BIOFIN

COMPILATION & SYNTHESIS OF VALUATION STUDIES ON PHILIPPINE BIODIVERSITY

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COMPILATION & SYNTHESIS OF VALUATION STUDIES ON PHILIPPINE BIODIVERSITY

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Background

This Report provides a compilation and synthesis of available information on resource/ecosystem valuation in the Philippines as part of BIOFIN's attempt to make a case in financing biodiversity conservation in the Philippine. It is hoped that government and various stakeholders can gain better appreciation and understanding of the breadth and value of the diversity of our ecosystems, and sustain - even increase, the current efforts and funding for the management and conservation of the environment for future generations.

Initial estimates suggest that natural capital accounts for about 15% of the Philippines' wealth in 2010 or about USD6,337 per capita.[1] Apparently, agricultural lands contributed the highest (69%), followed by pastureland, subsoil assets and minerals. Forest resources including protected areas accounted for less than 5% of this.

However, the full value of these resources is not fully understood by many. This endangers the sustainable use of these resources. More often, the problems of management and governance of

[1] 'Philippine Country Report 2015', PHIL-WAVES. World Bank, 2015. p.3

PURPOSE

The Philippines is one of the 17 countries with the most diverse biological resources and all efforts must be taken to preserve and conserve these resources.

However, the value of these resources is not fully understood by many. This endangers the sustainable use of these resources and oftentimes, wrong and conflicting policy actions from various government agencies and the private sector.

It is hoped that this compilation will be a useful reference for policy makers, community stakeholders, and other interested parties in improving the state of conservation of, and funding for Philippine Biodiversity.

ecosystems are caused by poor information and institutional failures. In some cases, knowledge is lacking about the contribution of ecosystem processes and biodiversity to human welfare and how human activities and decisions lead to environmental change with lasting impacts on the lives of people. In other instances, institutions, notably markets, provide the wrong incentives. (UNEP 2007)

One of the aims of this Report is to present valuation data that summarizes the peso/monetary values and economic significance of these resources and in the process, help government and private institutions make better policies and support.

This is a working document that can be built upon, as more studies on Philippine biodiversity values are made available. The Report is structured according to the following thematic areas:

- Forest
- Coastal and Marine
- Agrobiodiversity
- Urban Biodiversity

Each thematic area discusses the ecosystem services and economic values they provide. Discussion under each thematic area is organized such that 'function', 'service' and 'benefits' are discussed along with monetary valuation of each resource, where information is available. It must be remembered that information here are taken from various existing studies and reports, which utilized different methods of valuation.

Towards the end, summary tables of reference studies used are annexed including other reference from other countries as basis for valuing resources where there is no available information.

Methodology and Report Limitations

This Report was prepared over a period of three months from November 2015 to January 2016. Much of the time was spent on collecting and compiling available reports and studies from various sources and mining them for relevant information. The Report applied a systematic study of gathering available studies and reports on valuation of biodiversity resources in the Philippines.

1) An initial listing of possible local and international institutions (15) that conduct scientific environmental researches in the Philippines were inquired for availability of valuation reports. Due to the limitation in time, many organizations were not able to respond with the request. The institutions that provided valuation studies include:
   a) ASEAN Center for Biodiversity

b) Ecosystems Research Development Bureau (ERDB-DENR)
c) Palawan Council for Sustainable Development (PCSD)
d) Resources, Environment and Economics Center for Studies (REECS)
e) WorldFish Center

2) An Internet search was also conducted for available studies using key words: Philippines, biodiversity valuation, and resource valuation. This yielded a number of studies that provided further references for useful information. A progressive search was made to enable to find other sources of information that can be used to reference biodiversity values that may be applied to Philippine settings. There appear to be only a small number of studies available on the valuation of ecosystem services in the Philippines. There are ongoing studies being conducted but results are not yet available to be included in this study.

A summary of sample economic values for different ecosystems estimated at national and site-specific levels are provided for each thematic area. Valuation data were extracted from studies collected from various institutions, individuals and the Internet. As valuation methods have already been described in the reference studies, they will no longer be described in this study.

The most common valuation methods used where value transfers have been performed were:

1. Cost–benefit analysis (CBA) of investment projects and policies (both *ex ante* and *ex post* analyses). ◎

2. Environmental costing to determine the marginal environmental and health damages of air, water and soil pollution, among others, from energy production, waste treatment and other production and consumption activities. These marginal external cost can be used in investment decisions and operation (for example as the basis for 'green taxes'). ◎

3. Environmental accounting at the national level (green national accounts)

Ecosystem services are often assessed and valued at specific sites for specific services and cannot be interpolated to get a collective national value. For the purposes of arriving at some estimates of national level values, a constant unit value (often averages of different studies) per hectare of ecosystem type is multiplied by the area of each type to arrive at aggregate totals. To the extent possible, the Study attempted to unify the units of measure and monetary values taken from the different studies for purposes of determining an end value for a common resource. Due to the large volume of references, some discussions were lifted straight from the referenced studies to retain the context from where it was taken and acknowledged at the end of this Report.

A bibliography of studies used in this Report is provided in the Reference section of this Report. The files of referenced documents were organized in an Excel database and provided separately to the BIOFIN Project Management Office. The geographic distribution of information is uneven, with a large number of studies concentrated in protected areas. Forest and marine ecosystems have been by far the most extensively studied. The least studied are agro and urban ecosystems.

1. FOREST ECOSYSTEM VALUES

There are countless benefits from forest ecosystems in the form of goods and services such as food, wood, clean water, energy, flood and soil erosion prevention, tourism, carbon sequestration, and non-timber forest products. The full range of these goods and services make significant direct and indirect contributions to the national economy and welfare of communities surrounding it. Krieger (2001) estimated the ecosystem values of tropical forests as shown in Table 1 below.

Table 1. Estimates of Tropical Forest Ecosystem Values

Ecosystem service	Values (US$/ha)
Climate regulation	36.5
Disturbance regulation	0.8
Water regulation	1.0
Water supply	1.3
Erosion control and sediment retention	40.1
Soil formation	1.6
Nutrient cycling	151.0
Waste treatment	14.2
Food production	5.2
Raw materials	51.6
Genetic resources	6.7
Recreation	18.3
Cultural	0.3

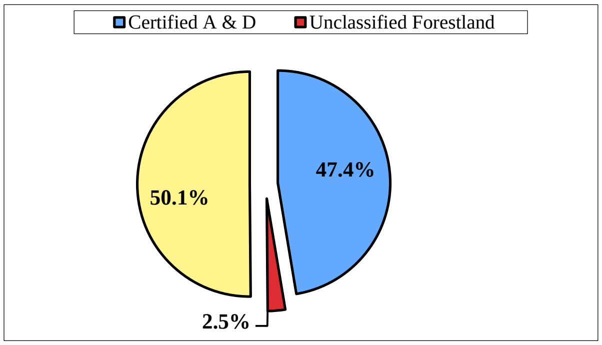
Quoted from: Technical Notes No. 7 SINP Phase 1

The total value for all these services would equal to about US$328.6 per hectare or in Philippine Peso at 2015 exchange rate would be about PhP15, 115 per hectare.

1.1. Philippine Forest Area and Cover

According to the National Mapping and Resource Information Authority (NAMRIA) about 52.6% of the Philippines' total land area (30 million hectares) is considered forestland. (Figure 1)

Figure 1. Philippine Land Classification (as of 2007)



The country's forest resources are increasingly under pressure from the increase in rural population and rural poverty. Based on the 2010 Philippine Land Cover by the National Mapping and Resource Information Authority (NAMRIA), the total forest cover of the Philippines is estimated at 6.840 million hectares (22.8% of the total land area of the Philippines). It has decreased significantly over the years due to deforestation and forest degradation.

1.2. Forest Ecosystem Direct Use Values

TIMBER & FUELWOOD

The timber values of forest ecosystems vary over time given the size and condition of forests at any given time. The most current physical and monetary estimate of forest timber stocks in the Philippines provided at the website of the Philippine Economic-Environmental Natural Resource Accounting (PEENRA) was from 1988 to 1994 as shown in Table 2.

According to the report, there was a general downtrend in terms of volume and value at constant prices of forest resources from 1988 to 1994. The estimation took into account the enforcement of total logban on old growth dipterocarp forests in 1992. The decrease will

THE VALUE OF A TREE

A tree is worth $193,250 according to Prof. T.M. Das of the University of Calcutta. A tree living for 50 years will generate $31,250 worth of oxygen, provide $62,000 worth of air pollution control, control soil erosion and increase soil fertility to the tune of $31,250, recycle $37,500 worth of water and provide a home for animals worth $31,250. This figures does not include the value of fruits, lumber or beauty derived from trees.

From Update Forestry
Michigan State University

continue as the size of closed forest areas decrease because of land conversion and encroaching urban developments. The PHIL WAVES Project observed drastic land cover changes in only a period of seven years.

