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Potential of a Forestry Carbon Project for the Magbukun Ayta of Bataan, Philippines

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ABSTRACT

The paper discusses the potential of developing a forestry carbon project for the Magbukun Ayta, an indigenous cultural community in the Philippines. The feasibility of the forestry carbon project was evaluated based on technical, financial and social aspects. The results of the feasibility analysis reveal that developing a forestry carbon project for the Magbukun Ayta of Kanawan, Morong, Bataan is technically and financially feasible.

The projected carbon loss in the ancestral domain due to possible deforestation in the old growth forest is a lot higher than expanding second growth forests and brushlands, thus creating an excellent opportunity for the community to be engaged in a forestry carbon project. The NPV and IRR at the most conservative conditions (i.e., high scenario, price of USD 5 t CO_2^{-1}, and 20% discount rate) are PhP70.728 million (about USD 1.61 million) and 27%, respectively, which show that the forestry carbon project is financially viable.

The Magbukun Ayta have also expressed in a resolution that they are amenable to the possibility of being involved in a PES project, specifically on the carbon sequestration potential of their forests, making the forestry carbon project socially acceptable. Likewise, the community's experience with implementing projects and contracts and benefit–sharing and conflict resolution mechanisms place the community in an advantageous position to implement this project. Thus, the project is socially feasible and acceptable. It is therefore recommended that the Magbukun Ayta engage in a forestry carbon project under the voluntary carbon market mechanism.

Keywords: carbon sequestration, feasibility analysis, forestry carbon project, Magbukun Ayta

INTRODUCTION

Philippine forestlands produce many ecosystem services, including carbon benefits. While some forestlands are being managed for industrial timber production, some have been placed under other forms of management, such as community–based forest management. The rights of indigenous peoples (IPs) over their ancestral lands are also recognized under the Indigenous Peoples' Rights Act (IPRA), many IP groups have formalized their claims through a Certificate of Ancestral Domain Claim (CALC) as a prelude to a Certificate of Ancestral Domain Title (CADT).

The Magbukun Aytas are an indigenous tribe living in the Bataan Natural Park (BNP). The Park is one of the 10 priority reserves of the Conservation of Priority Protected Areas Project (CPPAP) that was implemented with funds from the Global Environment Facility (GEF) through the World Bank (Forest Peoples Program 2008). The BNP covers 23,688 ha of land that fall under the jurisdiction of the municipalities of Hermosa, Samal, Orani, Abucay, Bagac, Balanga, and Morong in the province of Bataan.

In 2004, the Magbukun Aytas of Kanawan, Morong applied for a CADT for a 10,000–ha area that straddles the Morong and Subic Freeport Zone parts of BNP. The Aytas were also able to get funds from the Philippine Tropical Forest Conservation Foundation (PTFCF) to do ecorestoration work in about 1,500 ha of forest in the BNP. Under the project, the Aytas did an inventory of plants and conducted monitoring activities in their ancestral land, raised tree seedlings in community nurseries and backyards, and used indigenous forest trees for ecorestoration of forest gaps/denuded areas. The Aytas frown on monoculture of trees in the forest because monoculture conflicts with their concept of a natural or indigenous forest. From their point of view, ecorestoration should involve planting an assortment of trees found in BNP, particularly those that provide food for the birds, wild boars, bees, and other animals of the forest. The Aytas also planted fruit trees and vegetables within the 277 ha Kanawan Negritos Reservation Area (KNRA) for alternative livelihood activities based on non–timber forest products (NTFPs). Most of the seedlings raised in nurseries were used in reforesting the project area, but the Aytas have been selling seedlings of forest trees for additional income after the project period.

The funds that the Aytas receive for projects, such as the PTFCF project, are for a specific period of time and are therefore not sustainable. Although empowerment of the Aytas through the PTFCF project has significantly increased the income of Kanawan Aytas, the increase was just enough to bring up their economic status from way below the extreme poverty level to the boundary of extreme and moderate poverty levels. Definitely, they need funds to allow them to conserve and manage their ancestral land, which is under constant threat. Moreover, the Aytas need support to build their capacity to manage their ancestral land, particularly the technical know–how and the administrative and legal aspects. All these require substantial funds, which the Ayta community may not have at present.

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Thus, there is a need to explore possible mechanisms to raise funds for the Ayta community that would not only provide the Ayta with incentives to conserve and manage their ancestral land, but also build up their capacity to manage their natural and social assets. Aside from the seedlings and NTFPs that they have started to sell, the potential of selling some ecosystem services, particularly carbon, should be explored.

The atmosphere for involving indigenous and other local communities in carbon projects has become more conducive with REDD+ (Reducing Emissions from Deforestation and Forest Degradation, Conservation of forest carbon stocks, Sustainable management of forests and Enhancement of forest carbon stocks). The REDD+ strategy aims to create a financial value for the carbon stored in forests, and offers incentives for developing countries to reduce their emissions from forested lands and invest in low–carbon paths to sustainable development (http://www.un-redd.org/). During the United Nations Climate Change Conference held in Copenhagen in December 2009, the importance not only of reducing emissions from deforestation and forest degradation, but also the need to enhance the forests' capacity to remove greenhouse gases was recognized. Thus, "REDD+" came about, which addresses concerns about deforestation and forest degradation, as well as the role of conservation, sustainable management of forests, and enhancement of forest carbon stocks (Harvey *et al*. 2010).

This study sought to evaluate the feasibility of a forestry carbon project based on technical, financial and social aspects.

METHODOLOGY

To evaluate the technical feasibility of the forestry carbon project, the following activities were undertaken:

a. identification of the causes of land use change, degradation and deforestation through time;
b. estimation of carbon and potential carbon benefits, which involved the determination of land use change in the past 15 years, estimation of carbon losses, and estimation of carbon benefits with and without the project using carbon density values from previous studies; and
c. projection of carbon benefits through time.

