Journal of Environmental Science and Management 23-2: 89-101 (December 2020) ISSN 0119-1144

Social Capital and Vulnerability to Extreme Climate in a Semi-urban Fishing Community in Laguna de Bay, Philippines

ABSTRACT

The study looked into the risks associated with extreme climate events in the case of a semi-urban fishing community surrounding Laguna Lake in the Philippines. A survey was undertaken to determine the economic effects (loss of assets, foregone income, and changes in consumption patterns) of strong typhoons and torrential rains on fishing households. Vulnerability, estimated as the perceived probability of lower consumption after flooding or typhoons, was used to assess the economic impact on households. Household characteristics, including social capital, that may influence consumption vulnerability, were analyzed using a binary probit regression model. Social capital, a multi-dimensional concept consisting of social networks and skills possessed and used by household members to facilitate actions, was modeled using four indicators – two associational (membership in a formal organization and usefulness of informal social networks) and two behavioral (trust and cooperativeness). Regression results revealed that fishing income and household size significantly affect vulnerability. The higher the fish catch and the smaller the household, the less vulnerable is the household to strong storms and torrential rains. Social capital indicators do not significantly affect consumption vulnerability of households.

Keywords: *extreme climate events, typhoons, torrential rains, vulnerability, social capital*

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INTRODUCTION

The natural consequences of global warming include, among others, increased wind velocity and pressure, which make typhoons and torrential rains more frequent and much more severe (*Wendland 1977*), causing deaths, damages to property and means of livelihood, loss of income, temporary or permanent hunger and poverty, and unwanted migration for displaced shoreline communities. Developing countries, which are in the tropical, subtropical and arid regions and which do not have sufficient institutions, infrastructure and financial means to make adaptation easy, are particularly vulnerable to the negative impacts of climate change (*IPCC WG II 1997*).

The topography and the socio-economic structure of the Philippines put the country in the highly vulnerable group. With its more than 7,000 small islands and long coastline, much of its land and people are openly exposed to the dangers of strong tropical storms and flooding. A big chunk of the Philippine population is poor and dependent on agriculture and fisheries for livelihood. Extreme climate events can lead to lower production and lower income in these sectors, less supply of food for the continuously growing population, and higher food prices (*Palanca-Tan 2006*).

The effects of climate change on different countries, sectors, communities, housesholds and individuals are usually analyzed within the frame of vulnerability. The Intergovernmental Panel on Climate Change Working Group I (*IPCC WG I 2001*) defines vulnerability to climate change as "the degree to which a system is susceptible to, or unable to cope with, the adverse effects of climate change, including climate variability and extremes." *Brooks* (*2003*) distinguishes between biophysical vulnerability and social vulnerability and points to this difference as the root of many disagreements and incongruities in climate change vulnerability assessment literature. Biophysical vulnerability pertains to the ultimate impacts of a hazard event or the amount of damage experienced by a system as a result of an encounter with a hazard. Indicators, such as human mortality, value of property and asset losses, loss of income, production cost and ecosystem damage cost (*Lim et al 2005*) correspond to biophysical vulnerability. Social vulnerability, on the other hand, views vulnerability as an internal state or

inherent property of a system that makes the system susceptible to damage from external hazards (*Allen 2003*). While biophysical vulnerability depends on the hazard, social vulnerability is independent of the hazard. Social vulnerability depends on factors such as poverty, inequality, access to and control over resources (e.g. land, water sources and bodies), physical capital/assets such as housing quality, access to insurance, loans and other financial instruments, social networks, etc., that affect the ability of the system to take actions to adapt to and mitigate the harm caused by climate change (*Wisner et al. 2003; Adger 1999; Adger and Kelly 1999; Cross 2001*).

Apart from physical and financial capital, social capital can be considered as a resource that is possessed and utilized by an individual, a household or a community to faciltitate an undertaking. Social capital, the societal analogue of physical or economic capital, captures the value inherent in friendship networks and other associations, which individuals and groups can draw upon to achieve private or collective objectives (*Saguaro Seminar 2017*). *Afanas'ev et al.* (*2016*) refers to social capital as the "social glue" that unites natural, physical and human capital. Apart from the role of social capital in growth and economic stability (*Horvath 2013; Sangnier 2013; Dearmon and Grier 2009*), there is a growing body of knowledge regarding the link between social capital and climate change adaptation and mitigation in particular. Social capital is critical in the formation of public and private institutions for resource management that builds resilience to risks posed by climate change (*Adger 2003*). *Aldrich and Meyer* (*2015*) surveyed recent literature and evidence on the role of social capital and networks in disaster survival and recovery, and presented policy recommendations to strengthen social infrastructure at the community level to increase resilience to natural catastrophe. *Tamako and Thamaga-Chitja* (*2017*) found that social capital positively affects climate change adaptation strategies of smallholder farmers and contributes to livelihood diversification and food security. The results of the study of *Baird and Gray* (*2014*) likewise suggest that livelihood diversification is associated with evolving social networks of exchange. The study of *Yameogo et al.* (*2018*) suggests that social capital influences the choice of adaptation strategies, the number of adaptation practices used and the extent to which adaptation measures was applied. Similarly, *Balew et al.* (*2014*) reveal that the choice of climate change adaptation strategies is determined by social capital variables such as access to information on climate change, input and output market, credit facility and extension services. *Van Kien* (*2011*) contends that different forms of social capital have varying effects on different aspects of household resilience. In *Adger et al.* (*2009*), social capital and factors that are endogenous to the society are found to constraint climate change adaptation more than the traditionally considered biological, economic and technological factors. *Zacarias* (*2019*), on the other hand, highlights overall community vulnerability to climate change as jointly determined by vulnerability of physical, financial and social capitals.

