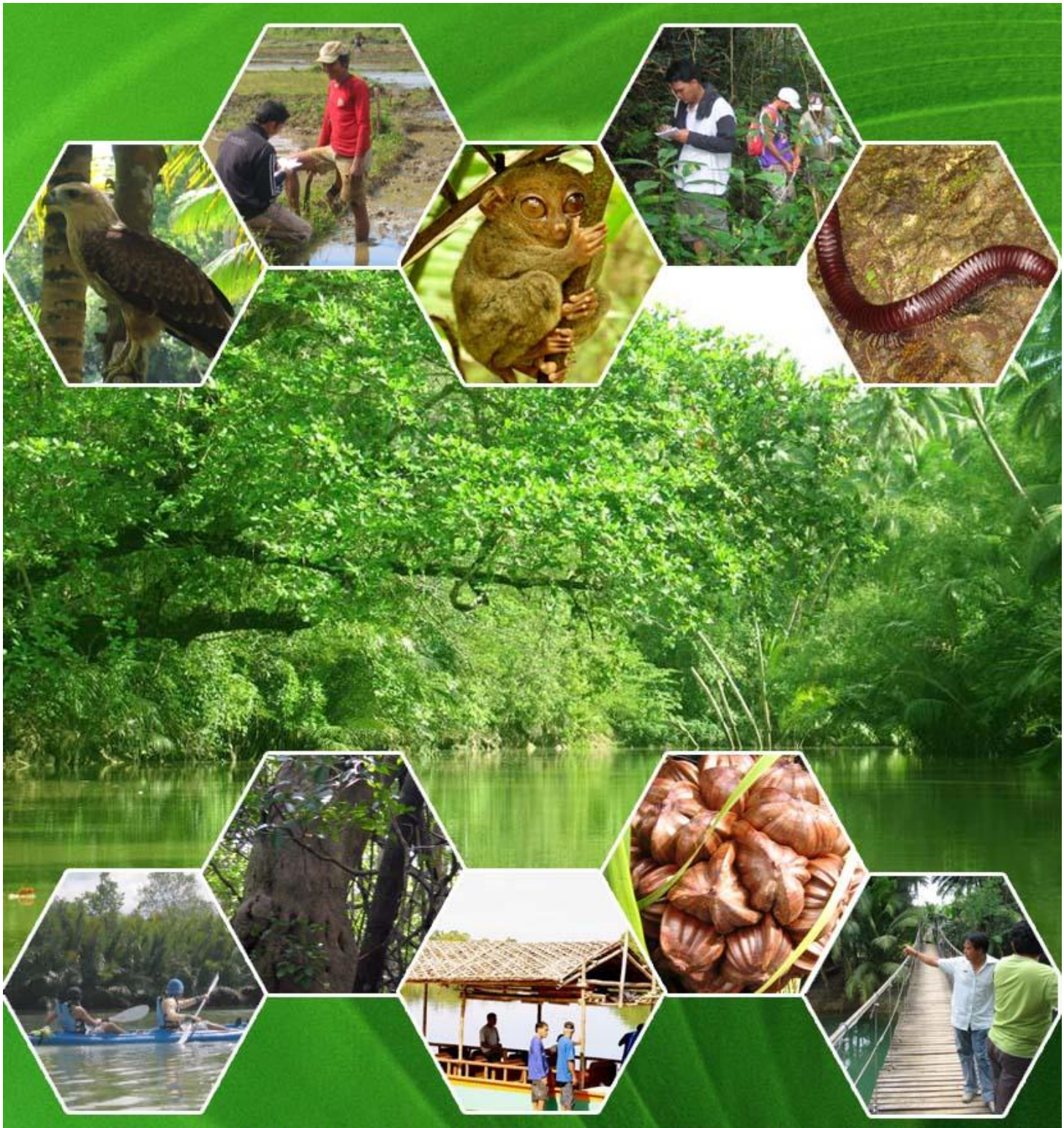


Abatan Watershed Characterization Report and Integrated Watershed Management Plan

Part I

ABATAN WATERSHED CHARACTERIZATION REPORT

I. INTRODUCTION AND BACKGROUND INFORMATION

The Abatan Watershed is the third largest of the 11 major watershed networks that support water needs and other requirements of the island province of Bohol. It covers some 38,628 hectares or close to 9% of the province's total land area. It has three distinct land divisions, coastal, lowland and upland. The coastal areas are marine and not along the most of the river.

Table 1. Municipalities and their barangays comprising the Abatan Watershed

Municipality	Barangay	Percent
1. Antequera	Angilan, Bantolinao, Bicahan, Bitaugan, Bungahan, Can-omay, Canlaas, Cansibuan, Celing, Danao, Danicop, Mag-aso, Poblacion, Quinapon-an, Santo Rosario, Tabuan, Tagubaas, Tupas, Ubojan, Viga, and Villa Aurora	100
2. Balilihan	Baucan Norte, Baucan Sur, Boctol, Boyog Sur, Cabad, Candasig, Cantalid, Cantomimbo, Datag Norte, Datag Sur, Del Carmen Este, Del Carmen Norte, Del Carmen Sur, Del Carmen Weste, Dorol, Haguilanan Grande, Magsija, Maslog, Sagasa, Sal-ing, San Isidro, and San Roque	71
3. Calape	Cabayugan, Sampoangon, and Sohoton	9
4. Catigbian	Alegria, Ambuan, Bongbong, Candumayao, Causwagan, Haguilanan, Libertad Sur, Mantasida, Poblacion, Poblacion Weste, Rizal, and Sinakayanan	54
5. Clarin	Cabog, Danahao, and Tubod	12
6. Corella	Anislag, Canangca-an, Canapnapan, Cancatac, Pandol, Poblacion, and Tanday	88
7. Cortes	Fatima, Loreto, Lourdes, Malayo Norte, Malayo Sur, Monserrat, New Lourdes, Patrocinio, Poblacion, Rosario, Salvador, San Roque, and Upper de la Paz	93
8. Loon	Campatud	1
9. Maribojoc	Agahay, Aliguay, Busao, Cabawan, Lincod, San Roque, and Toril	39
10. Sagbayan	Calangahan, Poblacion, Sagbayan Sur, San Antonio, and Santa Cruz	21
11. San Isidro	Abehilan, Baryong Daan, Baunos, Cabanugan, Caimbang, Cambansag, Candungao, Cansague Norte, Cansague Sur, Causwagan Sur, Masonoy, and Poblacion	100
12. Sikatuna	Abucay Norte, Badiang, Bahaybahay, Cambuac Norte, Cambuac Sur, and Can-agong	67
13. Tubigon	Buenos Aires, Libertad, and Tan-awan	9

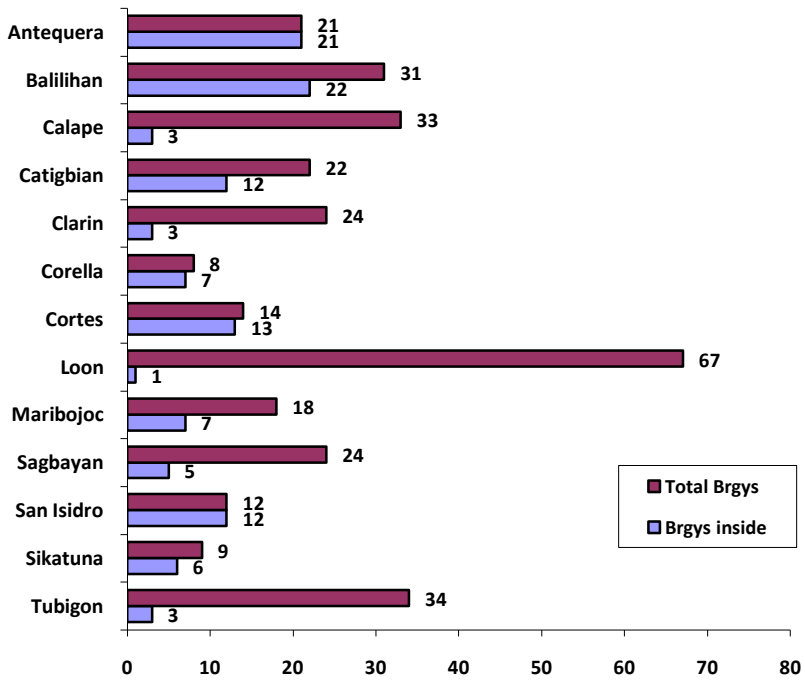


Figure 1. Ratio between Barangays inside Abatan Watershed and Total Barangays per Municipality

The watershed occupies all or parts of 115 barangays in thirteen (13) municipalities (**Table 1**) namely, Antequera, Balilihan, Calape, Catigbian, Clarin, Corella, Cortes, Loon, Maribojoc, Sagbayan, San Isidro, Sikatuna, and Tubigon. Four (4) of these municipalities are considered major as most of their land area is located inside the watershed boundaries. These are the municipalities of Antequera, Balilihan, Catigbian and San Isidro. The combination of these big four municipalities accounts 63% of the total watershed area, or approximately 24,224. has.. The other nine municipalities are deemed minor as they only contain small portions of the watershed (**Table 2**).

Table 2. Land areas of municipalities covered by the Abatan Watershed

Municipality	Total Land Area (Ha)	Area inside Abatan (Ha)
1. Antequera	6,406.92	6,010.65
2. Balilihan	11,833.92	8,626.56
3. Calape	5,795.01	281.05
4. Catigbian	10,043.03	3,946.14
5. Clarin	6,682.54	2,427.60
6. Corella	3,390.07	2,056.07
7. Cortes	3,398.72	2,925.09
8. Loon	10,867.56	5.52
9. Maribojoc	4,586.36	1,715.11
10. Sagbayan	7,110.34	1,432.42

11. San Isidro	5,906.67	5,641.21
12. Sikatuna	3,181.59	1,579.15
13. Tubigon	8,371.72	1,981.67
Total	**87,574.47**	**38,628.24**

The watershed consists largely of alienable and disposable lands (about 85.5% of total area or 33,032 hectares), thus are privately owned. However, the land still has a good vegetative cover of forests, wooded lands, shrubs, and mangroves that cover more than half of the area. This makes for a biologically diverse watershed. About 40% of the watershed (16,094 has) is devoted to the production of agricultural products as almost 60% of the watershed (22,946 has) is on level to undulating to rolling topography with slopes ranging from 0 to 18%. Basically, these areas support the economy of their component municipalities in varying degree according to the area of each municipality within the watershed.

The watershed has a population of 93,987 inhabitants (2007 census), who are generally agriculture dependent. However, the watershed is gifted with several tourist attractions and natural endowments that can be tapped for ecotourism purposes. Nowadays, the Abatan River is being developed as one of the major eco-tourism destinations in the province by a consortium of stakeholders called, the *Abatan River Development Management Council* (ARDMC).

The whole watershed is also considered as a potential source of water supply for nearby Metro Tagbilaran (composed of Tagbilaran City, Dauis, Panglao, and Cortes) and the Panglao Island Tourism Estate (PITE) in the next 25 years.

Annual rainfall of about 1,579 mm, on average, falling on the watershed is more or less evenly distributed throughout the year.

The Abatan Watershed is the nearest major watershed to the capital City of Tagbilaran thus making its natural resources prone to pressure from aggressive urbanization and development. Therefore, in order to enhance and protect its value to people the area should be managed well by the local stakeholders as well as by outsiders who come to enjoy the bounties of nature that are available in the watershed.

II. PRESENT STATE OF THE WATERSHED

2.1 PHYSICAL ENVIRONMENT

2.1.1 GEOPHYSICAL LOCATION

Geographically, the Abatan Watershed is located between 9°40'00" to 9°56'00" north latitude and 123°50'00" to 124°06'00" east longitude. Contiguous to it are the Mualong Watershed on the southwest and the Wahig-Inabanga and the Loboc Watersheds on the north and east, respectively (**Fig. 2**).

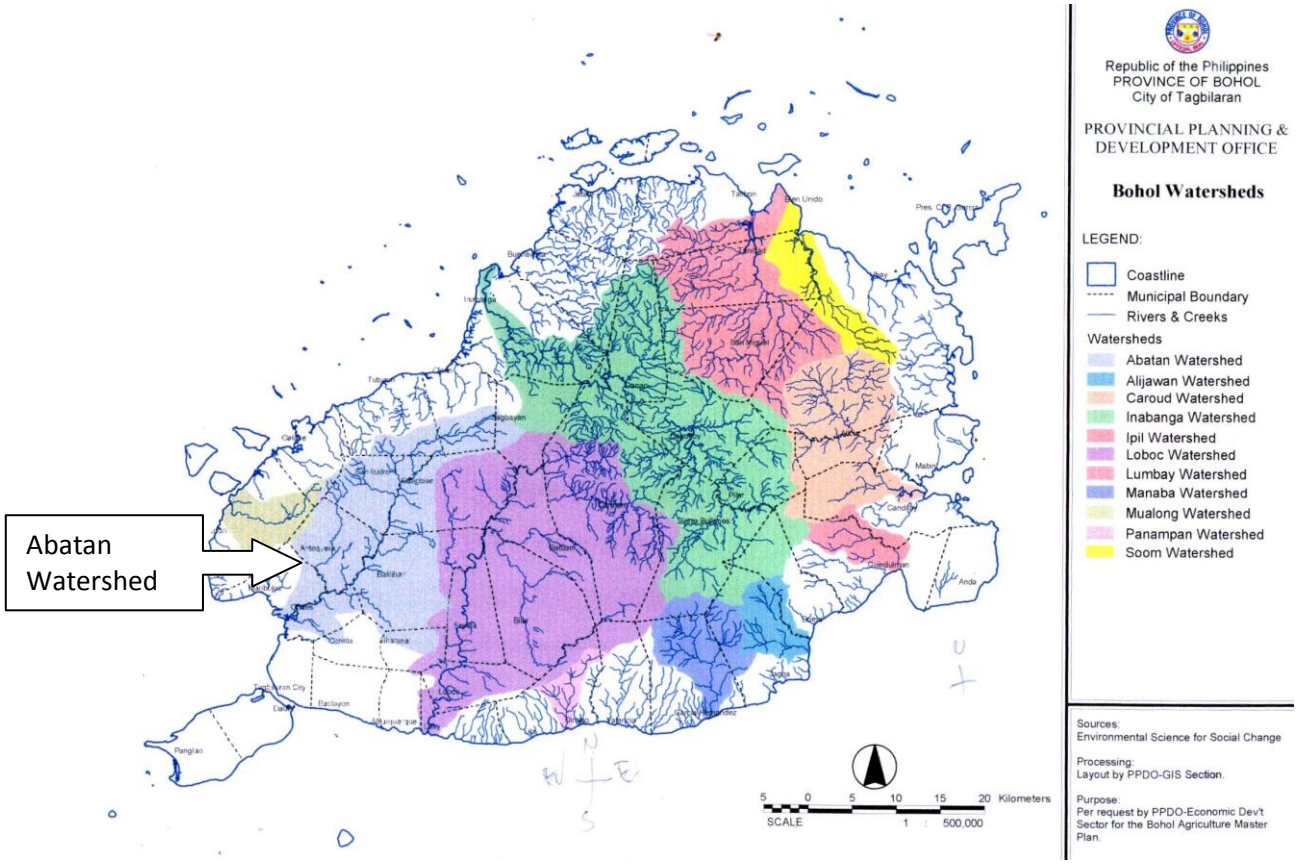


Figure 2. Bohol Map showing Location of Different Major Watershed Networks

Its main drainage system is the Abatan River that provides freshwater to Maribojoc Bay. This river serves as the natural boundary between the municipalities of Maribojoc and Cortes, Antequera and Balilihan, and San Isidro and Catigbian. The river width (bank to bank) varies from 25 to 50 meters up to Sampilangon Bridge linking the municipalities of Catigbian and Tubigon. Its total meandering length from the sea to its headwaters is estimated to be 40 kilometers. Its estuary and delta is located approximately 7 kilometers from Tagbilaran City.

The Municipality of Balilihan contains the most number of barangays comprising the watershed with 22 and followed by Antequera with 21 barangays. Although almost the entire town of San Isidro is situated within the Abatan Watershed at 95.5% or 5,641.21 hectares, the biggest percentage of the watershed belongs to the municipality of Balilihan at 22.33% which is equivalent to 8,626.56 ha (**Fig. 3**). The smallest contributor of land area is the municipality of

Loon with 5.52 ha of barangay Campatud which is barely .01% of the total land area of the whole watershed (**Fig. 4**).

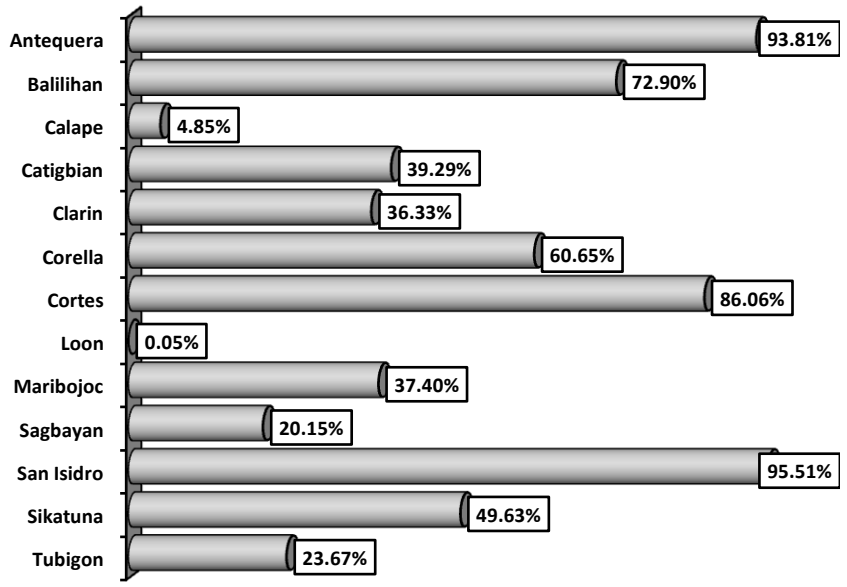


Figure 3. Percentage of Municipalities being covered by Abatan Watershed

Congressional District. Of the 13 municipalities that make up the Abatan Watershed, the municipalities of San Isidro, Sagbayan and Clarin belong to the second congressional district. The larger area is part of congressional District I. Being 100% inside Abatan Watershed and geographically isolated municipality from the rest of District II group of municipalities, San Isidro should have been part of District I in order to attain a truly integrated watershed management.

2.1.2 TOPOGRAPHY/GEO-MORPHOLOGICAL FEATURES

The geo-morphology of a watershed influences the amount and velocity of water moving over land surfaces, determines surface features and topography and is closely related to geology

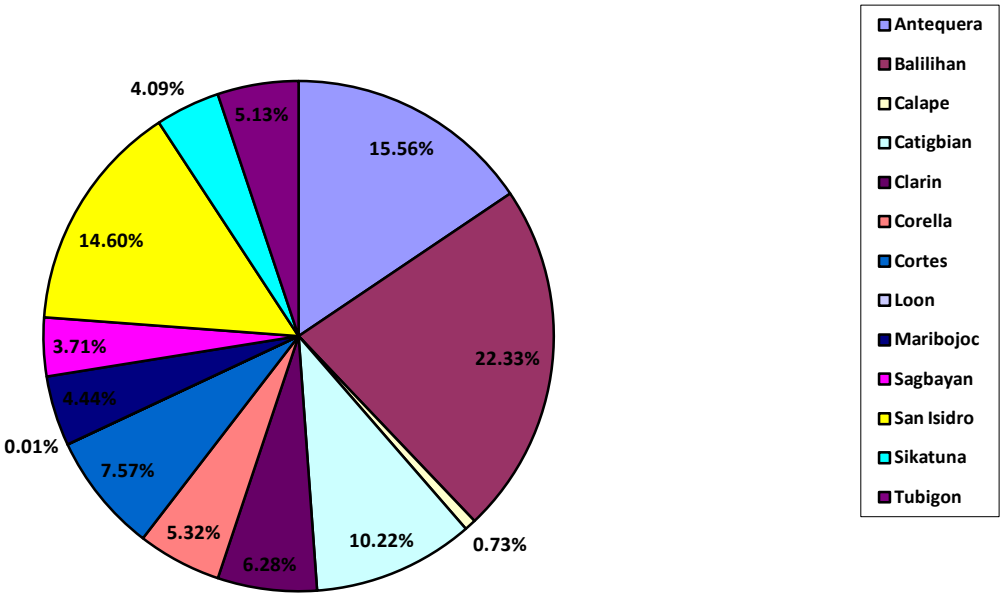


Figure 4. Percentage Share in Abatan Watershed per Municipality

and hydrology. These features are essential in assessing the soil erosion potential and land suitability for various land uses, as well as the design and evaluation of proposed management practices. These features can also provide insights into the hydrologic and other physical behavior of a watershed. . **Table 3** shows the geo-morphological features of Abatan Watershed.

Table 3. Relief features and other geo-morphological parameters of Abatan Watershed	
Parameters	**Whole Watershed**
Watershed Shape Parameters:	
Area (ha)	38,628.24
Area (km²)	386.28
Perimeter (km)	114
Gravelius Form Factor	.31
Bifurcation Ratio (total ratio)	**31**
Elongation Ratio	.63
Circulatory Ratio	.61
Relief Features:	
Relief Ratio	0.013
Relative Relief	0.004
Highest Elevation (masl)	466
Lowest Elevation (masl)	0.0
Mean Elevation	233
Channel Morphology:	
No. of Streams	119
Length of Streams (km)	224.4
Basin Length (km)	35
Drainage Texture Parameters:	
Drainage Density (km/km²)	.58
Stream Frequency/Density	.31

Note: *The terms in the above chart are explained below*.

A. Watershed-shape Parameters

1. Area

The area of a watershed affects the peak flow and the time it takes for a total flood flow to reach a given station. As the size of the watershed increases, peak flow decreases and runoff takes longer time to reach a given station.

The Abatan Watershed covers a total land area of approximately 38,628 ha that serves as its catchment to precipitation. It influences the Maribojoc Bay's mangrove area of 573 ha and coral reefs of 84 ha[1]. The body of the watershed is comprised of 8 sub-watersheds, namely: Magsija, Sal-ing, Sinakayanan, Sampilangon, Danicop, Ugay, Antequera (Tubig Daku) and Bacong. The Sampilangon Sub-watershed is the biggest as it bisects the entire headwaters from the point between Catigbian, San Isidro, and Tubigon up to Sagbayan and Clarin.

[1] Maribojoc Bay Resource Economic Valuation Final Report, 10 January 2005

2. Gravelius Form Factor

This factor is the ratio of the average width to the axial length of the basin. The axial length is measured from the outlet to the most remote point of the basin. The average width is obtained by dividing the area by the axial length. Basin with low form factor is less likely to have intense rainfall simultaneously over its entire extent than an area of equal size with a larger form factor.

$$\text{Average width} = \frac{\text{Area}}{\text{Axial Length}}$$

$$= \frac{386.28 \text{ km}^2}{35 \text{ km}}$$

$$= \mathbf{11.04 \text{ km}}$$

$$\text{Gf} = \frac{\text{Average width}}{\text{Axial length of basin}}$$

$$\text{Gf} = \frac{11.04}{35}$$

$$= \mathbf{.31}$$

3. Bifurcation Ratio

Bifurcation ratio indicates whether the drainage pattern is controlled or not by the area's geologic structure. It is a ratio of the number of streams (in the watershed) of any given order to the number of the streams in the next lower order and its influence on flood surcharges.

Bifurcation ratio of Abatan Watershed is 31 as shown in **Table 3**. Since the figure is high, this indicates that there is a lesser chance of flooding as the water is spread out.

4. Elongation Ratio

In terms of watershed shape factor, elongation ratio is defined as the ratio between the diameter of a circle with the same area as the watershed and the maximum length of the watershed

(distance from the outlet to the farthest point in the watershed). The elongation ratio for Abatan Watershed is computed at 0.63 which means the area is irregular in shape.

5. Circulatory Ratio (compactness coefficient)

Circulatory ratio is the ratio of the circumference of a circle of the same area, as the basin to the basin perimeter. The circulatory ratio is computed at 0.61, meaning that the area is elongated in shape.

6. Basin Length

Basin length is the measure from the outlet of the basin to its drainage divide of its farthest point. The total basin length is 35 kms.

B. Watershed-relief Features

1. Relief Ratio

It is defined as the ratio of the total basin relief to the maximum basin length. Relief ratio is related to sediment yield and is more useful when analyzed together with climatic factors of erosion.

$$\text{Relief Ratio} = \frac{\text{Highest Point} - \text{Lowest Point}}{\text{Maximum basin length}}$$

$$= \frac{466 - 0 \text{ m}}{35{,}000 \text{ m}}$$

$$= \mathbf{0.013 \text{ meter}}$$

Result of the computation reveals that the relief ratio of Abatan Watershed is very low. The low value can be associated to slower transportation rates of sediment produced in an erosion process in the watershed. Due to loss of momentum of the conveying mechanism, considerable sediment deposition occurs mostly in areas of the catchment with low slope, high roughness or very low velocities due to large expansion of flow area.

2. Relative Relief

Relative relief has similar significance to relief ratio and is the ratio of the maximum basin relief to the perimeter length.

$$\text{Relative Relief} = \frac{\text{Highest elevation}}{\text{Perimeter of the basin}}$$

$$= \frac{466 \text{ meters}}{114{,}000 \text{ meters}}$$

$$= \mathbf{0.004 \text{ meter}}$$

A watershed with low relief ratio and relative relief value is almost flat, which indicates a higher time of concentration and low peak flows in comparison to a similar watershed having higher relief.

3. Elevation

The variations in elevation, median and mean elevation of a watershed are important factors related to temperature and rainfall. These factors are also useful in comparing one watershed with other watersheds.

As shown in **Table 4**, about 90% of the watershed is below 300 masl. The drainage system in the upstream section down to the midstream section of the watershed is not well defined probably because of the topography where flat areas are spread out between hills. The highest point of Abatan Watershed, however, is the Candungao peak of San Isidro town at 466 masl.

Table 4. Elevation

Elevation (masl)	Area	
	Hectares	Percent
0-100	13,708	35.5%
100-200	12,690	32.8%
200-300	11,578	30.0%
300-400	610	1.6%
400-500	42	0.1%
Over 500	0	0.0%
Total	**38,628**	**100.0%**

4. Slope

The slope of a watershed is an important factor that has tremendous effect on hydrologic parameters. It affects the magnitude of floodwater, the time of overland flow and the time of rainfall concentration on rivers. When the slope of the watershed is very steep, flooding is likely to occur.

Table 5. Slope Classification			
Slope Category	Slope Range	Area	
		Hectares	Percent
Level to gently sloping	0-8%	14,226	36.8%
Moderate	8-18%	8,720	22.6%
Steep	18-30%	8,678	22.5%
Very Steep	30-50%	6,627	17.1%
Severely Steep	≥50%	377	1.0%
Total		**38,628**	**100.0%**

The terrain of Abatan Watershed from the coastal up to the mountain area is quite varied as shown in **Table 5**. Areas below 18% slope, where agriculture is best suited, cover more almost 60% of the watershed. Rolling terrain with slope between 18-30% constitutes only about 8,678 ha, roughly 22.5% of the total area while very steep areas with slope ranging from 30-50% cover an area of 6,627 ha (17.1%). Areas above 50% slope where extraction activities should be restricted or not permitted cover less than one percent of the watershed. Presented in **Annex A-5** is the slope distribution within the watershed.

C. Channel Morphology

Knowledge of channel morphology is useful in correlating hydrologic and sediment characteristics of a watershed, as well as in predicting the performance of ungauged areas.

Table 6. Channel Morphology and Bifurcation Ratio of Various River Systems or Tributaries

Name of River	No. of Streams	Total Length of Stream (km)	Bifurcation Ratio
1. Magsija			
1st Order	4	9.2	-
2nd Order	2	3.3	2.0
Total	**6**	**12.6**	**2.0**
2. Sal-ing			
1st Order	4	10.9	-
2nd Order	2	8.6	2.0
Total	**6**	**19.5**	**2.0**
3. Sinakayanan			
1st Order	2	1.8	-
2nd Order	1	4.6	2.0
Total	**3**	**6.48**	**2.0**
4. Sampilangon			
1st Order	8	18.9	-
2nd Order	6	16.3	1.3
Total	**14**	**35.2**	**1.3**
5. Danicop			
1st Order	6	10.5	-
2nd Order	4	9.2	1.5
Total	**10**	**19.7**	**1.5**
6. Ugay			
1st Order	8	11.5	-
2nd Order	5	6.1	1.6
Total	**13**	**17.6**	**1.6**
7. Antequera/Tubig Daku			
1st Order	4	9.8	-
2nd Order	2	1.9	2.0
3rd Order	1	15.4	2.0
Total	**7**	**27.1**	**4.0**
8. Bacong			
1st Order	2	6.6	-
2nd Order	1	2.0	2.0
Total	**3**	**8.6**	**2.0**
9. Abatan (Main) River			
1st Order	27	32.8	-
2nd Order	11	15.2	2.4
3rd Order	8	10.6	1.3
4th Order	10	13.4	0.8
5th Order	1	4.9	10.0
Total	**57**	**76.9**	**14.5**
Overall Total	**119**	**224.4**	**31.0**

D. Drainage Features of the Watershed

1. Drainage Density

Drainage density measures the efficiency with which a stream collects and discharges available water. It is a measure of how well or how poorly a watershed is drained by stream channels. It is equal to the reciprocal of the constant of channel maintenance and equal to the reciprocal of two times the length of overland flow.

Drainage density depends upon both climate and physical characteristics of the drainage basin. Soil permeability and underlying rock type affect the runoff in a watershed; impermeable ground or exposed bedrock will lead to an increase in surface water runoff and therefore to more frequent streams. Rugged regions or those with high relief will also have a higher drainage density than other drainage basins of the same other characteristics.

Drainage density can affect the shape of a river's hydrograph during a rain storm. Rivers that have a high drainage density will often have a more 'flashy' hydrograph with a steep falling limb. High densities can also indicate greater flood risk.

For the Abatan Watershed, the drainage density is quite low at .58 km/km² only. Therefore, incidence of flooding is less likely to occur.

$$Dd = \frac{L}{A} = \frac{\text{Total length of stream}}{\text{area of watershed}}$$

$$= \frac{224.4 \text{ kms.}}{386.28 \text{ kms.}^2}$$

$$= \mathbf{.58 \text{ km/km}^2}$$

2. Stream Density

Stream density or frequency is the number of streams per unit area. Abatan Watershed has one (1) stream for every 4 km² with an average length of 2.32 km as presented in **Table 3**. Stream density/frequency is much related to the infiltration capacity of the basin. Assuming that all other factors are constant, more streams will be developed in a watershed where the soil infiltration capacity is low.

$$DS = \frac{N}{A} = \frac{\text{Number of streams}}{\text{area of watershed}}$$

$$= \frac{119}{386.28 \text{ kms}}$$

= 0.31 km

3. Length of Overland Flow

Water runoff in Abatan Watershed has to travel over one-tenth of a kilometer (155 meters) before reaching and concentrating into permanent channels.

