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Environmental Conservation Mechanisms Of Small-Island In Capul, Northern Samar

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ABSTRACT: This is a documentation of various mechanisms of small-island ecosystem along environmental conservation which are dependent on their gained sound knowledge and understanding of their environment and the underlying ecological processes that formed the foundation for their well-being and environmental conservation. A mixture of qualitative and quantitative methods for data collection and analyses were employed. Common qualitative techniques like observation, key informants interview, focus group discussion and quantitative techniques like monitoring and measurement of runoff, sediment load and seagrass and net primary productivity (NPP) were used. Significant findings pointed that small-island ecosystems' coconut-based cropping system showed positive significant relation to the type of vegetation. Maximization of farm animal waste in sustaining fertility of the agricultural land resulted to the good quality of water with tolerable total suspended and dissolved solids and animal sedimentation rate from agricultural areas. The low rate of sedimentation and better quality of runoff water increased the seagrass NPP and high fish productivity, indicators of efficient islanders' livelihood practices and significantly conserve the coastal subsystem and subsequently the whole island ecosystem. The main threat to the coastal subsystem was exceedingly high coliform count which urges the promulgation of municipal ordinances and programs in relation to environmental health.

Keywords: environmental conservation, small-island ecosystem

1. INTRODUCTION

Conservation and sustainable use of resources are central to sustainable development of small-islands. Attaining this would mean thinking, designing and doing ways to battle the constraints for the conservation of resources in small-islands such as limited coastal area and small watersheds. Heavy dependence on the island's limited resources leads to their exploitation and degradation.

Similar to any island in the Philippine archipelago, the Abaknons, the local people of the island municipality of Capul, Northern Samar practiced the combined farming and fishing as their major source of livelihood. These are the islanders' activities that may contribute runoff and sediment load to the coastal subsystem which is ultimately the sink and catchment of the upland materials. This subsistence seemingly endangers the delicate coexistence of the Abaknon with the environment. This is because man readily abandoned the responsibility of protecting and managing natural resources in exchange of survival (Briones and Arboleda 2006).

The island resources – natural and human can either be lasting or fatal, analysis of the relation between Abaknon's livelihood strategy and the conservation of the island ecosystem is necessary. Conservation of ecosystems must start from the higher elevation terrestrial habitat down to the lowland, coastal and marine or from green to brown to blue environment sectors (CI-P 2007) vis-à-vis the livelihood strategy of the islanders. The problem at hand is whether the anthropogenic activities are but mechanisms in the conservation of the island resources or the otherwise specifically on whether the sediment load and runoff from this livelihood strategy affect the coastal subsystem.

This study therefore looked into the livelihood strategy and the quantity and quality of the sediment load and runoff and the present status of the island's coastal subsystem as indicators of the conservation of the island's ecosystems. Specifically, this paper 1) analyze the major practices strategy of the Abaknon; and 2) determine the relationship of the livelihood strategy to the conservation of the island ecosystem in terms of the (a) quantity and quality of runoff and sediment load, (b) net primary productivity, and (d) fish productivity.

2. METHODOLOGY

The study was conducted in the island municipality of Capul, Northern Samar. A mix of qualitative and quantitative methods for data collection and analyses were used. Sediment load, runoff water quality, seagrass productivity and fish productivity were used as indicators in the assessment of the impacts of the livelihood practices.

Data Collection Procedures

Interview. Unstructured interview was conducted to get data on cropping system, farming practices and the related beliefs. The oldest resident and five farmers cum fisherfolks in every barangay (12 barangays) with a total of 72 were interviewed. **Observation.** This helped in getting substantial data on the present environment of the island, and the farming practices of the islanders. **Focus group discussion.** The focus group discussion was composed of key informants such as the old islanders and the farmers cum fisherfolks. The key informants were knowledgeable about the culture of the islanders as well as their upland farming practices. **Review of secondary data.** Needed data on the biophysical characteristics of the island were secured from the Municipal Agriculture Office, the Northern Samar Provincial Profile, the Comprehensive Land Use Plan of Capul and from studies conducted. **Measurement of runoff and sediment load.** Catch basins were set in four cropping systems. The cans were calibrated for the easy monitoring of runoff quantity and were placed in sites of the major cropping patterns and livelihood strategies of the people. These cropping systems were identified as; Site 1 (S1), coconut monocrop, Site 2 (S2), coconut-vegetable crops intercrop, Site 3 (S3) coconut-root crops intercrop and Site 4 (S4) coconut-root crops-secondary trees intercrop.The volume of runoff water and amount of sediment load were collected and measured after each rain event for one year. There were three replicates in every site. **Analyses of runoff water quality.** Physico-chemical analysis was done in three significant periods; during the start, middle and end parts of the rainy season. The physico-chemical parameters analyzed were pH, color, total suspended solids (TSS), total dissolved solids (TDS) and total phosphorus. **Measurement of seagrass NPP.** Immediately down the catch basins, in the coastal area, three 1" x 1" quadrats were set for the measurement of the seagrass net primary productivity. Runoff and upland materials are expected to flow and settle in these coastal areas. **Fish productivity measurement.** A data on fish catch was monitored in 10 fish buying stations in the island; in the poblacion, 7 barangays and 2 big sitios. The daily fish catch in the island during the calm and wavy periods were monitored for 28 days (whole phase of the moon). Each buying station had an assigned monitor to get the accurate weight of every fish species caught. Weight of catch was obtained by using an ordinary weighing scale provided in each station.

From the catch information taken from the survey (monitor), CPUE (catch per unit effort) was obtained by dividing the total weight of catch over the total fishing effort in terms of man per hour. The effort was expressed in man-hour in order to account for the variation in the number of fishermen per fishing trip. The average numbers of fishermen and the average number of hours spent for fishing were estimated based on the interviews with the fisherfolks and the fish buyers who monitored the fish catch.