The study made use of secondary data (e.g. maps, satellite images, results of studies on carbon stock assessment) and primary data (e.g. information provided by community members during the community mapping and other activities). Due to time and financial constraints, the authors were not able to ground truth the maps and satellite images used in the study. Instead, validation was undertaken in consultation with knowledgeable community members.

The community was asked to identify the area covered by their ancestral domain on the map and indicate the condition of various areas, specifically with respect to original and current land uses, drivers of land use change, areal extent, and impacts on the environment, among others. Changes in land use and land cover in terms of vegetated and non–vegetated areas were estimated using Landsat ETM+[1] images from two time periods, 1976 and 2001. The values were then expressed in terms of change in vegetation density. These, in turn, were used to determine the amount of carbon gain or loss over time of the ancestral domain. Carbon contained in each land use was derived by multiplying the area covered by such land use with the biomass density and percent carbon. Biomass density values used were those derived from the previous studies conducted in the Philippines (Lasco and Pulhin 2009).

The financial feasibility of the forestry carbon project was evaluated by comparing the costs of implementing the project with the potential carbon benefits. The carbon benefits considered in the analysis are already net benefits, and were derived using with– and without–project analysis. Two scenarios were used in estimating carbon benefits. The high scenario assumed that all the old growth forests would be protected, 80% of the second growth forests would be enriched, and 50% of the brushlands would be reforested. Under the low scenario, enrichment planting would be undertaken in 50% of the area covered by second growth forests, and reforestation would be done in 20% of the area covered by brushlands. Similar to the high scenario, all the old growth forest would be under protection in the low scenario. The net present values (NPV) of the forestry carbon project at different prices t CO_2^{-1} (i.e. USD 5, USD 10 and USD 20 t CO_2^{-1}) and for both scenarios were computed using discount rates of 10%, 15%, and 20% over a 30–year period. The prices t CO_2^{-1} used in the financial analysis are within the range of current world carbon prices. The World Bank Carbon Pricing Watch (2015) reports that carbon prices are at historically low levels. In Kazakhstan, for example, the average Emissions Trading Scheme (ETS) allowance price was USD 2 t CO_2^{-1}, while the carbon tax in Chile (2014) and Portugal (2015) was USD 5 t CO_2^{-1}. The carbon tax in British Columbia, Canada remains at its 2012 level of USD 25 t CO_2^{-1}. The IRR were likewise computed.

The readiness of the community to implement a forestry carbon project was evaluated by assessing the indigenous system of governance through consultation meetings, key informant interviews, focus group discussions, review of the community Ancestral Domain Sustainable Development and Protection Plan (ADSDPP), and literature review. Two consultation meetings were held. The first was in February 2011, which was attended by 13 community members, and where the team presented the project concept. The community members who attended the first meeting echoed the matters taken up with other community members. This paved the way for the team's presentation to the General Assembly of the Magbukun Ayta in April 2011, which was attended by 39 community members, including the Tribal Chieftain. The results of the technical and financial assessments were presented to the community in July 2011 to determine the acceptability of the forestry carbon project.

RESULTS AND DISCUSSION

Technical Feasibility

During the community mapping process, the participants were first oriented on the map (Figure 1) and its features by asking them the question "What can you find in the area?" A preliminary set of features was collected from the ADSDPP as shown in Table 1. The participants then assigned appropriate

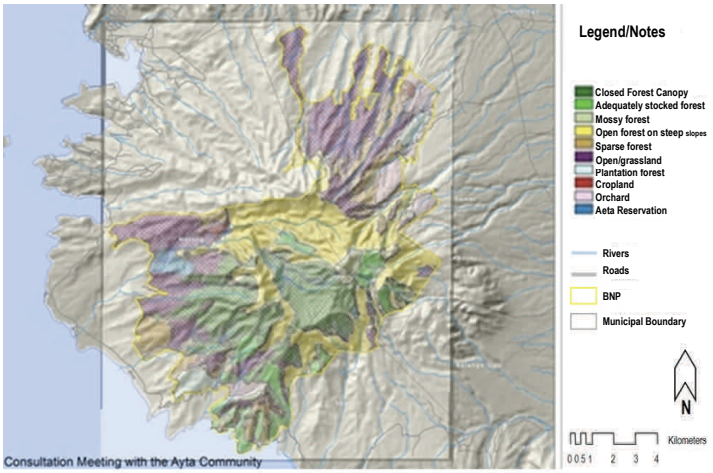


Figure 1. Map of the ancestral domain of the Magbukun Ayta before the community mapping exercise.

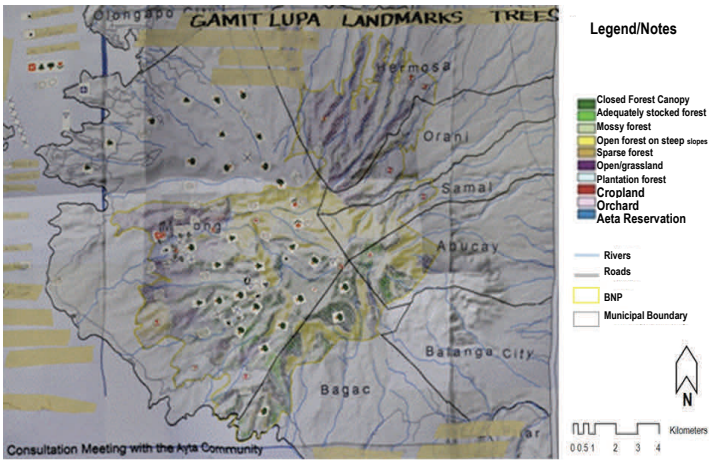


Figure 2. Map of the ancestral domain of the Magbukun Ayta after the community mapping exercise.

symbols to represent land use, landmarks, and other points of interest, and placed these symbols on the map. The result was an updated map showing the current features (Figure 2). The boundary of the ancestral domain extends toward the west inside of the Subic Bay Management Authority (SBMA). This follows the Boton River and the administrative boundaries between Morong and the adjacent towns of Orani, Samal, Abucay, and Bagac.