$Fl = ½ \times Dd$

$= ½ \times .31$

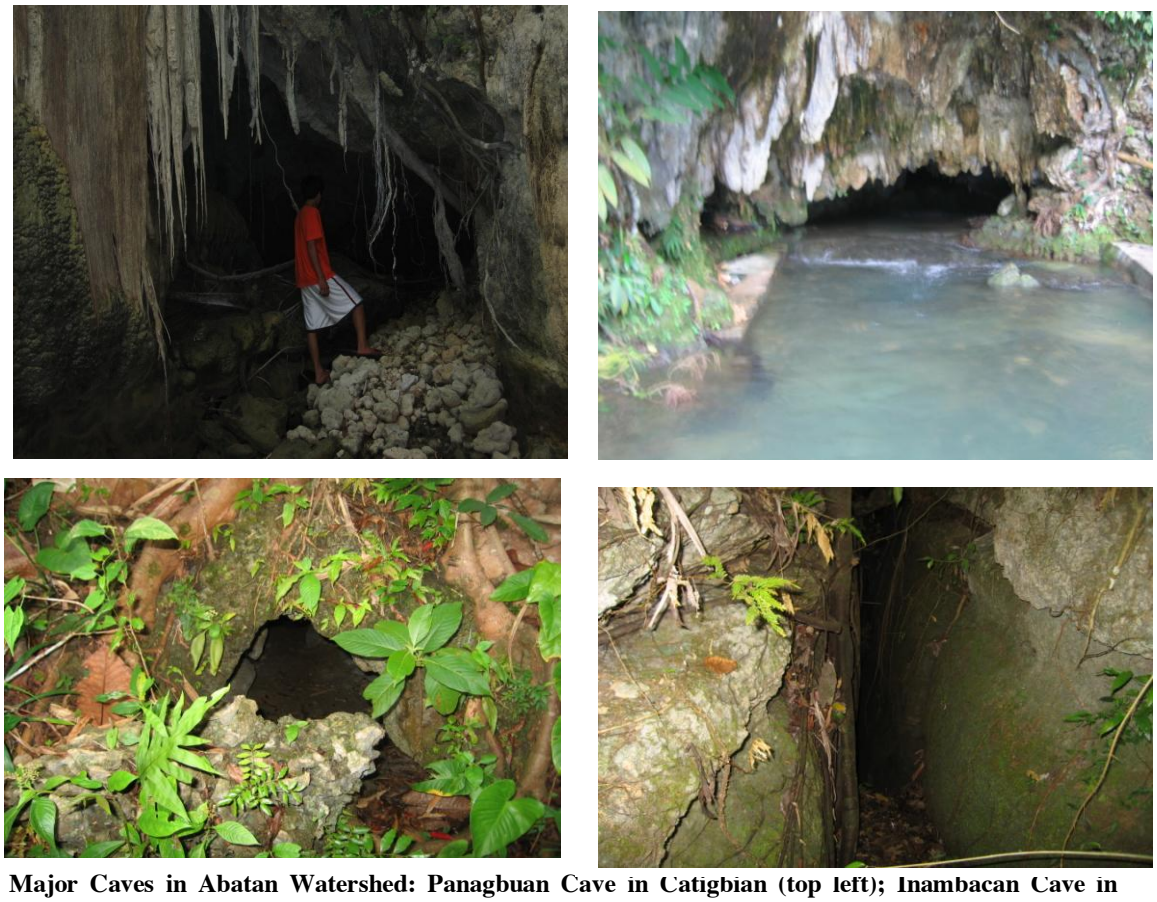
= .155 km

2.1.3 GEOLOGY

Based on the Provincial Geological Map, majority of the watershed falls under the Maribojoc Limestone Formation. There is small portion of alluviumin the low lying areas near the outlet of the Abatan River and area under the Carmen Formation along the Abatan River as well as at the edge of the watershed in Calape, Tubigon and Sikatuna. The Maribojoc Limestone Formation is composed of conglomerate, marl and limestone. It unconformably overlies the Carmen Formation.

The **Maribojoc Limestone** is highly coralline, bedded to massive, soft, chalky, non-compact and marly. Where composed of coralline reef and reef sands, Maribojoc limestone is highly porous and forms the water aquifer. This is confirmed by the presence of wells drilled in this area. The limestone permeability is very high and runoff is practically non-existent over this formation as indicated by poorly developed drainage network. Consequently, runoff occurs only during intensive rainfall, otherwise most of the effective rainfall infiltrates underground. When marls and clay layers are intercalated with Maribojoc limestone, artesian conditions and springs do occur. The limestone exhibits numerous sinkholes, caves and caverns, which are the product of chemical weathering of carbonate rocks, characteristic for karst terrains. Normally, in such aquifers, water table could be quite deep.

Table 7. Major Caves		
Name of Caves	**Location**	**Potential Use/s**
1. Inambacan	Villa Aurora, Antequera	Eco-tourism, water source
2. Hagakhak	Villa Aurora, Antequera	Eco-tourism
3. Camantong	Quinapon-an, Antequera	Wildlife habitat (pythons), Eco-tourism
4. Quinapon-an	Quinapon-an, Antequera	Dry, wildlife habitat
5. Esteban (Buhong Tiawan)	Tagubaas, Antequera	Dry, wildlife habitat
6. Magdahunog	Tabuan, Antequera	Eco-tourism & recreation
7. Sal-ing	Sal-ing, Balilihan	Dry, wildlife habitat
8. Dual	Dorol, Balilihan	Wildlife habitat, guano
9. Boho	Del Carmen Sur, Balilihan	Wildlife habitat
10. (Unnamed cave)	Del Carmen Sur, Balilihan	Water source
11. Poblacion	Poblacion, Catigbian	Water source, wildlife habitat
12. Panagbuan	Poblacion Weste, Catigbian	Water source, wildlife habitat
13. Candumayao	Candumayao, Catigbian	Eco-tourism, water source
14. Libertad Sur	Libertad Sur, Catigbian	Wildlife habitat
15. Cantigjong	Cansague Sur, San Isidro	Wildlife habitat, guano
16. Matin-ao	Cansague Sur, San Isidro	Wildlife habitat, guano
17. Casya	Cabanugan, San Isidro	Dry, wildlife habitat
18. Lahung	Cabanugan, San Isidro	Water source
19. (Unnamed cave1)	Caimbang, San Isidro	Water source
20. (Unnamed cave2)	Caimbang, San Isidro	Wildlife habitat
21. Botong	Caimbang, San Isidro	Wildlife habitat



Major Caves in Abatan Watershed: Panagbuan Cave in Catigbian (top left); Inambacan Cave in Antequera (top right); Botong Cave in San Isidro (below left); Dual Cave in Balilihan (bottom right)

The karst formation, has endowed the Abatan Watershed with many caves (**Annex A-6**). Based on the inventory conducted, there are 21 major caves existing in the watershed. Seven (7) of

these are in San Isidro, 6 in Antequera, 4 each in Balilihan and Catigbian. These caves are found to be prospective source of water for drinking and irrigation, habitat of wildlife especially for cave swifts and bats, and rich in mineral deposits such as guano and rock phosphate. Four of the caves have a potential for eco-tourism development if proper community-based systems can be established.

Carmen Formation, which outcrops are found in the lower portion of the watershed, is composed of extensive layers of shale, sandstone, siltstone, and marl of low permeability. The open dug and shallow wells drilled in this formation indicate predominantly shallow water-table aquifer that is readily recharged during rainy season. This formation has poor a potential for development of economic quantities of groundwater for Level III system, but can provide water for domestic purposes through shallow wells suitable for Level I systems.

Quaternary Alluvium covers a small area along the Abatan River. Riverbed deposits consist of undifferentiated layers of mud, clay, silt, sand and gravel. This formation has a good groundwater development potential, in places where permeable sand and gravel layers prevail, primarily because of riverbed infiltration.

2.1.4 SOIL

Soils can be enormously complex systems of organic and inorganic components. Here, the discussion will concentrate on a few of the most significant properties: texture, structure, bulk density and permeability, erosion condition, fertility, and depth.

The major soil types found in Abatan Watershed are clay and clay loam. The clay type belongs to the Annam, Bolinao, Lugo, Sevilla, and Inabanga series, while the clay loam type is from the Batuan and Calape series. The rest are classified as Batuan-Faraon complex and Hydrosol. In general, 17,235 ha or 44.6% of the soil in the watershed is clay and 3,000 ha or 7.8% is clay loam. The remaining 47.6% is classified under the Batuan-Faraon complex (18,167 ha) and hydrosol (226 ha).

Table 8. Distribution of Soil Types

Soil Type/Series	Hectares	Percent
Annam Clay	2,730	7.1%
Batuan-Faraon Complex	18,167	47.0%
Batuan Clay Loam	2,617	6.8%
Bolinao Clay	7,354	19.0%
Calape Clay Loam	383	1.0%
Hydrosol	226	0.6%
Lugo Clay	4,883	12.6%
Sevilla Clay	2,268	5.9%
Total	**38,628**	**100.0%**

Presented in **Annex A-9** is the soil type distribution in the watershed. The area distribution is summarized in **Table 8**.

A. Soil Texture

Soil texture refers to the relative proportion of sand, silt and clay size particles in a sample of soil. Clay size particles are the smallest being less than .002 mm in size. Silt is a medium size particle falling between .002 and .05 mm in size. The largest particle is sand with diameters between .05 for fine sand to 2.0 mm for very coarse sand. Soils that are dominated by clay are called fine textured soils while those dominated by larger particles are referred to as coarse textured soils. Soil textures can be divided into ***soil texture classes***. A soil texture triangle is used to classify the texture class (see below).

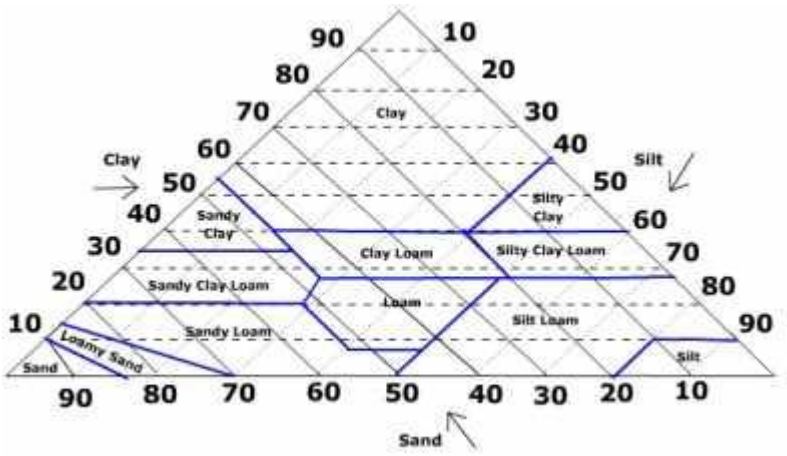


Figure 5. Soil Texture Triangle

Practical observations on the textural class and colour of the soils taken from the runoff plots at different elevations in the watershed are as follows:

A. Upper Watershed (Catigbian)

- area with soil and water conservation measures – sandy clay, black
- open cultivated – clay loam, reddish brown

B. Middle Watershed (Balilihan & Antequera)

- shaded area with Mahogany platation cover – clay, black color
- shaded area with natural forest cover – clay loam, dark grayish brown

C. Lower Watershed (Cortes)

- cultivated area planted with cassava – sandy clay, light grayish in color
- grassland – clay, reddish in color

Clayey soils can be classified as fine-textured soil. Generally, clayey soils have clay content of at least 35% and in most cases not less than 40%. They have a high water holding capacity and high cation exchange capacity (CEC) because clay soils not only have large surface area, but are also electrically charged. Therefore, the charge gives clay soils the capacity to hold water molecules and essential plant nutrients on its surface. The surface area per weight of soil is inversely proportional to the diameter of soil particle.

The CEC is a value given on a soil analysis report to indicate its capacity to hold cation nutrients. The CEC of the soil is determined by the amount of clay and/or humus that is present.

On the other hand, clay loam soil exhibits a loamy soil type but dominated by clay. In most cases, the textural name may be modified depending on the dominance of soil separates present.

B. Soil Structure

Soil structure is the aggregation of primary soil particles into compound particles or clusters, in terms of grade (structureless, weak, moderate, strong); size (very fine, fine, medium, coarse and very coarse); and shape or form (platy, prismatic, columnar, blocky, sub-angular or crumb). It is determined by how individual soil granules clump or bind together and aggregate, and therefore, the arrangement of soil pores between them. Soil structure has a major influence on water and air movement, biological activity, root growth and seedling emergence.

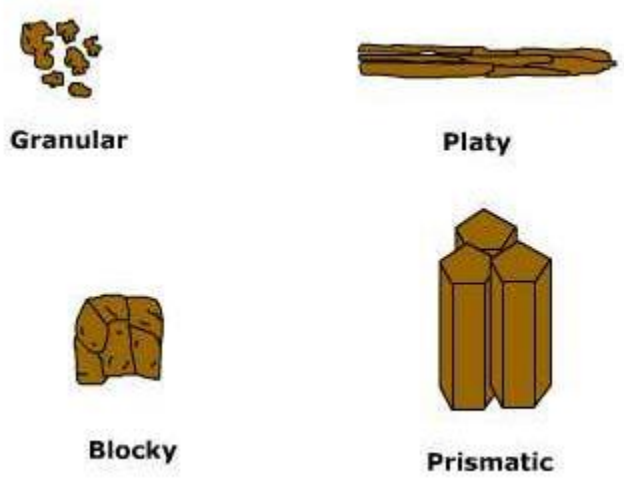


Figure 6. Common Soil Structure Forms

It has been observed that most soils in the watershed are generally platy in structure that looks like stacks of dinner plates overlaying one another. This structure tends to impede the downward movement of water and plant roots through the soil. Generally, it has weak soil structure having fine to medium soil particles.

C. Bulk density and Permeability

Bulk density of a soil is the mass per unit volume including the pore space. Bulk density increases with clay content and is considered a measure of the compactness of the soil; the greater the bulk density, the more compact the soil. Compact soils have low permeability, thus inhibiting the movement of water downward.

Permeability is the degree of connectivity between soil pores. A highly permeable soil is one in which water runs through it quite readily. Coarse textured soils tend to have large, well-connected pore spaces and hence high permeability.

Most soils in Abatan Watershed are observed to be compact brought about by the clayey type and further compacted due to human activities, especially in agriculture. It does mean that the area is high in bulk density but slightly low in soil permeability resulting in only a fair infiltration and percolation and circulation rates below the surface.

On the other hand, studies indicated that clayey soil texture has higher water holding capacity compared to other soil types including clay loam soils. This implies that these soils hold more water.

D. Erosion Condition

In general, soil erosion is not a serious problem in Abatan Watershed. This could be attributed to the good cover where majority of the area is currently vegetated with tree species. Changing the current use or vegetative cover to agricultural uses, however, could result to serious erosion in the watershed.

Table 9. Erosion Condition

Erosion Susceptibility	Area	
	Hectares	Percent
No apparent erosion	6,195	16.0%
Slight erosion	25,265	65.4%
Moderate Erosion	7,099	18.4%
Severe Erosion	69	0.2%
Very Severe	0	0.0%
Total	**38,628**	**100.0%**

Using the soil erosion parameters and indices, such as rainfall erosivity, soil erodibility, slope, vegetative cover, and disturbances of the Soil Erosion Design Curve Model, the watershed can be characterized in terms of soil erosion susceptibility. The results show that about 82% of the watershed has no apparent erosion to only slight erosion, while the areas considered having severe erosion covers only less than 1 percent.

Presented in **Annex A-14** is the erosion susceptibility of Abatan Watershed while the area and percentage distribution of erosion susceptibility is shown in **Table 9**.

E. Soil Fertility

As plant material dies and decays it adds organic matter in the form of humus to the soil. Humus improves soil moisture retention while affecting soil chemistry. Cations such as calcium, magnesium, sodium, and potassium are attracted and held in humus. These cations are rather weakly held to the humus and can be replaced by metallic ions like iron and aluminum, releasing them into the soil for plants to use. Soils with the ability to absorb and retain exchangeable cations have a high cation-exchange capacity. Soils with a high cation-exchange capacity are more fertile than those with a low exchange capacity.

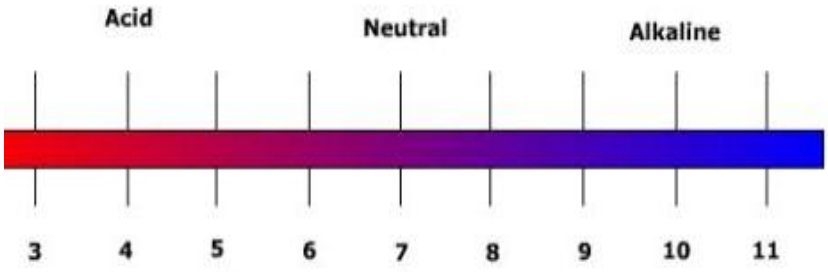


Figure7. Soil pH

Hydrogen ion concentration in the soil is measured in terms of the ***pH scale***. Soil pH ranges from 3 to 10. Pure water has a pH of 7 which is considered neutral, pH values greater than seven are considered *basic or alkaline*, below seven *acidic*. Most good agricultural soils have a pH between 5 and 7. Though acidic soils pose a problem for agriculture due to their lack of nutrients, alkaline soils can pose a problem as well. Alkaline soils may contain appreciable amounts of sodium that exceed the tolerances of plants, contribute to high bulk density and poor soil structure. Alkaline soils are common in semiarid regions.

Soil samples collected from the 3 sampling stations in each of the upper, middle and lower elevations of watershed were found to be generally poor in plant nutrients. **Table 10** has shown that essential elements, especially from organic matter, needed by the plants to grow are very low. However, there are 3 sites all in the upper elevation that are rich in potash.

Collection of soil samples in upper elevation; collected soil sample for lab analysis

Although, the 9 sites have pH value within the range for humid-region soils based on **Fig. 7** bar scale, Lots No. 8 and 9 are recommended to apply their respective farms with lime at a dose of 1 ton per hectare per cropping season until the soil acidity is neutralized. As indicated in **Table 10**, all the 9 sampling sites are deficient in organic matter and Phosphate (P_2O5) elements, but there are 4 of them that are satisfactorily rich in Potash (K_2O). Ideally, soils should have at least 100ppm of Phosphate and 150ppm of Potash to grow cash crops.

The acidic farm lots are presently planted with rice, corn, banana, coconut, cacao and mango. The less acidic soils, meanwhile, are grown mostly of vegetables, like ampalaya, eggplant, okra, squash, upo, tomatoes, patola, sayote and pechay.

Table 10. Soil Test Results

Elevations	Lot Owner	Location	Lab No.	Results of Analysis			
				pH	OM (%)	P_2O5 (ppm)	K_2O (ppm)
Lower	Adelfa Abanco	Poblacion, Cortes	-	7.50	3.60	23.1	44
	Segundo Gentallan	San Roque, Maribojoc	-	7.10	2.50	16.5	18
Middle	Crsipina Gementiza	Tabuan, Antequera	SCc 84	6.57	2.50	4.30	S
	Ma. Corazon Oñes	Boctol, Balilihan	2263	7.6	1.0	13.40	26.70
Upper	Siony	Masonoy, San Isidro	SCC 52	5.70	1.57	19.50	S
	Diosdado Apolinario	Candungao, San Isidro	SCC 55	6.98	1.19	4.30	D
	Luis Patulilic	Baryong Daan, San Isidro	-	7.20	3.00	8.5	90
	Catalino Andamon	Buenos Aires, Tubigon	-	5.40	3.30	16.5	76
	Ambrosio Limocon	Alegria, Catigbian		5.50	2.80	4.0	18

OM – Organic Matter; P_2O5 – Phosphate; K_2O – Potash; ppm – parts per meter; S – Satisfactory; D- deficient

F. Soil Depth

There were established 3 sampling stations in each at the upper, middle and lower elevations for a total of 9 stations overall (**Annex A-20**). Each air-dried soil sample was submitted to the soils laboratory at the Bohol Agricultural Promotion Center (B-APC) for analysis.

2.1.5 LAND CLASSIFICATION/LEGAL STATUS OF LAND

The majority of the watershed (about 85.5%) has been classified as alienable and disposable (A&D) lands that have likely been transferred to private ownership. The remaining 14.5% belongs to the timberland classification (**Table 11**).

Pursuant to PD 705, areas with slopes greater than 18% are classified as uplands, and ideally 40% of watershed should be classified as timberlands. In the case of Abatan Watershed, areas with over 18% slopes are totaled 40.6% but the actual classification is only 14.5% timberlands.

Table 11. Land Classification

Land Classification	Area	
	Hectares	Percent
Forestland	5,596	14.5%
Alienable and disposable land	33,032	85.5%
Total	**38,628**	**100.0%**

2.1.6 LAND CAPABILITY

The production of plants and animals and the allocation of different sub-watersheds for the best uses will largely depend on the capacity of land to support to such combinations. The most appropriate term for this type of production is agroforestry. It is a system of land management whereby forest and agricultural products are produced on appropriate and suitable areas simultaneously or sequentially for the social, economic and ecological benefits of the community (PCARRD, 1979).

In 1994, the University of the Philippines in Los Baños, Laguna had devised a user-friendly tool for land resource evaluation for agroforestry called ALCAMS or Agroforestry Land Capability Mapping Scheme. The development of ALCAMS model was based on the concept of agroforestry as a land-use system with the twin objectives of production involving multi-components (trees, crops, animal/fish) in various schemes.

There are three (3) significant factors to be considered in ALCAMS:

a) slope, as an indicator of erosion potential;
b) existing vegetation or land-use as an indicator of tree, crop, animal adaptation and their current level of production, and;
c) soil fertility, as an indicator of production potential and sustainable production levels.

Measurements and observations on the 3 factors are made following these specifications:

Slope	Vegetation/Land Use	Soil Fertility
S1 : 0 -18%	L1 : Forest	F1 : High
S2 : 18-25%	L2 : Brushland/Pasture	F2 : Medium
S3 : 25-50%	L3 : Open, Cultivated	F3 : Low
S4 : > 50%	L4 : Alienable and disposable	

Based on the measurements/observations, the land area is classified accordingly using the following criteria:

Class I - Highly capable for Agroforestry

Any combination with S1 plus L2 or L3 or L4 plus F1 or F2 or F3.

Class II - Marginally capable for Agroforestry

Any of the following combinations:

S1 plus F3; S2 or S3 plus L2 or L3 or L4 plus F1 or F2 or F3.

Class III- Conditionally capable for Agroforestry

Any combination with S4 plus L2 or L3 plus F3.

Class IV- Not for Agroforestry use

S4 plus L1 and/or other not included in specification.

Given these ALCAMS specifications, nearly 60% of the Abatan Watershed falls under Class I, meaning highly capable for agroforestry, about 22% is Class II or marginally capable for agroforestry, and some 17% is Class III or conditionally capable for agroforestry. Only 1% can be classified as Class IV or not suitable for agroforestry because of extreme condition, mostly severely steep slopes along the riverbanks of the main Abatan river system.

2.1.7 LAND USE

Only about 5.6% of the watershed remains under a closed forest canopy. Nevertheless, a large percentage of almost 60% of the watershed has managed to remain under good vegetative cover consisting of forest and other wooded lands, shrubs and mixed mangrove species and nipa

plantation (**Table 12**). This has been notwithstanding that no formal protection mechanisms for maintaining stable ground cover or land use have been put in place.

Table 12. Present Land Uses in the Abatan Watershed		
Vegetative Cover/Land Use	**Area**	
	Hectares	**Percent**
Closed Forest	2,177	5.6%
Wooded Lands	4,791	12.4%
Other wooded land, shrubs	13,892	36.0%
Mangrove	219	0.6%
Nipa	871	2.3%
Paddy rice non-irrigated	3,875	10.0%
Paddy rice irrigated	356	0.9%
Coconut	4,601	11.9%
Corn	7,262	18.8%
Built-up area	584	1.5%
Total	**38,628**	**100.0%**

The existing general land use pattern of the watershed is typical of Philippine rural communities, predominantly agricultural, with settlements widely dispersed and scattered. Houses are constructed along the road or in the middle of their farms, which makes it difficult to introduce basic facilities and services. There are areas, however, where the concentration of settlements is located near their sources of livelihood.

2.1.8 CLIMATE

Climate has been described as the sum of the prevailing weather conditions of a place over a period of time in terms of rainfall distribution in a locality. The Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) utilizes three climatic classification systems, namely: Corona, Hernandez, and Koppen. The Corona classification gives emphasis on season type, the Hernandez on the number of wet and dry months, and the Koppen on the temperature range and the amount of rainfall in the driest month.

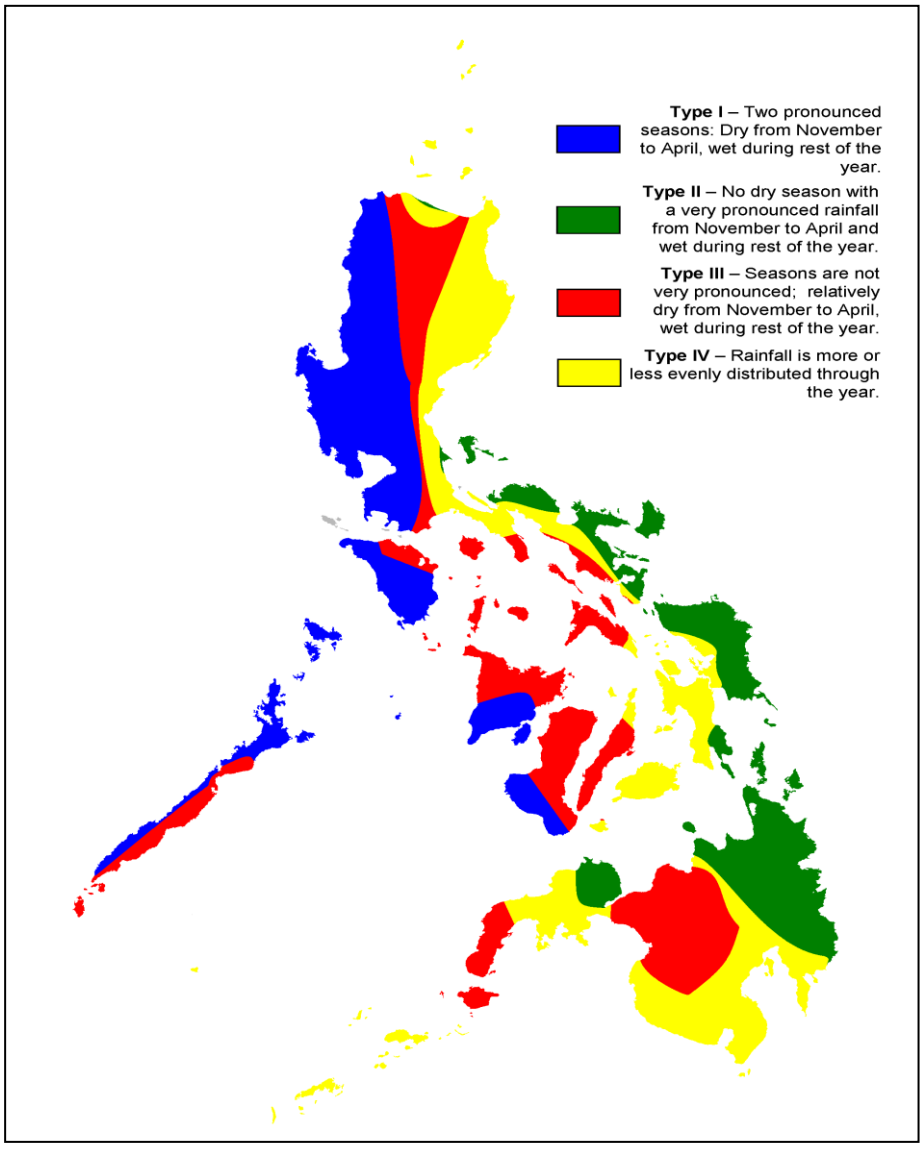


Figure 8. Philippine Climatic Map

Based on Corona Climatological Classification, the climate of the province of Bohol falls under the Type IV as reflected in **Fig. 8**. This is characterized by more or less evenly distributed rainfall throughout the year. The climate is influenced by southwest-originating monsoons, and is relatively dry from March to May. The wet season is from June to December with mean monthly rainfall averaging about 112mm to 182mm. the wettest months are October and November.

Similarly, under the Hernandez classification, the watershed belongs to Type A or rainy throughout the year and under Koppen, Type A for tropical wet climate.

Atmospheric temperature observations for Bohol are obtained from PAGASA's synoptic station in Tagbilaran City. The monthly mean air temperature recorded at the station ranges from 26.5°C to 28.7°C with the annual average being 27.7°C. The values indicated show that

temperature is fairly uniform throughout the year. The air temperature in the watershed can be considered low. This can be attributed to the mountains, alignment of the area and the prevailing winds that tend to reduce the movement of warm air from the sea and promote outflow from the watershed. As a result of these lower temperatures, the capacity of air to absorb water vapor (evaporation) is low. However, ground and water surface temperatures have a significant effect in the evaporation process.

The mean annual relative humidity recorded is 81.3% with monthly averages varying between 78 and 85%. Higher humidity is experienced from December to March.

Meanwhile, rainfall distribution is influenced by the prevailing air streams, the intertropical convergence zone (ITCZ) and the island's topography. The average annual rainfall in the watershed is about 1,360mm and the minimum monthly rainfall normally occurs in March at 62.8mm with about 10 rainy days while the maximum monthly rainfall occurs in November at 182mm with 18 rainy days.

Basically, the Abatan Watershed is out of typhoon belt and seldom experiences severe weather disturbances. The southwest monsoon usually starts during the month of July and lasts until October which is considered as the wettest months. Based on the observation of local residents, rainfall distribution and intensity is affected by the orographic effect of the topography thus, the distribution varies with the interior mountainous landscapes receiving greater rainfall as compared to the coastal and offshore islands. These values indicate that there is a very large variation in rainfall, not only between different locations, but from year to year.

The atmospheric pressure, derived from published mean annual isobars, ranges from 1,008.2 to 1,009.5 millibars with an average being approximately 1,008.9 millibars. Barometric pressures recorded at the synoptic station in Tagbilaran City averages 1,011.7 millibars and vary between 1,022.4 and 998.2 millibars. At these pressures, relative humidity can become quite high, which in turn may reduce the evaporation rate.

The prevailing wind direction from November to April is towards northeast with an average speed of 2 miles per hour. The months of May to October experience gentler winds oriented southward. Bohol is outside of the "typhoon belt" zone of the country, as typhoon rarely passes the province. However, typhoons passing below or above the island bring about greater volume of precipitation. This weather disturbance is experienced in the province 2-3 times annually.

Climatic data for the Abatan Watershed are currently recorded at the Demo Farms of municipal LGUs of Catigbian, Balilihan and Cortes representing the upper, middle and lower portions of the watershed, respectively.

2.1.9 HYDROLOGY

The hydrology component is largely concerned with water including their occurrence, distribution, circulation and interactions with living things. This component focuses on the measurement of the quantity and quality of water that is of beneficial use to the community at present and to the different industries in the near future.

Reading of staff gauge in upper elevation (left); installation of rain gauge in Catigbian Demo Farm

Surface Water. The Abatan Watershed is monitored by the Bureau of Research and Statistics (BRS) of the Department of Public Works and Highways (DPWH) in terms of flow, sediment load, and occasionally for water quality. A stream gauging station was established at San Isidro, Balilihan with the corresponding drainage area of about 14,000 hectares, which is less than 50% of the total area of the watershed.

Potential water yield was calculated using the recorded monthly and annual flows (1984-2000 records). The data were transposed to be representative of the bigger watershed area using the Basin-Factor Ratio Method. Dependable flows, which indicate the percentage of the time that the flow is equaled or exceeded, were established using the flow-duration analysis and at 80% and 90% probability level.

Summarized in **Table 13** are the estimated mean monthly flows and dependable flows.