Table 2. Physical and Monetary Estimates of the Closing Stocks of Dipterocaprs, Pine and Rattan at Constants Prices, 1988-1994

Year	Dipterocarps		Pine		Rattan	
	Closing Stock in ('000 cu.m.)	**Value at Constant Prices (in million PhP)**	**Closing Stock**	**Value at Constant Prices (in million PhP)**	**Closing Stock**	**Value at Constant Prices (in million PhP)**
1988	719,096	421,638	24,977	41,680	4,112	2,945
1989	694,248	413,153	24,888	38,396	3,894	2,543
1990	670,553	352,870	24,759	33,870	3,821	2,187
1991	647,953	322,081	24,626	32,249	3,627	1,960
1992	634,487	336,236	24,500	34,427	3,511	2,007
1993	622,272	337,898	24,377	31,379	3,371	1,736
1994	611,219	317,777	24,252	28,867	3,236	1,522

Using the 1994 closing values of stocks, the present worth of these stocks is estimated at **PhP 1,004 billion** or about **USD21,001 million** at 2016 prices.

Fuelwoods also provide significant economic contribution especially to the informal sector but there are no estimates yet available at the national level. Table 3 provides economic account for fuelwood for Siargao Island (2012) based on a **0.41 cu m of fuelwood per capita/year**. Assuming only the population of 50.5 million Filipinos living in the rural area in 2010, the average volume of fuelwood would be about 20.705 million cu.m. with an estimated value of about **PhP4,555 million**, using a stumpage value of about 220. It is assumed that the demand for fuelwood for household energy use will continue to rise with population increase and high cost of alternative fuel.

> Land conversion due to urban sprawl and rapid industrial development is causing a decline in forests and impacting agriculture production.
>
> A 7-year observation (2003-2010) of land cover in and around Laguna de Bay showed major land cover changes: closed forests decreased by 35% while built-up areas increased by 116%.
>
> - Laguna Lake Ecosystem Accounts Report

Table 3. Adjusted forest economic account for fuelwood

Fuelwood Economic Account	2011	2012	2013	2014	2015	2016	2017	2018
Closed Forests	1,096.6	1,110.4	1,124.3	1,138.2	1,152.0	1,165.9	1,179.7	1,193.6
Open Forest, mixed	1,772.7	1,751.7	1,730.6	1,709.6	1,688.6	1,667.5	1,646.5	1,625.4
Mangrove forest	4,001.9	3,968.5	3,935.2	3,901.9	3,868.5	3,835.2	3,801.9	3,768.5

Source: Integrative Report on Siargao Island Ecotown NRA[2]

There are indications of continued declining stocks of forest timber resources. Field observations from a USAID Study on Siargao Island showed that even small trees and saplings are at high risk of depletion. These small trees and saplings contribute to the active growth of the forest and therefore, could compromise the long-term sustainability and resilience of the forest ecosystem.

WATER SUPPLY

Water supply is one the important ecosystem services derived from the forest by local communities. Forests act as buffer in storing and gradually releasing water to the streams and rivers throughout the year. Change in forest cover affects flow of water from the watershed.

To estimate the value of this service, some authors estimate the total volume of domestic water generated per area and the amount paid per household for their water supply. Initial estimates under PEENRA indicate that the total groundwater withdrawal throughout the country grew from 4.3 billion cubic meters (bcm) in 1988 to 5.8 bcm in 1994. This represents an average annual

> Water is a main concern of farmers in Southern Palawan. The accounts show that if the forests upstream of the irrigation system would be lost, paddy production in the irrigation system would drop by 1,248 tons of paddy per year (around 20% of the current production in Pulot watershed) and economic loss would be an estimated 19.97 million pesos per year.
>
> Source:

[2] Lasmarias, N., Castillo, G., Carandang, A., Rosales, R.M., 'Natural Resource Assessment For Siargao Island, Surigao Del Norte As Part Of Demonstrating The Climate Change Commission's Ecotown Framework'. USAID, 2012

increase of 5.3%. Using an average water tariff of about PhP 8.78 per cu.m[3], the value of ***total water extracted and consumed*** at 1994 prices is about **PhP50.9 billion**. The said groundwater demand covered the domestic, industrial and commercial usage of water. Due to data limitations, the agricultural sector water demand was not included in the estimation. These estimates do not include the surface water found in rivers, lakes and other water bodies found above ground. According to WAVES' Philippine Country Report (2015), only about 36 percent of the river systems and surface water areas in the country are potential sources for drinking water, with the remaining 64 percent unfit for drinking even after complete treatment.

A case study of Mt. Mantalingahan in Palawan was prepared by the Palawan Council for Sustainable Development (PCSD) in 2015 to determine unit values of water fees attributed to the protected area watershed covering domestic, agriculture and fishery uses. Table 4 presents the summary of the computed water values.

The unit value estimated for Mt. Mantalingahan was about **PhP5,000/ha/year**. If this is applied to the almost 2.6 million hectares of critical watersheds[4] in the Philippines, this amounts to only about **PhP13 billion/year**.

Table 4. Estimated Forest Value from Water Use Fees

Reference	Unit Value	Value (PhP)
Sta. Cruz		15,491,133
Mt. Mantalingahan (272,366 has.)	PhP 5,000/ha/yr	
Domestic		15,343,673
Agriculture		587,687,455
Fishery		758,798,872
Total		1,361,830,000
Pulot watershed		19,970,000
Total		1,397,291,133

Eco-Tourism

Ecotourism is a growing activity and constitutes a potentially valuable non-extractive use of tropical forests. The natural beauty contained in forest ecosystems provide many

[3] Chia et.al. Water Privatization in Manila, Philippines. http://www.circleofblue.org/waternews/wp-content/uploads/2012/06/Insead_Water_Privatization_Manila_Philippines.pdf p.6

[4] Paragas, V.S., Manzanao Jr., J., Cacanindin, D.C., ' Land Use Strategies on Watershed Management and Disaster Reduction in the Philippines'. http://ces.iisc.ernet.in/energy/HC270799/LM/SUSLUP/Thema4/255/255.PDF. pa

attractions and opportunities for recreational activities such as walking, hiking, camping, fishing, and even swimming in rivers and lakes.[5] Considered to be a mega diverse country, the Philippines offer one of the best destinations for ecotourism in Asia and the ASEAN region as shown in Table 5.

Table 5. Ecotourism Resources and Products Available in the Philippines

Natural Areas/Resources	Mountains, Volcanoes, Hills, Forests, Coves, Formations, Marshes, Lakes, Rivers, White Beaches, Mangroves, Coral Reefs, Flora and Fauna, Landscapes, Seascapes
Culture/Tradition	Festivals, Fiestas, Cuisine, Historical Sites, Archaeological Sites, Rituals, Costumes
Production/Activities	Mountaineeing/Trekking, Hiking, Spelunking, Biking, Bird-watching, White water rafting, kayaking, scuba diving, snorkeling, dophin-/whale-/whaleshark-watching, firefly watching, Research

The NTSAP 2013-2022 estimated 4.3 million foreign tourists in 2012, and is projected to increase to 10 million in 2016. Domestic tourists reached 41 million in 2012 but is projected to level at 35 million in 2016. [6] Carved out of this figure is the potential market size for ecotourism estimated to be within the range of 1,251,293 to 14,176,500 in the same year. Financially, the potential gross earning from foreign ecotourism was from US$81.2 million to US$1.4 billion from 2013 to 2016. On the other hand, the potential earnings from domestic ecotourists could be from PhP 9.5 billion to PhP102 billion. Overall, the potential maximum earnings from ecotourism in Philippine Peso could reach **PhP157 billion by 2016.**

According to BMB account, the number of domestic and foreign visitors in over 200 protected areas under NIPAS alone averaged 778,008 annually for the period 2000 to 2010 (Table 6). This translates to the average annual earnings of **PhP14 million** from tourist visits to the protected areas in 2000–2010.

Table 6. Total Visitors in Protected Areas of the Philippines for 2000-2010

Year	Number of Visitors		Total No. of Visitors	Income Generated
	Local	Foreign		
2005	347,589	25,043	797,599	15,785,645

[5] De Groot, Rudolf, Wilson, Matthew, Boumans, Roelof. 2002. "A Typology for the Classification, Description and Valuation of Ecosystem Functions, Goods and Services". *Ecological Economics. Special Issue on Dynamics and Value of Ecosystem Services: Integrating Economic and Ecological Perspectives.* Volume 41, Issue 3.
[6] National Ecotourism Strategy and Action Plan 2013-2022. BMB-DENR, DOT. February 2014. p. 2

Year	Number of Visitors		Total No. of Visitors	Income Generated
	Local	Foreign		
2006	288,027	15,823	649,730	15,046,791
2007	337,317	16,470	756,976	9,204,381
2008	389,562	43,759	846,875	17,175,024
2009	350,788	48,642	815,496	25,382,496
2010	391,145	71,422	864,916	21,011,865

Quoted Source of DOT Basic Data, BMB-DENR:

While the total value of tourism receipts from these areas are moderate, the potential for increase in volume and value of receipts from eco-tourism will vary greatly from site to site. Table 7 presents a summary of the recreational and tourism values from different studies of different sites in Luzon and Visayas. The transferred values range significantly from as low as PhP20.7 per hectare to PhP54,231 per hectare.