Estimating Land Use Change

Land use and land cover changes were estimated using Landsat ETM+ images from two time periods, 1976 and 2001, and expressed in terms of change in vegetation density. The image processing techniques available vary depending on the purpose of the study. For land use and land cover change, Normalized Diffference Vegetation Index (NDVI) provides a quick estimate. NDVI is a ratio–based comparison of Red and Near–Infrared bands to represent vegetation density. Studies show that the Red and Near–IR bands are most sensitive to vegetation and thus ideal for estimating the amount of vegetation (Baret & Guyota 1991).

Table 1. Land use, land marks, points of interest, and important trees in the ancestral domain of the Magbukun Ayta, Morong, Bataan, Philippines.

Land Cover/ Use	Landmark	Important Tree*
Forest	Hanging foot bridge	Almaciga *(Agathis philippinensis)*
Agricultural farm	Bisay falls	Banaba (*Lagaerstroemia speciosa)*
Cogon grass	Snake trail	Binukao *(Garcinia binucao)*
Charcoal kiln	Mt. Silanganan peak	Lanas bundok**
Coffee plantation	Mt. Sta. Rosa peak	Tangisang bayawak *(Ficus variegata)*
Hunting area	Mt. Natib peak	Tibig *(Ficus nota)*
Gathering area	*Bulbophyllum dearei* Reich	Uai**
Gasak (rainfed farms)		
Irrigated rice		

**The Magbukun Aytas consider these trees important as they use them as markers*
***The team was not able to collect specimens for identification of these tree species, thus only the common names are provided*

The choice of the year stamp of the satellite image depended on the cloud cover. In this case, the data from 1976 and 2001 had the least cloud cover and thus allowed comparison. Moreover, the difference in time period was far enough, enabling carbon stock comparison. Due to lack of time and resources, it was not possible to undertake a comprehensive ground validation of the image processing. Alternatively, the results of the community mapping exercise were used to validate the land cover change analysis (Figure 2). The results of image processing generally agreed with the community's inputs.

Results showed a decrease in vegetation density between the two periods (Table 2 and Figure 3). An increase in area (ha) for vegetation density of less than 70% was observed. On the other hand, vegetation density of above 70% registered a decline from 6,973 ha to 5,540 ha or a decrease of about 20.6%.

Carbon of Ancestral Domain under Current Land Use

The amount of carbon gain or loss over time of the ancestral domain was estimated based on the rates of change of the different land cover types using the land cover data for 1976 and 2001. Results show that land with more than 70% cover annually decreased by 0.82% while lands with more than 40–70% cover and less than 40% cover increased yearly by 1.91% and 2.26%, respectively. Using these rates of change, areas

Table 2. Vegetation density (in %) between 1976 and 2001 (in ha) in the ancestral domain of the Magbukun Ayta, Morong, Bataan, Philippines.

Year	Bare	<20%	>20 – <40%	>40 – <70%	>70%	Total
1976	5	492	552	1,753	6,973	9,775
2001	115	538	990	2,592	5,540	9,775

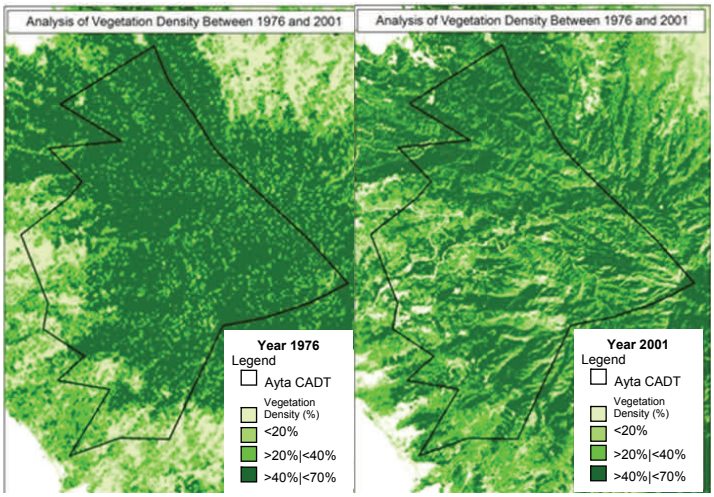


Figure 3. Analysis of vegetation density between 1976 and 2001 in the ancestral domain of the Magbukun Ayta, Morong, Bataan, Philippines.

covered by each land use were estimated over a 30–year period (2011–2040), the proposed project lifetime. Land with more than 70% canopy cover, which covered 5,100 ha in 2011, is expected to decline to 4,014 ha by year 2040. The more than 1,000 ha that would be lost in this land cover type is assumed to be converted into lands with 40–70% cover and those with less than 40% cover. Thus, land with 40–70% cover, having 2,848 ha in 2011, would increase to 3,484 ha by 2040; land with less than 40% cover, which was 1,825 ha in 2011, is expected to expand to 2,276 ha by year 2040.

Using these values, biomass loss through time was estimated by multiplying the area of a land cover type with its biomass density value. For land with more than 70% cover, the biomass density used was that of the old growth forests (445 t ha^{-1}); for the lands with 40–70% cover, the carbon density value of second growth forest (207.9 t ha^{-1}) was used. Lands with less than 40% cover were assumed to be areas with shrubs; hence the biomass density of brushlands (30.8 t ha^{-1}) was used. Corresponding carbon present in the different land cover types was calculated by multiplying the biomass with 45%, which is the average carbon content value for Philippine forests based on studies conducted.

