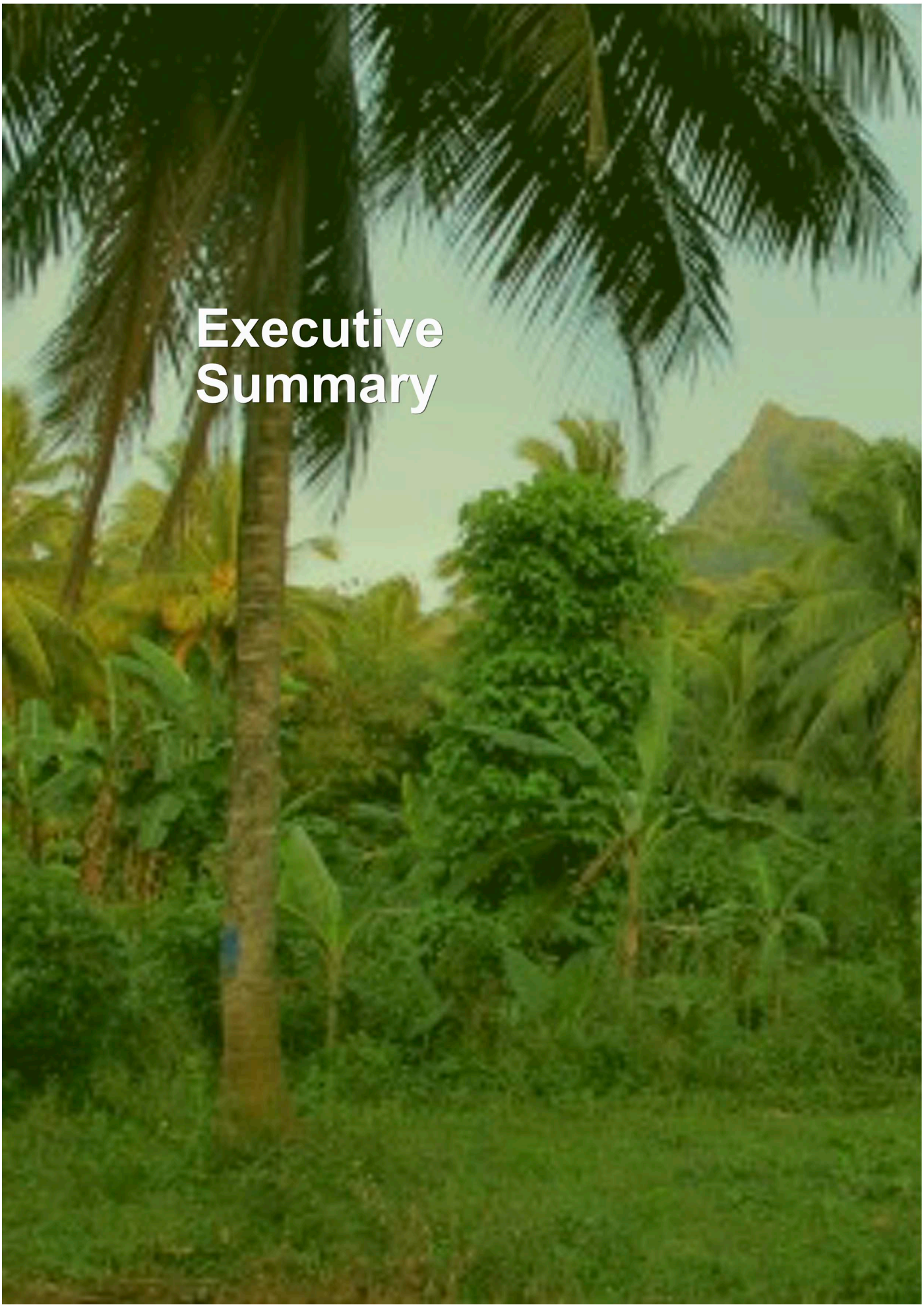
WAVES
Executive Summary

Philippines
May 2016

Southern Palawan Ecosystem Accounts

WAVES



Executive Summary

Technical Report: Experimental Ecosystem Accounts of Southern Palawan

Natural Capital

The Philippine archipelago is rich in biodiversity, coastal and marine resources, minerals, timber and other forest products. This natural resource wealth underpins the livelihoods of farmers and fishermen and provides an important social safety net for the rural communities, especially during times of crisis. Responsible management of natural capital is also critical to ensure future profit streams for private enterprises in the tourism, agriculture and fisheries, and mining sectors, as well as revenues to local and national governments.

WAVES

Wealth Accounting and the Valuation of Ecosystem Services (WAVES) is a global partnership led by the World Bank that aims to promote sustainable development by ensuring that the national accounts used to measure and plan for economic growth include the value of natural resources.

How will WAVES help?

WAVES will help the Philippines measure the country's natural resources and evaluate how these can be used equitably and sustainably. WAVES will provide key decision makers with scientific-based evidence and information to assess the social, economic and environmental trade-offs of different resource-use scenarios and their implications on the achievement of sustainable development.

