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Adaptive Capacity Index of Public Schools in the Municipalities of Bay and Los Baños, Laguna Philippines

ABSTRACT

An instrument to measure School Adaptive Capacity Index was developed using livelihood assets and school management as the main determinants using the theory driven approach to indicator development. Randomly selected teachers from the 38 public elementary and high schools from Bay and Los Baños Laguna, grouped according to the effects of floods experienced, were interviewed. It was found that the schools in general were highly adaptive. High schools have better human and physical assets than elementary schools, while non-flooded schools have better natural assets than flooded schools. SACI of high schools were significantly higher than elementary schools. On the other hand, flooded and non flooded schools have more or less the same SACI. School management and social assets were vital in increasing the adaptive capacity of schools in the different groups. Scores in a particular asset may vary between groups and within each group implying that there is no uniform approach to improving the adaptive capacity and that interventions should always consider the uniqueness among each of these schools. The instrument developed is highly recommended to assess the institutional adaptive capacities of other schools to floods.

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INTRODUCTION

The Philippines is among the most vulnerable countries to climate change (*Yusuf and Francisco 2010; Maplecroft 2010; Alave 2011*). Floods have become disastrous due to its magnitude and the failure of communities to cope with its physical and socio-economic impacts (*Eleazar 2011*). Heavy siltation of the Laguna Lake, the proliferation of settlements and uncontrolled developments in flood prone areas and natural waterways, and the accumulation of wastes have exacerbated flooding along the lakeshore communities and its river tributaries (*LLDA 2009*).

Floods as well as the conversion of both flooded and non flooded schools to evacuation centers damaged school buildings and materials, have displaced students and teachers, and disrupted normal school operations (*World Bank 2011; UNICEF 2009; Aljazeera-Asia Pacific 2012*). These impacts are common in the municipalities of Los Baños and Bay and other flood prone municipalities and cities of the province of Laguna, Philippines.

The way the system adapts to hazards is determined by its adaptive capacity or its ability to adjust in order to cope with stresses (*Brooks and Adger 2005*). Assessing the adaptive capacity of schools involves the identification of its strengths and weaknesses which may subsequently be followed by interventions to enhance such ability. Improving the school's adaptive capacity reduces vulnerabilities to climate related hazards like floods.

The *United Nations Development Program* (*ND*) in an article entitled "Sustainable Livelihoods: Concepts, Principles and Approaches to Indicator Development" stated that assessing adaptive capacity requires the identification of indicators that serve as tools to measure the performance of a system relative to its goal and should be both accurate and meaningful. Indicators of adaptive capacity therefore, are information or data that can be used to measure the performance of a system to adapt to hazards or stresses.

Development of indicators to assess vulnerability and adaptive capacity may be data-driven which involves the identification of a wide range of indicators and selecting those indicators having statistically significant relationship with vulnerability. Another approach is theory-driven approach which puts forward hypothesized relationships based on existing theory or conceptual framework or empirical observation and selecting indicators based on these assumed relationships (*Adger et al. 2004; Vincent 2007; Vincent and Cull 2010*).

Central to the Sustainable Livelihood Framework are the livelihood assets that can be used to pursue different livelihood strategies. The framework suggests that those having more assets are more likely to have greater options to pursue their goals and reduce poverty (*Allison and Horemans 2006; Haidar 2009*). It is with the same premise that having more human, social, natural, physical and financial assets will enable schools to employ different strategies making them more adaptable to floods and other climate related hazards. Hence, these livelihood assets were used as the determinants of SACI.

School management pertains to how the school head and his management team put plans into action and the actual day-to-day running of the school. Management of the different assets plays an important role in developing adaptive capacity of schools. Hence, school management was considered as the sixth determinant to assess SACI (*Equal Education 2011*).

The study aimed to determine the adaptive capacities to floods of public elementary and high schools using an instrument to measure the School Adaptive Capacity Index (SACI) based on the Sustainable Livelihood Framework. The specific objectives were to assess the SACI to floods of the 38 public schools in the two municipalities; compare the SACI of public elementary and high schools and the three different school groups; and compare the asset scores and SACI of the different schools belonging to each school group. The overall adaptive capacity and the ratings in the composite indices of the determinants of adaptability show the strengths and weaknesses of each school which could serve as basis to improve their overall adaptive potential.

METHODOLOGY

The study area

The study was done in the adjacent municipalities of Los Baños and Bay in the province of Laguna, Philippines, which is located immediately south of Metro Manila. Los Baños is geographically located 14º10'37.98' N and 121º13'18.83"E while Bay is located 14º 10'50.79" N and 121º 17' 5.39" E. These municipalities are bounded on the north by the Laguna Lake, on the west by Calamba City, to the east by the municipality of Calauan and on the south by Sto. Tomas, Batangas (**Figure 1**).

Large areas of these two municipalities fall within the watersheds of Mt. Makiling. Four major rivers of the Makiling watershed pass through the municipality of Los Baños while three traverse the area of Bay before draining to the Laguna Lake. Los Baños is classified as a first class while Bay is a second class municipality, with the latter being more dependent on farming and fishing for their livelihood. (*Updated Fact Sheet of the Municipality of Bay, Laguna 2011; Socio-economic and Physical Profile of the Municipality of Los Baños, Laguna 2010*).

Schools Under Study

All of the 38 public schools in Bay and Los Baños were included in the study. These include 27 public elementary schools and 11 public high schools. All the public elementary schools are administered by Department of Education (DepEd). Eight public high schools are administered by DepEd, two are run by State Colleges and Universities (SUCs) and the other is a special attached high school to DepEd. Codes were assigned to each school. These schools were grouped according to their level, separating elementary from high schools. Each level was further classified into three groups described as follows:

Group A- Flooded schools. These are schools whose buildings, other facilities and immediate vicinity were flooded during previous flood events causing harm or difficulty to students, damage to school property, have resulted to cancellation or disruption of classes or have impeded the access of students and teachers to their school thereby causing considerable impacts on the education of children. Elementary schools included in the group are BSES, BayCES, KES, MalES, MayES, PRES-Bay, PuyES, SAES-Bay, SIsidES, SDomES, TadES and TagES. High Schools included are LSPU-HS, NGMNHS and UPRHS.

Group B- Non-flooded but affected. These are schools that were not flooded but were used as evacuation centers or have shared its facilities with other schools that were flooded or were displaced by flood events, or have considerable number of students or teachers that were affected by flood thereby causing considerable impacts on education.BamES, BayogES, BNCalES, Calo ES, LalES, LopES, LBCES, MaaES, MaiES, PRES-LB and SAES-LB. High schools belonging in the group are LaSciNHS, LBCNHS, LBIS, LBNHS, MNHS and TPNHS.