3. RESULTS AND DISCUSSION

The 5th class island municipality of Capul in the province of Northern Samar lies at 124^{o} and 10'' E longitude and 12^{o} N latitude, southwest off the western tip of Northern Samar, in the middle of a windswept and dangerous whirlpool-dotted strip of rushing sea San Bernardino Strait and hemmed in by the western current from the Pacific Ocean and the eastward current from the China Sea.

In terms of the physical characteristics of the island, Capul falls within the Type II climatic condition which is the general classification of the province of Northern Samar where the island belongs. Corollary to this, PAGASA recorded 28 tropical cyclones in 12 years which simply means that the island is often visited by typhoons. This further implies suiting the crops to the climatic condition and environmental factors must be considered in the design of infrastructure projects.

Of the 3,500 hectares total land area, 80% is agricultural land and 76% of the agricultural land is occupied by coconuts showing that the farmers' major income is from coconut. Other areas are planted with rice (rainfed and irrigated) root crops, corn and vegetables. The distribution of the types of crops is dependent on the type of soil. Although the types of soil are classified as beach sand, faraon clay and mountain soil, the islanders have their own way of classifying their *lapuk* (soil) in which classification is based on the color of the *lapuk.* Such classification identifies the soil as *hirom, kapiyatan, anapog* and *burubaybay* which are also indicators of the type of crop to plant. Another indicator in the selection of the crop to plant is the slope in which around 70% of the total land area of the island has steep hills to mountainous. The islanders' deep knowledge of the biophysical environment and the climatic variation allow them to respond and fit their activities to these weather changes.

Livelihood Strategy/Mechanisms in conserving the island resources Utilization of the local knowledge of the resource bas

Local farming and fishing activities are believed to conserve resource systems that utilize the local knowledge of the resource base. The Abaknon's deep knowledge of the environment is exemplified by the local livelihood calendar. This calendar chronicles the season of cultivation of different agricultural crops and fishing activities the whole year round. Fishing activities use gears according to utility and season. Crops cultivated are patterned to make sure availability of food sources at different times of the year. Though not publicized, this traditional schedule is still widely used by the Abaknons as basis of the islanders' resource use activities.

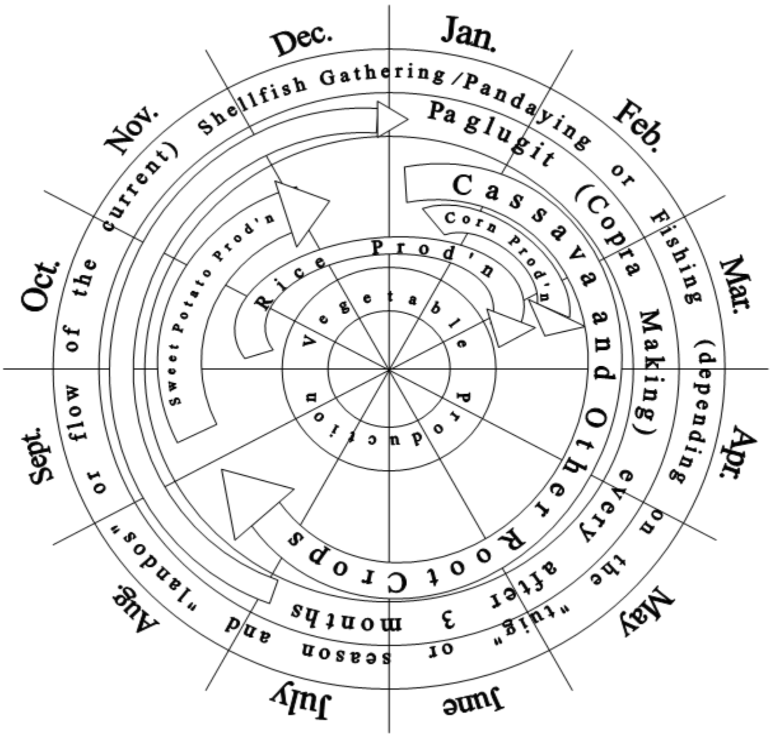

Figure 1. Abaknon calendar of the livelihood strategy activities

Basing calendar of farming activities on the information received from the biophysical environment

Their calendar of farming activities is based more on the information received from the biophysical environment. As to coconut farming, when harvesting falls on a rainy period, drying of the copra is in the *agunan*, a chamber-like structure where smoking of copra is being done. During sunny weather, copra is dried up in the coast or in any sun-exposed field.

The position of the slopes is made beneficial in deciding where and what crop to plant considering the occurrence of monsoon winds and typhoons. The sun-loving plants are planted on areas where they receive enough sunlight, they choose crops on steep slopes that help cover and protect the soil from erosion. On a specific period particularly few months before the occurrence of monsoon rains and wind, some crops are planted on one side of the slope opposite the direction of the expected rains and wind for protection of the crops. The Abaknon farmers are also well aware of the dangers that typhoons may bring especially during the "ber" months. Root crops are planted in such a way that during these months, crops like cassava are now ready for harvest that even typhoons will affect them; still they can be harvested and used for food and sold or bartered to fish or any other necessary commodity. Furthermore, quick maturing crops as camote are often grown after typhoon devastation for food security after three months. The common practice of cultivating root and vegetable crops in slopes facing the east practically recognizes the significance of sunlight in the photosynthetic activity of plants. The depth of knowledge of the local people about their natural environment and the occurring natural phenomena made them adapt and absorb these changes, thus reducing their vulnerability.