The Uses of the Ecosystem Accounting Approach

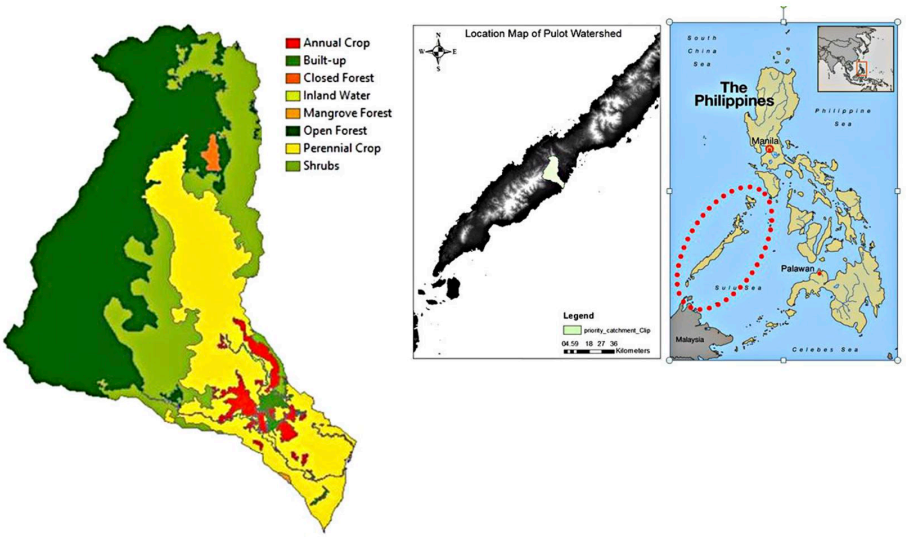
The ecosystem accounting approach is a practical and comprehensive tool to monitor changes in ecosystem condition and ecosystem use, providing information that can influence policy-making. It can be used for these purposes:

- to identify specific policy interventions needed to prevent environmental risks in the future (e.g. lack of connectivity to sewage systems that can endanger those in flood-prone areas)
- to define areas where specific policy interventions are needed (e.g. areas generating sedimentation, which should be prioritized for forest cover)
- to provide a benchmark for assessing the effectiveness of policy interventions, either through a long term monitoring system, and through a spatial information set that identifies different trends in different areas (e.g. closed forests inside and outside protected area boundaries)

This study of the ecosystem accounts will help policymakers make informed decisions that will lead to sustainable and inclusive development plans.

Introduction

Southern Palawan is one of the two test sites in the Philippines for the Wealth Accounting and the Valuation of Ecosystem Services (WAVES) project. Southern Palawan was selected as a pilot site because of its abundant natural capital in combination with ongoing rapid land use change. It has a significant remaining forest cover including mangroves, extensive coral reefs, and fishing grounds. Challenges in natural resource management in Southern Palawan include: (i) the increasing conversion of forest lands for plantation development and shifting cultivation; (ii) intensive mineral extraction; (iii) illegal timber logging and hunting; and (iv) destruction of coastal ecosystem and overfishing. A comprehensive understanding of the natural capital of Southern Palawan is important to manage the competing interests on natural resources and to support economic development.



Location and Land Cover Map of Pulot Watershed

Overall Methodology of Study

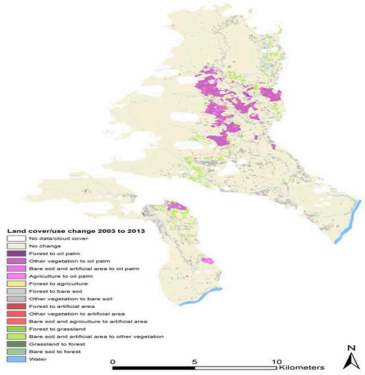
The Southern Palawan Pilot Ecosystem Account follows the System of Environmental Economic Accounting – Experimental Ecosystem Accounting (SEEA EEA) framework, and has as much as possible been aligned with the ongoing development of Technical Recommendations for SEEA EEA.

In the pilot phase, the Land and Carbon account were developed for the whole of Southern Palawan. The condition account was developed for the municipality of Sofronio Espanola, and the ecosystem services account was developed for Pulot watershed.

Land Account

Introduction

Land cover is the observed physical cover of the earth's surface, as defined by Food and Agriculture Organization (FAO). National Mapping and Resource Management Information Authority (NAMRIA), the country's mapping agency, aims to produce more detailed information on land cover extracted from the latest remote sensing data and to generate countrywide land cover statistics for resource managers, development planners and other related projects. For Palawan, NAMRIA has mapped land cover in 2003, 2010 and 2014, and created land cover change matrices for these three years.