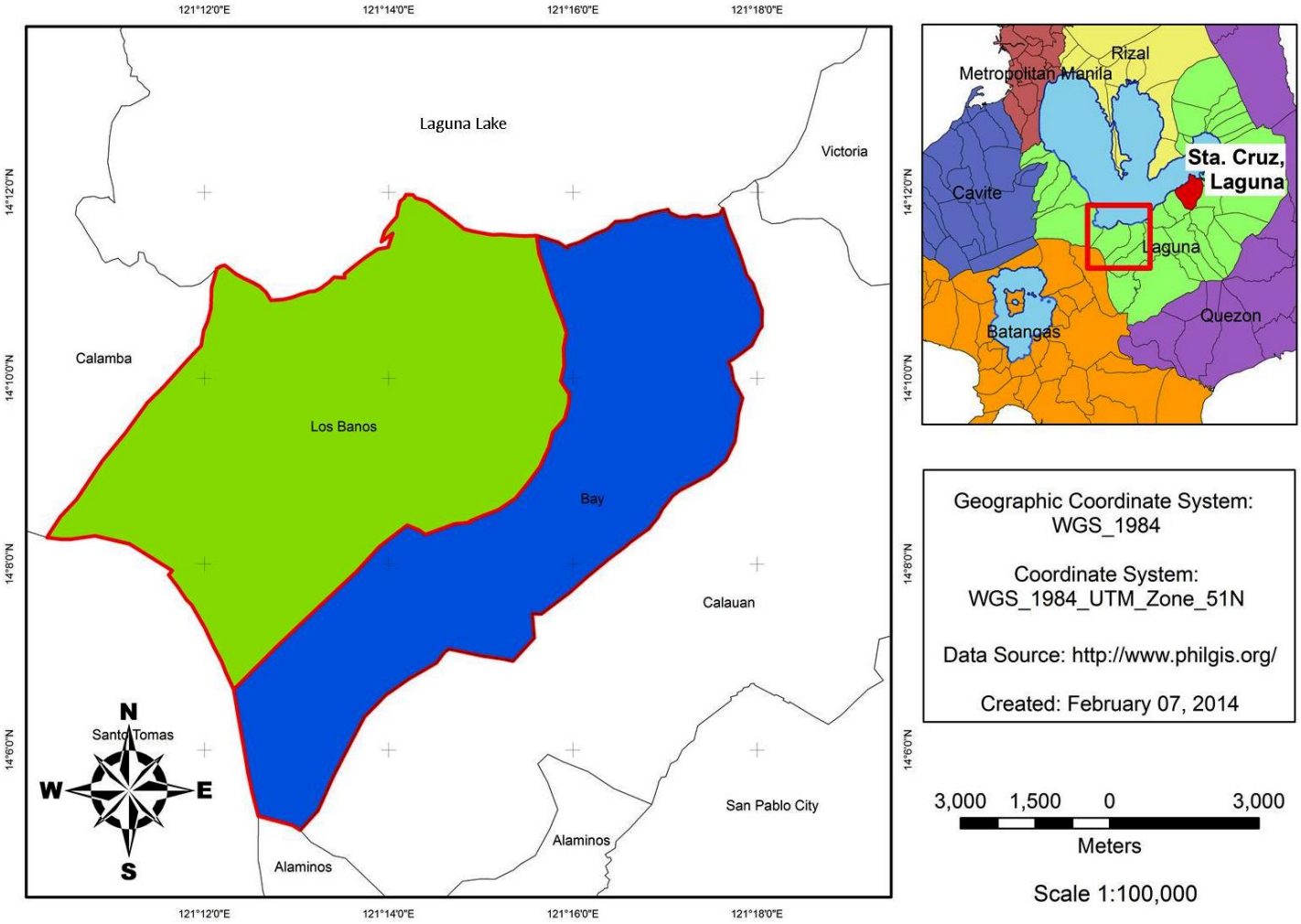

Figure 1. Location Map of Municipalities of Los Baños and Bay.

Group C- Non-flooded least affected. These are schools that were not flooded during the previous events, not used as evacuation centers and did not accommodate other schools that were flooded or displaced by floods. Very few of its teachers' and students' families may have been affected by floods thereby causing minimal effects on the education. BitES, MasES SCruzES and TranES. The two high schools under this group are BNHS and PHSA.

Research Design

Survey was used to determine the adaptive capacity index of the schools under study. Cross-sectional survey was employed through personal interviews of the respondents using a structured questionnaire.

Sampling Method

The 38 schools were stratified into three groups (A, B and C) differentiating between elementary and high school. An equal number of respondents were chosen from each of the schools due to very few teachers in some schools. Four teachers were randomly selected from among those who were qualified to serve as respondents. Considered qualified respondents were teachers who have been in active service during the occurrence of flood events in their school. An additional respondent was included for schools in each strata with the most number of teachers, for a total of 157, representing 20% of the 779 public school teachers in the two municipalities who were still in active service in the same school when the most recent flood in 2012 occurred (**Table 1**).

Instrument to measure SACI

The theory driven approach was used to develop an instrument to measure SACI using the categories of livelihood assets in the Sustainable Livelihood Framework which are: human, social, physical, natural, and financial assets as the major determinants. School management served as sixth determinant.

Human assets pertained to qualities, traits or conditions that can enhance or limit the ability of teachers and students and the school in general to perform their task and to respond to flood hazards. These included the age of the students (H-1); teachers' proficiency on flood hazards (H-2); (3) teachers' willingness to adopt new ideas and innovations; and, class size (H-4). The social assets of schools were assessed based on the quality of assistance provided by service institutions to the school (S-1); the range and scope of the school's linkages (S-2); the participation of the school community in collective efforts organized by the school (S-3); and equality in access to school resources and services (H-4).

Natural assets of schools included the presence of natural risk factors (N-1); the state of land and water resources (N-2); nearness of the school to emergency and safety facilities (N-3); and, the dependence of households on natural resources for their livelihood (N-4). Physical indicators of adaptive capacities of schools were assessed based on the durability of school buildings (P-1); buildings having elevated classroom or rooms on upper storey (P-2); number of means to access information and communication (P-3); the presence of alternative facilities for school operation (P-4); and, the quality of service provided by basic utilities (P-5).

The financial assets of schools was measured in terms of sufficiency of budget allocated for school operations and emergencies (F-1); availability of other sources of funds for emergency needs (F-2); capability of families to cover emergency expenses of their children (F-3); and, the provision of insurance coverage both personal and non personal (F-4). The level of flexibility given in handling academic and emergency procedures (SM-1); the integrity of school administration in handling financial and material resources (SM-2); the priority given for the improvement of personnel's knowledge and skills on Climate Change Adaptation (CCA) and Disaster Risk Management (DRM) (SM-3); and, the level of integration of CCA and DRM in the curriculum (SM-4) were the indicators used to assess school management aspect of the SACI. This study presented the indicators for each determinant, the scale used and the hypothesized relationship of the indicator with the school adaptive capacity (**Table 2**).

Data gathering

Permission to hold the study and endorsements letters were obtained from the Schools Division Superintendent of the province of Laguna and from the District Supervisors of Los Baños and Bay. Preliminary interviews were conducted to classify the schools into different groups based on the specific conditions experienced. These were determined by the school heads or their assigned representative. The groupings were further verified during the actual survey.

Survey of teachers was carried out simultaneously in each school by four enumerators trained by the researcher. Responses in the assessment of SACI were confirmed using available records or were verified through their respective school heads as needed. The survey was conducted from June to October, 2013.

Data Analysis

Data derived from the survey were encoded and analyzed using the Statistical Package for the Social Sciences (SPSS Version-2.0) software. Ratings of SACI obtained from the survey with teachers were combination of ordinal, interval, and ratio scale values. Since there was no uniformity in the scale and in the level of scores for the different indicators, all the scores obtained from the respondents were rescaled to a range of 0 to 1. using the normalization procedure of the United Nations Development Program (UNDP) applied in determining the Human Development Index (*Swanson et al. 2007*) shown below.

Modified Normalization Equations for UNDP HDI:

Equation 1. For indicators where higher obtained values are better

$$\text{Rescaled Value} = \frac{\text{Obtained Value} - \text{minimum value for the indicator}}{\text{Maximum value for the indicator} - \text{minimum value for the indicator}}$$

Table 1. Number of schools and teacher respondents in each school group.

Level	School Classification									Total		
	Group A			Group B			Group C					
	No. of Schools	F	%	No. of Schools	F	%	No. of Schools	F	%	No. of Schools	F	%
Elementary	12	48	43.6	11	45	40.9	4	17	15.5	27	110	70.9
High School	3	13	27.7	6	25	53.2	2	9	19.1	11	47	29.1
All Levels	15	61	38.8	17	70	44.6	6	26	16.6	38	157	100

Group A- Flooded; Group B- Non-flooded but affected; Group C- Non-flooded least affected; F- Frequency

Table 2. Description of indicators for each determinant, the scale of measurement used and the hypothesized relationship to the School Adaptive Capacity.

Determinants of SACI	Description and Code Used for Indicator	Scale Used	Hypothesized Relation
Human Assets	Age group of students (H-1)	Ordinal: 4 level	(+)
	Teacher's personal evaluation of their proficiency on CCA and DRM (H-2)	Ordinal: 4 level	(+)
	Teacher's personal evaluation of their willingness to adopt new ideas and innovations (H-3)	Ordinal: 4 level	(+)
	Class size or the average number students in a class assigned to the teacher-based on school records (H-4)	Ratio Actual number	(-)
Social Assets	Assessment of quality of assistance rendered by emergency service institutions (S-1)	Ordinal:4 level	(+)
	Teacher's assessment of the schools linkages and networks (S-2)	Ordinal:4 level	(+)
	Assessment of participation of school community in collective action organized by school (S-3)	Ordinal:4 levels	(+)
	Assessment of equality among all personnel and students in the access to resources and services (S-4)	Ordinal:Yes/No	(+)
Natural Assets	Presence of possible risk factors to floods (N-1)	Ordinal:Yes/No	(-)
	Description of the condition of land and water resources affecting the area (N-2)	Ordinal:4 level	(+)
	Distance of the school to emergency or safety facilities- obtained through Google Earth (N-3)	Ratio: Estimated distance to nearest facility	(-)
	Assessment of the dependence of families on natural resources for their livelihood (N-4)	Ordinal:4 level	(-)
Physical Assets	Description of the durability of school buildings (P-1)	Ordinal:4 level	(+)
	Percentage of rooms elevated or on upper storeys/floors (P-2)	Ratio:Percent	(+)
	Number of ways the school can access information and communication (P-3)	Interval:Number	(+)
	Presence of alternative venues for school operations (P-4)	Ordinal:Yes/No	(+)
	Description of the quality of services provided by basic utilities (P-5)	Ordinal: 4 level	(+)
Financial Assets	Assessment of sufficiency of allocated budget for school operations (F-1)	Ordinal:4 level	(+)
	Availability of other source of funds for emergency purposes (F-2)	Ordinal:Yes/No	(+)
	Assessment of capability of families to shoulder emergency needs of students (F-3)	Ordinal:4 level	(+)
	Provision of insurance (for students, staff and infrastructure) in case of emergency or disasters (F-4)	Ratio: Percent of students, staff and structures insured	(+)
School Management	Assessment of flexibility given to school administrator and teachers (SM-1)	Ordinal:4 level	(+)
	Integrity of school administration in handling financial and material resources (SM-2)	Ordinal:3 level	(+)
	Priority given to programs to improve skills of personnel on CCA and DRM (SM-3)	Ordinal:4 level	(+)
	Extent of integrating environmental concepts, climate change and disaster risk management in the curricula (SM-4)	Ordinal:4 level	(+)

