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DEVELOPING COMMUNITY WELLBEING INDEX (CWBi) IN DISASTER-PRONE AREA OF THE PHILIPPINES

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ABSTRACT – There is an urgent need for science based evidences in measuring and monitoring community wellbeing after a disaster. The main objective of this paper was to develop a community wellbeing index (CWBi) following a deductive approach in the selection of indicators. Face to face interviews were conducted using structured questionnaire to 220 households of the 3 cases as affected by volcanic eruption (Albay), earthquake (Bohol) and supertyphoon (Leyte). Qualitative data through key informant interview (KII) were gathered to determine weights of each indicator and dimension based on community capital framework. Indicators were then validated using *Pearson's rho* and subsequently normalized using min-max rescaling scheme. Finally, a CWB iwas established using the equation as follows:

$CWBi = (B \cdot W_{d1}) + (F \cdot W_{d2}) + (Po \cdot W_{d3}) + (SC \cdot W_{d4}) + (N \cdot W_{d5})$ where B is the built capital; F, the financial capital; Po, political capital; SC, sociocultural capital and N, the natural capital; W_{d1} to W_{d5} are weights of the five dimensions. A table for the interpretation of CWB ivalues (ranging from 0.00-1.0) was then developed, where a CWB iof 0.41-0.60 is moderate, above which a CWB iis either strong or very strong and below which a CWB iis either weak or very weak.

Keywords: analytic hierarchical process (AHP), community wellbeing index (CWBi), disaster, key informant interview (KII), survey method

INTRODUCTION

Community wellbeing (CWB) varies with contexts. It can be strong or low or moderate, all depending on contexts where the community is in. In the aftermath of a natural disaster, CWB can drastically change. The Philippines incidentally is considered to be one of the most susceptible countries to natural calamities or disasters (Yumul et at., 2008). Every year, an average of 20 tropical cyclones enter the Philippine Area of Responsibility (PAR), of which 8 or 9 made landfalls (Faustino-Eslava et al., 2011;Yumul et al., 2008; Bankoff, 2003). There are some provinces which are more frequently exposed to typhoons than others because of these cyclone routes. Samar and Leyte belong to top 10 most exposed provinces (Bankoff, 2003). The country can also experience more natural disasters such as volcanic eruptions and earthquakes because of the geographic location in the so called Ring of Fire (Yumul et at., 2008). The 2013 Bohol earthquake was the deadliest earthquake to hit the Philippines in 23 years (Lagmay et al., 2016). The 2013 seismic event occurred along a previously undiscovered fault now called

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North Bohol fault (Kobayashi, 2014). The country has hundreds of volcanoes of which 23 of them are active, 26 are considered as potentially active while numerous are inactive because there are records of eruption to base from (PHIVOLCS, 2008).

It would be best to establish a CWB index (CWBi) to monitor CWB of communities just like Gross Domestic Product (GDP) measuring the goodness of a country: the provision of education, health and other basic services for the people. Having a high GDP is highly correlated to good or best services the government can provide but equating GDP with quality of life was found out to be questionable (Cummins et al., 2003; Cummins & Nistico, 2002; Diener, 2000). GDP was insufficient to measure important aspects of living (Cummins et al., 2003). To make a reliable and inclusive measure, UNDP has used the Human Development Index (HDI) (Sen, 1999). HDI does not focus on the finances alone but included health and education dimension. However, other dimensions of wellbeing were not taken into account like security, or how people look at their lives even in the face of a disaster.

The concepts of CWB changes as the preference of the community is being modified (Lee et al., 2015). Community Wellbeing (CWB) of disaster-affected communities by may differ from each other due to several underlying factors. Bankoff (2003) declared that "the state of the Philippine environment in the new millennium is not encouraging." More and more hazards are coming in. And with the present inequalities in our existing social system, the more vulnerable sector of the society experienced the brunt of disaster impact (Bankoff, 2003). By establishing baseline conditions, it becomes possible to monitor changes in Community Wellbeing over time in particular places and maybe compare one place to another within similar context. This study aimed to develop the Community Wellbeing Index (CWBi) following the deductive approach in the selection of indicators. Indicators and sub indicators were determined using the community capitals framework (Emery and Flora, 2006).

