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National Greening Program Assessment Project: Environmental Component - Process Evaluation Phase

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FINAL REPORT

NATIONAL GREENING PROGAM ASSESSMENT PROJECT: ENVIRONMENTAL COMPONENT – PROCESS EVALUATION PHASE

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LOS BANOS, COLLEGE, LAGUNA

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Executive Summary

The Philippine Institute of Development Studies (PIDS) of the National Economic Development Authority (NEDA) commissioned the conduct of the ***Impact Assessment Study of the National Greening Program (NGP) of the Department of Environment and Natural Resources (DENR)*** to assess the NGP process as implemented in the field and the environmental impacts.

The municipalities of Sta. Cruz in Zambales, Basilisa in Dinagat Island, and Hinobaan in Negros Occidental were randomly selected from all the NGP sites.

The methodology employed consisted of key informant interviews (KII) and focus group discussions (FGD) for the survey, mapping, and planning (SMP), assessment of capability building, plantation quality assurance, seedling production, planting, and protection and maintenance, and actual impact measurements on the ground through sampling.

Results showed that the required NGP processes were not fully complied with. However, the required survival rates of 85% were satisfied through replanting. The environmental impacts were gaining positive momentum through reduced temperature, soil build up, soil fertility, soil moisture, wildlife, stumpage build-up, and carbon sequestration. The NGP's potential to produce wood is envisaged subject to maintenance of the plantations. Impacts to disaster risk reduction and climate change fell short due to lack of a suitable design

Recommendations to further improve NGP implementation include conduct of a ful-blown SMP and FS, compliance to required processes and standards, inclusion of a reforestation access road, establishment of a CENRO-Suboffice right in the reforestation areas, linking reforestation to a business plan, capability building of reforestation partners, use the IST survival rate formula for further improving reforestation management, conduct forest restorability assessment prior to selection of target areas for reforestation, integration of the DRR and CCA/M design in the SMP, engage ERDB in species-site matching and other studies that support reforestation,and include the environmental indicators in the M&E of the NGP plantations.

Key Words: Reforestation, NGP, Survival Rates, Disaster Risk Reduction, Climate Change Adaptation/Mitigation.

I. Background

In 2011, the Department of Environment and Natural Resources (DENR) launched the National Greening Program (NGP). The NGP was created under Executive Order 26 in February 24, 2011 with a state policy of pursuing sustainable development for reducing poverty, ensuring food security, conserving biodiversity, and promoting climate change mitigation and adaptation in the forestry sector. To achieve these objectives, a multi-sector approach of reforestation is implemented. This approach involves upland and coastal communities, people's organizations (POs), civil society, local government units (LGUs), national government agencies (NGAs), state colleges and universities (SCUs), and the private sector.

The target area for reforestation totals to 1.5 million hectares of grasslands and brush lands, while other open areas will be planted with 1.5 billion trees of combined forest species and fruit trees nationwide. This area will be reforested for over a period of six years with a total budget of about more than 5 billion pesos.

Now on its fifth year of implementation, NGP needs 1.5 years more to complete its target of 1.5 million hectares. According to the records, the program had planted 128,558 hectares in 2011, 221,763 hectares in 2012, and 333,160 hectares in 2013, with a total of 683,481 hectares planted from this period.[1] Last year, 2014, it planted a total area of 321,532 hectares. For 2015 and 2016, its target is 300,000 hectares each year, respectively.[2]

While the area planted as reported achieved the yearly target, no records were published yet by the DENR on the actual survival rates of seedlings in the planted NGP sites. Moreover, while there is supposedly a third party monitoring and evaluation (M&E) to be undertaken according to the guidelines of the NGP, there has been no official M&E report yet on the survival rates and growth performance of the seedlings that were planted.

To implement the NGP on the ground, the Memorandum Circular (MC) 2011-01 (Guidelines of NGP) was formulated and enforced to define the roles of the partner-agencies of the DENR. Initially, the partner-agencies are the Department of Agriculture (DA), Department of Agrarian Reform (DAR), Department of Education (DepEd), Commission on Higher Education (CHED), and Department of Social Welfare and Development (DSWD).[3] The list was further increased to include the number of NGAs into the convergence initiative of the government in which the Department of Budget and Management (DBM), Department of Interior and Local Government (DILG), Department of Health (DOH), Department of Public Works and Highways (DPWH),

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[1] DENR NGP Website.

[2] http://ngp.denr.gov.ph/index.php/basic-configuration/site-administrator/ngp-accomplishment-report

[3] Paje RJP. 8 March 2011. *DENR memorandum circular 2011-01: guidelines and procedures in the implementation of the national greening program.* Quezon City, Philippines: Department of Environment and Natural Resources. A PDF file. Retrieved 18 December 2014 from http://www.rainforestation.ph/news/pdfs/NGP%20PDFs/MCNo2011-01_Philippines_08Mar2011.pdf.

Department of Transportation and Communications (DOTC), Department of National Defense (DND), Department of Justice (DOJ), Department of Science and Technology (DOST), National Commission on Indigenous Peoples (NCIP), Technical Education and Skills Development Authority (TESDA), Philippine Amusement and Gaming Corporation (PAGCOR), government-owned and controlled corporations (GOCCs), LGUs, and SCU are included.[4]

Considering the huge budget of the NGP and the absence of a physical audit of the NGP plantations from a third-party evaluation, the Philippine Institute of Development Studies (PIDS) of the National Economic Development Authority (NEDA) recognizes the importance of investigating the impacts of the NGP forests to provide some answers to the questions of the public regarding the performance of the NGP and to find out ways that may further improve policies and implementation and management mechanism of reforestation program in the country.

Hence, this project on the impact assessment of the NGP. This project is composed of four (4) components: a) environmental impact study that will assess and evaluate the processes and impacts of the NGP to building up forests, conserving biodiversity, making disaster risk areas resilient, and ensuring NGP compliance to climate change in order to achieve environmental stability; b) social impact study that will assess and evaluate the NGP-related social processes and impacts to food security and to find out ways how to ensure attainment of social development objectives relative to the NGP; c) economic impact study that will assess and evaluate the NGP-related economic processes and impacts on income generation and livelihood of the communities so as to reduce poverty and to find out ways on how to optimize the economic benefits from the NGP; and d) institutional impact study that will assess and evaluate the NGP-related institutional processes and impacts to implementation arrangements among partners and to find out ways on how to further improve linkages to attain an effective institutional mechanism supportive of reforestation effort of the government.

The present component, the environmental impact study, will present how it will attain its objectives of assessing and evaluating the processes and impacts of the NGP.

II. Description of the Environmental Impact Component: Process Evaluation

1. Objectives

The overall objectives of the Environmental Component of the NGP assessment were to:

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[4]Aquino BS III. 24 February 2011. *Executive order 2011-26: declaring an interdepartmental convergence initiative for a national greening program.* Malacañang Palace, Manila, Philippines: Official Gazette of the Republic of the Philippines 106 (23). Retrieved 18 December 2014 from http://www.gov.ph/2011/02/24/executive-order-no-26-2/. 3195p.

1. Validate the survival rates and growth performance of the NGP forest plantations under different site conditions, and assess whether NGP could contribute to the forestation of the degraded uplands of the country and provide sustainable wood supply for the energy, furniture, housing, and other allied industries; and

2. Assess its impacts in improving on-site and off-site environmental conditions in terms of soil build up, water recharge, impact to disaster risk reduction and climate change adaptation and mitigation (DRR-CCA/M) objectives; and biodiversity enrichment.

For Phase 1, the primary objective of the project was to conduct a scoping and process evaluation of the NGP in selected provinces.

The secondary objectives are to:

1. Assess and evaluate the relevant processes that were or are being used in the different activity components of the national greening program of the DENR at different levels;

2. Assess and evaluate how the different forest establishment, protection and maintenance, and management activities were conducted by the NGP contractors at the site level; and

3. Determine the perception of non-NGP communities and NGP communities on the impacts of the NGP-established forests to the environment.

2. *Significance of the project*

The project will establish whether the NGP environmental objective of primarily restoring degraded/deforested forestland will achieve food security, minimize poverty, stabilize environmental condition, reduce soil erosion, biodiversity conservation, and uphold climate change adaptation/mitigation. Furthermore, the project will validate the survival rates and growth performance of the NGP forest plantations under different site conditions, and assess whether NGP could contribute sustainable wood supply for the energy, furniture, housing and other allied industries.

The Philippines will benefit from the environmental impact assessment and evaluation of the NGP in terms of the following potential contributions:

a. It will provide facts, information, and insights to policy makers on both the beneficial impacts (that should be further enhanced and sustained), and negative impacts (to be avoided) to the environment of similar reforestation[5] efforts of the government in the future. Such insights could be used for the formulation of new policies or further improvement of existing ones governing forest restoration of degraded forest ecosystem. Some of the potential policy contributions of the environmental component of the study are:

[5] Reforestation is interchangeably used in this report with forest restoration. Both terms have the same meaning in forestry parlance.

1) Before embarking on a national forest restoration program, a full blown in depth forest restorability assessment of all degraded forestland situated in every barangay may provide direction to the design of a national forest restoration program of the governments in the future. This will serve as a basis for the allocation of degraded areas for restoration using an optimal mix of forest land uses and for the allocation of funds. It will also be useful for the prioritization of forest restoration projects.

2) To fast tract reforestation with a realistic target, the barangays located in forestlands shall be trained in the establishment and sustainable management of forest and agroforest plantations under the guidance of the DENR. Assuming 50% of all the barangays in the uplands and coastal areas will be allocated 300 hectares to reforest in 6 years, that would mean 4.05 million hectares (45000 barangays * 30% (in upland and coastal only) * 300 ha.), 300 hectares spread over 6 years is only 50 hectares per year per barangay. This target is not difficult to plant in a year with a 3-month rainy season window.

3) Any reforestation program should be tied to a business plan where product development and marketing is an important component. This is necessary to make forest and agroforest plantation development and management sustainable. This will also make the livelihood of the people in the barangays sustainable.

4) To address climate change concerns, the planting of fast growing indigenous medium hardwood species suitable in degraded forestlands with the highest carbon content should be given priority in reforestation projects for planting. This may require nurse- crops during the first 3 years followed by indigenous medium hardwoods on the 3rd year. The nurse-crops will provide partial shades and soil nutrients to the newly planted species of medium hardwoods.

5) All areas above 50% slope must be planted with deep-rooted forest species for soil protection purposes. Harvesting of trees in these areas should not be allowed. Thus, addressing the concerns of DRR.

6) Existing forested areas must be protected and maintained. Such areas will provide planting materials such as seeds and wildlings to be used in the restoration of forest in degraded forestland. In fact through natural forest succession process, grasslands and brush lands may be reforested through regenerants from the forest. This is possible when birds, rats and other mammals and wind will eat the fruits of the forest and disperse them in the grasslands and brush lands. What is needed is on a protection of the regenerants.

b. Lessons learned from the management and technical aspects of reforestation that resulted in the best quality of forest plantations ensures the highest wood quantity and quality.

Such lessons could be used for the further improvement of forest restoration or reforestation techniques and management that will result in the most environmentally sound methods and practices of bringing back the forest cover of degraded forestlands.

c. Connecting the management and technical aspects of forest restoration to the environmental impact, economic impact, social impact and institutional impact of the NGP would result to better allocation of future forest restoration funds to the plantable sites, to the best suitable species, to the best practices of forest restoration and practices, to productive partners in the barangays and to social and civic organizations and other institutions that are supportive to attaining the objectives of forest restoration. Thus, achieving the targets through the most economical approach.

d. Planting the suitable areas with the right species that command high value, high positive environmental impact, high DRR impact and high CO2 sequestration capacity would minimize the cost of forest restoration with the highest possible monetary benefit. This will save a lot of government fund which could be used for other equally important projects of the government.

III. Review of Literature

1. Forest Land Use Change

The 2015 Revised Master Plan for Forestry Development[6] revisited the land use change in forest land. In 1575[7], the percent forest cover was 92% and in 2003, the forest cover was reduced to 24%. In a span of 428 years, the forest cover declined at an annual average of 47,429.91 ha. This reduction in forest cover has resulted in 20.3 million ha for several uses, two of which are for grasslands and brush lands.

Considering the land classification of the country into A&D and Forestland, where A&D is allocated 14,194,675 ha. And forestland is 15,805,325[8] ha., the area that needs to be reforested is less than 8,605,325 ha., taking into account non-plantable areas such as rivers, lakes and rocky mountains. Assuming that the net area of forestland is 7 million ha after deducting the areas of rivers, lakes and rocky mountains, and further subtracting the NGP-target areas of 1.5 million ha., the remaining area that would need reforestation in the future is 5.5 million ha. This estimate is an optimistic one considering a high survival rate in the 1.5 million ha NGP-planted areas.

2. General characteristics of degraded forestland

Imagine what an alternating wet and dry season in 428 years can do to the ground surface of sloping areas that have no permanent forest cover. The land cover types of such areas are grasses

[6] FMB DENR, 2015. Revised Master Plan for Forestry Development.

[7] ibid

[8] FMB-DENR PFS 2010

and brushes and its top soils are already thin due to soil erosion. The grassland's soil fertility is very low, its pH is acidic and deficit of nitrogen-phosphorous-potassium (NPK) and other important soil nutrients. Because the dominant land cover is grass, its organic matter is also low. Thus, soil carbon is also low. As time passes, the soil becomes more acidic, shallower and the soil depth where plants grow becomes thinner in soil layer and thinner in soil depth. With these soil characteristics, big trees can no long grow and survive. This is the reason why grasses such as cogon, talahib, shrub, and few pioneer species are the ones that grow. When big trees are planted, in most cases they die. This is one of the factors that contribute to difficulty in reforesting such areas resulting in low survival and poor growth performance of planted seedlings (Balangue, 2014)[9].

The other factor that had been hindering reforestation is the long dry season and short wet season in northern Luzon particularly in Ilocos region (R1), Cagayan valley region (R2) and Central Luzon region (R3)[10]. Long dry season means insufficient water for planted seedlings. Long dry season has two characteristics. First, from December to March, temperature is low from a range of 8.1-15.8 degrees Celsius[11], which further dries the moisture on the ground. Thus, depriving the seedlings with soil moisture that they need to survive and grow faster.

From April to June, the temperature becomes hotter[12] increasing to 30-37 degrees Celsius. This causes heat stress to the seedlings due to accelerated soil moisture evaporation. Both weather phenomena result in more mortalities of planted seedling. Reforestation is very much dependent on rainfall. Unfortunately, because of the narrow rainfall window, actual planting is limited to utmost two months and thus, restricting the extent of area to be planted. Also, it resulted in the death of seedlings planted early and late of the rainy season.

The problem on temperature is further aggravated by global warming and climate change. The regions' dry season in the past is now drier. It further lowered the temperature during coldest months and warmer during dry months with longer duration. In the dry regions, rainfall frequency is less than the normal rainfall but once it rains, the rainfall volume is very high to extremely high. The amount of rainfall usually poured monthly under normal climatic condition is poured in about 30 minutes to 12 hours during extreme rainfall events from 103.9 mm to 454.9 mm rainfall[13]. The wet regions, such as in the Visayas and Mindanao regions, extreme

[9] Balangue, T.O. 2014. Best Practices in Philippine Reforestation Using Indigenous Forest Species: Learning from the Field. Energy Development Corporation. Metro Manila.

[10] Thelma A. Cinco, Flaviana D. Hilario, Rosalina G. de Guzman and Emma D. Ares. October 1-2, 2013. Climate Trends and Projections In The Philippines. 12th National Convention on Statistics (NCS) at EDSA Shangrilla,

[11] Source: PAG-ASA. January 27, 2014

[12] Ibid

[13] http://en.wikipedia.org/wiki/Typhoon_Ketsana

rainfall events are more frequent with extremely high rainfall volume in about 30 minutes to 12 hours.[14]

While rainfall is important in reforestation to supply much needed soil moisture of seedlings, extreme rainfall events are mostly destructive causing moderate to heavy soil erosions to landslides in sloping areas. During typhoon Milenyo, second growth forest with more medium trees and few big trees were carried down by landslides during the typhoon in the western side of Mt. Makiling. With this experience, established forests through reforestation in sloping areas are highly vulnerable now to typhoons and extreme rainfall events.

The present ground characteristics of the grasslands, brush lands and other open areas that need forest restoration must be inputted to reforestation planning so that the desired survival rate could be achieved considering the very high investment in forest restoration.

3. Methods of Reforestation

1. Forest plantation approach

The common reforestation method used by government is the forest plantation approach. This requires the planting of single tree species in rows by block following a plantation pattern without any mixture of other tree species. Depending on the species and the objective of reforestation, the seedlings are planted following a given spacing of 1m x 1m, 2m x 2m, 2m x 3m for immediate cover and to reduce soil erosion and for watershed rehabilitations and 4m x 4m, 5m x 5m for timber production and for agroforestry5m x 5m to 10m x 10m with some variations[15].