Table 7. Recreational and Tourism Values in the Philippines

Location	Unit	Transferred Values, in PhP (2005 Prices)	Reference
Recreational benefits Sohoton, Samar	Per ha in NPV	2,437.9	Rosales 2001/ contingent method
Recreational benefits Sohoton, Samar	Per visit (mean WTP for local visitor)	23.88	Rosales 2001/ contingent method
Recreational benefits Sohoton, Samar	Per visit (mean WTP for foreign visitor)	244.43	Rosales 2001/ contingent valuation method
Recreational value Borongan, Samar	Per visit (mean WTP)	77.63	SIBP 2005/ contingent valuation method
Recreation value Pinipisakan Falls, Samar	Per visit (mean WTP)	110	SIBP 2005/ contingent valuation method
Recreation benefits Makiling, Laguna	Per visitor	20.7	Calderon 2001/ travel cost method
Tourism values Bacuit Bay	Per ha	54,231	Hodgson & Dixon 1988/ benefit of no logging vs. continued logging
Recreation benefits Lake Danao Natl. Park, Leyte	Per year (urban)	156.08	Francisco & Espiritu 1999/ contingent valuation method
Recreation benefits Lake Danao Natl. Park, Leyte	Per year (rural)	117.7	Francisco $ Espiritu 1999/ contingent valuation method

Quoted from

1.2.1. Other Income from Protected Area Fees

Aside from tourism, there are also varied users in the protected areas and applicable fees are applied for different types of uses. Table 7 summarizes some of the types of fees collected by protected area managements; from a minimum of PhP6,000 development fee for Cutflower raising to about PhP7,982,650 for agricultural rents.

Table 8. Potential Annual Revenues from different types of users in Protected Areas

Site/Use	Type of Fee	Potential Annual Revenues (PhP	
		Minimum	Maximum
Apo Reef Natural Park Recreation	**Entrance Fee**	**329,650**	**659,300**
Mt. Kitanglad Range Natural Park Summit	**Development Fee**	**290,000**	**370,000**
Mt. Kanlaon Natural Park		**1,040,748**	**9,907,035**
Watershed Protection	Resource User Fee	200,000	200,000
Recreation	Entrance Fee	45,021	91,185
Gamefowl Raising	Development Fee	58,035	127,200
Agriculture	Development Fee	444,392	7,982,650
Cutflower	Development Fee	6,000	6,000
Geothermal Extraction	Development Fee	287,300	1,500,000

1.3. Indirect Forest Use Values

Apart from the direct uses described above, the forests are of immense use to communities indirectly. They prevent soil erosion, regulate the flow of rivers and reduce the frequency and intensity of floods, check the spread of deserts, add to soil fertility and ameliorate the extremes of climate.

Additionally, indirect forest use values arise from other various services such as protection of watersheds and storage of carbon. It is difficult to quantify the value of these indirect uses but several studies were found which attempted to quantify these values.

Carbon (Offset) Stock Value

Forests and trees act as natural carbon stores, but this carbon is released when the trees are felled and the area deforested, contributing to climate changes and global warming.

It was estimated that the world's forests store 283 gigatonnes (1Gt = 1 billion tons) of carbon in their biomass alone and 638 Gt of carbon in the ecosystem as a whole (to a soil depth of 30 cm). Thus, forests contain more carbon than the entire atmosphere. Carbon is found in forest biomass and dead wood, as well as in soil and litterfall[7].

> "All ecological functions of forests are also economic functions. Many important forest functions have no markets, and hence, no apparent economic value, justifying the use of forest land for other purposes. Imputting economic values to nonmarketed benefits has the potential to change radically the way we look at all forests and to make the pendulum swing back from a presumption in favor or forest conversion to more conversation and sustainable use."
>
> - David W. Pearce
> University College of London

According to Lasco and Pulhin (2003), tropical forest lands in the Philippines have a wide range of carbon stocks. The highest stocks can be found in primary and secondary dipterocarp forests (more than 250 tC/ha) while the lowest are in grassland areas (< 50 tC/ha). They reported that for Philippine biomass, a default value of 45% could be used in determining carbon stock in trees. The main annual increment of carbon also varies widely with the highest increment found in tree plantations of fast growing species (close to 17.5 tC/ha/yr) and the lowest in natural forests (0.9 tC/ha/yr).

Using the default value of 45%, it can be interpolated from Tables 6 and 7 above, the **total carbon stock value** of Philippine forests would be roughly **PhP453 billion**.

Table 9 compiled some valuation of carbon stockes in selected forest protected areas in the Philippines. These estimates provide higher value estimates. Mt. Mantalingahan in Palawan alone is estimated to have a total 94 billion USD carbon stock value. Other sites such as Chocolate Hills natural monument and other sites in Samar provide varying value per hectare ranging from PhP2,932 to PhP45,592 per hectare.

Table 9. Value of Carbon Stock in Selected Forest Protected Areas

Location	Value	Unit Value	Reference
Mt. Mantalingahan[8]	94.854 billion USD		
Chocolate Hills natural monument	175,148 USD	20t/C	EEPSEA
Samar	2,932.43 PhP	Per hectare	Reyes 2001
Not specified		Per ha/yr (tree	Lasco 1997

[7] FAO. Global Forest Resources Assessment (2005). Progress towards sustainable forest management. FAO Forestry Paper 147: Food and Agriculture Organization of the United Nations. 350 p

[8] Total carbon stock value is only for old growth, mossy, residual, and mangrove forests

Location	Value	Unit Value	Reference
		plantation)	
Benguet Pine Plantations, Bukidnon			

Source: Technical Report No. 5 Phase 1 SINP 2006,

Flood Prevention

Forests are like giant sponges, which soak up moisture and release water slowly into river streams. This function moderates the flow of rivers to prevent flooding and ensure that rivers and creeks continue to flow during periods with lower rainfall. The sponge effect of forest to control flood events has economic benefits in terms of avoided damage in crop and tree losses. When the forest is cleared, rain falls directly onto the compacted soil, often resulting in serious soil- erosion, siltation and flooding. Major floods in southern Thailand, Bangladesh and the Philippines have been attributed to forest clearance.[9] Yaron (2001) estimated the benefit of flood protection provided by forests in Cameroon at about US$24 per hectare per year.

In the Philippines, EEPSEA (2014) calculated flood prevention services provided by forests and watershed for the Sta. Cruz River Watershed using Cost Benefit Analysis of the flood mitigation project in the area at about **PhP13.68 million per year.** If applied to total agricultural area, this is approximately **PhP45 billion/year**

Table 10. Flood protection in terms of value of avoidable crop and tree losses

Location		Unit Value	Reference
Korup, Cameroun	Flood protection only	$3/ha	Ruitenbeck 1992
Mt. Cameroun, Cameroun	Flood protection valued at value of avoidable crop and tree losses	$0-24/ha	Yaron 2001

Source: D.W. Pearce, 'Economic Values of Forest Ecosystems', Univ. of London

Soil Erosion Control

The soil erosion control function of a forest ecosystem is directly influenced by the vegetation cover and root system in the forest (Bishop 2003). Tree roots acts as soil stabilizer and its foliage intercepts rainfall, which prevents compaction and erosion of bare soil (de Groot et al. 2002). This is also important in maintaining agricultural productivity. In principle, many of the effects of soil erosion (landslides, flooding, etc) can be valued using the change in productivity approach or the production function

[9] http://www.rainforestinfo.org.au/good_wood/the_imp.htm

approach in terms of loss in crop yields, damages to human health and property, etc.[2] The resulting value is a measure of the damages avoided or benefits from soil erosion control. A study by the Grand Valley State University in Michigan USA reported that one acre of forest results in three fewer tons of soil erosion per year. One ton of soil is valued at $6.88 (Plantinga and Wu 2003).

Table 11 provides a contrast of costs of damage avoided for soil erosion. A study on Magat Watershed estimated a value of PhP 3,874 per hectare per year. Using this value relative to the total number of critical watersheds in the Philippines (2.6 million hectares), this amounts to about **PhP10 billion**.

Table 11. Cost of Damage Avoided For Soil Erosion

Location		Unit Value	Reference
Magat Watershed	Soil erosion	PHP3,874 per ha /yr	
Turkey	Replacement cost of nutrients, flood damage	$46/ha	Bann 1998
MI, USA	Soil erosion mitigation	$51.9/ha	Grand Valley State University

A study on Samar Integrated Natural Park calculated average percentage loss in productivity of croplands at 10-12.9% and about 43% for rangelands.