Land Cover / Use Change Map

Methodology

The Land Account focuses on the whole of South Palawan. Land cover was classified based on the national NAMRIA land cover classification system, which is aligned with the FAO Land Cover Classification System. To analyze land cover, NAMRIA used a SPOT image for 2003, Advanced Very Near Infra Red (AVNIR) Panchromatic Remote Sensing for Stereo Mapping (PRISM) and Satellite Pour l'Observation de la Terre (SPOT 5) images for 2010, and Landsat 8 for 2014. Ground-truthing of data was done for both the 2010 and 2014 data. A validation of results shows an accuracy of over 80% for both the 2010 and 2014 classification, which is in line with good practices in remote sensing interpretation. For 2003, no ground-truthing was done and the accuracy of the data is not known.

The land cover classification involve three main steps: (i) pre-processing and interpretation; (ii) field validation; and (iii) post-processing

Results

The Land account shows the major deforestation that took place in Southern Palawan, in particular in the period 2003 – 2010, when the closed forest cover decreased from some 130,000 ha to around 30,000 ha. The loss of closed forest cover seems to have halted in the period 2010-2014, when there was an increase from 28,000 to 33,000 ha. However, uncertainties in the land classification were not examined and the observed reduction in deforestation rates in the period 2010-2014 needs to be further verified. The Land Cover Account also shows the large growth in plantation crops, in particular coconut and oil palm plantations, which has also been apparent from the interactions with stakeholders. There was a marked increase in oil palm plantations in recent years, but a main issue is that productivity has been very low, thereby affecting farmers.

2010 Land Cover Map | 2014 Land Cover Map

Carbon Account

Introduction

Carbon has been included as a specific account in the ecosystem account. The physical and monetary accounts of carbon are important to facilitate advancing the Reducing Emissions from Deforestation and Forest Degradation Plus (REDD+) regime for forests in Palawan. Carbon sequestration is the capture of carbon from the atmosphere by the vegetation from different types of forests. REDD+ is an effort to create a financial value for maintaining the carbon stored in forests.

The carbon account for the years 2003, 2010 and 2014 was prepared to: (a) provide the 2003, 2010 and 2014 carbon stock, carbon sequestration and carbon values of forests in Southern Palawan; (b) provide insights or analysis based on the resulting accounts; (c) link the accounts with policy issues or concerns affecting the forestry sector; and (d) provide recommendations.

Methodology

Carbon storage

The carbon account specifies, in tons of carbon, the opening carbon stock, carbon removals, carbon emission, net carbon emission, and closing carbon stock. The stocks were calculated for the years 2003, 2010 and 2014. Biomass and Carbon Accounting data were derived from the established Volume account of timber. It is divided into five (5) parameters: Stem Biomass, Above Ground Biomass (AGB) – using Biomass Expansion Factor (BEF), Below Ground Biomass (BGB), Tree Biomass, and Tree Carbon Content.

Carbon Sequestration

This study analyzes the carbon sequestration service of the forest (i.e., closed forest, open forest, and mangrove forest) in Southern Palawan and Pulot Watershed. Mean Carbon Sequestration Rate in tons of CO_2 per hectare per year of each forest type was derived.

Monetary valuation of the carbon sequestration service was done for each major type of forests: closed, open forest and mangrove forest. Valuation has been based upon the Social Cost of Carbon (SCC). The appropriate method to calculate the costs of carbon emissions is still being discussed in the Ecosystem Accounting community.

The average carbon stocks and carbon sequestration rates of open forest, shrubland and wooded grasslands has been used to calculate the carbon stock and sequestration in the merged class 'open forest'.

Results

Carbon Stock in Southern Palawan

The Biomass and Carbon Account presents the carbon stock in years 2003, 2010 and 2014. The Carbon account shows that the forests of Southern Palawan are a major carbon sink. However, this has been affected by deforestation. The total carbon stock contained in these forests declined from 15.6 million ton C in 2003 to 9.2 million ton C in 2010 and stabilized in the period 2010-2014, with carbon stocks estimated to be 9.4 million ton in 2014. The decrease in the first period can be attributed to the decrease in the area and volume of closed forest and the wide-range conversion of closed forest to other land cover. The increasing carbon stock in the 2010 - 2014 period is due to a modest recovery of the closed forests in Southern Palawan.

Terrestial and Coastal

Introduction

The ecosystem accounts require the use of a range of different condition indicators. These are grouped in three categories: (i) geomorphological indicators; (ii) environmental state indicators; (ii) ecosystem condition indicators, in line with the recent discussions on the new Technical Recommendations for Ecosystem Accounting that have been released as a draft in 2015 by the UN Statistics Division.
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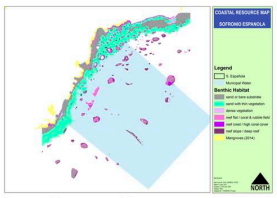
Methodology

Terrestrial condition account
The terrestrial condition account aims to record a number of key variables that reflect ecosystem components and functioning, focusing on Pulot watershed. For the Condition account, the following variables were selected. These include the geomorphological indicators: (i) elevation; (ii) precipitation; (iii) evapotranspiration; (iv) slope; and the environmental state indicators: (v) hazards; and (vi) soil loss.