METHODOLOGY

A total of 220 households in three sites frequented by particular disaster in Albay, Bohol and Leyte (Figure 1) respectively were the respondents in the survey to validate the indicators and sub indicators. The number of respondents were decided upon with the use of G*Power analysis and total n was proportionately divided based on the number of households (Faul et al., 2007) (Table 1). G*Power analysis was used to technically avoid Type II error in hypothesis testing. The analysis gave a grounded basis to estimate the parameters required to achieve a desired level of power. Furthermore, there was no need to get sample size greater than what was necessary (Faul et al., 2009). The illustration of calculation as shown below gave a minimum of 70 as n:

t tests - Means: Difference from constant (one sample case)

Analysis: A priori: Compute required sample size

Input:	Tail(s)	=	One
	Effect size d	=	0.4
	α err prob	=	0.05
	Power (1-β err prob)	=	0.95

Output:	Noncentrality parameter δ	=	3.3466401
	Critical t	=	1.6672385
	Df	=	69
	Total sample size	=	70
	Actual power	=	0.9524114

Face to face interviews were conducted with the household heads. Structured questionnaire was used. At the same time, qualitative data were gathered through Key Informants' Interview (KII) for the purpose of deriving the weights from the experts through Analytic Hierarchy Process (AHP) calculations (Table 2). Pairwise comparisons were carried for the dimensions and the indicators.

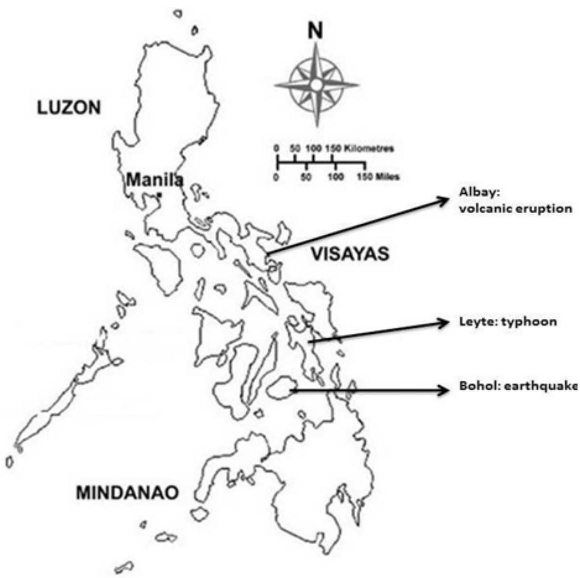

Figure 1. Three study sites representing three natural disasters: Albay (volcanic eruption), Bohol (earthquake), and Leyte (typhoon).

Table 1. The proportional distribution of the household respondents in three barangays of three different disaster types

SITE	BARANGAY 1	BARANGAY 2	BARANGAY 3	TOTAL
ALBAY	21	19	34	74
BOHOL	44	13	16	73
LEYTE	28	28	17	73
TOTAL				220

Table 2. The characteristics of the different experts for the Key Informant Interviews.

SECTOR	ALBAY	BOHOL	LEYTE
Education	Master Teacher II	Principal I	Assistant Professor
Business	Chairman/founder Cooperative	Owner	Owner
LGU	MDRRM Officer	MA Officer	MDRRM Officer
	University Professor	Barangay Chair	Provincial Environment & Natural Resources Officer
Socio-civic Organization	Professional Volunteer	Pastor-Church	based
	President-Student		Organization
People's Organization	Chairman	Secretary	Chairman

RESULTS AND DISCUSSION

Selection of CWB indicators. The first step in the developing of CWB was the selection of indicators. Indicators are quantifiable constructs in order to capture a complex reality that otherwise might not be visible (Vincent, 2007). It tells that a change people are interested in is happening, although indicators cannot explain why and how that change occurs (Sandhu-Rojon, 2004). The author continued to illustrate that results can be demonstrated by the use of indicators by providing "a reference point for monitoring, decision-making, stakeholder consultations and evaluation." These indicators are helpful to decision-makers at all levels, particularly in comparing across space and monitoring change over time (Vincent, 2007, Sandhu-Rojon, 2004). This ensures that indicators provide data that are appropriate and useful.

There are several ways to select the appropriate indicators but the challenge is to select indicators that can capture key changes combined with its relevance to achieve desired result (Cutter et al., 2010). These indicators are decided upon because they are relevant, analytically sound and measurable. Some studies set criteria for indicator selection such as its validity, sensitivity, and specificity to the underlying phenomenon being studied (Cutter et al., 2010; Morton & Edwards, 2012).