Results show that over time, carbon loss in old growth forests is primarily due to deforestation (Figure 4). Old growth forests (land with 70% cover) are being converted into second growth forests (40–70% cover) and brushlands (<40% cover). From a total of 1.02 million tons in 2011, the carbon contained in old growth forests is expected to be reduced to 0.804 million tons by year 2040. Carbon lost by old growth forests is carbon gained by brushlands and second growth forests. From 0.025 million tons in 2011, carbon present in brushland is expected to increase to 0.031 million tons in year 2040. In second growth forests, carbon is also expected to increase from 0.27 million tons in 2011 to 0.325 million tons in 2040. Overall, however, there will be carbon loss in the ancestral domain because the biomass density value of the land cover type (old growth forest) that is being lost over time is a lot higher than the expansion of second growth forests and brushlands. From 1.31 million tons in 2011, carbon contained in the ancestral domain is estimated to drop to around 1.16 million tons by 2040.

Carbon Benefits of the Proposed Forestry Carbon Project

To reverse the current deforestation trend in the ancestral domain, a forestry carbon project is proposed to be introduced in the area. The proposed project will have three components: reforestation, enrichment planting, and forest protection. Reforestation will be undertaken in the brushlands while enrichment planting and forest protection will be implemented in second growth and old growth forests, respectively. Two scenarios (high and low) were used in the analysis. Results show that without the project, the brushland would continue to be in a degraded state, and would sequester only a minimal amount of carbon. Under the high scenario, only 0.375 million tons of carbon would be contained in the brushlands; under the low scenario, the value goes down to around 0.15 million tons of

Community members during the participatory mapping activity.

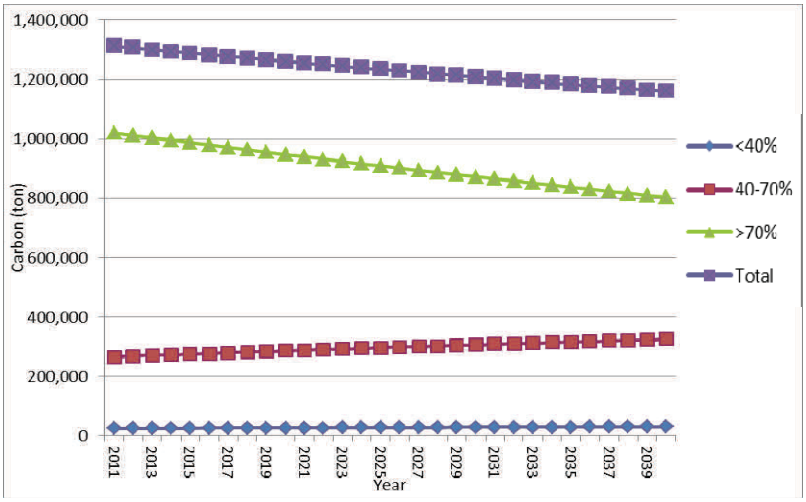


Figure 4. Carbon contained in the different land cover types over time (2011–2030).

carbon. With the project, however, the brushlands are expected to sequester around 1.01 million tons under the high scenario and 0.41 million tons under the low scenario. These values are around 2.7 times more than the amount of carbon sequestered by the brushlands without the project.

Similar to brushlands, second growth forests would remain in a degraded state without the project. Second growth forests are estimated to contain a total of 6.4 million tons and 3.99 million tons of carbon under high and low scenarios, respectively. With the project, on the other hand, the values increase by around 1.4%, resulting in a total sequestration of 8.89 million tons under the high scenario and 5.57 million tons under the low scenario.

With regard to old growth forests, without the project these would continue to be unprotected from illegal logging and encroachment, resulting in a decline of the area coverage through time and, thus, carbon loss. Under both scenarios, there would be carbon loss of around 11% due to the decline of areas covered by old growth forests. However, once forest protection is put in place in old growth forests, carbon loss would be prevented and the forests' capacity as a carbon sink would be enhanced. At the end of the 30–year period, old growth forests are expected to sequester a total of 37 million tons of carbon under both scenarios.

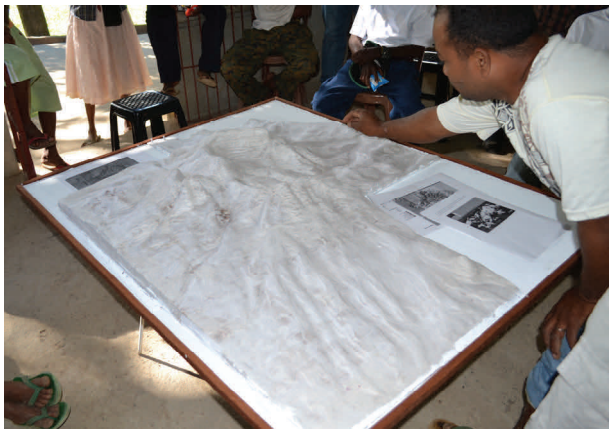
In terms of total net carbon benefits, the project under the high scenario is expected to bring a total of 6.836 million tons of carbon or 25.067 million tons of CO_2e for the 30–year period. Under the low scenario, total carbon benefit would be around 5.527 million tons of carbon or 20.264 million tons of CO_2e.