Seasonality of both fishing and farming

Both farming and fishing are seasonal. The seasonality of fishing is dominated by the accessibility of fishing sites influenced by monsoon winds. The reefs become completely inaccessible during brief storms. Fishing activity is influenced by sea roughness and monsoon wind conditions, with stronger winds during the northeast monsoon in October to February increasing water currents especially in *Takut* and *Parola.* In this period, possibility of increased sea water turbidity particularly in the coastal zones usually occurs and enhanced further by coastal flooding. Fishers end up moving from their usual fishing venue to areas of the island not affected by such weather condition. They also change fishing gears with the change in season. There are gears inapplicable during rough seas like spear fishing. Spearfishers are faced by the problem of low visibility, strong currents and cold sea water temperature reducing their fishing efficiency. Similarly, basket-like traps are not utilized during this season. The chances of destruction of these traps are high during bad weather conditions. The gear conforms to the condition of the sea, flow of the current and the species of the target fish catch. Fisherfolks predetermine the fish the gear is expected to catch and where what specific flow of current to catch the fish. During *subli* when the current is towards the lighthouse, fisherfolks fish in *Takut* and use *rambo, lagolo* or *kitang.* These gears are expected to catch *budlis, turingan, ahaan, kugtong* and other big fish. These examples strongly imply that local fisherfolks have a deep knowledge of the biology and life cycle of fish species in addition to the knowledge of their physical environment.

Coconut as dominant vegetation in all slope categories

In the island, almost all slope categories are dominated by coconut. These slopes are cultivated to vegetable and root crops as intercrop to the major crop, coconut. Farms are always cultivated to various crops.

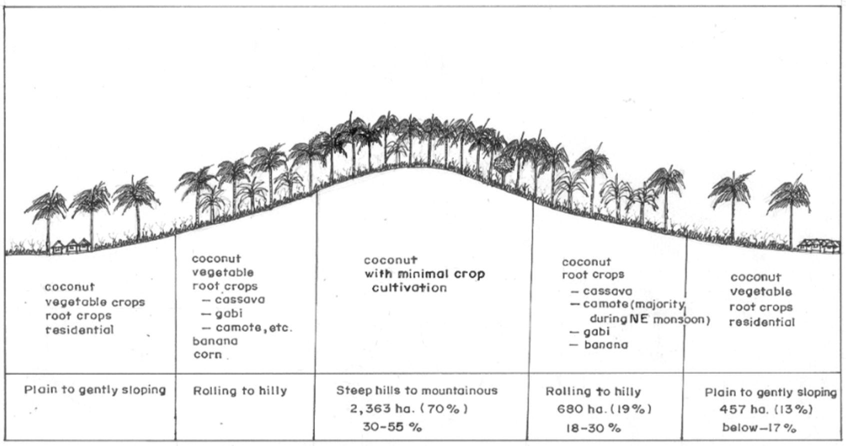

Figure 2. Crops cultivated in different slope categories

No “fallow

Similarly, Site 3 (S3) which is coconut intercropped with root crops extend from gently sloping areas to steep slopes. Coconut planting density is similar to Site 2. Root crops are planted in such a way that sweet potato or *kamonte* is always at the center leaving other root crops like cassava at the edge which serve as hedgerows. The sites chosen in S3 is really dominated by root crops, however, it is very rare to find a farm in the island in which other crops like vegetables crops are not mixed. This practice is done all throughout the year not allowing the soil to rest. To the Abaknons this is their way of conserving the soil from erosion.

Figure 3. Coconut mixed with root crops; cassava borders the sweet potato crop (no fallowing/year-round cultivation)

The practice of the "common property" principle

The "common property" principle is very evident; anyone can fish anywhere he likes. No traditional authority is enforced in the use of coastal and marine resources. However, in some places which the islanders call sacred fishing grounds, fisherfolks have to ask permission from the supernatural which they call *tagtalon*. The *tagtalon* are believed to be dwellers of rocks, trees and all of what nature gives. Asking permission before fishing is traditionally practiced because of experiences of some fishermen. In some fishing grounds like the *Timon-timon, Moroporo, Parola*, *Acapulco mark* and some other areas, dynamites were reported not to blast because the *tagtalon* did not allow it. In some instances, the dynamite exploded in the hands of the one blasting it. So, asking permission becomes a practice which comes in many forms. One is throwing odd number of coin denominations simultaneously murmuring the fisherman's wish. This association of the islanders with the supernatural ensures that fishing grounds are respected and protected at all times, and not only when enforcement officers are around. The thought of retribution of the fairies is a continuous reminder to the people of the need to treat resources properly. This further reminds every islander of the link between the seen and the unseen, between the living and the dead as components of the environment. Because of their belief of sacred places, enforcement officers are no longer needed to ensure environmental protection.

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Fisherfolks' ingenuity

Fisherfolks have shown their ingenuity making and modifying fishing gears out of gathered drifting materials in the sea. *Panyapak* or flippers are costly and no commercial form is available in the island. The innovation is the product of their imagination driven by their need for a device in adaptation to free flowing current. One thing more worth noting is the source of all the materials. They are all taken from drifting materials in the sea like plastic materials and rubber. Goggles are carved from woods and plastic materials from the sea also. Artificially modified baits for open sea hook and line fishing like *rapala, rambo, kitang* and some others are also made from wooden and plastic materials. To the fishermen, these are used to deceive fish and have more catch. The usefulness of the improvised gears and the durability of the materials are beyond compare. Designing gears from thrown materials just remind us that everything can be and must be recycled to avoid waste production. It further proves that local ingenuity can help and make livelihood. More significantly, behind the local people's ingenuity is the recognition that the knowledge are generated and transmitted through their interaction within specific social (their need to swim swiftly) and ecological (swimming against the strong current) contexts. The ingenuity is a form of technological innovation. People developed techniques that provide them reliable source of food and income. The local people's ability to invent and to accumulate knowledge allowed them to live in a more competitive environment without destructing the resource. The relation they show to the environment builds up what Raymond Dasmann call "ecosystem people". This describes the culture in which people adjust to the conditions of the environment rather than try to modify them (Anderson et. al. 1993).

