RURAL COASTAL HOUSEHOLDS' COGNITION OF SEA LEVEL RISE: THE CASE OF ZAMBALES, PHILIPPINES

by

Carmela G. Taguiam and Cecille B. Quiambao

ABSTRACT

Sea level rise (SLR) is caused by the melting of glacier ice and thermal expansion due to the climate change phenomenon. Scientists are continuously monitoring SLR as a change in the mean of sea levels poses a threat in low lying coastal zone. With 60% of the Philippine population living in low lying coastal zone, they are exposed to the hazards of coastal environment.

To understand cognition of SLR, a descriptive research swas conducted in four rural coastal settlements facing West Philippine Sea in Zambales composed of 210 men and women households. Twelve SLR statements were prepared and answered by households following the Likert-type scale. Results of the factor analysis showed that SLR was perceived by households in three dimensions and these are: affected the social well-being of households, changed the seascape of the coastal environment, and increased of sea water. The Pearson correlation showed that the first dimension was correlated to the households educational attainment (-0.139 at 0.05 level). The second dimension was correlated to the households' years of fishing experience (0.183 at 0.05 level) while the third dimension was found to be highly correlated to the households' length of residence along the coastline (0.224 at 0.01 level).

Introduction

Sea level rise (SLR) is one of the indicators of climate change in coastal areas (Nicholls, 2015). Records show that sea level is rising (IPCC, 2007; Church et al., 2013) and a serious threat in low-elevation coastal zones (Kada and van Schaik, 2003). Factors that contribute to SLR are thermal expansion of sea water due to ocean warming and glacier melting (IPCC, 2007; Nicholls and Cazenave, 2010).

During the 16th -18th centuries, sea level was relatively stable; by the 20th century, the global rise of sea level was observed at 17cm (Nicholls, 2015). Church et al (2013) noted that sea level will likely to accelerate in the 21st century with a rise of one meter or more should large ice sheets make a large positive contribution. The rate of SLR is not geographically uniform and it varies from location to location (Craig, 2010; Hamlington et al., 2014).

In Philippines, the vulnerability assessment revealed that parts Cavite, Bulacan and Metro Manila situated along the coast of Manila Bay could capitulate to a one meter SLR by 2100 (Perez et al., 1999). Corollary, the 40-year observation in the five primary tidal gauge stations (Manila, Cebu, Davao, Legazpi, and Jolo) showed a rise in sea level nearing 15cm (Rincon and Virtucio, 2008); the lowest expected figure set by the IPCC. Williams from the World Meteorological Organization (Hamlington et al., 2014) said the Philippines have the highest average increase in sea level at 60 cm as compared to the global average of 19 cm since 1901. Such increase threatens the 60% populace of the country dwelling along the coastline. Because of this, a research was undertaken with focus on the coastal households' cognition of SLR. Cognition refers to the households' perception of SLR. As residents in low-elevation coastal zones, it is important to know how the households perceive and understand the changes that take place in the environment where they found a niche for themselves; a niche that might put them at risk.

The objectives of this paper are: assess the households' perception of SLR vis-à-vis identify factors influencing formation of such perception.

Methodology

Research design

The research applied the descriptive design method. Descriptive design sets the initial or trend about the interrelationships among phenomena and the types of determinant to be measured (Parel et al., 1978). Both the anthropological and sociological approaches were employed in the collection of the primary data. The anthropological and sociological approaches include the different participatory methodologies such as the use of participatory rural appraisal (PRA) type of interview schedule, focus group discussion (FGD) and key informant interview.

Place of implementation

With the NAMRIA-developed indicative map of low-lying areas vulnerable to sea level rise in the Philippines served as the reference to identify the study areas of this endeavor (Fig. 1). The NAMRIA indicative map identified regions and provinces experiencing sea level rise at different levels: one meter elevation, two meter elevation and three-five meters elevation. After referring to this map, Region particularly the province of Zambales was chosen. Specific sites – municipal and barangay levels- were identified during the reconnaissance survey and consultation with the DENR regional offices including the CENRO and concerned local government units (LGUs).