Most government reforestation projects concentrated on the planting of fast growing exotic species in the past. The common species that were favorably planted were Mahogany, Gmelina, Mangium, Auriculiformis, Falcataria, and Ipil-ipil. In Mindanao, Bagras was also planted by the then PICOP. According to Baguinon (2013)[16], Mahogany is an invasive alien species dominating the species in areas where they were planted especially in Mt. Makiling although some foresters contested that if Mahogany is invasive, it would have already invaded most open areas adjacent to Mahogany plantations, which is not the case.

2. Nitrogen-fixing forest restoration approach

[14] Thelma A. Cinco, Flaviana D. Hilario, Rosalina G. de Guzman and Emma D. Ares. October 1-2, 2013. Climate Trends and Projections In The Philippines. 12th National Convention on Statistics (NCS) at EDSA Shangrilla,

[15] DENR Guidelines on reforestation in Loan 1 and some reforestation reports.

[16] N.T. Baguinon, M.O. Quimado and G.J. Francisco Country report on forest invasive species in the Philippines: The unwelcome guests. Proceedings of the Asia-Pacific forest invasive species ...
University of the Philippines, Los Baños, Forest Management Bureau, Department of Environment and Natural Resources (DENR) http://www.fao.org/docrep/008/ae944e/ae944e09.htm

Other approach to reforestation as reported by Balangue (2014)[17] is Combalicer (2005)[18] planting of nitrogen-fixing species mixed with non-nitrogen fixing species. The nitrogen-fixing species are native species of Erythrina variegata L., and Narra (Pterocarpus indicus Willd). The non-fixing species are Dao (Dracontomelon dao (Blanco) Merrille et Rolfe) and Dapdap (Bischofia javanica Blume). The idea is to plant first nitrogen-fixing species to enrich the soil with nitrogen and to provide partial shade to non-fixing species. E. variegata and Narra grew faster and fixed nitrogen better than the other non-fixing species. This means that E. variegata and Narra are better species for forest restoration. In terms of growth and physiological characteristics, those planted in the mountain area which has fertile and moist soil performed better than those in the plain area with dry soil. The same approach was experimented by Combalicer (2011)[19] by planting other exotic nitrogen-fixing species (Acacia auriculiformis A.Cunn. ex Benth., Acacia mangium Willd, and Pterocarpus indicus Willd.). The results showed that A. auriculiformis and A. mangium, are better than Narra in terms of surviving in adverse grassland condition and for serving as nurse crops. Further, a shade-demanding native species could be planted next to these species when the nurse crops have already attained an age that could provide sufficient shade to newly planted seedlings. From these experience, the forest restoration method that she recommended for use by the DENR is the planting first of nurse crops using nitrogen fixing species and then interplanting of shade-demanding native species after the nurse crops have already attained a wider canopy to partially shade the native species (Combalicer, 2014).

A parallel experience, in which the method of planting nitrogen-fixing species in an integrated fashion was used by the Mindanao Baptist Rural Life Center (MBRLC) (Palmer 1999).[20] The species to fix nitrogen were Ipil-Ipil, Falcataria, Kakawate, Calliandra tetragona, Calliandra calothyrsus, Leucaena diversifolia, Erythrina poeppigiana, Flemingia macrophylla, Desmodium rensonii, and Indigofera ani. These species performed well in survival and growth in the planted sites according Palmer (1999).

3. Accelerated pioneer and climax species (APCS) planting approach

[17] Balangue, T.O. 2014. Best Practices in Philippine Reforestation Using Indigenous Forest Species: Learning from the Field. Energy Development Corporation. Metro Manila.

18 Marilyn S. Combalicer*1, Don Koo Lee2, Su Yong Woo3, Yong Kwon Lee4 and Yun Ho Jang5. September 2005. Early Growth and
Physiological Characteristics of Planted Seedlings in La Mesa Dam Watershed, Philippines. Early Growth and Physiological Characteristics of
Seedlings. THE PHILIPPINE AGRICULTURAL SCIENTIST ISSN 0031-7454.Vol. 88 No. 3, 305 - 316

19 Dr. Marilyn S. Combalicer. Aug. 23, 2011. Planting exotic nitrogen-fixing species may improve forest restoration and rehabilitation. http://www.searca.org/index.php/knowledge-management/seminar-series/641-planting-exotic-nitrogen-fixing-species-may-improveforest-restoration-and-rehabilitation-study-says

20 Palmer, J. Jeff. (1999). Sloping Agricultural Land Technology (SALT): Nitrogen Fixing Agroforestry for Sustainable Soil and Water Conservation, A publication of the Mindanao Baptist Rural Life Center (MBRLC). ** p http://www.scribd.com/doc/20585279/NitrogenFixing-Agroforestry-for-Sustainable-Upland-Farming.

This method has not been officially used by the DENR in its forest restoration method. This method is based on the principle of forest succession stating that pioneer species will grow first followed by intermediate species and then finally the climax species. This method was tested in Vietnam (Nguyen Van So, nd)[21] by planting pioneer species, intermediate species and climax species in an integrated manner in a planting area. The pioneer species are: Indigofera *teysmanii*, Trema *orientalis*, Anthocephalus *chinensis*, Wrightia *tomentosa* etc.; the intermediate species: Dalbergia *cochinchinesis*, Xylia *dolabriformis*, Cassia *siamea* and Lagerstroemia *angustifolia;* the climax species: Dipterocarpus *alatus*, D. *dyerii*, Hopea *odorata*, Anisoptera *cochinchinensis.* Initial results were shortening of natural succession and enhancement of biodiversity. This has been tried in Vietnam and proved successful. Elliott, et. al (2002)[22] modified the APCS and named at the Species Framework Approach where the framework species are the pioneer and intermediate species and interplanted with climax species. This method was tested in degraded lands in Thailand where 37 native forest tree species acting as framework tree species planted in the degraded upper watershed in Doi Suthep-Pui National Park in northern Thailand. The tree density of 3125 per ha was used in 1998 and 1999. In this density all the best pioneer species, intermediate species and climax species are planted together.

4. Natural forest succession

Degraded forestlands undergo forest succession when forest gaps occur. Forest gaps encourage certain pioneer species to form a pioneer forest through the aid of seed dispersal agents such as birds, mammals and winds. Such pioneer species are short-lived and will be changed later by other species adapted to the changing conditions. The species that will take over the short-lived species are the seral species or intermediate species[23]. Long-lived species will eventually replace the short-lived ones forming a stable forest composition – the climax forest[24]. With forest

[21] Nguyen Van So, nd The Potential of Local Tree Species to Accelerate Natural Forest Succession on Marginal Grasslands in Southern Vietnam.

[22] Stephen Elliott, Puttipong Navakitbumrung, Cherdsak Kuarak, Sudarat Zangkum, Vilaiwan Anusarnsunthorn, David Blakesley. Selecting framework tree species for restoring seasonally dry tropical forests in northern Thailand based on field performance. Forest Ecology and Management 184 (2003) 177–191. ELSEVIER

[23] Seral species are vegetations between the pioneer species and climax species.

[24] Forest maintenance and succession. http://www.rainforestconservation.org/rainforest-primer/rainforest-primer-table-of- contents/f-forest-maintenance-and-succession/

succession, open lands, grasslands and brush lands can be restored through this approach as long as there are no further disturbances. What is needed therefore is to protect the areas that had been occupied by pioneer species until it is fully covered with climax species. The only problem with this approach is that it will take a long time to fully cover open lands, grasslands and brush lands. For forest succession to work in forest restoration, the following factors must be considered: a) Extent of the disturbed forest area (how large is the disturbed area?) this should be large enough for sunlight to reach the soil of the disturbed area; b) Degree of forest disturbances (partial clearing by tree or groups of trees, total clearing of trees and other vegetation to the ground?); c) Existence of coppicing species; d) Existence of residual species in the disturbed area; e) Species surrounding the disturbed area (How many seeding trees and how far they are located relative to the disturbed area?); and presence of seed dispersal agents available in adjacent undisturbed forest (birds, bats, animals, wind)?

4. Reforestation in other Countries

1. The Malay Experience

In Malaysia, agriculture and commercial logging are major forces in deforestation. However, unlike in other countries such as the Philippines (which started during colonization), it only started at the end of the 19th century wherein logged timber were entirely used for the country's development. In the 1970's, timber harvesting intended for conversion on other land uses such as plantation of oil palm were the main cause of large destructions reported in many studies. Shifting cultivation accounted for 50% deforestation while commercial logging and small-holder cultivation played the lesser roles (Brookfield, et.al. 1990; Collins, et.al. 1991; Repetto 1988)[25].

The reforestation process in Malaysia started in the 1980s where the Compensatory Forestry Project was implemented through the ADB loan. Unlike the other countries' experience in forest transition from net deforestation to net reforestation, Malaysia has a rather fluctuating forest areas thereby having a low deforestation rate with an annual change rate of -0.42% from 2005-2010 (Meridian Institute, 2009)[26].

2. Thailand experience

In 1998, Thailand's forest area decreased from 53.33% of its total land area to 25.13% (Charuppat, 1998; Lakanavichian, 2001)[27]; while in 1995, this was reduced to only 22.8 % of the

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[25] As cited by Wan Razali W.M and Mohd Shawadi H.O in "Transitions in Sustainable Forest Management and Rehabilitation in Malaysia. University Putra Malaysia.

[26] Ibid. Wan Razali W.M & Mohd Shawadi H.O. n.d.

[27] As cited by Lakanavichian S. 2006. *"Trends in Forest Ownership, Forest Resource Tenure and Institutional Arrangements: Are they contributing to better Forest Management and Poverty Reduction? A Case Study from Thailand."* Case Studies in South and East Asia

country's total land area. Jantakad and Gilmour (1999) (as cited by Lakanavichian, 2006)[28] reported an annual deforestation rate of 3.85 percent between 1976 and 1982, which was among the highest rates and the most rapid among tropical countries.

Reforestation started in 1906 where a teak plantation was established by the Royal Forest Department. However, the total land area reforested from 1906-2004 which is 1.07 million hectares were completely insignificant compared to the total deforested area of 10.76 million hectares from 1961-2004 (RFD, 2004)[29]. Even though reforestation was taking place, deforestation also continued at rates of about 2 to 2.6% every year (FAO, 1999)[30].

3. Indonesia experience

In a recent study by Margono and Potapov et.al (2014)[31], the annual primary forest loss in Indonesia was estimated to be higher than in Brazil in 2012. Indonesia had lost 840,000 hectares compared to 460,000 hectares in Brazil. This is alarming because Indonesia is now the major greenhouse gas producer, with 85% of its emission coming from forest destruction and degradation (Vidal, 2014)[32].

Numerous efforts have been done to reforest Indonesia which includes government efforts and private partnerships. In 2007, a $100 million project called the Kalimantan Forest and Climate Partnership was inaugurated by the foreign minister Alexander Downer of the Australian government; believing that the project would make a "very real and very practical contribution to improving our environment" yielding "immediate and tangible results." The plan was to plant 100 million trees and to rehabilitate 200 hectares of peatland and forests in Kalimantan until June 2012, but later was extended for a year. However, at the end of July 2012, there were only 2.5 million seedling raised in nurseries, which only constituted the 2.5% of the target. It was still then unclear how many of these seedlings were planted. With this, the Australian government aid agency, AusAID, decided to end the project, (Hamann, K., 2013)[33] making it a total failure.

Still, recently, it was reported that Indonesia's newly elected President Joko Widodo committed to reforest 2 million hectares of Indonesia's degraded land annually. The focus would be more on the country's highly degraded areas as suggested by a recent study led by Budiharta. Some

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[28] Ibid. Lakanavichian S. 2006.
[29] Ibid. Lakanavichian S. 2006.
[30] Ibid. Lakanavichian S. 2006.
[31] Margono, B.A., Potapov P.V. et. al. 2014. *Primary forest cover loss in Indonesia over 2000–2012.* Nature Climate Change.
[32] Vidal, J. 2014. *"Rate of deforestation in Indonesia overtakes Brazil, says study"*. The Guardian. http://www.theguardian.com/environment/2014/jun/29/rate-of-deforestation-in-indonesia-overtakes-brazil-says-study. Retrieved May 8, 2015.

[33] Hamann, K. 2013. *"Government ends AusAID reforestation program in Indonesia"* Posted July 2, 2013 in ABC News. http://www.abc.net.au/news/2013-07-02/government-ends-ausaid-reforestation-program-in-indonesia/4794554 retrieved May 11, 2015.

reforestation options include the Community-Based Programs and Ecosystem Restoration Concessions which are to be funded by private investments (Meijaard, 2014)[34].

4. Reforestation Techniques

In 1967 in Thailand, the Forest Industry Organization began to establish Forest villages to hasten reforestation efforts; with the "*taungya"* system being used as the primary reforestation method. In this method, tree saplings and agricultural crops are simultaneously planted until only the trees are left to complete reforestation (Combre, 1982 and Evans, 1982)[35]. Various combinations have already been tried since the establishment of the programme, which varies depending on the different climatic conditions in the country. Some examples include: teak combined with upland rice in the North, fast-growing trees with cassava in the Northeast, fast-growing trees with maize in the West and para-rubber or fast-growing trees with fruit trees in the South (Watanabe, H., Sahunalu, P., Khemnark, C., 1988)[36].

A study of Sardjono (1996)[37] showed that a traditional agroforestry system can be used to mitigate forest degradation. This type of agroforestry system is called the lembo system. The lembo system which was being practiced by the indigenous people of Barongtongkok Sub district of East Kalimantan involves traditional forest and domestic gardens. Most lembos are small, covering only 0.1 to 2.0 hectares depending on the number of families or group members using them. A plot of 0.25 hectares can already contain 40 different species, thus creating diversity. Ninety percent of these are trees while the other 10% are made up of palms, bamboos or lianas. The trees and woody plants dominating in this system belongs to families Anacardiaceae, Bombacaceae, Dipterocarpaceae, Euparbiaceae, Meliaceae, Moraceae, Sapindaceae, Palmae and Rubiaceae, with which most are indigenous species. Aside from ensuring ecological sustainability, there are also a lot of products which can be utilized out of the different species planted in the system, thus, also able to meet the people's needs.

A recent study in 2014 was conducted by Wasli, et.al[38] which was a preliminary assessment on the growth performance of *Dryobalanops beccarii* using the line planting technique.

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[34] Meijaard, E. (2014). *Indonesia's ambitious plan to reforest 2M ha annually*. The Borneo Iniatives. http://news.mongabay.com/2014/1205-meijaard-rps-indonesia-reforestation.html. retrieved May 8, 2015.

[35] As cited by Watanabe, H., Sahunalu, P., Khemnark, C., 1988. *"Combinations of trees and crops in the taungya method as applied in Thailand".* Agroforestry Systems. Vol. 6, Iss. 1. Kluwer Academic Publishers. Doldrecht: Netherlands.

[36] Ibid. Watanabe, H., Sahunalu, P., Khemnark, C., 1988.

[37] Sardjono, M.A. 1996. *"The Lembo System: A model for agroforestry in dipterocarp forest ecosystems of East Kalimantan."* Schulte, A. and Schone,D.H. 1996. Dipterocarp Forest Ecosystems: Towards sustainable forest management. World Scientific Publishing Co.: Singapore. Retrieved from http://books.google.com May 11, 2015

[38] Wasli, M.E, Sani, H. Ho, S.Y, et. al. 2014. *"Preliminary Assessment on the Growth Performance of Dryobalanops beccarii Dyer Planted under Enrichment Planting Technique at Gunung Apeng Forest Reserve, Sarawak, Malaysia."* Kuroshio Science, Vol. 8, Iss. 1. retrieved from https://ir.kochi-u.ac.jp/dspace/bitstream/10126/5418/2/8-1.45.pdf May 11, 2015.

Dryobalanops beccarii is a dipterocarp species and is one of the most commonly used species for reforestation purposes in Sarawak, Malaysia. It was also listed “endangered” in the Red List of Threatened Species under the International Union for Conservation of Nature (IUCN). This study focused on the current state of the growth performance and survival rate of D. beccarii planted in the reforestation areas in Gunung Apeng Forest Reserve in Sarawak Malaysia. Study sites were established in the areas where D. beccarii was planted in the year 2005; DB05 and 2008; DB08. The assessment on the growth performance of planted D. beccarii at different age stand was evaluated by measuring the stem diameter, height and survival rate from October 2010 to December 2012. Results then showed that the survival rate of planted trees in DB05 and D208 were at 88% and 86%, respectively; which indicates high survival rate. Thus, it was concluded that D. beccarii is suitable for forest rehabilitation purpose in the study site and positive outcome could be achieved from this reforestation effort on a long run.

