the local government and administered through village officials, is effective because there is to a large extent no information asymmetry between the donor and the recipient of aid.

Coping behavior during regular typhoons

The behavioral response of village residents to the Milenyo shock can be compared with the results from the 2003 survey which included a set of questions regarding the type of shocks and coping behavior during the previous decade (Fuwa 2006). The 2003 survey results indicate that ‘own savings and income’ and ‘help from relatives’ were the main coping mechanisms while sale of physical assets (such as land or animals) and consumption reallocation played minor roles regardless of the type of shocks (such as natural calamities and demographic shocks including the death or illness of household members).

Comparing the household responses to Milenyo as reported above with the responses to the typhoon damage to crops or property as reported in the 2003 survey, we find that the minor role of physical asset liquidation and the important roles of borrowing and receipts of assistances/remittances were found in both the responses to Milenyo and those to earlier typhoons in the 1990s. A major difference, however, appears to be the importance of the reduction in food consumption (as well as other consumption reallocation) in response to Milenyo in contrast with the conspicuous absence of such behavior in response to earlier typhoon shocks in the 1990s.

Such a contrast appears to reflect the sheer magnitude of the damage due to Milenyo, which was likely to be much larger than that of the typhoons in the period during 1994-2003, as suggested by our informal interviews with village residents. This interpretation is also consistent with the fact that a much larger proportion of households reported government aid as a coping mechanism after Milenyo compared to that of those found in the 2003 survey; the severity of the Milenyo damage perhaps combined with the prospect of the then-upcoming local elections likely necessitated a larger scale relief

operation on the part of the government. While village households were mostly able to shield their consumption from income fluctuations caused by earlier typhoons through various informal insurance schemes (including own savings and incomes, borrowings and assistance from relatives), the extent of income shock due to Milenyo was sufficiently large so that many households were forced to reduce their food consumption.

6. Changes in expenditure pattern

As revealed in recent studies on the aftermath of the currency crisis in Indonesia, Thailand, and Mexico, consumption reallocation is indeed an important coping strategy (Attanasio and Szekely, 2004; Frankenberg, Smith, and Thomas, 2003; Frankenberg, Thomas, and Beegle, 1999; McKenzie, 2003, 2004, 2006; Strauss et al., 2004; Townsend, 1999).² Interestingly, Olney (1999) showed that cutting consumption was the only viable strategy of American households against the recession of 1930, given the high default cost on their loans. Accordingly, consumer spending collapsed in 1930, turning a minor recession into the Great Depression.

In order to investigate consumption reallocation after Milenyo, we administered a detailed consumption expenditure questionnaire on food and nonfood items for three periods (1) one week before Milenyo, (2) one week after Milenyo and (3) one week before the survey. Overall, we find distinct changes in expenditure patterns, which are

² Similarly, Moser (1996) finds the importance of food substitutions and expenditure reductions in four poor urban least developed country (LDC) communities.

fairly similar among the farmer, landless and nonagricultural households so that we show the average expenditure for each consumption item for the three household groups combined. We consider one week before Milenyo and one week before the survey as normal periods.

Food expenditure

Table 6, 8 and 9 show the three major expenditure items namely food, nonfood, and utilities and alcohol. The average food consumption declined slightly (by 2%), in line with the household coping strategies as reported earlier (Table 4), but non-food consumption increased substantially by 31%. Total consumption also increased due to the increase in non-food consumption. However, the bulk of the increase in the non-food consumption (and thus the total consumption) was accounted for by house repair, which increased by over 800 percent, and other purchases (e.g., crockery) apparently made necessary directly by Milenyo.

Among the food expenditure items, we find a decline in the expenditure on rice (by 7 percent), as well as in more expensive rice substitutes such as pandesal bread, bread loaf and native cakes. This is roughly in line with the self-reported coping strategies as we find earlier. There was also an increase in the consumption of noodle soup, which is included in the food basket given by the local government and a political candidate.