Table 12. Estimated Productivity Loss Due to Erosion per Land Category

Land Category	Average Loss (%)
Irrigated Cropland	10.5
Rainfed Cropland	12.9
Rangeland	43

Quoted from: Technical Note No. 7: Phase 1 SINP October 2006

Value of Non use Benefits

There were other approaches that provide some rough estimates of nonuse values, such as willingness to pay for preservation, conservation of certain sites. Some of these are compiled in Table 13. According to the source studies, residents and tourists are willing to pay between PhP22 to PhP360 per household per year, depending on the site and resource to be conserved/protected. The total nonuse value of four sites in the Philippines is estimated at **PhP654 million**. The total value if applied to many conservation sites in the Philippines would be tremendous.

Table 13 Benefit Estimates from Philippine Non Use Valuation Studies

CVM Non Use Study	Benefit Estimates (PhP/HH/year)
WTP for Samar Island forest preservation (Sambio 2001)	172
WTP for Philippine Eagle conservation (EEPSEA 2006)	360
WTP for conservation of whale sharks (EEPSEA 2006)	22
WTP for conservation of marine turtle (EEPSEA 2006)	100

Source: Technical Notes No. 6: Phase 1 SINP 2006

Based on the technical report on the valuation of SINP, the total nonuse value of SINP at the national level is about PhP432.95 million.

Table 14. Total Non Use Values Philippines ,2006

Community	Total Non Use Values (PhP million)
Local (SINP)	0.78
National	432.95

Source: Technical Report No. 6, Phase 1 SINP, 2006

Watershed protection values appear to be small when expressed per hectare, but it is important to bear in mind that watershed areas may be large, so that a small unit value is being aggregated across a large area. Secondly, such protective functions have a public good characteristic since the benefits accruing to any one household or farmer also accrue to all others in the protected area. Third, the few studies available tend to focus on single attributes of the protective function – nutrient loss, flood prevention, etc – rather than the totality of protection value. Fourth, the Hodgson and Dixon study (1988) for the Philippines suggests that fisheries protection values could be substantial in locations where there is a major inshore fisheries industry. Comprehensive estimates have still to be researched.

Table 15. Watershed Protection Values in the Philippines

Location	Year	Unit	Transferred Values in PhP (2005 prices)	Reference/Valuation Method Used
Watershed Protection Makiling, Laguna	1996	Ave. WTP for a one time fee (HH)	157.19	Soguilon 1996/contingent valuation method
Watershed Protection Makiling, Laguna	1996	Monthly fee (HH	43	Soguilon 1996/contingent valuation method
Watershed Protection Makiling, Laguna	1996	Monthly donation estimated (HH)	2.26	Soguilon 1996/contingent valuation method
Watershed Protection Makiling, Laguna	1998	Per month (residential)	59.35	Cruz et.al. 1996/ contingent valuation method

Location	Year	Unit	Transferred Values in PhP (2005 prices)	Reference/Valuation Method Used
Watershed Protection Makiling, Laguna	1998	Per month (commercial)	24.59	Cruz et.al. 1996/ contingent valuation method
Watershed Protection Makiling, Laguna	1998	Per month (resort owners)	90.17	Cruz et.al. 1996/ contingent valuation method
Watershed Protection Angat, Ipo, Umiray, LaMesa watershed	2005	Per HH per month	29	Calderon et al. 2005/ contingent valuation method
Watershed Protection Pinacanauan watershed	2005	Per HH per month	20	Bennagen et al, 2005/ contingent valuation method
Management and protection Mt. Isarog watershed	2005	Per month	58.88	Calderon 2004/ contingent valuation method
Watershed protection Pinacanauan watershed	2004	Per/ha/crop (rice farmers)	182	Bennagen et al. 2005/ contingent valuation method
Watershed protection Pinacanauan watershed	2005	Per visit (local tourists)	37	Bennagen et al. 2005/ contingent valuation method
Watershed protection Pinacanauan watershed	2005	Per visit (adventure tourists)	135	Bennagen et al. 2005/ contingent valuation method
Soil erosion Magat watershed	1998	Per ha per year	1,068	Cruz et al. 1988/ replacement cost method

Quoted from Technical Notes 7 : Phase 1– SINP, October 2006

2. COASTAL AND MARINE ECOSYSTEMS

Goods and services derived from coastal and marine ecosystems include[10]:

- **Tourism:** People the world over visit coral reefs to enjoy the recreational opportunities that these ecosystems provide, including SCUBA diving, snorkeling, and glass-bottom-boat viewing.
- **Fisheries:** Coral reefs and their surrounding ecosystems, including mangroves and seagrass beds, provide important fish habitat.
- **Coastal protection:** Coral reefs serve as natural barriers to storm surges that can cause great destruction to coastlines and communities.
- **Biodiversity:** The United Nations' *Atlas of the Oceans* describes coral reefs as among the most biologically rich ecosystems on earth, with about 4,000 species of fish and 800 species of reef-building corals described to date.

[10] Global Compilation, Economic values of Coral Reefs, Mangroves and Seagrasses, 2008

- **Carbon sequestration:** Coral reefs remove carbon dioxide from the atmosphere and are thus important for the mitigation of global warming.

According to Carpenter and Springer (2005), the Philippines has some of the richest marine biodiversity in the world. Overall, its marine waters hold more than 500 species of stony corals, 12 of which are endemic, in addition to more than 2,724 species of marine fish, about 42 species of mangrove, and 16 species of sea grass[11]. With these abundant fisheries and marine resources, the Philippines' fisheries sector contributes significantly to fisheries output nationally and worldwide.

This section integrates coastal and marine ecosystem values from various Studies.

Important Facts:

1. PhP 5.7 billion: annual cost from degradation and mismanagement of coastal resources in the Philippines
2. PhP 30 billion/yr: Benefit of coastal resources including avoided damages
3. PhP 340 billion/person/yr: Total net value per person per year

- Padilla, J.E., 'Analysis of Coastal & Marine Resources, 2008

2.1. Philippine Coastal and Marine Ecosystem

With approximately 2,200,200 sq.km territorial water area, the Philippines is considered the center of the center of marine shore fish biodiversity in terms of number of species per unit area (Carpenter and Springer 2005). The larger center is the Coral Triangle that includes Indonesia, parts of Malaysia and some Pacific countries such as Papua New Guinea, Timor Leste, and Solomon Islands (Padilla 2008). Table 16 summarizes the Philippines coastal and marine resources by ecosystem or biome.

Table 16. Philippine coastal and marine ecosystems[12]

Total territorial water area (including EEZ)	2,200,00 km^2
Coastal	266,000 km^2
Shelf area (up to 200 m depth)	184,600 km^2
Coral reef (within 10-20 fathoms)	27,000 km^2
Mangroves	1,397 km^2
Seagrass/algal beds*	27,282 km^2
Other coastal	52,025 km^2
Oceanic	1,934,000 km

[11] State of the Coral Triangle Report-Philippines 2012

[12] Lifted from Jose E. Padilla, 'Analysis of Coastal and Marine Resources: A Contribution to the Philippine Environmental Analysis', 2008.

Coastline (length)	17,460 km

Sources: Philippine Fisheries Statistics (2006); Fortes (1995) for the seagrass area.

Table 17 approximates the potential fishery production from Philippine marine waters at 1,650,000 metric tons. Using the FAO approximate value of $1,469/metric ton, the approximate value of the potential production from Philippine marine waters is about **$2.42 billion or about PhP111 billion.**

Table 17. Estimated potential annual production from Philippine marine waters

Area	Potential Production (metric tons)		
	Pelagic	**Demersal**	**Total**
I. Coastal areas (up to 200 m isobath)	800,000 +/- 200,000	600,000 +/- 200,000	1,400,000 +/- 200,000
Region 1: Tayabas Sea; Camotes Sea; Visayan Sea; Sibuyan Sea; Ragay Gulf; Samar Seal; related bays	120,000 +/- 30,000	90,000 +/- 30,000	210,000 +/- 30,000
Region 2: South Sulu Sea; East Sulu Sea; Bohol Sea; Guimaras Strait; related bays	112,000 +/- 30,000	84,000 +/- 30,000	196,000 +/- 30,000
Region 3: Moro Gulf; Davao Gulf; Southeast Mindanao Coast	80,000 +/- 20,000	60,000 +/- 20,000	140,000 +/- 20,000
Region 4: East Sulu Sea, Palawan, Mindoro (West Palawan; Cuyo Pass; West Sulu Sea; Batangas Coast)	264,0000 +/- 70,000	198.000 +/- 70,000	462,000 +/- 70,000
Region 5: North and Northwest Luzon (Lingayen Gulf; Manila Bay; Babuyan Channel; Palawan Bay)	64,000 +/- 30,000	48,000 +/- 20,000	112,000 +/- 30,000
Region 6: Pacific	160,000 +/- 30,000	120,000 +/- 40,000	280,000 +/- 40,000
II. Oceanic areas	250,000 +/- 50,000	0	250,000 +/- 50,000
Total			**1,650,000 +/- 200,000**

Source: NRMC/FIDC (1980); also cited in Pauly (1986) and Padilla (2008)

2.2. Coral Reefs

The Philippines has an estimated 27,000 km^2 of coral reef with only about 5 percent of this area still in excellent condition.[13] Recent valuation studies indicate that reefs in the whole country are contributing a conservative **US$1.35 billion** or about **PhP62.1 billion** to the national economy and that one km^2 of healthy Philippine reef with some tourism potential produces annual net revenues ranging from US$29,400 to US$113,000 (White et al 2000).