These indicators were selected because, in addition to land cover, they are important for understanding the services provided by the uplands. The hydrological services are crucial in maintaining water supply throughout the year for paddy fields in the lowlands. Indicators are grouped in the three categories of geomorphological indicators, environmental state indicators and ecosystem condition indicators.

The data collected for these aspects come from international and local sources. In addition, the expansion and opening of new mines was mentioned as an important land use change that has taken place in the Southern Palawan including Pulot watershed in recent decades. This may affect ecosystem services in a number of ways, through land cover change and through changes in water quality in both rivers downstream of mining operations and in coastal zones where these rivers enter the sea. However, data on water quality was not available.

Coastal Condition Account
The coastal resources included in the account are coral reefs, seagrass beds and mangroves forests, representing the three key coastal ecosystems supporting the generation of fishery production services and other services. The Philippine coastal zone has been under intense pressure from overfishing, with fish capture believed to have exceeded the levels allowed to ensure maximum productivity of fish stocks some 20 years ago.



Coastal Resource Map
Sofronio Espanola

The accounts in this section include:

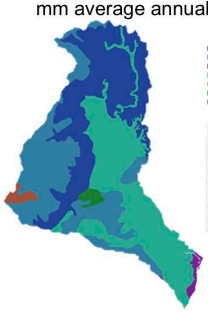
Environmental state indicators – these focus on pollution loading in the coastal zone of Sofronio Espanola municipality. The pollutants for the accounts are selected on the basis of (i) their likely discharge from mining operations and other land use in the watershed; (ii) their potential impacts on coastal ecosystems in particular coral reefs; and (iii) the availability of data. Data on pollution loads are collected by the Bureau of Mines and Geosciences. The coastal environmental state indicators focus on pollution loading in the coastal zone of Sofronio Espanola municipality including nickel, copper, lead and Total Suspended Solids (TSS). Heavy metal concentrations are analyzed with Atomic Absorption Spectophotometry, and TSS is analyzed through Gravimetric analyses, by the laboratories of CRL Environmental Corporation.

Ecosystem extent - The development of the Land Cover Ecosystem Account focused on the key coastal/marine ecosystems located within the municipal waters of Sofronio Espanola. These include the mangrove forest, seagrass beds and coral reef ecosystems. The accounts were developed primarily based on Landsat 8 image dated 8 August 2014 interpreted by the European Space Agency (ESA) and data from the Coastal Resource Monitoring Report 2011 generated by the Palawan Council for Sustainable Development for the municipality of Sofronio Espanola.

Results

Terrestrial condition account

Pulot catchment has an elevation ranging from 3 to 1,153 meters with 48% of its land area having slope of >18% which cannot be alienated or disposed under Philippine law, and 9% with slope above 50% which should be considered as protection forest. The large proportion of lower catchment is characterized by soil texture of sandy clay loam to clay, while the upper catchment is mostly covered by clay and clay loam to clay. Evapotranspiration ranges from 27-164 mm/year, and precipitation of 1769-1780 mm average annual rainfall.

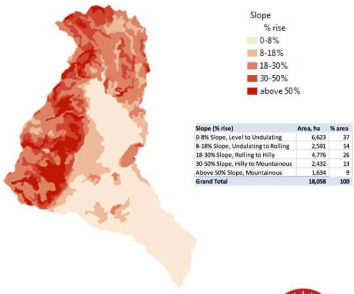


Soil Texture	Area (ha)	% area
Clay	5,751	31.8
Clay loam to clay	5,414	30.0
Loamy sand to clay	186	1.0
Metavolcanic mountain	221	1.2
Sandy clay loam to clay	6,264	34.7
Sandy to silt loam	1	0.0
Silty clay loam to clay	214	1.2
not classified	10	0.1

Coastal condition account

- **Environmental state indicators**. Available data is insufficient to analyze the potential impacts of pollution on coastal ecosystems. Hence, the results provide the set-up of the environmental state indicators of the ecosystem account, including four pollutants: (i) nickel; (ii) copper; (iii) lead; and (iv) total suspended solids (TSS). The first three may be present in run-off from the mines and the ore deposit located in the lower part of Pulot watershed. The fourth TSS is linked to mining operations as well as to deforestation and land use change.

- **Mangroves**. Palawan, in the year 2000, had the highest mangrove forest cover in the country covering around 58,400 hectares. While conversion of mangrove areas into fishponds or salt ponds still persists in some parts of the province, this did not affect the overall mangrove stand of Palawan. Natural regeneration of certain mangrove forests is believed to compensate for the loss due to fishpond conversion and to account for the slight expansion of mangrove areas.
- **Coral reefs**. Coral reefs in Palawan are under high pressure and are declining rapidly as a function of overfishing, physical destruction and pollution. The most recent 2004 monitoring report for the province involving 305 sites in 19 municipalities noted that only 1.1% of the coral reefs of the province are in excellent condition (75-100% live coral cover), 19% in good condition (50-74.9% live coral cover), 34% in fair condition (25-49.9% live coral cover) and 45% in poor condition (less than 25% live coral cover).
- **Seagrass fields**. Seagrasses are associated with mangrove forests and coral reefs and are considered as an ecotone between the two ecosystems. In the Philippines, 18 species of seagrass have been recorded and 14 species have been found and identified in Palawan.