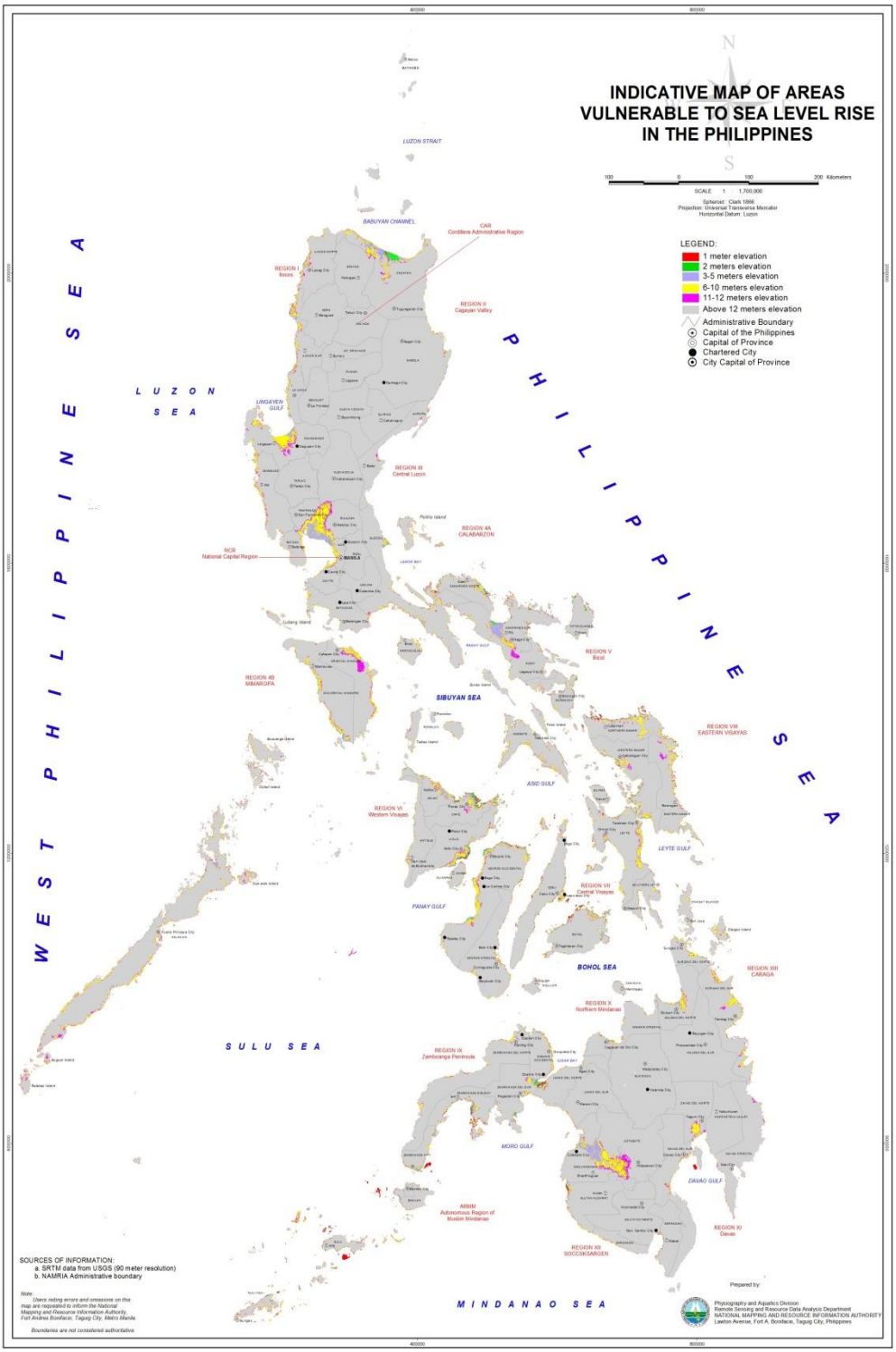

Fig. 1. Indicative map of areas vulnerable to sea level rise (NAMRIA, 2006).

Study sites

Zambales is a province situated in the Central Luzon. It is bounded on the north by Pangasinan; Tarlac and Pampanga on the east; Bataan on the south; and the West Philippine Sea on the west. It has an aggregate area of 3714.40 km^2 with two pronounced seasons: dry (October to June) and wet (July to September).

a. Palauig

Palauig was founded in 1870 and inhabited by the Aeatas. It is bounded on the south by Iba and on the north by Masinloc. It has a total land area of 31000 ha or 310 km^2. Palauig was previously named *manlawig* (which meant he is going to the field and tether his carabao); the Spanish solider wrongly heard the term and called it Palauig. Palauig has 19 barangays, 13 are categorized as coastal barangays.

Fig. 2. Shoreline of Brgy. Garetta.