[13] White, A.T., Ross, M. Flores, M., Benefits and Costs of Coral Reef and Wetland Management, Olango Island, Philippines; CRMP Document No. 04-CRM/2000

Table 18. Status of Philippine coral reefs (% of total area)

Location	Category			
	Poor (0-24.9%)	**Fair (25-49.9%)**	**Good (50-74.9%)**	Excellent (75-100%)
1982 (Gomez et al 1981)				
Luzon	31.40	42.80	22.30	3.50
Visayas	29.60	36.90	26.10	7.30
Mindanao	48.80	30.20	14.00	7.00
All	31.80	38.80	23.60	5.70
1997 (Licuanan & Gomez, 2000)				
All	27.00	42.00	28.00	4.00
2000 – 2004 (Nanola et al 2005, Nanola et al 2006				
West Philippine Sea	46.00	54.00	0.00	0.00
Northern Philippine Sea	48.10	51.90	0.00	0.00
Southern Philippine Sea	31.00	60.20	8.80	0.00
Visayas Region	47.60	50.00	2.40	0.00
Sulu Sea	56.00	36.00	8.00	0.00
Celebes Sea	20.50	48.70	28.20	2.60
All	40.80	53.30	5.70	0.20

Percentages encloses in parentheses after each category refer to live hard coral cover

POTENTIAL LOSS IN FISHERY VALUES

Damage to coral reefs result in dwindling fish stock that affect fishery production in an area. Table 19 summarizes the potential loss in fishery due to damage in selected locations. The average amount lost is about **US$2.2 billion** a year.

Table 19. Potential loss in fishery values due to damage in coral reefs

	Value (loss fisheries value)	**Area**	**Year**
ASEAN TEEB Study	2.2 billion USD	102,000 has	2007
EFACT[14]		Philippine area in coral triangle	2009
Capture fisheries prodn	2.454 billion USD	Same	
Value associated from coral reef associated species	932 million USD	Same	

[14] Economics of Fisheries and Aquaculture in the Coral Triangle, Asian Development Bank, 2014

Bolinao Aquaculture Fishery	US$36,358	4,000 sq.m.
Moalboal coral reefs	US$17,056/ha	
Siquijor coral reefs	US$14,225/ha	

2.3. Mangroves

Mangroves are communities of intertidal plants including all species of trees, shrubs, vines and herbs found on coasts, swamps or border of swamps. They are incredibly important ecosystems for biodiversity and people.[15] Mangroves support a wide range of organisms by providing habitats, breeding grounds, nurseries and food for a large variety of animals. Their roots, trunks and canopies are inhabited by numerous marine and terrestrial species of other plants, animals and microorganisms. The widely ramified mangrove roots provide perfect anchorage for sponges, algae and mussels, while prawns, crabs and fish use the open area between the roots for shelter, spawning, and food source. They also protect soils from erosion and thus stabilize a habitat that is exposed to continuous tidal movements

Mangrove diversity is relatively high in the Philippines. There are varying estimates on the number of plant species. Long and Giri (2011) estimated the Philippines has about 35 true mangrove species[16].

Human activities, however, have altered much of the mangrove forests in the Philippines.[17] The total mangrove area in the Philippines has decreased by almost half[18], from an estimated 500,000 ha in 1918[19]. A major driving force of mangrove forests loss in Southeast Asia, and in the Philippines, is the rapid expansion of aquaculture development[20]. Within the Philippines alone, an estimated 50 percent of mangrove deforestation can be directly attributed to brackish-water pond development. Mangrove degradation in the Philippines is anticipated to continue, despite greater conservation

[15] Handbook ‘Mangrove Restoration Guide;

[16] FAO. The World’s Mangroves 1980–2005: A Thematic Study in the Framework of the Global Forest Resources Assessment 205; Food and Agriculture Organization of the United Nations: Rome, Italy, 2007; pp. 1-74. Available online: http://www.fao.org/docrep/010/a1427e/a1427e00.htm (accessed on 25 February 2011) ◎

[17] Long, J.B and Giri, C. Sensors, 2011, ISSN 1424-8220 p. 2973

[18] Field, C.B.; Osborn, J.G.; Hoffmann, L.L.; Polsenberg, J.F.; Ackerly, D.D.; Berry, J.A.; Bjorkman, O.; Held, Z.; Matson, P.A.; Mooney, H.A. Mangrove Biodiversity and Ecosystem Function. Global Ecol. Biogeogr. Lett. 1998, 7, 3-14 ◎

[19] Brown, W.H.; Fischer, A.F. Philippine Mangrove Swamps; Bureau of Printing: Manila, Philippines, 1918, p. 132. ◎

[20] Dodd, R.S.; Ong, J.E. Future of Mangrove Ecosystems to 2025. In Aquatic Ecosystems: Trends and Global Prospects; Polunin, N.V., Ed.; Cambridge University Press: New York, NY, USA, 2008; pp. 172-287. ◎

and localized replanting efforts[21].

2.3.1. Total Mangrove Area in the Philippines

A Study by Long and Giri in 2011 revealed that 66 out of the Philippines' 82 provinces contained mangrove (Table 4), with the largest areas of mangrove forests located on the island provinces of Palawan and Sulu.

Table 20. Mangrove Areal Extent by Province

Province	Area (Hectares)	National Percentage	Province	Area (Hectares)	National Percentage
Agusan del Norte	244.98	0.10	Leyte	5,807.07	2.26
Aklan	1,144.44	0.45	Maguindanao	907.92	0.35
Albay	1,081.17	0.42	Marinduque	2,732.22	1.06
Antique	945.9	0.37	Masbate	5,302.08	2.06
Aurora	497.07	0.19	Metropolitan Manila	39.69	0.02
Basilan	7,641.18	2.97	Misamis Occidental	2,066.49	0.80
Bataan	238.59	0.09	Misamis Oriental	341.19	0.13
Batangas	508.95	0.20	Negros Occidental	4,393.26	1.71
Biliran	231.39	0.09	Negros Oriental	2,004.93	0.78
Bohol	9,490.50	3.69	Northern Samar	4,286.52	1.67
Bulacan	391.14	0.15	Occidental Mindoros	1,842.93	0.72
Cagayan	5,175.27	2.01	Oriental Mindoro	2,975.31	1.16
Camarines Norte	3,628.17	1.41	Palawan	56,261.3	22.23
Camarines Sur	5,315.31	2.07	Pampanga	251.73	0.10
Camiguin	4.95	0.00	Pangasinan	1,206.63	0.47
Capiz	1,999.80	0.78	Quezon	14,170.00	5.51
Catanduanes	1,671.30	0.65	Romblon	792.45	0.31
Cavite	35.73	0.01	Samar	10,140.60	3.94
Cebu	2,893.77	1.13	Sarangani	92.61	0.04
Compostela Valley	130.14	0.05	Shariff Kabunsuran	1,018.89	0.40
Davao del Norte	195.57	0.08	Siquijor	70.20	0.03
Davao del Sur	361.53	0.14	Sorsogon	3,895.74	1.52
Davao Oriental	1,975.50	0.77	South Cotabato	13.86	0.01
Dinagat Islands	1,654.56	0.64	Southern Leyte	643.68	0.25
Eastern Samar	5,595.93	2.18	Sultan Kudarat	949.95	0.37
Guimaras	577.08	0.22	Sulu	20,564.80	8.00
Ilocos Norte	127.53	0.05	Surigao del Norte	11,867.00	4.62
Ilocos Sur	228.87	0.09	Surigao del Sur	5,652.55	2.19
Iloilo	1,322.91	0.51	Tawi-Tawi	11,322.20	4.40

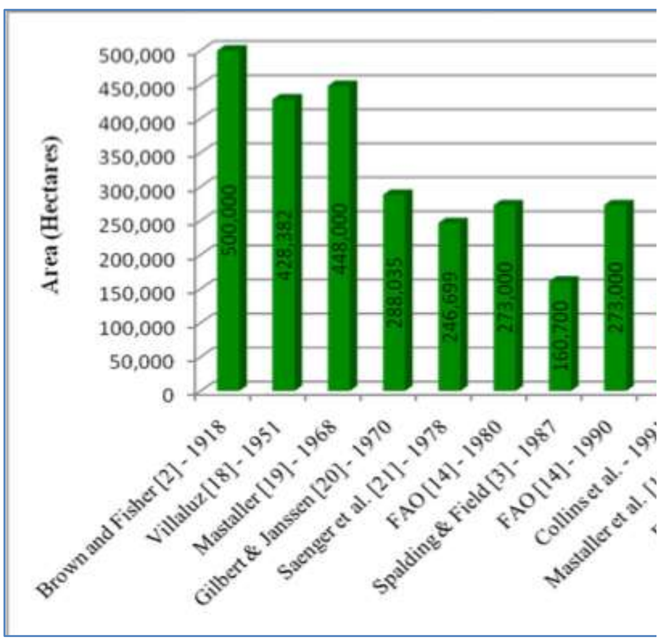
[21] Samson, M.S.; Rollon, R.N. Growth Performance of Planted Mangroves in the Philippines: Revisiting Forest Management Strategies. Ambio 2008, 37, 234-240 ◎