- *Pamangaraw*

(Hook and line)

Kitang hook and line with real fish as bait

Hook and line fishing "lagolo"with artificial bait *rapala"*

Adherence to simple traditional rituals

Simple traditional ritual is usually done to new fishing gears. During the first day use, the gear undergoes *paharang*. This comes in two ways. One is whipping the gear most especially fishing nets and traps with *panauli* or *pandan* leaves for more catch and to do away with bad luck. Gears using hook and line and spears and even nets use the other method, *pag-agon* which is smoking the gear with *kamangyan* burned in charcoal. Aside from the belief attached to it, smoking strengthens the material of the gear.

Figure 4. A lengthy recital of the *tambalan;* inviting the unseen spirits

Practice of multi-cropping

Consequently, fisherfolks resort to farming when the condition of the sea is not fit to any fishing activity. Traditional agricultural systems of *kaingin* and multi-cropping are considerably the suitable farming system in small-islands with limited resources like Capul. Multi-cropping means, almost all crops are cultivated in combination or mixture with the most dominant crop, coconut. Coconut in this type of combination, protect the undergrowth crops from the effects of strong winds and rains as the weather drastically changes in the area. If strong typhoons devastate the coconut, the undergrowth crops sustain the people's basic needs. Farming ensures income generation. Aside from the income they gain, farmers have stability of products, too. Different crops planted in the same area have different maturation and harvest period. This provides farming islanders a variety of sources of food resulting to diet diversity. Root crops and vegetable crops are commonly intercropped with coconut with no specific size of area for every type of crop. The farm size for every crop greatly depends on the availability of the planting materials and the size of the land a farmer owns/cultivates. This minimizes risk and reduces insect and disease incidence. The flood or drought that may affect the vegetables may not in the same manner affect the root and other crops like the banana and coconut. In same way, an insect that may attack a vegetable crop may not devastate the root and other crops. Similarly, multi-cropping promotes efficient use of labor, intensification of production with limited resources and the maximization of returns under low level of technology. With the crude tools that Abaknons use, the clearings are limited allowing small size of farm only but with compounded production. The word compounded may be exaggerated, but returns from the farm is more than what is expected from such a low level traditional technology being used as *sundang*, *bando*, and to a few *piko*, and carabao-driven plow.

Mixed crops are cultivated satisfying the multi-needs of the household and highlighting the vast wealth of their local knowledge in managing their limited natural asset, land. Multi-cropping ensures diversity of food sources and allows continuous food availability (Veitayaki 2006).

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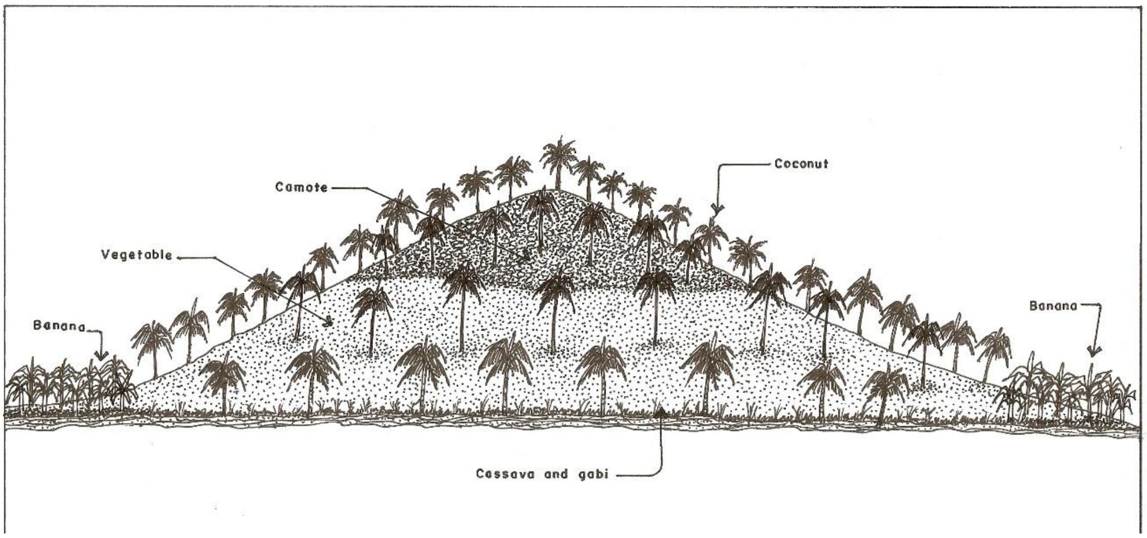

Figure 5. Plate Typical *uma* of Abaknon

Farmers' way of classifying soil according to their own knowledge

The farmers' way of classifying soil which was locally based on color, texture and its use might not have its scientific equivalent of classifying soil according to its structure and nutrient content. However, the *kapiyatan* which the Abaknons believed to be unproductive and only good for corn, cassava and banana is scientifically classified as the lateritic soil, unproductive, with very low organic matter, low in potassium and less porous (Banzon and Velasco 1982). Such classification of *kapiyatan* as only good for the identified crops coincides with the characteristics of the lateritic soil. The *kapiyatan's* nutrient composition will not change as the farmers are not used to apply fertilizer to any upland crop.