Social capital can be defined in two levels; one as an individual person's characteristic, and two, as a group's characteristic. On either level, social capital is a multidimensional concept. Social capital, originally conceived as a community variable, is defined as a common property of a group that facilitates collective action for the mutual benefit of group members (*Putnam 2000; Krishna 2004*). Group social capital, consists of the network of formal and informal organizations, can link and bind people, and serve as platform for information and resource sharing as well as collective action and decision-making. This dimension of group social capital is externally observable and can be measured relatively more objectively (*Buchenrieder 2006*). It can be assessed, for example, by counting the number of established organizations, the number of members in the organizations (in proportion to the population of the community), and by the frequency of meetings. Another dimension of group social capital, which is more difficult to assess and quantify, revolves around the central theme of trust and cooperation. This dimension focuses more on the quality of the relationship among members of the organization rather than the existence of the organization or the number of organizations (quantity). *Ostrom* (*1990*) defines social capital as the "shared knowledge, understanding and patterns of interaction that a group of individuals bring to any productive capacity". *Pretty* (*2005*) defines it as the set of interpersonal and inter-institutional relationships in society – the better these relationships are, the greater the degree of trust, and the higher the chances of success of any community endeavor. *Pretty* (*2005*) argued that complementary to social capital is the existence of local institutions consisting of social and legal norms of behavior that determine the extent to which individuals combine to undertake collective action. This suggests that local institutions are the visible consequences of social capital. *Pretty and Smith* (*2004*) expand the scope of group social capital to include relations of trust, reciprocity and exchanges, common rules, norms and sanctions, and strength of connectedness in networks and groups.

Individual level social capital refers to social

networks and skills that are possessed by an individual or household (*Pham 2010*). The individual uses these networks and skills to facilitate his/her activities. Social networks, also referred to as associational social capital, can be a membership in formal organizations or involvement in informal networks. *Adger* (*2003*) argues that involvement in both formal and informal groups can serve as a useful asset of the individual in so far as it enables him to benefit from interaction with others through information sharing, and increased access to physical and financial capital. Social skills or behavioral social capital, on the other hand, refers to the propensity of the individual to trust and cooperate with other individuals for mutual benefits (*Carpenter et al. 2004, Grootaer et al 2004*). The World Values Survey methodology of measuring generalized trust based on the question developed by *Rosenberg* (*1956*), which goes as "Generally speaking, would you say that most people can be trusted or that you can be careful in dealing with people?", has been employed by several authors (*Knack and Keefer 1997; Zak and Knack 2001; Uslaner 2002; and Bjornskov 2003*).

This study looked at the vulnerability to extreme climate events, specifically typhoons and flooding, and how this vulnerability was influenced by household characteristics, including social capital, in the fishing households of Barangay Malaban, a sub-urban fishing community surrounding Laguna Lake. In addition to the challenges posed by pollution from domestic, industrial and agricultural sources, dikes and highway construction, illegal land reclamation, proliferation of fish pens and cages that threaten their fishing activities and land tenure, the small fisherfolks face immense risks arising from strong typhoons and torrential rains causing floods. Social capital could influence the fishing households' susceptibility to climate change hazards. The fishing households have lived in these communities for a long period of time and have provided the neighboring villages and cities with fish supply. Most of them are fishermen because their parents were fishermen. The fishermen have organized themselves into a small fishermen federation assisted by non-government organizations to raise their voice so that their concerns may be included by local and government agencies in their development plans and programs for Laguna Lake and the neighboring areas.

Specifically, the study aimed to accomplish the following tasks: document the impact of climate hazards, mainly typhoon and flooding, on a fishing community surrounding Laguna Lake; assess household level economic vulnerability in terms of perceived probability of lower consumption after flooding or typhoons, identify the factors that influence households' vulnerability to climate change; and determine the role of social capital in households' vulnerability to climate change.

MATERIALS AND METHODS

The study site

Laguna Lake, with a total surface area of 90,000 ha, which is almost half of the total lake area in the Philippines of 190,000 ha, is the biggest lake in the country and the second largest inland body of water in Southeast Asia. With a total shoreline of 220 km, Laguna Lake is bounded by Metropolitan Manila in the northwest, Rizal in the northeast, and Laguna in the southwest and southeast. The lake is surrounded by poor fisherfolk communities in the urban cities of Laguna and even in the highly urbanized cities of Metropolitan Manila.

Being surrounded by commercial, industrial and residential areas as well as sub-urban and rural agricultural and fishing communities, Laguna Lake serves as a huge sink for domestic, industrial and agricultural (livestock and fisheries) wastes; surface water run-off from urban areas, croplands and forest lands; and water inflow from Pasig River and the Manggahan Floodway. Hence, pollution and flooding are among the serious problems confronting the poor fishing communities surrounding the lake. These problems are aggravated by climate change hazards. Further, economic plans and programs undertaken by both private and public entities such as infrastructure projects (construction of highway and dikes), land reclamation, fish pens/cages confound the problem.

Survey respondents were drawn from among fishing households in Barangay Malaban, Biñan, Laguna (**Figure 1**). Biñan is a first class component city in the province of Laguna in the island of Luzon in the Philippines. Being only 34 km south of Manila and accessible through the South Luzon Expressway and the National Highway, the city of Biñan has served as a sub-urban residential community for people working and studying in Metropolitan Manila. It is also the location for two of the country's largest industrial estates/export processing zones (Laguna International Industrial Park and Laguna Technopark Incorporated), a special economic zone (Southwoods Center) and a business park (One Asia Business Center). Local industries for which Biñan has been known for a long time are footwear and headwear manufacturing.

Figure 1: Study area of the assessment of the extreme climate events vulnerability of a semi-urban fishing community in Barangay Malaban, Biñan, Laguna, Philippines.

Biñan, with a population of 333,028, is the third largest city in Laguna (*PSA 2015*). It is composed of 24 barangays, one of which- Barangay Malaban, is a lakeshore barangay with its entire area extending thinly along the shore of Laguna Lake (one other barangay in Biñan that shares the shore of Laguna Lake is Dela Paz, but only a very small portion of its area is along the lake). Thus, Malaban is the only barangay in Biñan which has a large fishing community. In 2010, Barangay Malaban's population of 28,550 is the third largest in Biñan. In terms of number of households, it ranks second with 6,259 households (*PSA 2010*). Being along the lakeshore, fishing is expectedly the main livelihood. Another major livelihood activity in Malaban is the manufacture of shoes and slippers for which Biñan is famous.