Equation 2. For indicators where lower obtained values are better

$$\text{Rescaled Value} = 1 - \frac{(\text{Obtained Value} - \text{minimum value for the indicator})}{\text{Maximum value for the indicators} - \text{minimum value for the indicator}}$$

The average of all the rescaled indicator scores for all the respondents in each school were computed to get the indicator value for the school. The indicators under each determinant were given equal weight. Being equally important, the average of the different indicators under each determinant were computed to get the determinant value. Again, assuming equal importance in each of the determinants, the average of all the determinant scores were likewise computed to obtain the overall SACI for the particular school (procedure adopted with modifications from *Peñalba and Elazegui 2011*).

The scale used by *Yusuf and Francisco* (*2010*) for determining the adaptive capacity of different provinces of ASEAN countries based on socio-economic factors, technology and infrastructure was modified (**Table 3**). This served as the basis for classifying the overall SACI and the performance in each of the main determinants and the indicators for each school.

Mean scores in each of the assets and in the SACI scores were compared between elementary and high schools using the Independent Samples t-test. The Mann-Whitney, a non-parametric test was used when the assumptions of the Independent Samples t-test were violated as determined by the Shapiro-Wilk Test for normality of data and the Levene's Test for homogeneity of variances.

One-way Analysis of Variance (ANOVA) was used to determine significant differences in mean scores and in each of the determinants and the mean SACI scores between the three different school groups. Post hoc analysis using Tukey's HSD was done as needed, to further determine which of the means are significantly different from each other. The Kruskal Wallis, a non-parametric test was resorted to whenever the assumptions of ANOVA were violated as determined by the abovementioned tests for normality of data and equality of variances.

The performance of each school in the six school assets that ascertain SACI were determined using radar or spider web charts (*Mosley and Mayer 1998*). Each of the axes of the SACI hexagon formed represents the ratings for each of the determinants of adaptive capacity with the zero point at the center of the figure. The higher the rating in each of the determinants, the farther the point reaches from the center of the graph. The bigger the area of the inner hexagon formed by connecting the ratings on each of the axes, the higher is the adaptive capacity of the school. The use of such analysis provided a simple representation of the assets of each school and their adaptive capacity to floods. The SACI hexagons of all the schools belonging to the same group were presented side by side to compare the assets of each schools and their adaptive capacity.

RESULTS AND DISCUSSION

Asset Scores and Overall SACI of Schools

The average SACI of all the 38 schools was 0.655 (**Table 4**). The schools in general got high mean scores in school management (0.778) and social assets (0.774). Lowest mean ratings were on physical and human assets which were 0.565 and 0.574, respectively. This value is lower than the adaptive capacity of the whole province which was 0.74 obtained in a previous study (*Yusuf and Francisco 2010*). Laguna was the ninth highest rank among the provinces in the country. The reason for the lower SACI in the present study may be because these are public schools that cater mostly to the education needs of children from poor families except for non-DepEd administered high schools such as UPRHS, LSPU-HS and PHSA and LaSciNHS,. These schools admit highly selected students

Table 3. Scale for classifying School Adaptive Capacity Index.

Range of Adaptive Capacity Index (*Yusuf and Francisco 2010*)	**Range of School Adative Capacity Index** (present study)	**Classification**
0.22- 0.38 0.39- 0.46 0.47- 0.49	0.000- 0.499	*Low adaptability*
0.50- 0.54 0.55- 0.57 0.58- 0.63	0.500- 0.639	*Moderate adaptability*
0.64- 0.69 0.70- 0.81 0.82-1.00	0.640- 1.000	*High Adaptability*

Table 4. Assets and School Adaptive Capacity Index scores by the schools.

School Code	Human Asset	Social Asset	Natural Asset	Physical Asset	Financial Asset	School Management	SACI
BSES	0.577	0.806	0.578	0.233	0.580	0.750	0.587
BamES	0.510	0.729	0.604	0.564	0.625	0.750	0.630
BayCES	0.532	0.854	0.517	0.586	0.635	0.875	0.667
BayogES	0.470	0.875	0.601	0.567	0.801	0.875	0.698
BNCalES	0.478	0.802	0.804	0.508	0.692	0.792	0.679
BitES	0.512	0.775	0.788	0.663	0.604	0.883	0.704
BNHS	0.782	0.883	0.722	0.480	0.193	0.817	0.646
CaloES	0.542	0.813	0.623	0.610	0.605	0.854	0.675
KES	0.466	0.688	0.415	0.536	0.343	0.792	0.540
LSNHS	0.790	0.781	0.621	0.726	0.750	0.698	0.728
LalES	0.460	0.615	0.561	0.479	0.673	0.896	0.614
LopES	0.544	0.708	0.628	0.491	0.841	0.650	0.644
LBCES	0.541	0.938	0.747	0.651	0.801	0.833	0.752
LBCNHS	0.736	0.875	0.777	0.755	0.708	0.833	0.781
LBIS	0.639	0.615	0.497	0.408	0.576	0.750	0.581
LBNHS	0.749	0.750	0.758	0.584	0.651	0.642	0.689
LSPU-HS	0.921	0.719	0.450	0.750	0.813	0.760	0.735
MaaES	0.476	0.802	0.603	0.463	0.694	0.865	0.650
MaiES	0.466	0.771	0.416	0.525	0.453	0.708	0.557
MalES	0.416	0.698	0.437	0.550	0.694	0.823	0.603
MasES	0.506	0.615	0.602	0.512	0.604	0.760	0.600
MNHS	0.695	0.573	0.665	0.483	0.701	0.667	0.631
MayES	0.441	0.692	0.691	0.522	0.691	0.725	0.627
NGMNHS	0.765	0.808	0.372	0.670	0.574	0.917	0.684
PRES-Bay	0.446	0.615	0.637	0.632	0.502	0.625	0.576
PRES-LB	0.403	0.865	0.663	0.572	0.750	0.781	0.672
PHSA	0.845	0.833	0.542	0.767	0.979	0.833	0.800
PuyES	0.451	0.771	0.491	0.466	0.468	0.792	0.573
SAES-Bay	0.534	0.875	0.494	0.448	0.631	0.771	0.625
SAES-LB	0.496	0.844	0.804	0.608	0.799	0.781	0.722
SIsidES	0.534	0.885	0.394	0.425	0.570	0.802	0.602
ScruzES	0.491	0.688	0.687	0.617	0.671	0.833	0.664
SDomES	0.500	0.552	0.562	0.458	0.493	0.719	0.547
TadES	0.598	0.823	0.394	0.583	0.499	0.938	0.639
TagES	0.634	0.958	0.375	0.583	0.551	0.938	0.673
TranES	0.463	0.781	0.644	0.600	0.536	0.719	0.624
T-PNHS	0.674	0.813	0.663	0.613	0.563	0.698	0.670
UPRHS	0.743	0.917	0.707	0.776	0.917	0.781	0.807
Mean	**0.574**	**0.774**	**0.593**	**0.565**	**0.638**	**0.788**	**0.655**

that may come from families with better economic status.

Classification of SACI

The mean SACI of 0.655 for the 38 schools fall within the high adaptive capacity range based on the scale used (**Table 5**) which implies that public schools in the two municipalities are generally capable of adapting to floods better than other public schools in less adaptive provinces in the country. Twenty-one were considered highly adaptable while 17 were considered moderately adaptable. Nine out of 11 (81.8%) high schools and 12 out of 27 (44.4%) elementary schools are highly adaptive. Mean SACI scores of the three high school groups were consistently higher than their counterparts in the elementary level. This means that high schools in the two municipalities are more adaptive than the elementary schools.