Non-use of fertilizer and pesticide

The use of fertilizer and pesticide to them is another expense which can be devoted to buy other necessity of the household. This avoids degrading agricultural farms from the action of chemicals and fertilizers. While preventing environmental degradation, healthy foods, free from harmful chemicals and toxic materials are also produced. Instead of using chemicals when insect pests attack most especially camote, local farmers just burn rubber slippers usually gathered from the coast brought by strong current and waves. The farmers believe the rubber smell drive away insect pests. Rubber slippers were made from latex of rubber tree and mixed with carbon and sulfur. Sulfur which may be one of the chemicals causes the bad smell of slippers when burned. Insect pests cannot withstand the bad smell of sulfur.

Adherence to farming-related beliefs

There are also farming related beliefs which are usually done during harvest period. The most common are *pagtunggo* and *paharang* in thanksgiving for the protection and good harvest. This they offer to the Great Provider, souls of the land owner and the spirit dwellers. During the ritual, an invited old prayerful person usually *tambalan* recites prayers and phrases of thanksgiving. Merry making follows the ritual. This may indicate equitability of agricultural resources.

Indicators of Resource Conservation

Traditional techniques of land use are proven to be sustainable because they have given good results over a long period of time (Zwahlen 1996). In other words, the local people have lived in harmony with their environment. Their dependence on their immediate environment to meet most of their basic needs help them gain the sound knowledge and understanding about the environment and its underlying ecological processes. It is then their local knowledge of the environment that formed the foundation for decision making in their day-to-day livelihood activities (Veitayaki 2006) for their well-being and conservation of the environment.

Physico-chemical Characteristics of the Sediment Load

The physico-chemical characteristics of the sediment load in the six sites were analyzed. The parameters analyzed were pH, the presence of total (%) Nitrogen (N), (%) available Phosphorus (P) and (%) exchangeable Potassium (K). In the analysis, the highest pH value was observed in S5 with 7.23 while S1 had the lowest pH value of 6.50. The six sites did not significantly differ in terms of pH value. Moreover, the pH value of the sediment load did not significantly differ in time or period which means that the load during the initial, middle and end parts of the rainy season were not significantly different in pH value (Table 1).

In terms of organic matter (%) OM (present in the sediment load) loss, all sites had medium losses except for S1 which had low OM removed. The six sites did not significantly differ in terms of organic matter loss (Table 19), but they significantly differed in organic matter loss in time or period (Table 20). This implies urgency of the farmers' action to replenish the lost organic matter through application of fertilizer in order to maintain soil productivity (http://www.fit.edu/isrs).

Table 1 shows that sediment load in S2 and S3 had high phosphorus content while the sediment load in S4 has low phosphorus. The other 3 sites (S1, S5 an S6) had sediment load with medium available phosphorus content. This means that medium to high phosphorus content had been taken away from the sites and/or from the agricultural areas of the island. This result equates with Phu and Mendoza's (2003) findings that annual cropping system lost more phosphorus through soil erosion. This further means that alternatives must be done to substitute the lost phosphorus brought about by erosion. Considering the time or period, the six sites lost medium available phosphorus content during the initial, middle and end parts of the rainy season (Table 2).

In terms of exchangeable potassium, all sites lost sufficient amount (Table 2) and the amount of loss significantly differed in time or period. Removal of low amount of potassium was observed during the end of the rainy season relatively different with the sufficient exchangeable potassium (K) being removed during the initial and middle parts of the rainy season (Table 2). The remarkable losses of potassium occur in all cropping systems either through the harvested parts, residues or through soil erosion (Phu and Mendoza, 2003).

Although there was low amount of sediment load from the various sites, eroded sediment was even to the advantage of the growth of the aquatic organisms. No traces of smothering of seagrass and any other aquatic flora was observed in any coast of the island.

Table 1. Physico-chemical characteristics of sediment load collected at the different study sites

SITES	PHYSICO-CHEMICAL CHARACTERISTICS OF SEDIMENT LOAD			
	pH	**(%) Organic Matter (OM)**	**(%) Available Phosphorus (P)**	**(%) Exchangeable Potassium (K)**
S1	6.50	1.67	Medium	Sufficient
S2	6.80	3.40	High	Sufficient
S3	6.83	3.83	High	Sufficient
S4	7.07	3.63	Low	Sufficient
S5	7.23	3.83	Medium	Sufficient
S6	6.55	3.80	Medium	Sufficient
Level of Significance	ns	ns		

Legend: ns – not significant

In a column, means followed by the same letter entails that the data are not significantly different.

Table 2. Mean comparison between the physico-chemical characteristics of sediment load collected at the different time of the year.

TIME (SEASON)	MEAN PHYSICO-CHEMICAL CHARACTERISTICS OF SEDIMENT LOAD			
	pH	**(%) Organic Matter (OM)**	**(%)Available Phosphorus (P)**	**(%)Exchangeable Potassium (K)**
Initial part of the rainy season	6.87 a	5.87 a	Medium	Sufficient
Middle part of the rainy season	7.10 a	0.67 c	Medium	Sufficient
End part of the rainy season	6.52 a	3.50 b	Medium	Deficient

Level of Significance	ns	**		

Legend:
** - significant at 1% probability level
ns – not significant
In a column, means followed by the same letter are not significantly different.

Physico-chemical Characteristics of Runoff Water

All of the six sites had contents within the tolerable pH range of 6.0-9.0 (Table 3) under the Class D water quality criteria set by the DENR. No significant difference was observed in the six sites (Table 3) but a highly significant difference of pH level of the runoff water was observed in relation to time or period. The mean pH of the runoff water during the middle part of the rainy season differed with the mean pH of the runoff during the initial and end parts of the rainy season.