There was an increase in mango consumption, a substantial portion of which is home produced coming from fallen mango trees. Although some households reported that

they cut back consumption of protein as a coping strategy, we find that the total expenditure on meat actually increased on average after Milenyo. As we take a closer look at the composition of the consumption of meat and fish, however, we observe some significant patterns of substitution; there was a decrease in the expenditure allocated for the more expensive protein sources such as pork and milk and an increase in the expenditure allocated for cheaper protein from chicken and fish (*bangus* and *tilapia*).

Table 7 shows there was no substantial increase in the price of rice, bread, noodle soup, and fresh chicken and pork perhaps because of strict local government monitoring and a substantial decline in the price of *bangus* fish (down by almost 70%) and tilapia fish (down by 7%) owing to the abundant supply of fish in the market. As expected, there was a decline in the expenditure for food taken outside such as restaurant food and meal and *merienda* (snack) outside.

The farmer households have the highest level of household expenditure and the landless households the lowest. Interestingly, the gap in food expenditure between the farmer and landless group rose: one week before Milenyo the expenditure of landless households is 34% of that of the farmer households while one week after Milenyo the expenditure of the former has become only 20% of that of the later. Indeed, the brunt of Milenyo is felt more severely by the poor landless households.

Nonfood expenditure

Nonfood expenditure on personal care products, clothing and footwear, personal accessories, home furnishing, telephone services, and various contributions remained fairly stable through the period between one week before and after Milenyo, even though Christmas expenditures on clothing, footwear, and personal accessories increased as Filipinos consider Christmas as the most special event in the year. Most notably, however, the expenditures on house maintenance rose substantially after the devastation of Milenyo (Table 8).

Power supply was cut off for about two weeks after Milenyo so that households increased their expenditures on candles and kerosene gas. Interestingly, there was also a shift away from LPG fuel to firewood, as firewood (shadow) prices declined because of the abundant supply of firewood coming from the branches of fallen trees. Water expenditure, mainly bottled water for drinking, also increased because there was no electricity to boil water for a few households who drink boiled water. Overall, for both food and nonfood items, our data clearly show that rural households change their expenditure patterns in response to the changes in market prices induced by a calamity.

Changes in fuel use

As noted above, we find that the expenditure on firewood went up substantially while the expenditure on LPG and charcoal went down, which indicates that many households shifted their fuel use away from LPG and charcoal to firewood. The average expenditure on charcoal declined from PHP28 before Milenyo to PHP17 after Milenyo and that on LPG decreased from PHP68 to PHP31 (Table 9). Forty eight households decreased their

expenditure on charcoal and 46 households decreased their expenditure on LPG whereas 70 households increased their expenditure on firewood after Milenyo. The price of firewood declined because of the abundant supply of tree debris that could be used as firewood whereas the average price of one tank of LPG rose from PHP411 to PHP472. There was also an increase in the expenditure on candles and kerosene gas used as lamp fuel when the power supply was cut down. A sari-sari store owner in the village reported that candle prices went up because of the increased demand.

An auxiliary questionnaire administered in 10 households selected randomly from each site in the village showed that a large majority of these households have multiple stoves and use different stoves for different purposes in order to use fuel efficiently with charcoal and firewood stoves as most frequently used. We found that there was an increased preference on firewood because of the decrease in its price and an increase in the price of LPG and charcoal. Households shift their use between charcoal and firewood in response to changes in the relative prices of these fuel sources. Firewood is largely home produced whereas charcoal is largely imported from outside the village and thus maybe more expensive during disaster. Charcoal price rose from PHP5 to PHP6 for one pack of 250g weight and this price rise is consistent with the observed decrease in the average expenditure on charcoal and the increase in the number of households whose expenditure on charcoal declined. Our respondents also explained that the main reason for the increased usage of firewood after Milenyo is the rise in the price of LPG and the decline in the price of firewood indicating clear changes in household behavior in response to changes fuel prices.