Table 13. Estimated Water Yield

Month	Mean Monthly Flow (m^3/sec)	Dependable Flow, m^3/sec	
		80% Probability	90% Probability
January	10.18	2.50	1.25
February	8.71	1.00	0.95
March	5.94	1.14	0.95
April	5.10	0.85	0.73
May	8.70	0.90	0.56
June	13.50	0.85	0.68
July	14.90	4.00	3.00
August	8.37	1.87	1.60
September	8.30	3.10	1.44
October	15.97	5.00	3.00
November	13.00	5.50	2.30
December	12.60	2.03	1.65
Annual	**125.71**	**1.70**	**1.00**

Water quantity measured in 2 methods: propeller method by WRC-USC (left) and float method using ponkan fruits (right)

Groundwater. The static water level (SWL) of Bohol Island ranges from 0.3 to 115.9 meters below ground surface (mbgs), while the provincial SWL average is 11.6 mbgs. The provincial specific capacity ranges from 0.05 lps/m to 2.55 lps/m. Based on the report entitled, "Rapid Assessment of Water Supply for Bohol Province", which was published by the National Water Resources Council in 1982, the watershed is classified as deep well area. The SWL in deep well areas are greater than 6 meters.

The average discharge of the province is 0.61 lps. The wells in the town of Antequera, which are within the watershed, have the highest discharge of 1.17 lps. At present, the ground water resource in the area is commonly used for irrigation and domestic water supply.

Major Water Users. **Annex B-1** has shown that the data from 1975 to 2006 on water permittees for the entire province of Bohol, both for surface and groundwater, were used to determine the locations of major water users in the Abatan Watershed. An updated listing of irrigation systems was also obtained from the provincial office of NIA. As per record, there are 29 communal and private irrigation systems and 3 systems for domestic water supply. There is no recorded industry issued with water permit in the area. The majority of the permittees utilize springs or groundwater.

The number of registered users/permittees particularly for domestic and industry is not realistic. During the reconnaissance survey in the area, facilities have been observed drawing water either from spring and groundwater both for domestic and industrial use. In order to account for the water utilization in the area, a current inventory survey should be undertaken. The above mentioned facilities appear to have yet acquired the necessary permits.

Water Balance Analysis. For purposes of evaluating the capacity or contribution of the watershed to supply the projected water requirements of nearby urban centers like Tagbilaran City and Panglao Island, direct comparisons of the potential water yield with that of the projected annual water requirements was undertaken. The projected water requirement was based on the estimates made in the **Bohol Integrated Water Supply Master Plan, February 2008**.

Gerlach trough in open cultivated area

Based on the plan projection, Abatan River alone could possibly supply the total requirements for the first 3 years and is still capable of supplying up to 40% of the total water requirements by year 2022. The expected benefits however will depend on the management of the watershed.

Sediment Yield. Sediment concentrations were monitored on various occasions from 2002 to 2007 representing a wide range of river discharges. Using the estimated mean annual discharge and the mean of the observed sediment concentrations, the estimated annual sediment yield for the Abatan Watershed is about 1.14 tons/ha-yr. The low sediment yield is representative for a well vegetated watershed. This could be the outcome of good vegetation and appropriate land use practices in the watershed.

Run-off samples for laboratory analysis

Water Quality. **Table 14** presents some observations of parameters that can be used to gauge the level of pollution of the Abatan River based on its intended uses or classifications. The middle and upstream areas from Dorol Bridge is classified under Class A, which is primarily used as source of water supply that requires complete treatment in order to meet the Philippine National Standards for Drinking Water (PNSDW), while the downstream area is under Class B for recreational or tourism purposes.

Table 14. Water Quality

Parameter	Standard/Criterion		Actual Observations		Year of Observation/Data Source
	Class A	Class B	Maximum	Average	
BOD5, mg/l	5	5	2.5	1.0	2003 DENR/EMB-7
Total Coliform, MPN/100 ml	1,000	1,000	500,000	1,700	2003 DENR/EMB-7
Total Coliform. MPN/100 ml	1,000	1,000	No data	220	2007 Water Supply Master Plan
Faecal Coliform, MPN/100 ml	100	200	40,000	670	2003 DENR/EMB-7
TDS, mg/l	1,000	1,000	51,400	10,551	2003 DENR/EMB-7
TDS, mg/l	1,000	1,000	1,701	243	2001-2007 BRS-DPWH
pH	6.5-8.5	6.5-8.5	7.79	7.85	2007 Water Supply Master Plan

Results showed that the BOD_5, a parameter used to measure the level of pollution from organic matter, meet the standards. On the other hand, the bacteriological pollution indicated by the level of *total coliform*, as well as the *faecal coliform* content, normally derived from animals and human waste discharge, failed the standards. Likewise, the total *dissolved solids*, often used to gauge the salinity of river water, also failed the standards. However, a follow-up monitoring of these parameters by BRS-DPWH showed that the standards had been met.

On the other hand, a separate study was conducted on hydrology and sedimentation in the upper, middle and lower elevations of Abatan Watershed. The Water Resources Center of the University of San Carlos (WRC-USC) in Cebu City was contracted to undertake the said study solely for this project. Reports of the study are hereby attached and marked as **Annex B-2** and **Annex B-3.**

1.1.10 INFRASTRUCTURE

Schools. Most infrastructure facilities in Abatan Watershed are provided by the government. Schools (primary and secondary) are distributed in the municipalities. There are more public schools than private schools. There are also schools and training centers that are offering tertiary courses, but which are of technical schools, such as the state-run fisheries colleges in Calape and Clarin, and the privately-owned computer college in Catigbian.. High school students vying for courses in college that are not offered in those municipalities often go to Tagbilaran City or Cebu City to study. Distance has discouraged families with meager income to send their children to faraway universities. This appears to be one reason for increasing juvenile delinquency and drug addiction in Calape. Corella has reported to have highly dilapidated school buildings and absence of elementary school facilities in 2 barangays of Anislag and Pandol.

Transportation. In the municipalities, the availability of various forms of transportation ranges from habal-habal (passenger motorcycles) and tricycles, to jeepneys and buses as well as private cars and other vehicles. There are also facilities present like terminals, roads (barangay, municipal and national), and bridges made of concrete, steel and wood to facilitate the movement of goods, services and people.

Communication. Communication facilities, such as PLDT, post offices, private courier services, and cellular stations of telecommunication companies, are available in Abatan Watershed communities.

Recreation. Recreational facilities like barangay or municipal basketball courts and mini-parks, as well as markets, are a commonplace. However, only Catigbian has the availability of a private cemetery.

Irrigation and Potable Water Supply. The people of Abatan Watershed have also enjoyed water facilities for household consumption and agriculture which vary in number and geographical spread. At least 3 municipalities have been vested with small water impounding systems, i.e., in Calape, Tubigon, Clarin and Tubigon. Household potable water requirements are supplied through Level1, 2 and 3 systems. However, potable water is still a problem to some municipalities, such as reported by Corella with only 80% of the population being served with potable water supply. A number of municipalities have undeveloped water sources, e.g., Antequera and San Isidro.

Electricity. Electric power is distributed by an electric cooperative, BOHECO I. However, not all 100% of households are electrified primarily due to poverty.

2.2 BIOLOGICAL RESOURCES

In any attempt towards watershed resource protection, management, development and conservation, it would be of significance to know what resources are still present within the subject area. The availability of information of the present resource would give understanding as to what proactive development and management interventions that will be implemented.

The biological resources form an integral part of the watershed complex. Understanding what was and is now present will generate a better understanding of what proactive programs, activities and management interventions will be required to help sustain this watershed component. This is critically true given that several parts of the watershed are considered major eco-tourism destinations which are built on the biodiversity of the area.

2.2.1 VEGETATION

2.2.1.1 Coastal and Marine Resources

The coastal wetlands are largely concentrated in two towns, namely: Maribojoc and Cortes. These coastal towns are the estuary of the Abatan River that drains into Maribojoc Bay. The wetland areas include approximately 209 ha. of mangroves and 832 ha. of nipa plantation. The Cortes side alone hosts 275 ha of marshland, of which 146 ha are nipa groves, 87 ha are mangroves, and another 42 ha are fishponds (either abandoned or productive).

The estuary is teeming with 17 species of mangroves with *Rhizophora apiculata* (Bakauan lalaki), *Avicennia marina* (Bungalon) and *Sonneratia alba* (Pagatpat) as the dominant species. Seagrass is a common sight in the nearshore area with 6 species in 5 genera with *Enhalus acoroides* (lusay) species predominate and occupying about 3 ha. This is interspersed with sargassum (samo) beds with 12 species in 10 genera (3 red, 4 brown, and 5 green algae) and dominated by green algae. Maribojoc Bay has poor coral cover with only 27 species dominated by massive (*Porites sp*.) and encrusting (*Montipora sp*.) types (Silliman University, 1997).

There are 25 species of mangroves found in Maribojoc Bay that is particularly dominated by *Nypa fruticans* with few species of the family Rhizophoraceae (**Table 15**). Mudflats and open areas in the estuary also serve as feeding grounds to 2 resident species, as well as 10 transient migratory shore birds. This zone also harbors seagrass plant communities and. algae such as samo

(sargassum), lumot (ulva) and others that provide habitats for fishes and invertebrates. Interestingly, a new species of false spider crabs (Decapoda: Brachyura: Hymenosomatidae) been recently been found in the estuary of Abatan River and named after it – *Amarinus abatan*. Similarly, the first burrowing shrimp species (*Lepidopthalamus tridentatus*) in the Philippines was first recorded in the sandy substrate of Abatan River.

Table 15. Common Mangrove Species

Common Name/Vernacular	Species Name	Family Name
Bakauan babae	*Rhizophora mucronata*	Rhizophoraceae
Bungalon	*Avecinnia marina*	Acanthaceae
Nipa	*Nypa fruticans*	Arecaceae
Pagatpat	*Sonneratia alba*	Sonneratiaceae
Saging-saging	*Aegiceras corniculatum*	Myrsine

Research conducted in 2004 by PROCESS-Bohol revealed that the most common species of marine organisms caught and sold from Abatan River estuary and Maribojoc Bay are as follows:

(a) **Fish** – tulingan (skipjack tuna), tamarong, borot-borot (round scad), bangus (milkfish), mangsi (herring/sardine), salimbagon (tuna), bolinao (anchovies), anduhaw, danggit (rabbitfish), amag-amag, and katambak (emperor breams);

(b) **Algae** – guso (red algae), lukot, lato (green algae), and ambang; and

(c) **Other seafoods** – nokos (squid), aninikad (miter shell), kandiis, amahong (brown mussel), dawo-dawo, pasayan (shrimp), saang (spider conch), torong-torong (periwinkle), litub (bubble shell), lambay (blue crab), imbao, and alimango (mudcrab).

2.2.1.2 **Resource Base Inventory (RBI) Methodology**

Biodiversity is rich inside the Abatan Watershed not only in forests, other wooded lands, shrub lands, and mangroves, but also in agricultural lands, although much more diversity is present in forest and wooded areas. About 2,177 ha (5.6%) of closed natural forest and another 4,791 ha (12.4%) of wooded lands along with their associated floral diversity are still found in the Abatan Watershed. In addition, the watershed includes about 1,090 ha (2.9%) of coastal wetlands dominated by nipa and mangroves. Details on this subject are presented in **Table 12**.

Foresters & field guides taking a break (left); marking a station in each transect line (right)

Between the months of December 2009 and March 2010, the forestlands of the watershed were inventoried to help determine their biological resources. It was done to establish baseline data and information on the status of natural resources, including topography, elevation, soil type and texture, land use and environmental issues and concerns. The RBI survey was undertaken using the **Line Intercept Method** because it is quicker and more objective taking into consideration the timeframe of the project. As agreed at the onset, it applied a sampling intensity of barangays within timberlands, plus a barangay on A&D lands.

Table 16. RBI Sampling Sites

Name of Blocks	Municipality	Barangays	Land Area
Block A-1	Antequera	Tabuan	79.0
	San Isidro	Abehilan, Baunos & Cansague Sur	
Block B-1	San Isidro	Cambansag & Cansague Norte	16.5
Block B-2	Corella	Pandol	3.0
	Cortes	New Lourdes	
Block B-4	Balilihan	Baucan Norte, Baucan Sur, Boctol, Datag Norte, Datag Sur & San Roque	212.5
	Catigbian	Ambuan	
Block C-1	Catigbian	Haguilanan & Sinakayanan	82.5
	Balilihan	Cantomimbo & Haguilanan Grande	
Block C-2	San Isidro	Causwagan	22.5
	Catigbian	Libertad Sur & Rizal	
Block D	San Isidro	Caimbang & Poblacion	11.5
A&D	Antequera	Danao	4.0
7 Blocks + 1 A&D	**6 Municipalities**	**25 Barangays**	**431.5**

The survey covered seven (7) blocks of timberlands and one A&D land area spanning 25 upland barangays in 6 upland municipalities for a total of 431.5 ha (**Table 16**). It ran several lines through the plant community identifying, counting and measuring the plants that intercept each

line. A total of 228,000 meters of transect length were laid out on the ground and 174 stations established (**Table 17**). Each station has an interval of 100 meters.

Table 17. Transect Length and Number of Stations		
Blocks	**Number of Stations**	**Transect Length (meter)**
A-1	21	32,000
B-1	33	16,500
B-2	5	1,500
B-4	53	106,000
C-1	33	49,000
C-2	11	11,000
D	10	10,000
A&D	8	2,000
7+1	**174**	**228,000**

Discussion of the survey results is hereby presented as follows:

A. FLORA INVENTORY RESULTS AND DISCUSSION:

Plant Species. A total of 273 plant species consisting of ferns, grasses, herbs, palms, shrubs, trees and vines were identified. Taxonomic lists of forest species encountered in the survey are shown in **Annex C-1**. Indicator plants included in the lists are signs of progression of natural regeneration and the improving terrestrial ecosystem diversity. Over half of these floral species are trees and followed by a community of herbs comprising 19%. As shown in **Table 18,** only few fern and palm species were encountered at 3% and 4% only.

Table 18. Number of Plant Species		
Classification	**Total**	**Percent**
Ferns	8	3%
Grasses	32	12%
Herbs	52	19%
Palms	10	4%
Shrubs	20	7%
Trees	138	51%
Vines	13	5%
TOTAL	**273**	100%

Plant Population. Proportionate to the number of plant species are their individual populations. Of the 150,439 total individuals counted, 68,995 are trees (**Annex C-2**). As indicated in **Fig. 9**, trees account 47% of the total population. Grasses and herbs come next at 15% each

having a population of 22,286 and 22,744 individuals, respectively. Plants with less population are palms of 3,683 individuals at 2% overall.

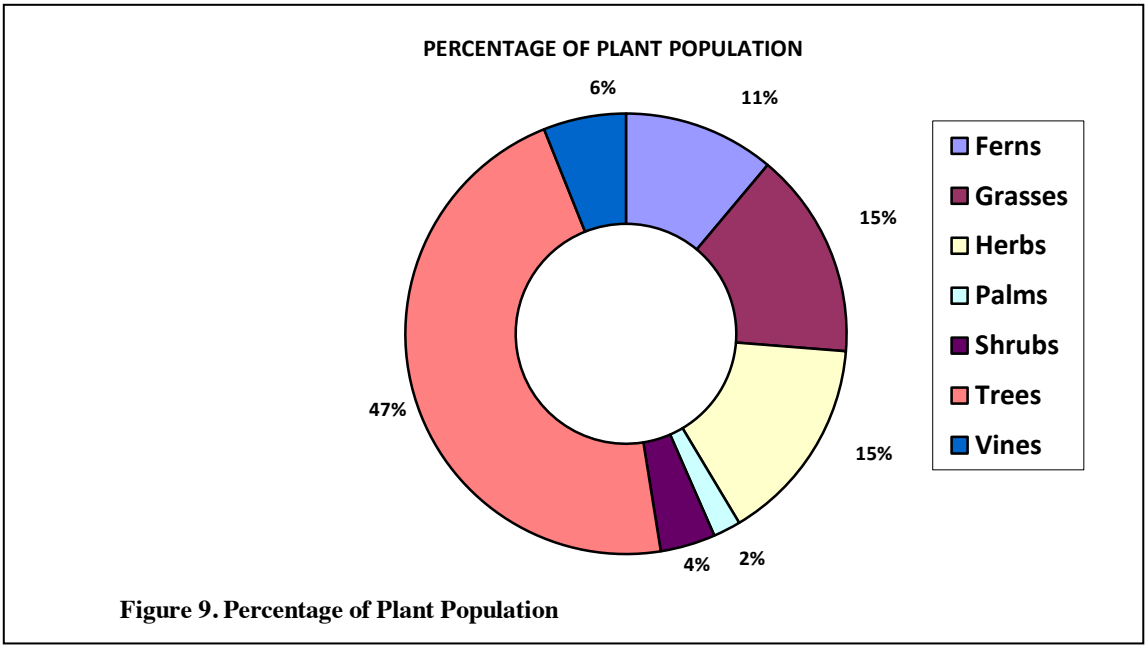


Figure 9. Percentage of Plant Population

1. **Ferns**

There were 17,018 total fern individuals encountered. As presented in **Fig. 10**, 48% of those plants were found in Block B-4 and some 20% were in Block C-1. The Blocks with lowest number of ferns are B-2 and D with 1% and 2%, respectively. A&D also registered as the third lowest ferns with 3% only.

The most dominant ferns are **Selaginella** (*Selaginella aristata)*, **Locdo** (*Hedyotis corymbosa)*, and **Paco** (*Diplazium esculentum*). These ferns are abundant in B-4 and C-1 and, except for **Paco**, they are present in all Blocks.

The least number of fern individuals are **Pagongpagongan** (*Pyrrosia piloseloides*) and **Common Stag Horn** (*Platycerium coronarium*). These two fern species were not found in many Blocks. **Pagongpagongan**, for instance, was counted only in B-4 and A&D, while the **Common Stag Horn** in B-1, B-4 and A&D.

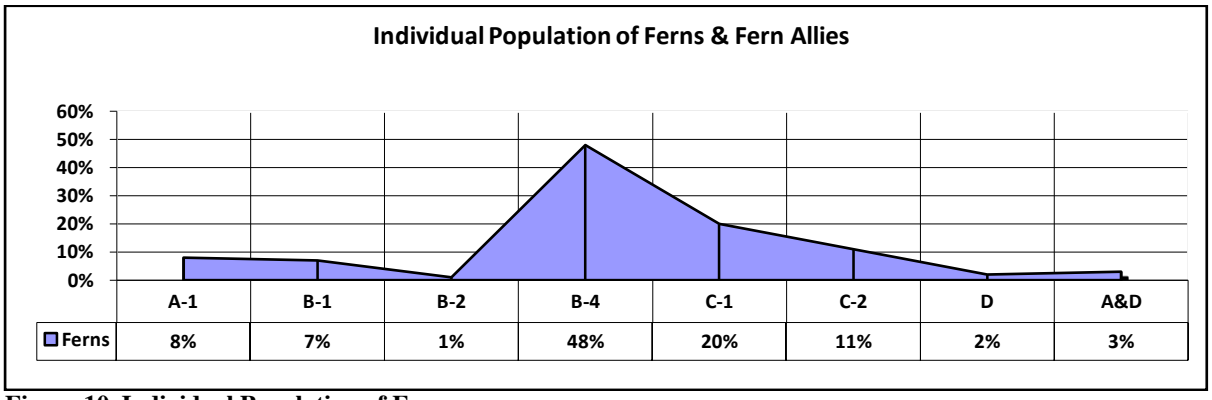


Figure 10. Individual Population of Ferns

2. Grasses

B-4 and C-1 also owned the highest number of grass individuals with 48% and 20%, respectively, of the 22,286 total grasses. Likewise, less grassy areas are B-2 having 1% only, D with 2% and A&D, 3%.

The most common grasses are **Daat** (*Scleria scrobicolata*), **Talahib** (*Saccharum sponteneum*), and **Cogon** (*Imperata cylindrica*). Plenty of these grasses are covering the ground surface of B-4 and C-1. However, they are relatively fewer in number in B-2.

Vetiver grass (*Vetiveria zizanioides*), **Balbas kalabaw** (*Scirpus supinus*), and **Waliswalisan** or **Eskubang haba** are considered less common grasses because they are virtually less in numbers when inventoried. All these grasses were contained in C-1, although some **Marasaluyot** were also found to have sparsely occupying some portions of B-4.

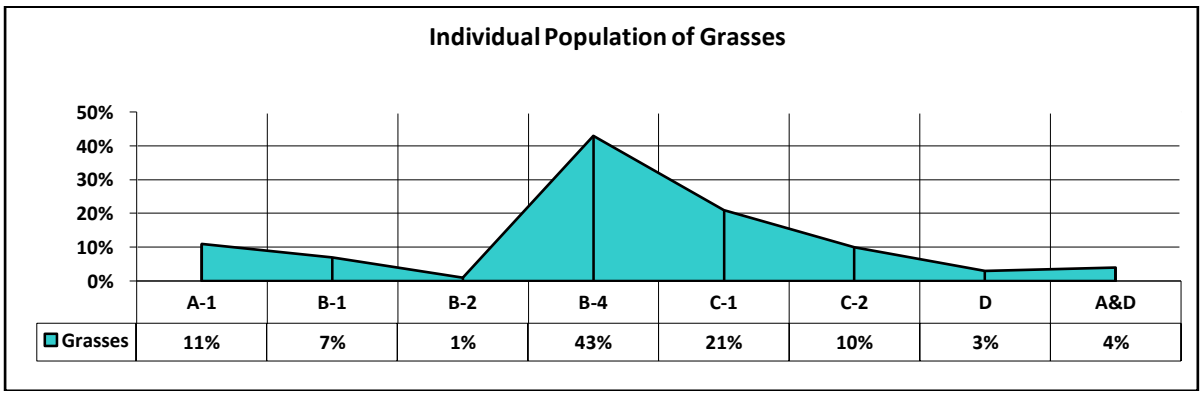


Figure 11. Individual Population of Grasses

3. Herbs

Again, a number of herbs were recorded in B-4 and C-1 alike. Of the 22,744 total herbs registered, about 39% and 22% were found on these blocks. Consistently, B-2 and D are in the bottom of standing for having less grown herbal plants at 1% and 3%, respectively.

Among the herbal plants counted, **Tagbak** (*Kolowratia elegans*), **Tab Tabacco** (*Elephantopus tomentosus*), and **Dalili** were having the most number of individuals accounting a combined 58% of total herbal population. The trio are high in B-4 and C-1 in so far as population is concerned. Surprisingly, A-1 exhibited the highest number of **Tawa-tawa** or **Gatas-gatas** (*Euphorbia hirta*), **Payang-payang** or **Kagay-kagay** (*Moghania strobilifera*), and **Dilang baka** (*Elephantopus tomentosus*) which is equivalent to 25% of total herbs in said timberland block if combined.

Less populated herbal plant is **Lubilubi** where there were only 2 individuals sighted in A-1.

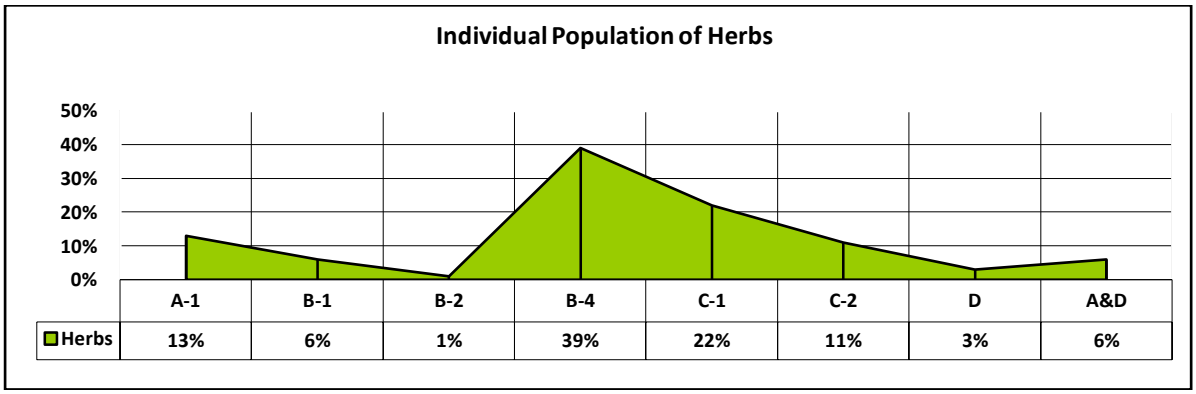


Figure 12. Individual Population of Herbs

4. Palms

B-4 has again claimed the top spot with 39% of the 3,683 palm population. While A-1 and C-1 are almost identical in number to occupy the second and third place positions with 16% and 15% apiece. B-2 remains at the cellar with only 1% of total palm individuals being run into by the transect line.

The palm variety with the highest population was **Takipan** (*Caryota rumphiana*) comprising 45% of total palm individuals. Several of them are growing in B-4 (58%) and A-1 (11%).

Tailing after **Takipan** were **Coconut** (*Cocos nucifera*) and **Sagisi** (*Heterospathe elata*) which account 27% and 21%, respectively, of total palm population. More **Coconuts** were hit in C-1 (22%) and B-4 (21%). While much of **Sagisi** palms were sighted in B-4 (25%) and followed by A-1 (22%). These three leading plants mentioned were the only palms available in all the Blocks.

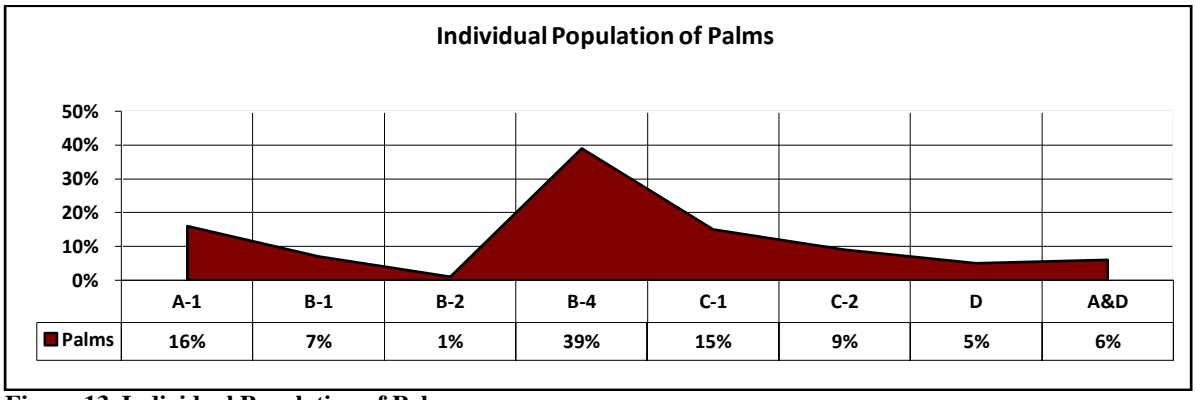


Figure 13. Individual Population of Palms

5. Shrubs

Out of the 6,469 shrubs recorded, about 28% are growing in B-4 and 26% in C-1. Only a handful of these types of plant are thriving in B-2 (1%), A&D (2%) and D (3%). **Hagonoy** (*Chromolaena odorata*) has appeared to be majority in number with 3,491 individuals or approximately 54% overall. About 31% of such plant was found in B-4 and 23% in C-1. This condition indicates that most farmlands are having soil fertility problem but are in the process of natural regeneration through the occupation of **Hagonoy** plant.

Next in number belongs to **Malatungao** (*Melastoma affine*) and **Scuba** (*Sida acuta*) comprising 16% and 6% only of total shrub population.

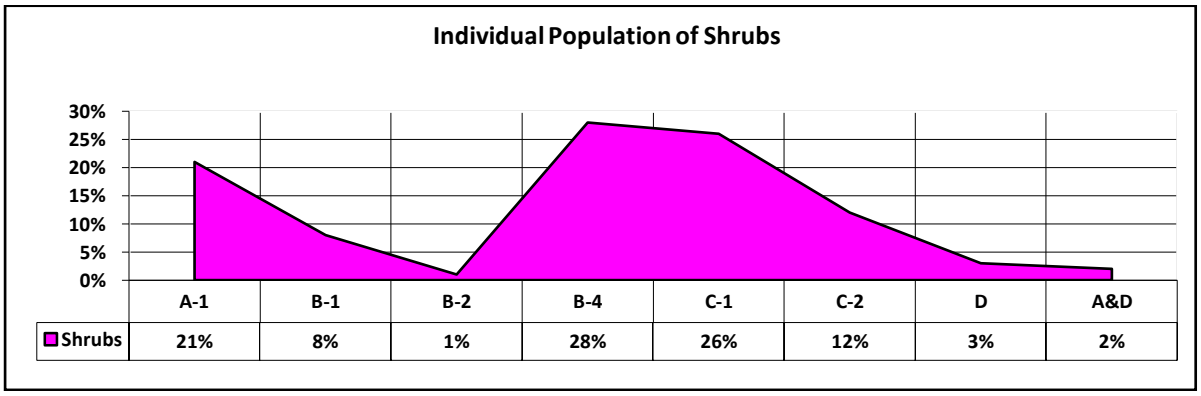


Figure 14. Individual Population of Shrubs

6. Trees

Of the 68,995 total tree individuals tallied, 44% were recorded in B-4, 18% in C-1 and 12% in C-2. The most number of individuals were **Tamaho** (*Gleocarpus patentivalvis)*, locally known as **Badbaran**, **Alahan** (*Guioa keolreuteria*), and **Anislag** (*Securinega flexuosa*). **Tamaho** and **Alahan** are prevalent in B-4 and C-1, while **Anislag** are numerous in B-4 and C-2.

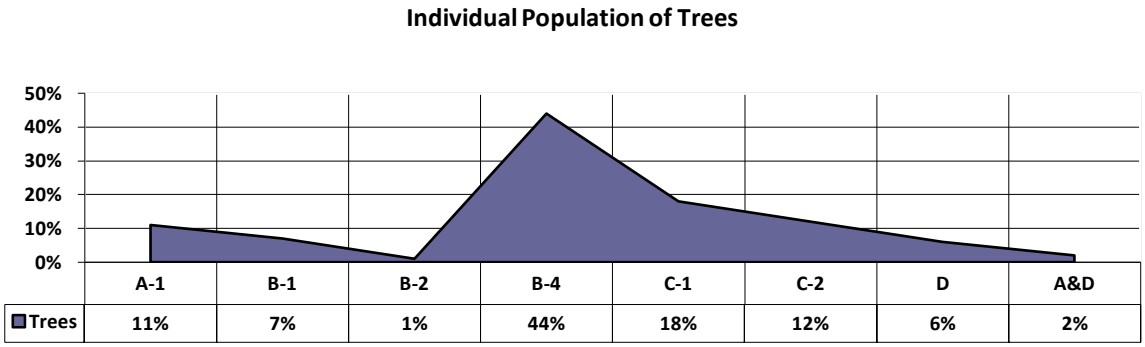


Figure 15. Individual Population of Trees

It is important to note that most of the trees found are indigenous species. Only broad-leafed **Mahogany** (*Swietenia macrophylla*) and **Yemane** (*Gmelina arborea*) are exotic trees. There were 250 Mahogany and 23 **Yemane** trees intercepted. Some 40% of these **Mahogany** trees were located in B-4, while 35% in A&D. The A&D also contained 74% of the total **Yemane** trees listed.

Specimen for identification (left); measuring the DBH of a tree (right)

Size Brackets. It is important in resource management to determine which areas have big trees and which have small in sizes. Likewise, the study will also tell what trees belongs to a particular size bracket. During the survey, timber trees were measured based on *diameter breast height* (DBH) in centimeters. These trees are grouped together according to their size ranges as follows: 15-20 cm, 21-25 cm, 26-30 cm, and 31 cm & above.

