COST-EFFECTIVENESS ANALYSIS (CEA) ON COMMUNITY ADAPTATION STRATEGIES OF MEN AND WOMEN OF PANGASINAN, PHILIPPINES

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Abstract: Climate change impact chooses no one to harm, thus; by increasing one's resiliency can lessen a person's worry in dealing with such situations. Using the participatory-based approach in determining the most extreme and recent hazard that affected a certain coastal area particularly in selected towns in Pangasinan, Philippines facing West Philippine Sea as well as identifying the most possible, feasible and suitable adaptation strategies in a community is an avenue where direct and decisive solutions of related hazards were pointed out by groups of men and women representatives from various sectors whose experiences brought relevant lessons in their respective lives. It is then believed, that to reduce the destructive effects of a hazard, gathered common adaptation strategies from the focus group discussions (FGDs) subjected to cost-effectiveness analysis (CEA) can serve as a basis and frame of reference in selecting the most cost-efficient so the best project may be implemented to address an issue that is detrimental to their resources. Further, men and women should be both proactive and reactive in making decisions on hazard related matters so as to enhance the empowerment index of women.

Index Terms: Cost-effectiveness analysis, community adaptation strategies, men and women climate change related-hazard experiences

1. INTRODUCTION

COASTAL hazards (Gonzales and Bernabe, 2017) are believed to pose great and vicarious risks to community folks living near the coastal areas. These hazards are beyond the control of man, they are considered to be physical phenomena that expose people's loss of lives, damages to properties and environmental degradation. Rapid-onset hazards last over periods of days and that include major cyclones accompanied by high winds, waves and surges or tsunamis created by submarine earthquakes and landslides. Slow-onset hazards develop incrementally over longer time periods and examples include erosion and gradual inundation (Schwartz, 2005). This study assessed and validated the hazards experienced by men and women in their respective communities; identified the adaptation strategies as specified by each group of men and women from various community sectors; evaluated the cost-effectiveness of adaptation strategies to climate change, and; determined the women empowerment index in decision making.

2 METHODS

2.1 Research Design

The study used an adaptive research strategy and the group explored the possibility of extending the methods used in the different study sites as deemed necessary. This involves, among others, consideration of other criteria (e.g. flexibility) in deciding which adaptation to pursue.

2.2 Respondents

Representative members from various sectors of men and women groups in selected barangays along the coastal towns facing West Philippine were the main respondents.

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2.3 Procedure

Cost-Effectiveness Analysis (CEA) was used as in choosing the option that can achieve a specific objective at the least cost. In cases where the objective of adaptation is multiple, CEA was applied by assigning importance (weight) to the objectives. Cost-effectiveness (CE) was measured in terms of cost per unit of outcome effectiveness. The CE ratio was interpreted as the average cost per unit of effectiveness. In other words, the most cost-effectiveness adaptation option has the lowest average cost per unit of effectiveness. In the climate change context, adaptation projects may incur cost at different times over the life of the project thus required for computing the net present value when comparing among various adaptation options. On the other hand, women empowerment was measured by using the concept of the Women Empowerment Index (WEI) with the formula (Paris et al., 2010):

$$WEI_i = \frac{\sum x_1}{d}$$

where:

WEI = Women's Empowerment Index for identified activities of each respondent

$$x_i = \begin{cases} 1 \text{ the husband solely makes the decision} \\ 2 \text{ the husband dominates the decision} \\ 3 \text{ the husband and wife makes joint decision} \\ 4 \text{ the wife dominates the decision} \\ 5 \text{ the wife solely makes the decision} \end{cases}$$

x = value of decision-making on the i^{th} activity and has the following values:
d = total number of decisions given by the respondent
I= is the i^{th} decision-making activity

3 Results and Discussion

3.1 On Coastal Hazards Experienced by Men and Women

The hazards experienced by the men and women in selected coastal areas are shown through a historical timeline (see sample figures 3 and 4); and, resource hazard mapping (see sample figures 5 and 6).