It is worth discussing the environmental impacts of the shift to firewood from LPG as an energy source for cooking. In terms of environment, it is known that burning LPG emits much less carbon dioxide (CO₂) than burning coal or oil. Woodfuel use is considered to be carbon-emission neutral, i.e. there is no net emission of carbon into the environment because the same amount of CO₂ emitted by wood combustion, is recaptured from the atmosphere by regrowth of wood (FAO, 1997). Hence, FAO (1997) concluded that, in terms of quantity of avoided CO₂ emission, the very fact of using wood energy by the majority of people is even more important than adoption of efficient wood stoves by a limited number of users. However, there is a debate over this statement because traditional cooking stoves are extremely inefficient, to the point of losing ninety percent of the heat to the surroundings in some case (UNDP, 2004). Hence, fuel wood may generate a substantially larger volume of greenhouse gas per meal than does LPG.

7. Summary and conclusions

This paper examines how rural households were able to cope with tropical storm Milenyo in the Philippines. We found among other things that the expenditure behaviors of rural households were dynamically changing in response to changes in commodity prices. For example, we found a decrease in the expenditure on relatively more expensive sources of protein (such as pork) and an increase in the consumption of *bangus* fish, whose price declined sharply due to the surge in its supply in the aftermath of Milenyo. Nonfarm employment played a crucial role as an insurance mechanism for rural households in the

face of the declining income from agriculture. The community networks in securing emergency loans and the personal networks in receiving remittances were particularly important for the landless poor. The active local government participation in managing the disaster was considered by the poor as another important factor that allowed them to cope with the disaster.

We also found that households shifted their fuel use away from fossil fuels such as LPG toward firewood because of the decrease in firewood prices. This indicates that households are responsive to price changes in choosing cooking technologies. Hence, taxes imposed on the use of fuel that emits more carbon gases may effectively induce households to shift to a more environmentally friendly fuel source.

Our results from the East Laguna village on the changes in the fuel prices and the resultant changes in household behavior can be seen as a natural experiment on the determinants of fuel use. Future micro-level research along similar lines appears to be a promising avenue for a search for effective policies for reducing greenhouse gases.

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Table 1

Number of households respondent, East Laguna Village, Philippines, 2006

Description	Number	%
Farmer households	41	10
Landless households	148	37
Nonagricultural households	210	53
Total	399	100

Table 2

Description of Milenyo damages to the households, East Laguna Village, Philippines, 2006

Kind of damage	Farmer		Landless		Nonagricultural	
	Number	%	Number	%	Number	%
None (0)	10	24	63	42	108	51
Lost house (1)	0	0	0	0	0	0
House seriously damage (2)	5	12	39	26	62	30
Lost utensils (3)	0	0	0	0	0	0
Lost productive assets (4)	1	2	1	1	5	2
Lost job (5)	0	0	1	1	5	2
Income declined (6)	9	22	16	11	6	3
Lost members (7)	0	0	0	0	0	0
Members got injured or sicked (8)	0	0	0	0	0	0
Crop damage (9)	1	2	5	3 ^a	13	6 ^b
Others (10)	0	0	0	0	4	2
Combination of (2) and (4)	0	0	0	0	1	0
Combination of (2) and (5)	1	2	0	0	0	0
Combination of (2) and (6)	2	5	11	7	2	1
Combination of (2) and (9)	1	2	0	0	2	1
Combination of (4) and (6)	0	0	2	1	0	0
Combination of (6) and (9)	7	17	9	6 ^a	1	0
Combination of (2), (6) and (9)	4	10	1	1 ^a	0	0
Combination of (1), (6) and (9)	0	0	0	0	1	0
Combination of (6) and (10)	0	0	1	1	0	0
Total	41	100	149	100	210	100

^aCrop share for porcientuhan and harvest share for wage workers.^bCrop share on rented-out plots.