Annex C-3 has shown that out of 138 tree species identified, only 105 or about 76% are considered timber trees based on prescribed DBH size ranges. Its total population could reach as much as 41,231 individuals across the subject areas.

It has been observed that the number of trees is inversely proportional with their sizes, i.e., the bigger the size, the lower the population. As reflected in **Fig. 16**, majority of trees measured (66%) are smaller in sizes belonging to 15-20 cm DBH bracket. Only 16% had sizes ranging from 21-25 cm, 11% from 26-30 cm, and only 7% from 31 cm and above.

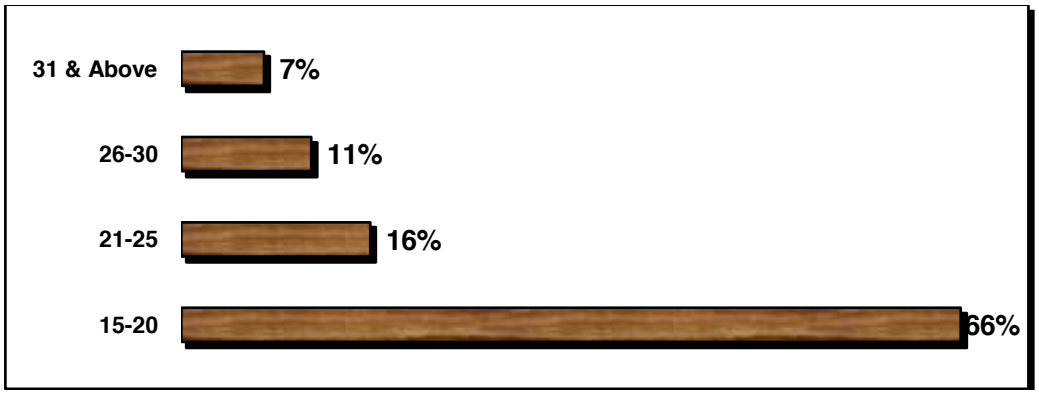


Figure 16. Percentage of Trees based on DBH Range in Centimeters

Approximately half of these trees have grown in B-4. Following B-4 are A-1 and B-1 with 14% and 12%, respectively. Less population of timber trees was detected in B-2 and A&D.

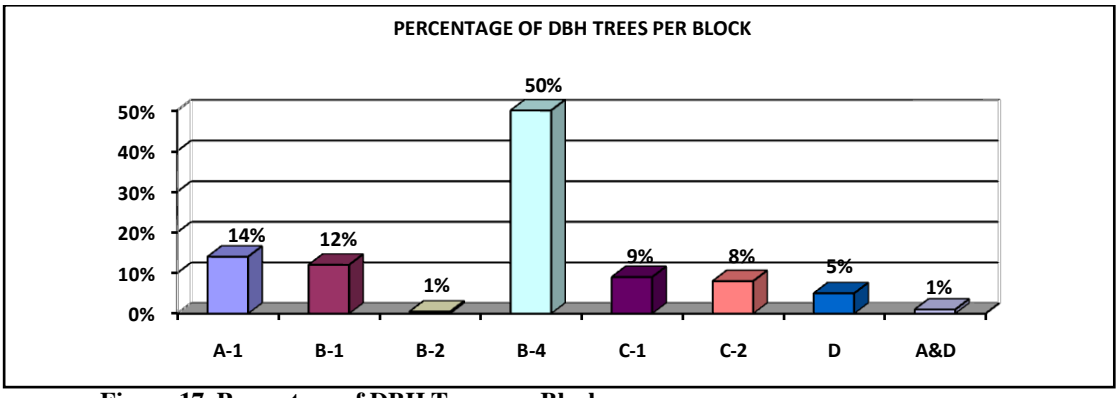


Figure 17. Percentage of DBH Trees per Block

Among the 105 timber tree species identified, **Tamaho** (*Gleocarpus patentivalvis)* appears to be the most abundant, although majority of about 56% are smaller in sizes measuring within the 15-20 cm DBH. It has an Importance Value of 4.41. Out of 5,198 **Tamaho** trees encountered, 2,904 individuals or 56% were found in B-4.

Table 19. Top 15 Common Timber Species in Abatan Watershed			
Rank	**Common Name**	**Scientific Name**	**No. of Individuals**
1	Tamaho/Badbaran	*Gleocarpus patentivalvis*	5,198
2	Anislag	*Securinega flexuosa*	3,328
3	Alahan	*Guioa keolreuteria*	2,958
4	Binunga	*Macaranga tanarius*	2,580
5	Hambabalod	*Neonauclea formicaria*	2,331
6	Gumihan	*Artocarpus sericicarpus*	1,898
7	Bayukbok/Maksa	*Eleocarpus macranthus*	1,841
8	Mamalis	*Pittosporum pentandrum*	1,713
9	Ilang-ilang	*Cananga Odorata*	1,062
10	Takip-asim	*Macaranga gradifolia*	1,012
11	Kalumala	*Eleocarpus calomala*	977
12	Molave	*Vitex parviflora*	952
13	Hagimit	*Ficus minahassae*	948
14	Alagasi	*Leucosyke capitellata*	935
15	Pagoringon	*Cratozxylum sumatranum*	924

The other dominant species are **Anislag** (*Securinega flexuosa*), **Alahan** (*Guioa keolreuteria*), **Binunga** (Macaranga *tanarius*), and **Hambabalod** (*Neonauclea formicaria*). **Anislag** has considerable number in all four size brackets yet 65% of which are between 15 and 20 cm DBH. Most **Alahan**, **Binunga** and **Hambabalod** trees are also smaller in sizes within the same minimum range. Again, Block B-4 owns the most number of populations of these timber species.

The information of these five leading species coincides with the results of the analytical computation in **Annex C-4** in terms of Importance Value (IV). However, a list hereunder details the economic and ecological importance of some species:

Table 20. Economic and Ecological Importance of Some Tree Species		
Plant Group and Species	**Economic/ Importance**	**Ecological Importance**
Alagao/Abgaw	Fire wood	Fruits eaten by birds
Alagasi	Firewood	Fruits eaten by birds
Anislag	Firewood	
Bago	Leaves as vegetables to humans	
Bahai	Siding & Flooring	
Balete	Firewood	Fruits are edible to wildlife
Balinghasai/An-an	Light construction interior finish	
Banaba	Flooring, interior finish woodcraft and novelties Capsule fruits for decoration	
Banai-banai	Furniture & cabinets, wood carving, boxes & crates	Branches usually nested by pigeon or dove species
Bangkal	Pulp & paper	
Banuyo	Furniture & cabinets, flooring	
Batino	Household implements House flooring & framing, Furniture & cabinets	

Table 20. Continued . . .		
Bayukbok/Maksa	Firewood	
Binunga	Bark and leaves for making of Basi wine	
Bitanghol	Furniture making/Firewood	Sap is used to cure eye illness
Bugas	Firewood	
Bugauak/Bintuko	Firewood	
Dita	Firewood	
Dugoan	Firewood/medicinal, Boxes and crates	Decoction of barks is used to stop bleeding
Gisok-gisok	Construction materials	
Hagimit	Firewood	Water inducer species
Hambabalod	For post	
Hauili	Firewood	Water inducer species
Hinlaumo	Firewood	Fruits are eaten by birds
Ilang-ilang	Wooden shoes Fishnet floats	
Ipil-ipil	Firewood Leaves for swine feeds/forage	
Is-is	Firewood and leaves used for varnishing floors & furniture	
Katmon	Interior, siding and panelling Mouldings	Fruits are edible to human beings and animals
Kubi/Barasbaras	Firewood and construction materials	Fruits are edible to bats and other animals.
Lago	Poles & Piles	
Lanete	Ornamental	
Lanutan	Veneer and plywood House framing Furniture and cabinets	
Mahogany	Construction materials	Seeds are medicinal
Malakmalak	Firewood	
Malapapaya	Firewood, Wooden shoe, match sticks and boxes Veneer for miscellaneous products	
Marang/Bakan	Construction materials	
Nangka	Firewood and furniture	Fruits are edible
Nato	Veneer and plywood	
Pagoringon	Firewood	
Pagsahingin	House framing, boxes and crates	
Pahutan	Firewood	Fruits are edible to bats
Talisai-gubat	Firewood	Fruits are edible
Taloto	Construction materials	
Tangisang bayawak	Firewood	Water inducer species
Teak	Ship building, high grade construction	
Tibig	Firewood	Water inducer species
Tindalo/Bajong	Flooring	
Tuai	Firewood/Construction materials	
Upling gubat		Fruits are eaten by birds and monkey
Wisak	Lathe work Structural timber, Moulding	
Yemane/Gmelina	Pulp, Paper and poles	

7. Vines

There were 9,244 individuals of vines recorded. About 42% of these vines were intercepted in B-4 and 24% in C-1. Majority of these plants consist of 63% **Nito** (*Lygodium japoricum*) and followed by 16% **Ooko** (*Micamia cordata*) and 11% **Tuka manok**. These three leading vines are available in all the blocks, including the A&D.

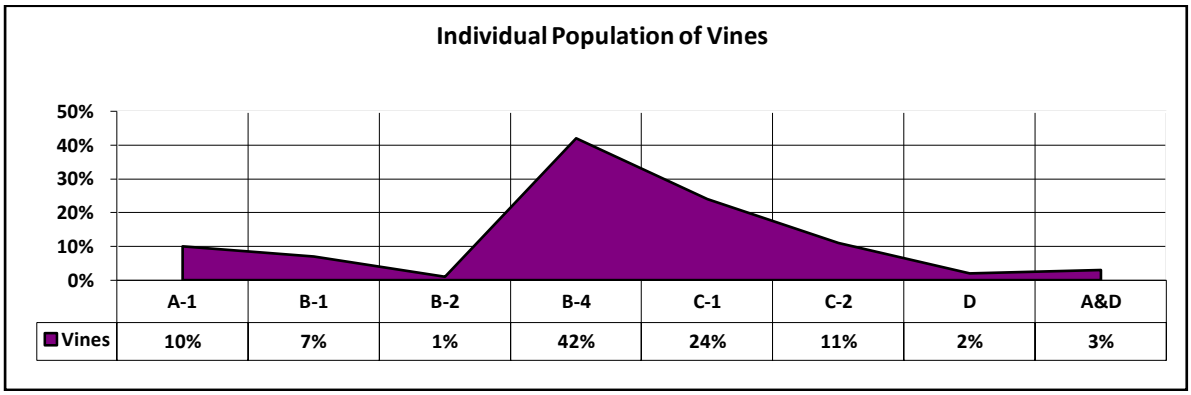


Figure 18. Individual Population of Vines

2.2.2 FAUNA

2.2.2.1 Existing Biodiversity and Wildlife

The biodiversity of **Bohol** is highly significant as regards to the existing and potential development of tourism in the province. The upland and forest areas with dense vegetation and thickets that offer protection are home of the endangered endemic **Philippine tarsier** (*Tarsius syrichta*), known locally as **Maumag** in Visayan dialect. They inhabit in some areas of the Abatan Watershed. The tarsier is now regarded as a major tourism product in the area, particularly in the Municipality of Corella where a tarsier sanctuary has been established.

Although the known bird watching destination is in the neighboring watershed of Loboc particularly in Rajah Sikatuna Protected Landscape (RSPL), the Abatan Watershed could become another preferred bird watching destination. Given enough environmental interventions like establishment and protection of natural areas and planting of "wildlife" vegetation (e.g. ficus), and enforcement of no hunting and collection laws, there is a good chance that the biodiversity in the watershed can significantly rebound.

2.2.2.2 **Biodiversity Monitoring System (BMS)**

The inventory/recording of wildlife resources was done simultaneously with the RBI survey. Observations were recorded in a field book. The information gathered was through own observation and second-hand information. Materials and equipments used were notebook, pencil/ballpen and binocular.

B. FAUNA INVENTORY RESULTS AND DISCUSSION:

Faunal Species. In a recently conducted survey involving 8 stations, including one A&D, some 67 animal species (mainly birds) were observed. **Annex D-1** revealed that six (6) of these wildlife species are amphibians, 47 are birds, thirteen (13) mammals, and 16 reptiles. Of these species, 38 are considered resident and 43 endemic, including the **Philippine Tarsier**. Only 1 is known to be migratory and that is a bird whose common name is **Brown shrike** (*Lanius cristatus*) or **Tibas** in Visaya of the family Laniidae. **Tibas** was seen in A-1, C-2 and D.

Table 21. Number of Animal Species

Classification	Residency Status			Total
	Endemic	Resident	Migratory	
A. Amphibians	2	4	0	6
B. Birds	25	21	1	47
C. Mammals	6	7	0	13
D. Reptiles	10	6	0	16
Total	43	38	1	82

Faunal Population. A total of 775 individuals of animals were seen, heard or as told by the residents of the watershed (**Annex D-2**). Of this animal community, more than half are birds (62%) and seconded by mammals (25%). The amphibians and reptiles are sharing the bottom spot with 4% and 9%, respectively, of the total animal population.

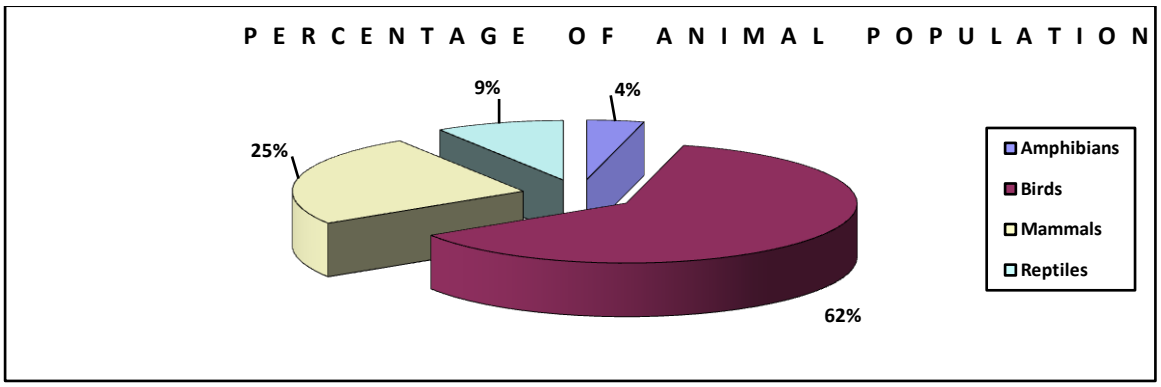


Figure 19. Percentage of Animal Population

Their individual populations are almost well distributed in all the stations. Sixteen percent (16%) of these animals were tallied in B-4, and 15% in A-1 and 14% in each of B-2 and C-1. The remaining 40% animal population was equally distributed in the other 4 subject areas each having 10% shares.

1. Amphibians

There were 31 amphibians in the overall tally. The **Giant marine toad** (*Bufo marinus*) got the highest number over other amphibian species with 18 individuals or equivalent to more than 58% of the total. Most of these amphibians were found in B-2 and A&D numbering about 8 and 7 individuals, respectively.

2. Birds

Data gathered have shown that birds are the dominant animal species inhabiting the area. There were a total of 479 bird individuals detected or mentioned by the local people. Birds are prevalent in B-4 (20%) and A-1 (19%). B-2 and C-1 each has 14% of the bird population.

BMS using human senses (left); a captured Brahminy kite bird, locally known as *banug* (right)

The most common birds are **Asian glossy starling** or **Lansiyang** (*Aplonis panayensis*), **Chestnut munia** or **Maya** (*Lonchura malacca*), **White eared brown dove** or **Limokon** (*Phapitreron leucotis*), **Black naped oriole** or **Antolihaw** (*Oriolus chinensis*), and **Philippine Bulbul** or **Tagmaya** (*Hypsipetes philippinus*). These birds have also registered the highest Importance Value (IV).

Based on computation, **White eared brown dove** is number one in terms of Importance Value with 53.88 and followed by **Black naped oriole** with 52.055, **Asian glossy starling** 51.075, **Phil. Bulbul** 45.215, **Olivebacked sunbird** 44.8 and **Chestnut munia** 36.26.

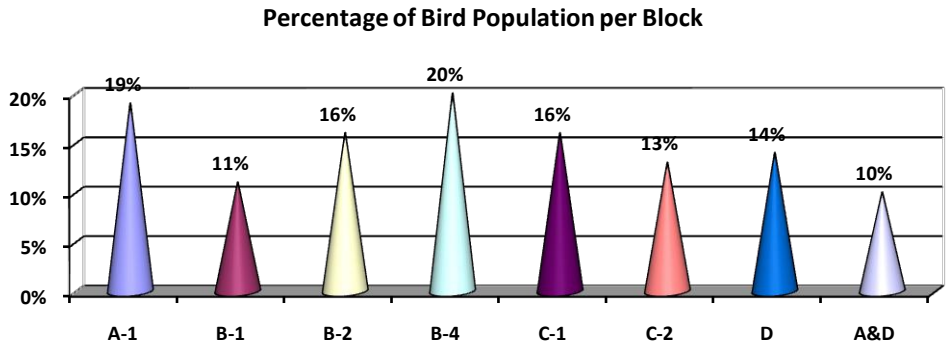


Figure 20. Percentage of Bird Population per Block

Some 20% of the birds were listed in B-4, followed by 19% in A-1, and 16% in C-1. Less inhabited station was B-1 with only 11% birds of the total.

3. Mammals

About 195 mammals were noted during the survey. The most common of them all are fruit bats, namely: **Dog-faced Fruitbat** (*Rousettus amplexicaudatus*), **Jagors Fruitbat** (*Ptenochirus jagori*), **Giant Golden-crowned Fruitbat** (*Aceron jubatus*), and **Malaysian Fruitbat** (*Cynopterus brachyotis*). Populations of these fruit bats when combined will account 63% of the total mammals. Besides, they are present in all the stations.

The largest bat species is the **Giant Golden-crowned Fruitbat**. Besides, it is a rare fruit bat and endangered species belonging to the megabat family. It is active at night and can fly long distances up to 40 kilometers while hunting for food and eating a variety of fruits. Its favorite food is the ripe fig. Called the silent planter, it contributes greatly to forest regeneration given its diet of fruit and seeds.

4. Reptiles

As regards to reptiles, there were 70 individuals counted using own senses and per interview with residents. Reptiles with the highest number were **Common Pond Turtle** or **Ewon** (*Coura amboinensis*), **Green Tree Skink** or **Tabili** (*Lamprolepis smaragdina*), and **Reticulated Python** or **Baksan** (*Python reticulatus*) Reptiles were almost well distributed in all stations.

C. CONCLUSION:

Looking back at the individual population data per Block, B-4 has been found to have the most diverse floral ecosystem and rich in biodiversity as well. As indicated in **Table 22**, it accounts 42% of the total plant population, while C-1 comes out second with 20% and then followed by C-2 with 11%. The poorest Block then is B-2 claiming only 1% of total individuals. The second poorest is understandably the A&D site with 3% only.

Table 22. Summary of Plant Population per Block

Classification	A-1	B-1	B-2	B-4	C-1	C-2	D	A & D	TOTAL
1. Ferns	1,364	1,133	174	8,137	3480	1,807	422	501	**17,018**
2. Grasses	2,469	1,665	199	9,537	4602	2,137	711	966	**22,286**
3. Herbs	2,880	1441	184	8,765	4992	2,508	574	1400	**22,744**
4. Palms	589	269	48	1,444	568	343	195	227	**3,683**
5. Shrubs	1,370	513	49	1,794	1682	759	187	115	**6,469**
6. Trees	7,368	4,547	399	30,405	12562	8,461	3848	1405	**68,995**
7. Vines	937	661	53	3,838	2236	1,051	170	298	**9,244**
TOTAL	**16,977**	**10,229**	**1,106**	**63,920**	**30,122**	**17,066**	**6,107**	**4,912**	**150,439**
PERCENT	**11%**	**7%**	**1%**	**42%**	**20%**	**11%**	**4%**	**3%**	**100%**

However, **Fig. 21** indicates that there is an exception to the rule that plants and animals go hand in hand, and that is in the case of B-2. The said Block has only 1% of the total plant population, yet it possesses 14% of the total animal population encountered. This happened perhaps because of time schedule the survey was conducted. Other areas like D and A&D that is both have lesser in plants but relatively have average percentage in animal population.

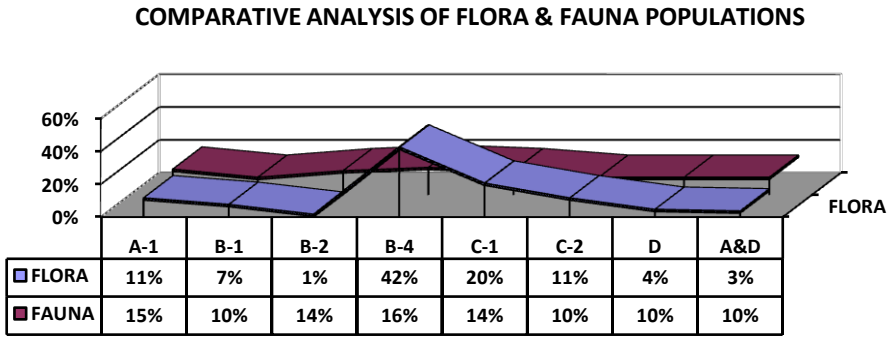


Figure 21. Comparative Analysis of Flora & Fauna Populations

Of all the subject areas, Block C-2 looks very consistent to the rule because its average plant and animal percentages are proportionate to each other with 11% and 10%, respectively.

2.3 SOCIO-ECONOMIC SURVEY AND DEMOGRAPHY

The reason behind this activity is based on the strong presumption that the success of watershed management is determined by the level of support from the people who directly depend on its resources. Either way, the presence of occupants in the forestlands may have positive and negative effect. They are the key actors in keeping the forest resources sustainable to benefit not only their present needs but also the needs of their children and their children's children. On the other side, they could pose a serious threat to the remaining natural resources in the watershed if no appropriate programs are undertaken.

Upon the onset of the project, a socio-economic questionnaire has been developed and finalized upon consultation with key personnel at DENR-Bohol. Then it was applied in 100% of 9 timberland blocks and in an A&D barangay in seven (7) municipalities inside the Abatan Watershed (**Annex A-22**). These timberland blocks cover a total of 29 barangays. The names of barangays are enumerated in **Table 23** in the following page.

The survey was implemented parallel to the flora and fauna inventory between December 2009 and March 2010. It involved a total of 203 respondents (135 males and 68 females). About 97% of whom or equivalent to 197 households are forest occupants, while the rest numbering some 6 households are A&D residents in barangay Danao, Antequera.

Table 23. Distribution of Household (HH) Respondents

Timberland Blocks	Municipality	Barangays	No. of Respondents	Total HHs in the Block	Block Percentage
TIMBERLANDS					
A-1	Antequera	Tabuan	6	35	17.24%
	San Isidro	Abehilan	8		
		Baunos	5		
		Cansague Sur	16		
A-2	Corella	Canangcaan	10	15	7.39%
		Canapnapan	3		
		Cancatac	2		
B-1	San Isidro	Cambansag	6	15	7.39%
		Cansague Norte	9		
B-2	Corella	Pandol	4	11	5.42%
	Cortes	New Lourdes	7		

Table 23. Continued . . .					
B-3	Sikatuna	Abucay Norte	7	9	4.43%
		Can-agong	2		
B-4	Balilihan	Baucan Norte	9	54	26.6%
		Baucan Sur	4		
		Boctol	10		
		Datag Norte	10		
		Datag Sur	7		
		San Roque	3		
	Catigbian	Ambuan	11		
C-1	Catigbian	Haguilanan	16	45	22.17%
		Sinakayanan	10		
	Balilihan	Cantomimbo	4		
		Haguilanan Grande	15		
C-2	San Isidro	Causwagan	0	2	0.99%
	Catigbian	Libertad Sur	2		
		Rizal	(Recorded in Block D)		
D	San Isidro	Caimbang	6	11	5.42
		Poblacion	0		
	Catigbian	Rizal	5		
Sub-Total (Timberlands)				**197**	**97%**
ALIENABLE & DISPOSABLE (A&D) LAND					
-------	Antequera	Danao	6	6	3%
Sub-Total (A&D)				**6**	**3%**
9 Blocks + 1 A&D	**7 Municipalities**	**30 Barangays**		**203**	**100%**

Results of the study were analyzed and presented below:

A. SURVEY RESULTS AND DISCUSSION:

Annex E-1 manifests the demographic profiles of the respondents by block.

I. DEMOGRAPHIC PROFILES

(1) Age, Gender, Civil Status, Religion, Residency History

Except for Block C-2, the results showed that most of the respondents were 50 years or more of age. Most of them are males, married and Catholics. Some 96% were native to the place,

only about 4% were originally from other barangays. One was from Bukidnon in Mindanao. A total of about 81% have been residing in the area for 31 to 40 years or for 50 to 70 years. B1, B3 and C1 respondents had the highest average of about 25% longest residency of 71-80 years in the site.

(2) Educational Attainment, Occupation, Size of Family

About 80% attained only elementary education and about 18% of high school level. Only Blocks A-1, B-1, B-4 and C-1 had college graduates or college level respondents. Most were farmers (about 80%), a few were barangay officials, basket weavers, carpenters, municipal employees. Barangay officials-respondents were in Blocks A-1, B-1, B-4, C-1 and in Danao (A&D). The rest were housekeepers. Most households (about 60%) had 4-6 children in the family. This was followed by those having 1-3 children in the family (about 40%).

Those ranges of family members are more or less similar to the average provincial household size of 5.43 persons per household.

(3) Number of Household (HH) Members and Occupation of the Rest of the HH Members

Majority of the HHs had 1-5 members. Others had 6- 10. The rest of the HH members were also mostly farmers themselves, followed by housekeepers, students, construction workers. A few were barangay officials, salesmen, employees in money changing shops, etc.

II. ECONOMIC PROFILES

Annex E-2 presents the economic profiles of the respondents who were mainly in the timberland areas of the watershed.

(1) **Location and size of farms, land classification & status, duration of occupancy and tenure**

The respondents simply named the respective Purok as farm location. It may imply ready access to the area time-wise. On the overall, most (42%) of the respondents had farms with an area of 0.6 – 1.0 hectare. This was followed by 29% saying they had 0.26 - 0.50 ha. farm area. B-4 and C-2 had the most number of cultivators-respondents of 54 and 45 respectively. This was followed by A-1 with 35 respondents.

All or 100% of the cultivations in Blocks A-2, B-2, B-3 and B-4 were in timberland areas while an average of 74% were in the timberland areas of blocks A-1. B-1 and C-1. Block D had only 18% cultivation in timberland areas, the bigger portion (63%) were in A&D lands. Danao were all in A&D lands.

An average of 68% of the timberland cultivators in 7 blocks (Blocks A-1, A-2, B-1-B-4 and C1 had tenurial instruments (TI) over the area, such as Certificates of Stewardship Contract (CSCs). An average of 22% of the timberland cultivators had only tax declarations. These were in blocks A-1 to B-4. One respondent in Block B-3 has a land title and TI in the area. Danao was all in A&D land.

Some 27% had been occupying portions of timberlands within a decade (1-10 years) while another 25% had it in 41-50 years already. The longest occupying respondent was in Block A-1. He's been in the area for more than 60 years.

Most of the respondents (72% ave) were claimant-cultivators who were in Blocks A-2 to D while an average of 30% was owner cultivators who occupied A-1, B-1, C-1 and D. Another 20% were share tenants in Blocks A-1 and C-1.

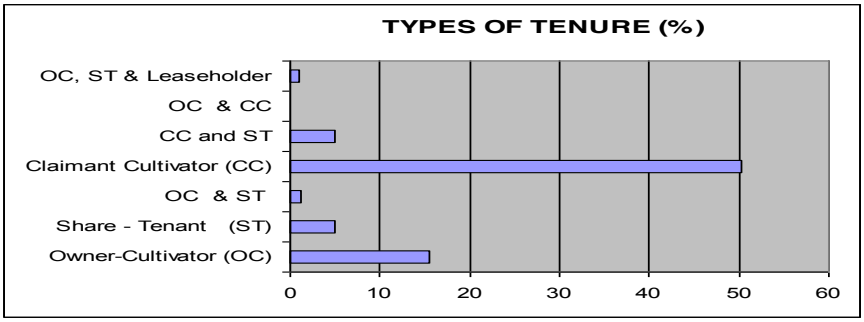


Figure 22. Types of Tenure

Overall, a good 50% of the respondents were claimant cultivators (CC) as shown in **Fig. 22**. This is followed far behind by owner-cultivator (OC) s and claimant-cultivators & share tenants (ST).

(2) Types of Cultivation, Farming Systems and Practices

An average of 83% indicated of having cultivated only their old or existing farms. Only 5-7 % said they practiced shifting cultivation. Those in blocks A1 to B3 claimed to be solely

(100%) cultivating existing farms only. Most of the shifting cultivation was in Block C-2 where 50% claimed to be doing it.

A block average of 48% practiced organic farming while 47% said they do both organic and inorganic. Organic farming was highly practiced in blocks B-1, B-2 and A-2. It was least practiced in block D and block A-1.

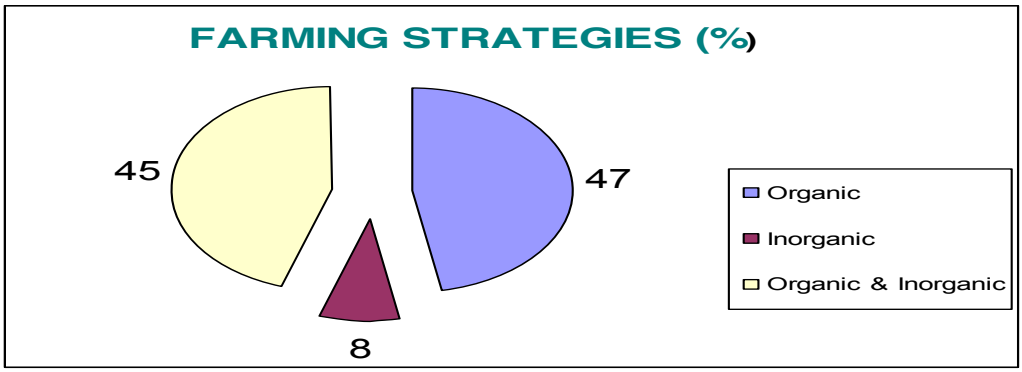


Figure 23. Farming Strategies

Fig. 23 shows that most of the respondents were either into organic farming (47%) or organic and inorganic combined (45%). Only very few (8%) went into pure inorganic.

SWCM Adoption. On the overall, there was a good adoption of SWCM with block average of 71 % in the study area. Blocks B-2 and B-3 had 100% adopters followed closely by A-1 with 97% block total. However only 20% in A-2 practiced SWCM and this was in the form of riprap and contour farming. Contour farming was the most practiced (42%) SWCM in all 5 blocks (, B-1, B-2, B-3, B-4 and C-1) followed by a combination of riprap and contour farming (28%). Block A-1 and C-1 had the most varied SWCM practiced while A-2 and C-2 had only 1 each, check dam and combined riprap and contour farming, respectively.

Rice Farming System*.** With a 92% block average, rain-fed rice fields dominated in all sites. In fact, 5 blocks had ***100% rain-fed rice farms. Most (52%) of the farms had an area of only 1/4 to 1/2 of a hectare. About 28% had ½ to 1½ hectares. Blocks A-1, A-2 and D had more rice farms than the others while block C-2 had none at all.