Slope (% rise)	Area, ha	% area
0-8% Slope, Level to Undulating	6,623	37
8-18% Slope, Undulating to Rolling	2,591	14
18-30% Slope, Rolling to Hilly	4,776	26
30-50% Slope, Hilly to Mountainous	2,432	13
Above 50% Slope, Mountainous	1,634	9
Grand Total	18,058	100

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Ecosystem Services Supply and Use Account

Crop Production, Water Regulation, and Fisheries

The Ecosystem Services Supply and Use account records the flow of ecosystem services, in both physical and monetary terms. For the pilot ecosystem account, the services: carbon sequestration, water regulation, and the ecosystem's contribution to palm oil production, rice production, coconut production and fisheries were selected. The selection was made on the basis of the relative importance of these services for the local economy, and the availability of data. For all services, physical and monetary values were analyzed in the account. Note that the service carbon sequestration is covered in the Carbon account.

Crop production

Given the importance of these crops for Southern Palawan, and the increasing trends in plantation crops, these crops were selected for the ecosystem account:

Rice

The Philippines remains a rice-importing country but the province of Palawan has been a net exporter of rice to other provinces in the country for years, having a rice sufficiency average level of 161% (2009-2013). In Palawan, rice harvested areas and yields have been increasing.

Coconut

The Philippines is the world's largest producer of coconut oil and desiccated coconut. Production of coconut in the Philippines increased from 11.3 million MT of coconut produced in 1991 to 15.4 million MT in 2013. In the same period, the coconut production in Palawan shows a proportionally larger increase, from 0.11 MT in 1991 to 0.36 MT in 2013 (PSA, 2015).

Palm oil

The Philippines is among the Asian countries that have invested in oil palm development but production is marginal compared to Malaysia and Indonesia. In the last decade, plantations have expanded to Palawan, particularly in the southern portion of the island province.

Methodology

Data Collection. Secondary data was gathered from government offices, private companies, farmers' associations, and cooperatives. The base map was provided by the NAMRIA. Focus group discussions were conducted for crop yields, and inputs to and costs of crop production. For all crops, the amount of hectares grown, and the harvest in terms of kg products per hectare per crop (and per year) have been calculated.

Mapping. The 2010 and 2014 land cover maps provided by NAMRIA classifies crops into annual and perennial only, and further disaggregation was carried out on the basis of field visits to delineate paddy rice, oil palm and coconut areas, as well as the European Space Agency map.

Valuation. Resource rent was used as an indicator for the value provided by the ecosystem. The 15% social discount rate was used, in line with the NEDA guidance for cost benefit analysis. All data on costs were from farmer interviews.

Results

Paddy rice production.

Rice production covers about 570 hectares of land in Pulot Watershed. There are three distinct cropping systems for paddy. There is variation in crop yield between farmers. For irrigated rice, the minimum yield encountered in the survey is 3.9 tons ha^{-1} yr^{-1} and the maximum yield is 4.8 tons ha^{-1} yr^{-1}. There is no information as yet that would allow linking information form the condition account (e.g. soil type) to yields. Between 2010 and 2014, the irrigated area decreased and the rainfed area significantly increased, which might indicate that irrigation water supply does not meet the requirement of existing irrigated paddies.

Coconut production.

Coconut is a key plantation crop across Palawan. The average yield reported is 1.28 tons per hectare based on the results of the FGD/interview with 29 coconut farmers. This is very low compared to the reported average yield for the country.

Palm oil production.

The conversion of land to oil palm plantations started in 2007 and is currently expanding within Pulot Watershed. Farmers have either a Production, Technical and Marketing Agreement or a Land Lease Agreement with the private company through the cooperatives. The area covered by palm plantations is 1,012 hectares. The average Fresh Fruit Bunch (FBB) harvest is 9.7 tons $ha^{-1}yr^{-1}$. This average yield includes relatively many young plantations with low production due to the age of the trees.

Monetary values of ecosystem service supply.
For all three ecosystem units, the resource rent generated by the crops was calculated. Paddy-corn-paddy cropping system yields the highest resource rent. On the other hand, unirrigated (rainfed) rice paddies produce the lowest resource rent per hectare which underlines the significance of irrigation water in rice production. The resource rent from coconut production, however, is still lower than that from unirrigated rice paddy. The value of resource rent from oil palm production was zero in 2010 since milling operations began in 2011. In 2014, value for the flow of ecosystem service in oil palm production was negative due to the very low yield. How plantation crops can best be included in the accounts need to be examined.