Province	Area (Hectares)	National Percentage	Province	Area (Hectares)	National Percentage
Isabela	592.29	0.23	Zambales	981.54	0.38
La Union	144.18	0.06	Zamboanga del Norte	1,961.82	0.76
Lanao del Norte	1,580.94	0.61	Zamboanga del Sur	9,501.66	3.70
Lanao del Sur	620.37	0.24	Zamboanga Sibugay	13,889.20	5.40

Source: Sensors 2011

According to their estimates, the total area of the Philippines' mangrove forests was 256,185 ha. circa 2000. However, they claimed that their estimates are higher than the most recent estimates published by the FAO and the Philippine Department of Environment and Natural Recourses (DENR) (Figure 2). These estimates were produced through differing methods and technologies. The FAO utilized "reliable" estimates from previously published and unpublished sources to calculate the mangrove extent for 2000. The DENR 2003 estimate was derived from interpretation of 2001–2003 Landsat imagery. This analysis, however, was part of a broad national land cover mapping project, which could have resulted in an underestimation of mangrove areal extent due to a higher occurrence of misclassification.

Figure 2. Comparison of Mangrove Areal Estimates by Province



The mangrove forests of S. Española experienced a net loss in mangrove area of 684 hectares or about 38 percent of the original mangrove area of 1,776 hectares over a 10 year period (2001-2010).

This major loss has a corresponding decline of over 60% in the overall volume of trees in the study area from 206,300 cubic meters in 2001 to only 69,310 cubic meters in 2010. The reduction was attributed to cuttings, conversion into fishponds and patches of clearings that were observed during the 2011 monitoring survey. It was noted that people in the municipality used the mangrove poles and piles in their fish pens, for construction purposes and other domestic uses.

Source: PCSD

2.3.2. Mangrove Ecosystem Services

Mangroves⊚ecosystem services that contribute to human wellbeing include provisioning (e.g., timber, fuel wood, and charcoal), regulating (e.g., flood, storm and erosion control; prevention of salt water intrusion), habitat (e.g., breeding, spawning and nursery habitat for commercial fish species; biodiversity), and cultural services (e.g., recreation, aesthetic, non-use)[22].

2.3.3. Estimated Values

The average mangrove value in the sample used in ASEAN TEEB study is **4,185 USD/ha/year** and the median is 239 USD/ha/annum. Variation in values can be attributed to the characteristics of each mangrove site (area, ecosystem services provided), characteristics of the biophysical context of each mangrove (area of other mangroves, fragmentation), and the socio-economic characteristics of the population of ecosystem service beneficiaries (income and population size).

In the Philippines, various studies have shown that the direct and measurable sustainable benefits from mangroves come in the form of fish catch and wood harvested. These annual net revenues are slightly more than **US$600 per hectare** for fairly marginal, not pristine stands of mangroves, from two net revenue streams from wood products (US$90) and fishery products (US$538)[23].

Location/Source	Unit Value	Area	Reference
Philippines	US$4,185/ha	102,000	ASEAN TEEN Study, 2000
S. Espanola, Palawan		684 has	2010

Using the combined values from wood and fishery products in the Philippines provided from these studies, the total value of mangrove in the Philippines is estimated at about **US$160.88 million or about PhP7.4 billion**.

2.4. Beachscape

[22] Spaninks and van Beukering, 1997; UNEP, 2006; TEEB, 2010

[23] Schatz 1991; White and Cruz-Trinidad 1998

Payments for environmental services in maintaining beachscapes are expressed in willingness to pay for the conservation of beachscape beauty by tourists and local residents. Table 21 summarizes the value of selected beachscapes to local tourists.

Table 21. Value and willingness to pay of local tourists to selected beachscapes in the Phllippines

Location	Value to local tourists	Total Economic Value	Reference
Caramoan (347 has)		PhP 13.764 Million	EEPSEA 2014
Diving fees	PhP 897/visit		
Anilao	PhP 552/visit		
Moalboal	Php 49/visit		
Tubbataha	PhP 543/visit		
San Fernando Bay, La Union (shoreline erosion threat)	PhP 148.63 million		
El Nido		USD 19.3 million	1996
Moalboal beaches	8260 USD/ha		
Bolinao		482,000 USD	

2.5. MARINE PROTECTED AREAS

There are about 160 MPAs in the Philippines, divided into the following categories: national marine park (1), national marine reserve (1), marine turtle sanctuary (7), tourist zone and marine reserve (65), wilderness area (52), protected landscape/seascape (2), seashore park (1), and fish sanctuary (31).

One way to manage the increasing threats in marine and coastal resources is through Marine Protected Areas (MPAs), which safeguard valuable ecosystems within their confines. A summary of valuation studies done for the different marine protected areas provided the figures in Table 21. Tourism fees from diving range from US$7.11/diver to as much as US$66.64/diver particularly in Tubbataha Reef Marine Park (TRMP). Apo Island which is about 74 hectares receives about US$87.57 million per year in tourism fees.

Table 22. Value of fishery and tourism fees from selected MPAs in Philippines

Location	Fishery	Tourism fees	Reference
Sogod Bay, Southern Leyte	PhP 928,465/ha		WorldFish
Tubbataha Reef National Marine Park		PhP 3,085,518 @ 2005 prices	

Caramoa Natural Protected Area		
Apo Island (74 has.)	US$87.57 million/yr	2014 EEPSEA
TRMNP	US$66.64/diver	
ARMNP	US$10.66/diver	
BIPLAS	US$7.11/diver	

3. AGRICULTURAL BIODIVERSITY

Agrobiodiversity is the result of the interaction between the environment, genetic resources and management systems and practices used by culturally diverse peoples. Therefore land and water resources are used for production in different ways.

A DEFINITION OF AGROBIODIVERSITY

The variety and variability of animals, plants and micro-organisms that are used directly or indirectly for food and agriculture, including crops, livestock, forestry and fisheries. It comprises the diversity of genetic resources (varieties, breeds) and species used for food, fodder, fiber, fuel and pharmaceuticals. It also includes the diversity of non-harvested species that support production (soil micro-organisms, predators, pollinators), and those in the wider environment that support agro-ecosystems (agricultural, pastoral, forest and aquatic) as well as the diversity of the agro-ecosystems.

Source: FAO, 1999a

According to Biodiversity International, approximately 940 species of cultivated plants are threatened globally (Khoshbakht and Hammer, 2007). Agricultural biodiversity is the source of genetic material that is vital to future generations. When a species or the diversity within a species is lost, we also lose genes that could be important for improving crops, promoting their resistance to pests and diseases, or adapting to the effects of climate change.

According to FAO, there are several distinctive features of agrobiodiversity, compared to other components of biodiversity:

- Agrobiodiversity is actively managed by male and female farmers;
- Many components of agrobiodiversity would not survive without this human interference; local knowledge and culture are integral parts of agrobiodiversity management;
- Many economically important agricultural systems are based on 'alien' crop or livestock species

introduced from elsewhere (for example, horticultural production systems or Friesian cows in Africa). This creates a high degree of interdependence between countries for the genetic resources on which our food systems are based;

- As regards crop diversity, diversity within species is at least as important as diversity between species;
- Because of the degree of human management, conservation of agrobiodiversity in production systems is inherently linked to sustainable use - preservation through establishing protected areas is less relevant; and
- In industrial-type agricultural systems, much crop diversity is now held ex situ in gene banks or breeders' materials rather than on-farm.

Some of the benefits of agrobiodiversity according to Thrupp (1997):

- Increase productivity, food security, and economic returns
- Reduce the pressure of agriculture on fragile areas, forests and endangered species
- Make farming systems more stable, robust, and sustainable
- Contribute to sound pest and disease management
- Conserve soil and increase natural soil fertility and health
- Contribute to sustainable intensification
- Diversify products and income opportunities
- Reduce or spread risks to individuals and nations
- Help maximize effective use of resources and the environment
- Reduce dependency on external inputs
- Improve human nutrition and provide sources of medicines and vitamins, and
- Conserve ecosystem structure and stability of species diversity.

3.1. IDENTIFYING AGRICULTURAL BIODIVERSITY VALUES

Economists have identified various categories of the values of agricultural biodiversity. However, the economic valuation of many aspects of agricultural biodiversity remains problematic.

Direct uses of agricultural biodiversity include a range of products, which provide dietary diversity and make important nutritional contributions. They include:

- Consumptive uses: goods that do not appear in national economic statistics, but which local people need (e.g. medicinal plants, wild vegetables, building materials) can be value at the cost of market alternatives.
- Productive uses: (goods sold in commercial markets) are conventionally valued at the net price at the point of sale.