Data collection

The study employed primary data collection methods, namely key informant interview (KII), focus group discussion (FGD) and a survey of fishing households. The FGD with respresentative households from the target population in combination with KII with community leaders, local officials as well as non-government organizations present in the community were undertaken to obtain preliminary background information and inputs for the drafting and finalization of the survey instrument.

The survey was conducted to gather detailed data on household level impacts of climate hazards and household characteristics pertinent to the analysis. The 15-page survey instrument consisted of 4 parts. The first part asked questions about the fishing activties of household member/s – type of fishing with the gears and materials used and their costs and sources of capital, frequency and duration of fishing, kinds of fish caught, volume of catch and sales as well as problems encountered and future plans. Part 2 dealt with the household budget, other sources of income, detailed consumption items and values, savings and loans, and other socio-economic questions. In part 3, questions about the experience of the household with strong typhoons and flooding were posed. Although most of the questions were provided with multiple choice answers, respondents were encouraged to give narratives of their experience after the multiple-choice question. Finally, Part 4 posed the social capital questions.

A sample of 93 fishing households was generated for the study. Respondents were selected randomly by stationing student enumerators along the shore to interview fisherfolks arriving from the lake. The survey was implemented through personal interviews during the months of September and October 2017. College students majoring in Economics served as survey enumerators as a service-learning activity for their Statistics class. The research team was assisted by Ateneo's Office

of Social Concern and Involvement (OSCI) and the Community Organizers Multiversity (COM).

Data analysis

Vulnerability, measured in this study in terms of the perceived probability of a decrease in consumption after flooding or typhoons, was used to assess the economic impact on fishing households. This self-assessed measure of vulnerability was based on the assumption that extreme climate events such as typhoon and flooding can cause a disruption in income generating activities, which leads to lower consumption levels (*Deressa et al. 2008*).

To come up with this measure, the following questions were included in the survey instrument. The consumption vulnerability variable took on the value of 1 (one) if the respondent chooses (c), or 0 (zero) if either (a) or (b) is chosen (**Figure 2)**.

Following the approach of *Pham* (*2010*), this paper distinguished among the four dimensions of individual social capital. Associational social capital is categorized into membership in a formal organization and membership or inclusion in informal organizations/ networks. For the formal organization indicator, the organization that is generally relevant to the fishing households of the study is the Samahan ng mga Maliliit na Mangingisda (Federation of Small Fishermen). The respondent was asked questions if he/she is a member of the Federation, and because the formal organization indicator must also capture the extent of the fisherfolk's participation in the organization, the respondent was also asked if he/she regularly attends the monthly meeting of the organization, and how many monthly meetings had he/she attended during the past year 2016.

For the informal network indicator, *Grootaer et al.'s* (*2004*) concept of the size and usefulness of the network was adopted. For the size of the network, questions posed were: "Do you have relatives in the same barangay?", "About how many close friends do you have these days? These are the people you feel at ease with, can talk to about private matters, or call on for help.". For the usefulness of the network, the questions asked was: "If you suddenly needed a small amount of money enough to pay for expenses for your household for one week, how many people beyond your immediate household could you turn to who would be willing to provide this money?"

For behavioral social capital, two indicators were derived- one for trust and another for cooperation. The indicators were derived using scaled responses to three opinion statements two for trust: "Most people who live in this barangay can be trusted" and "Most of the residents in this barangay do not trust each other in money matters (particularly in borrowing/lending money)"; and one for cooperativeness: "Most of the residents in this barangay are ready to help in case of need".

The binary vulnerability variable was regressed with household characteristics and social capital indicators using the binary probit procedure. Household characteristics included respondent's age, household size and daily fish catch. Results of the regression analysis can be used to identify and construct profiles of vulnerable households. These findings can serve as guide to national and local governments, non-government organizations and the communities in formulating strategies for enhancing climate change preparedness.

RESULTS AND DISCUSSION

On the average, the respondents are 47 years old who have lived in the area for an average of 37 years, that is since their childhood days. Seventy-one percent of respondents are the male household heads, the fisherfolk themselves while the remaining 29% are the female spouses or children of the fisherfolk (**Table 1**). The majority of the respondents are Roman Catholic (89%)

53a. How was your household's food consumption affected during the two months following the typhoon/flooding? **_____a. Same as before the typhoon/flooding** **_____b. Lower than before the typhoon/flooding but still enough to remain healthy/happy and contented** **_____c. Lower than before the typhoon/flooding and not sufficient such that our health/happiness and contentment had diminished**
53b. How was your household's other consumption (clothing, medicine, education & leisure) affected during the two months following the typhoon/flooding? **_____a. Same as before the typhoon/flooding** **_____b. Lower than before the typhoon/flooding but still enough to remain healthy/happy and contented** **_____c. Lower than before the typhoon/flooding and not sufficient such that our health/happiness and contentment had diminished**

Figure 2. Questions on consumption vulnerability in the survey instrument used in the study.

and Tagalog (68%). Tagalog are members of an ethnolinguistic group in the Philippines.

When asked why they have become or have chosen to be fishermen, the foremost reason cited was that their parents are/were fishermen. The next most cited reasons were: they get better income from fishing than any other work they can do, and they do not know how to do any other work. Tilapia is the fish mostly caught in the area. During the time of President Gloria Arroyo, fingerlings of the smaller strain of tilapia were scattered all over Laguna Lake and ever since this smaller-sized tilapia, which is called ”Tilapia Arroyo”, has been the major fish catch from open fishing in Laguna Lake. Of the fisherfolk surveyed in this study, 98% indicated Tilapia as their main fish catch (57% ”Tilapia Arroyo” and 41% the bigger and original ”Tilapia Karaniwan”).