Table 3

Damages of Milenyo to farm endowment, East Laguna Village, Philippines, 2006

Farm endowment	Number completely lost	Number heavily damaged	Estimated value lost (PHP)
Avocado	4	5	2,100
Banana	441	402	17,755
Jackfruit	17	42	5,400
Mango	239	98	271,950
Rambutan	18	27	26,525
Chicken	19	0	2,250
Pigs	7	0	9,100

Table 4

Description of household coping mechanisms, East Laguna Village, Philippines, 2006

Coping mechanism	Farmer households (%)	Landless households (%)	Nonagricultural households (%)
1.Reduce food consumption	27	76	47
1.1 Rice	0	15	8
1.2 Protein	5	27	13
1.3 Food taken outside	22	34	26
2. Switch consumption to own produce	12	34	22
3. Reduce child schooling	2	1	4
4. Reduce medical expenses	0	3	3
5. Sale of valuable items	0	4	6
6. Emergency borrowing	33	50	30
6.1 Bank	5	3	2
6.2 Relatives	12	13	10
6.3 Friends	3	7	3
6.4 Neighbors	0	6	0
6.5 Moneylender	10	6	5
6.6 Pawnshop	0	0	0
6.7 Sari-sari store	3	15	10
7. Emigration	0	0	0
8. Received remittances	25	16	21
9. Aid from local government and NGO	46	65	58
10. Nonfarm employment	85	60	94

Table 5

Primary occupation of economically active population (15 to 65 years old who are not in school) before and after Milenyo, East Laguna Village, Philippines, 2006

Primary occupation	Before Milenyo		After Milenyo	
	Number	%	Number	%
Self-employed:				
Farm: Rice production	21	3	22	3
Duck raising	5	1	5	1
Fishing and fish ponds	1	0	1	0
Nonfarm: Commerce and trade	28	4	29	4
Transportation	42	6	42	6
Carpentry and electrical	36	5	37	5
Rural industry	4	1	4	1
Hired work:				
Farm hired work	157	22	152	21
Paid domestic work	13	2	11	2
Personal services	4	1	4	1
Casual work	88	12	87	12
Religious	1	0	1	0
Factory work	35	5	35	5
Professional services	14	2	14	2
Education and government	17	2	16	2
Overseas work	31	4	31	4
Housekeeping/none	230	32	236	32
Total	727	100	727	100

Table 6

Food expenditure one week before Milenyo, one week after Milenyo and one week before the survey, East Laguna Village, Philippines, 2006

Food item	[A] One week before Milenyo	[B] One week after Milenyo	% change from [A] to [B]	[C] One week before the survey	% change from [A] to [C]
Special rice	40.18	51.18	27	46.66	16
Ordinary rice	212.75	184.07	-13	212.26	0
NFA rice	3.87	4.26	10	3.91	1
Corn	3.37	2.00	-41	7.15	112
Pandesal	15.53	14.00	-10	17.98	16
Bread loaf	14.55	13.65	-6	14.81	2
Biscuits	13.89	12.45	-10	15.66	13
Flour	0.24	0.44	86	1.43	501
Native cakes	3.05	3.00	-2	4.44	46
Noodles	4.76	4.64	-3	5.99	26
Noodle soup	23.05	25.86	12	25.96	13
Cereal	3.57	3.35	-6	4.26	20
Potato	3.58	3.00	-16	5.33	49
Cassava	1.82	2.54	39	3.68	102
Camote	2.61	2.03	-22	3.28	25
Gabi	2.46	2.37	-4	3.73	52
Tubers	0.00	0.00	0	0.44	0
Banana	11.50	9.10	-21	10.26	-11
Mango	3.24	7.15	120	10.19	214
Citrus	7.62	4.99	-35	18.82	147
Papaya	3.65	4.24	16	8.87	143
Cabbage	6.49	4.10	-37	11.06	70
Kangkong	3.20	2.48	-22	4.26	33
Malunggay	3.66	1.76	-52	3.92	7
Camote tops	3.67	2.40	-34	4.78	30
Eggplant	7.57	6.33	-16	10.79	43
Okra	4.01	1.44	-64	3.07	-23
Tomato	8.03	5.63	-30	9.31	16
Ampalaya	3.84	1.92	-50	6.66	74