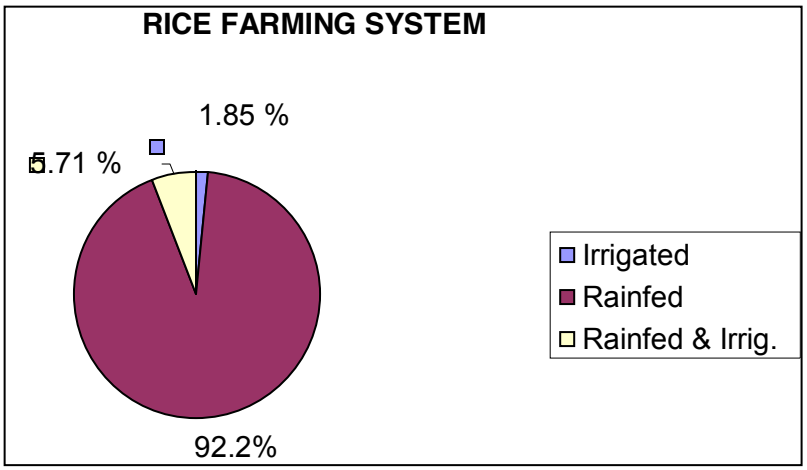


Figure 24. Rice Farming System

A great majority (92.2%) had rainfed rice-fields only. Only very few had irrigated (1.85) and rainfed-irrigated (5.71%) farms.

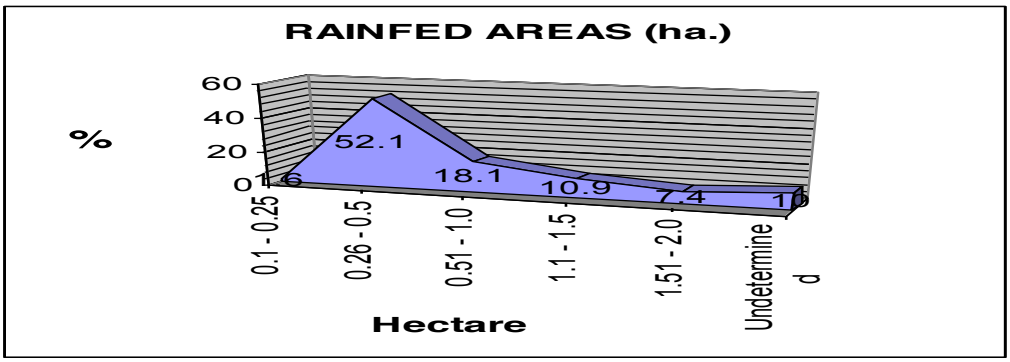


Figure 25. Rainfed Areas

The highest rainfed area of rice fields were between **0.26 - 0.5 of a hectare** (52.1%). Trailing far behind were those ½ to 1 (18.1%) and 1.1 to 1.5 (10.9%) hectares in area.

(3) Crops Other than Rice

Mono-cropping. Cassava was singly raised the most (38%) other than rice. This was followed by camote or sweet potato and corn. However, sweet potato was raised in more blocks than the rest. It was ***grown*** in 5 blocks (especially in block B-2) followed by cassava in 3 blocks. No other crops were indicated in blocks B-1 and D.

Intercropping or Crop Combos. It was sweet to note that sweet potato or camote was present in most crop combinations or combos. It was intercropped mostly with 1 or 2 of the

following crops: banana, corn, gabi, beans, eggplant, bell pepper, peanuts and cassava. Block D respondents were highest (73%) in **sweet-potato combo cropping** followed by Danao (51%), C1 (42%) and A-2 (40%) as next 3 highest. Notably, blocks B-2 and C-2 did not practice all any sweet potato combo.

Coconut was intercropped with bananas, cassava, gabi or corn as but practiced only in 3 blocks (A-2, B-3 & B-4). **Cassava** was found to be commonly combined with corn, bananas, or gabi, but was practiced only in 4 blocks. (A-1. A-2, C-1 and D) by a block average of 13% among the practitioners. **Gabi** was also intercropped with wither peanut, corn, beans or bananas but practiced only in two blocks (B-4 and C-1). A combo of eggplant-squash-beans was practiced in block C-1.

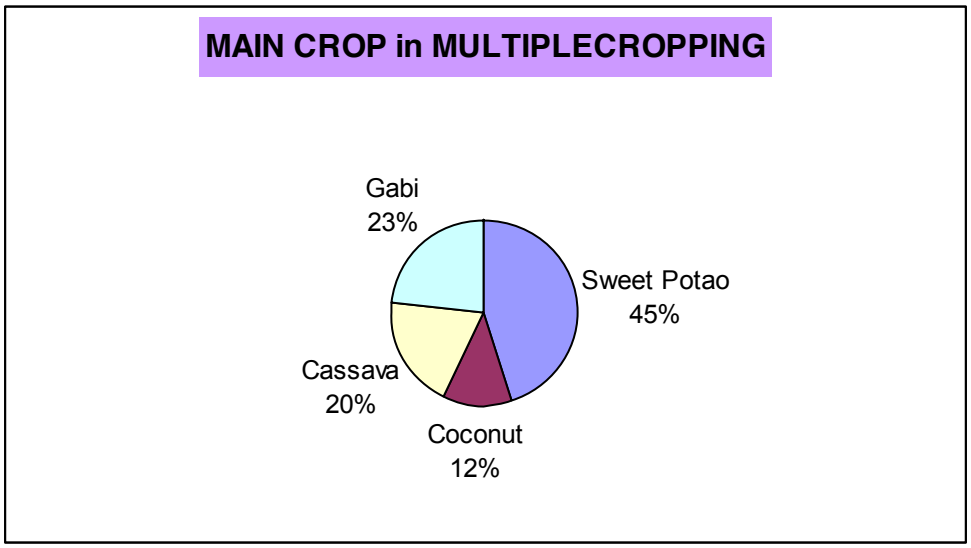


Figure 26. Main Crop in Multicropping System

As indicated in **Fig. 26**, the **most common main crop** was **sweet potato** (45%) intercropped with 1 or 2 of the following: banana, corn, gabi, beans, eggplant bell pepper, peanut, cassava (Table 3). This was followed by **gabi** (23%) which was planted with either peanut, corn, beans or banana and cassava. **Cassava** (20%) was next which was grown with corn, banana or gabi.

Consciously or unconsciously, ***agroforestry*** has been practiced in the study sites.

(4) Fruit Trees

Monoplanting of Fruit Trees. About 47% planted either coconuts, mango or nangka (jackfruit) as a mono crop. Other ***fruits*** singly planted in one or two of the blocks were lanzones, avocado, guava, tambis, star apple or caimito and banana.

Diversified Growing of Fruit Trees. It was nice to note that diverse fruit-tree growing was more practiced than single-cropping. . **Jackfruit or nangka** was involved in 26 crop combinations usually with two or more of the following fruit trees: mango, chico, santol, papaya, star apple, coconut, tambis, guyabano, citrus, lansones, guava, cacao, buongon / pomelo and avocado. Only Block B-1 did not practice this particular combo with jackfruit. Around 33% (average) in each of blocks A-1, B-2 and B-3 had these various combos with jackfruit. **Mango** was next to jackfruit in terms of common component in combo with 2 or 3 of the following: Guava, tambis, rambutan, santol, lansones avocado, cacao, caimito, coconut, banana, chico, papaya, marang and citrus. An average of about 26% in each of the 8 blocks had this various mango combos. Only B-1 and C-2 did not contain this practice. Lanzones was also grown combined with either cacao, coconut, chico, rambutan or lemonsito in four (4) blocks only: A-1, B-3, B-4 and C-1 with an average of 8.5% in each block including Danao.

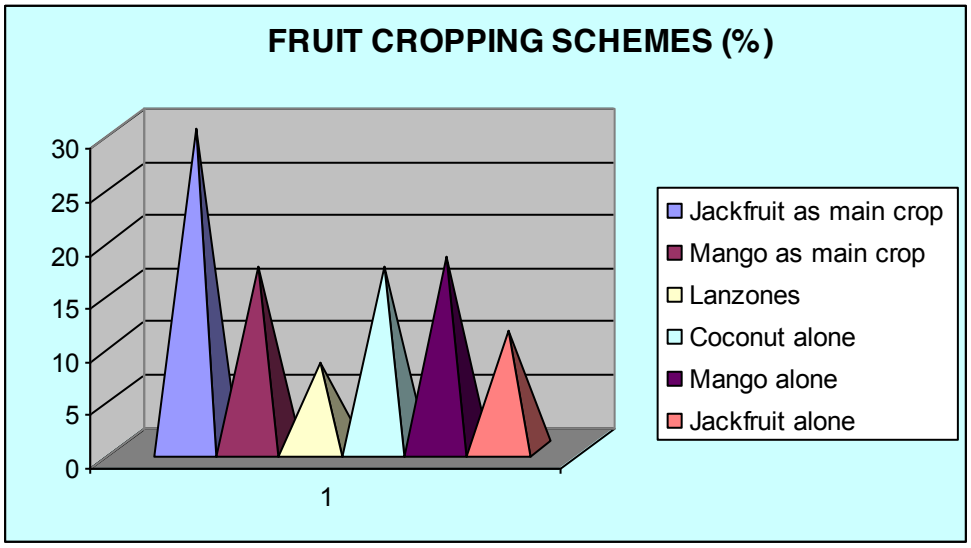


Figure 27. Fruit Cropping Schemes

The most popular fruit planted was **jackfruit** (30%) which was found in 26 combinations with 2 or more of the following: mango, chico, santol, papaya, star apple, coconut, tambis, citrus, lansones, guava, cacao, guyabano, buongon / pomelo and avocado (Table 3). This was followed by **mango** (17%) in combo with 2 or 3 of the following : guava , tambis, rambutan, santol, lansones, avocado, cacao, caimito, coconut, banana, chico, papaya, calamansi, marang and

citrus. Lansones (9%) came next as combined with 1 or 2 of the ff: cacao, coconut, chico, rambutan, lemonsito, tambis, caimito. For solo crops, mango and coconuts led.

(5) Livestock Raised

Carabaos were mainly raised either species-singly or with other animals. Like crops, animals were mostly raised in a diversified manner. There were 23 livestock combinations in all the blocks with carabao as the common component, an average of about 45% in every block. In this scheme, carabaos were raised with 1,2 or 3 of the following kinds of animals: cows, horses, pigs, goats, chickens and piglets. Blocks C-2, D, C-1 and B-3 had more involved in carabao combinations than the rest. Pigs were also a common component with either chickens or cows. Other animals raised singly were goats (4%) and cows (2%).

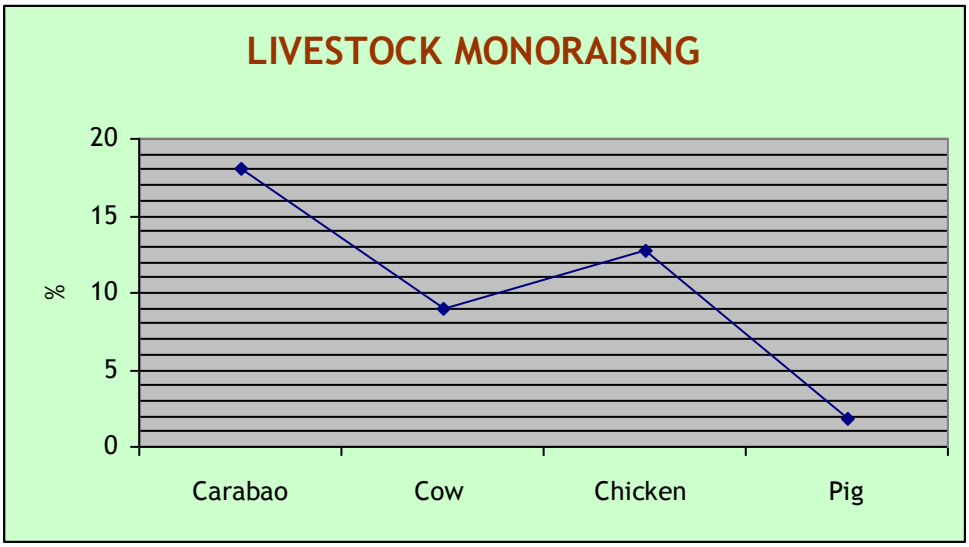


Figure 28. Livestock Monoraising

The carabao was the most common animal raised alone or singly. This was followed by the chickens, cows and pigs, respectively.

(6) **Trees Planted**

Mahogany was the most common timber species planted either singly or in combo with other trees. Next was gmelina. In combination scheme, mahogany was planted with 1 or 2 of the following: gmelina, coconut, jackfruit, ipil-ipil, acacia and mango. An average of about 44% in each block practiced this. A few (about 5%) grew g-melina and coconuts combined.

. Highest block average of about 40% had only 0.1 to 0.25 hectare planted to trees. This was followed by 26% utilizing 0.26 to 0.5 hectare to tree planting

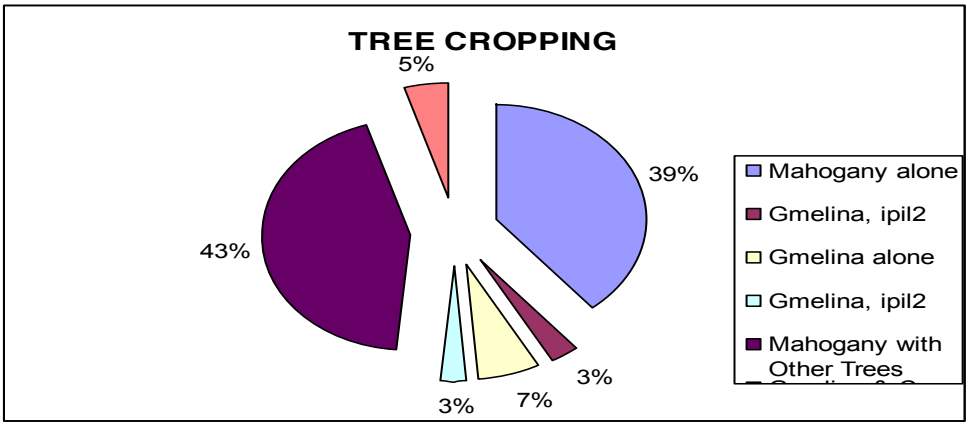


Figure 29. Tree Cropping Schemes

It was also good to note that diversified cropping was not only practiced with agronomic crops but with trees as well. Mahogany and gmelina were the most common main crops. Mahogany was combined with 1 or 2 of the following: gmelina, coconut, jackfruit, ipil-ipil, acacia, and mango.

Notably, the planting of **indigenous timber** species like molave, dipterocarps, narra and other good native timber trees, was **NOT** practiced by the respondents.

(7) Forest Products Utilization

Some 53% of the respondents indicated to be sourcing lumber from the forests. Another 26% were extracting trees either for lumber or firewood or along with some coconuts (for copra-making). Very few (3%) said they also gather **bago** (*Gnetum gnemon*) leaves and /or birds. The rest did not answer. More (32%) said that the extracted forest products were for ***commercial*** use. Some 23% said it was for domestic use only. Another 14% said it was for both domestic and commercial use. Some had no answer or refused to answer (31%).

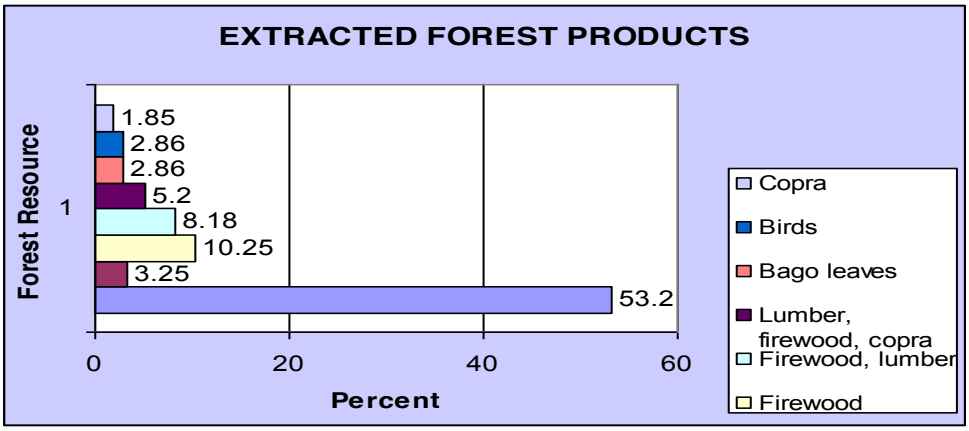


Figure 10. Extracted Forest Products

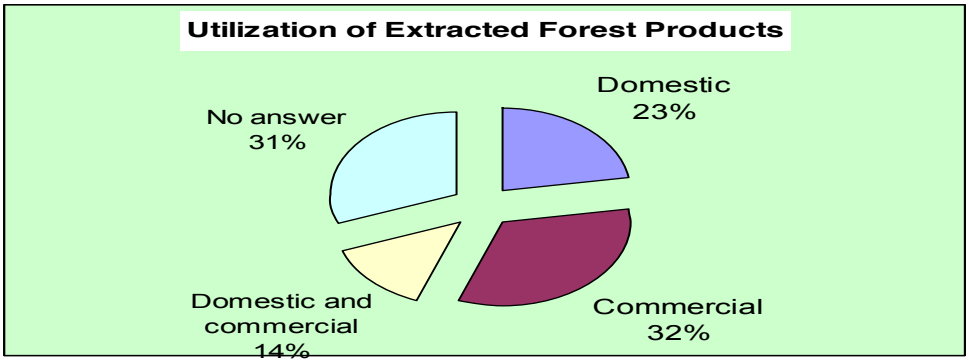


Figure 11. Utilization of Extracted Forest Products

It was very evident that unregulated cutting of trees still abound also in Abatan Watershed as shown in the above graph. Lumber was the main (54%). This was followed by lumber and firewood (12%) and firewood only (10%). Other forest resources gathered were coconuts (copra) birds and bago.

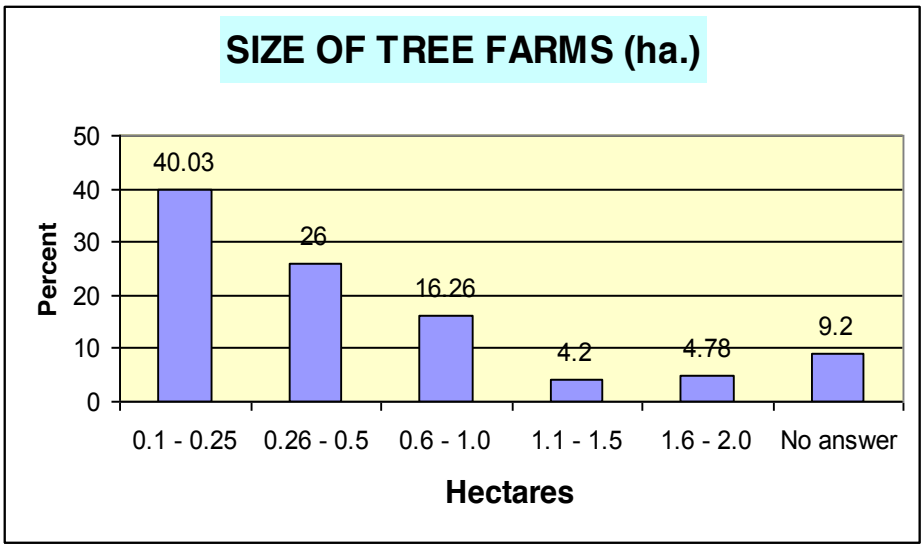


Figure 12. Size of Tree Farms

Most (40.03%) of the tree farms or tree planting sites of the area were only ¼ of a hectare or less. This was followed by those areas which were 0.26 – 0.5 of a hectare (26%) and 0.6 – 0.1 of a hectare.

(8) Monthly Income and Expenses

Most **(26.4%)** indicated to be having a monthly income of **P1,001 to P2,000**. This was followed by those with a monthly income of **P3,001 – P4,000 (11.5%)** and **P4,001-5,000 (10.2%).** Most (32%) worked outside the barangay. Eighteen percent (18%) worked within the village only. There were 12% who worked both inside and outside the village while another 12% did not indicate.

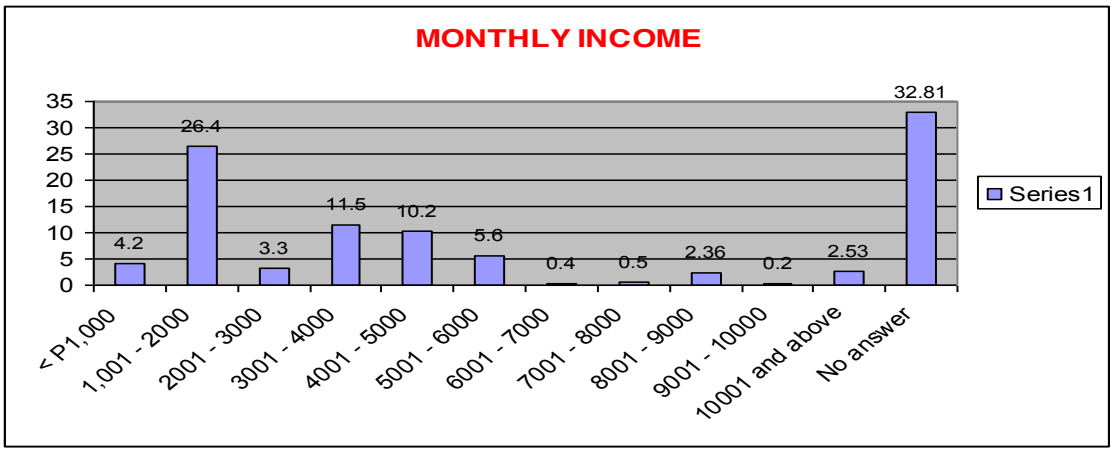


Figure 33. Monthly Income

As to monthly expenses, 37% said they spend around P1,000 – 2,000 per month. This was followed by 30% who said HH monthly expenses is from P2,000 – 3,000.

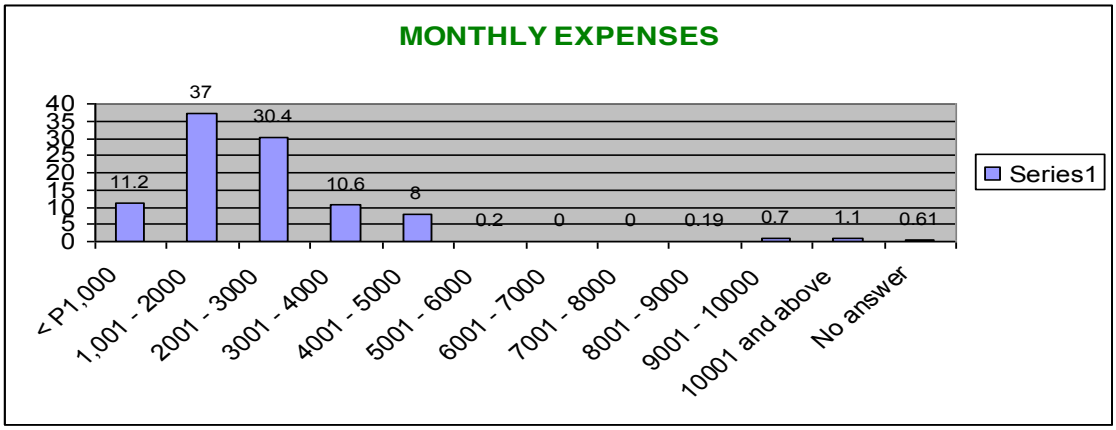


Figure 34. Monthly Expenses

III. SOCIAL STATUS

(1) Household Conditions

Annex E-3 shows household conditions in terms of type of housing, home appliances, waste management and other HH facilities. About 74% had semi-concrete houses. All respondents in Blocks B-2 and C2 had semi-concrete houses. This was followed by 27% who had

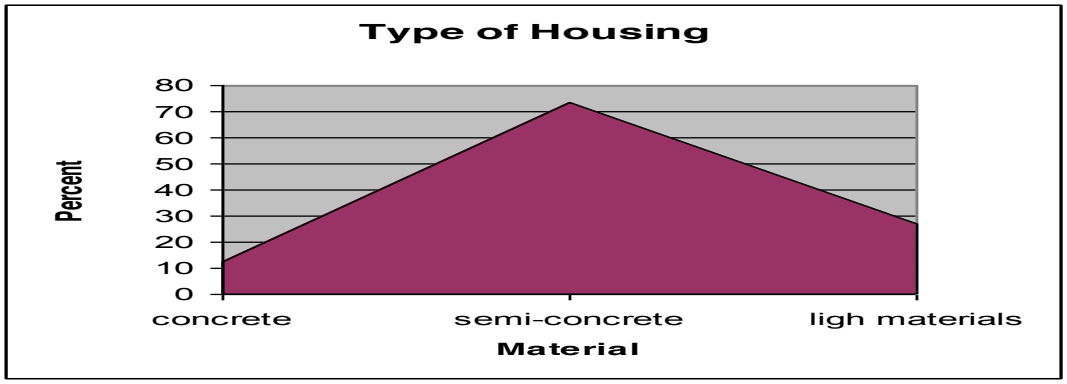


Figure 35. Type of Housing

houses made of light materials, 73% of which were in Block A-2. Some 90% indicated to have been practicing proper waste management. Another 90% indicated to have water-sealed toilets, 13% to have open pit and 2 % with no toilet at all.

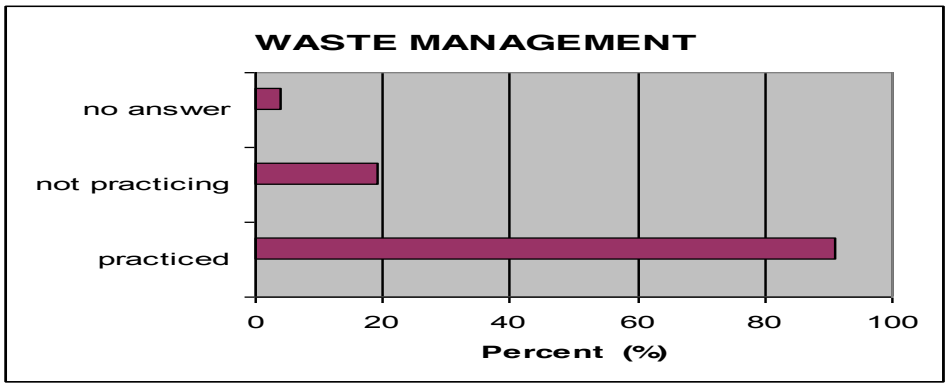


Figure 36. Household Waste Management

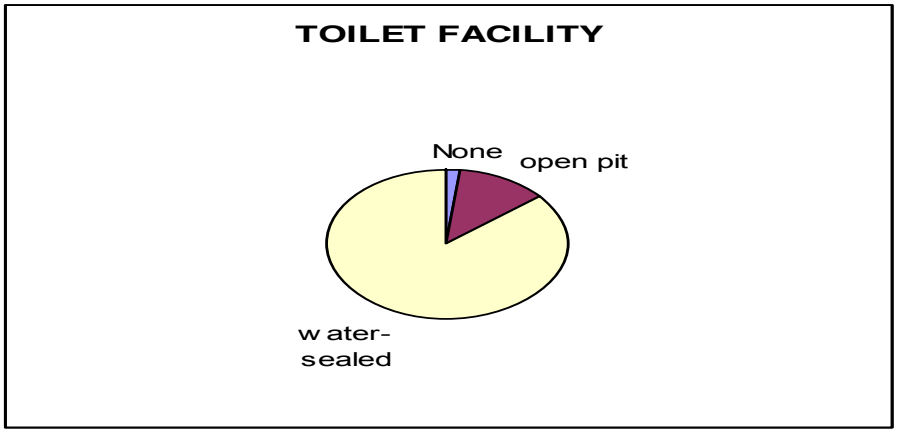


Figure 37. Available Toilet Facilities being Used

Television set (TV) was the most common appliance in the home, either singly (7%) or in **combination** with other appliances (82%). There were **45 cases of TV combined** with other appliances. Karaoke and CD / DVD player usually goes with the TV. Other appliances that go with TV are radio, refrigerator, electric fan, gas stove, water dispenser, flat iron, rice cooker and computer. Only 8% had radio alone. This finding has an implication to advocacy through audio-visual media. Before, the radio was believed to be the most effective medium of advocacy. Now it appears that advocacy through media would be most viewed or heard through TV. The respondents with the most number and kind of appliance came from blocks C-2 (98%), B-1 (93%) and B-2 (91%) and followed by B-4 (89%) and C-1 (87%) and D (82%).

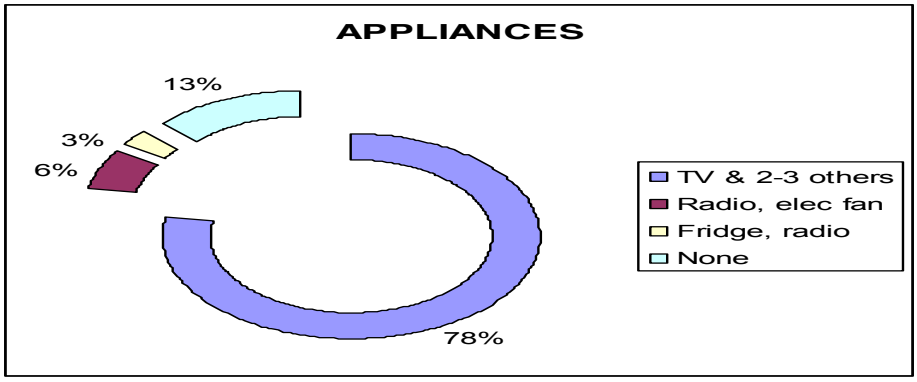


Figure38. Common Household Appliances

(2) Roads, Transportation and Institutions

Roads and Transportation. **Annex E-4** reveals that most (44%) of the study sites had barangay roads; 31% had mainly a **barangay** road coupled with municipal, provincial or national road while 25% had provincial roads. Blocks B-2 (63%) and B-3 (44%) were the most accessible with all four kinds of roads (from barangay to national). Blocks A-1, B-1, C-2 and Danao were accessible only through the provincial and a barangay road. The motorcycle or *habal-habal* was the most common form transportation (31%). Some areas (39%) had the *habal-habal* and with either jeepney, bus or both.