On a bad day, mean fish catch was 4.2 kg, 0.7 kg of which was consumed by the houseold while 3.7 kg were sold at an average price of PhP 42.42 (US$0.83) kg^{-1}, giving the household a daily cash earnings of only PhP 158.65 (US$3.10). On a good day, however, mean fish catch was 25.2 kg, 1.0 kg of which was consumed at home and 27.4 kg were sold at PhP 44.67 (US$0.87) kg^{-1}

Table 1. Characteristics of the respondents in the study of the extreme climate events vulnerability of a semi-urban fishing community in Malaban, Biñan, Laguna, Philippines, 2017 (n=93).

	Mean
Age, yr	47.0
Gender (proportion of male), %	71.0
Religion (proportion of Roman Catholic), %	89.2
Ethno-linguistic group (proportion of Tagalog), %	67.7
Number of years in current residence, yr	37.0
Number of fishing household members	1.0
Number of non-household fishing members	3.5

generating a cash earning of PhP1,057.77 (US$20.66). Last remembered catch, which was the most recent fishing day catch, was 7.2 kg yielding a cash sales of PhP303.33 (US$5.92) from 6.4 kg sold and 0.7 kg of fish for the household’s food intake for that day. (**Table 2**). One, there was wide variability among respondents in terms of fishing scale. This was reflected by the high standard deviation values which were in all cases (bad day, good day and last remembered catch) even greater than mean catch. Second, since generally the fishing community consists of small open fisherfolks who sell their daily catch in stalls in the neighborhood or as itinerant vendors or to public market vendors/stall-owners or to middle men who bulk-buy the catch and bring them to the nearby public markets, fish catch that was given away for free was almost nil. This was also reflective of the urban nature of this fishing community. Third, the average price of the catch hovered around PhP40.00 (US$0.78) kg^{-1}, which was the price most commonly quoted for Tilapia everywhere around Laguna Lake, corroborating the response that Tilapia is the most commonly caught fish in the area as well as indicating somewhat uniform and stable prices for this fish species.

Typhoons were cited as the first most serious problem by 22% of rsepondents, as the second most serious by 12% of respondents, and as third most serious by 13%. Only 25% did not cite typhoons as a problem (**Table 3**). Typhoons prevent their normal fishing activities, taking away potential cash income and food supply during the duration of the typhoon, destroy fishing gears and tools and can lead to flooding and damage to their houses. Survey respondents and FGD participants also indicated that although there were occassions when typhoons result in the overflowing of fish from fish cages and pens to the shores, which they can gather and sell, fish prices during this time usually fall so low because of the abnormally high supply and they are not able to gain much from it.

Table 2. Daily fish catch of a semi-urban fishing community in Malaban, Biñan, Laguna, Philippines, 2017 (n=93).

	Bad day		Good day		Last remembered catch	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
Catch (kg)	4.23	4.45	25.15	27.64	7.22	7.73
Home consumption	0.74	0.67	1.01	1.95	0.74	0.82
Sold	3.70	4.50	23.99	27.42	6.41	7.67
Given away to friends/ relatives	0.00	0.00	0.34	2.18	0.09	0.63
Left-over	0.00	0.00	0.00	0.00	0.28	2.59
Value (PhP/US$)[a]						
Average price per kg	PhP42.41b (US$0.83)	16.40	PhP44.67 (US$0.87)	13.52	PhP39.42 (US$0.77)	18.93
Total sales	PhP158.65 (US$3.10)	179.94	1,057.77 (US$20.66)	1,380.39	PhP303.33 (US$5.92)	584.92

[a] Philippine Peso to US Dollar exchange rate in September 2017 = PhP51.20/US$1

Table 3. Fishing problems of a semi-urban fishing community in Malaban, Biñan, Laguna, Philippines, 2017 (n=93).

Problem	Proportion of Respondents (%)				
	1st	2nd	3rd	Cited	Not a problem
Shortage of financial capital, equipment and materials	8.8	5.5	1.1	44.0	40.7
Lowering fish stock	16.5	8.8	7.7	31.9	35.2
Limited growth of fish	0.0	1.1	2.2	39.6	57.1
Low and fluctuating fish prices	0.0	0.0	1.1	39.6	59.3
Typhoons	22.0	12.1	13.2	27.5	25.3
Flooding	4.4	7.7	4.4	45.1	38.5
Water pollution	9.9	15.4	18.7	28.6	27.5
Water lily	17.6	31.9	16.5	22.0	12.1
Not sufficient knowledge and training in fishing	0.0	1.1	0.0	17.6	81.3
Strict fishing rules/regulations (zoning, license/registration procedures/fees)	2.2	0	2.2	24.2	71.4
Smaller fishing area and/or increasing distance of fishing area due to reclamation	2.2	0.0	4.4	31.9	61.5
Increased difficulty in going to fishing areas due to construction of dikes and highways	3.3	1.1	3.3	28.6	63.7
Government dismantling/ban of fish cage/pen/pond	1.1	0.0	5.5	22.0	71.4
Fish kill	3.3	1.1	4.4	28.6	62.6

Water lilies block movement of fishermen's boats hence, prevent fisherfolks from reaching fishing areas. In some instances in the past, fishermen were unable to fish for several days up to 1-2 weeks due to water lilies. Thus, the proliferation of water lilies is always an immediate and serious day-to-day concern for fisherfolks. Water lilies proliferate due to high pollution load from wastewater. The water lilies get stuck near the shores of Laguna Lake when river flow is weak and unable to wash the water lilies away from Laguna Lake shores. Apart from typhoons and proliferation of water lilies, flooding, water pollution and lowering of fish stock were the more frequently cited problems by fisherfolks.