Two out of 12 (16.7%), eight out of 11(72.7%) and two out of four (50%) elementary schools were highly adaptable from Group A, B and C, respectively. In addition, mean SACI scores of Group B schools were also highest followed by Group C and Group A in the same level at 0.663, 0.648 and 0.605, respectively. This suggests that non-flooded but affected elementary schools are most adaptive, followed by non-flooded least affected and least adaptive are flooded schools in the same level.

Table 5. Summary of SACI and adaptability of public schools in the study area.

School Level and Group	Number	Mean SACI Scores	SD	Adaptability		
				Low	Moderate	High
Elementary						
Group A	12	0.605	0.043	0	10	2
Group B	11	0.663	0.053	0	3	8
Group C	4	0.648	0.046	0	2	2
Total	27			0	15	12
High School						
Group A	3	0.742	0.061	0	0	3
Group B	6	0.680	0.071	0	2	4
Group C	2	0.723	0.109	0	0	2
Total	11			0	2	9
OVERALL	**38**	**0.655**	**0.067**	**0**	**17**	**21**

Group A- Flooded; Group B- Non-flooded but affected; Group C-Non-flooded least affected

At the high school level, all schools from Group A and Group C were considered highly adaptive against only two-thirds of the schools under Group B. Mean SACI scores of Group A schools were highest at 0.742 followed by Group C at 0.723, and the least was obtained by Group B at 0.680. Contrary to the results at the elementary level, flooded schools at the high school level seem to be the most adaptive, followed by non-flooded least affected schools, then lastly by non-flooded but affected schools as the least adaptive.

Comparison of Assets and SACI between School Levels and School Groups

Comparison of the Assets between School Level and School Group. High schools have very highly significantly higher mean scores in human assets (0.758 ±0.079) than elementary schools (0.500 ±0.054). High schools received higher scores in age (H-1) since students are older, less dependent on adults and could adapt better to hazards than elementary students (*Save the Children n.d.*). High school teachers are also more proficient in CCA and DRM (H-2) than elementary teachers particularly in flooded and non-flooded least affected schools (**Table 6**).

Mann-Whitney Test showed that mean rank of high schools (25.91) in physical assets is significantly higher than that of elementary schools (16.89). This is because high schools have more classrooms that are elevated (P-2) or on upper levels (**Table 6**). Elevated classrooms can still be used for classes or for keeping equipment, supplies, records and instructional materials to avoid damage during floods. Most of the high school buildings have second floors since students are more mature and less prone to accidents. Most high schools administered by DepEd also have two-storey buildings in order to have more classrooms in a limited land area due to large student population. Furthermore, high schools have more means of receiving information and communications (P-3) especially through the internet probably since these are more frequently used as part of their school work. Greater access to information and communication leads to timely and appropriate response to hazards (*Swanson et al. 2007*).

There were significant differences in the mean scores among school groups in natural assets. Mean scores of Group B (0.649 ± 0.106) and Group C 0.(664 ± 0.088) were highly significantly higher than the mean scores of Group A (0.501 ± 0.112). Post-hoc analysis using Tukey HSD showed highly significant differences between Group A and B (mean difference of - 0.148), highly significant between Group A and C (mean difference of -0.163) but not between Group B and C (mean difference of -0.015). Hence, natural assets of the two non-flooded school groups which are more or less equal are significantly better than natural assets of flooded schools.

Flooded schools are exposed to natural risks factors because these are located in lakeshore areas with major river tributaries (N-1), while non-flooded schools in general, are located in areas that are safer from floods (**Table 6**). The poor condition of land and water resources in the area (N-2) have also contributed to the lower scores in natural assets of flooded schools.

Comparison of Mean SACI Scores between School Level and Group. the Mann-Whitney test showed that the mean SACI rank of high schools (27.18) is highly significantly higher than elementary schools (16.37). The higher SACI in high schools may be due to better human assets (more mature students) and physical assets (more elevated classroom, means of receiving information and communication) among high schools compared to elementary schools. Kruskal-Wallis Test on the other hand, failed to show significant

Table 6. Summary of school group ratings in the different indicators of School Adaptive Capacity Index.

Level-Goup	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
	H-1		**H-2**		**H-3**		**H-4**			
E- A	0.000	0.000	0.573	0.180	0.929	0.098	0.541	0.125		
E- B	0.000	0.000	0.573	0.112	0.900	0.109	0.486	0.068		
E- C	0,.000	0.000	0.556	0.066	0.906	0.120	0.509	0.061		
HS- A	1.000	0.000	0.808	0.188	0.925	0.066	0.506	0.163		
HS- B	1.000	0.000	0.533	0.138	0.900	0.050	0.422	0.075		
HS- C	1.000	0.000	0.663	0.053	1.000	0.000	0.591	0.230		
	S-1		**S-2**		**S-3**		**S-4**			
E- A	0.725	0.301	0.902	0.143	0.779	0.143	0.777	0.208		
E- B	0.720	0.224	0.861	0.206	0.824	0.200	0.789	0.263		
E- C	0.646	0.163	0.938	0.125	0.821	0.184	0.792	0.160		
HS- A	0.794	0.274	0.833	0.243	0.761	0.167	0.889	0.091		
HS- B	0.722	0.152	0.867	0.177	0.653	0.207	0.617	0.299		
HS- C	0.742	0.389	1.000	0.000	0.775	0.232	0.783	0.171		
	F-1		**F-2**		**F-3**		**F-4**			
E- A	0.389	0.000	1.000	0.000	0.456	0.210	0.464	0.378		
E- B	0.758	0.000	1.000	0.000	0.506	0.158	0.464	0.323		
E- C	0.667	0.000	1.000	0.000	0.513	0.135	0.165	0.130		
HS- A	0.889	0.000	1.000	0.000	0.639	0.217	0.713	0.483		
HS- B	0.722	0.000	1.000	0.000	0.544	0.260	0.282	0.311		
HS- C	0.500	0.000	0.500	0.000	0.692	0.232	0.607	0.556		
	N-1		**N-2**		**N-3**		**N-4**			
E- A	0.140	0.184	0.579	0.182	0.977	0.000	0.299	0.220		
E- B	0.486	0.330	0.614	0.137	0.957	0.000	0.508	0.280		
E- C	0.750	0.394	0.683	0.173	0.951	0.000	0.338	0.228		
HS- A	0.083	0.167	0.494	0.105	0.899	0.000	0.561	0.199		
HS- B	0.708	0.346	0.586	0.230	0.934	0.000	0.425	0.308		
HS- C	0.750	0.289	0.758	0.158	0.410	0.000	0.608	0.232		
	SM-1		**SM-2**		**SM-3**		**SM-4**			
E- A	0.673	0.221	0.745	0.271	0.708	0.223	0.946	0.087		
E- B	0.667	0.251	0.716	0.284	0.844	0.155	0.959	0.086		
E- C	0.588	0.127	0.438	0.373	0.833	0.131	1.000	0.000		
HS- A	0.639	0.167	0.925	0.158	0.861	0.134	0.833	0.192		
HS- B	0.600	0.153	0.621	0.297	0.800	0.163	0.917	0.167		
HS- C	0.733	0.091	0.900	0.137	0.925	0.158	0.875	0.250		
	P-1		**P-2**		**P-3**		**P-4**		**P-5**	
E- A	0.719	0.188	0.175	0.000	0.423	0.186	0.346	0.398	0.847	0.000
E- B	0.721	0.168	0.218	0.000	0.389	0.201	0.523	0.437	0.894	0.000
E- C	0.729	0.158	0.186	0.000	0.529	0.121	0.713	0.406	0.833	0.000
HS- A	0.750	0.198	0.558	0.000	0.694	0.184	0.767	0.342	0.889	0.000
HS- B	0.697	0.172	0.292	0.000	0.517	0.186	0.608	0.341	0.861	0.000
HS- C	0.900	0.091	0.567	0.000	0.658	0.188	0.325	0.524	0.667	0.000

E- Elementary; HS- High School; A- Flooded schools; B- non-flooded but affected schools; C- non- flooded least affected schools

difference among the three school groups.

Comparison of Asset and SACI Scores in each School Group

Radar graph analysis of flooded elementary schools. School management and social assets were relatively high in majority of the 12 flooded elementary schools (**Figure 2**).