Table 6 (Continued)

Food item	[A] One week before Milenyo	[B] One week after Milenyo	% change from [A] to [B]	[C] One week before the survey	% change from [A] to [C]
Baguio bean	0.32	0.30	-5	0.50	57
Mongo	2.74	2.55	-7	3.10	13
Stringbeans	4.47	2.62	-41	6.21	39
Legumes	0.26	0.19	-29	0.51	92
Carrot	1.16	0.68	-41	1.62	40
Onion	10.79	8.96	-17	12.64	17
Fresh veggie	1.52	1.20	-21	4.13	171
Coconut	6.61	5.66	-14	11.08	68
Peanuts	0.31	0.24	-24	0.58	85
Guavajelly	0.22	0.17	-23	0.83	284
Tokwa	2.61	2.62	0	3.93	50
Peanut butter	2.21	1.47	-33	4.22	91
Chicken	34.34	67.78	97	44.58	30
Beef	1.31	9.37	616	2.37	81
Pork	66.28	47.81	-28	74.50	12
Carabeef	0.85	0.48	-44	1.68	97
Corned beef	10.88	11.16	3	15.77	45
Luncheon meat	2.33	2.26	-3	2.72	17
Canned meat	3.64	3.53	-3	4.51	24
Longanisa	9.77	9.15	-6	12.65	29
Hotdog	16.18	15.35	-5	23.40	45
Tocino	3.48	2.27	-35	4.22	21
Milk	30.55	26.48	-13	33.02	8
Infant milk	25.81	32.91	28	31.93	24
Icecream	2.53	1.79	-29	7.40	193
Butter	1.83	1.45	-21	3.60	97
Balut	4.69	3.78	-20	7.80	66
Fresh eggs	22.97	23.00	0	26.74	16
Bangus	9.05	43.68	383	18.78	108
Galunggong	17.78	14.42	-19	27.54	55
Tilapia	35.74	42.18	18	44.09	23
Anchovies	2.63	1.87	-29	3.14	19
Canned fish	17.78	20.60	16	20.61	16
Daing	12.41	14.00	13	15.62	26
Salted fish	2.66	3.04	14	4.05	52
Canned squid	0.10	0.36	264	0.52	431
Coffee	22.12	21.48	-3	23.64	7

Table 6 (Continued)

Food item	[A] One week before Milenyo	[B] One week after Milenyo	% change from [A] to [B]	[C] One week before the survey	% change from [A] to [C]
Cocoa	8.87	8.46	-5	12.41	40
Tea	0.50	0.19	-62	0.76	53
Softdrinks	9.98	7.24	-28	14.14	42
Fruitjuice	9.69	7.45	-23	10.72	11
Icecandy	1.67	1.48	-11	2.02	21
Sugar	27.16	26.41	-3	29.08	7
Candies	8.89	6.13	-31	10.17	14
Cooking oil	18.68	19.77	6	22.21	19
Margarine	0.79	0.65	-17	1.15	47
Patis	3.50	2.84	-19	4.03	15
Catsup	7.17	6.14	-14	9.69	35
Toyo	8.12	7.45	-8	9.26	14
Mayonnaise	0.28	0.35	24	0.93	229
Salt	5.32	4.22	-21	5.68	7
Blackpepper	1.86	1.86	0	2.34	26
Garlic	6.98	5.85	-16	7.70	10
Ginger	1.83	3.19	74	2.72	48
Vetsin	3.43	3.13	-9	4.83	41
Vinegar	5.65	5.16	-9	5.95	5
Restaurant	62.63	58.66	-6	64.96	4
Honey	1.71	0.93	-46	1.75	2
Meal outside	29.98	16.21	-46	32.40	8
Merienda out	13.93	3.18	-77	16.10	16
Beer	4.94	2.39	-52	8.38	69
Ginebra	7.79	8.63	11	10.38	33
Lambanog	0.94	0.39	-59	1.07	14
Wine	9.67	11.15	15	12.93	34
Total household food expenditure	1068.67	1046.73		1286.95	