Vulnerability

As a lakeshore community, respondents are highly susceptible to typhoons and flooding. All of the respondents mentioned at least one strong typhoon or torrential rains that caused damage – typhoons Milenyo (Xansane) in September 2006, Ondoy (Ketsana) in September 2009, Santi (Nari) in October 2013, Yolanda (Haiyan) in November 2013, Glenda (Rammasun) in July 2014, Maring (Doksuri) in September 2017, and the severest torrential rains caused by the southwest monsoon (termed in the Philippines as Habagat) in August 2012, August 2013 and July 2015. More than half of the respondents (52%) had their roof detached from their house, a common damage on shanty houses during typhoons. A substantial 29% of respondents had their house totally destroyed by at least one of the typhoons/ southwest monsoon mentioned. More than a fifth of the respondents had their walls detached, and about a quarter had damaged properties inside the flooded houses. Damage to furniture, appliances and other properties inside the house was usually caused by flood or rainwater dripping in the house. The mean cost of damage is PhP13,368 (US$261.09) with a very high standard deviation of PhP19,591 (US$382.64), indicating a wide range of damage costs endured by different households (**Table 4**).

Majority of respondents (70%) repaired their homes, built a new house (4 households) or moved to a relative's house (2 households) or did nothing at all due to lack of funds (2 households). To save on costs, 9% of respondents specifically indicated that they salvaged for used materials in repairing their houses. For damaged furnitures and appliances, the proportion of responding households, which resorted to repair (17%) slightly higher than those which purchased replacements (15%). Half of the households used their own savings while about 22% borrowed money. Of those who made loans, almost half (48%) obtained the loan from loan sharks or the so-called 5/6 scheme, an informal market that effectively collects an interest rate of 17% over a very short period of one month. Smaller proportions of households borrowed money from relatives (24%) and/or from friends (17%). About 16% of households received financial help from relatives.

For damages to fishing structures and tools, 43% of respondents conducted repairs and 23% constructed new ones (**Table 5**). But as most local fisherfolks only engage in open fishing (none of the respondents are fish cage/pen operators), the mean cost of repair/construction was PhP3,706 (US$72.38) with a standard deviation of

Table 4. Climate disaster (typhoon and flooding) effects –on houses of a semi-urban fishing community in Malaban, Biñan, Laguna, Philippines, 2017 (n=93).

Type of Damage	Proportion of Respondents (%)
House destroyed	29.4
Damage to roof (detached)	51.8
Damage to walls (some parts detached)	21.2
Damage to furniture, appliances and other things inside the house	25.9
Estimated costs of all damages (PhP/US$)	Mean: PhP13,368.17/US$261.09 Std dev: PhP19,591.13)
Action taken for house	**Percentage**
Repaired house	70.1
Looked for used materials/things	9.2
Did nothing due to lack of funds	2.2
Built a new house	4.3
Moved to a relative's house	2.2
Action taken for damaged/destroyed appliances	
Repair	17.3
Bought new things and appliances	14.7
Source of funds for repair and purchase of new things	
Savings	50.5
Financial assistance from relatives	16.2
Financial assistance from government	0.0
Loan from	21.6
Bank	0.0
5/6	47.6
relative/s	23.7
friend/s	16.7

[a] Philippine Peso to US Dollar exchange rate in September 2017 = PhP51.20/US$1

Table 5. Climate disaster (typhoon and flooding) effects on fishing structures and tools.

Measures and Source of Funds	Proportion of Respondents (%)
Repaired fishing structures and tools	42.9
Constructed another structure	22.9
Cost of repair and/or construction in PhP[a]	Mean: PhP3,706.41/US$72.38Std Dev: PhP4,409.51
Did not do anything dues to lack of funds	18.9
Source of funds	
Savings	40.8
Financial assistance from relatives	12.2
Financial assistance from government	0.0
Loan from	27.1
Bank	0.0
5/6	27.8
relative/s	16.7
friend/s	11.1
Others	15.8

[a] Philippine Peso to US Dollar exchange rate in September 2017 = PhP51.20/US$1

PhP4,410 (US$86.13). Thus, damage to fisherfolks houses were significantly higher than damages to their means of livelihood. The single most expensive gear in open fishing was the boat, which FGD and survey respondents secured in safe places when typhoon or "Habagat" warnings were given. As in the case of house damages, the biggest proportion of respondents (41%) relied on their own savings for repairs and building of fishing gears. Likewise, the next major source of funds was loans (27%) from informal loan markets, relatives and friends.

Not a single respondent obtained financial assistance from the government nor borrowed from a bank (**Tables 4** and **5**).

In the case of food consumption, 28% of the respondents indicated that their consumption remained the same as before the climate disaster (**Table 6**). Of the remaining households that claimed their food consumption had gone down, a big portion (52% of all respondents) said that even with

Table 6. Vulnerability of a semi-urban fishing community in Malaban, Biñan, Laguna, Philippines, 2017 (n=93).

How is your household's consumption affected during the two months following the disaster?	Proportion of respondents (%)	
	Food	Other basic goods (clothing, medicine, education)
Same as before the disaster	28.1	48.9
Lower than before the disaster but still enough to remain healthy/ happy and contented	52.2	31.1
Lower than before the disaster and not sufficient such that our health/ happiness and contentment had diminished.	18.9	18.0

their lower food intake, it was still enough for them to remain as healthy and contented as before the disaster. Only 19% of households indicated that their health and contentment had diminished due to lower food consumption after the storm/torrential rains. With regards to other consumption of clothing, medicine, education and leisure, almost haf (49%) of respondents indicated that their consumption of these goods and services had remained the same as before the climate disaster. As the fishing households belong to the lowest income brackets, households' consumption of these goods were already minimal even before the climate disaster. Hence, even after the disaster, many of the households tried every way they could to sustain this minimum neccessary consumption of the basic non-food goods and services. Of the remaining half who reported that their consumption of the other basic goods and services decreased, 63% (or 31% of all responding households) indicated that the lower consumption level was still sufficient to keep them as happy and contented as before the disaster while 37% (18% of responding households) said their happiness and contentment diminished with lower consumption.

Social capital

For formal social networks, the respondents were asked for involvement of any household member/s in the Samahan ng Maliliit na Mangingisda as well as in any financial and credit cooperatives (**Table 7**). Almost three-fourths (74%) of the households are members of the Federation but only 49% are attending the monthly meeting resulting in an average of 4 meetings per household in a year. These data imply that not so many fishing households were actively participating in the Federation.