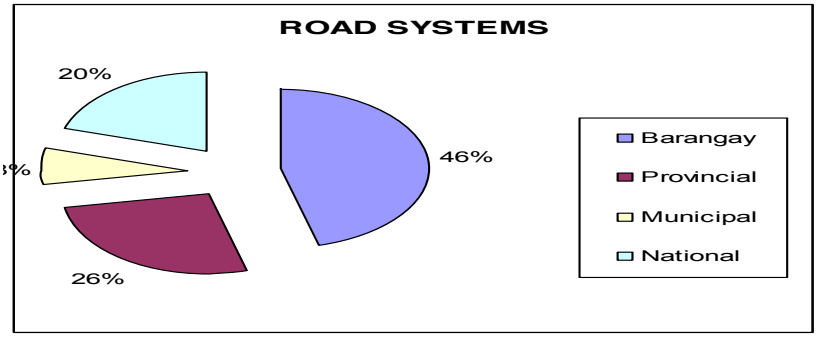


Figure 39. Road Systems

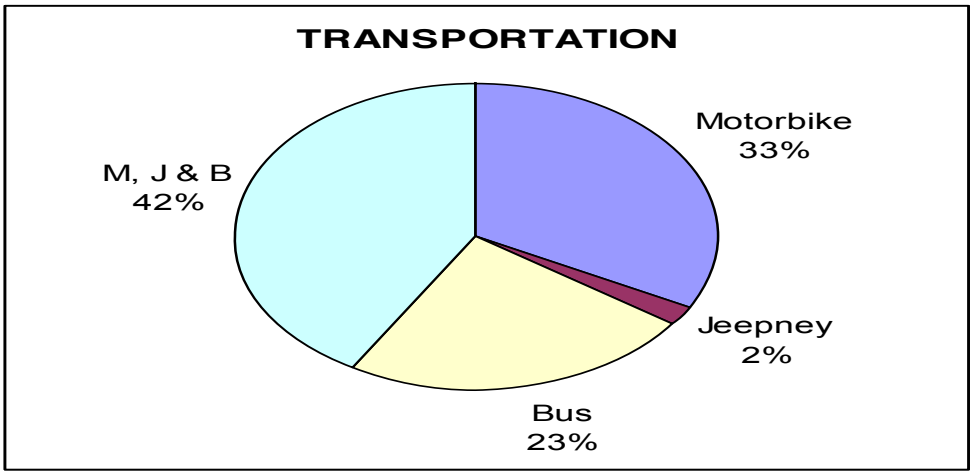
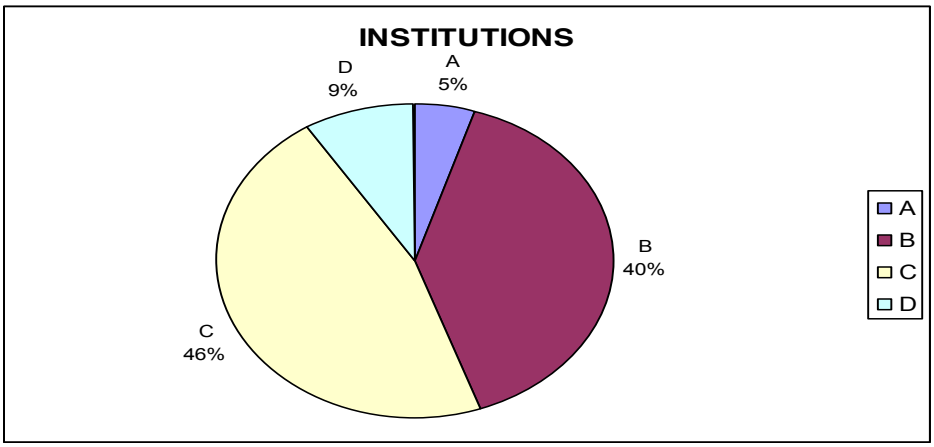


Figure 40. Means of Transportation

Institutions. **Fig. 41** shows that 47% were having an elementary school in their area. With such school, 2 or 3 of the following facilities were also present: barangay hall, health center, daycare center, sports area and a church. Another 40% had elementary school together with 2-3 of the following: barangay hall, sports center, library and daycare center but no health center. Thirty-six percent (36%) had primary school only together with a health center, daycare center and barangay hall. This was in block B-2 only. Still another 37% had primary school only with either church, daycare center and barangay hall but with no health center. Blocks A-1 and B-1 had a high school, daycare center and barangay hall but no health center. Block C-2 had all four levels of educational institutions (primary, elementary, hi school and collegiate).



A - Brgy hall/ High school,/ day care,(no health center)
B - Elem. School plus 2-3 of the ff: bgy hall, sports center, library, daycare, (no health center)
C - Elem school plus a health, daycare & sports center, & a church
D - Primary school only with church, daycare center,

Figure 41. Institutions

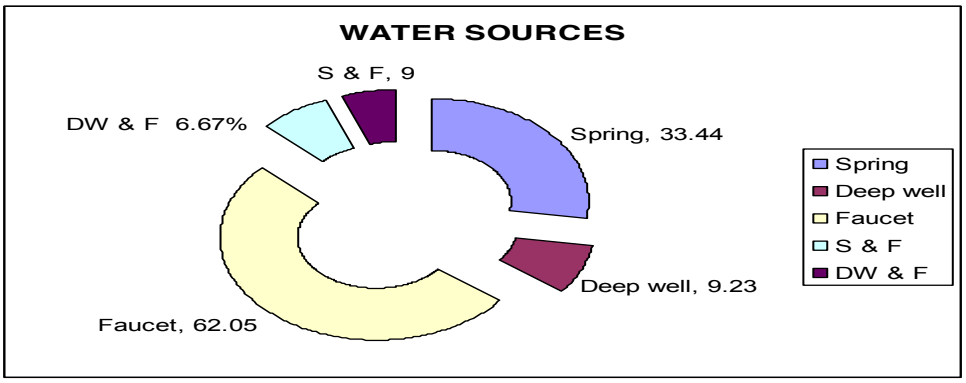


Figure 42. Potable Water Systems

Electricity and Water System. Most (***93***%) had electricity. The 7% without electrical connections were the respondents in blocks A-1, A-2, B1, B-4 and C-1. Faucets were the most common cited water system (62%); followed by springs (33%) and deep well (9%). Some 89% said the water supply is continuous and 94% said it was potable. All blocks had faucets except A-1. Block C-2 had 100% faucet as water system. Block B-2 and Danao had only 7% and 3% respectively of faucet source.

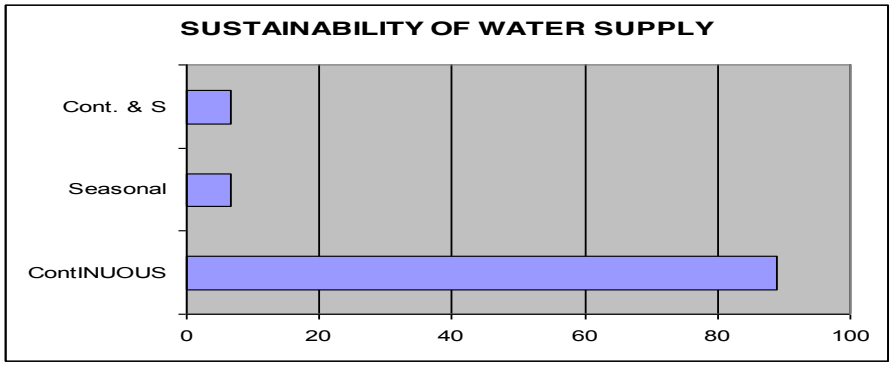


Figure 43. Sustainability of Water Supply

IV. COMMUNITY ISSUES AND CONCERNS

Rats appeared to be the number one problem in the farm, either singly (27%) or in combination with other problems (57%). The rats infest on young coconuts and young corn. Young coco nuts gnawed by the rats fell to the ground before reaching maturity. Rats had been a problem as cited in 14 types of combinations or with 2-3 of the following: monkeys, lack of water irrigation or water source, bird hunting, beetle infestation, illegal logging, kaingin and lack of fertilizers. The rats problem was most noted in blocks B-2, B-3 and C-2. Most (94%) did not give any cause(s) of the cited concerns or problems and 87% were also silent or did not give any recommendation or suggestion on how to mitigate the identified major problems.

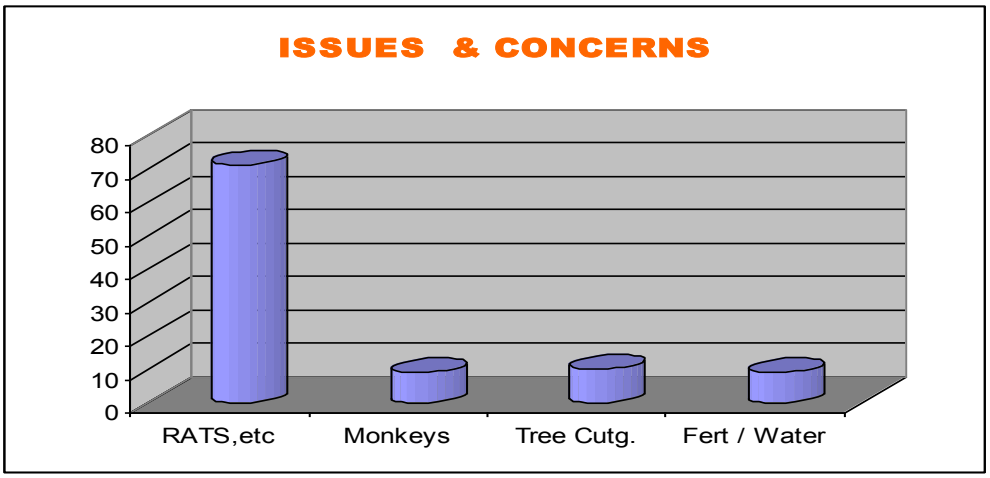


Figure 44. Community Issues and Concerns

B. SUMMARY AND CONCLUSIONS:

(1) Demography

Majority of the respondents were above 50 years of age with many between 60-70 years old. Almost all had been local residents since birth most had attained only elementary education. Farming was the main occupation. A few were barangay officials and housekeepers. Households had mostly 1-5 members with 4-6 children as common occurrence.

(2) Economic Profile/Activities

Many indicated to be having a monthly income of P1,001 to P2,000 and monthly expenses of P1,000 – 2,000 per month. Locations of farms were simply cited as within a ***purok***. Most of the farms were only 0.6 - 1.0 hectare. . B-4 and C-2 had the most number of cultivators-respondents of 54% and 45% respectively. All or 100% of the cultivations in Blocks A-2, B-2, B-3 and B-4 were in timberland areas while an average of 74% were in the timberland areas of blocks A-1. B-1 and C- Danao were all in A&D lands. Most had some form of TIs or tax declaration. Most had been occupying the timberland areas for a decade already, followed by 25% who were in the area for 41-50 years already. Most were claimant cultivators. Most (80%) claimed to be cultivating only existing farms. Shifting cultivation was mostly reported among block C-2 respondents.

Organic farming was practiced by about half of the respondents while another half said they both practiced organic and inorganic farming. Many also applied SWCM in their farms through contour farming and riprap. A few others apply check dams. Most (92%) rice fields were rain-fed. The individual farms were also mostly ¼ to ½ ha only. Mono-cropping was practiced particularly with cassava, sweet potato and corn.

Intercropping with **sweet potato** was highly practiced in several crop combinations involving banana, corn, gabi, beans, eggplant, bell pepper, peanuts and cassava. **Coconut** was also main crop involving bananas, cassava, gabi or corn while cassava. In 4 of the 10 blocks, **Cassava** was commonly combined with corn, bananas, or gabi. Consciously or unconsciously, ***agroforestry*** has been practiced in the study sites.

It was great to note that **diverse fruit-tree** growing was more practiced than single-cropping. . **Jackfruit** was involved in **26 crop** combinations usually with two or more of the following fruit trees: mango, chico, santol, papaya, star apple, coconut, tambis, guyabano, citrus,

lansones, guava, cacao, buongon / pomelo and avocado. **Mango** was next to jackfruit in terms of common component in combo with 2 or 3 of the following: Guava, tambis, rambutan, santol, lansones, avocado, cacao, caimito, coconut, banana, chico, papaya, marang and citrus.

Mahogany was the most common timber species planted either singly or in combo with other trees. Next was gmelina. In combination scheme, mahogany was planted with 1 or 2 of the following: gmelina, coconut, jackfruit, ipil-ipil, acacia and mango.

The planting of **indigenous timber** species like molave, dipterocarps, narra and other good native timber trees, was **NOT** practiced by the respondents

Carabaos were mainly raised either species-singly or with other animals. Like crops, animals were mostly raised in a diversified manner. There were 23 livestock combinations in all the blocks with carabao as the common component.

Majority were involved in **forest-based products extraction**. These were mainly lumber and firewood. Others were coconuts for copra-making, bago leaves and birds. These forest products gathering was more for **commercial** purposes.

(3) Social Status

A big majority owned semi-concrete houses and water-sealed toilets. **Television set (TV)** was the most common appliance in the home, **either** singly (7%) or in combination with other appliances (82%). There were **45 combinations of TV** with other appliances. Karaoke and CD / DVD player usually goes with the TV. Other appliances that go with TV are radio, refrigerator, electric fan, gas stove, water dispenser, flat iron, rice cooker and computer.

(4) Roads, Transportation and Institutions

Most study sites had barangay roads or a barangay road coupled with either municipal, provincial or national road. The motorcycle or ***habal-habal*** was the most common form transportation. Other areas had the *habal-habal* and with either jeepney, bus or both. A good majority had **electricity** and also faucets as water source. Use of spring-waters was next to the faucet system. Both water sources were said to be potable and sustainable.

(5) Issues and Concerns

Rats appeared to be the number one problem in the farm, either singly or in combination with other problems. The rats infest on young coconuts and young corn. Young coco nuts gnawed by the rats fell to the ground before reaching maturity. Rats had been a problem as cited in 14 types of combinations or with 2-3 of the following: monkeys, lack of water irrigation or water source, bird hunting, beetle infestation, illegal logging, kaingin and lack of fertilizers.

No data were gathered on the measures or initiatives made by the people to mitigate those problems.

Project Staff Jonas Buñao interviews a farmer in Barangay Cansague Sur, San Isidro (left); Project staff Felix Calabria (standing) pays courtesy call and consultation in Barangay Bantolinao, Antequera

2.3.1 POPULATION AND DENSITY (WHOLE WATERSHED)

Annex E-6 bares the latest information gathered from the Provincial Planning and Development Office (PPDO) which has shown that the 115 barangays situated within the Abatan Watershed have a combined population of 93,987 people, which is practically 36% of the sum of the total population of the 13 component municipalities. **Table 24** has indicated that 100% of Antequera and San Isidro's residents are living inside the watershed simply because all their barangays are situated within the watershed. Other municipalities having the highest percentage of population residing within the watershed are Corella with 84%, Cortes 83%, and Balilihan 79%.

Table 24. Watershed Population per Municipality					
Municipality	**Municipal Population (1-Aug-07)**	**Annual Growth Rate (%)**	**No. of Bgrys. Inside**	**Watershed Population**	**Percent**
1. Antequera	14,357	0.59	21	14,357	100%
2. Balilihan	17,131	0.24	22	13,588	79%
3. Calape	29,786	0.9	3	1,913	6%
4. Catigbian	23,333	1.16	12	13,907	60%
5. Clarin	18,871	0.62	3	2,083	11%
6. Corella	7,471	2.96	7	6,259	84%
7. Cortes	14,586	1.92	13	12,071	83%
8. Loon	42,441	-0.87	1	366	1%
9. Maribojoc	15,716	1.05	7	5,895	38%
10. Sagbayan	19,399	0.77	5	7,426	38%
11. San Isidro	9,176	0.11	12	9,176	100%
12. Sikatuna	6,335	-0.57	6	4,003	63%
13. Tubigon	44,434	1.33	3	2,943	7%
Total	**263,036**	-	115	**93,987**	36%

Given this number of population, the Abatan Watershed has a population density of 243 persons per square kilometer when computed. This figure is quite low if compared to the province's population density of 299 persons per square kilometer. It means that some areas of the watershed are less inhabited. The least populated municipality in the province, however, is Balilihan with only 145 persons per sq-km.

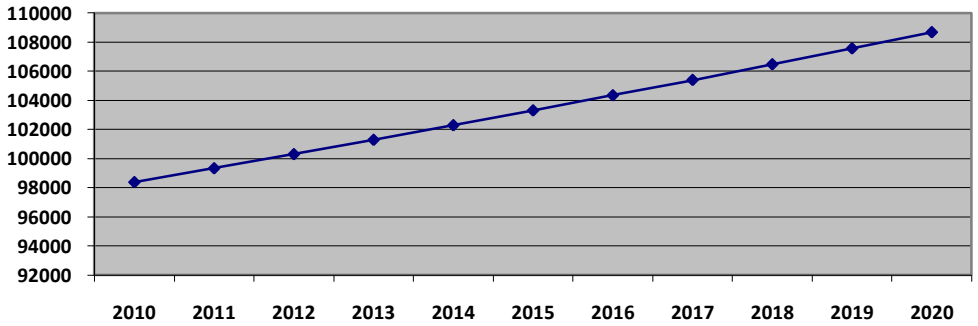


Figure 45. Projected Annual Population Growth

The average population growth rate of municipal LGUs embracing the watershed is 0.79% only per annum from 2000-2007. Again, this is smaller compared to the entire Bohol's annual growth of 1.06%. Of the 13 component municipalities, the town of Corella gets the highest growth rate in human population, whereas Loon and Sikatuna have shown declining population with -0.87% and -0.57%, respectively. Should this trend continue, **Fig. 45** has projected that the Abatan Watershed will have a population of 108,653 individuals in year 2020.

Records taken from the Municipal Health Offices for the period from January-August 2010 have shown that there are a total of 4,449 new acceptors of family planning methods, about 90% of whom are into modern methods. Only 10% are adopting the natural family planning methods. Some 37% of women of reproductive age are taking pills to avoid unwanted pregnancy,

and followed by a permanent tubal ligation with 26% and injectables 22%. Only 6% of these women are using IUD.

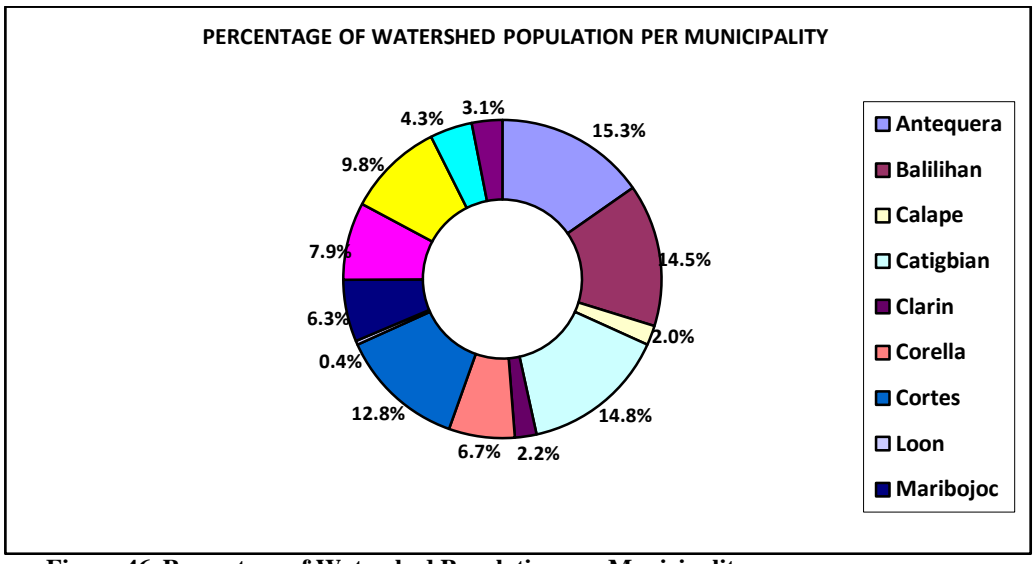


Figure 46. Percentage of Watershed Population per Municipality

Of the 93,987 people around the Abatan Watershed, a big chunk of this number comes from the four municipalities, namely: Antequera, Catigbian, Balilihan, and Cortes. As presented in **Fig. 46**, 15.3% belongs to Antequera, 14.8% living inside the jurisdiction of Catigbian, 14.5% in Balilihan and 12.8% Cortes. The smallest population share of course is the municipality of Loon comprising only 0.4% of the total watershed population.

There are no gender segregated data in the demographic profiles of Cortes, Calape, Tubigon and Sagbayan, but available data of other 9 municipalities show that Abatan Watershed population is generally equally distributed by gender, although females slightly outnumber males, i.e., 132,277 vs. 125,801. Females outnumber males in Maribojoc, Antequera and San Isidro, while males outnumber females in Clarin, Catigbian, Corella and Balilihan.

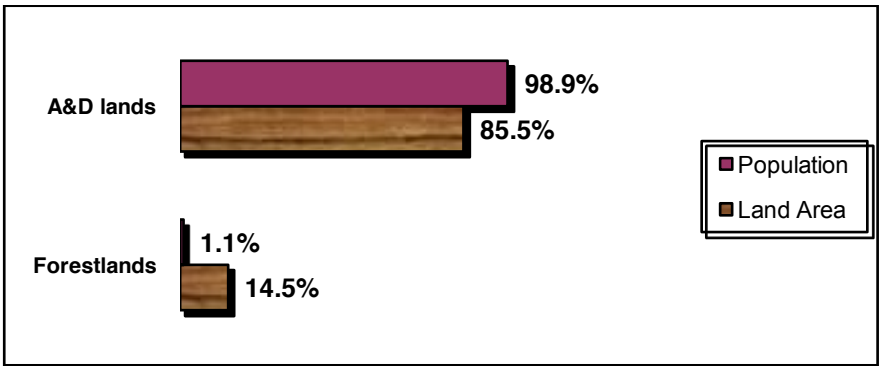


Figure 47. Watershed Population Based on Land Classification

During the socio-economic survey, there were a total of 197 respondents being interviewed representing in as many households living inside the 9 timberland blocks of the Abatan Watershed. Multiplying it with the average provincial household size of 5.43 persons per household, the Abatan Watershed forestlands/timberlands will have a combined total population of approximately 1,070 people. The figure, of course, does not include those outsiders who have cultivations inside the forestlands.

Fig. 47 indicates that the forestlands are less inhabited with only1.1% of the total watershed population. Dividing the forestland population by the total timberland area of 55.96 sq-km, the forestlands will have a population density of about 19 persons per square kilometer.

2.3.2 AGE STRUCTURE

The ABS-CBN Bantay Kalikasan Foundation has also made its own assessment of Bohol's major watersheds, including the Abatan Watershed. According to their report being furnished to stakeholders, the population of Abatan Watershed is generally young. Even if the figures do not jive exactly with those in the preceding data, **Fig. 48** will give out an idea that 19,433 individuals or around 30% are within the age range of 0-10 years old. This is followed by a batch of youngsters composed of 12,884 individuals or about 20% who are between 11 and 20 years of age. The age groups with least population are those ranging from 41-50 and 51-60 years old.

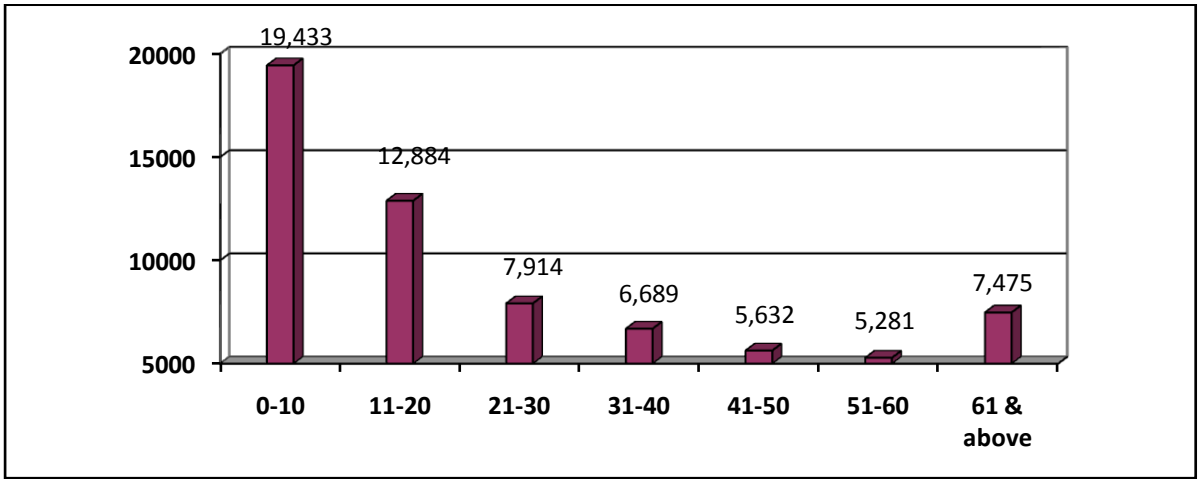


Figure 48. Population Distribution by Age Class

The above graph is scary since it means the population growth in the next ten to twenty years will be significant in terms of water needs within the watershed communities, infrastructure such as schools and the pressure for more lands for farming, etc.

Based on the Boholano culture, children within 0-10 and 11-20 age brackets are highly dependent of their parents to support of their basic needs. In economics, it means more mouths to feed, and in labor sector more labor has to be used to watch the younger people of less productive age.

2.3.3 EMPLOYMENT PATTERN AND PROJECTION

The range of municipal populations in the Abatan Watershed that is generally dependent on farming for daily subsistence is from 15% to 78%. The largest farm-dependent populations can be found in Calape, Antequera and Corella. Municipalities that do not have data on sources of employment in their socio-economic profiles also indicate agriculture dependence as shown in large tracts of farmlands in both low-lying and sloping areas.

Table 25. Employment in Some Municipalities

Municipality	% Employment Rate			
	Agriculture	Non-Agriculture	Industry	Self-Employed
Maribojoc	30	10	-	-
Antequera	67	33	-	-
San Isidro	40	-	-	-
Calape	78	20	15	-
Tubigon	30	16	7	-
Clarin	29	27	-	-
Catigbian	15	16	5	8
Corella	57	37	-	8

Between 16-37% of the municipalities' population is able to access occasional employment in offices and stores, or in on-call jobs as carpenters, construction workers, and drivers, as well as find jobs as OFWs. Self-employment by tending small backyard poultries or in


Handicraft making in Barangay Abehilan, San Isidro (left); Nipa weaving in Barangay Lincod, Maribojoc

micro-enterprises engaged in sari-sari stores, buy-and-selling of dry goods, handicraft making, nipa weaving and food processing is considered as either additional or main sources of income by some families, mostly in Catigbian, Corella and Sikatuna.

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2.3.4 SOCIAL, EDUCATIONAL, AND MEDICAL SERVICES

In addition to the results of the socio-economic survey presented in the preceding pages, it is deemed necessary also to share the salient points of the separate study conducted by PROCESS-Bohol in 2004. One of its major objectives was to determine the prevalent causes of morbidity and mortality among children and adults of the four (4) LGUs (Antequera, Balilihan, Cortes and Maribojoc) within and along the Abatan River and Maribojoc Bay.

Results showed that UTI (urinary tract infection), coughs and colds, diarrhea, fever, dermatologic disorders, wounds, hypertension, pneumonia, parasitism and gastrointestinal disorders are the prevalent causes of morbidity. Whereas the leading causes of mortality are cardiovascular disease, pneumonia, cancer, hypertensive vascular disease, tuberculosis, unknown cause of death, stroke, septicemia, chronic renal failure and chronic liver disease.

2.3.5 TOURISM AND RECREATION

The tourism industry in Bohol is seen as the engine for economic growth of the province. Among its products are those located in Abatan Watershed where natural attractions are combined with cultural presentations of native dances, songs and plays.

The majestic Kawasan Falls in Barangay Candasig, Balilihan (left); the cultural presentation in Barangay Sto. Rosario, Antequera

The existing and potential eco-tourism and recreational spots in the locality are enumerated in **Table 26**.

Table 26. List of Potential Tourism Sites

Name	Location	Remarks
Bili-bili Spring	Brgy. Malayo Norte, Cortes	The site has been identified as a new tourism destination based on the 2007 Abatan Tourism Master Plan. Volume of water is flowing freely from a spring down to Abatan River. A fraction of the water is utilized by the local community for the swimming pool and laundry purposes during summer.
Mag-aso Falls	Brgy. Mag-aso, Antequera	It has long been developed by the municipal government for tourist attraction. There are rustic facilities built near the cascade.
Inambacan Falls	Brgy. Villa Aurora, Antequera	The site has been partly developed by the local government. There are proposals to tap the source for the water needs of the municipality.
Magdahunog Spring	Brgy. Tabuan, Antequera	Little-known by the tourism sector in Bohol, the site has a natural swimming area fed by a water spring.
Kawasan Falls	Brgy. Candasig, Balilihan	This site is located about 22 km from Tagbilaran City. This is being developed by the municipality as the end point of Abatan River cruise.
Kilab-kilab Falls	Brgy. Caimbang, San Isidro	About 32 km from Tagbilaran City, the site has an impressive waterfall and lagoon flanked by limestone walls.
Abatan River (mouth)	Between Maribojoc & Cortes	The mouth of the Abatan River has started to be developed for various water-based recreation such as kayaking and boating. One can also explore various mangrove areas. A possible activity that can also be done is bird watching.
Buhong Tiawan Cave	Brgy. Tagubaas, Antequera	This cave is located one and a half kilometers from the town center of Antequera. The entrance can be found in the wall of a limestone hill. One has to walk one kilometer through dense vegetation before reaching the entrance.

Table 26. Continued . . .		
Hagakhak Cave	Bgry. Villa Aurora, Antequera	The site is around two km away off Antequera town proper. This can be reached via a dense trail whose entrance is estimated to be 15 meters wide at the base of a sinkhole.
Inambacan Cave	Brgy. Villa Aurora, Antequera	About two kilometers from the town center, the cave is more accessible than Hagakhak and Buhong Tiawan caves. Its special feature is the cavern with small stalactites and stalagmites which is often submerged in running water.
Camantong Cave	Bgry. Quinapun-an, Antequera	Also known as Snake Pit, this is home to pythons that feed on the rats and other small animals. The cave is also famous for its natural beauty with underground spring.

2.3.6 RELIGIOUS SECTORS, POLITICAL, AND SOCIAL ORGANIZATIONS

2.3.6.1 **Cooperative/NGOs/Social Organizations**

In a partial list (**Annex F**) taken from the Municipal Local Government Operations Officers (MLGOOs) assigned and SB secretaries, there are at least 7 NGOs, 14 cooperatives and 34 associations that were accredited with the respective municipal LGUs inside the Abatan Watershed. These NGOs all have offices in Tagbilaran City but operate in different municipalities. In their operations, they provide various programs and activities in accordance with their organizational expertise and experience that range from sustainable agriculture to water and sanitation, health and nutrition, livelihood development and natural resource management. These NGOs are as follows:

a) **FCB Foundation Incorporated** – is a social development arm of the First Consolidated Bank (FCB) that extends livelihood programs and activities to community groups and individuals all over the province of Bohol, including micro-financing to local entrepreneurs. It is accredited in Antequera, Catigbian, Cortes, San Isidro and Sagbayan.

b) **Participatory Research, Organization of Communities and Education towards Struggle for Self-reliance** (PROCESS)**-Bohol, Inc.** – is operating in the province since 1985 by working closely with subsistence fisherfolk and marginal farmers in the field of natural resource management, sustainable agriculture, water and sanitation, gender and development, among others. Its application for accreditation was duly approved in Antequera, Balilihan, Catigbian, Cortes, Corella, Maribojoc, San Isidro, Sikatuna and Loon.

c) **Feed the Children Philippines** (FTC) **–** is an organization named sought to respond to the needs of disadvantaged Filipino children. In Bohol, it concentrates

in the feeding of the malnourished, providing them medical services and sponsorship programs in schools. The municipalities of Catigbian, Corella and Sikatuna had accredited this organization.

d) **Environmental Legal Assistance Center** (ELAC) – is an environmental NGO committed to helping communities uphold their constitutional right to a healthful and balanced ecology. It sought accreditation and was approved in the towns of Cortes and Maribojoc.

e) **Bohol Alliance of Non-Government Organizations** (BANGON) – is a group of social development organizations in the province of Bohol that decided to band together in meeting the demands for sustained development among the marginalized Boholano communities. Its secretariat office was accredited in Cortes, Maribojoc and Sagbayan.

f) **People's Fair Trade Assistance Center** (PFTAC), Inc. – is a local NGO that builds the capability of small farmers through sustained organic banana enterprise. It applied for accreditation in the town of San Isidro only and was approved.

g) **Community Awareness & Services for Ecological Concerns** (CASEC), Inc. – is a service oriented organization whose aim is to enhance the people's consciousness about the ecological situation in the country. It is accredited in the upland municipalities of San Isidro and Sagbayan.

Most of the cooperatives and associations are engaged in trading of goods and services, micro-lending, and capacity building. The majority of them were initiated by community-based programs and projects of NGOs and government agencies with foreign funding assistance.