Financial Feasibility

The costs of implementing the carbon forestry project were compared with the potential carbon benefits. These costs are for reforestation, enrichment planting and protection, and do not as yet include opportunity costs (i.e. in case the community's farming activities will be affected), transaction costs of bringing the carbon forestry project to fruition, and the costs of monitoring, and measurement, reporting and verification (M&MRV). Table 3 summarizes the costs that will be incurred for the different activities over the 30–year period, while Tables 4 and 5 show the costs and benefits of the project at different prices t CO_2^{-1} for the low and high scenarios, respectively. At USD 5 t CO_2^{-1}, the net benefits for years 1 to 5 will be negative, but will become positive from year 6 onward. At USD 10 and USD 20 t CO_2^{-1}, the net benefits will be negative at years 1 to 3 and years 1 to 2, respectively.

The net present values (NPVs) of the forestry carbon project at different prices t CO_2^{-1} and for both scenarios were computed using discount rates of 10%, 15%, and 20% (Table 6). As expected, the highest NPVs (PhP 3.647 million and PhP 3.310 million, respectively) will be realized for the highest price t CO_2^{-1} of USD 20 for both the low and high scenarios at 10% discount rate. However, the NPVs of the project under the low scenario at the three alternative t CO_2 prices and alternative discount rates are all higher than the NPVs under the high scenario. This is explained by the higher costs of the different project components under the high scenario, owing to the higher areas that will be subjected to reforestation and enrichment planting. The internal rates of return (IRR) of the project under the low scenario at the three alternative t CO_2 prices are likewise higher than their high scenario counterparts. Expectedly, the highest IRR would be attained at the highest tCO_2 price (USD 20). Still, even at the most conservative price of USD 5 t CO_2^{-1}, the NPVs at the highest discount rate of 20% for both the low and high scenarios are positive at PhP 77.446 million and PhP 70.728 million, respectively, indicating that the forestry carbon project is financially feasible.

At present, there are two carbon markets that exist: compliance carbon market (CCM) and voluntary carbon market (VCM). The CCM supports the Kyoto Protocol, where Annex 1 countries must implement program/s or policies that will lead to the reduction of GHG emissions. In addition to domestic actions, Annex 1 countries can meet their emission reduction targets through Emissions Trading (ET), Joint Implementation (JI), and Clean Development Mechanism (CDM). In the Philippines, there have



The 3D map of the Magbukun Ayta's ancestral domain before painting.

Table 3. Cost per year of different forestry carbon project activities (PhP).

Component	Year					
	1	2	3	4	5	6 Onward
Low scenario						
Reforestation	2,190,300	2,190,300	2,190,300	2,190,300	2,190,300	
Enrichment planting	5,697,800	5,697,800	5,697,800	5,697,800	5,697,800	
Protection	7,651,260	15,839,370	24,027,480	32,215,590	40,403,700	40,940,550
Total	15,539,360	23,727,470	31,915,580	40,103,690	48,291,800	40,940,550
High scenario						
Reforestation	5,475,600	5,475,600	5,475,600	5,475,600	5,475,600	
Enrichment planting	9,116,600	9,116,600	9,116,600	9,116,600	9,116,600	
Protection	7,651,260	16,260,045	24,868,830	33,477,615	42,086,400	43,043,925
Total	22,243,460	30,852,245	39,461,030	48,069,815	56,678,600	43,043,925

been several attempts to develop Afforestation/Reforestation (A/R) projects under CDM. However, none was successfully registered with the CDM Executive Board, thus no certified emissions reduction (CER) was issued. The main reasons for this are: 1) the small income from carbon credits cannot cover the cost of planting and maintenance; 2) high transaction costs; and 3) the Philippines has not yet submitted its definition of "forest", which is required prior to approval of project (Lasco *et al*. 2011).

On the other hand, carbon sequestered by a forestry project can be sold in a voluntary carbon market. An advantage of the VCM is that it does not need to comply with any legal binding caps; thus, any institution, business, or individual can offset its emissions through financing forestry projects (Lopes 2009). In the Philippines, two forestry carbon projects in the provinces of Quirino and Cagayan have passed the VCM standard, both of which were developed by Conservation International. The Quirino project covers 13,457 ha of Community–based Forest Management Agreement (CBFMA) farms. It is funded by More Trees, and targets to generate 18,000 t CO2e (Pasion 2009).

The Peñablanca project in Cagayan has a total area of 2,500 ha. Funded by Toyota Motors Corporation in Japan, the project aims to generate 362,000 t CO2e (Duya 2009). The Magbukun Ayta can explore the VCM for its forestry carbon project.

Social Feasibility and Acceptability

This aspect looked into how the community implements projects, its benefit sharing and conflict resolution mechanisms, the members' familiarity with PES, the acceptability of a forestry carbon project, the community's experience with contracts, and whether contracts are compatible with the community's cultural values and practices.

Management Structure

The Magbukun Ayta have already developed their ADSDPP with funding support from the World Bank and the Japan Social Development Fund, and assistance from the Department of Agrarian Reform, NEDA, National Commission on Indigenous Peoples (NCIP), and Philippine Rural Reconstruction Movement, among agencies and organizations. The Magbukun Ayta's ADSDPP reveals that they already have a management structure, policies, and mechanisms for the implementation of the community's programs and projects (DAR and NCIP n.d.). The political structure of the Magbukun Ayta (Figure 5) shows that the community is divided into three levels: *Pangkatutubong Kapulungan* (Indigenous General Assembly), *Konseho ng Matatanda* (Council of Elders), and *Pamunuan ng Tribo* (Tribal Council). The *Pangkatutubong Kapulungan* is the highest decision–making body and is composed of all members of the community.

The responsibility to administer, implement, and supervise the community's programs and projects lies with the *Pamunuan ng Tribo* in coordination with NCIP. The Tribal Council and Council of Elders consult the *Pangkatutubong Kapulungan* for any development, decision, or policy that will be conducted, made, or implemented in the community. The general assembly meets quarterly, every last Saturday of the third month. The General Assembly proceeds with its meetings if 60% of the members are present. A community agreement is reached if at least 90% of the community members support the decision. Members who are absent when a decision is made are expected to abide and respect the agreement, provided they are informed of it. To ensure continuity, newly– elected officers are expected to abide and respect the agreements made by the community before their term. On the other hand, the Magbukun Ayta allow only legitimate members of the community to participate in the decision–making process.