Brgy. Garetta was selected as one of the study sites due to the reported incidence of sea level rise and in consultation with the CENRO-Masinloc.

b. Masinloc

Masinloc is bounded on the north by Candelaria, on the east by Mt. Masinloc, on the south by the towns of Palauig and Iba, and on the west by Oyon and Masinloc Bays. In 1572, it was visited by Juan de Salcedo. It got its name from Bolinao-Zambal phrase *babali nin masin ilog* which meant the town where there is a river. By 1607, it served as the first capital of Zambales. Masinloc has an aggregate land area of 30600 ha and a total coastline of 42.2 kilometers including the San Salvador Island.

Brgy. Bani was chosen as the study site due to its changing seascape and as per recommendation of the LGU.

Fig. 3. Shoreline of Brgy. Bani with AES-Philippines.

c. Candelaria

Candelaria is nestled at the foot of Zambales mountain range on the east, Philippine West Sea on the west and by the municipalities of Sta. Cruz and Masinloc on the north and south, respectively. Candelaria has a land area of 38359.1896 ha with an estimated coastline of 13.5 kilometers. Candelaria is subdivided into 16 barangays; eight are classified as coastal barangays.

Two barangays were surveyed in Candelaria. Brgy. Binabalian was identified by the LGU experiencing sea level rise while Brgy. Uacon was chosen due to the June 2013 coastal erosion.

Fig. 4. The shoreline of Brgys. Binabalian and Uacon.

d. Sta. Cruz

Sta. Cruz is the northernmost municipality of Zambales. It is bounded on the north by the municipality of Infanta, Pangasinan, on the south by Candelaria, on the east by the province of Pangasinan, and on the west by the Philippine West Sea. Sta. Cruz has total land area of 43846 ha and two islands (Hermana Mayor and Hermana Menor). Sta. Cruz is composed of 25 barangays; 11 of these are categorized as coastal barangays. It has a coastline of 15 kilometers.

Brgy. Naulo was picked as the study sites due to a number of houses and settlers displaced by the rising sea water.

Fig. 5. House destroyed along the shoreline of Brgy. Naulo.

Selection of respondents

Respondents of the research were the households dwelling along the coastlines for a certain period of time. Simple random sampling was applied in the selection of households. Kerlinger (1986) stated that random sampling is required by inferential statistics. When the researcher longs to make inferences on population based on the behavior of samples, random sampling must be applied (Key, 1997). After consultation with the LGUs, the sampling size was set at 50 households per barangay. In social science research, sample size is set at a minimum of 50 (Peng et al., 2002). In the municipalities of Palauig and Masinloc sample size was ≤ 50 due to unavailability of household heads. Whereas in Candelaria, the coastal community identified by the LGU had few residents, thus, additional community was surveyed. Overall, the number of households interviewed was 210.

Data analyses and Interpretation

In the collection of primary data, a pre-tested interview schedule was used. The collected primary data was subjected to both quantitative and qualitative methods of analyses. In the quantitative method, the statistical tests used include both descriptive and inferential statistics (Pearson product-moment correlation coefficient and factor analysis).

To ascertain the households perception of sea level rise, 12 positive and negative perception statements were prepared. Each statement was scored from one to five following the Likert-type scale. For the positive statement, the scoring was 1 – strongly disagree, 2 – disagree, 3 – neutral/undecided, 4 – agree, and 5 – strongly agree. The scoring pattern was reversed for the negative statement. The lowest possible score that a household could get was 12 and the highest was at 60. Likert-type scale is a summated rating scale (Kerlinger, 1986) where scores obtained from statements are summed and averaged to yield an individual score. Also, item is presented in statement rather than question and respondents rate their level of agreement with the statement (Jackson, 2012).

In the analysis of the households' perception of sea level rise, factor analysis was applied. Factor analysis is the grouping of variables in the fewest possible wholes, that is, variables with the same manifestations proceed to delineate new independent factors which are responsible for the groupings (Cattell, 1952).

Correlation coefficient measures the degree of relationship between two sets of variables and enables to make predictions from one variable to another (Jackson, 2012). The Pearson product-moment correlation coefficient is specifically used when the nature of variables measured are interval or ratio scale.

Results and Discussion

Households' demographic characteristics

A total of 210 households composed of male (38.1%) and female (61.9%) was interviewed. Households' age ranged from 21 years to 85 years old with a mean age was 45.28 years. More than half (66.7%) were in the age bracket of 31-55 years. A large number of households (99.5%) received formal education with the majority (52.9%) reaching the high school level. Most of the households (72.4%) were married. Number of household dependent was from one to 14; average household size was five.