5. Thinning in forest plantations in the Indonesian and Malaysian forest development projects

In terms of reforestation design and implementation at the field level, there is a big difference in the practices of the Philippines, Malaysia and Indonesia. The 3 countries used similar spacing ranging from 2m x 2m to 4m x 4m in forest plantations for timber production. Closer spacing of 2m x 2m was used in Malaysia and Indonesia. However, thinning operation is included in the design and practiced on the ground where after 1 to 2 years, the original density was reduced to 50% and another thinning to further reduce the final density to 50% on the 4th to 5th year of the forest plantations. Doing this increased the volume at final harvest[39]. This practice is in the silvicultural design of most forest plantations in the Philippines but due to political reason this has not been implemented on the ground thinking that this is a timber cutting technique that will circumvent harvesting

5. Applicability of the reforestation methods and experiences in other countries

1. Reforestation method

All the reforestation methods discussed above are applicable in the reforestation of degraded lands in the Philippines. The forest plantation approach is a very popular method for those whose primary objective is timber production using fast growing species. In fact the private wood industry that ventured in industrial plantations used this approach with high survival rates. The nitrogen-fixing series planting approach has been tried in Mindanao with good result. This approach was based on the studies of forest scientist in UPLB[1]. It is only waiting to be adopted by the government in its reforestation program. Indonesia, Malaysia and Thailand are using the

[39] Balangue, T.O. 1989. Post-Evaluation Report of the Indonesian Forestry Development Project. ADB Post-evaluation mission.

same forest plantation method being used by the DENR here in the Philippines. Except for Thailand, Indonesia and Malaysia in their ADB-funded forest development projects planted Mangium and Eucalyptus in monoculture. The forest plantations had high survival rates. In Thailand, Teak was planted also in monoculture.

The Accelerated Pioneer and Climax Species has not been tried yet in the Philippines but it has been tried in Vietnam (Nguyen Van So, nd)[1] and in Thailand (Elliot, 2002) by planting pioneer species, intermediate species and climax species in an integrated arrangement following how such species grow on the ground. This method has been successful in Vietnam and in Thailand according to the authors. What is necessary is to first identify on the ground the pioneer species (these are the species that grow first when a forest canopy is open. These species are also nitrogen-fixer and are good shades for intermediate species and climax species. When there are sufficient numbers of pioneer species on the ground, intermediate species may be planted in between until both species have already survived after which the climax species are planted under the canopy of the pioneer and intermediate species. There are plenty of pioneer, intermediate and climax species in the Philippines which can be combined and it is only matter of trying this approach even in an experimental stage.

The last approach is natural forest succession. The first company in the Philippines that has planned or is already using natural forest succession in its areas is the Energy Development Corporation. This is applicable in reforesting forest gaps that are not too wide and where human intervention on site is zero. This approach will only take time because it is dependent on birds/rats/wind-aided seed dispersal.

What is needed is to identify the forest gaps and mother trees. The next step is to provide a vegetative fence to prevent and protect the regenerants[40] from destruction. Regenerants come from fruits/seeds of climax species eaten by birds and mammals, and also dispersed through winds. Then the regenerants are protected from forest fires, hunters, and shifting cultivators.

This method is applicable in brushland areas and in adequately stocked residual forest in the Philippines where there are small to medium trees that are already growing on site. These trees will serve as shades to regenerants of climax species. This approach can also be modified by interplanting the climax species near the pioneer species that are already growing on the ground. This approach does not follow a specific density resulting in a random spacing.

2. Implementation arrangement

The reforestation implementation arrangement ***in the Philippines*** before 1996 implemented 3 modalities: a) Individual contracting; b) family contracting and c) PO corporate contracting. Of

[40] Regenerants are wildlings.

the 3, PO corporate contracting was successful in terms of survival rates. This was the basis of the community-based forest management agreement (CBFMA) where good performing communities are given 50 years-tenure to plant, protect and manage their areas. Some of the CBFMA holders were given contracts to reforest their areas but majority was not provided such contract because of the limited funding. Funding still remains a problem in the 5.3 million hectares under CBFMA.

Almost at the same time, Thailand launched its community forestry program in 1970, now under the Office of Community Forest Management[41], of which its concept has been adopted by other countries under different people-oriented forest development programs**.**

In Indonesia, community forestry[42]has established a co-management approach allowing communities as cooperatives to gain 25 year leaseholds on unencumbered State forest lands.

In Malaysia, social forestry is applied with 3 distinct approaches: ***a)*** In Sabah, social forestry programmes are designed for community development***. In Sarawak,*** the programme is agro-based and in Peninsular Malaysia for amenity and the creation of awareness among the people. In the whole of Malaysia**,** social forestry is only second to primary wood production for industrial uses because there is already a thriving export trade primarily for wood products as well as for the strong domestic demand for timber products[43].

6. Contributory factors to high survival of forest plantation

High survival rates and good forest growth performance depend on the existence of the right area to be planted, good weather timing, healthy seedlings, proper site preparation and planting, proper applications of methods and techniques, proactive protection and maintenance, dedicated project implementers at all levels, longer contract following a three-year contract from planting to protection and maintenance, ensure stakeholders benefits to the plantations, and timely releases of sufficient resources.[44] Added to these are climate change adaptation measures for forest plantations to survive such as the use of supplemental water system where rain harvesting may be used to collect water, tapping live springs and streams, and installation of water impounding ponds. Also, important are access roads and foot paths to the reforestation to

[41] Patrict Durst, 2009. Working Paper No. APFSOS II/WP/2009/22. Thailand Forestry Outlook Study. http://www.fao.org/3/a-am617e.pdf

[42]Marcus Colchester, nd Bridging The Gap: Challenges To Community Forestry Networking In Indonesia http://www.researchgate.net/profile/Marcus_Colchester/publication/237607645_SNAPSHOTS_OF_INTERNATIONAL_COMMU

[43] T.Y. Chee Agro, Community or Social Forestry In Malaysia - Time To Act HTTP://WWW.FAO.ORG/DOCREP/ARTICLE/WFC/XII/0438-C1.HTM

[44]Balangue, T.O. 2014. Best Practices in Philippine Reforestation Using Indigenous Forest Species: Learning from the Field. Energy Development Corporation. Metro Manila.

facilitate the transport of manpower, seedlings and supplies and to carry out emergency activities like putting out forest fires.

7. The Forestry Sector Project (FSP)

The FSP was implemented by the DENR in 1993 to 1999 as commissioned by the Asian Development Bank (ADB)[45], and in 1996 to 2003 by the Overseas Economic Cooperation Fund (OECF)/ Japan Bank for International Cooperation (JBIC)[46]. The FSP aimed to: a) reverse the process of upland and mangrove forest degradation; b) ensure the long-term sustainability of sector investments through broadly based community participation; c) enhance environmental rehabilitation through forest protection and law enforcement, and d) reduce poverty and augment income-earning opportunities among rural communities in the project areas. At the national level, the FSP is coordinated by the National Forestation Development Office (NFDO), while the regional subprojects were implemented by the 15 DENR regional offices.

While both components were originally designed for a six-year implementation covering the preparatory activities and completion of targets, the ADB component was extended for one (1) year while the OECF/JBIC was extended for three (3) years. The FSP-ADB commenced implementation in May 1993 and concluded in December 1999 while the FSP-OECF/JBIC ran from 1996 to 2003.

The FSP under ADB financing targeted the reforestation of 170,000 ha through community-based approach where 93,000 ha are for management of residual upland and mangrove forest, 55,000 ha for reforestation of degraded sites, and 22,000 ha of critical watersheds for rehabilitation. Conversely, the FSP under OECF/JBIC component targeted 80,000 ha of watersheds and mangrove areas. The ADB component reduced and accomplished its target of 35,000 ha in 1998 while the OECF/JBIC component reduced and accomplished its target of 69,571 ha in 2003. These target reductions demonstrated that the DENR has been more effective on small scale than nationwide scale projects[47].

The FSP was implemented in six (6) phases: 1) site identification and selection; 2) survey, mapping, and planning; 3) feasibility studies or appraisal of the sites; 4) community organizing; 5) comprehensive site development; and 6) monitoring and evaluation. In implementing each phase, the DENR has worked with various organizations as it initiated the first phase of site identification and selection: non-government organizations (NGOs) were tapped for the SMP,

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[45] ADB. November 2003. Forestry Sector Project Completion Report. Loan 119(SF)/1192-PH. PCR PHI 24266.

[46] Masashi Takano. Sept-Nov. 2005. OECF/JBIC. Forestry Sector Project.

[47] ADB Project Completion Report.

community organizing (CO), and monitoring and evaluation (M&E); technical consultants for the feasibility studies and/or appraisal reports; and people's organizations (POs) for the comprehensive site development.

The ADB component had numerous small scale subproject sites each with an area of more than 50 ha, while OECF/JBIC had few but bigger subproject areas each with area no less than 2000 ha. The FSP sites nationwide under the ADB funding were located in remote and hardly accessible areas, while in the OECF/JBIC component the sites were accessible because access road upgrading was integrated into the design.

Additional support livelihood projects to People's Organizations consisted of seven (7) small-scale forest industries with good domestic and/or export market potential: handicrafts, management of logged-over forests, coconut husk processing, handmade pulp making, handmade paper making, cut flower production, and sericulture. However, there were no reports received by ADB whether such livelihood projects flourished into community-based forest industries as a result of the project. Livelihood projects in CFMAs, such as poultry, piggery, and carabao dispersal and charcoal briquette production were also implemented to augment income of members of the People's Organizations (ADB, 2003).

Sustainability of the projects was ensured by providing various support for the POs such as issuance of tenure, capability building assistance, maintenance of audited book of accounts, and implementation of viable livelihood enterprises (ADB, 2003). The 50-year tenure issued to POs under the Community Forest Management Agreement (CFMAs) provided adequate security and stability to its members, resulting in the reduction of poverty and improved environmental protection (ADB, 2003).

Further benefits from the FSP included income for PO members, topsoil stabilization, erosion control and siltation reduction, increased water in streams, and improvement of microclimate (Takano, 2005).

In terms of survival rate of the FSP plantation, the OECF/JBIC audit mission recorded an 84% survival rate more than the minimum of 80% (Takano, 2005). There was no report on the survival rate of the FSP component under the ADB.

8. Some successful reforestation projects

Several reforestation projects were implemented in different parts of the country in different periods. The seedlings that were planted grew and mature into forests. Some of these are the Osmeña Reforestation Project (ORP) in Minglanilla, Cebu province in 1919. It was declared as an experimental forest station under DENR Administrative Order 2004-51.[48] The ORP generates cool and fresh air from its tall trees, provides life support system, and offers aesthetic and educational benefits. With the declaration, the biodiversity and the benefits remain. However, human exploitation threatens the area.[49] In April 2014, eight men, including government officials, were filed administrative and criminal charges for cutting trees in a protected area in Barangay Manipis, Talisay City.[50] They were charged of cutting mahogany trees in the ORP in Sitio Campinsa.[51]

In 1919, the Magsaysay Reforestation Project was established in Arayat, Ilocos, and Zambales. This was followed by the establishment of the Cinchona plantation in Bukidnon (Mindanao)[52] in 1927.

The other one was the Makiling Reforestation Project which was planted in 1916, and in 1937-1941 by the forestry and agriculture students. The resulting forest was declared as the Makiling Forest Reserve, which is now under the administrative jurisdiction of the University of the Philippines at Los Banos. The existing mature forest cover in these reforestation projects indicates the high survival rate of species planted in the grassland and barren areas.

9. Survival rates of some reforestation projects

A review of some of the reforestation projects in terms of their survival rates was conducted. The survival rates of these reforestation projects by sector are presented below:

a. Forestry Sector Project, Phase I - 42 percent and below (UNAC 1992), (CIFOR, 2006). DENR records show a range of 29-86 percent. The factors that contributed to low survival rates of this project were attributed to activity contracting where planters such as individuals and families were contracted to perform planting only. After planting the seedlings, the contractors were paid without any responsibility of protecting and maintaining what they have planted. Also, replanting dead seedlings was not part of their contract. The project design did not consider the planters as important partners or

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[48] Gozun EA, Acosta RT and Diaz CP. 31 August 2004. *DENR administrative order no. 2004-51. Quezon City, Philippines: Department of Environment and Natural Resources. A PDF file. Retrieved 13 January 2015 from http://www.denr.gov.ph/policy/dao2004/dao2004-51.pdf.*

[49] Lanuza RL. 2013 June 7. *From Osmeña reforestation project to experimental forest station: potentials and implications.* Philstar. Retrieved 13 January 2015 from http://www.philstar.com/cebu-news/2013/06/07/951173/osmena-reforestion-project-experimental-forest-station-potentials-and.

[50] Vestil JK. 7 April 2014. *8 face raps for cutting trees. Cebu*, Philippines: Sun.Star Publishing, Inc. Retrieved 13 January 2015 from http://50.28.66.108/cebu/local-news/2014/04/07/8-face-raps-cutting-trees-337122.

[51] Vestil JK. 27 March 2014. *City sent chainsaw to cut trees.* : Sun.Star Publishing, Inc. Retrieved 13 January 2015 from http://www.sunstar.com.ph/cebu/local-news/2014/03/27/city-sent-chainsaw-cut-trees-335377.

[52] Ibid

stakeholders necessary to sustain the established forests. Also, the project was managed by the CENROs or PENROs that remotely managed the project sites.

b. Forestry Sector Project, Phase II (OECF/JBIC) - weighted survival rates – 80% (FSP Completion Report, 2003). The deficiencies of FSP1 were addressed in FSP II. POs were contracts were extended to 3 years where the first year was for seedling production and planting, second year for protection and maintenance and replanting, and the third year for continuation of protection and maintenance and replanting ensuring that the established forests will be able to cross the 3rd year up to the 10th year. Another feature of FSP II that made it attractive to upland and coastal communities was the issuance of CBFMA which gave them the tenure of 50 years to the areas that they have planted and at the same time giving them the right to harvest and market whatever products they have in the plantations. This is similar to owning the fruits or harvests from the land. And in order to ensure sustainability of the project and whatever investments introduced in the area were co-managed by the DENR Subproject Site Management Office and the CBFMA holder.

c. Reforestation by Administration (DENR) – no published records on survival rates.

d. Tree farms reforestation project of the National Power Corporation in Lake Lanao-Agus River watershed reservation in 1992, Lanao del Sur, Philippines with technical assistance from PICOP[53]

e. EDC BINHI, Negros Island forest restoration program planted local indigenous species of trees primarily to attract biodiverse species - 60-80% survival rates[54].

10. Environmental Impacts of reforestation projects

Not all reforestation projects were monitored and evaluated in terms of their quantitative environmental impacts. Environmental impacts were generally qualitative.

1. Carbon sequestration

Campbell (2012) cited the environmental effects of forest restoration. Among these are air quality, water quality, tree health, soils and the understory, and wildlife habitats and populations. Non-market benefits and costs, such as watershed and habitat protection, biodiversity, and

[53] Danilo C. Mero. 1992.. Financing Community Based Watershed Reforestation In The Philippines. Department of Forestry, College of Forestry and Environmental Studies, Mindanao State University, Marawi City, Philippines; Tel.: +63-633-520982; Cell phone No.: +63-919-4383905; E-mail: *danmero@eudoramail.comftp://ftp.fao.org/docrep/fao/007/ad496e/ad496e04.pdf*

[54] EDC-Negros. Reforestation Project Announced For Negros Island, Philippines. Http://Thinkgeoenergy.Com/Archives/19672

carbon mitigation are included (Viers, 2005, as reported by Campbell, 2012)[55]. Furthermore, reforestation increases the density of trees that will crack the soil to increase water percolation into the soil. This also results to increased stream flow in watersheds.

The impact of reforestation to the amount of carbon captured is proportional to the annual biomass increment and dependent on the annual diameter and height growth.

The reforestation project in the Philippines that was evaluated according to its impacts is the CBRM project implemented by the Department of Finance. REECS (2005) in its impact assessment of CBRM concluded that the reforestation of degraded watersheds and deforested mangrove lands exhibited positive effects when reforested. The positive impacts were on making the environment cooler, recharging water to creeks, minimizing soil erosion, recharging soil fertility, and in bringing back wildlife to the reforested areas[56].

Lasco and Pulhin (2006)[57] observed in CBFM projects where the planting of trees in farms and landscapes by the people has led to soil and water conservation, carbon sequestration and biomass production. It is very obvious that reforestation projects promote CO2 capture from the atmosphere, thereby decreasing the greenhouse effect through the photosynthesis where carbon is stored in vegetation biomass and forest soils.

The total amount of CO2 accumulated in trees were approximated based from Huy et al. (2008) who reported the following relationship: Total CO2 accumulation in trees: = 62 % in stem = 26 % in branches = 10 % in bark = 2 % in leaf[58]. According to Tagupa et al (2010) in Tampisilan campus by area of species, the species CO2 densities (kT) are: a) Mohogany (Swietenia macrophylla) is 1.87kt; b) Gmelina (Gmelina arboreaI) 0.47kt; c) Mangium (Acacia mangium) 1.51kt; d) Rubber (Hevea brasillensis) 56.41kt; and e) Natural Forest Trees 27.91kt.