Very few households were involved in financial cooperatives. Only 18% were members of financial cooperative/s and the same proportion borrowed money from the cooperative with an average amount of PhP9,025.00 (US$176.27). Majority of the members thought the cooperative was very helpful.

For informal social networks, the respondents were asked questions that would reveal the extent of their informal network and its usefulness to them. Eighty-five percent of the households have relative/s residing in the same barangay. Likewise, majority of households claimed that they have relative/s (73% of households) and friend/s (72%) residing within and outside the barangay from whom they can borrow money (PhP500 or more) in times of emergency. On the other hand, 84% of respondents indicated they have neighbors who they trust and to whom they can readily lend money (PhP500 or more) in case of need.

To come up with behavioral social capital indicators, respondents were asked to agree or disagree to three statements using a scale of 1 (strongly disagree) to 5 (strongly agree). Statements (1) and (3) pertain to community trust (**Table 8**). Statement 1 (trustworthiness of the residents) has an average score of 3.55. Statement 3, trusting attitude of the residents in the barangay) referring specifically to trust in money matters has an average score of 3 (neutral). The cooperativeness score is 4 (somewhat agree). Over-all, there appears to be a decent degree of behavioral social capital- trust and cooperativess in the barangay as perceived by respondents.

The dependent variable used in the regression is the consumption vulnerability variable. It is assigned a value of 1 if an extreme climate event led to a lower consumption and diminished happiness and contentment for the household (**Table 8**). The coefficients of *DailyFishCatch* and *Household Size* are both statistically significant and of the expected signs. Households with a higher daily fish catch, a measure of household income and economic status, are less likely to be vulnerable to strong storms and torrential rains and flooding. Bigger households, on the other hand, are more vulnerable to these extreme climate events. The signs of the coefficients of indicators for formal social networks (SC1SamahanMember), informal social networks (CS2Friends) and cooperativeness (SC4Cooperative) imply that social capital lowers vulnerability. Households

Table 7. Indicators of formal and informal social networks.

Social Capital Indicator	Proportion of Respondents (%)
Federation of Small Fishermen	
Respondent and/or any household member is a member	74.2
Attending monthly meeting of the Federation	48.5
Frequency of attendance in Federation meetings in 2016	Mean: 4.0 meetings
Financial/credit cooperative	
Respondent and/or any household member is a member	18.3
Experience in borrowing from the cooperative	18.3
Loan amount[a]	Mean: PhP9,025.00/US$176.27 Std. dev: PhP12,346.40
Informal social networks	
With relative/s living in the same barangay	84.9
With relative/s from whom they can borrow money (PhP500 and up) in times of emergency	74.2
How many? Mean (std deviation)	3.5 people (4.1 people)
With friend/s from whom they can borrow money (PhP500 and up) in times of emergency	73.1
How many? Mean (std deviation)	11.4 people (60.2 people)
With neighbor/s who they trust and to whom they can readily lend money in case of need?	83.7
How many?	4.7 people (6.6 people)
Up to how much can you lend? Mean (std deviation)	PhP1,337.95 (PhP1,784.45)

[a] Philippine Peso to US Dollar exchange rate in September 2017 = PhP51.20/US$1

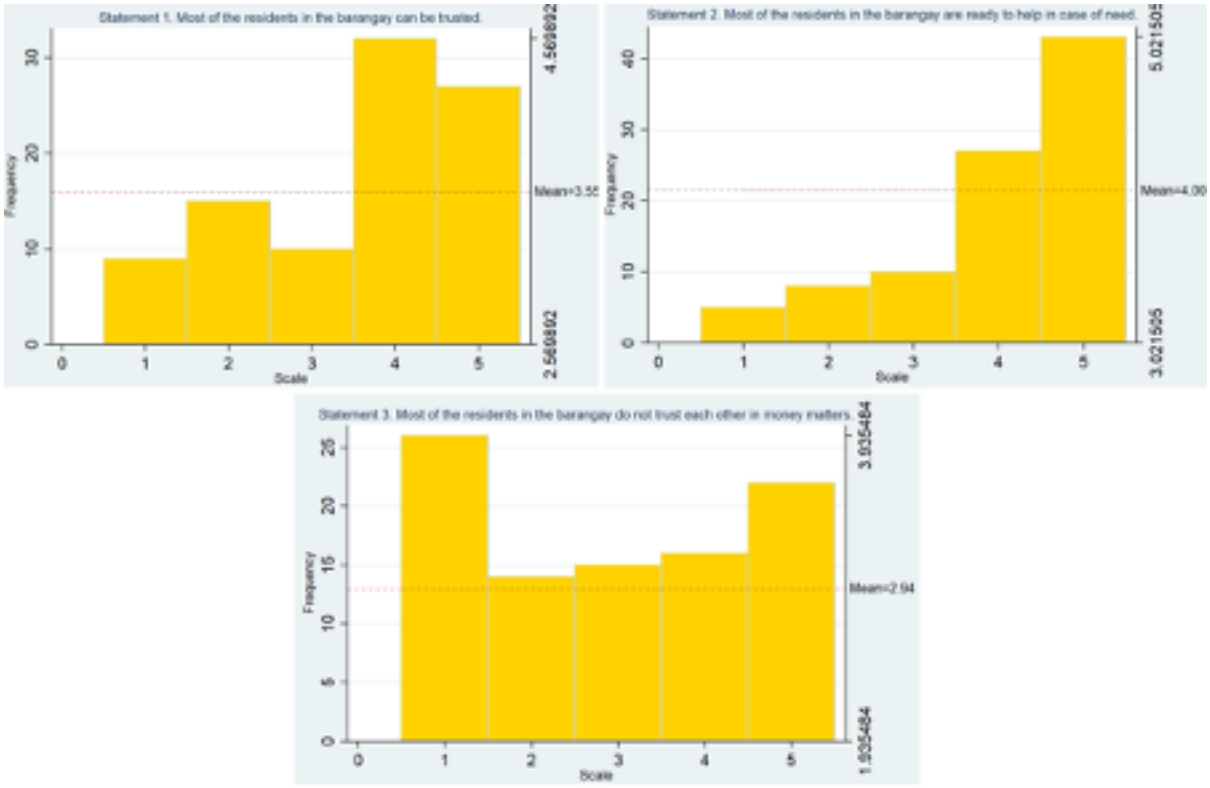

Figure 3. Community trust and cooperativeness measures.