As regards to mobility pattern, over two-quarters of households (52.4%) were born-residents, the remaining group (47.6%) identified themselves as migrants. Nearly an equal number of households lived in the coastal communities for less than 25 years (43.3%) and 26-50 years (43.85%), respectively; average length of residence was 29.8 years. A large number of households (54.8%) belonged to the Sambal group. Households were conversant in Zambal, Tagalog, and Ilocano.

Households' economic characteristics

Fishing (68.1%) was the households' primary occupation (Table 1). Households learned fishing at an early age as their fathers were also engaged as fishermen. The municipal water served as the fishing ground but in recent years, a number of household-fishermen have gone as far as the West Philippine Sea or the *Bajo de Masinloc* to increase fish catch. Fishing was a daily activity to support the needs of the family; fishing takes six to eight hours depending on the season. Others opted to fish three to four times a week; this was practiced by those opting

to fish in West Philippine Sea and Pangasinan Gulf. Each of the municipality with the assistance of the Bureau of Fish and Aquatic Resource (BFAR) established fish sanctuary for resource enrichment and secure food source of the community members. Household-fishermen revealed that not all of them own or equip with appropriate fishing gears. Out of the 143 household-fishermen, only 84 owned or shared their motorized boats to relatives and friends. Those who chose to fish at twilight use lamp (10 P.M. – 6 A.M. or 4 A.M. – 11 A.M.). A household-fisherman in Brgy. Garetta owned and used the Global Positioning System (GPS) to locate the area abundant with school of fishery to increase his catch. Similarly in Brgy. Naulo, household-fishermen revealed that fish dealers provide them with GPS to increase fish catch which are brought to Olongapo and Metro Manila.

Table 1 Economic activities and Income.

Particulars	Frequency	Percent
Source of income		
Fishing and fish-related activities	143	68.1
Skilled labor (hired labor, beautician, therapeutic massage, farmer, etc.)	26	12.4
Employed (driver, business, army/securityguard, OFW)	28	13.3
Support from children	13	6.2
Income		
Below Php 30,000.00	73	34.8
30,001.00 - 50,000.00	37	17.6
50,001.00 and above	100	47.6

In the past five years, households (79.2%) engaged in fishing as primary and secondary occupation noted a change on the volume of fish catch. Approximately 66% mentioned there was a decrease on fish catch and the cause of which was attributed to change in the coastal environment.

As shown in Table 2, nearly half of households (47.6%) from all sources of economic activities had annual income of Php 50,001 and above. More than a quarter (34.8%) received gross annual income of Php 30,000 and below; few were fortunate to earn as much as Php 30,001.00 to Php 50,000.00 in a year. Average annual income from all sources was Php 72,332.40.

Among the 143 household-fishermen, majority (47.6.3%) earned Php 50,001.00 and above per year. Others (35%) had meager earning with less than Php 30,000.00 a year. Household-fishermen mentioned there were times they were unable to catch a fish even for their meals. They incurred expenses which they were unable to recover or repay. Average annual income obtained from fishing was Php 74,038.00.

For households working as skilled laborer, a considerable number (42.3%) had annual pay Php 50,001. 00 and up; a small group (38.5%) had a base income as low as Php 30,000.00 a year. Average take home pay was Php 56,818.07. Households employed in private companies and agencies had fixed salary with over two-quarters (64.3%) receiving annual remuneration of Php 50,001.00 and above; mean income was Php 96,996.85. Aged households were supported by grow-up children with a measly annual stipend Php 30,000.00.

Perception of SLR

Households (86.2%) affirmed that incidence of SLR has been observed along the coastline of Zambales. To determine the households' perception, 12 statements focusing on the different dimension of SLR were prepared. Through factor analysis, the 12 statements were reduced into three dimensions to form the households' perception of SLR (Table 2). Cumulative variance in per cent of the three perception dimensions was 53.59 (Table 3).

Table 2. Perception statement.