2.3.6.2 **Religion**

Roman Catholic is the predominant religious affiliation in Abatan Watershed with about 91% of the total population. There are also Evangelicals, Iglesia ni Kristo, United Church of Christ in the Philippines and Jehovah's Witnesses.

2.3.6.3 **Political**

As cited in the preceding pages that out of 13 municipalities comprising the Abatan Watershed, only the municipalities of San Isidro, Clarin and Sagbayan are not part of Congressional District I. Unlike the latter, however, the former appears to be isolated from the rest of District II. Therefore, in order to have a comprehensive watershed management strategy, there may be a need to append the municipality of San Isidro to District I.

2.3.6.4 **Citizen Participation**

The stakeholders of Abatan Watershed actively participate in planning and decision-making processes of their respective political units and organizational affiliations. Since 2005, there is an existing inter-agency and multi-sectoral governing body for the Abatan River, named as the ***Abatan River Development Management Council*** (ARDMC). Its creation was an offshoot of the Abatan River Ecotourism Development Program initiated by the Office of First District Congressman Edgar Chatto. The Executive Order No. 19 issued by Governor Erico Aumentado in November 18, 2005 gave a mandate to the Council to oversee the development and management of the Abatan River as one of the major eco-tourism destinations of the province.

The Council was responsible for the formulation of the Framework Plan and the Abatan River Code which serve as the guidelines in the operationalization of the Abatan River Community Life Tour. The Council was also instrumental in formulating the Conceptual Ecotourism Master Plan for the Abatan River.

2.3.7 BEHAVIORAL AND CULTURAL PATTERNS

Most residents are of Boholano origin and speak the ethnic Bol-anon language, although a some have been influenced by other cultures due to inter-cultural marriages and migration.. Ninety-six percent of the local residents surveyed indicated they were born in the area.

The tradition of exchanging labor called, *hungos* in Bohol, is still being practiced by the residents and prevalent throughout the place. Farmers are joining *hungos groups*, a mutual help group designed to work each other's farm, to save labor costs. A number of residents also have *sosyo* for fiesta purposes and *abonohay* for weddings of siblings. A majority form *dajong* groups

that provide mortuary aid. Their contributions vary from in-kind (drinks, rice grits, firewood, etc.) to labor and cash.

Farmers help each other in farm preparation through *hungos* system (a mutual help group) in Barangay Tabuan, Antequera

Other citizen groups also exist which are instrumental in addressing local concerns and in shaping the future of their communities. However, most of these organizations are male dominated. Women usually take the secondary role and act only as representatives of their husbands during meetings and other formal gatherings.

Women groups abound in the municipalities through the Local Government Code but these groups are most often involved in activities which perpetuate and reinforce the traditional role of women, e.g., beautification projects, cooking and sewing lessons or as entertainers (dance numbers) during celebrations. This rich source of human resource needs intensive gender sensitization to facilitate GAD (gender and development) mainstreaming in the barangays.

Out of the 13 municipalities, only the municipality of Tubigon passed an ordinance creating a GAD Office, including the appointment of a GAD Officer and a list of functions of said office.

III. VULNERABILITY ASSESSMENT

Based on existing data and information from different sources and results from critical assessment on factors affecting its present condition, the Abatan Watershed is slightly vulnerable to natural and anthropogenic hazards.

A. Hazard and Critical Factor Analysis

1. **Landslide and Soil Erosion** – In 2007, the PPDO conducted a geo-hazard assessment across the province with the aim at identifying specific areas that are prone to disasters frequently hitting Bohol (**Annex G**). All the 13 municipalities encompassing the Abatan Watershed participated in the workshop subjecting 274 barangays to it, which are approximately 86% of their combined total of 317 barangays. Fortunately, it included 100% of 115 barangays inside the watershed.

Table 27. Number of Barangays Prone to Landslide

Municipality	Susceptibility						Total Brgys
	None-Low	Low	Low-Moderate	Moderate	Moderate-High	High	
1. Antequera	-	11	1	2	-	-	**14**
2. Balilihan	1	12	1	1	-	-	**15**
3. Calape	-	-	-	1	-	2	**3**
4. Catigbian	-	3	-	1	-	3	**7**
5. Clarin	2	1	-	-	-	-	**3**
6. Corella	-	1	-	-	-	-	**1**
7. Cortes	-	3	1	3	-	-	**7**
8. Loon	-	1	-	-	-	-	**1**
9. Maribojoc	-	-	-	-	-	-	**-**
10. Sagbayan	4	-	-	-	-	-	**4**
11. San Isidro	-	4	-	4	-	-	**8**
12. Sikatuna	1	-	-	-	-	-	**1**
13. Tubigon	-	2	-	-	1	-	**3**
TOTAL	**8**	**38**	**3**	**12**	**1**	**5**	**67**

Table 26 shows that there are 67 barangays or close to 58% of the total barangays assessed have been found to be at risk of landslide at varying degrees. Of these total barangays, only 6 are highly susceptible to such mass movement of earth and rocks and these are in the municipalities of Catigbian, Calape and Tubigon. But in terms of number of barangays regardless of susceptibility level, the municipalities of Balilihan and Antequera are leading with 15 and 14, respectively.


Roadside soil slip on the ongoing road improvement in Barangay Caimbang, San Isidro (left); massive river sand extraction near Dorol Bridge

This susceptibility level, however, involves a purok or two only and not the entire barangay. In spite of this rating, there is no incidence of landslide has been reported in these areas so far that has adverse impact on people, property and the environment. Should there are soil slips taking place inside the watershed, these are isolated cases and insignificant as these happened in steep slopes along riverbanks and roadsides. This natural event usually occurs during heavy and continuous rains. Riverbanks also collapse because of over-extraction of sand aggregates.

In terms of soil erosion potential, existing data have shown that about 82% of the watershed has no apparent erosion to only slight erosion, while the areas considered having severe erosion covers only less than 1 percent.

According to the rainfall-runoff analysis that forms part of the **Bohol Water Supply Master Plan**, the values for Abatan Watershed are more acceptable than that of the other catchments in Bohol. The study considered the basin retention losses, land cover and existing diversion of water in determining the runoff coefficient ratio.

The above observations could be attributed to its geology which is largely characterized with the prevalence of limestone rock units covering almost the entire Abatan Watershed. The topography of the watershed is also generally flat from gently sloping to rolling terrain, while the surface soil is relatively thin and contains gravely to cobbly fragments of limestone with considerable amount of clay and other fine-grained derivatives mostly in platy structure.

Besides, the vegetative cover of the Abatan Watershed is quite good. Though only about 5.6% of the watershed remains under closed forest, a large portion of almost 60% has managed to remain under good vegetative cover consisting of forest and other wooded lands, shrubs and mixed mangrove species and nipa plantation.

2. **Flood** – Of the 115 subject barangays during the assessment, only 26 or some 23% are diagnosed as vulnerable to flooding of which 15 are seasonal between 5-10 years interval. Majority of these barangays happened to be in Antequera with 11.

Table 28. Number of Barangays Prone to Flooding

Municipality	Susceptibility				Total Brgys
	Rare	Rare/Low	Low	Seasonal	
1. Antequera	-	1	-	10	**11**
2. Balilihan	-	-	-	-	**-**
3. Calape	-	-	-	-	**-**
4. Catigbian	-	-	-	2	**2**
5. Clarin	-	-	-	1	**1**
6. Corella	-	-	-	-	**-**
7. Cortes	1	-	-	1	**2**
8. Loon	-	-	-	-	**-**
9. Maribojoc	-	-	-	1	**1**
10. Sagbayan	4	-	-	-	**4**
11. San Isidro	3	-	-	-	**3**
12. Sikatuna	-	-	-	-	**-**
13. Tubigon	-	-	2	-	**2**
TOTAL	**8**	**1**	**2**	**15**	**26**

This assessment output only confirms to the result of the **Bifurcation Ratio** analysis which indicates that there is a lesser chance of flooding inside the watershed as the water is spread out. Aside from this watershed-shape parameter, the entire Abatan Watershed is under limestone deposition which is generally karst consisting of layers of porosity and permeability with the occurrence of numerous sinkholes, caverns, solution channels and other crevices.

3. **Fire** – Forest and grassfires usually happen during summer and El Niño phenomenon while the litters and grasses are dry. The common causes are slash-and-burn farming or *kaingin* system and wild honey gathering. Sometimes, the case was done intentionally by unscrupulous people like drunkards and by residents who just wanted to turn that particular piece of land into grazing ground of their animals.

The fire from this kaingin in Barangay San Roque, Balilihan also damaged the natural grown trees nearby

In Abatan Watershed, however, this kind of incidence is seldom to happen. As observed, there is high sense of ownership among CSC holders over their tenured properties and the public are getting vigilant in the protection and conservation of forest resources.

4. **Deforestation and Biodiversity Loss** - It has been observed that most residents in A & B-1 were not concerned about the plight of birds and other wildlife. They treat them as food and as a source of income and the worst thing is that they will catch them just for fun. Almost all houses in these places have one or more birds in cages, usually **White eared brown dove** popularly known as **Limokon**. They call this bird in cage "KATI-AN" because they use it to attract and catch another bird of same kind. That makes **Limokon** bird highly vulnerable to extinction and threatened by hunting.

With reference to official conservation status, the **Philippine Tarsier** was categorized to be endangered by the IUCN/SSC Primate Specialist Group[2] since 1986 and the Convention on International Trade in Endangered Species (CITES) as early as 1991. The said mammal usually inhabits in grasslands, brushlands, open forest and closed forest ecosystems.

A kaingin system in Barangay Datag Norte, Balilihan (left); Project staff Felix Calabria walks past a clearing of newly sawn Gumihan tree in Barangay Baucan Norte, Balilihan (right) during RBI

According to reports, the population of the **Philippine Tarsier** has been declining continuously. This is due to the conversion of its habitats into settlements and agricultural land through *kaingin* system, and also because of continuous timber poaching and illegal trade, especially for tourism purposes.

Deforestation remains a major issue in Abatan Watershed. Being close to the capital City of Tagbilaran, the area is known to be the main supplier of firewood materials for the fuel needs in

[2] International Union for Conservation of Nature/Species Survival Commission

bakeries and households. **Fig. 11** revealed that10% of extracted forest products are firewood while 12% are both lumber and firewood. As observed, this means of livelihood is rampant among the residents in the municipality of Balilihan.

Piles of firewood for sale and transport along the highway (left) and farm cultivation in Barangays Cantomimbo and San Roque, Balilihan, respectively

Results of the socio-economic survey also indicated that 53% of respondents are getting lumber from the forest. As shown in **Fig. 10**, 32% of these lumber materials were sold commercially to traders and about 22.8% were for domestic use.

5. **Water Pollution** – Findings from the Assessment of Heavy Metal Pollution in Abatan River and Maribojoc Bay [3] in 2002 and 2006/2007 had concluded that the downstream portion of the Abatan River from the point at Dorol Bridge all the way down to the estuary is polluted with cadmium and lead. As reflected in **Table 28**, the concentrations of cadmium and lead are far beyond the reference values for unpolluted water. For both cadmium and lead, the concentrations found are some 8 times higher than the DENR water quality criteria for Class C water bodies. The high heavy metal concentrations in Abatan River indicate a long-termed pollution caused by repeated discharges of cadmium and lead coming from Abatan River.

Table 29. Cadium and Lead in Water Samples from Abatan River

	Concentrations given in ppm			
	Abatan River (mean of 7 samples)	1 km seaward	DENR criteria for Class C water bodies	Reference unpolluted water bodies
Cadmium	0.08	0.11	0.01	<0.0005
Lead	0.41	0.44	0.05	<0.005

Sediment samples were also taken from the riverbed. Findings of the study suggested that the accumulation effects of both cadmium and lead are noticeable. However, the concentration

[3] A project of PROCESS-Bohol with technical support from German Development Service (DED) and EMB-DENR

levels are not really strikingly high, possibly because of wash out and dilution effects by tide or rain fall.

Table 30. Cadium and Lead in Sediment Samples from Abatan River

	Concentrations given in ppm			
	Abatan River (mean of 8 samples)	Sediment samples	Unpolluted Sediments (literature data)	Reference values
Cadmium	2.32	30	0.2	3.0*
Lead	20.25	50	1.0	20-25**

* Generally accepted maximum tolerable content

** Background level of River Elber, Germany

The primary culprit of this situation is no other than the ***Southern Industrial Project*** (SIP), a galvanizing plant in Cortes town. Heavy metal pollution is a point-source pollution coming from industrial activities or discharges. The natural background levels generally are low. The most important raw material in the galvanizing industry is zinc, which usually contains cadmium and lead in trace amounts.

Sludge pile at SIP and the Abatan River at the background (left); DED consultant Andreas Koenig inspects the site.

In two separate GTZ studies conducted in September 2004 and September 2006, results indicated that the pollution level in Abatan River has risen over the past years. The coliform counts have exceeded set of standards for Class A water in the DAO 34. Therefore, the water quality of Abatan River was classified by EMB as Class C, which, based on beneficial use, is intended primarily for recreational, fishery and industrial uses. The water quality results are found to be with the values set by EMB.

6. **Typhoons and Earthquakes –** As recorded by the Office of Civil Defense and the Provincial Government of Bohol, the natural disasters that were experienced in the province particularly within and surrounding areas of Abatan Watershed (**Table 30**) may be grouped into

two factors: climatic and seismic factors. Climatic factors result from frequent and strong typhoons that directly pass through or near the Province. These events bring excessive rainfall that results in flashfloods in low lying areas and inflicts costly damages to infrastructures like irrigation. It could also trigger landslides in unstable, steep slopes. The latter impact, however, is very minimal considering the stable vegetative cover and land uses in the watershed.

Table 31. List of Natural Disasters that Brought Damage to the Watershed and Nearby Areas

Date	Nature of Events	Location	Cost Estimate of Damage (PhP)
December 31, 2008	Flashflood	Municipalities of Clarin & Tubigon	10,500,000
November 8, 2008	Tropical Depression (TD) "Rolly"	Provincewide	No data
June 3, 2008	Minor landslide	Barangay Sagasa, Balilihan	No data
June 25, 2008	Typhoon "Frank"	Provincewide	3,140,000
May 12, 2008	Low Pressure Area	Provincewide	No data
May 8, 2008	TD "Butchoy"	Provincewide	No data
April 14, 2008	TD "Ambo"	Provincewide	No data
March 5-6, 2008	Minor flashflood	Tubigon	No data
January 2, 2008	Flashfloods	Tubigon	No data
November 18, 2007	Earthquake	Provincewide	No data
September 27, 2007	Earthquake	Provincewide	No data
August 31, 2007	Earthquake	Provincewide	No data
March 6, 2006	Land cracks	Sierra Bullones & Cortes	No data

Source: Office of Civil Defense-DND; NIA Headquarters and PPDO-Bohol

Seismic factors result from the country's major faults and trenches that could generate strong earthquakes. In fact, Bohol Island alone has the East Bohol Fault, which although very narrow is classified as active and could cause movement in the province resulting in damages to infrastructures and could also trigger landslides in steep slopes of the watershed.

B. Mitigating Measures

To lessen the incidence of disasters to happen in vulnerable areas of Abatan Watershed, the following activities are highly recommended:

1. **Slope Rehabilitation**. Hazard prone areas identified in the 2007 Geo-hazard Assessment should be vegetated at all times with deep rooted and slender leafed indigenous trees and grasses. As learned from the previous watershed management projects of PROCESS-Bohol from 2000 through 2006, the planting of vetiver grass and kakawate trees works effectively against shoreline erosion and further widening of the Bilar River, a tributary of the adjacent Loboc Watershed.

Presently, the bamboo plantation in the upper slopes of the Abatan River which was established by the Environmental Research and Development Bureau (ERDB) of the DENR in 1987 through the Integrated Social Forestry Program (ISFP) has helped secure the site from any fortuitous events like landslides and soil erosion.

2. **Riverbank Stabilization**. The riverbank of the main channel of the Abatan River in Camayaan area (composed of Barangays Rosario and Loreto in Cortes, and Barangays Tupas and Sto. Rosario in Antequera) needs immediate attention. Shoreline dwellers and LGUs concerned should install any vegetative and engineering structures on this area, including riverside walls made of concrete, wooden slabs or bamboo poles and live fences, to arrest soil erosion and prevent land slips.

   LGUs should also regulate sand extraction in Abatan River by limiting the issuance of permits to small concessionaires only and by conducting periodic monitoring of their operations.

3. **Agroforestry**. Agroforestry is a sustainable land management system which increases the overall yield of the land, combines the production of crops (including tree crops) and forest plants and/or animals simultaneously or sequentially on the same unit of land, and applies management practices that are compatible with the cultural practices of the local population (Bene et al, 1977).

   To materialize this, farmers groups should be strengthened and trained on the different technologies of agroforestry until a pool of trainors is created. It is a vital step to expedite the spread of technologies among fellow farmers even beyond the program term. But prior to dissemination, these farmer-trainors will have to apply the technologies on their own farms as proof of their experience.

   The range of agroforestry systems that are applicable in Abatan Watershed are as follows:

   - *Agri-silvicultural system* – refers to the concurrent production of agricultural crops and forest crops in same unit of land.
   - *Silvi-pastoral system* – an agroforestry system which involves the integration of forest trees with animal production.

- *Agri-silvi-pastoral system* – involves the production of agricultural crops, tree crops and animals in same unit or underneath the trees.

Rockwalls (left) and contour farming (right) in Barangays Datag Norte in Balilihan and Barangay Candungao in San Isidro, respectively.

Soil and water conservation measures that are appropriate for Land Capability Classes II and III (please refer to Land Capability Map in **Annex A-17**) are: cover cropping, strip cropping, multiple cropping, mulching, contour hedgerows, contour canal, contour rockwalls, checkdams, terracing, water impounding dams, riprap, balabag, and drainage canals.

4. **Fire Protection**. In the case of Abatan Watershed, the establishment of fireline is not suitable because of its natural vegetative cover and karst terrain. What is more appropriate is the planting of fire-resistant species (e.g., kakawate, ipil-ipil, bananas, etc.) along vulnerable portions of the natural forest, forest plantation and grassland. This is deemed lasting and effective firebreak which will be done yearly during the onset of rainy season. Firebreak species shall be planted close to each other along the line to minimize the growth of grasses. Three lines/rows will be planted to form a hedge. The established hedges of ipil-ipil and kakawate are also good sources of leaf meal, organic fertilizers and firewood. Thus, controlled harvesting may be allowed.

5. **Timber and Wildlife Protection**. This can be done with the cooperation of LGUs concerned and the local people through their associations. It will start with the integration of the Forest Land Use Plan (FLUP) into the Comprehensive Land Use Plan (CLUP) and Comprehensive Development Plan (CDP) of each Municipal LGU. Like the Municipality of Balilihan, all other component

municipalities should enact a Municipal Environment Code in consonance to the provisions of the Bohol Environment Code and pertinent national laws. They could also pass an ordinance declaring portion of the Abatan Watershed as their **Municipal Watershed** pursuant to the provisions of the Local Government Code of 1991. Other ordinances may be passed to strictly prohibit the cutting of trees inside timberlands and ban the hunting of birds and other wildlife. Signages and billboards shall be installed in strategic conspicuous locations.

To mobilize community participation, it is better to tap the services of the Barangay Officials, particularly the Committee on Environment, and people's organizations by deputizing them to become Forest Guards. It is ideal to construct a lookout tower in each timberland block and a trail connecting to the boundary lines ad corners.

6. **Water Quality Monitoring**. Findings of the Assessment on the Heavy Metal Pollution in Abatan River and Maribojoc Bay had shown that the Abatan River is polluted with cadmium and lead. It further found out that the bioaccumulative effects in fish and shells already put a potential risk to the consumers and Abatan residents.

   Few months after the study concluded, the SIP was reported to have complied all the recommendations set, including the construction of sludge depository building. They also conducted clean up drive and removal of the sludge from the **Water Treatment Facility** and the flux which both were disposed on open stock piles inside the SIP compound.

   With this development, it is highly recommended that the DENR through the EMB should form a multi-sectoral monitoring team that will look into the condition of water in Abatan River for at least once a year.

7. **Building Community Resilience vs. Climate Change**. Climate change scenarios for Bohol suggest erratic climatic pattern greatly influenced by oceanic activities, such as El Niño and La Niña phenomena, with shorter rainy season, increased precipitation and increased probabilities for extreme events, especially with respect to precipitation. It is commonly assumed that more extreme weather will lead to an increase in the frequency of floods, landslides, storms and also droughts.

To reduce impact of disaster on life, property and livelihood, the local people have to be ready to withstand extreme weather conditions and capable to recover after the calamity. The suggested implementation steps are as follows:

- *Formation of Technical Working Group* (TWG) – It will focus on disaster mitigation and risk reduction. The group's members will be drawn from the membership of the Abatan Watershed Management Council, and its tasks include planning. Documentation, training (from design to implementation), waste management and drainage maintenance.
- *Continuous Capacity Building* – The TWG will have to undergo a training of trainors so that from them, the capacity building activities can be fanned out to the communities. During the trainings, the participants will identify and study the disaster hazards, vulnerabilities, capacities and elements present in their community.
- *Disaster Risk Management Plan* – The plan may be composed of the following components:
    - Reactivation of the Barangay Disaster Coordinating Councils
    - Installation of early warning devices
    - Community flood response simulation
    - Small-scale mitigation programs, e.g. micro-enterprise and livelihood projects for vulnerable population

Part II

ABATAN WATERSHED INTEGRATED MANAGEMENT PLAN

1. Vision and Mission Statements

Vision Statement – A vision defines the desired future state of Abatan Watershed. It also reflects a variety of perspectives of stakeholders and describes what they hope for to become in the future. Below are the shared and inspiring vision statements of stakeholders for the Abatan Watershed and its people:

- Healthy watershed
- World eco-cultural tourism destination
- Improved quality of life
- Abatan-wide Management Council
- Environment friendly people
- Institutionalized laws, policies and plans

Mission Statement – It is the reason for being and the critical roles that the stakeholders have to perform to achieve the vision. It makes concrete the leader/s view of the direction and purpose of the organization.

- To protect, conserve, rehabilitate, and invigorate the Abatan Watershed
- To generate active involvement of all stakeholders in rehabilitating, conserving, protecting the Abatan Watershed
- To enact and implement a comprehensive set of rules and regulations in the utilization of resources within Abatan Watershed
- To develop opportunities for an environment friendly economic activities
- To develop and promote world class eco-tourism products within Abatan Watershed

2. Goals and Objectives – These are broad statements of something that the group of stakeholders expects to attain or achieve. These are specific accomplishments that must be accomplished in total, or in some combination, in order to achieve some larger, overall result preferred from the system.

- Adopted Natural Farming System (NFS)
- Signed covenant of cooperation by and between all Abatan stakeholders
- Enhanced capacity building program
- Developed and promoted eco-cultural tourism destination
- Organized and institutionalized the Abatan-wide Management Council/Board
- Provincial ordinance instituting Abatan Watershed management plan (expanded Abatan River code) and providing funds thereof in place
- Implemented Livelihood programs
- Well managed and wised utilization of resources in the Abatan Watershed
- Strict enforcement of environmental policies and laws

3. Scopes and Limitations of the Plan

This *Integrated Watershed Management Plan* (IWMP) is designed to cover the entire Abatan Watershed as a unit of planning and management for its sustained development while serving the resource needs of its stakeholders. It has a term of twenty-five (25) years although the IWMP activities are sub-divided into 3 different timeframes, i.e., long-term (25 years), medium-term (5-10 years) and short-term (1-5 years) period.

What is not covered in this document are comprehensive disaster risk management plans specifically addressing the infrastructure and capacity needs of vulnerable communities to deal with and recover from the catastrophic impacts of climate change and other calamities.

4. Processes and Methodologies

A. Preparatory activities

a. ***Formation of project team*** – Upon receipt of the Notice to Proceed from PENRO-Bohol, the proponent immediately called for individual interviews of applicants who have been shortlisted based on qualifications required in the job descriptions. A total of seven (7) staff hired for the project occupying the positions of the Project Team Leader (1), Lead Persons (2), Field Assistants (2), and Research Assistants (2) for hydrology & soils/sedimentation. Except for the Research Assistants (RAs) for hydrology & soils/sedimentation, the rest have solid experience in social development work and natural resource assessment.

   Both RAs, however, were trainable and eager to learn by doing under close supervision by an expert. They got ample coaching from the personnel of the Water Resources Center at the University of San Carlos (WRC-USC) in Cebu City.

   There was also a Pool of Consultants being created which was composed of 5 technical experts. Their wealth of expertise and experiences ranges from natural resource management to environmental researches.

b. ***Ocular visit*** – Prior to the crafting of the Activity Plan, the newly hired staff composing the Project Team toured around the watershed while they occasionally stopped on bridges to indicate locations of sub-watersheds and tributaries to the main water channel, and on water divides between Loboc and Abatan Watersheds. The purpose then was for them to have an initial understanding on the situation of the subject area and preliminary contact with community residents and other stakeholders, and determine present and possible constraints or limitations and opportunities (both of which may look into the peace and order situation, reluctance or acceptance of the people, transportation needs, etc.).

c. ***Crafting of activity plan*** – The Project Team underwent a day Orientation about the Project and the NGO who hired them before they proceeded to their respective assignments. Dovetail to the Orientation was the crafting of their Activity Plan good for the first quarter of work. Then out from their group Activity Plan, each staff prepared and submitted their Individual Monthly Schedule to their Team Leader for review, monitoring and supervision. They kept a copy of their Schedule as reference.

d. ***Procurement of supplies and materials (logistics)*** – Supplies and materials needed by the Project Team to undertake the project were procured during the preparatory phase. Some other equipment, instruments and gears were just borrowed or rented from acquaintances and friends.

e. ***Acquisition of secondary data (base maps, etc.)*** – Pertinent data and information, including maps, were acquired. Except for the Land Capability Map, all maps were available at any of the following: LGUs (barangay, municipal and provincial), DENR, PAG-ASA, Phivolcs, NAMRIA, and BSWM.

f. ***Analysis and interpretation of secondary data to determine extent of the study and data gaps*** – Maps and secondary data acquired were referred to the Pool of Technical Consultants for analysis and interpretation. Results of their analysis were presented back to the Project Team to further familiarize the scope of the project and its data gaps. All thesed serve as basis for improving their group and respective plans and/or designing future actions.

g. ***Leveling-off workshops and meeting*** – A number of workshops and meetings were conducted between the Project Team and their counterparts at the local DENR units to clarify things and level-off present and possible issues and constraints. Due to budgetary constraint, both parties agreed that the implementation will focus on key activities that can generate data and information vital to the plan preparation.

h. ***Public information and consultation meeting*** - Having all matters clarified, the Project Team conducted public information and consultation meetings in 13 component municipal LGUs across the Abatan Watershed. It was attended by any of the following: MENRO staff, MPDC, SB chair on environment, and Barangay Captains inside the Abatan Watershed. The purpose of that particular activity was to generate LGU support and cooperation, and to set schedules for consultation and coordination meetings at the barangay levels.

i. ***Staff trainings*** – Despite their professional backgrounds, the Project Team went through some quick refreshers on the following topics: Resource Base Inventory (RBI), including the establishment of transect routes and stations and field identification of plants and animals through sounds and sightings; soil sedimentation; hydrology; and other related subject matters.

B. Watershed Characterization

a. ***Consultation and coordination meeting*** – This refers to community meetings which were conducted in 29 barangays within timberlands and one barangay in A&D lands. The said meetings were attended by barangay officials, purok leaders, tanods, forest occupants/shoreline dwellers, POs and NGOs operating in the area. At the end of the meetings, the participants were able to identify key informants (KIs) and mark dates for the next set of activities.

b. ***Focus group discussion (FGD)*** – This was done with the active participation of KIs numbering about 12-15 per barangay. This was done using casual interaction with local people. The purpose of which was to familiarize the behavioral activities and cultural patterns of watershed dwellers taking into consideration their positive and negative responses and attitudes along with their reasons towards projects and other interventions.

c. ***Key informant interviews*** – This was done in an optional basis in areas only where there were data gaps following the FGD or vague information that needed clarification.

d. ***Transect walks*** – Using sampling method, transect walks were applied only to 20% of total covered barangays, particularly those within timberlands representing each major sub-watershed. Site selection was based on the proximity to water channels, identified issues and concerns, and size of timberlands.

e. ***Socio-economic surveys and profiling*** – A survey questionnaire was the tool to accomplish this task. It covered 29 barangays in 9 timberland blocks plus one A&D barangay in 7 municipalities. But prior to its administration in the field, this was referred to key personnel at DENR-Bohol for further critiquing and refinement.

   It took four months to finish the survey spanning from December 2009 to March 2010. The collation and analysis of survey results were contracted out to a qualified professional from the pool of consultants.

f. ***Collection of soil samples for analysis (at least 3 sites)*** – A total of 9 sampling stations were established thus making it 3 sampling stations per elevation (upper, middle and lower). The soil samples were then air-dried before they were submitted to Bohol Agricultural Promotion Center (APC) for laboratory analysis. In addition to this, the Project Team also gathered secondary information.

g. ***Study on soil condition*** – Sediment deposits derived from run-off were measured twice a day (early morning and late afternoon) or every after rainfall from 8 run-off plots with gerlach troughs. Aside from elevation considerations, each run-off plot also represents a particular land use, like open cultivated cultivation with soil and water conservation measures, under canopy of tree plantation, shaded under natural forest, or grassland.

h. ***Study on hydrology*** – There was established one hydrologic station each at the upstream, midstream and downstream elevations of the main river system of Abatan watershed. Each station has a staff gauge to find out the water depth and is being read twice daily by a paid household living nearest to it. The flow rate was measured using two methods: the float (ponkan) method and the propeller current meter of WRC-USC.

The project took advantage of available secondary data from reliable sources, like the GTZ-Water Program, EMB-DENR and the Provincial LGU, to determine the quality of water flowing the tributaries and main channel of the Abatan River.

i. ***Study on climatic condition*** – With technical assistance from PAG-ASA weather bureau, the project fabricated and installed one rain gauge per elevation in the LGU Demo Farms of Cortes, Balilihan and Catigbian. The reading was done by the Office of the Municipal Agriculturist of each LGU. It also obtained climatic data from the PAG-ASA weather station in Tagbilaran City.

j. ***Flora and fauna inventory*** – A ground survey was conducted with the purpose of establishing baseline data and information on the status of natural resources, including topography, elevation, soil type & texture, land use and environmental issues and concerns. It covered a total of 7 timberland blocks consisting of 25 barangays plus one A&D barangay in 6 municipalities. To note, Blocks A-2 and B-3 were excluded from this survey because these areas were already inventoried by the DENR just recently.

C. Analysis of Data and Information

1. ***GIS analysis*** – This portion was contracted out to an expert on this field. He was using software called as Manifold System 8.0.21 in analyzing data and generating the thematic maps. Most of the existing data files being digitized for the project came from the DENR and PPDO-Bohol. All these data were thoroughly verified and validated on the ground to

ensure reliability during planning and program implementation processes. The final production of the digital maps was done after approval by the DENR Technical Team.

D. Formulation of the IWMP

a. ***IWMP workshop*** – The *Abatan Watershed Integrated Management Planning Workshop* was finally conducted on November 16-17, 2010. This was participated in by a total of 76 participants and representatives led by no less than the Provincial Governor himself and 5 Municipal Mayors who quickly delivered their respective messages (**Table 32**). But prior to the workshop proper, all pertinent data and information were presented by way of tables, graphs and maps. It gave the participants the bird's eye-view of what is really happening inside the watershed. The discussion centered on the identified issues and concerns as basis for future actions.

Bohol Governor Edgar Chatto addresses to the workshop participants; Mayors at their seats listening to the presentation.