Table 4. Benefits and costs of the forestry carbon project, low scenario (PhP).

	Carbon Benefit (PhP, USD 1:PhP 44)				Net Carbon Benefit (PhP, USD 1:PhP 44)		
Year	USD 5 t CO_2^{-1}	USD 10 t CO_2^{-1}	USD 20 t CO_2^{-1}	Total Cost (PhP)	USD 5 t CO_2^{-1}	USD 10 t CO_2^{-1}	USD 20 t CO_2^{-1}
2011	–3,185,937	–6,371,875	–12,743,749	15,539,360	–18,725,297	–21,911,235	–28,283,109
2012	5,287,935	10,575,869	21,151,739	23,727,470	–18,439,535	–13,151,601	–2,575,731
2013	14,577,299	29,154,598	58,309,197	31,915,580	–17,338,281	–2,760,982	26,393,617
2014	24,674,903	49,349,806	98,699,611	40,103,690	–15,428,787	9,246,116	58,595,921
2015	35,579,779	71,159,559	142,319,118	48,291,800	–12,712,021	22,867,759	94,027,318
2016	46,476,461	92,952,922	185,905,843	40,940,550	5,535,911	52,012,372	144,965,293
2017	57,369,874	114,739,749	229,479,497	40,940,550	16,429,324	73,799,199	188,538,947
2018	68,259,920	136,519,839	273,039,679	40,940,550	27,319,370	95,579,289	232,099,129
2019	79,150,663	158,301,326	316,602,651	40,940,550	38,210,113	117,360,776	275,662,101
2020	90,040,713	180,081,427	360,162,854	40,940,550	49,100,163	139,140,877	319,222,304
2021	100,931,789	201,863,578	403,727,157	40,940,550	59,991,239	160,923,028	362,786,607
2022	111,823,745	223,647,490	447,294,980	40,940,550	70,883,195	182,706,940	406,354,430
2023	122,716,295	245,432,590	490,865,179	40,940,550	81,775,745	204,492,040	449,924,629
2024	133,609,095	267,218,191	534,436,382	40,940,550	92,668,545	226,277,641	493,495,832
2025	144,422,562	288,845,124	577,690,247	40,940,550	103,482,012	247,904,574	536,749,697
2026	154,917,475	309,834,950	619,669,899	40,940,550	113,976,925	268,894,400	578,729,349
2027	165,413,424	330,826,848	661,653,696	40,940,550	124,472,874	289,886,298	620,713,146
2028	175,911,604	351,823,208	703,646,416	40,940,550	134,971,054	310,882,658	662,705,866
2029	186,411,469	372,822,938	745,645,877	40,940,550	145,470,919	331,882,388	704,705,327
2030	196,912,406	393,824,812	787,649,623	40,940,550	155,971,856	352,884,262	746,709,073
2031	207,413,855	414,827,710	829,655,420	40,940,550	166,473,305	373,887,160	788,714,870
2032	217,916,994	435,833,988	871,667,975	40,940,550	176,976,444	394,893,438	830,727,425
2033	228,419,422	456,838,844	913,677,688	40,940,550	187,478,872	415,898,294	872,737,138
2034	238,922,343	477,844,686	955,689,372	40,940,550	197,981,793	436,904,136	914,748,822
2035	249,426,949	498,853,898	997,707,797	40,940,550	208,486,399	457,913,348	956,767,247
2036	259,930,858	519,861,716	1,039,723,432	40,940,550	218,990,308	478,921,166	998,782,882
2037	270,435,249	540,870,497	1,081,740,994	40,940,550	229,494,699	499,929,947	1,040,800,444
2038	280,937,743	561,875,486	1,123,750,971	40,940,550	239,997,193	520,934,936	1,082,810,421
2039	291,441,388	582,882,775	1,165,765,550	40,940,550	250,500,838	541,942,225	1,124,825,000
2040	301,943,715	603,887,429	1,207,774,858	40,940,550	261,003,165	562,946,879	1,166,834,308

Table 5. Benefits and costs of the forestry carbon project, high scenario (PhP).