with members who are involved in the Federation of Small Fishermen, who have friends from whom they can borrow money in time of need, and who believe that residents of the barangay are ready to help and be cooperative are less vulnerable to extreme climate events. The sign of the indicator for community trust (SC3Trusting), however, imply that households who perceive greater community trust are more vulnerable. Trust, especially in terms of lending money to one another, may lead to leniency in lending and less resources in case of loan payment default, a common scenario among low income households; and hence higher

Table 8. Binary Probit regression results of the vulnerability to extreme climate events with household characteristics and social capital of respondents in Malaban, Biñan, Laguna, Philippines, 2017 (n=93).

Explanatory Variables	Coefficient
Constant	0.1593
RespondentAge	-0.0085
HHSize	0.1533*
DailyFishCatch	-0.0288*
SC1SamahanMember	-0.2297
SC2Friends	-0.0423
SC3Trusting	-0.0857
SC4Cooperative	-0.0776
Log likelihood	-37.2089
Pseudo R2	0.1125

* significant at the 10% level.

vulnerability. It must be noted, though, that the coefficients for the social capital indicators are not statistically significant and hence the regression results on the impact of social capital on vulnerability are not conclusive.

CONCLUSIONS AND RECOMMENDATIONS

This study focused on the impact of strong typhoons and torrential rains on fishing-dependent households in Barangay Malaban in Biñan, an urban city in the province of Laguna, which is immediately to the south of Metropolitan Manila. The fishing community in the barangay belongs to the lowest income group with average sales of fish catch ranging from PhP158.65/US$3.10 (on a bad day) to PhP1,380.39/US$26.96 (on a good day). Typhoons and torrential rains that lead to flooding are perceived to be the most serious threats to fishing, their main, if not the only, source of livelihood as well as to their minimal assets (shanty houses and inexpensive fishing gears). Majority of fishing households experience house and fishing structure damages during major typhoons and flooding. Most resorted to repair using savings rather than moving.

About 18-19% of fishing households experienced reduced consumption of food and other basic goods (such as clothing, medicine, etc.) to a level that was not sufficient to keep them as healthy and happy as they were before the climate hazard.

Regression results revealed that fish catch, a proxy for income or economic status of the household, significantly affects vulnerability. The higher the economic status of the household, the less vulnerable it is to strong storms and torrential rains. Household size, on the other hand, has a significant positive effect on vulnerability. Smaller households are less vulnerable to extreme climate events.

The study finds that individual-level social capital, in its different forms and dimensions (formal and informal social networks, and trust and cooperativeness), does not significantly lower households' vulnerability. This may be because during times of crisis, disaster relief and assistance which mainly address consumption vulnerabilities of low-income households are fundamentally extended to all households regardless of membership or non-membership in organization/s, regardless of the household's active or inactive involvement in community undertakings, and regardless of the household's perception of trust and cooperation in the community.

For future studies, it is recommended that the relationship between vulnerability and social capital be investigated on a community-level. Higher degree of community-level social capital may lower the incidence of vulnerability in the community. Laguna Lake is surrounded by many communities with different characteristics and varying forms and degrees of social capital. A study of a sample of these communities may provide more insights on the link between social capital and vulnerability to climate change.

REFERENCES

Adger, W.N. 2003. "Social Capital, Collective Action and Adaptation to Climate Change." *Economic Geography* 79: 387-404.

Adger, W.N. 1999. "Social Vulnerability to Climate Change and Extremes in Coastal Vietnam." *World Development* 27(2): 249-269.

Adger, W.N. and Kelly, P.M. 1999. "Social Vulnerability to Climate Change and the Architecture of Entitlements." *Mitigation and Adaptation Strategies for Global Change* 4: 253-266.

Adger, W.N., Dessai, S., Goulden, M., Hulme, M., Lorenzoni, I., Nelson, D.R., Naess, L.O., Wolf, J. and Wreford, A. 2009. "Are there Social Limits to Adaptation to Climate Change?" *Climatic Change* 93(3-4): 335-354.

Afanas'ev, D.V., Guzhavina, T.A. and Mekhova, A.A. 2016. "Social Capital in a Region: Revisiting the Measurement and Building of an Indicator Model." *Economic and Social Changes: Facts, Trends, Forecast* 6: 110-125.

Aldrich, D.P. and Meyer, M.A. 2015. "Social Capital and Community Resilience." *American Behavioral Scientist*

59(2): 254-269.

Allen, K. 2003. "Vulnerability Reduction and the Community-based Approach: A Philippines Study." In Natural Disasters and Development in a Globalising World. (ed. M. Pelling). Routledge, New York. pp. 170-184.

Baird, T.D. and Gray, C.L. 2014. "Livelihood Diversification and Shifting Social Networks of Exchange: A Social Network Transition." *World Development* 60: 14-30.

Balew, S., Agwata, J. and Anyango, S. 2014. "Determinants of Adoption Choice of Climate Change Strategies in Crop Production by Small Scale Farmers in Some Regions of Central Ethipia." *Journal of Natural Sciences Research* 4(4): 78-93.

Brooks, N. 2003. Vulnerability, Risk and Adaptation: A Conceptual Framework. Tyndall Centre for Climate Change Research Working Paper 38, Centre for Social and Economic Research on the Global Environment (CSERGE), University of East Anglia, Norwich.

Bjornskov, C. 2003. "The Happy Few: Cross-Country Evidence on Social Capital and Life Satisfaction." *Kyklos* 56(1): 3-16.

Buchenrieder, G. 2006. "Issues and Evidence of Social Networks in Boosting Rural Households' Welfare." In Making Rural Households' Livelihood More Resilient: the Importance of Social Capital and the Underlying Social Networks. (eds. G. Buchenrieder and T. Dufhues). Leibniz-Institu fur Agrarentwicklung in Mittel-und Osteuropa (IAMO).