Table 32. Workshop Attendance	
1. POs	8
2. NGOs	3
3. LGUs	
3.1 Barangay	13
3.2 Municipal	27
3.3 Province	12
4. NGAs (DENR)	3
5. Office of the Congressman (Rep. Relampagos)	1
6.Academe (BISU*)	1
7. PROCESS-Bohol	8
Total	**76**

* Bohol Island State University

a.1 SWOT Analysis. The participants were divided into four groups to take part in the SWOT Analysis to analyze data and information gathered during the Characterization Phase. The SWOT Analysis is a strategic planning tool used to evaluate the Strengths, Weaknesses, Opportunities and Threats involved in a development initiative. It is basic, straightforward model that provides direction and serves as a basis for the development of plans. It is the first stage of planning and helps decision makers to focus on key issues.

Outputs of the SWOT Analysis are as follows:

Table 33. SWOT Analysis Matrix

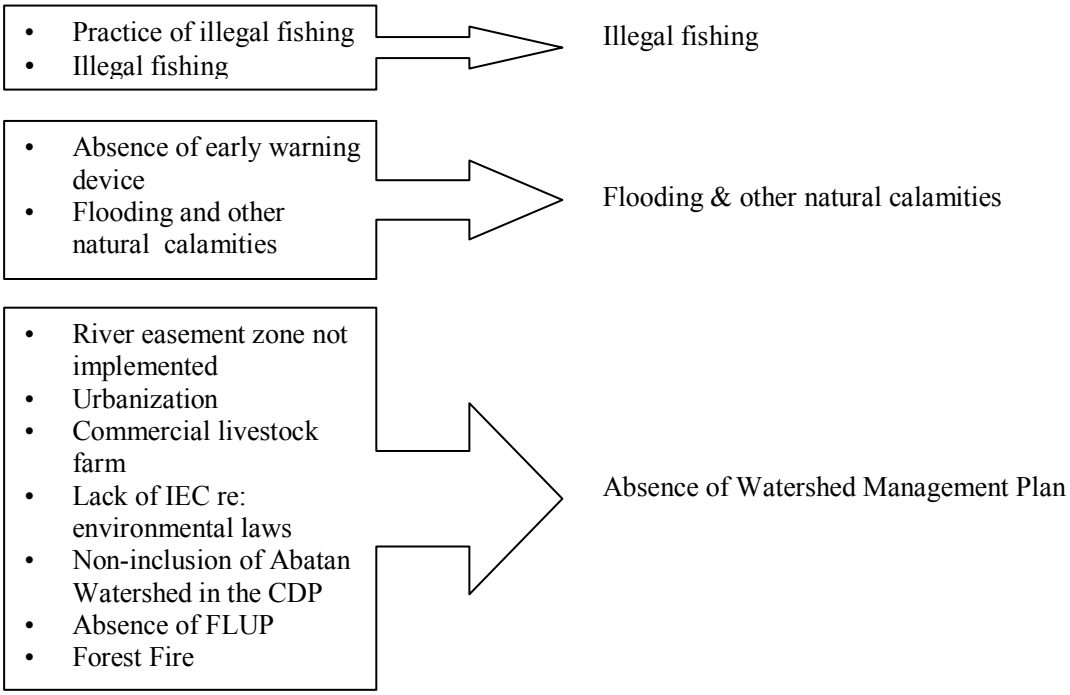
STRENGTHS	WEAKNESSES
▪ High biodiversity ▪ Presence of a management council (ARDMC)* ▪ Operational ecotourism activities ▪ Supportive LGU (barangay and municipal) ▪ Existing people's organizations ▪ Existing CLUP per M/LGU ▪ The soils are not prone to landslide because of its karst environment ▪ Presence of Bohol Environmental Management Code ▪ Presence of Flora & Fauna ▪ Implementation of solid waste management	▪ Lack of IEC regarding environmental laws ▪ Illegal cutting of trees ▪ Solid waste management not fully implemented ▪ Absence of early warning devices ▪ River easement zone not implemented ▪ No regular shoreline clean-up ▪ Practice of illegal fishing ▪ Soil Erosion ▪ Non-implementation of organic farming ▪ Presence of kaingin system ▪ Illegal sand and gravel extraction ▪ Non-inclusion of Abatan Watershed in CDP** formulation per municipality
OPPORTUNITIES	**THREATS**
▪ Tourism Destination ▪ Possible source of potable water supply for drinking ▪ Potential site for ecological museum/ wildlife sanctuary for ecotourism ▪ Available labour force for employment/livelihood ▪ Abundant of trees/root crops and other agri-products ▪ Low risk to major disaster ▪ Tourism project is accessible to Tagbilaran City ▪ Implementation of solid waste management ▪ Possible funding source showcasing Abatan Watershed ▪ Additional tax collection to every municipality	▪ Illegal cutting of trees ▪ Kaingin system ▪ Sand extraction ▪ Illegal fishing ▪ Flood/Natural Calamities ▪ Hunting of wildlife ▪ Use of chemicals/pesticides ▪ Indiscriminate quarrying (regulated/unregulated quarrying) ▪ Commercial Livestock Farm ▪ Unregulated garbage disposal ▪ Urbanization

* Abatan River Development Management Council
** Comprehensive Development Plan

Participants contribute whatever knowledge in mind for the workshop group; Antequera MPDC Moning Diez presents their group output.

a.2 Clarification and Prioritization of Issues and Concerns. This followed taking into considerations the outputs from the SWOT Analysis. Related issues and concerns that were written down in meta-cards were grouped together and given a title that captures all the ideas in it. Results of such workshop are placed below:

• Unregulated quarrying • Illegal sand and gravel extraction	Illegal sand and gravel extraction
• Unregulated garbage disposal • solid waste management not fully implemented	Unregulated garbage disposal
• Non-implementation of organic farming • excessive use of chemicals/pesticides	Excessive use of chemicals/pesticides
• Hunting of wildlife	Hunting of wildlife
• Illegal cutting of trees	Rampant cutting of trees
• Kaingin • Presence of kaingin system • soil erosion	Presence of kaingin system



After the clustering of similar ideas, the issues and concerns were then prioritized according to urgency, magnitude, extent and doability. Through consensus, the top 5 issues were identified as follows:

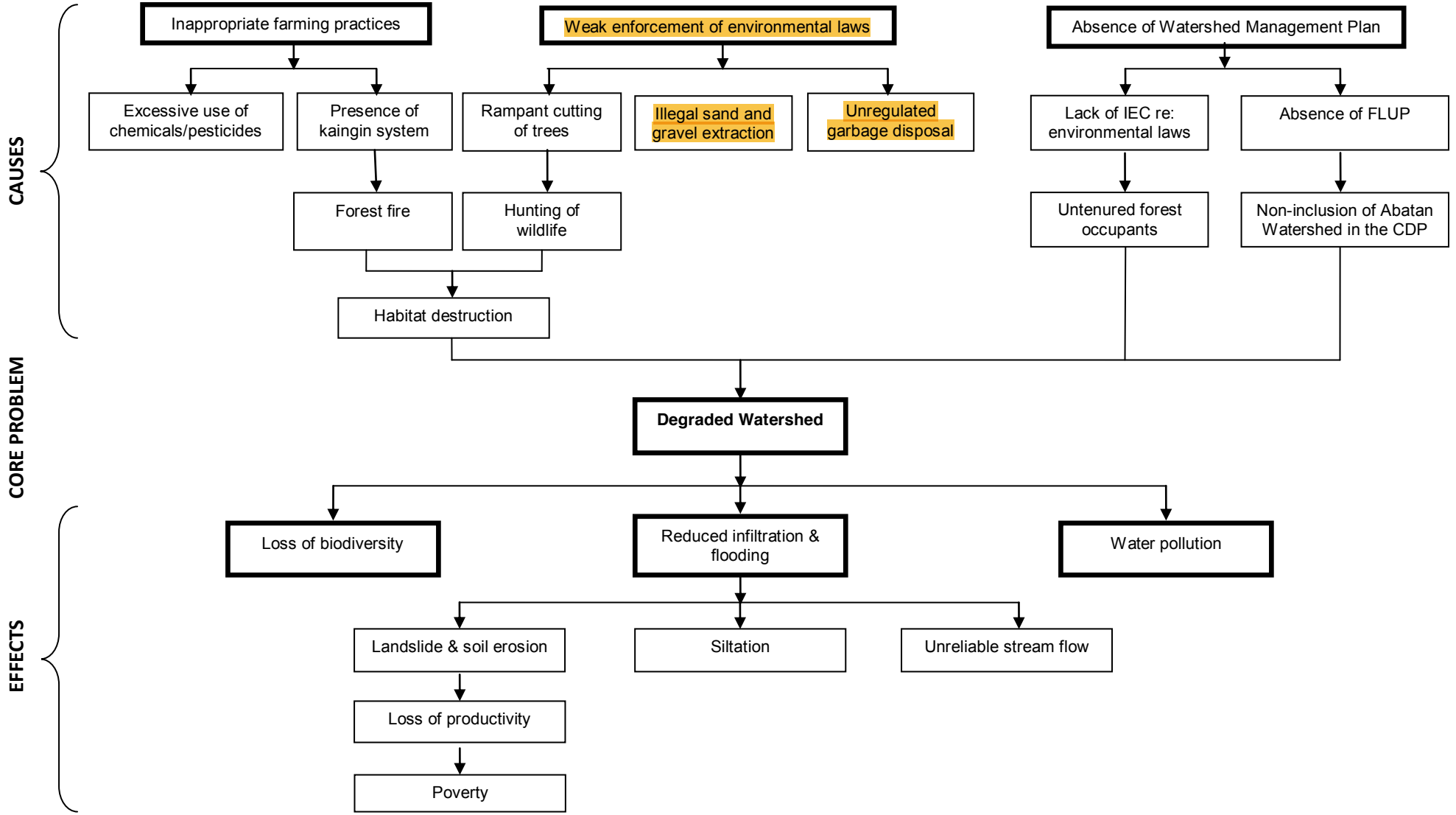
1. Presence of kaingin system
2. Illegal sand and gravel extraction
3. Unregulated garbage disposal
4. Rampant cutting of trees
5. Absence of watershed management plan

The issues identified were also clustered according to ecosystems. After intensive discussion on the matter, what came out was only dominant issue per ecosystem as set hereunder:

- **Forest/Upland** - kaingin system
- **Lowland/Urban** - improper waste disposal
- **Coastal/Marine** - illegal fishing

a.3 Problem Tree Analysis. Problem tree analysis is central to many forms of project planning and is well-developed among development agencies. Problem tree analysis (also called Situational Analysis or just Problem Analysis) helps to find solution by mapping out the anatomy of cause and effect around an issue.

Following the steps, each issue or problem was listed down in the meta-card while at the same time identifying the core problem. From this, the issues in meta-cards were arranged in hierarchical order to determine which problems are causes and which are effects and how these relate to each other or lead to another.


CAUSES
Inappropriate farming practices
Weak enforcement of environmental laws
Absence of Watershed Management Plan
Excessive use of chemicals/pesticides
Presence of kaingin system
Rampant cutting of trees
Illegal sand and gravel extraction
Unregulated garbage disposal
Lack of IEC re: environmental laws
Absence of FLUP
Forest fire
Hunting of wildlife
Untenured forest occupants
Non-inclusion of Abatan Watershed in the CDP
Habitat destruction
CORE PROBLEM
Degraded Watershed
EFFECTS
Loss of biodiversity
Reduced infiltration & flooding
Water pollution
Landslide & soil erosion
Siltation
Unreliable stream flow
Loss of productivity
Poverty

a.4 Strategies – These are the methods or processes required to achieve the goals.

Table 34. Strategies & Expected Outputs

STRATEGIES	EXPECTED OUTPUTS
1. Promotion and marketing	• Holding of Annual Abatan Tourism Promotion Festival • Financial capability through counterparting
2. Formulation & implementation of plans, laws & policies	• Review of the Abatan River IWMP • Crafting of the Abatan Watershed Code • Formulation of Barangay Resolutions & Municipal/ Provincial Ordinances • Instituting plans & providing funds thereof • Formulation of indicative resource utilization plan • Creation of TWG to review the Abatan Watershed IWMP • Ask the provincial Board to enact Abatan Watershed Code
3. Creation of (expanded) Abatan Watershed Management Council	• Requesting the Governor to issue EO creating the Abatan Watershed Management Council with expanded membership • Convening the 13 LGUs and all other stakeholders for signing of MOA/covenant of cooperation in Abatan Watershed conservation • Forging of MOA between component Municipalities • Conduct of strategic planning workshop
4. Information education campaign	• Dissemination of information to stakeholders re outcome of this 2-day workshop • Educating the people down to the barangay level re: vision & mission of the watershed council & the existing laws, ordinances, statutes, proclamations, EOs, penalties- penal provisions & benefits
5. Capacity Building	• Benchmarking of best practices of other watersheds by stakeholders
6. Promotion and adoption of organic farming	• Introduction of NFS* technology
7. Watershed protection, conservation & rehabilitation	• Implementation of air and water pollution act • Acquiring land to be made into permanent tree planting or forest land area • Minimizing and control of Kaingin system
8. Monitoring and evaluation	• Formulation of monitoring and evaluation mechanisms

* Natural Farming System

a.5 Planned Activities – These are a list of detailed activities which are essential to achieve the Vision, Mission, Goals and Objectives.

Table 35. Planned Activities

STRATEGIES/ PLANNED ACTIVITIES	SHORT TERM	MEDIUM TERM	LONG TERM
1. **Watershed protection, conservation & rehabilitation**			
a) Rehabilitation of vulnerable areas	■		
b) Regulation on the issuance of sand extraction permit	■	■	■
c) Regulation on the construction of structures along the River	■	■	■
d) Identification/acquisition of lot for tree parks	■	■	
e) Prohibition of wild life hunting in forestlands	■	■	■
f) Prohibition on the gathering of flora and fauna	■	■	■
g) Conduct continuous seminar/workshop for natural farming method	■	■	■
h) Strict implementation of ESWM plan	■	■	■
i) Conduct of annual river clean up	■	■	■
j) Deputation of forest guards	■		
k) Establishment of municipal tree nursery	■	■	
2. **Creation of Expanded Abatan Watershed Management Council**			
a) Issuance of EO for the creation of AWMC	■		
b) MOA signing/forging of MOA of cooperation between component municipalities	■		
c) Strategic planning by the newly created council	■		
d) Annual budget allocation for the AWMC plans & programs by the provincial gov't & national line agencies	■	■	■
e) Adoption of AWMC plans & programs by the SP	■		
f) Drafting of the Constitution & By-Laws for the AWMC	■		
g) Conduct of regular monthly meeting of the component municipalities' convergence of concerned line agencies	■	■	■
3. **Promotion and marketing**			
a) Holding of annual Abatan tourism promotion festival	■	■	■
b) Installation of signage on Abatan Watershed	■	■	
c) Establishment of Abatan Watershed information database	■	■	
d) Creation of Abatan Watershed website	■		
e) Development of Abatan Watershed Audio/video ad	■	■	■
4. **Formulation and implementation of laws, plans & policies**			
a) Drafting & enactment of environmental laws	■	■	
b) Documentation of Abatan Watershed best practices	■	■	■
c) Integration of Abatan Watershed IWMP into the CDP	■		
d) Crafting of the Expanded Abatan Watershed Code	■		
5. **Information education campaign**			
a) Courtesy call to the Local Chief Executives (LCEs)	■		
b) Attend ABC meeting	■		
c) Attend Brgy assembly	■		
d) Installation of billboards & signages	■	■	
e) Implementation of environmental laws, plans & programs	■	■	■
f) Production of IEC materials	■	■	■
g) Radio & TV plugging	■	■	■

Table 35. Continued . . .			
6. **Capability Building**			
a) Courtesy call to the Local Chief Executives (LCEs)	■		
b) Attend SB session	■		
c) Identification of probable participants	■		
d) Preparations of activity design	■		
e) Implementation/Training proper	■	■	■
Trainings:			
- Values Formation			
- Watershed Management			
- Lakbay aral			
- Agro-forestry courses			
- Livelihood			
- Eco-tourism			
7. **Promotion and adoption of organic farming**			
a) Adopt and implement the provincial ordinance on organic farming	■	■	■
b) IEC to identified farmers	■	■	
c) Conduct regular "TABO" at strategic areas for watershed wide organic products	■	■	■
d) Encourage composting to complement ESWM	■	■	
e) Provide financing and marketing assistance to organic farmers	■	■	
f) Provide incentive and awards system to farmers adopting organic farming	■	■	
g) Participation in Agro-fairs	■	■	■
h) Establishment of seed banking of organic rice and vegetables in per municipalities	■	■	■
i) Integration of NFS in the academic curricula	■		
j) Provide organic farming inputs to farmers	■		
k) Promotion of organic products to general consumers	■	■	■
8. **Monitoring and Evaluation**			
a) Formulate a unified monitoring tool	■		
b) Mobilize MAFC and BALA & other Organization in the LGUs to get involved in the monitoring	■		
c) Acquisition of equipment to monitor rainfall, stream flow, weather forecasting	■		
d) Acquisition of communication device and distribute to component LGUs	■	■	
e) Conduct regular meeting	■	■	■

b. ***Drafting and editing of final report*** – During the 3-month extension, all the necessary **Annexes** were compiled. The draft characterization report containing the findings of the study, including the processes and methodologies employed, was saved in the diskettes and printed out in hard copies. These soft and hard copies were then circulated among the members of the Pool of Consultants for their edits, comments and inputs. After integrating changes in the document, the draft report was reproduced in book-bound form and submitted to DENR units (PENRO-Bohol, CENRO-Tagbilaran & Region VII) for their final critiquing. The date of submission was December 20, 1010.

5. Main Strategies – It is understood in this document that watershed and ecosystem management is a basic approach that integrates and coordinates existing programs and activities geographically by watershed zones and watershed management areas. Watershed management is the process of managing all the natural resources within the watershed's entire area, rather than on a site-specific basis. A watershed management approach is not a regulatory program rather it is a strategic approach to operating existing regulatory and non-regulatory programs more efficiently and effectively to protect, enhance and restore the watershed's natural resources.

A. Water Management – Being eyed to be the main source of bulk water supply for the Metro Tagbilaran and the Panglao Island Tourism Estate, an integrated water resource management (IWRM) approach should be adopted for Abatan Watershed to ensure the sustainability and preservation of its water sources. IWRM is a process that promotes the coordinated development and management of water, land and related resources in river basins in order to maximize the economic benefits and social welfare in a sustainable and equitable manner. It seeks to reconcile the demand for water resources with the limitations of what those water resources can accommodate. A body of water can only withstand so much extraction and pollution by competing user groups with ever-growing needs (such as factories versus agriculture, or upstream communities versus downstream communities. Consistent with the Bohol's IWRM framework, the following measures should be undertaken:

a) A continuous monitoring program of rainfall and flow of surface waters as well as water quality in 3 hydrologic stations along the Abatan River will provide data that will guide future evaluation;
b) The watershed should be regularly monitored and protected from any practices that may lead to the deterioration of quantity, quality and rate of runoff;
c) A sanitary zoning plan should be implemented with special emphasis on protection of the most economical water resources. It should be integrated into the general zoning plan.

To improve water use efficiency, there is also a need to employ the following strategies:

a) Adoption of water conservation measures (e.g., alley cropping, rock walls, check dams, etc.);
b) Establishment of water impounding structures (e.g., small water impounding systems, small farm reservoir, recharged pits and trenches, etc.)
c) Enhancement of spring utilization (e.g., periodic monitoring of water quality, treatment/disinfection, maintenance of vegetative cover, etc.)

B. Management of Vulnerable Areas – (Please turn to **Page 85** under the sub-heading **B. Mitigating Measures**.)

C. Allocation of Best Land Uses

1. Management of Forest and Upland Ecosystems

a. **Tenured Areas** – Out of 9 timberland blocks being assessed inside the Abatan Watershed, only 5 blocks in 11 barangays have tenured migrants with tenurial instrument on the strength of the *Certificate of Stewardship Contract* (CSC). Based on the record at the *Community Based Forest Management* (CBFM) Unit at CENRO-Tagbilaran (**Table 36**), there are 568 CSC holders covering a total of 467.084 has. in a span of 10 years from 1983 to 1993 of program implementation. Most of these tenurial instruments were granted during the term of the *Integrated Social Forestry Program* (ISFP) of the DENR which was later devolved to the Provincial LGU.

Table 36. Number of CSC Holders & Size of Tenured Areas

TIMBERLAND BLOCK	LOCATION	NO. OF CSC HOLDERS	LAND AREA (Has)	YEAR ISSUED
A-1	Tabuan, Antequera	23	33.554	1985, 1988, 1990, 1991
	Abehilan, San Isidro	41	18.388	1986,1988, 1989, 1990
	Baunos, San Isidro	40	29.934	1985, 1988, 1990, 1991
	Cansague Sur, San Isidro	44	30.96	1985, 1986, 1987, 1988, 1989, 1990
A-2	Canangcaan, Corella	10	5.20	1985
	Canapnapan, Corella	43	28.47	1984
B-1	Cambansag, San Iidro	35	20.498	1993
	Cansague Norte,San Isidro	10	8.46	1985
B-4	Boctol, Balilihan	144	91.16	1983, 1984, 1986, 1990, 1991
C-1	Haguilanan, Catigbian	55	92.05	1987, 1989, 1990, 1991
	Haguilanan Grande, Balilihan	123	108.41	1987, 1988, 1989, 1990, 1991
5 Blocks	**11 Barangays**	**568**	**467.084**	**1983-1993**

CSCs that were awarded in 1985 and backwards are already considered expired and need to be renewed. The only available and applicable tenurial instrument at this point is the CBFM Agreement.

a.1 Protection Forest cum Biodiversity Conservation

In highly erodible areas or areas adjacent to stream banks (30 m both sides of the drainage), slopes exceeding 50%, and in uninhabited areas, protection forests can be established. These areas can be designated as not suitable for timber harvesting and any activity involving extraction of products should be strictly prohibited. Suitable reforestation species, preferably indigenous tress will be used. Fruit-bearing trees and other trees serving as habitat or food sources for wildlife will be planted in the area.

This land use will promote both the preservation of the indigenous species and increase the wildlife population. Additionally, this could also be an important contribution to the development of land-based ecotourism projects.

The LGUs should take an active role in developing the protection forest and biodiversity conservation areas. Likewise, LGU should encourage the involvement of local population in the protection aspect. Aggressive and innovative IEC programs should be instituted to inculcate to the local populace the importance and impacts of these forests to their daily lives and even as possible source of livelihood for them.

A "Bantay-Lasang" (Forest Watch) or "Bantay-Kabukiran" (Environment Watch) Task Force Project could be spearheaded by the LGU and the Provincial/Community DENR office. Incentives for adequate protection of the forest adjacent to the communities could be given in the form of community assistance projects.

The indicative cost estimate for implementing such option is usually PhP 30,000/ha. At this rate, the total cost of implementing the protection forest cum biodiversity conservation option in 446 has. (377 has. with slope over 50% as shown in **Table 5** and 69 has. severely eroded lands in **Table 9**) is PhP 13,380,000.

a.2 Production Forest

The dependence of a significant segment of the local population on forest products extraction specifically timber and materials for novelty items justifies the establishment of a forest-base source of these materials. Appropriate selection of a variety of suitable trees exhibiting fast growth rate and slow-growth but durable and dense wood is essential to address the short-term and long-term wood requirements in the area.

The following areas could be converted to production forest: areas with slopes less than 50%, inadequately-stocked second growth forest with no adverse claims, open areas such as grasslands and brushlands with no adverse claims and accepted by the community as public property, and open areas such as grasslands and brushlands with adverse claims can be designated as communal forests. The extensive coconut groves could be developed under agroforestry system to serve also as production forests. These areas could be made more productive through active and conscious intervention efforts of planting commercially valuable tree species.

The implementation of CBFM Program could drum up the much needed community support for the Abatan Watershed conservation initiatives. The scheme could actively incorporate people's participation in the development and protection of the watershed which is very limited at this stage. The 'sense of ownership' that the stewardship contract would impart will hopefully cause the people to actively develop and protect the area. The program will also be an important component of the alternative livelihood programs.

The forest land classification type where the land cover is still forested/shrub/banana would be the most probable area where the establishment of a production forest option could be feasible. The indicative cost estimate for implementing the production forest option is PhP 45,000/ha. At this rate, the cost for implementing this option in 4,791 has. of wooded lands (as shown in **Table 12**) is PhP 215,595,000.

b. **Untenured areas** – The deliberate incorporation of woody perennials with annuals in the same piece of land is an age-old practice of upland communities not just in Abatan Watershed, but province-wide. Coconut is a major crop grown widely in the area. There is some semblance of a multi-storey structure to a tropical rainforest, which is a paramount example of productivity and efficient ecosystem. These coconut plantations could be improved and made more productive. Selection of more suitable crops and high value crops could enhance the productivity and income of the farmers. Moreover, the practice could protect the area from accelerated soil erosion. The forest land classification type where the land cover type is still mix coconut, grassland and annual crops would be the most probable area where the establishment of an agroforestry option could be feasible. The indicative cost estimate for implementing the production forest option in untenured areas is PhP 50,000/ha. At this rate, the cost for implementing this option in 4,601 has. (as shown in **Table 12**) is PhP 230,050,000.

For conservation and rehabilitation purposes of untenured areas, the following watershed management interventions are highly recommended:

- Soil and water conservation measures, e.g. organic farming, agroforestry
- Rehabilitation/protection of riparian zones
- Conservation of flora and fauna of economic value
- Assisted Natural Regeneration (ANR)
- Enrichment planting
- Establishment of forest/fruit tree plantations using indigenous species

2. Management of the Lowland Ecosystem

The island of Bohol is a famous tourist destination. The study has identified numerous potentials for expanding the current destination spots with vast lands with rolling to hilly slopes could well be developed along the true essence of ecotourism. In its real essence, ecotourism projects should promote environmental conservation, maximum economic benefits to the local people, and respect for people's culture. Currently, rich businessmen mainly manage resorts concentrated in Panglao Island, which caters mainly to rich clients. The benefits that the local people get from these establishments are in the form of mediocre employment. This current trend creates a wedge that accentuates the social status difference of the rich and the poor.

Development of a community-based ecotourism could alleviate if not totally eradicate this problem. Furthermore, the scheme could provide a better alternative source of livelihood for hundreds or even thousands of local people. Expanding the scope to land-based ecotourism instead of concentrating to purely water and shoreline activities could also diffuse the potential projects to many people or organizations. The community-based scheme will tap the potential of the local people to develop on their own.

The indicative cost estimate for implementing such option is usually PhP 1,000,000/ha. The probable sites where this option is suitable are any of those listed under **Table 26**.

On the other hand, this ecotourism option for lowland ecosystem will lead to naught if the issue on massive sand and gravel extraction in Abatan River remains unattended. There should be stricter rules and regulations to be imposed to quarry applicants and permittees. The Municipal LGUs should be involved in the process, especially in the conduct of on-site monitoring.

3. Management of Freshwater/Coastal or Marine Ecosystems

It has been observed that illegal and destructive fishing methods, such as the use of obnoxious substances, fine-meshed nets, and scaring devices, are still widely practiced in the estuaries, tributaries and main channel of the Abatan River. Part of the management option should include the strict enforcement of fishery laws and apprehension of violators. Another option is the periodic monitoring of the nine (9) existing marine protected areas (MPAs) along the Maribojoc Bay by the communities concerned through their respective MPA councils.

6. Support Activities

a. **Information, Education and Communication** (IEC) – This involves the dissemination of relevant information to stakeholders with the aim at generating their participation in watershed management and raising their consciousness towards the environment. Watershed communities, especially upland farmers, shall be invited to undergo trainings on a wide range of agroforestry technologies, organic farming techniques and integrated pest management. Dovetail to this is the production and installation of IEC materials, including signages, billboards, streamers and posters, in strategic conspicuous locations.

IEC materials are important to enhance general awareness and appreciation for watershed management concept, principles and practices; and build-up technical capability of all stakeholders and sectors involved in the watershed management. This could be done through:

- Consultations
- Workshops
- Trainings
- Brochures, handouts, primers
- Broadcast media; and
- Cross-watershed visits

b. **Linkaging and Networking** – Once created, the *Abatan Watershed Management Council* (AWMC) should link with other organizations and networks with development thrusts similar to theirs. It is an essential support component in order to strengthen the AWMC advocacy for balanced and healthy environment and fund allocation from the government. The AWMC could also learn a wealth of lessons and insights, and vast experiences in watershed management from other resource management bodies that remain functional for many years.

The AWMC should also collaborate with government and private agencies and offices to ensure successful implementation of the IWMP.

c. **Research and Development** – This includes generation and management of scientific data and public information in support to on-going and future activities of AWMC.

d. **Human Resources Development** – Basically, this is a capacity enhancement for the general membership of AWMC to make them effective and efficient decision-makers and planners in their own field of expertise and positions. The conduct of trainings, cross-visits and study tours is deemed inevitable.

e. **Monitoring and Evaluation** (M&E) – Any progress of the plan implementation shall be assessed periodically using the unified M&E tool to be formulated by the AWMC. The MAFCs and BALAs should get involved in the monitoring. Despite the end of the characterization project, the Municipal LGUs should still continue monitoring of rainfall and stream flow in their area of jurisdiction.

f. **Information and Database Management** – An integrated database building and management system shall be established as a source of accurate and reliable data and tool for policy and management planning. Any applicable data and information shall be analyzed through GIS technology to keep track of development changes and see to it that these changes will benefit the majority and deserving local populace.

g. **Reporting** – A reporting system will be developed taking into consideration the analysis on the performance in managing the watershed vis-à-vis the approved integrated management interventions and activities, resources and timeframe.

h. **Administration and Supervision** – For the management plan to be fully implemented, the Abatan Watershed Management Council (AWMC) shall be formed. Part of the process is the crafting of its organizational functions and responsibilities and the manpower requirement for its Secretariat.

7. IWM Implementation

A. Legitimization of the Plan

The Regional Office shall approve the plan. However, this shall be subject to review and affirmation by a Watershed Multi-sectoral Technical Evaluation Committee (WMTEC) in the Central Office.

The plan may be legitimized for adoption through:

- Resolutions
- MOAs/MOUs
- Any formal arrangement endorsed by the watershed stakeholders

B. **Institutional Arrangements**

The following are partner agencies, institutions and organizations that will be invited to form the Abatan Watershed Management Council:

1) LGUs
   - Provincial – Governor, SP Chair on Environment, SP Chair on Tourism, PPDC, BEMO Head, PTO Head
   - Municipal – Mayor, SB Chair on Environment, SB Chair on Tourism, MPDC
   - Barangay – All Barangay Captains inside timberland areas

2) NGAs
   - DENR (province & community), also acts as the Secretariat
   - BFAR
   - DOLE
   - DTI

3) Academe
   - BISU

4) Accredited NGOs
   - FCB Foundation Inc.
   - PROCESS-Bohol, Inc.
   - Feed the Children Philippines
   - Environmental Legal Assistance Center (ELAC)
   - Bohol Alliance of Non-Government Organizations (BANGON)
   - People's Fair Trade Assistance Center (PFTAC)
   - Community Awareness & Services for Ecological Concerns (CASEC)

5) POs whose thrusts and programs are closely related to environment and ecotourism

C. **Work and Budgetary Requirements** (Please refer to **Table 35** and to sub-heading **C. Allocation of Best Land Uses** in **Pages 103** to **104** and **106**, respectively.)

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Provincial government of Bohol through the PPDO and BEMO

National Government Agencies such as the DENR, BSWM, Phivolcs, PAGASA and NAMRIA

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