Proposed dimension themes. The second step in the developing of a CWB was to determine the dimension themes. It is crucial to understand the unique experiences of community stakeholders during natural disasters, regardless of a community's successes and losses seen during the post-disaster period. The impacts of natural disasters, indeed, differ across different areas and individuals have unique accounts of their experiences. As communities go through different situations and events, people's perceptions regarding community wellbeing also evolve (Lee et al., 2015). This is why in a disaster-prone nation, extracting and exploring the personal and collective meanings of community wellbeing is a good way to understand the experiences of communities as they tried to make use of the window of opportunities to build a better community.

The Community Capitals Framework (Flora & Flora, 2013) revealed the interactions between different parts of a community. While the capitals were separated into seven separate categories, each of them were related with each of the other types. For this specific study, the community capitals were used as dimensions although human, social and cultural capitals are rolled into one dimension, the sociocultural capital. Human skills and knowledge together with the community sense were combined for the analysis.

Built capital was referring to the infrastructure in the community. It is considered as the delivery system of how other capitals can be utilized. It is a human-made environment and its strength is vitally important in determining the coping range of a population. Financial capital on the other hand is the economic wealth of the community. These are resources measured in terms of money. Communities that have high percentages of households with vehicle access, telephone access, and health insurance also can demonstrate higher levels of coping with the impact (Vincent, 2007) therefore might have a strong wellbeing.

The strength of an institution and its access to resources is what is meant by political capital. The sociocultural capital refers to the human labor with its skills and knowledge that enhances community trust, connection and cohesion. There is a strong link between demographic attributes to social capacity. A suggestion that communities with higher levels of educational equality, and those with lesser number of dependents and without disabilities, likely exhibit a strong level of wellbeing. Lastly, the natural capital refers to the natural environment which in the case of this study: the forest with its ecosystem services.

Validation and Screening of Selected Indicators. The third step is validation and screening of selected indicators. It is always difficult to measure CWB in absolute terms considering that wellbeing can be critically challenged as being subjective. The selection of variables as proxies of CWB in the aftermath of disaster was based on: 1) justification based on the literature with regard to relevance to CWB, and 2) the experts' knowledge and recommendations about the construct validity. With these two considerations, the initial list of indicators under each dimension was then decided.

However, further consideration was done in order to minimize the number of questions or indicators while still being able to provide an indication of relative CWB (Morton & Edwards, 2012). Guided by the law of parsimony, simplifying the list of assumptions but maintaining the greater explanation of the current construct was more helpful. Thus, the need for the sub-indicators to be examined for significantly high correlations between individual sub-indicators (e.g. Pearson's $r>0.70$). When such high correlations were found, related sub-indicators were eliminated (Vincent, 2007). Originally, there were more than 110 sub-indicators and was finally reduced to 62 for final consideration in the analysis (Table 3).

Normalization of Values. The fourth step was normalization. All raw data values were transformed into comparable scales of normalization. These forms of normalizations were essential to avoid problems when mixing measurement units. This study used a Min-Max rescaling scheme to normalize the variables (Yoon, 2012; OECD, 2008). Min-Max rescaling is a method in which each variable is decomposed into an identical range between zero and one (a score of 0 being the worst rank for a specific indicator and a score of 1 being the best). An indicator may have either a positive or negative influence on CWB.

Table 3. Final indicators and sub-indicators selected for constructing community wellbeing index (CWBí).

DIMENSION	INDICATORS	SUB-INDICATORS	EFFECT ON COMMUNITY WELL-BEING (+) or (-)
Built Capital	Road Infrastructure		
		Accessibility by road	+
		Duration of travel to be reached by GO or NGO from barangay hall	+
	Quality Evacuation Center		+
		Duration of travel to reach an evacuation center	+
		Evacuation center was available	+
		Evacuation center was livable	+
	Communication Infrastructure		
		Duration of time to reach a functional post office	+
		Duration of time to reach a working telephone	+
		Proportion of household that has access to internet	+
	Water & light infrastructure		
		Proportion of household that has electricity	+
		Proportion of household that has piped water	+
Financial Capital	Income stability		
		Aggregate Income (Income and subsidy)	+
		Proportion of household that has work/source of income even after the occurrence of disaster	+
		Proportion of household that has work/source of income before the occurrence of disaster	+
	Housing quality	House materials	+
		Age of houses	+
	No. of assets	Proportion of household that own any form of vehicle (Auto, motorcycle, bicycle, etc.)	+
		Proportion of household that has a telephone/ cellphone	+
		Proportion of household that has kitchen appliance	+
	House ownership	Proportion of household that own/inherit their house	+
		Proportion of household that own lot	+
	Credit support and insurance		
		Proportion of household that has members who have acquired insurance from current/past employer	+
		Proportion of household that has members who have directly purchased the insurance	+
		Availability of loans	+
Political Capital	Availability of Gov't and Non-Gov't aid		
		Proportion of household that are recipient of government & non-government subsidies	+
		Repaired public physical facilities within a month	+
		Conducted clearing activities within a month	+
		Provided assistance for crop insurance	+
		Monitored incidence of injury	+
		Continuous monitoring and assessment	+
	Disaster preparation and management		
		Emergency plans are known to all	+
		Communication protocol established	+