Seven schools got moderate scores in human asset, namely: BSES, BayCES, SAES-Bay, SIsidES, SDomES, TadES and TagES. Low scores were obtained by KES, MalES, MayES, PRES-Bay and PuyES. Aside from having low scores in age of students (H-1), the five schools alsoincurred low scores in the proficiency of teachers in CCA and DRM (H-2). MayES and MalES also obtained low scores in class size (H-4) (**Table 7**). TagES scored highest (0.634)

while MalES scored the lowest (0.416) in human assets.

MayES scored high (0.691) in natural assets whereas BSES, BayCES, PRES-Bay and SDomES obtained moderate scores (Fig. 2). Meanwhile, KES, MalES, PuyES, SAES-Bay, SIsidES, TadES and TagES obtained low scores with TagES scoring the lowest at 0.375. Table 7 shows that low scores in natural assets were due to exposure to natural flood-risk factors (N-1) coupled with families that were highly dependent on natural resources for their livelihood (N-4) in most of these schools.

Highest score of 0.632 in physical assets was obtained by PRES-Bay while BSES got the lowest score at 0.233 (**Figure 2**). Five schools (BSES, PuyES, SAES-Bay, SIsidES and SDomES got low while the rest got moderate scores. Low physical assets in the five schools were mostly due to few elevated classrooms (P-2), less means of receiving information and communication (P-3) and lack of alternative venues to hold classes during floods (P-4).

Financial assets were high in MalES and MayES; moderate in BSES, BayCES, SAES-Bay, SIsidES and TagES; and low in KES, PuyES, SDomES and TadES (**Figure 2**). Flooded elementary schools with high financial assets mostly come from Los Baños which is a First Class municipality. The highest score of 0.694 in this asset was in MalES while the least was in KES at 0.343. The four schools with low financial assets have insufficient budget for school operations (F-1) and families that were incapable

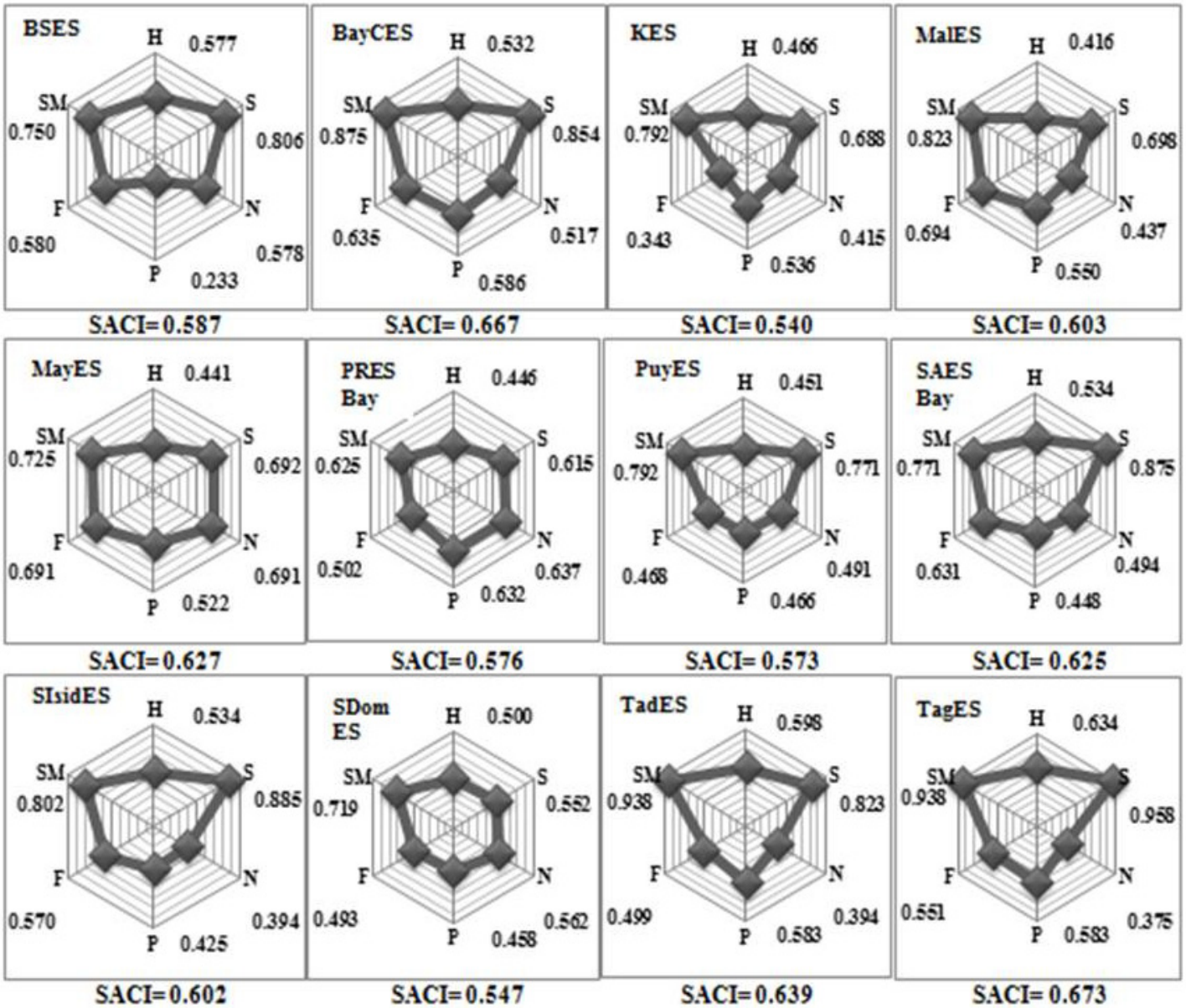

Figure 2. Radar graphs of flooded elementary schools. (Determinants: H- Human Assets, S- Social Assets, N-Natural Assets, P-Physical Assets, F-Financial Assets and SM- School Management).

Table 7. Ratings of schools in selected indicators of School Adaptive Capacity Index.

School	Indicator Scores												
	H1	**H2**	**H4**	**N1**	**N2**	**N4**	**P2**	**P3**	**P4**	**F1**	**F2**	**F3**	**F4**
	Flooded Elementary School												
BSES	.000	.500	.810	.333	1.00	.000	.000	.278	.000	.000	1.00	.667	.654
BayCES	.000	.625	.504	.000	.667	.417	.222	.708	.250	.667	1.00	.583	.290
KES	.000	.375	.615	.000	.417	.333	.182	.417	.500	.000	1.00	.250	.122
MalES	.000	.375	.413	.000	.500	.250	.333	.417	.250	.667	1.00	.500	.610
MayES	.000	.500	.365	.600	.533	.667	.174	.467	.400	.667	1.00	.467	.629
PRES- Bay	.000	.500	.536	.500	.833	.250	.200	.375	1.00	.333	1.00	.417	.258
PuyES	.000	.500	.556	.250	.583	.167	.286	.375	.250	.333	1.00	.333	.206
SAES- Bay	.000	.750	.385	.000	.500	.500	.117	.542	.000	.667	1.00	.583	.274
SIsidES	.000	.500	.635	.000	.500	.083	.000	.375	.250	.333	1.00	.583	.362
SDomES	.000	.500	.500	.000	.667	.583	.000	.375	.250	.333	1.00	.417	.223
TadES	.000	.750	.643	.000	.250	.333	.333	.250	.500	.000	1.00	.333	.663
TagES	.000	1.00	.536	.000	.500	.000	.250	.500	.500	.667	1.00	.333	.202
	Non-flooded but Affected Elementary Schools												
BamES	.000	.500	.540	.500	.583	.333	.154	.333	.750	.667	1.00	.167	.667
BayogES	.000	.500	.381	.750	.583	.250	.333	.500	.500	1.00	1.00	.583	.621
BNCalES	.000	.500	.536	1.00	.667	.583	.000	.375	.500	.667	1.00	.500	.600
Calo ES	.000	.625	.544	.250	.750	.500	.133	.417	1.00	.667	1.00	.500	.254
LalES	.000	.625	.341	.000	.583	.667	.144	.250	.250	.667	1.00	.417	.609
LopES	.000	.800	.476	.600	.667	.333	.286	.233	.000	1.00	1.00	.733	.632
LBCES	.000	.750	.540	.750	.750	.500	.256	.750	.500	1.00	1.00	.583	.622
MaaES	.000	.500	.528	.250	.500	.750	.150	.333	.250	.667	1.00	.500	.611
MaiES	.000	.500	.488	.000	.333	.333	.333	.375	.750	.333	1.00	.333	.147
PRES- LB	.000	.500	.488	.250	.750	.667	.111	.250	.750	.667	1000	.667	.667
SAES- LB	.000	.500	.484	1.00	.583	.667	.500	.458	.500	1.00	1.00	.583	.613
	Non-flooded Least Affected Elementary Schools												
BitES	.000	.600	.448	1.00	.733	.600	.182	.533	.600	.667	1.00	.467	.284
MasES	.000	.500	.524	.500	.667	.250	.143	.500	.750	.667	1.00	.500	.249
SCruzES	.000	.625	.587	.750	.667	.333	.167	.500	1.00	.667	1.00	.667	.349
TranES	.000	.500	.476	.750	.667	.167	.250	.583	.500	.667	1.00	.417	.059
	Flooded High Schools												
LSPU-HS	1.00	1.00	.683	.000	.417	.417	1.00	.417	.500	1.00	1.00	.583	.667
NGMNHS	1.00	.800	.362	.000	.400	.267	.381	.833	.800	.667	1.00	.333	.296
UPRHS	1.00	.625	.472	.250	.667	1.00	.294	.833	1.00	1.00	1.00	1.00	.667
	Non-flooded but Affected High Schools												
LaSciNHS	1.00	.625	.536	.250	.500	.750	.714	.667	.750	.667	1.00	.750	.583
LBCNHS	1.00	.625	.444	1.00	.833	.417	.276	.833	1.00	1.00	1.00	.500	.333
LBIS	1.00	.375	.306	.500	.500	.167	.000	.208	.000	.667	1.00	.333	.304
LBNHS	1.00	.700	.397	1.00	.600	.467	.488	.433	.400	.667	1.00	.600	.339
MNHS	1.00	.500	.405	.750	.583	.333	.000	.583	.750	1.00	1.00	.500	.303
P-TNHS	1.00	.375	.444	.750	.500	.417	.272	.375	.750	.333	1.00	.583	.333
	Non-flooded Least Affected High Schools												
BNHS	1.00	.700	.429	1.00	.600	.467	.133	.567	.400	.000	.000	.467	.304
PHSA	1.00	.625	.754	.500	.917	.750	1.00	.750	.250	1.00	1.00	.917	1.00