Water Regulation

The Pulot Municipal irrigation scheme supplies irrigation water to around 500 hectares of rice paddies. However, due to water deficiencies, only part of the 500 ha is actually irrigated. Since 1989, Pulot watershed has a dam that regulates water supply which increased rice sufficiency of the area compared to rain-fed farming prior to the dam. Moreover, there is an existing Level III Water System serving the two barangays of Pulot Center and Pulot Shore, which supplies domestic water to around 780 households and establishments. This latter aspect has not been included in the account.

One cause of reductions in water supply in dams is sediment deposition which makes the reservoir shallower, decreasing its storage capacity; creating shortage in rice paddy areas; and causing damage to coral reefs from sedimentation and/or pollution. Flooding also occurs in the lowland part of the watershed particularly in Pulot Center, while Pulot River overflows during the rainy season.

The objective of the account is to model two hydrological ecosystem services of Pulot watershed: water regulation and sedimentation control. Water regulation is essential in providing water to irrigated rice paddies in the watershed. Sedimentation control is important because it reduces siltation of the irrigation reservoir and leads to lower sediment loads in coastal coral reefs.

Methodology:

Sedimentation Modelling. The SedNet model was used to quantify the sediment inputs and outputs (source and deposition) of the watershed in kilotons per year. It provides a summary budget containing all parameters generated from the model. Results are exportable and were then post-processed in GIS software.

Hydrological Modelling. The Hydrologic Engineering Center - Hydrologic Modeling System model was used to simulate inflow and outflow accounting parameters of water loss from rainfall to the discharge of water from the Pulot Dam using rainfall data from three stations of PAGASA in Southern Palawan over a thirteen year period (2000-2013).

Field work / Key Information Interviews. Actual measurement of the Pulot Dam was done to compute its dimensions and volume. Assumptions on rice paddy water consumption came also from key informants supported by published studies. Dam volume was modelled in one period due to lack of available historical bathymetry records.

Results

The Pulot Dam

The reservoir has an average depth of 2.7 meters including dead storage. Above that, water spills to an adjacent river, which happens during excessive rains. The dam has available maximum water storage of around 3,949 m^3 with an average discharge ranging from 0.4-0.5 m^3/sec according to NIA data.

Water supply

In the past decade, the irrigation water deficit in the scheme has evidently been increasing. The two reasons for this were sediment trapping of the dam, which reduces its storage volume for available water and changes in stream flow related to land use change. Land use change, specifically deforestation, has caused a reduction in the water buffering capacity of the vegetation and a lower base-flow during the dry season. Both effects have led to a reduction in water available for irrigation. Around 50 hectares were not irrigated in 2000-2005. This area almost doubled to 96 ha in the period 2006-2010. Water inflows have been particularly deficient in 2008 and 2009.

Sedimentation pressure

Total suspended sediment of the whole watershed was around 50kt/year in 2014 based on the land cover data and DEM. Results from the model show that around 35kt/year, or around 70% of the total suspended sediments come from 6 sub-catchments upstream from the dam, almost all from hillslopes. Most sediments are trapped in the reservoir, with a minor part deposited in the river during spill-over, and in the irrigation canals during every water release.

Existing Land Use

The headwaters of the dam are predominantly covered by forests, shrubs, and perennial crops (mostly oil palms). There is also an area of bare soil in one of the sub-catchments which is a main source of sediments.

Ecosystem Service modelling

The sediment regulation ecosystem service can be determined by converting all vegetation into bare soil thus giving a projection of the sediments avoided for the whole watershed. The model reveals that around 703 and 745 kt/year is retained by forests using 2010 and 2014 land cover data.

The monetary value of water regulation generated by the forests in the upper part of the Pulot watershed (the source of water for the Pulot municipal irrigation scheme), valued with an accounting-conform approach based on resource rent, can be roughly estimated at 13.9-11.6 = 2.3 million pesos per year (17%). On a per-hectare basis, amounts to 2.3 million / 5.425 = 424 pesos/ha/year (equally distributing water regulation over open and closed forests).

Fisheries

In the absence of quantitative data for the fisheries service, a survey was carried out in the context of the Phil-WAVES program. The objective of the survey was to collect the required information to analyze the fisheries services in physical as well as in monetary terms (using resource rent as the value indictor).

Methodology

Data on the number of fishermen were collected from the Barangay Fisheries and Aquatic Resource Management Council (BFARMC). The survey was carried out in July 2015 in the coastal zone of the municipality of Sofronio Espanola, corresponding to the study area of the pilot Ecosystem Account. A total of 31 fishermen were interviewed, equally distributed over three different Barangays (Pulot Shore, Iraray, Punang).

Results

The total Coastal Ecosystem Accounting Unit counts 28,813 hectares, of which 10,125 ha Coastal/ Marine deep waters. The total catch by all fishermen in Sofronio Espanola amounts to 1,665,853 kg/year and the total resource rent generated by fisheries in Sofronio Espanola is estimated at 42 pesos/kg * 1,665,853 kg/year = 70 million pesos per year. Note that this is a preliminary indication of the value of the ecosystem service 'providing fish for fisheries'.