Table 7

Prices of basic food items before and after Milenyo,
East Laguna Village, Philippines, 2006

Item	Unit	Price before Milenyo (PHP)	Price after Milenyo (PHP)	Price the week before the survey (PHP)
Special rice	kg	23.07	24.13	23.70
Ordinary rice	kg	22.57	22.62	22.50
NFA rice	kg	19.90	20.00	20.00
Pandesal bread	piece	1,20	1.22	1,23
Noodle soup	pack	6.18	6.15	6.25
Fresh chicken	kg	106.46	104.74	104.69
Fresh pork	kg	124.55	125.89	122.75
Egg	piece	4.52	4.55	4.63
Fish (bangus)	kg	81.53	25.56	84.07
Fish (tilapia)	kg	70.61	65.89	70.10
Sugar (brown)	kg	31.97	31.97	32.03

Table 8

Nonfood expenditure one month before Milenyo, one month after Milenyo and one month before the survey, East Laguna Village, Philippines, 2006

Nonfood item	[A] One month before Milenyo	[B] One month after Milenyo	% change from [A] to [B]	[C] One month before the survey	% change from [A] to [C]
Shampoo	99.31	98.06	-1	107.92	9
Soap	55.26	55.27	0	64.92	17
Toothpaste	45.56	44.50	-2	48.16	6
Napkin	20.32	18.26	-10	19.51	-4
Cosmetics	11.97	9.12	-24	27.61	131
Powder	18.33	17.60	-4	21.02	15
Cream	26.59	26.39	-1	45.62	72
Haircut	31.76	23.32	-27	46.64	47
Toiletpaper	2.92	2.76	-6	4.06	39
Detergent	96.63	89.80	-7	99.86	3
Dryclean	19.18	19.68	3	20.37	6
Floorwax	9.88	10.82	10	25.20	155
Kitchensupply	8.78	8.73	-1	9.89	13
Sheets	4.41	9.03	105	62.38	1314
Blender	2.43	37.59	1450	63.36	2512
Crockery	2.55	33.20	1204	20.61	709
Pots	45.49	15.91	-65	18.17	-60
Women's cloth	5.64	9.40	67	28.16	399
Women's cloth (Christmas)	2.88	4.26	48	305.20	10489
Men's cloth	4.79	8.06	68	32.64	582
Men's cloth (Christmas)	10.76	4.71	-56	290.05	2595
Girl's cloth	2.41	3.22	34	7.49	211
Girl's cloth (Christmas)	2.51	0.00	-100	124.91	4884
Boy' cloth	0.65	1.83	181	8.41	1191
Boy's cloth (Christmas)	0.48	0.00	na	131.45	na
Women's footwear	2.79	4.21	51	26.71	858
Women's footwear(Christmas)	1.63	0.86	-47	111.87	6767
Men's footwear	3.66	2.72	-26	14.18	287
Men's footwear (Christmas)	0.11	0.16	na	123.82	109687

Table 8 (Continued)