	Carbon Benefit (PhP, USD 1:PhP 44)				Net Carbon Benefit (PhP, USD 1:PhP 44)		
Year	USD 5 t CO_2^{-1}	USD 10 t CO_2^{-1}	USD 20 t CO_2^{-1}	Total Cost (PhP)	USD 5 t CO_2^{-1}	USD 10 t CO_2^{-1}	USD 20 t CO_2^{-1}
2011	–8,587,124	–17,174,248	–34,348,496	22,243,460	–30,830,584	–39,417,708	–56,591,956
2012	1,173,421	2,346,841	4,693,682	30,852,245	–29,678,824	–28,505,404	–26,158,563
2013	12,375,189	24,750,378	49,500,757	39,461,030	–27,085,841	–14,710,652	10,039,727
2014	25,007,602	50,015,205	100,030,410	48,069,815	–23,062,213	1,945,390	51,960,595
2015	39,067,349	78,134,698	156,269,397	56,678,600	–17,611,251	21,456,098	99,590,797
2016	53,109,056	106,218,112	212,436,224	43,043,925	10,065,131	63,174,187	169,392,299
2017	67,140,431	134,280,861	268,561,723	43,043,925	24,096,506	91,236,936	225,517,798
2018	81,162,959	162,325,918	324,651,835	43,043,925	38,119,034	119,281,993	281,607,910
2019	95,181,704	190,363,408	380,726,817	43,043,925	52,137,779	147,319,483	337,682,892
2020	109,196,021	218,392,042	436,784,084	43,043,925	66,152,096	175,348,117	393,740,159
2021	123,208,131	246,416,262	492,832,525	43,043,925	80,164,206	203,372,337	449,788,600
2022	137,218,292	274,436,584	548,873,169	43,043,925	94,174,367	231,392,659	505,829,244
2023	151,226,546	302,453,092	604,906,183	43,043,925	108,182,621	259,409,167	561,862,258
2024	165,232,778	330,465,555	660,931,110	43,043,925	122,188,853	287,421,630	617,887,185
2025	179,240,204	358,480,408	716,960,816	43,043,925	136,196,279	315,436,483	673,916,891
2026	192,533,693	385,067,386	770,134,772	43,043,925	149,489,768	342,023,461	727,090,847
2027	205,826,841	411,653,682	823,307,364	43,043,925	162,782,916	368,609,757	780,263,439
2028	219,120,902	438,241,804	876,483,608	43,043,925	176,076,977	395,197,879	833,439,683
2029	232,415,392	464,830,784	929,661,568	43,043,925	189,371,467	421,786,859	886,617,643
2030	245,709,838	491,419,676	982,839,352	43,043,925	202,665,913	448,375,751	939,795,427
2031	259,003,690	518,007,380	1,036,014,760	43,043,925	215,959,765	474,963,455	992,970,835
2032	272,298,202	544,596,404	1,089,192,808	43,043,925	229,254,277	501,552,479	1,046,148,883
2033	285,591,042	571,182,084	1,142,364,168	43,043,925	242,547,117	528,138,159	1,099,320,243
2034	298,883,442	597,766,884	1,195,533,768	43,043,925	255,839,517	554,722,959	1,152,489,843
2035	312,176,634	624,353,268	1,248,706,536	43,043,925	269,132,709	581,309,343	1,205,662,611
2036	325,468,286	650,936,572	1,301,873,144	43,043,925	282,424,361	607,892,647	1,258,829,219
2037	338,759,674	677,519,348	1,355,038,696	43,043,925	295,715,749	634,475,423	1,311,994,771
2038	352,048,334	704,096,668	1,408,193,336	43,043,925	309,004,409	661,052,743	1,365,149,411
2039	365,337,412	730,674,824	1,461,349,648	43,043,925	322,293,487	687,630,899	1,418,305,723
2040	378,624,510	757,249,020	1,514,498,040	43,043,925	335,580,585	714,205,095	1,471,454,115

Table 6. Net present value (NPV) and internal rate of return (IRR) of the forestry carbon project at different prices t CO_2^{-1} and at the low and high scenarios.

Scenario	Net Present Value (PhP)*			IRR (%)		
	USD 5 t CO_2^{-1}	USD 10 t CO_2^{-1}	USD 20 t CO_2^{-1}	USD 5 t CO_2^{-1}	USD 10 t CO_2^{-1}	USD 20 t CO_2^{-1}
Low scenario				29	58	103
i=10%	650,782,274	1,649,535,250	3,647,041,203			
i=15%	223,340,520	678,172,309	1,587,835,888			
i=20%	77,445,801	323,082,478	814,355,831			
High scenario				27	46	69
i=10%	538,047,468	1,462,087,982	3,310,169,011			
i=15%	205,497,135	673,610,383	1,609,836,880			
i=20%	70,727,515	335,797,616	865,937,817			

**USD1:PhP 44*

The Council of Elders is composed of respected elder members of the community. The members are chosen by the community based on their credibility and wisdom and not through election. There is no definite number of members in the Council. Among the Council of Elders' duties is to serve as arbitrator in settling critical problems in the community. The Tribal Council administers, regulates, and implements the community affairs. It also formulates policies, rules and regulations, as well as screens, assesses, facilitates, and recommends programs and projects to the Council of Elders and General Assembly. The Tribal Council likewise represents the community in external affairs. The ADSDPP describes in detail the qualifications, role, duties, and responsibilities, including resignation and/or impeachment and replacement processes of different positions and committees in the Magbukun Ayta's organizational structure.

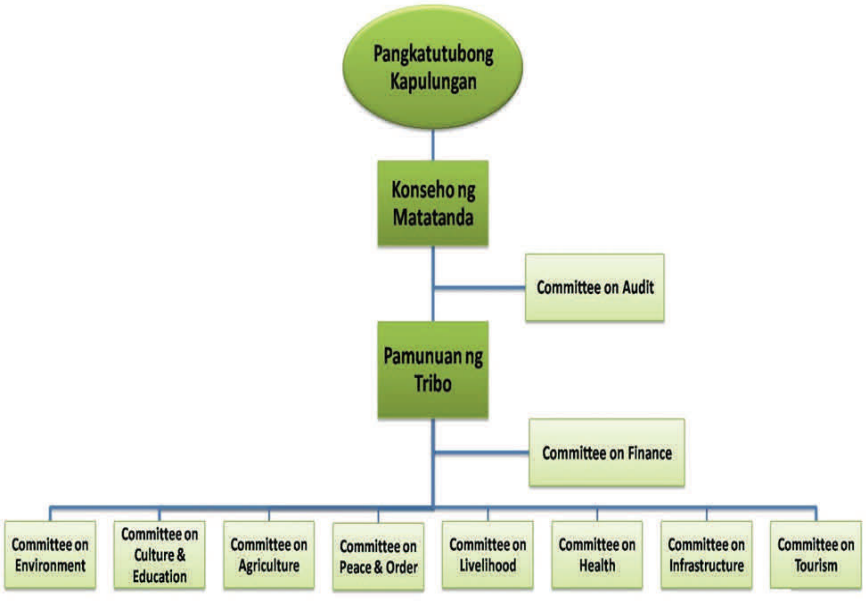


Figure 5. Organizational structure of the Magbukun Ayta.