Additionally crop diversity can generate improvements in yields through plant breeding. For example, genetic improvements in US crops were responsible for increasing the value of the harvest by an average of $1 billion per year from 1930 to 1980 (Primack, 1993).

Indirect uses of agricultural biodiversity include production effects such as adaptation to lower input conditions; specific adaptation (intra-farm and inter-farm); reduction of risk; potential for high biological production; and having a range of varieties and species with complementary agro-ecological requirements.

Indirect uses also include ecosystem services: biodiverse agriculture provides more of these important services than does monoculture. Some ecosystem services can be valued relatively straightforwardly, for example wild insects pollinating crops can be valued at the incremental value of the crop, or the cost of hiring honey bees. Others, such as CO2 absorption by plant communities, are much harder. However, the value of these services is rarely captured in a market. Indeed, the value of ecosystem services is inadequately captured using conventional economic analysis. ◎

Goods and Services	Examples	Nature of value	Approximate Value
Goods			
1. Products derived directly from biological resources hunted or gathered from natural or semi natural systems	Most fish, wildlife, gathered wild foods and medicinal plants, etc.	Direct use values (consumptive much not traded in markets)	
2. Products derived from biological resources hunted or gathered from managed systems through agriculture	Crop and livestock production, timber from plantation forestry, and fish from aquaculture	Direct use values (consumptive, some not traded in markets)	
3. Products derived indirectly (i.e. from the information content) of collected genetic resources	Pharmaceutical derivatives and new plant varieties	Direct use value (current use) Option value (known material, not used currently) Exploration value (undiscovered sources)	
Services			
4. Essential processes to ensure continued functioning, resilience and productivity of ecosystems which provide the goods, 1,2 and 3	Nutrient cycling, pest and disease control, pollination	Indirect use values	
5. Wider ecosystem functions	Watershed protection, carbon sequestration, habitat protection	Indirect use values	
6. Cultural and aesthetic functions	Scenic landscapes, species (esp. of charismatic	Direct use value (recreation) Indirect use value	

	animals), crop varieties of cultural importance	Existence Value

Source:

3.2. VALUES FROM FOOD PRODUCTION

Total value from agricultural crops as reported by PSA in 2012 is about **PhP1,416,794 million** and about **PhP 90,448 million** for livestock and poultry. Table 20 presents the total value of major crops planted by farm practice in ____. The traditional practice produced less than best practice farming.

Table 23. Philippines net present values of benefits from agricultural crops by farm practice, 2014-2018

Crops Planted	NPV (PhP/ha)		Total Area Planted (ha)	Total Value (PhP/ha)	
	Best Practice	Traditional Practice		Best Practice	Traditional Practice
Rice	92,813.62	63,870.77	55.93	5,191,065.95	3,572,292.34
Coconut	154,735.44	62,367.26	327.00	50,598,489.61	20,394,095.34
Abaca	128,754.07	6,425.20	4.00	515,016.29	25,700.81
Banana	346,877.31	15,464.53	4.00	1,387,509.23	61,858.14
Root crops	178,786.36	3,747.98	5.00	893,931.82	18,739.92
Total	901,966.80	151,875.74	395.93	58,586,009.90	24,072,686.55

3.3. VALUES DERIVED FROM MANAGEMENT OF PESTS AND DISEASES

Agricultural biodiversity can provide a cost-effective way for farmers to manage pests and diseases. Each year an estimated 10-16% of global harvests are lost to plant disease (Strange & Scott, 2005; Oerke, 2006). Using diversity allows farmers to limit the spread of pests and diseases without investing in high chemical inputs.

For example, in the Central Highlands of Vakinankaratra, Madagascar, growing fodder radish next to rice acts as a natural barrier that significantly reduces the rice damage caused by the larvae and adults of black Dynastid beetles (Avelino et al, 2011). In Uganda, pest and disease damage was substantially reduced when farmers grew different varieties of common bean with different resistance together. Growing a combination of varieties together also makes farming systems more resilient to new pests and diseases (Mulumba et al, 2012).

3.4. BENEFITS IN CLIMATE ADAPTATION

All farmers are susceptible to extreme weather events, and many are already feeling the effects of climate change. Agricultural biodiversity can provide smallholder farmers with more crop options and help buffer the effects of extreme events such as droughts or floods. For example, in Ghana, farmers are planting varieties of crops that mature faster in order to deal wit changes in seasonality and rainfall brought on by climate change (Adjei-Nsiah et al, 2010). More and more farmers are also turning to varieties that are more drought-, salt- or flood-tolerant to cope with changing environmental conditions. In Ethiopia, farmers who face high rainfall variability plant more teff, barley and grass pea rather than wheat and lentils (Haile Abreha, 2007). They also respond to high rainfall variability by sowing different varieties of the same crop species (Di Falco et al, 2010).

3.5. VALUE OF GENETIC RESOURCES

Majority of modern crop and livestock varieties today are derived from their wild relatives and it is estimated that products derived from genetic resources (including agriculture, pharmaceuticals etc.) is worth estimated $500 billion/annum (ten Kate and Laird 1999).

Around one billion people rely on wild harvested products for nutrition and income and the "invisible" trade in wild resources is estimated to generate $90 billion/annum (Pimentel *et al*. 1997). In India alone the livelihoods of around 6 million people are maintained by the harvest of forest products (Tuxill 1999) and many studies highlight the importance of wild harvested plants and animals to the rural poor, particularly from forests (de Beer and McDermott 1989, Nepstad and Schwartzman 1992, Prance 1992, Colfer 1997, Pimentel *et al*. 1997, Shanley *et al*. 2002, Scherr and McNeely 2005, Belcher and Schreckenberg 2007, Paumgarten and Shackleton 2009). In many rural locations, particularly areas that lack basic infrastructure and market access, the collection of wild resources provides considerable subsistence support to local livelihoods (Delang 2006). In addition, the harvest and sale of wild products often provides one of the only means of access to the cash economy (Ros-Tonen and Wiersum 2005). Access to markets is particularly important for food security.

Additionally crop diversity can generate improvements in yields through plant breeding. For example, genetic improvements in US crops were responsible for increasing the value of the harvest by an average of $1 billion per year from 1930 to 1980 (Primack, 1993). ◎

4. *URBAN BIODIVERSITY*

Although ecosystem services have been intensively examined in certain domains (e.g., forests and wetlands), little research has assessed urban ecosystem services. A study by Larson et. al posits that urbanization leads to similarities in the social-ecological dynamics across cities in diverse biomes. By extension, the study suggests that urban ecosystem service priorities will be similar regardless of whether residents live in the humid East or the arid West, or the warm South or the cold North. Results underscored that cultural services were of utmost importance, including aesthetics, low-maintenance, and personal enjoyment.[24]

In an urban context, even small green spaces can provide high- impact ecosystem services, if they are well planned. For example, small wetlands can improve urban hydrology by absorbing contaminants or buffering against flooding (Pankratz et al. 2007), and vegetated rooftops can reduce the heating and cooling costs of buildings and slow runoff during rainstorms (DeNardo et al. 2005).

4.1. VALUES FROM POLLUTION AND CLIMATE CHANGE MITIGATION

There is very little, if any, available material on valuation of urban biodiversity in the Philippines. Instead, there are some cost-benefit analysis of projects to mitigate threats of pollution and climate change in urban areas.

Costales and Catelo[25] in early 2015 presented a paper that computed the monetary value of ailments directly attributed to concentrated exposures from air pollution in downtown Baguio. They said a seven-minute reduction in travel time to downtown amounts to a savings of **P98.3 million** in opportunity costs.

They also studied the social benefits from an Automated Guideway Transit in terms of savings for medical treatments of respiratory infected patients. According to their study about **P77 million** is estimated savings for payment for medical treatments of respiratory infected patients or the income loss from their caregivers.

A USDA Forest service study reportted that city vegetation removes nearly **784,000 tons of air pollution** and reduces atmospheric carbon dioxide every year by about 100 to 200 pounds per tree. Shady canopies help reduce urban temperatures, which are often hotter than neighboring rural areas. Cooler days temper airconditioning usage, so trees help save on utilities and reduce carbon emissions.

[24] K.L. Larson, S.R. Samples, S.J. Hall, N. Bettez, J. Cavender-Bares, P.M. Groffman, M. Grove, J.B. Heffernan, et.al. 'Ecosystem services in managing residential landscapes: priorities, value dimensions, and cross-regional patterns'. July 2015. http://link.springer.com/article/10.1007/s11252-015-0477-1

[25] Cost-Benefit Analysis of Automated Guideway Transit for Baguio-La Trinidad

4.2. VALUE OF URBAN TREES

In the United States of America, a study was made to estimate the value of trees planted in urban areas relative to the various services it provides. Studies have shown that there is a higher demand for trees in wealthy neighborhoods while low-income residents, and renters enjoy less tree cover. This is almost always true in the case of the Philippines.