Asset Account for Crop Production

Introduction

An asset account was developed only for crop production. For provisioning services, capacity is a relevant concept to consider for the asset account. Capacity is defined for individual ecosystem services as: 'the ability of the ecosystem to generate an ecosystem service under current ecosystem conditions and uses at the maximum level that does not lead to degradation of the ecosystem'

The assets for crop production relate to both the area used for growing specific crops, and the actual harvests that are achieved, under current farming systems. In this pilot, for agriculture, current flows are assumed to also express the capacity to generate the crop.

Methodology

The asset account considers two years, 2010 and 2014. The asset is quantified based on hectares in the physical account. The opening area in 2010 for coconut and oil palm was based on the 2010 ESA land cover map, while area of irrigated and unirrigated rice paddies were determined based on the 2010 NAMRIA land cover map analyzed along with the 2005 PCSD map. The closing areas in 2014 were all based on the 2014 NAMRIA land cover map wherein cropland areas of interest were disaggregated by interpreting 2013-2014 Google Earth images and using spatial data from a private company managing the oil palm farms and operating the milling plant.

In monetary terms, the asset account is calculated in terms of the Net Present Value (NPV) of the expected flow of ecosystem services per hectare.

Results

Ecosystem Units	Area	Resource Rent Pulot Watershed	Net Present Value at Discount Rate		
			10%	12%	15%
	(ha)	(millions pesos)	(millions pesos)	(millions pesos)	(millions pesos)
2010					
Rice	529	26.8	251	224	193
Coconut	1,315	12.7	119	106	91
2014					
Rice	608	35.5	332	297	256
Coconut	1,455	19.7	184	165	142

Monetary Account for Ecosystem Assets in Rice and Coconut for Pulot Watershed

In monetary terms, the asset account is calculated in terms of the NPV of the expected flow of ecosystem services per hectare. The resource rent is used to indicate the value of the ecosystem service. In computing the NPV of each crop system, much consideration was placed in determining the appropriate discount rate to be applied. The SNA (UN et al., 2009) specifies that a real discount rate should be used when the future flows are expressed in terms of current period prices, as we have used in our calculations. The SNA is less specific in terms of indicating how the appropriate real discount rate can be established. An option that is aligned with the overall SNA approach is to use the real market lending rates faced by the asset owner, in this case the farmers. These rates however may be high in a rural, developing country setting, given that the local money market may not be very efficient. It is also not always straightforward to deduct inflation from the nominal lending rates, since inflation rates can vary strongly from one year to the next. Another consideration is alignment with relevant national guidelines. NEDA estimates the values of the shadow discount rate (SDR), reflecting the true opportunity cost of money, which is estimated to be 15% (NEDA et al., 2007). Therefore, we have analyzed the asset value for three different discount rates, i.e. 10, 12 and 15%. For oil palm, the asset account could not be completed since there is no conclusive information on the production of oil palm throughout one planting cycle (generally around 25 years).

	Land Cover : Area (in hectares)					
	Rice of Which			Coconut	Palm Oil	Total
	Rainfed	Irrigated	Irrigated +Corn			
Opening 2010	57	446	27	1,315	910	2,745
Addition to Stock						
Regeneration, Natural (net of normal natural loss)						
Regeneration through Human Activity	93		34	140	415	634
Reclassification						
Total Addition to Stock	93		34	140	415	634
Reductions in Stock						
Reductions due to ongoing human activity		-48				
Catastrophic losses due to human activity						
Catastrophic losses due to natural events						
Reclassifications						
Total Reductions in Stock		-48				
Revaluations						
Closing Stocks (2014)	150	398	60	1,455	1,316	3,379

Biophysical Asset Account for Rice, Coconut and Oil Palm and ecosystem for 2010 and 2014, Pulot watershed.

Table above shows the result of compiling data to form the asset account. The asset account considers two years, 2010 and 2014. The asset is quantified based on hectares in the physical account. The opening area in 2010 for coconut and oil palm was based on the 2010 ESA land cover map, while area of irrigated and unirrigated rice paddies were determined based on the 2010 NAMRIA land cover map analyzed along with the 2005 PCSD map. The closing areas in 2014 were all based on the 2014 NAMRIA land cover map wherein cropland areas of interest were disaggregated by interpreting 2013-2014 Google Earth images and using spatial data from a private company managing the oil palm farms and operating the milling plant. The table presents the summary of the asset account. It is assumed that crop yields remain static at 3.9 tons/ha for rice and 1.3 tons/ha for coconut (hence no change in ecosystem condition, in the agricultural lands – note that this assumption would not be appropriate for uplands where croplands are under heavy threat from erosion. For the generally flat paddy lands and coconut plantations this assumption seems more realistic. However it needs to be further tested when the accounts are scaled-up). For oil palm this is an unlikely assumption given the young age of the plantations, and this crop is not included in the monetary asset account.