Benefit Sharing and Conflict Resolution Mechanisms

As revealed in their ADSDPP, the community already has a benefit sharing mechanism, which is guided by the principles of equity and greatest number of beneficiaries possible. The community has been involved already in at least nine projects, one of them with foreign funding. In 2001–2002, the community had a project on commercial beekeeping. The proceeds from the sale of honey were divided among community members based on their inputs. Food–for–work is also practiced in the community.

The ADSDPP also contains the community's conflict resolution mechanism in the context of the Magbukun Ayta's customary laws. Conflicts among community members are usually resolved by the Tribal Council and community elders through amicable settlement where both parties are appeased and an agreement is arrived at.

Community's Familiarity with Payment for Ecosystem Services (PES)

When the community members were asked if they were aware about payments for ecosystem services (PES), one member answered in the affirmative. He described the potential of PES as *"manggagaling din sa gubat ang gagamitin natin para mapangalagaan ang gubat"* (what we need to conserve the forest will come from the forest itself). The community members were concerned that some of their practices may be affected if they will participate in PES, such as their traditional activities like hunting and honey gathering, where for the latter they have to cut

branches and burn leaves and twigs to smoke the bees out of their hives; their bonfires, where they discuss matters concerning the community; and their use of fire to warm their bodies in the morning and at night. The community also revealed that they have already been doing reforestation as part of their culture, e.g. they need to plant 15 to 20 seedlings for every tree they cut to use as house post.

Community's Experience with Contracts

Of the nine projects the community has been involved in since the 1990s, only one (1) project involved a contract. This project was implemented in three phases over a five–year period, with total funds amounting to PhP 6,000,000. Mostly, the members benefited from the project's food–for work scheme, for actively participating in the following activities: biodiversity inventory, development of a pictorial guide to the plants of Bataan National Park, collection of seeds and phenology data, establishment and maintenance of nurseries, enrichment planting in forest enrichment areas, planting of fruit trees in agroforestry areas, maintenance of forest restoration areas, conservation efforts, ecotourism and bird watching, monitoring and protection of the ancestral domain, zoning of the Kanawan Negritos Reservation Area (KNRA), establishment of a duck farm, production of non–wood forest products, information and education communication (IEC), capability–building, and protection of IP rights.

Acceptability of a Forestry Carbon Project

After deliberation, the Magbukun Ayta issued a resolution dated 1 July 2011 stating that they are amenable to the possibility of being involved in a PES project, specifically on the carbon sequestration potential of their forests. The resolution was signed not only by officers of the Tribal Council and Council of Elders, but also by 74 members of the General Assembly. The rate of deforestation can be reversed by providing Ayta with support and incentives to continue their efforts in ecorestoration and forest protection beyond the project that recently ended. For Magbukún Ayta, conservation of the forest in their ancestral domain is integral to the preservation of their identity and cultural heritage. Thus, the PTFCF project envisions the Ayta to continue on with their role as stewards of the forest for as long as they can sustainably maintain livelihood activities based on non–timber forest products and the sale of fruits and other crops from small farms within the 227–ha KNRA.

From 2005 to 2011, the income of Kanawan Aytas had increased from USD 0.47 per day per person (Motin *et al*. 2006) to the upper border of extreme poverty level or getting by at USD 1.25 per day per person. The improvement in economic status has come from the employment of more Aytas at the Subic Bay Freeport Zone (SBFZ), which according to the key informants, came after the Aytas asserted their IP rights on their ancestral domain that extends into a big portion of SBFZ. The Aytas of KNRA who are not employed go on with their traditional way of life as hunter–gatherers in the forest in addition to tending small farms in KNRA. Although the unemployed Aytas continue to monitor and to take care of the forest by spreading seeds and transplanting seedlings into forest enrichment sites as they hunt and gather NTFPs, persevering with the conservation effort remains a tall order for a community that remains at the border of extreme poverty. A big threat is the increasing encroachment into the Aytas' ancestral domain by informal settlers who compete with the Aytas for honey and cut trees for charcoal making. The proposed forestry carbon project can provide Ayta the means to increase their effort in performing their responsibilities and implementing strategies for forest protection, enrichment planting, and reforestation. The Ayta can undertake also other protective strategies to ensure symbiosis of community and the BNP.

CONCLUSIONS AND RECOMMENDATION

The results of the study revealed that developing a forestry carbon project for the Magbukun Ayta of Kanawan, Morong, Bataan is technically, financially and socially feasible and socially acceptable. Overall, there will be carbon loss in the ancestral domain because the biomass density value of old growth forest being lost through time is a lot higher than expanding second growth forests and brushlands.

The NPV and IRR at the most conservative conditions (i.e., high scenario, price of USD 5 t CO_2^{-1}, and 20% discount rate) are PhP 70.728 million and 27%, respectively, which show that the forestry carbon project is financially viable.

The project is also socially feasible and acceptable. The Magbukun Ayta already have their ADSDPP, as well as benefit–sharing and conflict resolution mechanisms, which will be important if they decide to pursue a forestry carbon project. The Magbukun Ayta have expressed in a resolution that they are amenable to the possibility of being involved in a PES project, specifically on the carbon sequestration potential of their forests.

The finished 3–D map of the Magbukun Ayta's ancestral domain with the community members and research team.

Based on the foregoing, it is recommended that the Magbukun Ayta engage in a forestry carbon project under the voluntary carbon market mechanism.

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[1]A joint initiative between the U.S. Geological Survey (USGS) and NASA. Landsat is a space–based moderate–resolution land remote sensing data suitable for agriculture, geology, forestry, regional planning, education, mapping, emergency response, disaster relief, and global change research.