Historical Timeline Analysis

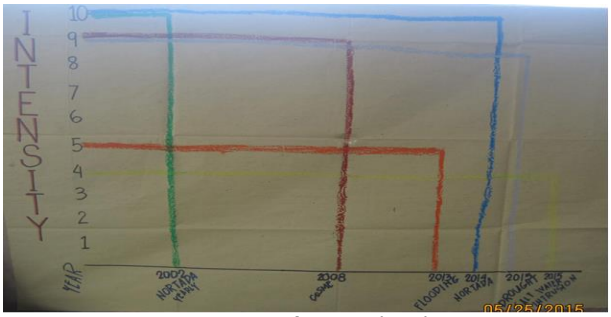

***Figure 1**. (Men)*

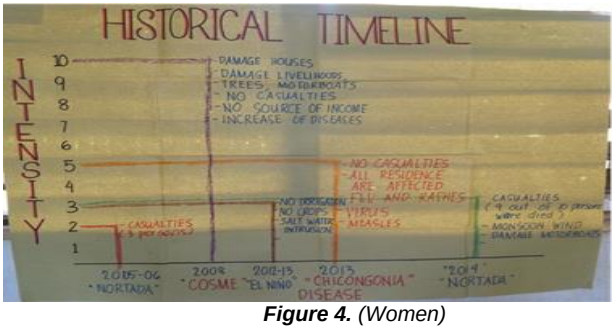

***Figure 4.** (Women)*

Men told that in the year 1998 typhoon Gading destroyed many houses and properties. It also caused unavailability of electricity and transportation. Ten years after, Typhoon Cosme with the same intensity affected most of the fishermen. Norte or Nortada along with storm surge was experienced in the said barangay causing many people to die and get lost in the sea in 2002. Nortada again happened in 2014 wherein fourteen (14) fishermen were lost and their fishing equipment/gears were destroyed. Flooding happened a year before that led to overflowing of fishponds and even caused residents to evacuate in more stable houses. Drought occurred in 2015 that destroyed crops, affected animals' health and dried their source of water. According to women, in 2005-2006, Nortada fishermen experienced Nortada at sea which caused three casualties. It again occurred in 2014 where motorboats were damaged and nine (9) people died. In the year 2008, a typhoon named Cosme damaged houses, livelihood, trees and motorboats. Based from the result, it shows that men are better in recalling hazards that happened in their barangay and are more specific in identifying the year of each hazard's occurrence over women. They are common in mentioning the term "Nortada" that usually cause loss of lives and missing fishermen. However, they differ in the year 2013 where males mentioned flood while females mentioned drought.

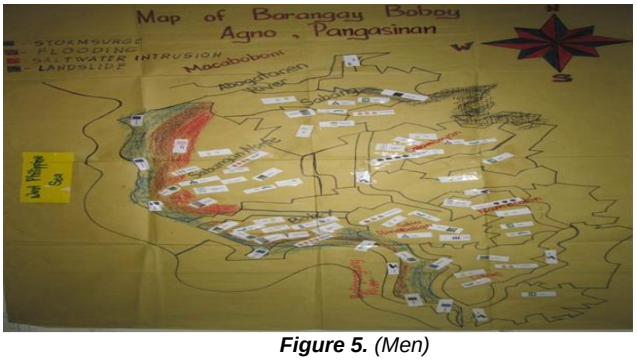

***Figure 5.** (Men)*

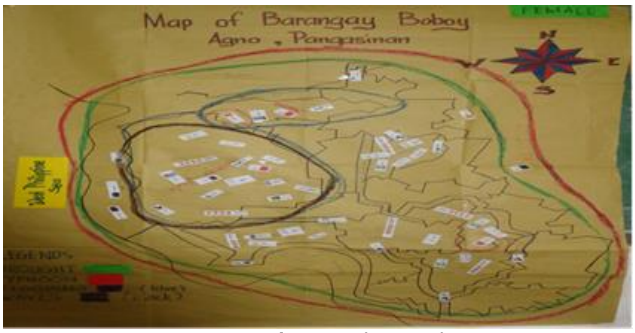

***Figure 6.** (Women)*

Men have identified five (5) types of hazards in their map namely: typhoon, storm surge, flood, salt water intrusion and landslide. Its main effects were: loss of income, loss of life and loss of properties. Women's group identified "typhoon" as the first hazard and main cause of salt water intrusion. It brought damages on houses and livelihood aside from the recorded missing fishermen. The second identified hazard was drought, followed by flood which destroyed their physical and natural resources.

3.3 On Vulnerability Assessment Matrix (VAM)

The chart and table show the combined and agreed rank of hazards as well as the planned adaptation strategies of the males and females of the barangay. After thorough deliberations males were able to encourage females that their barangay should address typhoon first because it

***Figure 7.** Sample Combined VAM (Brgy. Baruan)*

caused more damages over the other hazards, followed by drought, salt water intrusion, and flood so the interventions were enriched and accepted.

3,2 Resource and Hazards Mapping

Figure 8. *Sample Combined VAM (Brgy.)-Boboy)*

Table 1. *Sample Combined VAM (cascaded from figure 7)*

Household Adaptation Strategies	Hazard(s) being addressed	Rank	**Details**
Evacuation center Availability of transportation	Typhoon	1	- Agricultural damages - Damaged houses and livelihood (e.g. boats and trees)
Irrigation system Deep well Water system	Drought	2	- Damaged crops - Lack of water
Water system for every group	Saltwater intrusion	3	- All of their deep well becomes salty and cannot use for drinking
Drainage system Tree planting	Flood	4	- Damaged crops