The unequal allocation of city greenery means that many low-income are missing out on the benefits of having trees on their city blocks, which, it turns out, are significant. If a street is peppered with trees, the neighborhood will look better, sound better, and be less windy. Trees in urban spaces suppress noise, beautify monochromatic pavement, and reduce wind speeds.

According to a 2010 study by the USDA Forest Service, more foliage also means fewer felonies. Because urban greenery indicates that a neighborhood is well maintained, potential criminals believe they are more likely to be caught and are therefore less likely to risk committing a crime, suggested researchers.

A 2010 study pointed to the importance of maintaining urban forests as refuges for migrating birds looking for food and rest. They also help out animals and birds, by providing sanctuary from the dangers of city living.

REDUCED SOIL WATER RUN-OFFS

Water and soil quality will also benefit from a few Acacias on the street. Trees filter out some of the harmful substances that wash off of roads, parking lots, and roofs during storms, while also reducing surface run-off and flooding risks.

Storm Water Tree Credits

A number of municipalities across the US have established stormwater credit programs that grant flow control credits for existing or newly planted trees. The City of San Jose, California has a program that gives credits for trees planted within 30 feet of impervious surfaces and existing trees that are kept on a site if their canopies are within 20 feet of impervious surfaces. The impervious surface reduction credit for existing trees is the square footage equal to one-half the area of existing tree canopy (credit is equivalent to a reduction in the site's impervious area). The credit for each new deciduous tree is 100 square feet, and the credit for each new evergreen tree is 200 square feet. No more than 25 percent of a site's impervious surface can be credited through the use of trees (San Jose 2007).

ENERGY SAVINGS

Using vegetation to reduce the energy costs of cooling buildings has been increasingly recognized as a cost effective reason for increasing green space and tree planting in temperate climate cities (Heidt and Neef, 2008). Plants improve air circulation, provide shade and they evapotranspire. This provides a cooling effect and help to lower air temperatures. A park of 1.2 km by 1.0 km can produce an air temperature between the park and the surrounding city that is detectable up to 4 km away (Heidt and Neef, 2008).

4.3. ECOLOGICAL BENEFITS OF URBAN PARKS

Urban green spaces supply to cities with ecosystem services ranging from maintenance of biodiversity to the regulation of urban climate. Comparing with rural areas, differences in solar input, rainfall pattern and temperature are usual in urban areas. Solar radiation, air temperature, wind speed and relative humidity vary significantly due to the built environment in cities (Heidt and Neef, 2008). Urban heat island effect is caused by the large areas of heat absorbing surfaces, in combination of high energy use in cities. Urban heat island effect can increase urban temperatures by 5°C (Bolund and Sven, 1999). Therefore, adequate forest plantation, vegetation around urban dweller‟s house, management of water bodies by authorities can help to mitigate the situation. Green spaces that feature good connectivity and act as „wildlife corridors‟ or function as „urban forests‟, can maintain viable populations of species that would otherwise disappear from built environments (Haq, 2011; Byrne and Sipe, 2010). Regional green space is based on the protection and optimization of natural ecological system and actually refers to continuous suburban green space of large size. It not only improves the whole ecological environment of the city region and its neighbors, and provides important support of urban environmental improvement. Furthermore, introduction of suburban green space into city also acts as the base of ecological balance. In practice, problems of urban woods and citied agriculture should be paid sufficient attention (Wuqiang et al., 2012).

Pollution Control

Pollution in cities as a form of pollutants includes chemicals, particulate matter and biological materials, which occur in the form of solid particles, liquid droplets or gases. Air and noise pollution is common phenomenon in urban areas. The presence of many motor vehicles in urban areas produces noise and air pollutants such as carbon dioxide and carbon monoxide. Emissions from factories such as sulphur dioxide and nitrogen oxides are very toxic to both human beings and environment. The most affected by such detrimental contaminants are children, the elderly and people with respiratory problems (Sorensen et al., 1997). Urban greening can reduce air pollutants directly when dust and smoke particles are trapped by vegetation. Research has shown that in average, 85% of air pollution in a park can be filtered (Bolund and Sven, 1999). Noise pollution from traffic and other sources can be stressful and creates health problems for people in urban areas. The overall costs of noise have been estimated to be in the range of 0.2% - 2% of European Union gross domestic product (Bolund and Sven, 1999).

Urban parks and water management

Water management is crucial to cities, particularly in times of climate change. Cities often import water from surrounding areas in addition to converting land cover from vegetated surfaces to buildings, pavement, and other impermeable surfaces. This land-cover change radically alters the pathways and magnitude of water and pollution flows into, within, and out of urban systems. Surface water flooding describes the combined flooding in urban areas during heavy rainfall. Surface water flooding is mainly caused by short duration intense rainfall, occurring locally (Fryd et al., 2011 and Pataki et al., 2011).

Property Value

Areas of the city with enough greenery are aesthetically pleasing and attractive to both residents and investors. The beautification of Singapore and Kuala Lumpur, Malaysia, was one of the factors that attracted significant foreign investments that assisted rapid economic growth (Sorensen et al., 1997). Indicators are very strong that green spaces and landscaping increase property values and financial returns for land developers, of between 5% and 15% depending on the type of project (Heidt and Neef, 2008). Different ways of estimating the economic value of nature have been explored over time. Especially in an urban setting, a way of indirectly assessing the economic value of green spaces is to study the impact of these spaces on house prices. If for example parks are valued by property buyers, this would be reflected in the premium they are willing to pay for the house or apartment. Quite a number of studies carried out, especially during 1990s. The real estate market consistently demonstrates that many people are willing to pay a larger amount for a property located close to parks and open space areas than for a home that does not offer this amenity (Crompton, 2001). (Luttik, 2000) in the Netherlands found that overlooking attractive landscapes and water resulted in a price premium of 8-12 respectively 6-12%.(Cho et al., 2008) studied the impact of forests on property prices in Knoxville City, USA and also found a positive impact on property prices caused by proximity of green spaces.

Social and Psychological Benefits: Recreation and Wellbeing

Urban parks have been viewed as an important part of urban and community development rather than just as settings for recreation and leisure. Urban parks have been suggested to facilitate social cohesion by creating space for social interactions (Coley et al., 1997; Van Herzele and Wiedemann, 2003; Parr, 2007; Maas et al., 2009).

Human Health

People who were exposed to natural environment, the level of stress decreased rapidly as compared to people who were exposed to urban environment, their stress level remained high (Bolund and Sven, 1999). In the same review, patients in an hospital whose rooms were facing a park had a 10% faster recovery and needed 50% less strong pain relieving medication as compared to patients whose rooms were facing a building wall. This is a clear indication that urban green spaces can increase the physical and psychological wellbeing of urban citizens.

Urban parks and tourism

Urban parks do not only provide recreational settings to local residents. Also visitors from out of town will use these areas. Urban parks can play an important role in attracting tourists to urban areas, e.g., by enhancing the attractiveness of cities and as harmonize to other urban attractions (Majumdar et al., 2011).(Wu et al., 2010) mention that within the field of eco-tourism, defined as responsible travel to natural areas that conserves the environment and improves the well-being of local people (TIES, 1990), there has been increasing attention to urban ecotourism, defined by the Urban Ecotourism Conference in 2004 as nature travel and conservation in a city environment.

Reducing Crime

Access to public parks and recreational facilities has been strongly linked to reductions in crime and in particular to reduced juvenile delinquency. Research supports the widely held belief that community involvement in neighborhood parks is correlated with lower levels of crime. In neighborhoods where collective efficacy was strong, rates of violence were low, regardless of socio demographic composition and the amount of disorder observed. Collective efficacy also appears to deter disorder: Where it was strong, observed levels of physical and social disorder were low (Sampson, 2001).

SUMMARY

Ecosystems provide a range of services that are of fundamental importance to human well-being, health, livelihoods, and survival (Costanza et al., 1997; Millennium Ecosystem Assessment (MEA), 2005; TEEB Foundations, 2010; TEEB Synthesis, 2010).

The role of ecosystem services emphasizes our natural assets as critical components of inclusive wealth, well-being, and sustainability. Sustaining and enhancing human well-being requires a balance of all of our assets—individual people, society, the built economy, and ecosystems. This reframing of the way we look at ‘‘nature’’ is essential to solving the problem of how to build a sustainable and desirable future for humanity.

Estimating the relative magnitude of the contributions of ecosystem services is difficult but an important part of policy making and how people importance to biodiversity in general. The estimate for the total global ecosystem services in 2011 is $124 trillion/yr according to UNEP. A rough estimate of total ecosystem services in the Philippines is about PhP 2,309 billion per year. Table 24 provides a summary of ecosystem values compiled in this report.

Table 24. Summary of Ecosystem Biodiversity Values, Philippines

Ecosystem Service	Philippines (PhP billion)
Timber & fuelwood production	1.05
Water provision	50.9
Ecotourism	157
Carbon offset	453
Flood prevention	41.04
Soil erosion	10
Fishery production	111
Crop production	1,416
Coral reef	62.1
Mangrove	7.4
TOTAL	**2,309.49**

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