According to Lasco and Pulhin (2009), Carbon (C) density in aboveground biomass (AGB) declines by about 50% after logging, grasslands and annual crops have C density less than 15 MgC/ha, conversion of natural forests to tree plantations and perennial crops reduce C density by about 50%, and in reforestation activities in degraded areas C density is increased with a mean

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[55] Marti Campbell, May 2012. Benefits Of Forest Restoration: Literature Review
Coalition for the Upper South Platte.
file:///C:/Documents%20and%20Settings/fujitsu/My%20Documents/Downloads/Review%20of%20literature%20envi%

[56] REECS (2005), Impact Assessment of the Community-Based Resource Management Project. Department of Finance.

[57]Rodel D. Lasco and Juan M. Pulhin. Environmental impacts of community-based forest management in the Philippines. Int. J. Environment and Sustainable Development, Vol. 5, No. 1, 2006.
http://www.worldagroforestrycentre.org/downloads/publications/PDFs/bc06025lasco.pdf

[58] C. Tagupa , A. Lopez And F. Caperida , G. Pamunag , A. Luzada. Carbon Dioxide (Co2) Sequestration Capacity Of Tampilisan Forest -International Scientific Research Journal Issn: 2094-1749 volume: 2 issue: 3, 2010 182

annual accumulation of up to about 10 MgC/ha/yr for fast growing species and 3 MgC/ha/yr for slow growing species, and silvicultural treatments such as mycorrhizal inoculation can increase C accumulation.[59]

Furthermore, Lasco and Pulhin (2009) reported from the 1997 Buante's data that Acacia mangium has 25.61 Mg/ha, Gmelina arborea 31.59 Mg/ha, and A. auriculiformis 28.58 Mg/ha.[60]

According to Palma and Carandang (2014) an agroforestry system planting Bagras and corn along the boundary of the agroforestry area has a biomass production based on site indexes of 52 trees per hectare was 24.44, 73.07 and 78.67 Mg ha-1. The mean annual aboveground biomass accumulation was 24.44, 7.31 and 3.93 Mg ha-1 y-1 at ages 1, 10 and 20 years.

Inside the agroforestry area, establishing bagras at a distance of 2 m, site index equal to 19 m, age set at 10 years was predicted to yield 0.1974 m3 per tree in 2020 and increased to 3.1182 m3 per tree in 2050. Yield and biomass production in boundary plantings can be highly variable – dependent on environmental and soil characteristics and tree spacing[61].

Benguet pine (*Pinus kesiya*) plantations in Bukidnon, Philippines sequester carbon ranging from about 22 to 607 Mg per ha. The second-growth forest patches have total carbon density of 450 to 529 MgC per ha. *P. kesiya* tree plantations have carbon stocks that are 4.8 to 77.4% lower than the second-growth forests. However, *P. kesiya's* sequestration rate of 12.7 MgC per ha while second-growth forests which take so much time to develop have an average sequestration rate of only 4.8 MgC per ha[62].

2. Reduced air pollution

Air pollution is one of the problems that cause multiple damages to human and environment. Thus, there is a need to reduce air pollutants. According to Yang et. al (2004)[63], trees play two

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[59] Rodel D. Lasco and Florencia B. Pulhin. Carbon Budgets of Forest Ecosystems in the Philippines. Journal of Environmental Science and Management 12(1):1-13 (June 2009) ISSN 0119-1144

[60] Ibid

[61] Richmund A. Palma and Wilfredo M. Carandang. Carbon Sequestration and Climate Change Impact on the Yield of Bagras (Eucalyptus deglupta Blume) in Bagras-Corn Boundary Planting Agroforestry System in Misamis Oriental and Bukidnon, Philippines Journal of Environmental Science and Management 17(2): 29-37 (December 2014) ISSN 0119-1144

[62] Jose Hermis P. Patricio and Adrian M. Tulod (2010). Carbon Sequestration Potential of BenguetPine *(Pinus Kesiya)* Plantation in Bukidnon. Philippines Journal of Nature Studies 9(1):Iss□: 1655-3179

[63] Yang, J., ET. Al (2004). The Urban Forest In Beijing And Its Role In Air Pollution Reduction. Department of Environmental Science, Policy and Management, University of California at Berkeley, Berkeley, CA 94720-3110, USA. Institute of Forestry Science, Chinese Academy of Forestry Science, Beijing 100091, China.

important roles in reducing air pollutants, first is by direct reduction by absorbing gaseous pollutants (sulfur dioxide, nitrogen dioxide and ozone) from air and by indirect reduction of air temperature through direct shading and evapotranspiration for cooling purposes. Also by lowering air temperature, the activity of chemical reactions can be decreased (Taha, 1996)[64].

One of the studies in Beijing, China (Yang, et. al, 2004) shows that 2.4 million of trees can remove 1261.4 tons of pollutants from the air. The air pollutant that was most reduced was PM10 (particulate matters with an aerodynamic diameter smaller than 10 mm) and the reduction amounted to 772 tons. The carbon dioxide (CO2) stored in biomass form by the urban forest amounted to about 0.2 million tons.

3. Reduced events of landslide and flooding

Land cover could be a good indicator of the watershed's rating for landslide susceptibility because the forest covers contribute to the integrity of the soil. It could also lessen the possibilities and risks of having landslides and erosion (Begueria, 2006)[65]. Characteristics of land cover affect susceptibility to landslide with the amount of number of trees and density of tree. Vegetation is influenced by removing soil moisture through evapotranspiration and by providing root cohesion to the soil mantle (Gray and Megahan, 1981)[66]. The presence of vegetation can mitigate the occurrence of landslide since trees and other plants will make the soil more compacted making it resistant to any pressure applied.

According to Rickli and Graf (2009)[67], forest can stabilize steep slopes. Their study showed that landslide densities were lower in forested terrain than in open land. Furthermore, landslides mapped in forests occurred on steeper slopes than slides mapped in open land.

4. Reduced temperature

According to its situation, species, size and condition, the shade from trees can reduce spending on air conditioning for residential and commercial buildings from a percentage of 15% to 50%. The shade from trees helps in cooling the streets and parking lots. Temperatures in cities tend to register between 5.09 degrees more than in regions where there are plenty of trees.

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[64] Taha, H., 1996. Modeling Impacts of Increased Urban Vegetation on Ozone Air Quality in the South Coast Air Basin. Atmospheric Environment 30, 3423–3430.

[65] Begueria, S., 2006. Changes in Land Cover and Shallow Landslide Activity: A Case Study in the Spanish Pyrenees. Geomorphology 74: 196–206

[66] Gray, D.H., and Megahan, W.F., 1981. Forest Vegetation Removal and Slope Stability in the Idaho Batholith. USDA Forest Service. Paper INT-127: 23.

[67] Rickli, C. and Graf, F. (2009). Effects of Forests on Shallow Landslides – Case Studies in Switzerland. WSL Swiss Federal Institute for Forest, Snow and Landscape Research, CH-8903 Birmensdorf, Switzerland.

The reason for the reduction in temperature by plants is due to photosynthesis where water will split to hydrogen and oxygen when there is light energy. The formula for photosynthesis is shown as,[68]

Photosynthesis

carbon dioxide + water + light energy = glucose + oxygen

$$6CO_2 + 6H_2O + \text{light energy} = C_6H_{12}O_6 + 6O_2$$

According to Northwest Territories Forest Management as reported by Helmenstine, 6000 pounds of oxygen are easily produced by a 100-ft tall tree with a base diameter of 18"[69]. Also, she quoted the figure of Environment Canada that on the average, one tree produces nearly 260 pounds of oxygen each year. Two mature trees can provide enough oxygen for a family of four." In a joint publication of the *U.S. Forest Service and International Society of Arboriculture, the article reported the* "Mean net annual oxygen production (after accounting for decomposition) per hectare of trees (100% tree canopy) offsets oxygen consumption of 19 people per year (eight people per acre of tree cover), but ranges from nine people per hectare of canopy cover (four people/ac cover) in Minneapolis, Minnesota, to 28 people/ha cover (12 people/ac cover) in Calgary, Alberta."

5. Soil temperature

Reforestation can also impact the soil temperature as attested in the study conducted by Correa and Scull (2005)[70], Hamilton, NY (Madison County). According to them, the soil temperature in fields are warmer than those of forested lands. The field's mean temperature during the month of November 12-May 31 was 4.09°C while 3.57°C in the forest. The field soils had greater variation than the forested soils with standard deviations of 3.31 and 2.43. Of the three seasons examined in this study the forested soils were warmer in both the fall and the winter, but not significantly. The mean soil temperature in the fields during the fall was 4.67°C and the forest was 5.10°C. The wintertime mean soil temperature for the fields was 1.30° C while the forest was 1.37°C. The spring marked the greatest difference in mean soil temperature between the forest and the field with mean field temperature at 8.13°C whereas the forest has a temperature of 5.89°C.

6. Soil organic carbon

[68] http://www.ext.colostate.edu/mg/gardennotes/141.html

[69] Anne Helmenstine (nd) How Much Oxygen Does One Tree Produce? http://chemistry.about.com/bio/Anne-Marie-Helmenstine-Ph-D-7815.htm

[70] Correa, S. M. and Scull, P. (2005). The Impact of Reforestation on Soil Temperature. Department of Geography Colgate University, Hamilton, NY, 13346.

Soil organic carbon (SOC) storage and CO_2 flux into the atmosphere can be influenced by land use change, especially reforestation. Coniferous forest land uses have the highest SOC storage (SF1=255.00 and SF2=237.90 Mg C ha^{-1}). Then followed by deciduous forest (PF1=216.74 and PF2=159.12 Mg C ha^{-1}) and abandoned rangeland (AR1=185.31 and AR2=151.60 Mg C ha^{-1}). According to Moghiseh, et, al (2013*)*, changes in the use of lands had a significant impacts on soil CO_2 efflux. The highest recorded soil CO_2 efflux in a wide range of land uses were obtained in August to October due to more suitable temperature and rainfall distribution. Based on lower CO_2 emission in abandoned rangelands, lesser soil organic carbon is related to lower input to soil. The higher C: N ratios in litter and some of mineral horizons (SF2) and lower CO_2 emissions by the higher lignin and polyphenol concentrations (SF1) in coniferous forests compared to deciduous forests have probably caused increasing SOC storage.

7. Soil organic matter

On the other hand, reforestation can also affect the soil organic matter and its other properties. Reforestation increases soil organic matter by 49%-72% which was more significant compared to the cultivated control soils. Reforestation with olive increased mean weight diameter by 81% and reforestation with Cupressus increased MWD by 83.6%. Therefore forest clearing followed by cultivation of the hilly slopes resulted in the decline of the soil quality attributes, while reforestation improved them in the study area.

IV. Research Gap and Potential Contribution of the Environmental Impact Study

1. Research gaps

A review of the studies of the Ecosystems Research and Development Bureau published in Sylvatrop and other published materials showed that most studies conducted were on the seeding duration and schedules of exotic and indigenous forest species, seed germination technology, cloning or vegetative propagation techniques of planting materials, and effects of fertilizer and mycorrhiza applications. Almost all studies were conducted at experimental nurseries and some trial plantings of cloned seedlings in selected field conditions.

Studies designed to provide scientific information to reforestation projects before, during and after establishment of forest conducted in reforestation sites are seldom read in literatures. This indicates that reforestation projects and research studies are somehow disconnected particularly at the field level. To gain fruitful result in any greening program of the government, research should always be supportive to the needs of such greening program on site.

Some of the research gaps are:

For further improving the usefulness of Survey, Mapping and Planning (SMP)

1. Incomplete site capacity assessment as reflected in the reviewed SMP reports[71]. Soil characterization was not given much importance. What are the site factors that should be addressed in the SMP that are better predictors of survival rate?
2. There are no trial plantings of forest species (preferably indigenous ones) in different barangays that cut across elevations and slopes. The growth performance of such species will provide guidance to species-site matching in reforestation projects.

For planning and actual planting activities

3. When is the right time to start and stop planting? Wrong timing in planting results to low survival rate because soil moisture might be insufficient. Is the regular rainy season a sufficient indicator of when to start and stop planting on a per site basis? Is the soil moisture content on the ground a better indicator than rainfall season? A study that will establish the soil moisture level per rainfall intensity in an area is important to establish the best indicator that will define the reforestation window[72] in a particular place. Similarly, during dry season, what temperature is critical to the survival of forest plantations during the early stage of development?

For maximizing the use of planted species

4. Which forest species would better build up soil accretion, NPK, carbon and soil moisture, result in cool temperature, attract wildlife, sequester carbon, and build-up stumpage on site considering the planted species?

For species adaptation to high temperature condition

5. Which forest species would survive in high temperature, drought, El Niño? What are the special features of species that could survive in high temperature?
6. Innovations in reforestation areas to reduce the effect of dryness, high temperature, drought and El Niño to newly planted seedlings and forest plantations in their early stage of development?

For species diversification with high survival rate

7. Growth performance at different time frames of planted species in monoculture and mix planting pattern given prescribed density.

[71] Based on initial review of SMP documents for NGP sites in CENRO Masinloc, Zambales. http://news.mongabay.com/2014/1205-meijaard-rps-indonesia-reforestation.html

[72] Reforestation window is the best time of the rainy season where soil moisture is sufficient to support the growth of newly planted seedlings and forest plantations in their early stages of development.

8. To move forward from the usual reforestation of planting fast growing exotic species, what are the indigenous pioneer, intermediate and climax species that would grow well in an area? What ecological habitat do they require?

For systematic assessment and evaluation

9. A systematic environmental impact assessment of reforestation project focusing on processes, effects and outcomes

For reforestation project implementation arrangement and management

10. Optimal configuration of reforestation project implementation arrangement and management considering, restorability of degraded forestlands, capable warm bodies at the barangay level, weather condition, funding, local government machinery and CENRO project management capacity.

For creating planting materials that can withstand strong wind.

11. Effectiveness of root trainer in assisting seedling roots to grow deeper into the soil and be able to hold itself even under strong wind. What is the best size of the root trainer for every species?

2. Potential contribution of the study

The environmental impact study is expected to contribute in terms of the following possible observations:

1. Provide a systematic assessment and evaluation methodology focusing on how the processes were implemented, estimating their effects and outcomes and pointing out critical processes for further improvement and how improvement can be attained. Current monitoring and evaluation system being implemented focuses solely on survival rates of forest plantations rather than on a holistic approach as what is being proposed in this study.

2. Recommendations for upgrading measures to reforestation processes that were haphazardly implemented in the field.

3. Recommendation on research and reforestation tandem to focus on research opportunities that will further improve implementation of reforestation projects.

4. Recommendation on the optimal CENRO-BLGU management configuration that will implement and manage any reforestation project with the primary objective of further improving survival rate and producing a quality forest.

5. Recommendation on specific forest species that will have the highest contribution to wood supply, soil accretion, cool temperature, carbon sequestration, wildlife, soil nutrients and soil moisture, DRR and CCA/M.

V. Conceptual Framework and Methodology

The conceptual framework and the methodology of the environmental component of the Impact Project of the NGP were based on the Theory of Change of the Social Component of the Impact Project by Noela Lasmarias (2015). The Theory of Change diagram is in Appendix Figure 1. For details please refer to the Social Component Report. The activities in Appendix Figure 1 are the NGP activities and considered in Figure 1 below as the processes that were assessed and evaluated in the environmental impact study. These were compared to the specifications of the activities defined in the NGP guidelines and best practices benchmark.

1. *Conceptual framework for assessment and evaluation*

The framework of analysis of the environmental component in schematic diagram is shown in Figure 1.

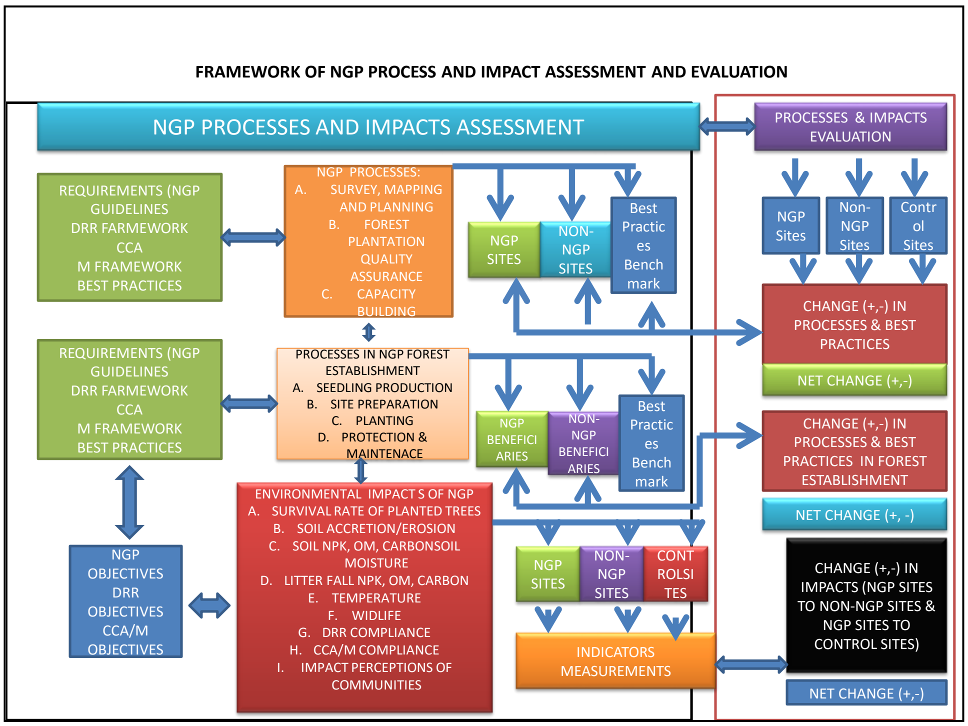

Figure 1. Schematic Diagram of NGP Processes and Impacts Assessment and Evaluation

There are two major components of Figure 1. One is the NGP processes and impacts assessment, and the other one is the processes and impacts evaluation.