Table 2. *Sample Combined VAM (cascaded from figure 8)*

Planned Intervention	**Hazard(s) addressed**	**Rank**	**Details**
Disaster preparedness Allocate funds	Typhoon	1	Heavy rains Sand storm Damage houses, livelihoods Overflowing of fishponds
Group discussion Livelihood for all	Storm Surge	2	Damage of boat High tide Damage houses
Save water	Drought	3	Fish kills Damage to poultry
Tree planting activities	Floods	4	Damage of crops Overflow of fish ponds
Solid waste management Invite speakers	Salt water Intrusion	5	The crops stop growing The water tastes salty
Allocate funds Provide water system Tree planting activities	Landslide	6	Road blocking Harvest cannot be transported

Men were able to encourage females that "typhoon" should be ranked first. Rank 2 was storm surge, drought as third, 4th to the rank was flooding followed by salt water intrusion and the last was landslide. After presentation of the outputs, the following interventions are enumerated: 1) disaster preparedness, 2) group discussion, 3) save water, 4) tree planting, 5) invite knowledgeable speakers, and; 6) allocate funds for water system.

3.4 On Cost Effectiveness Analysis (CEA)

The planned adaptation strategies to mitigate the effects of typhoon were: 1) construction of an evacuation center, 2) ensure safety of residents, and 3) the availability of transport. Planned strategies for effects of drought were construction of: 1) an irrigation system, 2) deep wells, and 3) a water system. To help ease the effects of saltwater intrusion, the planned adaptation strategy was for the construction of a water system by cluster. Lastly, the planned adaptation strategies for flooding were 1) construction of a drainage system, and 2) tree planting. In selecting the priority planned adaptation strategies, both groups (men and women) agree that typhoon was the number one hazard affecting their barangay; however, the female group influenced the males that drought (El Niño) was second-ranked since a wider area are affected. Both groups agreed that saltwater intrusion was third-ranked and lastly, flooding since only a few households were affected.

The following table shows the assumptions for the Cost-Effective Analysis (CEA) of the planned adaption strategies. For all CEA computations the discount rate is 8% and the project duration is 15 years and no population growth is assumed during the duration of the project.

Table 3. *Sample CEA (Brgy. Baruan)*

Hazard	Objective / Goal	Effectivity Measure	Adaptation Options (CEA Result)
Typhoons	To reduce the number of households affected by typhoons.	No. of households accommodated.	Construction of an evacuation center
Drought	To reduce the farm areas affected by drought.	Hectares of farm lands irrigated	Construction of an irrigation system.
Saltwater intrusion	To help ease the effects of salt water intrusion.	No. of households assisted.	Construction of a water system by cluster.
Flooding	To reduce no. households affected by flooding.	No. of households helped.	Construction of a drainage system. Tree Planting

Table 4*. Sample CEA (Brgy. Boboy)*

Hazard	Objective / Goal	Effectivity Measure	Adaptation Options (CEA Result)
Typhoons	To reduce the number of households affected by typhoons.	No. of households assisted.	Disaster preparedness, seminars, workshops, and allocation of funds
Storm Surge	To reduce the number of households affected by storm surge	No. of households assisted.	Group Discussion.
Drought	To reduce no. of households affected by drought.	No. of households helped.	Saving water.
Flooding and landslides	To reduce no. households affected by flooding and landslides.	No. of households helped.	Tree planting activities.
Saltwater Intrusion	To reduce no. of households affected by salt water intrusion.	No. of households assisted.	Invite a knowledgeable person. Construction of a water system

3.5 On Women Empowerment Index

Men as shown in table 5 (whole sample) are more reactive in terms of decision making on adaptation choices. This means that men are more prepared and active in taking the role and in performing necessary steps to address hazards.

Table 5. *Women empowerment index, Whole Sample*

Hazard	Man	Woman	Women Empowerment Index (Man's Perspective)	Women Empowerment Index (Woman's Perspective)	Mean Household Women Empowerment Index
Typhoon/ Flooding (Reactive)	93	91	2	3	2
Typhoon /Flooding (Proactive)	89	74	1	3	2
Storm Surge	47	24	1	3	2
Coastal Erosion	3	5	1	3	2
Salt Water Intrusion	17	22	2	3	2

4 CONCLUSIONS

Result of Cost Effective Analysis (CEA) showed that in reducing the number of households affected by typhoon and floods in the study sites construction of alternative and existing drainage were the most cost effective planned adaptation strategy while to reduce the number of households affected by storm surge and coastal erosion the best cost effective planned adaptive strategy was to rehabilitate the existing sea walls in the study sites. On the other hand, to reduce the number of households affected by saltwater intrusion, cluster distribution of safe drinking water through a NAWASA connection was the best cost-effective planned adaptation option. Men are more reactive in making decisions in relation to adaptation choices on climate change related hazards over women who are proactive.

5 RECOMMENDATIONS

The result of the study should be presented to government officials, barangay/community people and other stakeholders for them to take the necessary steps in implementing projects for the study sites and increase their awareness and knowledge regarding the conducted study. Men and women should be encouraged to become equally proactive, reactive and share in decision making on adaptation choices on hazards, therefore; seminars-workshops/trainings on life-saving skills, first-aid and risk-reduction disaster programs should as well be provided to them to become ready in facing hazards.

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