(Table 3 continued)

Provision of basic resources			
		Level of agreement: Financial assistance for house repair	+
		Provided livelihood assistance	+
	Availability of evacuation center		
		Provided an organized release of relief goods	+
		Accessibility of evacuation center for all	+
		Policemen were visible	+
		Evacuation was organized	+
		Health professionals were available	+
		Political Leaders were visible	+
Sociocultural	Household attributes		
		Household size	+
		Proportion of household that attend religious service	+
		Proportion of household that has members who got sick a year after the disaster	-
		Proportion of household that has member(s) with disability	-
		Age	+/-
		Educational attainment	+
	Organization membership		
		Proportion of household that has membership to an organization	+
		Proportion of household that participated in any disaster-related meetings	+
		Proportion of household that volunteered time in a barangay project related to health	+
		Level of trust: Businessmen	+
		Level of trust: Local government officials	+
		Sense of community	
		Level of trust: People from your own barangay	+
		Level of trust: Health workers	+
		Level of trust: NGO	+
		Peace condition: Barangay	+
		Length of stay/residency	+
	Emotional Connection		
		Talked with my family members	+
		I volunteered to help the authorities	+
		Formed plan of actions in my mind	+
		Availability of help from barangay/neighborhood	+
		Proportion of household that joined in the planning of barangay development programs	+
		Proportion of household that alerted newspaper, radio or tv about a local problem	+
Natural Capital	Ecosystem	% of forest cover to total land area	+

For indicators that have a positive influence or impact on CWB, equation 1 will be used as follows:

Equation 1 $$y = \frac{X_i - Min\{X_i\}}{Max\{X_i\} - Min\{X_i\}}$$

Where,

y	:	normalized value
Xi	:	value of the observation
Min{Xi}	:	minimum value for all observations
Max{Xi}	:	maximum value for all observations

On the other hand, having a negative influence on the CWB, equation 2 will be used:

Equation 2 $$y = \frac{Max\{X_i\} - X_i}{Max\{X_i\} - Min\{X_i\}}$$

Determining weights through Analytic Hierarchical Process (AHP). The fifth step was to obtain weights for each dimension and indicators using Analytic Hi-erarchical Process (AHP). AHP is a relative measurement that provides both the objective and subjective parts. The objectivity is reflected in its use of mathematical procedure, while the subjectivity is shown when personal or group judgement, in the derivation of weights is required (Saaty, 1987; Eakin & Tapia, 2008). The very essence of the analysis was to construct a matrix expressing the relative values of a set of attributes. In this study, the determination of weights for the indicators and dimensions of CWBi was based on the AHP calculation technique.

The AHP is based on pairwise comparisons of elements in the decision hierarchy with respect to the parent element at the next higher hierarchy level. For each level, a pairwise comparison matrix is generated to evaluate the relative importance of the elements within that level of the hierarchy.

Specifically, key informants (Table 2) from the different sectors of every site were asked about their judgements on which among those indicators and dimensions were much more important over the other. Judgement was given based on a scale of 1 to 9, with 1 being of equal importance and 9 of extreme importance. The odd values represented intermediate degrees of importance while the even values were considered when compromised had to be met. The process involved developing a pairwise comparison matrix, normalizing the resulting matrix, and averaging the values to get the estimated weights.

There were 10 combinations produced from 5 dimensions: B, F, Po, Sc, N= B-F, F-Po, B-Sc,B-N, F-Po, F-SC, F-N, Po-Sc, Po-N, Sc-N. The combination used was without replacement and without regard to order. The next consideration in using the derived weights with the AHP tech-nique was the calculation of a consistency ratio to check whether these weights were consistent. A Consistency Ratio (CR) of 0.10 or lower is acceptable and weights were therefore acceptable (Table 4). A higher value of 0.10 at any level demands a reassessment of the judgement. The degree of consistency was measured through the consistency ratio, CR, which is a proportion of the consistency index, CI of an n x n pairwise comparison matrix, with respect to the average consistency index of randomly generated n x n pairwise comparison matrices, or random index RI:

$$CR = \frac{CI}{RI}$$

where CI, which is the Consistency Index, is computed as follows:

$$CI = \frac{(\lambda - n)}{n-1}$$

where the average value of the consistency vector, and n is the total number of factors.