H-1 Age of students; H-2 Teachers' Proficiency on CCA and DRM; H-4 Class size; N-1 Presence of risk factors to floods; N-2 Condition of land and water resources; N-4 Dependence of families on natural resources; P2 Percent of rooms elevated or on upper storeys; P-3 Access to information and communication; P-4 Alternative venues for school operation; F-1 Budget for school operation; F-2 Other source of funds, F-3 Families' ability to shoulder emergency schooling needs; F-4 Provision of personal and non-personal insurance.

of supporting the emergency school needs of their children (F-3) (**Table 7**). Insurance coverage (F4) was particularly low in KES, PuyES and SDomES. which is common in most of the schools from Bay in this group.

TagES obtained the highest SACI of 0.673 while the lowest score of 0.540 was in KES (**Figure 2**). Only BayCES and TagES were considered highly adaptive while the rest have moderate adaptability to floods. Although TagES has higher SACI than BayCES, the ratings in each of the assets in BayCES were more even resulting to a more balanced SACI hexagon.

Radar graph analysis of non-flooded but affected elementary schools. School management were high in all the eleven schools with LalES (0.896) scoring the highest (**Figure 3**). Social assets was high in ten schools with LBCES obtaining the highest score of 0.938 while LalES obtained only a moderate score of 0.615.

BayogES, BNCalES, LalES, MaaES, MaiES, PRES-LB and SAES-LB scored low in human assets while the other four got moderate scores (**Figure 3**). Highest score of 0.544 was in LopES while PRES-LB got the lowest score of 0.403. Low scores in human assets were due to young age of students (H-1) and large class size (H-4) in most of these schools (**Table 7**).

BNCalES and SAES-LB scored highest at 0.804 which together with LBCES and PRES-LB obtained high scores in natural assets. MaiES on the other hand got a low score of 0.416 due to the presence of flood risk factors (N-1), poor state of land and water resources in the area (N-2) and high dependence of livelihood on natural resources (N-4) (**Table 7**). All the other schools in this group incurred moderate scores.

LBCES scored high at 0.651 in physical assets while LalES, LopES and MaaES got low scores with the latter obtaining the lowest score of 0.463 (**Figure 3**). The other

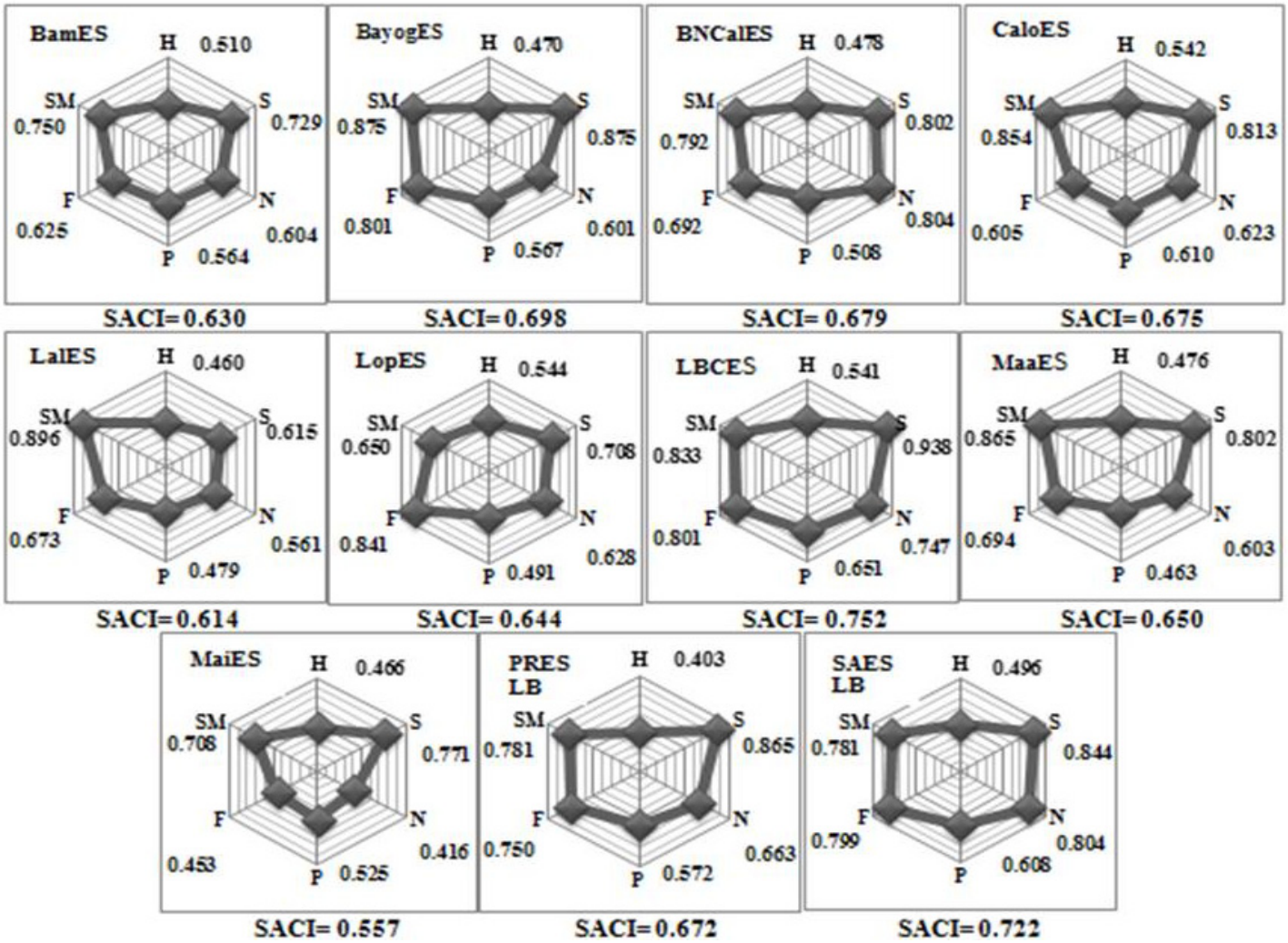

Figure 3. Radar graphs of non-flooded but affected elementary schools. (Determinants: H- Human Assets, S- Social Assets, N-Natural Assets, P-Physical Assets, F-Financial Assets and SM- School Management).

seven schools got moderate scores in physical assets. The three schools with low physical assets have few elevated classrooms (P-2) and have no alternative venues to hold classes in case of floods (P-4) (**Table 7**).

The eight schools that scored high in financial assets were all from Los Baños led by as LopES at 0.841. Two got moderate (BamES and CaloES) while only MaiES got a low score of 0.453. Low financial asset of MaiES was reportedly due to insufficient school budget (F-1), inability of families to support emergency schooling expenses (F-3) and low insurance coverage (F-4) (**Table 7**).