Another parameter which was analyzed was color. Color indicates percent of absorption of the water sample at 446 nm of wavelength of light (DOST VIII). Runoff water in all six sites had significant abnormal discoloration except in S4 which had 29.88 %A lower than the 0.5-50.0m-1 range of acceptable color of runoff water (Table 3). The presence of OM can be the cause of the tainted color of the runoff which had a carry over on the brown color of the seawater during rainy season. This discoloration can be attributed to the different human activities from the lowland to the upland. This discoloration may also be due to the use of layered stockings or women hosiery rather than the filter paper in filtering runoff water. Filter paper would have removed fine particulates that gave color to the runoff water better than hosiery. A larger quantity of discoloration was observed during the end part of the rainy season which was relatively higher than in the initial and middle parts of the rainy season. This means that there was a longer period of the accumulation of the loads that contributed to the discoloration of the runoff during the end part of the rainy season. Moreover, small events of rain did not usually produce runoff during this period, so when heavy rainfall occurred, it carried all the sediment loads accumulated in water ways.

The total solids include both total suspended (TSS) and total dissolved solids (TDS). The mean total dissolved solids (TDS) of the runoff water in the six sites did not significantly differ from each other. All sites had runoff water with lower TDS ranging from 116.7 to 590.2 (Table 22) compared to Class C fr esh water standard of acceptable TDS at 1000mg/l. This result implies that the amount of dissolved solids in the runoff may not significantly influence organisms in catchment area, i. e. coastal sub-ecosystem. On the other hand, TSS in all sites showed very high values way above the normal range of 155mg/l the standard set by DENR. The least TSS among the six sites was observed in S6 (103.1mg/l), a little below the standard. This can be attributed to the less agricultural activities and the less number of people residing in the area. Turbidity is highly correlated to total suspended solids (TSS). The high concentrations of suspended solids degrade optical water and impact water quality in downstream reservoirs (http://www.omlake.org). Parallel to this was the finding that during rainy season the seawater clarity is up to 6 meters, highest visibility and 4 meters, the lowest visibility compared to the 22 meter visibility during summer months. However, the mean annual sediment load and volume of runoff water were minimal, thus not detrimental to the growth of coastal organisms. The fewer loads can even fertilize the aquatic flora.

Looking at the specific sites, S2 had the highest mean phosphorus of 1.05 mg/l in runoff water, relatively higher than the other sites (S3, S4 and S5) whose mean phosphorus did not reach 1.0mg/l but higher than the standard phosphorus for fresh water which is .05mg/l. Sites 1 and 6, however had lower phosphorus loss. This reaffirms the previous statements that erosion in agriculture did not significantly contribute to the high loss of phosphorus in the soil.

Microbial Load of Runoff Water

In terms of total coliform count, all sites had very alarming fecal coliform count in which S4, urban center had the highest count of 4,820,000 MPN/100ml. S6, which had the lowest count of 424,500 MPN/100ml. All these results were still far above the Class B fresh water quality for fecal count of 200MPN/100ml. The high fecal count in all sites specifically in S4 can be accounted to the observed dumping of human wastes in canals especially those of infants. Children's disposable diapers were usually seen in canals which ended up in bridges and consequently in the coastal zone. No significant difference in fecal coliforms was observed in the six sites as all sites had high fecal counts. However, in terms of period, a significant difference was observed. The initial part of the rainy season had the highest mean fecal count followed by the end part of the rainy season and the middle part of the rainy season having the least mean fecal count. This simply implies more accumulated wastes with fecal coliforms during summer and eventually drained by the runoff water during the start of the rainy season. Observations showed that especially in barrios near the coastal areas some of the residents do not have their toilets and they dispose their wastes anywhere and in the shoreline.

Table 3. Mean biophysico-chemical characteristics of runoff water collected at the different study sites

SITES	MEAN BIOPHYSICO-CHEMICAL CHARACTERISTICS OF RUNOFF WATER					
	pH	**Color (% A)**	**TDS (mg/l)**	**TSS (mg/l)**	**Phosphorus (mg/l)**	**Fecal (MPN/100ml)**
S1	7.74 a	143.07 ab	200.4 a	898.6 a	0.02 a	1106333 b
S2	7.46 a	166.43 ab	118.9 a	1857.3 a	1.05 a	163333 b
S3	7.57 a	230.08 a	116.7 a	621.5 a	0.09 a	1136667 b
S4	7.53 a	29.88 b	419 a	597.8 a	0.67 a	4820000 ab
S5	7.27 a	60.53 ab	590.2 a	222.3 a	0.15 a	11005667 a
S6	7.49 a	50.75 ab	164.7 a	103.1 a	0.03 a	424500 b
Level of Significance	Ns	ns	Ns	ns	ns	ns

Legend:
ns – not significant

In a column, means followed by the same letter are not significantly different.

Table 4. Mean biophysico-chemical characteristics of runoff water collected at the different time of the year

TIME (SEASON)	MEAN BIOPHYSICO-CHEMICAL CHARACTERISTICS OF RUNOFF WATER					
	pH	**Color (% A)**	**TDS (mg/l)**	**TSS (mg/l)**	**Phos-phorus (mg/l)**	**Fecal (MPN/100ml)**
IRS	7.26 b	71.5 b	213.2 a	324.3 b	0.22 a	3866667 ab
MRS	8.01 a	25.92 b	160.9 a	240.9 b	0.26 a	184167 b
ERS	7.21 b	281.4 a	484.1 a	1881.6 a	0.62 a	6248000 a
Level of Significance	**	**	ns	*	ns	*

****** - significant at 1% probability level ***** - significant at 1% probability level **ns** – not significant
In a column, means followed by the same letter are not significantly different.
IRS-Initial part of the rainy season **MRS**-Middle part of the rainy season
ERS-End part of the rainy season

Relation of runoff and sediment load

In the island, the sediment load from coconut-based cropping system shows positive significant relation to the type of vegetation. The positive relation of steep slope and high rate of erosion was negated in the study which indicates that even steep slopes could produce minimal eroded solid materials. Furthermore, the total suspended and dissolved solids both from the runoff and seawater showed results better than the quality of Class C water. Good color and pH of seawater could mean minimal sedimentation rate from upland activities.