Statement	SD	D	U/N	A	SA
The level of sea water is rising	2	14	10	144	40
Shoreline retreat is cause by sea level rise	1	22	20	137	30
Sea level rise leads to frequent flooding in the settlement area	6	55	13	114	22
Sea level rise is triggered by the melting of ice in the polar	3	33	85	79	10
The aesthetic value of coastal environment has improved due to sea level rise	21	128	27	27	7
Sea level rise makes the household feel more composed and relaxed	1	15	15	138	41
Coastal households are more healthy with the rise of sea water	-	21	23	129	37
Sea level rise has encouraged households to engage more in water-related recreational activities	31	129	21	27	2
Households catch more fish due to sea level	2	22	28	117	41
Sea level rise has contributed to the socioeconomic status of households	2	21	24	124	39
Sea level rise is driving the households to leave their houses	20	99	19	60	12
The status or condition of the sea – coastal environment is in equilibrium	26	103	13	61	7

Factor 1 was formed by the grouping of six statements (5, 6, 7, 8, 9, and 10) with an Eigen value of 3.044 and per cent variance of 25.365. With such grouping, it was perceived that SLR *affects the social well-being* of *households*. The social well-being encompasses the households' economic, health, safety and psychological attributes. Result of the Pearson correlation showed that this dimension is significant at 0.05 level to the households age (-0.139*). The inverse relationship could mean that households from all ages no longer enjoy the once calm and serene environment of the coastline. As youth, households played ball-and-water games along the shoreline; to date their playground had been submerged and the sea with strong current. Whyte (1984) stated that socio-economic parameters like age, sex, occupation, and education had minor role in the formation of perception. Whereas, Harvatt et al (2011) noted the influence of socio-demographic attributes such as age and gender have subtle relationship with perception. Among the indigenous people of Chakma in Bangladesh, it was found that age is significantly associated with perception on climate change (Huda, 2013).

Factor 2 had high factor loading in statements 1, 2, and 12 with a variance of 15.093% and responsible for the formation of the households' perception of *change on seascape of the coastal environment*. Change on the seascape of coastal environment was correlated to the households years of fishing experience and activities; computed Pearson value of 0.183* was significant at 0.05 level. As majority were engaged in fishing with an average of 22 years of experience, households witnessed the changes (reclamation and infrastructure) in the coastal environment. These changes either natural or anthropogenic in nature affected the households' socio-economic condition. Experience with continual engagement in environment could influence the households' perception and knowledge of the environment (Casey, 1994).

Corollary, individuals from low income bracket seem to be more perceptive and responsive to changes in the environment (Semenza et al., 2008).

Table 3. Perception of sea level rise.

Particulars	Eigen value	Percent variance	Cumulative percent
Affect social well-being	3.044	25.365	25.365
Change the seascape of coastal	1.811	15.093	40.457
environment	1.576	13.134	53.591
Cause displacement of households			

Factor 3 resulted to the fusion of statements 3, 4, and 11 with a corresponding Eigen value of 1.576 vis-à-vis per cent variance of 13.134. The melting of polar ice was perceived to trigger increase of sea water resulting to chronic coastal flooding during typhoon, tropical cyclone and southwest monsoon seasons. Inevitably, it led to *displacement of households* from their original place of residence as their houses were inundated by the rise of sea water. Perception is most accurate among people with direct personal experience of specific natural hazards (Saarinen, 1966). The Pearson correlation with a p value of 0.244** revealed that the relationship between the households' perception of increase sea water and length of residence along the coastline was highly significant at 0.01 level. Result of the correlation was true among households who have resided in the coastline below 25 years and above 51 years with mean difference of 0.505* and 0.669* and significant at 0.05 level, respectively. Being long-time residents, households have seen and experienced the impacts of changes in the coastline. Due to the rise of sea water, households abandoned their abodes and forced to move inland for safety purposes. In UK, the time of residency indirectly affect the formation of perception (Harvatt et al., 2011).

Conclusion and Recommendation

The households' affirmation of SLR in their province near the West Philippine Sea indicates their awareness of changes in the coastal environment. Awareness of change in the coastal environment could be influenced and ascribed to their dependence on its resources as majority rely on fishing as primary and secondary employment. As residents for a long-period of time in the coastline, households witnessed and experienced the after-effects or impacts of SLR. However, a number of households' were skeptics with regard to the presence of SLR; they opined that the level of sea water did not change.

The result of the factor analysis (cumulative variance of 53.59%) which showcased the three perceptual dimensions indicates the need for households to have a better grasp or understanding of SLR. Having experienced a number of negative impacts of SLR, households should consider options like relocation for the safety of their well-being. If households are apprehensive of being relocated, there are adaptation measures which they can apply.

To improve the households' grasp of SLR, technical assistance in the form of education and information campaign like environmental awareness, protection and conservation of coastal environment must be done. There is also a need for local government units to institutionalize mechanisms that would strengthen the capability of coastal communities.

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