Highest SACI score of 0.752 was in LBCES while MaiES obtained the lowest SACI score of 0.577. Eight schools in the group were considered highly adaptive while three were moderately adaptive to floods. LBCES also exhibited the most balanced and ideal performance in the different assets among the different schools in this group.

Radar graph analysis of non-flooded least affected elementary schools. School management scores were high in all the four schools in this group with BitES obtaining the highest score of 0.883 while TranES got the lowest score of 0.719 (**Figure 4**). Social asset scores were high in three but moderate only in MasES at 0.615.

Human assets were moderate in BitES (0.512) and MasES ((0.506) while SCruzES and TranES got low scores of 0.491 and 0.463, respectively. Low human assets were primarily due to age factor (H-1) (**Table 7**). TranES also scored low in class size (H-4).

Natural assets were high in three schools and was moderate in MasES. Only BitES obtained high scores while the rest got moderate scores in their physical asset. Only SCruzES scored high in financial assets with the rest having moderate scores.

BitES got the highest SACI score of 0.704 while MasES incurred the least SACI score of 0.600. BitES and SCruzES were considered highly adaptive while MasES and TranES moderately adaptive to floods. BitES obtained higher scores in most of the assets and did not incur low ratings in any of the six school assets compared to SCruzES that scored low in human assets.

Radar graph analysis of flooded high schools. School management, social, human and physical assets were rated high in all the three flooded high schools (**Figure 5**). Financial assets were high in UPRHS and LSPU-HS and moderate in NGMNHS.(F-4). Natural assets were high in UPRHS but were low in both LSPU-HS and NGMNHS. The low scores in natural assets were due to the presence of natural flood risk factors (N-1), the poor condition of land and water resources in the area (N-2) and families' dependence on natural resources for their livelihood (N-4) (**Table 7**).

All of the three flooded high schools were considered highly adaptive. Highest scores were obtained by UPRHS in social, physical, financial and natural assets, LSPU-HS in human assets and NGMNHS in school management. UPRHS got the highest SACI score of 0.807 while NGMNHS got the lowest SACI score in the group. Aside from garnering the highest SACI rating, the SACI hexagon of UPRHS was also the most balanced among the three schools in this group. Advantage of UPRHS in terms of natural assets is because families are not dependent on natural resources for their livelihood while the capability of families to shoulder emergency school expenses of children is the key to its financial advantage over other flooded high schools. The physical advantage of UPRHS over other flooded schools could be attributed to the presence of alternative venues that are adequate for its school operations.

Radar graph analysis of non flooded but affected high schools. School management was high in all the six schools

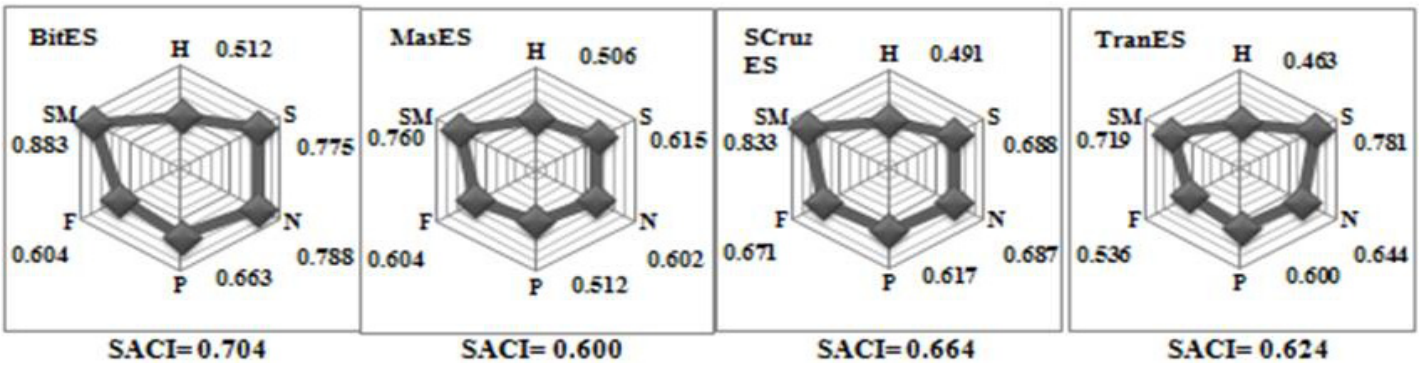

Figure 4. Radar graphs of non- flooded, least affected elementary schools. (Determinants: H- Human Assets, S- Social Assets, N-Natural Assets, P-Physical Assets, F- Financial Assets and SM- School Management).

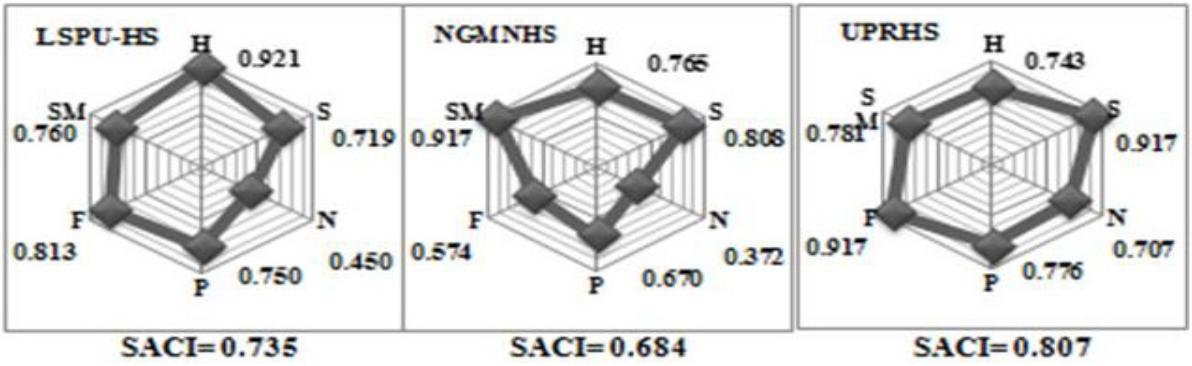

Figure 5. Radar graphs of flooded high schools.(Determinants: H- Human Assets, S- Social Assets, N-Natural Assets, P-Physical Assets, F-Financial Assets and SM- School Management)ining using JACCARD coefficient. Numbers on the tree represent bootstrap analysis performed on the clusters.

(**Figure 6)** in this group. Social assets were high in four high schools namely: LaSciNHS, LBCNHS, LBNHS and TPNHS and middling in LBIS and MNHS. Human assets were mostly high except in LBIS that incurred middling scores. LBIS and TPNHS got moderate scores while the other four schools garnered high scores in financial assets.

Although majority obtained high scores, LaSciNHS got moderate while LBIS got low score in natural assets. Families in LBIS were highly dependent on natural resources for their livelihood (N-4) (**Table 7**).

Physical assets varied with two schools (LaSciNHS and LBCNHS) getting high, two schools (LBNHS and TPNHS) garnering moderate and the other two schools (LBIS and MNHS) obtaining low scores. Low scores in physical assets were mainly due to lack of elevated classrooms (P-2). LBIS also scored low in terms of access to information and communication (P3) and alternative facilities for school operation (P4).

LBCNHS scored highest in school management, social, natural and physical assets while LaSciNHS was highest in human and financial assets. The highest SACI score of 0.781 was in LBCNHS while the least in the group was in LBIS at 0.581. Four high schools in the group were considered highly adaptive, these were: LaSciNHS, LBCNHS, LBNHS and TPNHS. On the other hand, LBIS and MNHS were considered moderately adaptive to floods. The radar graph of the LBCNHS was also the most balanced in terms of score in the different school assets.

Radar graph analysis of non-flooded least affected high schools. Both schools in this group were rated high inhuman, social assets and in school management (**Figure 7**). PHSA was higher in human assets and school management while BNHS got equal score in social assets.

There was a big difference in the financial, physical and natural assets between the two schools in this group. PHSA got high scores in both financial and physical assets and moderate in natural assets. BNHS, on the other hand, got low scores in physical and financial assets but was high in its natural assets. Low physical asset scores of BNHS were due to lack of elevated classrooms (P-2) and lack of alternative venues to hold classes in case of emergencies (P-4). It was also low in all the four indicators of financial assets especially in terms of the budget allocated for school operations (F-1) and availability of other sources of funds (F-2) (**Table 7**).

SACI rating of PHSA (0.800) is a lot higher than that of BNHS (0.646). The radar graph of PHSA was almost balanced except for being lopsided in its natural assets while the graph of Bitin NHS was low in its physical assets and extremely low in its financial assets.