Seagrass NPP

The same low rate of sedimentation could have been the reason for the dominance of Cymodocea species of seagrass which thrive best in muddy soft bottom substrate. Seagrasses registered higher NPP during the rainy season than the summer season implying that the loaded materials are beneficial to their growth.

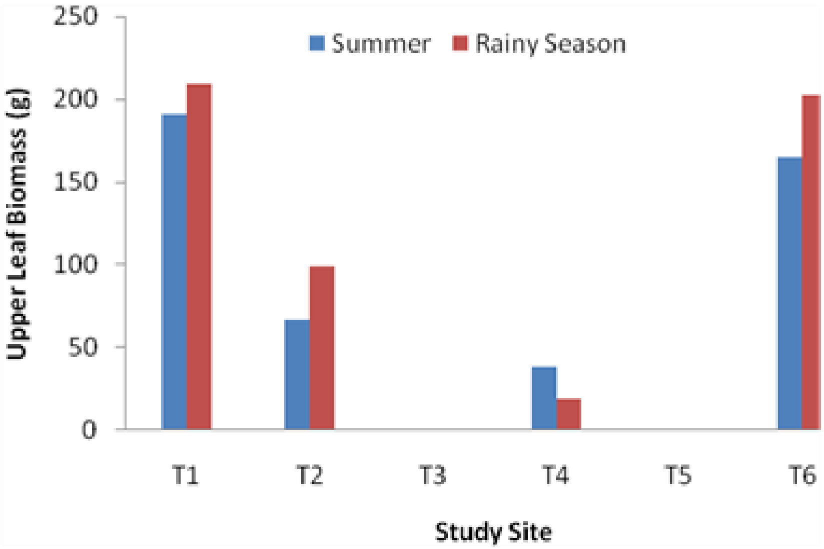

Figure 6. Upper leaf biomass of seagrass during summer and rainy season in the six study sites

Fish productivity

One thing more worth noting in the result of the study are the good gathering techniques of regular and intermittent shellfish gatherers. Doing the activity in various gathering stations in well-spaced and –timed intervals resulted to the sustainability of the highly priced commonly gathered shellfish. The same findings prove to support the family needs of the gatherers. The biology of mollusk species is hard to understand, but islanders know well where, when, to what substrate and to what depth to gather specific species. These good results coincide with the good fish catch. Although there was no previous survey on fish catch for comparison of the result of the present study, the dependence of the people on fish especially during calm weather and the selling of fish to outside markets (Bulan, Sorsogon and Allen, Northern Samar) are indications of such good fish catch. This implies that their livelihood strategy which is farming-fishing has supported the island population since time immemorial up to now. On top of this, the fish catch and monetary returns sufficiently support the cash needs of the fisherman's family. Aside from the daily cash money earned by shellfish gatherers, the protein needs of the people have been supplied. Rice although some are exported and camote fill the food and carbohydrates needs. Similarly, root crops have the nutritional contribution in the diet of every Abaknon. This further means recognition and promotion of the local people's knowledge as it sustains the coastal subsystem. Such recognition would boost local people's self-esteem and assure them of the many things they can do in the conservation of the island resources.

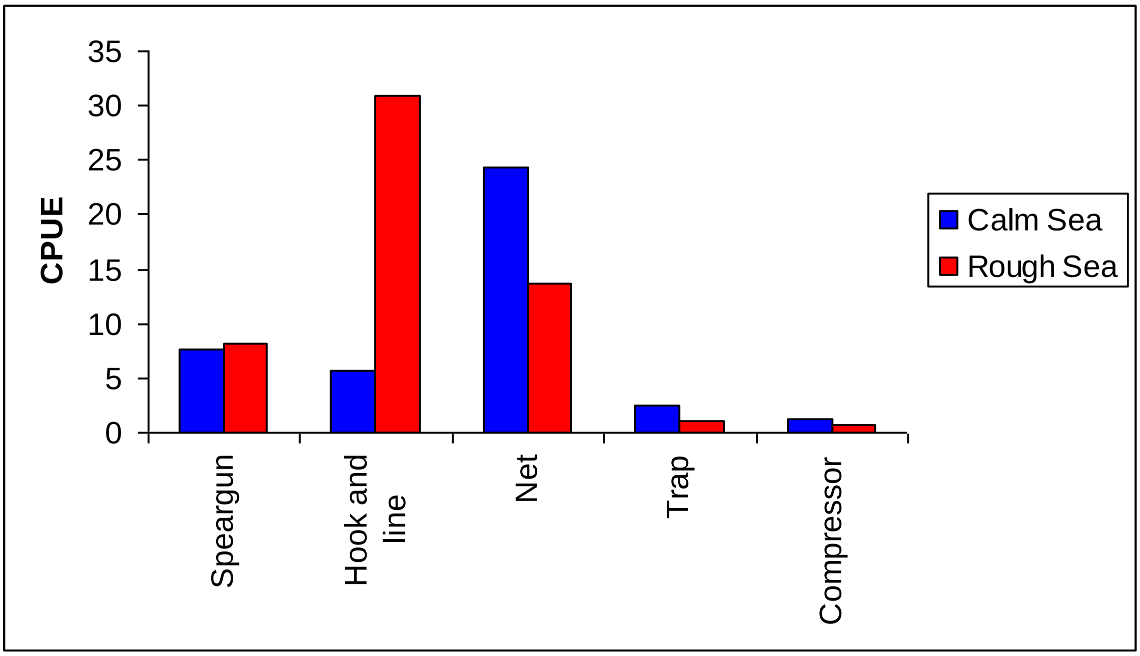

Figure 7. CPUE of five fishing gears during the calm and rough sea periods.