Carpenter, J., Daniere, A. and Takahashi, L. 2004. "Cooperation, Trust and Social Capital in Southeast Asian Urban Slums. *Journal of Economic Behavior and Organization* 55: 533-551.

Cross, J.A. 2001. "Megacities and Small Towns: Different Perspectives on Hazard Vulnerability. *Environmental* Hazards 3: 63–80.

Dearmon, J. And Grier, K. 2009. "Trust and Development." *Journal of Economic Behavior and Organization* 71(2): 210-220.

Deressa, T.T., Hassen, R.M. and Ringler, C. 2008. Measuring Ethiopian Farmers' Vulnerability to Climate Change across Regional States." International Food Policy Research Institute (IFPRI) Discussion Paper 00806, Washington, D.C.

Grootaert, C., Narayan, D., Jones, V. and Woolcock, M. 2004. "Measuring Social Capital: An Integrated Questionnaire." World Bank Working Paper No. 18.

Horvath, R. 2013. "Does Trust Promote Growth?" *Journal of Comparative Economics* 41: 777-788.

Intergovernmental Panel on Climate Change Working Group I. 2001. "Climate Change 2001: The Scientific Basis." In: Third Assessment Report. (ed. J.T. Houghton, Y. Ding, D.J. Griggs, et al. IPCC, Geneva.

Intergovernmental Panel on Climate Change Working Group II. 1997. The Regional Impacts of Climate Change: An Assessment of Vulnerability, ed. R. Watson, M. Zinyowera, R. Moss, and D. Dokken. IPCC, Geneva. 17 pp.

Knack, S. and Keefer, P. 1997. "Does Social Capital Have an Economics Pay-off? A Cross Country Investigation." *Quarterly Journal of Economics* 112(4): 1251-1288.

Krishna, A. 2004. "Understanding, Measuring and Utilizing Social Capital: Clarifying Concepts and Presenting a Field Application from India. *Agricultural System* 82: 291-305.

Lim, B., Spanger-Siegfried, E., Burton, I., Malone E. and Huq, S. 2005. Adaptation Policy Frameworks for Climate Change: Developing Strategies, Policies and Measures. Cambridge University Press and United Nations Development Programme, Cambridge. 258 pp.

Ostrom, E. 1990. Governing the Commons. The Evolution of Institutions for Collective Action. Cambridge University Press, Cambridge. 280 pp.

Palanca-Tan, R. 2006. "The Kyoto Protocol's Clean Development Mechanism: Prospects for Japan-Philippines Partnership." *Philippine Studies* 54(1): 41-81.

Pham, N. 2010. "Cooperative Behavior, Social Capital and Development: Evidence from the Mekong River Delta in Vietnam." Environment and Economy Program in Southeast Asia (EEPSEA) Research Report No. 2010-RR11. EEPSEA, Singapore.

Philippine Statistics Authority (PSA). 2015. Census of Population and Housing 2015. PSA, Quezon City, Philippines.

Philippine Statistics Authority. 2010. Census of Population and Housing 2010: Total Population by Province, City, Municipality and Barangay. PSA, Quezon City, Philippines.

Pretty, J. 2003. "Social Capital and the Collective Management of Resources." *Science* 302(5652): 1012-1914.

Pretty, J. and Smith, D. 2004. "Social Capital in Biodiversity Conservation and Management." *Conservation Biology* 18(3): 631-638.

Putnam, R.D. 2000. Bowling Alone: The Collapse and Revival of American Community. Simon and Schuster, New York.

Rosenberg, M. 1956. "Misanthropy and Political Ideology." *American Sociological Review* 21: 690-695.

Saguaro Seminar. 2017. "2000 Social Capital Community Benchmark Survey." The Roper Center for Public OpinionResearch, Cornell University. Accessed 7 December 2018 from https://ropercenter.cornell.edu/2000-social-capital-community-benchmark-survey/.

Sangnier, M. 2013. Does Trust Favor Macroeconomic Stability?" *Journal of Comparative Economics* 41: 653-668.

Tamako, N. and Thamaga-Shitja, J.M. 2017. "Does Social Capital Play a Role in Climate Change Adaptation among Smallholder Farmers for Improving Food Security and Livelihoods?" *Journal of Consumer Sciences* 2: 16-27.

Uslaner, E.M. 2002. The Moral Foundations of Trust. Cambridge University Press, Cambridge. 52 pp.

Van Kien, N. 2011. "Social Capital, Livelihood Diversification and Household Resilience to Annual Flood Events in the Vietnamese Mekong River Delta." EEPSEA Research Report No. 2011-RR10. EEPSEA, Singapore.

Wendland, W.M. 1977. "Tropical Storm Frequencies Related to Sea Surface Temperatures." J*ournal of Applied Meteorology and Climatology* 16: 477-481.

Wisner, B., Blaikie, P., Cannon, T. and Davis, I. 2003. At Risk: Natural Hazards, People's Vulnerability, and Disasters. Routledge, New York. 471 pp.

Yameogo, T.B., Fonta, W.M. and Wunscher, T. 2018. "Can Social Capital Influence Smallholder Farmers' Climate Change Adaptation Decisions? Evidence from Three Semi-Arid Communities in Burkina Faso, West Africa." *Social Sciences* 7(3): 33, https://doi.org/10.3390/socsci7030033.

Zacarias, D.A. 2019. "Understanding Community Vulnerability to Climate Change and Variability at a Coastal Municipality in Southern Mozambique." *International Journal of Climate Change Strategies and Management* 11(1): 154-176.

Zak, P. and Knack, S. 2001. "Trust and Growth." *The Economic Journal* 111: 295-321.

ACKNOWLEDGMENT

This study was undertaken with support from the Philippine Commission on Higher Education-Philippine Higher Education Research Network (CHED-PHERNET) and the University Research Council of the Ateneo de Manila University.