Nonfood item	[A] One month before Milenyo	[B] One month after Milenyo	% change from [A] to [B]	[C] One month before the survey	% change from [A] to [C]
Girl's footwear	0.26	0.36	38	6.57	2395
Girl's footwear (Christmas)	2.00	0.00	-100	62.96	3044
Boy's footwear	0.25	2.86	1040	4.46	1679
Boy's footwear (Christmas)	2.51	0.75	-70	68.21	2622
Tailoring	0.05	0.91	1911	0.67	1389
Tailoring (Christmas)	0.00	0.56	na	0.54	na
Handbag	5.34	7.42	39	22.92	329
Handbag (Christmas)	0.32	0.94	198	44.14	13877
Tricyclfare	139.47	138.90	0	164.44	18
Tricyclfare (Christmas)	1.16	1.05	-9	23.86	1960
Jeepney fare	62.34	57.04	-9	86.52	39
Jeepney fare (Christmas)	1.02	1.01	-1	14.19	1295
Bus fare	30.89	38.48	25	45.12	46
Bus fare (Christmas)	5.96	7.22	21	24.84	317
Gasoline	129.46	135.22	4	161.08	24
Gasoline (Christmas)	17.27	17.27	0	20.28	17
Traditional medicine	52.49	65.77	25	102.56	95
Modern medicine	61.59	86.33	40	289.87	371
Tuition	113.83	192.32	69	166.33	46
Uniform	18.47	15.41	-17	28.67	55
Textbook	191.54	137.08	-28	237.78	24
Books	7.20	7.74	8	26.15	263
Cellphone load	97.09	91.11	-6	112.15	16
Cellphone load (Christmas)	4.46	5.34	20	48.90	996
Postal	0.14	0.14	0	1.20	755
Postal (Christmas)	0.00	0.00	na	0.87	na
Movies	1.35	0.78	-42	65.74	4757
Gambling	38.00	37.63	-1	54.10	42
Bulb	10.19	7.59	-25	15.58	53
Bulb (Christmas)	2.67	1.47	-45	7.53	182
House articles	77.07	2.42	-97	27.82	-64
Radio	3.01	0.75	-75	29.30	874
Furniture	43.86	0.00	-100	157.94	260

Table 8 (Continued)

Nonfood item	[A] One month before Milenyo	[B] One month after Milenyo	% change from [A] to [B]	[C] One month before the survey	% change from [A] to [C]
Hammer	0.00	0.88	na	0.68	na
Maid	2.51	2.51	0	18.05	620
Sports	0.00	0.00	na	3.47	na
Toys	0.80	0.00	-100	5.82	631
Toys (Christmas)	4.56	0.50	-89	62.11	1262
Vehicle	11.50	3.96	-66	174.57	1418
House maintainance	6.27	554.35	8747	97.18	1451
Home addition	77.07	81.00	5	867.89	1026
Auto insurance	1.57	3.95	152	4.22	170
Health insurance	16.05	16.05	0	20.47	28
Excursion	1.75	19.42	1007	26.07	1386
Excursion (Christmas)	0.00	1.88	na	8.65	na
Community contribution	8.35	7.56	-9	22.17	166
Church contribution	9.36	6.07	-35	15.00	60
Church contribution (Christmas)	6.05	4.81	-20	163.10	2595
Charity	7.56	0.41	-95	109.67	1351
Income tax	2.96	2.96	0	7.02	137
Land tax	0.00	0.00	na	6.42	na
Property tax	17.54	17.54	0	56.85	224
Cooperative	1.73	1.73	0	4.87	181
ROSCAS	74.09	72.55	-2	144.67	95
Savings account	679.59	677.59	0	839.72	24
Notary service	0.00	0.38	na	21.30	na
Marriages	226.02	81.73	-64	411.40	82
Funeral	0.00	511.78	na	150.88	na
Total expenditure on nonfood item	2816.23	3690.98		7275.69	

Table 9

Expenditure on utilities and tobacco one week before Milenyo, one week after Milenyo and one week before the survey, East Laguna Village, Philippines, 2006

Item	[A] One week before Milenyo	[B] One week after Milenyo	% change from [A] to [B]	[C] One week before the survey	% change from [A] to [C]
Tobacco	28.03	27.05	-4	29.28	4
Charcoal	27.77	16.78	-40	27.28	-2
Firewood	29.14	67.03	130	34.21	17
LPG	67.87	31.33	-54	63.43	-7
Kerosene	10.93	26.54	143	10.22	-6
Electricity	136.46	31.47	-77	201.70	48
Candle	1.69	41.61	2362	3.38	100
Water	3.03	5.71	89	10.93	261
Total household expenditure on utilities and tobacco	304.90	247.52		380.44	