The NGP Process Assessment component determines the actual performance of the specific NGP sites in terms of putting on the ground the forests while the NGP Process Evaluation component compares the performance of the NGP sites to the Non-NGP sites and to the Best Practices Benchmark in forest restoration. The expanded form of the framework considering the important technical processes in forest restoration is presented in Appendix Table 1 to Appendix Table 7. Apendix Table 1 is for the assessment and evaluation of SMP, Appendix Table 2 is for the capability building of the NGP workers, Appendix Table 3 is for the NGP forest quality plantation assurance, Appendix Table 4 is for seedling production, Appendix Table 5 is for site preparation, Appendix Table 6 is for planting, and Appendix Table 7 is for protection and maintenance. The specific activity process assessment and evaluation formats are presented in the following sections:

2. Structure of the framework in matrix format

The structure contains 5 major columns. These columns are “Basis”, “Process/Criteria/Indicator”, “Finding”, “Positive Rating”, and “Negative Rating”. The column title “Basis” contains the NGP DENR guidelines defining the activities that are relevant to the activity. It also includes DRR and CCA/M framework. The column “Process/Criteria/Indicator” contains the criteria or indicators to be used in describing how the activities where conducted in the NGP sites and Non-NGP sites. The column “Finding” contains the observations in the NGP site and Non-NGP Site according to the KII/FGD results. The columns “Positive Rating” and “Negative Rating” contain the evaluation of the process according to the indicators. Comparing the findings in the NGP site with the Non-NGP site and Best Practices Benchmark gives the positive or negative qualitative or quantitative observations which may be rated through a rating scheme involving experts in forest restoration. The most common rating scheme that may be used is through the allocation of a scale from 1 to 5 where a scale of 1 means low importance and 5 means very high importance.

The study assessed and evaluated the following NGP processes:

3. Survey, mapping and planning (SMP)

SMP is the first major activity of any reforestation project. SMP includes surveys, mapping and planning. SMP in general is designed to determine the areas that are suitable for planting (Article 2, DAO 31, series of 1991 Revised Guidelines for Contract Reforestation; NGP Implementation Manual, 2012). It involves surveying the boundaries of the potential areas for reforestation and establishing the areas to be free from other claims and assuring that they are under the domain or jurisdiction of the DENR. To determine whether the species to be planted will thrive or not, activities such as soil assessment survey and identification of growing species on sites are undertaken. These also serve as inputs to species-site matching. If the selected species matched with the sites, then the survival and the growth performance of the species planted are expected to be high.

Since the NGP has expanded its objectives to include DRR and CCA/M compliance, the SMP should also address these concerns.

Detailed enumeration of the sub-activities under SMP are indicated in Appendix Table 1.

The format of the process assessment and evaluation of the SMP activity is described in same Appendix Table 1. Only critical sub-activities of SMP are included for assessment and evaluation. The entries are defined at the Note section of the table. SMP is divided into: a) Survey and its indicators: boundary, soil survey, vegetation survey, DRR areas, and CCA/M areas, plantable and non-plantable sites as indicators; b) mapping those that were surveyed in <u>*Item a*</u>; and d) planning with its indicators: feasibility design and forest restoration plan.

4. NGP beneficiary capability training

Proper training on the processes and standards of establishing NGP forests are necessary for the contractors before commencing to the NGP sites to ensure that their outputs would meet the objectives and standards of the NGP. This training shall involve providing knowledge on proper handling and management of contract funds to avoid potential conflicts between and among the workers and managers of the contractors, as well as knowledge on the right billing processes based on actual acceptable activity outputs for transparency purposes.

Training forest restoration workers on the different activities of the NGP will improve the capability of the workers to properly conduct such activities resulting in the right quality of output. Appendix Table 2 presents the indicators to be assessed and evaluated.

The basic training topics that should have been given by DENR to the NGP beneficiaries before starting their assigned tasks.

5. NGP Forests quality assurance

NGP Forests quality assurance involves activity and output inspection to ensure that minimum standards required by DENR were met, quality grading of the outputs of each of the above activities which are usually the basis of payments to the contractors, back job instructions to redo substandard qualities before recommendation for payment is prepared until the required minimum standard is satisfied, and instructions for conditional payments.

There are best practices in ensuring the success of establishing forest plantations that have been developed in similar reforestation projects in the past. One of the best practices relevant to ensuring the quality of forest plantation is the conduct of activity inspection to check whether such activity is properly implemented. Activities that are not properly implemented result to poor quality of output. Example in reforestation is when the sites are prepared haphazardly where weeds can recover within weeks. When the site is planted, the seedlings will not be able to grow well because the weeds will grow faster than the seedlings. This will end up in high mortality of the seedlings. Before planting, therefore, strip brushing should be able to clean well the area where the seedlings will be planted. Appendix Table 3 presents the assessment and evaluation of the NGP forest plantation quality assurance. The same weighing or rating scheme applies.

6. Seedling production

Seedling production starts from seed collection, wildling collection, cloning (to some extent) and other modes of acquiring seedlings. There is no guideline limiting seedling production to the project beneficiaries. Seedlings can be produced by members of the communities or People's Organizations. In other situation, the seedlings are produced and provided by the DENR at cost. It is also possible that the contracted members of the communities or POs are allowed to procure the seedlings from outside suppliers. The quality of the seedlings disposed of from the nursery to NGP sites should satisfy the standard set by the DENR for seedlings ready for planting. This will include seedling transport from the nursery to the sites to be planted (Article 2, DAO 31, series of 1991 Revised Guidelines for Contract Reforestation NGP Implementing Guideline, 2012).

Seedling production is one of the critical aspects of any reforestation projects. The quality of forest plantations depends on the sources of seeds, wildlings and other planting materials and on how these are grown in the nursery. Thus, the indicators that should be assessed and evaluated are the sources of planting materials, the growth period spent, and the growth rate of the seedlings are important in evaluating whether the project will be a success or failure. Appendix Table 4 presents the process assessment and evaluation for seedling production. The same descriptions of the table columns apply, except for the "Process/Criteria/Indicators." This column contains the indicators for seedling production. The same process and rating scheme applies for the evaluation of the Findings and the Negative and Positive Ratings.

7. Site preparation

Site preparation processes include strip or ring clearing of the areas to be planted, removal on-site of the cut grasses and weeds, staking of planting sites along the strips or rings according to prescribed spacing, hole digging according to prescribed hole dimension, full cleaning of the hole and its immediate vicinity (within 0.5m radius from the hole) removing all grass roots, preparation of satellite nurseries[73] in the planting sites where seedlings are temporarily stocked, construction of firelines/firebreaks, construction of composting area (optional for those who used fertilizers) (Article 2, DAO 31, series of 1991 Revised Guidelines for Contract Reforestation; and NGP Implementation Guideline 2012).

Construction of water system (optional), and construction of feeder roads or foot paths in the planting site are considered as important innovations.

Appendix Table 5 shows the process assessment and evaluation for site preparation. The "Process/ Criteria/ Indicator" Column contains the activities conducted in the preparation of the site where the seedlings are to be planted. Again, same process applies for the evaluation of the Findings and the Negative and Positive Ratings. The most common rating scheme which may be used is through the allocation of a scale from 1 to 5 where a scale of 1 means low importance and 5 means very high importance.

8. Planting

Planting processes include seedling distribution to the planting sites from the satellite nurseries or temporary seedling depots, use of seedling carriers to minimize damage to seedlings during transport, proper removal of seedling plastic bags without bursting the balled soil, erection of the

[73] Satellite nurseries are temporary in nature provided with shades and watering system where seedlings for planting are temporarily stocked.

seedlings on the hole with proper depth of root collar, filling up the hole with fertile soil, pressing the filled up soil around the planted seedling, staking back to mark the hole has been planted, and placement of a mulch on every planted seedlings in preparation for the incoming dry season. The proper timing of planting, such as considering the start and end of the actual rainy season is part of the processes of planting (Article 2, DAO 31, series of 1991 Revised Guidelines for Contract Reforestation; ERDB, 2010[74] and NGP Implementation Manual, 2012)

Appendix Table 6 shows the process assessment and evaluation for Planting NGP sites. The "Criteria/Indicator" column contains the activities necessary in planting at the site. Again, observations will be discussed in the Findings section, and the processes will be assessed and evaluated according to the indicators through the scale of 1-5.

9. Protection and maintenance

Under protection and maintenance, NGP forests are periodically inspected to assess their growth and health condition. Other activities such as replanting of trees to meet required survival rate, ring weeding and remulching, applying fertilizer, brushing and cleaning fire breaks and fire lines, patrolling, mobilizing fire fighters during dry season and information campaigning are also conducted under this NGP process (Article 2, DAO 31, series of 1991 Revised Guidelines for Contract Reforestation; ERDB Guidebook on Reforestation of 2010; and NGP Implementation Manual, 2012).

Appendix Table 7 contains the process assessment and evaluation for the protection and maintenance of the NGP established forest plantation. The Criteria and Indicator column includes several activities necessary to protect the planted seedlings and maintain the good condition of the seedlings and the site. Observations will be discussed in the Findings section, and the processes will be assessed and evaluated according to the indicators through the scale of 1-5.

10. NGP impacts to environmental attributes

The effects or outcomes of the processes that will be assessed and evaluated in Appendix Table 1 to Appendix Table 7 are believed to result in the level of survival rates of the NGP forest plantations that were established. Thus, survival rate is very important because all the other impacts of the NGP biodiversity, social, economic, and institutional will hinge from it. The environmental indicators that will be measured in the sampled NGP and Non-NGP sites and control sites indicated in the approved proposal and Terms of Reference are presented in the process and impact assessment and evaluation matrix (Table 8).

[74] Ecosystems Research and Development Bureau. 2010. Development and management of forest plantations: a guidebook. College, Laguna: Ecosystems Research and Development Bureau, Department of Environment and Natural Resources. 80p; 185p; 195p; 223p 183p; 188p; 191p; 226p

1. Survival rate

Survival rate is the number of seedlings or trees that are still alive during assessment time given the total number of seedlings that were planted and paid. It is determined by the formula indicated in Figure 22 and Figure 23.

A minimum survival rate of 85% prescribed by NGP will be followed (NGP Implementation Guideline, 2012).

Criteria for judging seedling condition

A seedling is evaluated as living if it has any of the following health conditions:

a. All parts (stem, branch, leaves) are alive.

b. A seedling is declared alive even if any of its parts is damaged under the following conditions:

   - ❖ Leaves, majority of the seedling crown is damaged
   - ❖ Branches and twigs, majority of its branches and twigs is not damaged.

c. A seedling is declared dead under the following conditions:

   - ❖ Leaves, all leaves are dried or totally damaged except for deciduous and coppicing species
   - ❖ Almost all of its branches and twigs are dried except for deciduous[75]and coppicing [76]species

2. Soil erosion/soil accretion

Soil is a very important component of the natural resources. Without soil there are no forest and food crops to talk of. Thus, it is a very important concerns. Because of this, any reforestation projects implemented by government, should always have an objective of reducing soil erosion because trees perform such function[77]. Thus, it is one of the environmental indicators that should be measured in this study.

The project will also find out the impact of the NGP forests to soil erosion or accretion. Physically, the root system will hold the soil thus minimizing the movements of soil particles and through the root system soil particles are trapped and through time build up the soil. Also, the

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[75] Deciduous species that shed off all their leaves by nature specially during summer time.

[76] Coppicing species have the capability to bear shoots and develop into full stem and become a tree even if the whole tree is cut as long as the stump and the root are still in the ground.

[77] Forestry Sector Project (1996 to 2003). A Community-Based Reforestation Project Implemented By DENR.

litter falls from the canopy of the NGP forests are expected to become humus and eventually mix up with the soil, thus, resulting to its accretion. Both soil erosion and soil accretion will be measured through NGP forests.

3. Temperature

Trees, through the process of photosynthesis, provide fresh and cool oxygen to the atmosphere[78].It also capture carbon in the atmosphere. Carbon is one of the atmospheric elements that contributes to global warming. The impact of reforestation to the amount of carbon captured is proportional to the annual biomass increment and dependent on the annual diameter and height growth. Lasco and Pulhin (2006)[79] observed in CBFM projects where the planting of trees in farms and landscapes by the people has led to soil and water conservation, carbon sequestration and biomass production. It is very obvious that reforestation projects promote CO2 capture from the atmosphere, thereby decreasing the greenhouse effect through the photosynthesis where carbon is stored in vegetation biomass and forest soils.

Thus, temperature is considered as one of the environmental indicators to be measured.

4. Nitrogen, Potassium and Phosphorus (NPK)

Vegetation by nature is a source of NPK from their dead parts. NPK are nutrients to trees and crops. Farmers are dependent of commercial fertilizers for their farms to produce more yields. According to Nazir and Netajini (2014)[80] three forest types i.e., sal (Shorea robusta), teak (Tectona grandis) and shisham (Dalbergia sissoo) average available potassium was maximum (147ppm) in Shorea robusta forest followed by teak and shisham with 102ppm and 32ppm respectively. Similarly, available phosphorus was highest in teak (19.33ppm) followed by sal and shisham 18.17ppm and 2.75ppm, respectively. Organic carbon and total nitrogen were maximum under teak plantation. These findings showed that trees provides NPK.

In reforestation projects in the Philippines, planted seedlings or trees shed off their leaves, twigs and other dead parts that fall on the ground and become parts of the humus which later would mix with the soil. When decayed, the plants parts are rich in nutrients needed by other plants to grow. The primary soil nutrients are NPK. As the NGP forests grow, their litter falls will also increase and automatically resulting to an increase in the NPK available to plants on the ground.

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[78] Taha, H., 1996. Modeling Impacts of Increased Urban Vegetation on Ozone Air Quality in the South Coast Air Basin. Atmospheric Environment 30, 3423–3430.

[79] Rodel D. Lasco and Juan M. Pulhin. Environmental impacts of community-based forest management in the Philippines. Int. J. Environment and Sustainable Development, Vol. 5, No. 1, 2006. http://www.worldagroforestrycentre.org/downloads/publications/PDFs/bc06025lasco.pdf

[80] Tahir Nazir and Ningthoujam Netajini, 2014. Economic Valuation of NPK and Soil Vegetation Interrelationship in Three Forest Types of Dehradun. Nature and Science 2014;12(9). http://www.sciencepub.net/nature/

This NPK will also be transported downhill during rains contributing to the fertility of the lands in lower slope areas.

Because of this, NPK is considered as one of the environmental indicators that will be measured in the NGP sites to determine whether the plantations are contributing to enriching nutrients to the soil.

5. Carbon sequestration

Increasing atmospheric carbon dioxide can be addressed through forestry and forest management[81]. Reforestation is one of the forestry activities that captures carbon from the atmosphere. Carbon is stored in the wood biomass and in the soil from the residues of the litter falls that fell to the ground. This becomes part of the carbon trapped in the soil. The more carbon trapped the better to the environment because high temperature will be further reduced. Initially, the effect of cooling the temperature would be felt at the micro-ecosystem level and later on as the forests become mature, the cooling effect would be felt at the macro-ecosystem level.

6. Soil moisture

According to Tyagi, et al, nd[82] soil moisture under dense forest cover is higher than in degraded forest during all seasons. The values during monsoon, winter and summer seasons were obtained as 40.33, 29.29 and 25.95% respectively under dense forest; and 39.34, 25.50 and 22.58% respectively under degraded forest. The figures indicate that there are more soil moistures in forested areas than in adequately forested areas. Following the trend, it is possible that reforested areas have more soil moisture than the grasslands. It is for this reason that soil moisture is selected as one of the environmental impact indicators that will be measured in the NGP sites to determine whether there NGP forest plantations can recharge moisture into the ground as initial impact of reforestation to water recharging.