In general, the radar graph analysis had shown that school management and social assets were vital in increasing the adaptive capacity of schools in the different groups. Almost all school groups were rated high in all the indicators of school management (**Table 6**). Social assets were consistently high in the participation of the school community in cooperative efforts for the school (S-3) and in equal treatment to students and school personnel. Strong support of the PTA and other stakeholders was evident in school cooperative action like the Brigada Eskwela. The Parent Teachers Association (PTA) is also an active partner of the school in most of its activities and in addressing school concerns. Equal treatment given to all students and personnel (S-4) is also important in assuring that no particular group or individuals are disadvantaged or discriminated.

Human and physical assets were generally low in the elementary than in the high school level. Flooded elementaryand high schools generally obtained low scores in

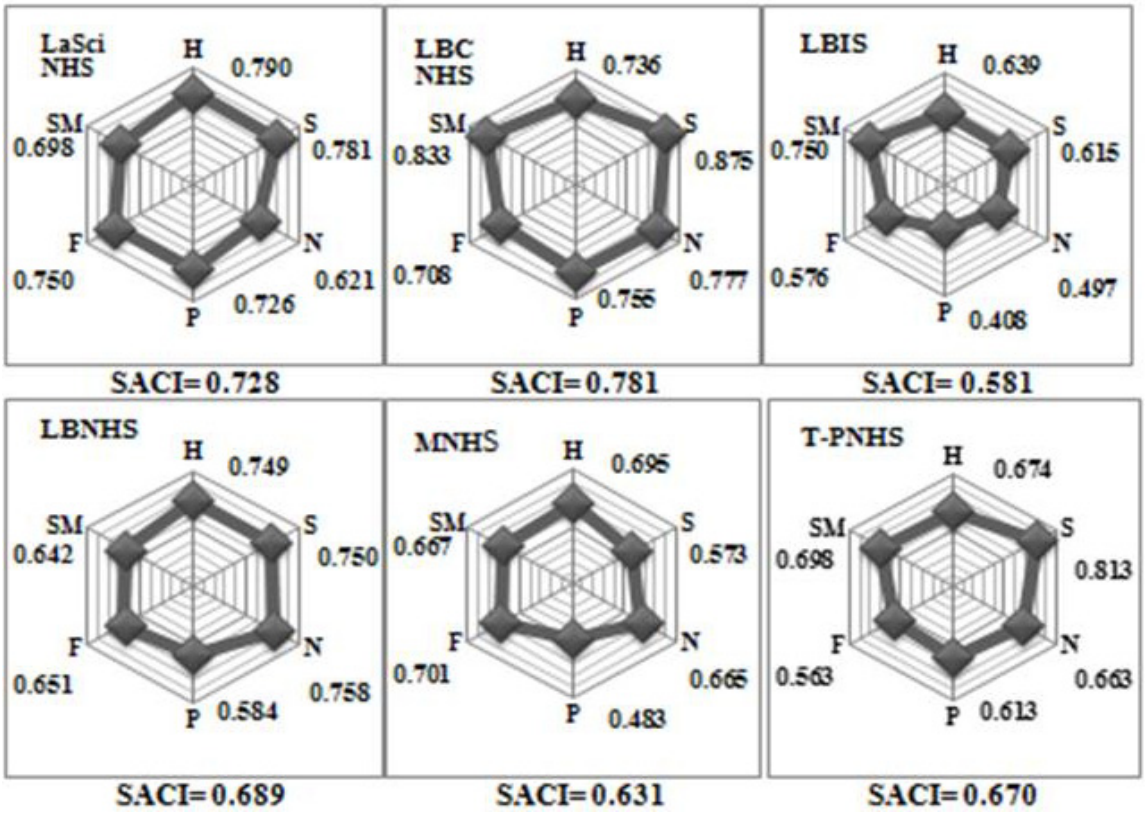

Figure 6. Radar graphs of non-flooded but affected high schools. (Determinants: H- Human Assets, S- Social Assets, N- Natural Assets, P-Physical Assets, F-Financial Assets and SM- School Management).

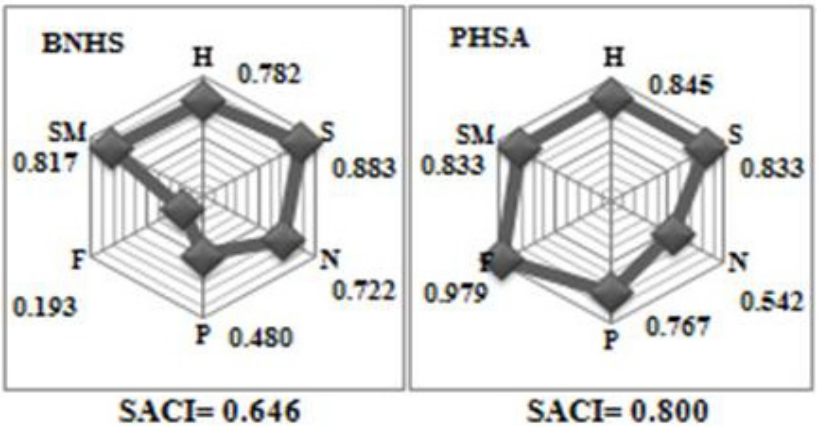

Figure 7. Radar graphs of non-flooded, least affected high schools. (Determinants: H- Human Assets, S- Social Assets, N- Natural Assets, P-Physical Assets, F- Financial Assets and SM- School Management).

natural assets than the rest of the school groups. This trend is consistent with the results of the statistical comparisons of SACI and its assets.

Scores of schools in a particular asset may vary from low to high between groups and within each group. This means that interventions to increase adaptive capacity should always consider the uniqueness among each of these schools.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The following conclusions were drawn from the results of the study:

1. Public schools in the two municipalities, in general, are

highly adaptive to floods based on the scale adopted. Mean SACI of public schools to floods is lower than the adaptive capacity of the entire province to climate change because the schools cater mostly to the education needs of children from poor families.

2. High schools in the two municipalities have better human and physical assets than elementary schools. High school students are more mature and are less vulnerable to hazards like floods. Teachers in the high school are more proficient in CCA and DRM than elementary teachers.

High school also have better physical assets than elementary schools due to more elevated classrooms that are still functional during floods and more means of receiving information and communications which favors timely and appropriate response to hazards.

Natural assets in flooded schools are less favorable than non-flooded schools since the former are exposed to natural risk factors to floods. This is aggravated by poor condition of land and water resources in the area.

High schools also have better SACI compared with elementary schools. The higher SACI in high schools may be due to better human assets and physical assets compared to elementary schools. On the other hand, SACI of the different school groups were more or less the same. Scores in the other assets were able to compensate for the low score of flooded schools in natural assets.

3. Radar graph analysis show that high scores in school management and social assets were vital in increasingthe adaptive capacities of schools in all school groups. Scores in a particular asset may vary between groups and within each group which means that there is no uniform approach to improving the adaptive capacity of different schools. Interventions should always consider the uniqueness among each of these schools.

Recommendations

Efforts should be exerted to improve the capability of the young children to cope up with the effects of floods both in school and at home. This could be done formally, as part of the curriculum, or informally through normal day-to-day interactions with their teachers. A reliable disaster risk management team should also maintained in schools especially in elementary schools to address the needs particularly of young children. Hence, there is a need for DepEd to continuously improve the knowledge and skills of their teachers and staff in CCA and in DRM to benefit students especially in the elementary level.

DepEd and LGUs through their Local School Boards, should address the need to improve the physical assets of elementary schools by providing elevated classrooms that are safe for young pupils. Elementary schools should also be provided better means of communication and receiving information not only for timely and appropriate response to these hazards but also to improve their understanding on climate related hazards like floods.

Efforts should be exerted to mitigate these natural risk factors through a combination of structural and non-structural means. Government should also strictly implement or formulate better policies and programs to protect and restore the natural environment in the area.

Priority in improving adaptive capacity to floods should be given to elementary schools than high schools. However, there is no uniform approach to improving the adaptive capacity of different schools. Interventions should always consider the uniqueness among each of these schools.

DepEd and LGUs should adopt the proposed instrument to assess SACI to determine the adaptive capacities of their schools. This would enable determination of which school/s to prioritize and what particular action must be taken in order to improve their adaptability to floods.

The study may be replicated in other municipalities in the Laguna de Bay region and other areas where schools are affected by floods. It may also be used to compare the adaptive capacities of public and private schools. Subsequent studies may be done to further improve SACI by using other indicators under the different livelihood assets that are more appropriate to the prevailing conditions of schools to be studied.

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