Policy Implications and Recommendations

1

There has been a strong expansion of oil palm plantations in the watershed in the past decade, facilitated by the development of a palm oil mill, but this expansion may not bring huge economic benefits to farmers due to low productivity. Policy makers should go slow in giving new permits for oil palm cultivation, at least until water availability for new areas proposed for oil palm has been analyzed.

2

The deforestation rate in Palawan seems to have been reduced and potentially reversed in the period 2010-2014. Further analysis and field verification would be needed to fully confirm the results, but the Land Account produced by NAMRIA for the overall island of Palawan suggests that forest loss, which was high in the period 2003-2010, improved to a small net gain in areas covered with dense forest in the period 2010-2014. Continued enforcement of the logging ban seems an important prerequisite for recovery of the forests.

3

There have been dramatic negative changes in coral reef quality in the period 2001-2010. The ecosystem condition account showed that coral reefs declined rapidly during that period. The number of coral reefs in good or very good condition declined from 9 to 1 in this period, and the coral reefs in poor or fair condition increased from 4 to 10 reefs. Loss of coral will have a number of consequences, including reduced fisheries production and potentially a reduction in the storm protection service of the coral reefs. These impacts cannot yet be assessed with the current ecosystem account.

4

Mangrove and seagrass ecosystems also showed a strong decline in ecosystem condition. Several potential causes can be identified including land conversion and logging. There is an urgent need to consider how mangroves can be better protected.

The accounts can support policy making in different ways.

First, they can inform policy makers of the status, uses and monetary values of ecosystems at the time a policy is designed. For instance, the account can indicate sensitive areas, or areas that are particularly important for supplying ecosystem services. This is relevant for the formulation of the new land use plan for Palawan in 2016. The accounts clearly show that water is a critical and scarce resource, for drinking water production and irrigation. The ongoing conversion of forests in uplands is reducing the water regulation service of the forests and forest degradation has already affected the island's potential to grow paddy. Hence, forests should be protected both to maintain water supply and to reduce sedimentation of coral reefs and seagrass fields and to protect fisheries around the island. The accounts also show that oil palm is not the most suitable crop for Palawan. Yields are low and because of the need for irrigation production costs are high compared to producers in Indonesia and Malaysia. Irrigating oil palm also uses scarce water at the expense of other water uses downstream.

Policy Implications and Recommendations

The declines in coastal ecosystems may be related to dynamite fishing and increased sediment loads in coastal waters. This points to a need to improve the management of run-off and drainage from the ore deposition site.

5

The forests of Southern Palawan are an important carbon sink. The total carbon stock contained in these forests declined from 15.6 million ton C in 2003 to 9.4 million ton in 2014. The decrease can be attributed to the decrease in the area and volume of closed forest and the wide-range conversion of closed forest to other land cover. There is also important sequestration of carbon in the forests. The annual sequestration of carbon is about 4.6 ton CO_2 per ha in closed forest while in open forest this is 4.9 ton CO_2 per ha. Sequestration is generally higher in open forest because the mean annual increment of wood in these forests is generally higher since forest growth tends to slow down in established forests.

6

The forests of Southern Palawan are important to maintain water supply to irrigated paddy fields Water is a main concern of farmers, but part of the Pulot irrigation scheme is not used for cropping because of insufficient water. Cutting the forests reduces water supply to the irrigation scheme because without forest cover rainwater is very rapidly drained from the watershed. The accounts show that if the forests upstream of the irrigation scheme were lost, paddy production in the irrigation scheme would drop by around 17%. Given the continuous threat of illegal logging and illegal land conversion, this requires continued attention from policy makers.

7

There are important trade-offs in ecosystem management in Palawan, and these can be revealed through an ecosystem accounting approach. There are important trade-offs in land and resource management, as elicited in the ecosystem accounts. The accounts also show that it is paramount to safeguard the remaining forests of Palawan. The potential of the forests to provide other ecosystem services, in particular ecotourism (mountain biking, hiking), could be explored.

8

Second, the accounts can alert policy makers to trends in ecosystems and the services they supply. In some cases this may already have affected incomes of the people depending upon these ecosystems, in other cases this information can be used to forecast potential future impacts. For instance, in case the underlying ecosystem condition and capacity to generate services is deteriorating, but the actual supply of services is not (e.g. because of increases in harvest efforts). By monitoring trends in ecosystems over time, they can also provide information on the effectiveness of specific policies. In this context, it should be one of the top priorities of policy makers in Palawan to stop dynamite and cyanide fishing given the major economic and environmental damages this fishing methodology causes.

A particular feature of the accounts is that they make information available in an aggregated and coherent way. The accounts include information that is usually dispersed in different agencies and line ministries, hence leading to easier access to an integrated dataset and new insights resulting from consolidating these data.

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Facilitated by the World Bank, Wealth Accounting and the Valuation of Ecosystem Services is a global partnership that aims to promote sustainable development by ensuring that the national accounts used to measure and plan for economic growth include the value of natural resources.