7. Wildlife

The revegetation of grasslands attracts fauna and flora species. Fauna uses the forest as habitat area and in return they will bring in fruits and seeds of tree species that will be grown naturally to the NGP-planted area. So if there are wildlife browsing in the area, this will be due to the established forest. If other tree species are growing together with the species that were planted in

[81] Roger Sedjo (2001). Forest Carbon Sequestration: Some Issues for Forest Investment. RFF. http://www.rff.org/Documents/RFF-DP-01-34.pdf

[82] J.V. Tyagi, NIH Roorkee Nuzhat Qazi, FRI Dehradun S.P. Rai, NIH Roorkee M.P. Singh, FRI, Dehradun. Effect Of Forest Cover Structures On Soil Moisture Variation A Case Study In Oak Forested Watersheds http://www.apafri.org/activities/Forest%20Hydrology%20Workshop%20Dehradun/PPTs/24-09-2013/Theme%203/6._jb%20

the NGP project sites, these are attributed as impact of the planted species. Fauna and flora observed on site will also be identified and counted.

According to Ochterski, et. al., 2009.[83]Wildlife benefits from reforestation projects. berry-producing shrubs attracts songbirds, trees that bear nuts attract turkey and small mammals, evergreens and dense shrubs for cover for wildlife habitat and for foraging wildlife.

8. Disaster risk reduction

The DRR law and its IRR relevant to the NGP will be considered in the environmental impact assessment and evaluation[84]. Translating the NGP areas into vulnerable and high risk areas due to extreme rainfall events, typhoons, droughts such as high slopes, water lagged, stream banks, gullies, landslide areas will be considered as among the environmental impact indicators under NGP compliance to DRR.

9. Climate change adaptation and mitigation

The environmental impact indicators to measure NGP compliance to climate change will be based on the National Framework Strategy on Climate Change (2010-2022). The whole NGP-established forests are also ways to adaptation/mitigation to climate change. This is due to the carbon being sequestered by plants in general. The bigger the tree species, the higher carbon is captured. Also, the faster the growth rate of the tree, the more carbon is sequestered. If NGP planted such tree species, then it has addressed these concerns in climate change.

10. Stumpage build-up

The NGP- established forests are also meant to produce wood in designated production forest for the wood industry. This is intended to supply lumber, veneer, plywood, paper and other wood-based products. A high survival rate would mean high stumpage at economic or biological rotation. Therefore, there would be sufficient supply of wood for the wood industry.

In the protected area sector, the buildup of stumpage is important for the production of environmental services.

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[83] Jim Ochterski, Cornell University Cooperative Extension of Ontario County Peter Smallidge, Cornell University Cooperative Extension, Department of Natural Resources Jeff Ward, The Connecticut Agricultural Experiment Station, Department of Forestry and Horticulture. Dec 2009. Northeastern Tree Planting & Reforestation. http://www.cce.cornell.edu/Environment/Documents/PDFs/TreePlantingBulletin12-09.pdf

[84] Republic Act No. 101211. An Act Strengthening The Philippine Disaster Risk Reduction And Management System, Providing For The National Disaster Risk Reduction And Management Framework And Institutionalizing The National Disaster Risk Reduction And Management Plan, Appropriating Funds Therefor And For Other Purposes. http://www.ndrrmc.gov.ph/attachments/article/45/Republic_Act_10121.pdf

11. General impacts of NGP forests according to peoples' perceptions in the communities

According to the findings of the social study group, some of the respondents interviewed in Zambales informed them that after a year of planting in the NGP, a dead spring was recharged with water during the summer season. Some of the questions to be asked are those that pertain to whether NGP has already reduced siltation of streams, flooding during wet season, increased stream flow of rivers, increased volume of ground water through recharging of wells, cooling of temperature in the barangay, increased number of wildlife, and other observed impacts based on the perceptions of the people in the communities.

Environmental impact evaluation for NGP sites is presented here in Appendix Table 8. "Criteria and Indicator" includes impacts to Soil Indicators, soil NPK, Carbon, Organic Matter and soil moisture, litter fall NPK, and Carbon, DRR, CCA, and Biodiversity Conservation. The three different sites will be compared to one another using the indicators.

VI. Methodology

1. Sampling NGP provinces, municipalities and NGP and Non-NGP sites

The sampling methodology for selecting the NGP sites for assessment and evaluation followed a multi-stage sampling with proportional allocation to the provinces that implemented the NGP.

The steps in the sampling process were:

1. Stratifying the sampling population – the provinces by major islands: Luzon, Visayas and Mindanao. The stratum are Luzon Stratum, Visayas Stratum, and Mindanao Stratum.
2. The total number of provinces by stratum was determined. This resulted to:

    a. Luzon stratum – 39 provinces
    b. Visayas stratum – 17 provinces
    c. Mindanao stratum – 24 provinces

3. The maximum number of provinces was significantly dictated by available resources and time constraint for the environmental impact study. Budget calculation and fund allocation to the different activities and time constraint indicated that it was only sufficient for 6 provinces.

4. The 6 provinces were allocated to the major islands using proportional allocation, the percentage was calculated for each stratum. The results are:
    a. Luzon stratum: 39/80 = 48%

    b. Visayas stratum: 17/80 = 21%

c. Mindanao stratum: 24/80 = 30%

5. The number of provinces that were selected for sampling are:

   a. Luzon stratum: 48% of 6 is 2.88 rounded up to 3 provinces.

   b. Visayas stratum: 21% of 6 is 1.26 rounded up to 1 province.

   c. Mindanao stratum: 30% of 6 is 1.86 rounded up to 2 provinces.

6. Random selection of the 6 provinces

   To avoid bias in the selection process, the provinces in Luzon stratum, Visayas stratum and Mindanao stratum, were selected by random draw lots by the NGP Assistant Coordinator and staff together with the presence of the PIDS consultants and PIDS representative. For phase 1, 3 provinces were selected. Another 3 provinces will be selected in Phase 2.

   The randomly selected provinces for Phase 1 were Zambales, Dinagat and Negros Occidental.

7. The municipalities that were sampled were determined through cluster sampling where all the municipalities in each of the selected provinces having 196 hectares or more planted under the NGP and another 196 hectares or more under non-NGP sites (planted under different funding mechanism) were clustered.

8. The municipality that was randomly selected corresponds to where the NGP sites and non-NGP sites are located.

9. Purposive selection of the NGP site and Non-NGP site in the randomly selected municipality by selecting the NGP sites and non-NGP sites that are contiguous or at most within 1 to 3 hours travel time from site to site.

10. At the NGP site or Non-NGP site level, 100% inventory and measurements of the seedlings/trees planted were conducted.

11. Sampling plots for the environmental indicator measurements were conducted using a 30% sampling intensity of the inventoried seedlings/trees. The seedlings/trees where measurements of environmental indicators were randomly selected on the ground.

2. Selected provinces, municipalities and NGP sites

The sampling resulted to the selection of the following provinces and municipalities (Figure 2). The random selection of the provinces and municipalities were conducted with the DENR NGP National Coordinator and staff, FMB Director's Office Representative, consultants and NEDA-PIDS Representative.

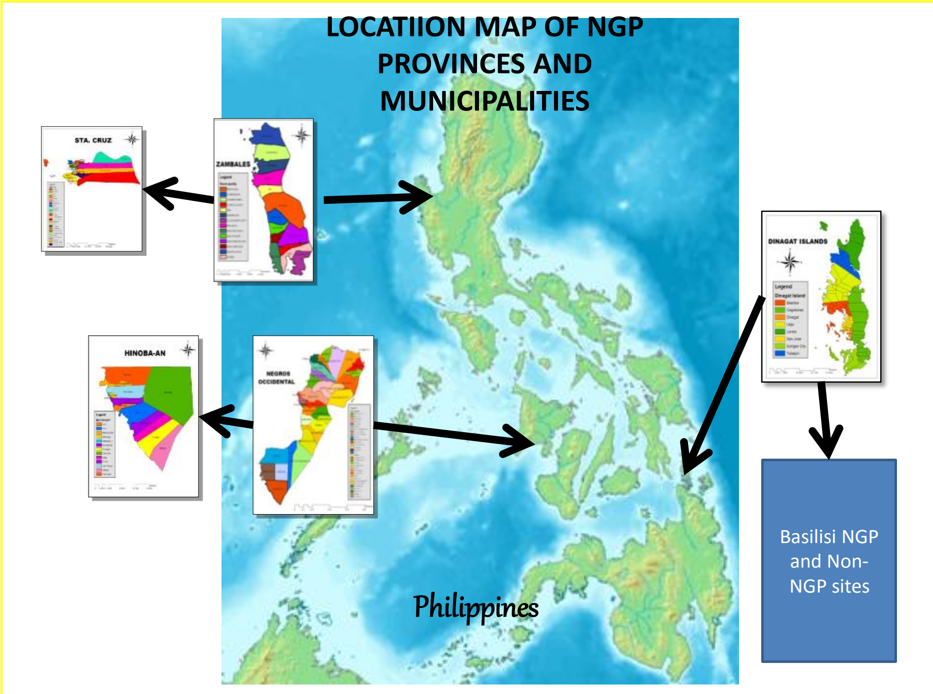

Figure 2. Locations of NGP Sites for Assessment and Evaluation.

In Zambales, the municipality of Sta. Cruz was randomly selected. In Dinagat Islands, the municipality of Basilisa was selected. In the province of Negros Occidental, the municipality of Hinobaan was selected.

3. Data collection methodology

The general methodology used is KII/FGD for the process assessment and evaluation. For the environmental indicators, actual measurements were used.

The reasons for selecting the KII/FGD as the methodology for the process assessment and evaluation are: a) this activity was budgeted; b) implementation procedures in reforestation activities were the same for all workers and that payments were based on physical outpust according to standards. Thus, this did not require a higher number of respondents.

1. Sampling KII/FGD participants

The respondents to the KII/FGD were randomly selected from the list of workers in the NGP and Non-NGP sites provided by the CENRO. From the list, random selection was conducted by drawing the names of the workers. The respondents came from those who worked in seedling production, site preparation, planting, and protection and maintenance in the NGP and Non-NGP sites.

1.1. FGD instrument

The FGD invited the officers of the CENROs, PENROs, Regions and People's Organizations involved in executing Survey, Mapping and Planning (SMP), Capability building, and NGP forest quality assurance.

The FGD instruments for these activities were:

a. Annex 1 is for the assesment and evaluation of the process of Survey, Mapping and Planning (SMP) implemented by the PENRO and/or the CENRO or sometimes contracted to technical service providers. The target respondents were enumerated in the KII/FGD guides.

b. Annex 2 is for the assessment and evaluation of the processes in NGP forests quality assurance. The respondents were those engaged in periodic inspection of the quality of processes and their outputs to ensure that the minimum standards prescribed by the DENR are satisfied.

c. Annex 3 is for the assessment and evaluation of the processes performed by the CENRO and/or PENRO or his/her staff to train/orient or leveling of the PO and/or community-member contractors who were assigned in specific reforestation activities. The respondents were the officers and members of the PO who attended the training or orientation, the CENRO and PENRO technical staff who acted as resource persons.

1.2. KII instrument

The KII instruments used for assessing seedling production, site preparation, planting, and protection and maintenance were:

a. Annex 4 is for the assessment and evaluation of the processes of how seedlings were produced whether from seeds collected, wildling collected and cloned seedlings, or procured from accredited nurseries or from other sources. The target respondents should be those engaged in the actual preparation and taking care of the seedlings at the nursery. These were the PO or community members who worked in the seedling production process.

b. Annex 5 is for assessment and evaluation of the processes of how the reforestation sites were prepared for planting by the contracted PO or community members. The target respondents were those that participated in actual site preparation activities.

c. Annex 6 is for the assessment and evaluation of the processes of how planting was conducted by the PO or community members in the reforestation sites that were prepared for planting. The respondents to the KII/FGD should be those that participated in the planting activities.

d. Annex 7 is for the assessment and evaluation of the processes of how protection and maintenance activities were implemented by the PO or community members. The respondents were those who conducted the actual protection and maintenance activities.

2. Environmental impact measurement

The second part of the process assessment and evaluation is the validation or measurement of environmental impact indicators to see whether NGP will be able to result on quality forests expected to be established and managed, achieve the NGP objectives, and whether such forests will attain positive impacts.

The following environmental impact indicators measured and/or validated on the ground were:

2.1. Survival rate

The survival rate is important because the NGP's impacts to the environmental, social, economic and institutional will hinge from it. Impacts included both positive and negative effects to the environment, social, economic, and institutions.

1. Area for measurement

The total area sampled per province was 569 ha. This area was divided into 3 parts, 190 ha for NGP sites, 190 ha for non-NGP sites[85], and 190 ha for control sites. Some province have no Non-NGP sites so the 190 ha was added and sampled in NGP sites, making a total area of 380 ha in NGP sites. The 190 ha control site was sampled in adjacent grassland, bare soil or not-planted areas near NGP sites.

The purpose of the non-NGP site, also planted with forest species, is to have a comparison in terms of survival rates and processes used with the planted NGP site. The control site, which is mostly grassland, is for comparison of the other environmental impact indicators with the NGP site planted with forest species. The difference between the NGP site and non-NGP site in terms of survival rates and processes implemented provides insights on whether NGP implementation is better than the non-NGP site or vice versa. On the other hand, the difference between the NGP site and the control site in terms of the environmental impact indicators, provides insights on whether the NGP site is beneficial or not to the environment. The original condition of the environment of the NGP site befor it was planted is similar to the control site.

[85] Non-NGP sites by definition are area reforested or planted using non-NGP funds. This may include EDC reforestation projects, NAPOCOR Watershed reforestation projects, FSP CBFMA reforestation projects, mining reforestation projects and other projects not funded under NGP. Private sector reforestation projects are also included in the definition of non-NGP sites.

2. Allocation of the 190 hectares in NGP sites

Some NGP sites were more than 190 hectares exceeding the area to be sampled. In this case, proportionate allocation of the area to be sampled was conducted. If the area is equal to 190 ha, proportionate allocation was not necessary. The sampling plot was a strip plot with a dimension of 20 meters x 50 meters across the slope of the NGP site. There were several 20m x 50m plots from boundary to boundary of the selected NGP site that was sampled.

3. 100% inventory of seedlings/trees in the NGP site and Non-NGP site

All seedlings inside all the plots within an NGP site were counted and graded whether living or dead including a description of the health of the living seedlings.

The same procedure was conducted in non-NGP sites.

In the control sites, which were generally bare soil or grassland, the procedures mentioned in the NGP and non-NGP sites were not performed.

2.2. Indicators for measurements

1. Survival rate

For survival rate, the following information were measured:

a. Species planted
b. Year planted
c. Area planted
d. Year replanted
e. Area replanted
f. Spacing (based on SMP)
g. Actual spacing to be randomly sampled on the ground
h. Number of living planted seedlings
i. Number of dead planted seedlings
j. Potential/probable cause of seedlings mortality
k. Health condition of living seedlings

l. Height of planted seedlings

m. Diameter of planted seedlings

n. Number of leaves of living seedlings

o. Recommendations on how to improve growth and survival of planted seedlings

2. Potential stumpage buildup

The build-up of wood volume of the NGP sites made use of projected survival rates of the planted species through time. The projected survival rates were based on natural thinning process as a function of the overlapping crowns of individual trees as the trees grow. Existing growth and yield models for the planted species were used to project their potential stumpage. For species without growth and yield models, a simple linear projection was used to estimate their potential stumpage by computing their total wood volume divided by their age.

2.3. Measurements of environmental impact indicators

The following environmental impact indicators were measured in the NGP site, non-NGP site and control sites

1. Impact on Soil

The NGP forests will contribute to erosion or accretion of the soil. Physically, the root system will hold the soil thus minimizing the movements of soil particles and through the root system, soil particles are trapped and build up the soil. Also, the litter falls from the canopy of the NGP forests are expected to become humus and eventually will mix up with the soil. Thus, resulting in the accretion of the soil.

Soil erosion/accretion impact was measured through following steps:

a. Randomly select 10 seedlings along the center within the sampling plot (20m x 50m plot), measure the soil build up at the base (upper hill base) and soil scouring (lower hill base) of each of the randomly selected seedlings. Use a calibrated erosion bar for measuring the heights of soil buildup and depths of eroded soil.

b. The algebraic sum of the upper hill base and lower hill base gives the NGP contribution to soil accretion or soil erosion per living seedling. Do the same process for all sampled planted seedlings.

c. Calculate the average soil erosion/accretion per plot by multiplying the average soil erosion/accretion per seedling by the number of live seedlings in the sample plot.

d. Repeat *items a to c* for the other sampling plots.

e. Repeat the process in the non-NGP sites.

f. Repeat the process in the control sites by randomly selecting 10 grass spots for soil erosion and accretion measurements.