Table 4. Consistency ratio of dimensions and indicators in each dimension based on the informants' judgement.

SITES	CONSISTENCY RATIO					
	Dimension	Built	Financial	Political	Sociocultural	Natural
ALBAY	0.08	0.10	0.07	0.02	0.09	0
BOHOL	0.09	0.06	0.05	0	0.01	0
LEYTE	0.07	0.07	0.07	0.03	0.09	0

The Random Index (RI), is purely random judgement as shown in the Table 5 (Saaty, 1987). Therefore, if the dimension has 1 or 2 indicators, the RI value is 0. Table 3 shows 4 indicators included in built capital. Hence, the RI value to be used is 0.9.

Table 5. Constant value of RI. (Saaty, 1987)

No. of factors	1	2	3	4	5	6	7	8	9
Random index value	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45

<u>Additive Aggregation Methods</u>. The sixth and final step was the aggregation of weights of indicator and then finally the dimension to come up with the CWB i. The formula was used:

$$I_{ij} = \sum_{k}^{n_k} s_{ijk}$$

where s_{ijk} is the k^{th} sub-indicator data value under i^{th} dimension and j^{th} indicator; n_k total number of sub-indicators. Likewise to come up with the dimension value, the following formula was proposed:

$$D_i = \sum_{j}^{n_j} w_{I_i} I_{ij}$$

where I_{ij} is the j^{th} indicator data value under i^{th} dimension; w_{I_i} is the indicator weight under i^{th} dimension; n_j total number of indicators.

Trade-offs among indicators and sub-indicators were tolerable by having 1 as the highest value. A bad performance of one indicator or sub-indicator can be compensated by a good performance of another one.

Coming up with the Community Wellbeing Index (CWBi). After having considered the weighting process and ensuring the quality of the values of the data, Community Wellbeing index (CWBi) of an area under study was computed as follows:

$$CWBi = (B \cdot W_{d1}) + (F \cdot W_{d2}) + (Po \cdot W_{d3}) + (SC \cdot W_{d4}) + (N \cdot W_{d5})$$

where B is the built capital; F, the financial capital; Po, political capital; SC, sociocultural capital and N, the natural capital; W_{d1} to W_{d5} are weights of the five dimensions.

The CWB ivalues can then be compared to the interpretation of values in Table 6.

Table 6. Interpretation of CWB ivalues in the aftermath of a natural disaster.

CWB ivalues	Qualitative Category
0.81-1.00	Very strong
0.61-0.80	Strong
0.41-0.60	Moderate
0.21-0.40	Weak
0.00-0.20	Very weak

A CWB ivalue of 0.625 means that the level of CWB in the area visited by a disaster remains strong, despite the pressures brought by the terrifying event. On the other hand, a CWB ivalue of 0.20 indicates a very weak CWB. The LGU, therefore has to closely examine the various indicators and decipher which dimension needs urgent attention in order to raise the level of CWBi.

CONCLUSION AND RECOMMENDATIONS

This paper provided the first-attempt in developing replicable and robust baseline indicators for measuring and monitoring community wellbeing. Once established, the community wellbeing indicators provide a useful way to examine not only the composite score to pinpoint which indicator needs to be attended to and enhanced to increase WCB.

CWB is a multidimensional concept. Elaborating its nature can help understand why people act the way they do especially in the aftermath of disaster. Providing metrics that are easy to understand, monitor, will enhance decision making process.

Developing better measures of wellbeing and progress is an international goal. The pro-posed equation in this study should be used and at the same time has to be evaluated for further improvement. The inclusion or deletion of appropriate indicators may be done as the need arises for community capitals to be enhanced and hence, the CWB.

The stability of a country cannot be measured in terms of GDP alone. It can be measured in terms of CWB as well. CWB gives a picture of the level of stability, security and trust among in-dividual members of the community.

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STATEMENT OF AUTHORSHIP

The first author conceptualized theoretical framework, identified key informants and undertook the writing up. The second and the third authors suggested important points in the choice of the cases and the key informants. While the fourth and fifth authors helped in the discussion of the theories.

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