4. CONCLUSION

This study therefore concludes that combined coconut-based farming, fishing and shellfish gathering is the most common form of livelihood in the island of Capul and that it is a conserving and environmentally sound farming system. The Abaknon lived for centuries adapting to and altering the terrestrial and coastal subsystems (as clearly reflected in the conceptual framework). It is important to note that although the island is no longer geographically isolated and modern farming methods and technologies are available, the Abaknon still chose to practice their traditional livelihood strategies. Hence, the Abaknons' local knowledge, beliefs and practices conserved the coastal subsystem, a good indication of the conservation of the entire island.

Traditional knowledge, wisdom and experience are valuable, appropriate and contribute much to the conservation of the island resources. This livelihood strategy depends ultimately on the natural assets expressed in terms of the natural resources of the island and human or man-made assets that households have. These are essential to pursue livelihood.

Multi-cropping, evident among the islanders' farms, was the excellent ecological response to the challenges of the biophysical environment of the island. The utility of slopes for cultivation did not only sustain their basic needs but subsequently protected crops from monsoon winds. This increased production and maximized returns from limited land resources and crude tools. Similarly, both traditional and newly designed fishing gears allowed them to adjust to the erratic weather changes that cause rough seas. Their own ingenuity led to technological innovations that allowed them to be at par with fishers with more advanced gears. Local people of islands with similar marine resource structure may adopt the gears as these made the islanders "ecosystem people", adjusting to the conditions of the environment rather than modify them. But what counts most is their local knowledge of having pre-determined species of fish catch in a pre-determined location which could mean their deep knowledge of the biology and life cycle of fishes.

Significantly, their capability of coping to both natural and man-made adversities made the islanders live in the island for centuries. The islanders' human assets helped shape their physical assets and consequently correlate the geography of climate with the geography of their lives. This may not only be substantial to the islanders but also to those whose biophysical environment is apparently similar to the island being studied.

Furthermore, this study and its findings reflect that the Abaknons' combined livelihood strategy redound to ecosystem conservation that would make the people of the island appreciate and acknowledge the value of their local knowledge on ecosystem management. The findings may not find any impediment on the use of the so-called science-based contemporary resource use strategies and methods. However, they must blend to the protection and management of the island ecosystem. This study therefore believed that the pillars in the conservation of island ecosystem are beliefs and traditions, knowledge development, institutional arrangements and local governance.

The islanders' knowledge developed as the emergent output of the trial and error, their experiences and the deep understanding of the environmental phenomena. Indeed, the local fishing techniques like the use of deceiving artificially carved baits, illustrate the people' intimate understanding of their food source and their environment. This too, was exemplified by the use of traditional calendar for their on-farm and off-farm livelihood activities. Such calendar helped the local people determine what sources of food are available at different times.

The social structure and the close knit units in the island means that there are protocols done particularly in fishing. The group of fishers create/becomes an institution that decisions made by the group especially on matter of disciplines are conveyed through the social channels of communication. A fisherman for instance is not reprimanded through the barangay council but through the group of fishermen. Adhering to illegal practice due to peer pressure is a form of cultural adaptation which redound to the formation of social organizations and belief systems. The social organization provides a structure in which a fisherman defines his relationship to his co-fisherfolk. What further emerges is the understanding of societal responsibility, and the rights and privileges he expects to receive (as being helped in time of disaster for instance). This shows the magnitude of working together which is impossible for one person working alone.

Small-island resource conservation is dependent on the type of assets households and the community have and how these assets are combined and managed. Added concepts which may redound to resource conservation are the concepts of institutional arrangement, governance which may blend to the knowledge development among the islanders. Any weakening in any of these concepts will eventually lead to the degradation of the island resources.

RECOMMENDATIONS

In the desire to make people live with livelihood in harmony with conserved subsystems of the island, various things have to be sustained and to be modified. As was found in the study, the islanders' traditional knowledge, practices and experiences related to their combined farming, fishing and gathering of shellfish are valuable, appropriate and still relevant for the people. This was depicted in the reliance and dependence of the islanders on their traditional practices which sustain their basic and other needs. Local governance need to incorporate therefore, this traditional knowledge into sustainable development planning, contemporary development strategies and resource management arrangements. This opportunity will ensure the islanders not to lose the benefit of the knowledge which has been passed on from generation to generation, reminisce and resume the closer relations the islanders' forefathers had with their environment. This however, would not delimit the external and scientific intervention that would strengthen the practices which was in place for generations.

Human-environment interaction was used to analyze the sustainability of the Abaknon's livelihood and to assess the effects of this livelihood strategy on the coastal subsystem. The Abaknons development of their livelihood is dependent solely on their own assets and resources. This study therefore recommends that in the pursuit of livelihood for economic development and human well-being, government subsidy and support from private sectors need to be recognized in their potential to contribute to livelihoods.

Resource management initiatives will only be successful if approaches are holistic. In this case people's well-being and environmental health must always be emphasized. With the contamination of coliform in the coastal areas as was found in this study, local people must be made aware of the present status of the coastal waters. This will strengthen people's active participation in resource conservation activities. Local government intervention is deemed necessary, too. Passing of municipal ordinances and the like would in effect beneficial.

Furthermore, future studies which will assess the impacts of other livelihood strategies like corn, rainfed and irrigated rice farming would help local planners design mitigating measures before the effects exist. Although upland farming activities were observed not using fertilizers and chemicals this was prevalent in lowland rice farming. Survey on the use of agro-chemicals and their effects to other subsystems would help in designing solutions that would protect the affected subsystem. Moreover, this study found very minimal studies of human-environment interaction in the context of small-islands. Future studies on small-islands will give rich ideas and experiences of their natural assets and how people live with their environment relative to the use of their existing livelihood assets.

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