2. Impact on temperature

For temperature measurement, the following were the steps undertaken:

a. Using the same 10 seedlings randomly selected in the soil erosion and accretion measurements per plot, take temperature readings below the crown or branches of each seedling within the sampling plot.

b. Repeat the process in every sampling plot.

c. Repeat the process in every sampling plot in the non-NGP sites.

d. Repeat the process by selecting 10 grass spots in the control sites for temperature measurements.

3. Impact on NPK, carbon and soil moisture

1. NPK, carbon and moisture in the soil

The NPK, carbon and moisture serve as baseline information on the quantity of NPK, carbon and moisture already stocked in the soil. When forest species are planted in the NGP sites, NPK, carbon and moisture in the soil are expected to increase. The increase is due to the contribution of the forest species to the soil.

Sampling method

The sampling method used was the stratified randomized sampling method. The procedures in implementing this method were:

a. Stratify the NGP area to be sampled into slope classes. Different slope classes have different NPK, carbon and soil moisture. This means that for a single slope class, for instance, 0-18% slope, all ground points have the same (with insignificant variation) NPK, carbon and soil moisture contents because they share the same species (grasses), the same effect of soil erosion, and the same effect on the deposition of NPK, carbon and moisture. Thus, all ground points within the slope class have more or less similar NPK, Carbon and soil moisture contents.

Under this situation, there is no need to sample several soil sampling plots and that one plot will suffice. This is so because the accuracy of information that can be generated from a single sampling plot is similar to those taken from several plots. The other consideration is that the cost of sampling and laboratory analysis of a single sample versus several samples counts with very little value added information that can be generated from several sampling plots in the same ground condition. What is important is how the sampling point will be selected whether randomly or purposively selected.

Comparing the soil sampling method for the NGP sites with that of the DA Region2 in 2014 in updating its map, it conducted a soil survey for NPK soil survey and analysis covering 114,000 hectares establishing on 4,430 soil samples. This had a ratio of 25.73 hectares of agricultural land represented by 1 sample[86]. It appears that the soil sampling in the NGP site has more samples per NGP site area than in the agricultural sector.

The point of interest is the contribution of the NGP site to NPK, carbon and soil moisture in enriching the soil over different ground slopes planted with different species. Thus, the sampler will randomly select on the ground within the slope class where to establish one sampling point. As a result of this process, there will be one soil sampling plot for each of the following slope classes: a) 0-18% slope class; b) 19-36% slope class; c) 37-55% slope class; and >55% slope class.

b. Weigh all the plastic bag with zip lock and label properly indicating the following:
    a. Weight of the plastic bag
    b. NGP site
    c. Slope class
    d. Weight of the soil sample in the plastic bag
    e. Forest species planted
    f. Date and time sampled
    g. Sampled by
c. Take each of the soil samples at a soil depth of 0-30cm.
d. Place each collected soil samples in a plastic bag with zip lock.
e. Weigh each of the soil samples with the plastic bags.
f. Complete the label in the plastic bag upon filling it in soil sample and weighing it.

[86] **Rudy A. Fernandez**, August 14, 2011 R-2 updates soil fertility map. http://www.philstar.com/agriculture/716089/da-r-2-updates-soil-fertility-map

g. Bring all the soil samples that were already properly weighed and labeled to the soil laboratory for the analysis of NPK, carbon and soil moisture.

h. Repeat the process from items *a to g* for the non-NGP sites and control sites.

2. NPK and carbon from litter falls of NGP planted seedlings

The sampling method used here was a stratified random sampling of living seedlings within each of the plots. The stratification was based on forest species planted and year planted.

The procedures followed consisted of the following steps:

a. Locate on the ground in the NGP site, the forest species and the year where such forest species were planted.

b. For a given forest species in a block, randomly select 10 seedlings along the center line of the 20m x 50m sampling plot.

    a. Weight of the plastic bag

    b. NGP site

    c. Slope class

    d. Weight of the litter fall sample in the plastic bag

    e. Forest species planted

    f. Date and time sampled

    g. Sampled by

c. Under the crown or branches of each seedling, collect the litter fall or fallen leaves.

d. Place collected litter falls in a plastic bag with zip lock.

e. Weigh the plastic bag filled with litter falls

f. Complete the label in the filled plastic bag by indicating the weight of the plastic bag with the litter fall.

g. Repeat the process in the non-NGP sites.

h. Since the control site is mostly grassland, no litter fall sample will be collected. Grassland species have negligible NPK and carbon contribution to the soil compared to forest species.

3. For DRR compliance of NGP site, non NGP site

There was no sampling method used here. Instead, mapping of the following risky areas were conducted. Existing topographic maps of the NGP sites were classified according to slope classes considered as high risk areas.

The risky areas were:

a. High slopes and above planted.

The necessary information are:

Slope range (%)	Area (hectares)	Percent Area over Total NGP Area	DRR Design[87]	Forest Species Planted
36 – 55%				
>55%				

b. River banks, gullies and land slide areas

Ground Natural Feature	Area (hectares)	Percent Area over Total NGP Area	DRR Design[88]	Forest Species Planted
Vulnerable river/stream banks				
Existing gullies				
Existing land slides				

4. **For Climate change adaptation and mitigation of NGP sites, non-NGP sites**

Climate change adaptation[89]

[87] DRR designs refer to any features that will reduce the impact of rainwater and surface runoff to areas that may collect rainwater and eventually result in flooding, landslides, gullies etc.

[88] Ibid

[89] Climate change adaptation refers to the activities necessary to reduce the vulnerability of the NGP reforested areas to climate change effects such as El Nino, drought, floods due to extreme rainfall events, rainfall of typhoons, La Nina, landslides, excessive soil erosion that will reduce the viability of establishing forests under the NGP.

Climate change Factor	Climate Change Effect	Adaptation Measures to NGP sites	NGP compliance to Climate Change Adaptation
Extreme rainfall events, heavy typhoon rainfall, La Nina	Floods	Construction of intercepting ditches to divert surface water from passing through planted areas	See if the adaptation measures were conducted
	Landslides	Planting of deep-rooted forest species in close spacing	Same above
	Extreme soil erosion	Planting of hedge rows of kakawate and deep rooted forest species in between hedgerows.	Same above
	Gully formation	Construction of diversion canals to deviate surface runoff from gully directions and planting of gullies with deep –rooted forest species to hold back the soil.	Same above
Dry season, drought, el Niño	Soil moisture depletion in NGP areas that were already planted and about to be planted.	Provision of improvised water system such as rain water harvesting, drip method of watering seedlings, tapping of spring water, stream water for the NGP plantations. Planting of water loving plants or drought resistant species before desired forest species are	Same above

		planted	
	High mortality of planted seedlings in NGP sites resulting in low survival rates	Same above	Same above
	Reduce target of NGP plantable areas	Same above	Same above

For climate change mitigation[90]

Climate Change Problem	Mitigation Measures	NGP compliance to climate change mitigation
Increase in temperature	Establishment of NGP forests to provide more carbon sink thus capturing substantial amount of carbon from the atmosphere	This project calculated the carbon sequestration of each of the NGP planted forest species, determined their growth rates and observed whether the NGP sites were correct in selecting and planting such forest species.
		Increase in soil carbon from the litter falls of the NGP planted forest species.

5. Wildlife impact of NGP plantations

This was composed of two wildlife classes. These are: a) fauna; b) flora. The impact of NGP to the influx of fauna into the planted areas was estimated through the following steps:

Fauna

a. Showing pictures of fauna that returned to the NGP sites. The respondents identified the species of fauna giving them local names, and they were asked on what time of the day

[90] Climate change mitigation refers to activities that will reduce carbon emission and capture more carbon from the atmosphere.

such species of fauna were spotted. They were asked also how many times they have spotted the species of fauna that they have identified.

b. The responses were recorded.

Flora

a. While doing the inventory of planted NGP forest species, pioneer forest species growing in the area were counted per spot.
b. Their diameter and height was measured.
c. Flowering pioneer forest species growing in the area were recorded to indicate that these are potentials for providing wildlings to regenerate the area.

4. *Data processing and analysis*

Going back to Appendix Table 1 to Appendix Table 8 indicators, the data and information taken during the KII and FGD and the actual measurements of the environmental impacts, were processed using the following statistical tests. The analysis followed the results of the ANOVA or F-test of the following:

1. In comparing the provinces in terms of the environmental indicators, Analysis of variance or F-test was used. A one-Way ANOVA (Analysis of Variance) was used to test whether 3 or more means of the NGP sites are equal. It tests if the value of a single variable differs significantly among three or more factors.

The correlations of the indicators or variables were tested using Pearson's correlation coefficient for quantitative variables and Spearman's rank order correlation for qualitative variables.

VII. Environmental Profile of the NGP Provinces, Municipalities and NGP Forest Plantations

The environmental profile information was generated from the internet. These information include geographic location of the province, municipality and the NGP sites, population and density, land area, topography, climate (rainfall and temperature), soil and geology, land cover, forest species, and water sources. Some useful environmental profile maps available from the internet were downloaded and were used in describing the environmental profile of the provinces and municipalities. In some cases, the provincial and municipal environmental profile with the desired features visible were downloaded from Google Earth. Environmental maps that are not available in the internet were not presented in the environmental profiles of the provinces and municipalities.

On the other hand, some available environmental profile maps of the NGP sites were requested from the CENRO or PENRO.

1. Province of Zambales

1. Geographic Location

The coordinates of the province and the municipality sampled including the sampled NGP sites where environmental impact evaluation was conducted are described in Table 1

Table 1. Geographic Location of Zambales, Sta. Cruz and NGP Project Sites.

	N	E						
Zambales	15° 20′ 0″	120° 10′ 0″						
Sta. Cruz	15° 46′ 0″	119° 55′ 0″						
NGP Site	Corner 1		Corner 2		Corner 3		Corner 4	
	N	E	N	E	N	E	N	E
Babuyan	15° 51′ 29″	120° 2′ 46″	15° 51′ 29″	120° 2′ 46″	15° 51′ 21″	120° 2′ 48″	15° 51′ 15″	120° 2′ 44″
Guinabon	15° 51′ 29″	120° 2′ 46″	15° 51′ 29″	120° 2′ 46″	15° 51′ 29″	120° 2′ 46″	15° 51′ 29″	120° 2′ 46″
	15° 51′ 29″	120° 2′ 46″	15° 51′ 29″	120° 2′ 46″	15° 51′ 29″	120° 2′ 46″	15° 51′ 29″	120° 2′ 46″

2. Population and population density

Zambales is located in the Central Luzon region (Region III) which is bounded by the West Philippine Sea to the west, Pangsinan to the north, Tarlac and Pampanga to the east, then Bataan to the south. It has a total land area of 3,830.83 km^2 and is considered as the second largest province among all the provinces of Central Luzon (Region III).[91]Table 2 shows the population and population density by municipality and city of Zambales.

Table 2. Population and Population Density.

Municipalities and Cities	**Population[92]**		**Pop Density (2010)**	**Pop Density (2015)**
	2010	**2015**		
Botolan	54,434	60,177	0.74	0.82
Cabangan	23,082	25,517	1.32	1.46
Candelaria	25,020	27,660	0.75	0.83
Castillejos	48,845	53,998	5.25	5.81
Iba	46,761	51,694	3.05	3.37
Masinloc	44,342	49,020	1.34	1.48
Olongapo	221,178	244,512	11.96	13.22
Palaguig	33,286	36,798	1.07	1.19
San Antonio	34,217	37,827	1.82	2.01

[91]Department of Tourism, 2015; National Statistics Office,2015.

[92] Source: NSO, 2015, www. NSO.gov.ph

San Felipe	22,020	24,343	1.97	2.18
San Marcelino	31,879	35,242	0.76	0.85
San Narciso	26,966	29,811	3.77	4.16
Santa Cruz	***53,867***	***59,550***	***1.23***	1.36
Subic	89,724	99,190	3.12	3.45
Data source: Source: NSO, 2015, www. Nso.gov.ph				

The least populated municipalities are Botolan and San Marcelino. The highest populated municipalities are Olongapo, Castillejos, San Narciso and Subic. The population density of the study site, the Municipality of Sta. Cruz, is 1.36. This means that a little more than one person is living in a hectare of land in Sta.Cruz this 2015.

3. Land area

The total land area of Zambales is 383,083 hectares and its total forest land is 36,806 hectares (Table 3)

Table 3. Land Area and Forest Land Area of Zambales.

Municipalities and Cities	Land Area[93] (ha)	Forest Lands[94]	% Forested Land
Botolan	73,528	0	0.0
Cabangan	17,529	11,750	67.0
Candelaria	33,359	0	0.0
Castillejos	9,299	0	0.0
Iba	15,338	0	0.0
Masinloc	33,150	1,487	4.5
Olongapo	18,500	12,291	66.4
Palaguig	31,000	1,014	3.3

[93] Ibid

[94] Source: DA BAR Maps

San Antonio	18,812	0	0.0
San Felipe	11,160	0	0.0
San Marcelino	41,686	0	0.0
San Narciso	7,160	0	0.0
Santa Cruz	***43,846***	***10,264***	23.4
Subic	28,716	0	0.0
Total Land Area	383,083	36,806	

Out of the 14 municipalities, Cabangan (67%), Olongapo (66.4%) and Sta Cruz (23.4%) are those still with forests. The total forest land is only 9.6% of the total land area of the province. This percent forest land cover is much way below the national forest land cover figure of about 24% of the total land area of the country. It can be deduced that 9 of these have minimal potentials to recharge water, minimize soil erosion, capture carbon, and other environmental services, which means that Zambales is one of the provinces where its forest land has been degraded significantly.

Increasing the area of degraded forest lands for forest restoration must be pursued by the province in order to restore back the productivity of the forest ecosystems for forest goods and environmental services and environmental development of the province.

4. Land use and vegetative cover

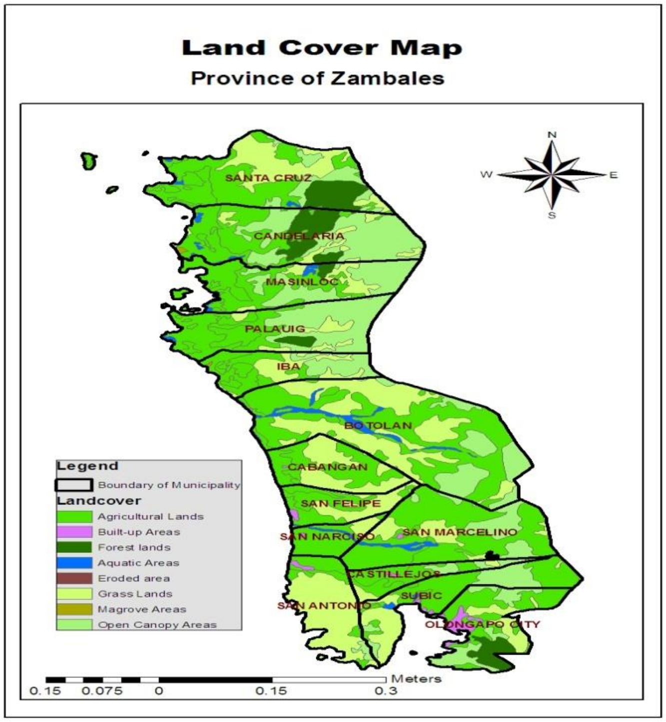

Figure 3. Land Cover of Zambales.

As shown in the Land Cover Map (Figure 3), forested areas are relatively negligible in area compared to agriculture lands. The forested lands are situated in Santa Cruz, Candelaria, Masinloc, Palauig and Olongapo. Open canopy areas composed of Mango and other fruit trees, small trees and shrubs, cover about 35% of total area of Zambales.

Forests play a very important role in providing wood for the lumber industry, in recharging water to the watersheds, in sequestering carbon, in producing fresh and clean oxygen, in serving as wildlife sanctuary and in many other environmental services. Based on the density and distribution of the forest in the province, it can be deduced that the supply of wood and environmental services is already at an alarming level.

The common types of forest species that can be observed in Zambales are Agoho (***Casuarina equisetifolia***), Acacia (*Samanea saman),* Bagras *(Eucalyptus deglupta),* Benguet pine *(Pinus kesiya), Banuyo (**Wallaceodendron celebicum)*** and Mangium *(Acacia mangium*). Bagras, Benguet pine and Mangium are exotic to the place and introduced in reforestation areas. However, they are adapted to the place and are thriving well. These forest species are growing throughout the whole area of Zambales. These species have different characteristics. Acacia, Benguet pine and Banuyo, for example, grow up to 30 meters with a diameter of 120 cm or higher often with a straight trunk. Mangium is a popular species for forest plantation and used also for agroforestry projects. It can reach a height of 15 meters and a diameter of 70 cm.

The other vegetative cover that is widespread in the province is grassland mostly covered with cogon grass. Grassland is very common to grazing. Roughly, 75 % of the total area of the province is grassland including the unproductive agricultural land (Figure 4). Burning of grasses is common in grazing to improve young shoots that are palatable to cattle. Grass burning is practiced at least twice a year. This explains the high soil erosion of the mountains in the province.

Figure 4. Other Vegetative Covr Types of Zambales.

5. Land use classification

In 2010, 68 percent of the area was forested but unfortunately it decreased by 18 percent since 50 percent of the area was already denuded. The remaining 31.33 percent of the total land area of the province is considered part of alienable and disposable lands, including agricultural land, uncultivated, built-up areas and creeks/rivers (Table 4). Figure 5 shows the land classification map of Zambales.

Table 4. Land Use Classification of Zambales, 2010.

Land Classification	Area (Hectares)	% Area
Alienable and Disposable Land		
Agricultural	52,370	14.10
Uncultivated	28,335	7.63
Built-up Areas	28,468	7.66
Creeks/Rivers	7,205	1.94
TOTAL	116,378	31.33

Classified Forest/Timberland		
Remaining Forest Area	140,284.10	37.77
Denuded Area	114,777.90	30.90
TOTAL	255,062.00	68.67
GRAND TOTAL	371,440.00	100
Data source: Department of Agriculture		

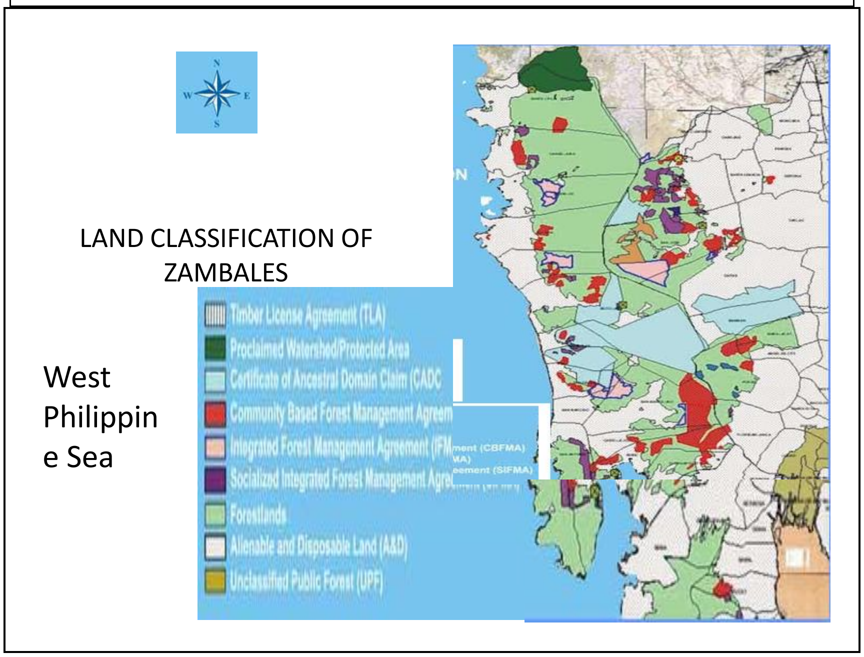

Figure 5. Land Classification Map of Zambales.

6. Topography

Zambales is generally mountainous to the east. Terrain ranges from a stretch of narrow plain to the west from high to very high slopes to the east. It has a small area that is swampy to the north bordering with Pangasinan (Google Earth, 2015).

7. Climate

The climate of Central Luzon where Zambales is located is generally influenced by three predominant air streams, namely: the northeast monsoon (Amihan) common from November to February, which is relatively cool and less humid; the tradewinds common during late March and early May, which is very warm and humid; and the southwest monsoon (Habagat) common from June to October. The climate of the Philippines is generally described in terms of the distribution of rainfall received in a locality during the different months. Based on the Corona classification of climate types, most of Central Luzon is described as Type I, with two pronounced seasons: typically dry from December to May and wet during the rest of the year.

a. Rainfall

For the period observed (1969-1995), the average annual precipitation ranges from a low 1036.7 mm to a high 3857 millimeters. The maximum rainfall was observed at Cabangan (Zambales) station during the month of August at 2712.1 mm. Rainfall is relatively heavier along the peripheries of the province in the coastal areas than its inner mountainous areas. This is attributable to the condensation of clouds formed through evaporation of sea water from the ocean[95].

b. Temperature

The average normal maximum and minimum temperatures are 32°C and 22°C, respectively. The coldest period is from December to February. The hotter months are from April to June.

c. Typhoons and Storm Surge

Typhoons frequency in Zambales area coming from the east is low due to its mountain ranges blocking the north-easterly winds. While it is free from the north-easterly winds, it is vulnerable to the southeast monsoon and cyclonic typhoons[96].

During the past 40 years (1946-1985), the region was visited by typhoons averaging 22 surges annually.[97] The typhoons that passed through Zambales from 1947-2002 causing peripheral impacts were Trining which occurred from October 16-31, 1991 (wind speed of 204kph, no rainfall data), Yoling in November 17-20, 1970 (wind speed of 200kph, no rainfall data) and Didang in May 12-17, 1976 (wind speed of 150kph, no rainfall data). These typhoons caused deaths and damages to properties worth billions of pesos. Didang killed 374 persons in Iba, Zambales and Yoling resulted in 611 dead persons. The other typhoons that landed in Zambales are Juan (wind speed of 30-60kph, rainfall of 50-65mm), Basyang (wind speed of 65-145kph, rainfall of 150mm), and Caloy (wind speed of 130-150kph, rainfall of 80-90mm). These typhoons damaged mostly the agricultural crops of Zambales through flooding and wind throws.[98]

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[95] Final Report for the Tourism Master Plan for Region III (Central Luzon). Engineering and Development Corporation of the Philippines (EDCOP)

[96] Ibid

[97] Final Report for the Tourism Master Plan for Region III (Central Luzon). Engineering and Development Corporation of the Philippines (EDCOP)

[98] Typhoon2000 official website. Retrieved from: *http://www.typhoon2000 .ph/stormstats/ Worst LuzonTyphoons.htm*

The last typhoon that hit Zambales in 2014 was Glenda (wind speed of 110-140kph, rainfall of 7.5-25mm). Figure 6 shows the typhoon path passing through Zambales.

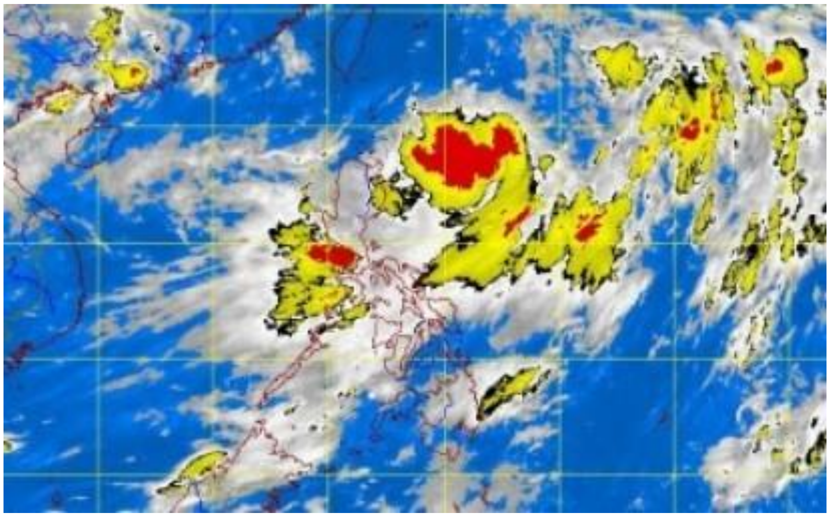

Figure 6. Typhoon Path Passing Through Zambales.

8. Soil

There are 7 types of soil found in the province of Zambales. These are mountain soil, undifferentiated soil, Antipolo Clay, Angeles Sand, Quingua Silt Loam, Cabangan Sandy Loam, and Hydrosol. More than 60 percent of the total land area of the province exhibit mountain soil type since it is traversed by the Zambales Mountain Ranges (Table 5).

Table 5. Soil Types in Zambales, 2010.

Soil Type	Area	% Area
Mountain Soil	242,284	64.96
Undifferentiated	60,130	16.19
Antipolo Clay	33,292	8.96
Angeles Sand	16,983	4.57
Quingua Silt Loam	11,308	3.05
Cabangan Sandy Loam	6,723	1.81
Hydrosol	1,720	0.46
TOTAL	37,440	100
Data source: Department of Agriculture		

According to Carating[99] (2014), mountain soil was formed from weathered quartz, diorite, and sandstone. It occurs at elevation even higher than Natubleng series, at around 2,262 m above mean sea level. The relief is moderately steep to very steep. The external drainage is good to excessive while the internal drainage is poor. This means that surface runoff is high and water recharge is low probably due to impermeable hard rock underneath the soil. Another is the antipolo clay which belongs to the Antipolo series formed from basalt, igneous, and other volcanic rocks. The relief is rolling basaltic hills and ridges to mountainous. Some portions are slightly rolling to almost flat, especially the localized valleys. Next is the Angeles sand. It is a river–terrace soil basically used for agricultural production. Then the Cabangan series was first described in the municipality of Cabangan, Zambales, and it was the secondary soil developed from older alluvial materials deposited on fans or terraces and classified as Aquic Eutrudepts. The external drainage is fair to good while internal drainage is poor. The relief is level to gently sloping. It has a topsoil of about 25cm, pale brown in color and slightly compact. A total of 129,965 ha of Cabangan sandy loam, clay loam, and clay were mapped in Agusan, Zambales and Davao provinces (Fernandez and Jesus 1980). And lastly, the Hydrosols, a soil classified as saturated with water for longer period of time and have poor drainage. The soils were influenced by the seasonal wet conditions of the year for at least 2-3 months (McBartney and Minasny, 2007)[100].

9. Water Resources

Heavy precipitation occurs generally from June to October, the period of southwest monsoons. More than 90% of the annual rainfall concentrates in this period with August experiencing the heaviest downpour. The annual amounts range from 1,036 mm in the central portion of Central Luzon to 3,856 mm along the western coasts[101].

Generally, the central plain is good for shallow wells, and the mountain areas in the east and the west are difficult areas for groundwater utilization as indicated in the report of National Water Resources Council (NWRC) in 1992 popularly known as the "Rapid Assessment of Water Supply". Deep wells that can be found in Zambales are at the northern part of Tarlac[102].

Irrigation water for agricultural land of Sta. Cruz, Zambales was described by people in the community to appear red due to nickel mining in the area. This indeed became a threat to the

[99] Carating,R.B., Galanta, R. G. and Bacotio, C.D (2014). The Soils of the Philippines. World soil book series.

[100] Minasny, B., A.E. Hartemink, A.B. McBratney & H.J. Jang 2013. Citations and the Index of Soil Researchers And Journals In The Web Of Science, Scopus, And Google Scholar *PeerJ* 1:e183; DOI 10.7717/peerj.183

[101] Final Report for the Tourism Master Plan for Region III (Central Luzon). Engineering and Development Corporation of the Philippines (EDCOP)

[102] Ibid as reported by EDCOP

livelihood of the people as well as to their lives. The need to rehabilitate the denuded area of Zambales is deemed important.[103]

10. Volcano

There are two volcanoes found in Zambales. These are Mt. Cuadrado, an inactive volcano. The other one is Mt. Pinatubo in Botolan, Zambales[104].

11. Environmental Profile of the Municipality of Sta. Cruz, Zambales

1. Location map of Sta Cruz, Zambales

The location of Sta. Cruz is shown in Figure 7.

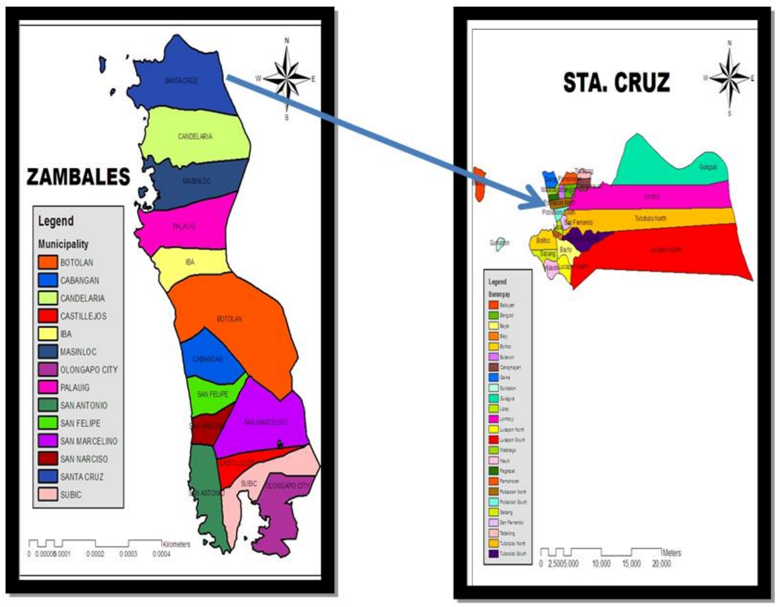

Figure 7. Location Map of Sta. Cruz, Zambales

The environmental profile of Sta. Cruz is similar to that of the province of Zambales. They only differ in land uses and land cover types and in area allocations.

2. Forest land uses

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[103] Ibid as reported by EDCOP

[104] Final Report for the Tourism Master Plan for Region III (Central Luzon). Engineering and Development Corporation of the Philippines (EDCOP)

In the case of Sta. Cruz, the forest land uses and land cover types are summarized in Table 6. The land uses are dominated by arable lands, crop lands with coconut plantation, and cultivated area mixed with brushland and grassland. All these account for 49.8%. Grassland accounts for 26.8% and forested lands account for 22.3%. This implies that the current forested lands may not be sufficient to provide on a sustainable basis the important goods and environmental services of the existing forest ecosystems. Thus, the need for expanding the forest cover possibly in all the grasslands, and brushlands in the municipality is necessary to strike a balance on the sustainable production of land-based goods and environmental services.

Figure 8 shows the forest cover of Sta Cruz, Zambales. The forested areas are colored green while the bare lands or crop lands are colored gray.

Table 6. Environmental Profile of Sta. Cruz, Zambales.

Land Uses	Area (Ha)	% Area
Arable land, crops mainly cereals and sugar	9940.07	26.5
Built-up Area	58.52	0.2
Closed canopy, mature trees covering > 50 percent	3863.52	10.3
Coconut plantations	217.37	0.6
Coral Reef	7.81	0.0
Crop land mixed with coconut plantation	4324.05	11.5
Cultivated Area mixed with brushland/grassland	4164.08	11.1
Fishponds derived from mangrove	338.79	0.9
Grassland, grass covering > 70 percent	10037.55	26.8
Open canopy, mature trees covering < 50 percent	4498.3	12.0
Quarry	17.17	0.0
Total land area	37467.23	100.0
Data source: DA-BAR.		

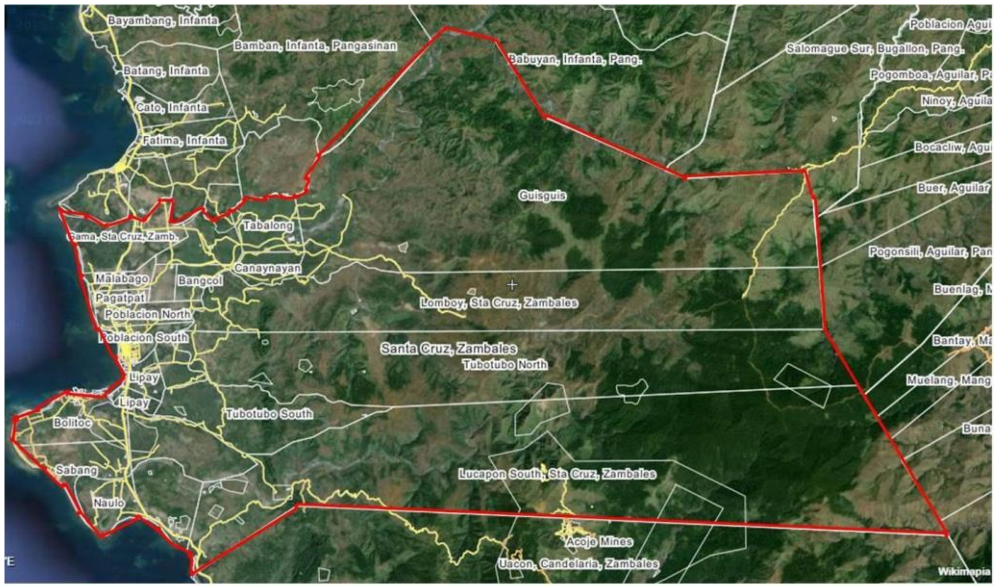

Figure 8. Forest Cover Map of Sta. Cruz, Zambales (Google Earth)

3. Environmental profile of the NGP sites

The environmental profile of the NGP sites is similar with that of the province of Zambales as well as with the municipality of Sta. Cruz in terms of rainfall, temperature, soil and geology. They differ only in terms of slopes, elevation, land cover and stream network. Selecting the sites for the NGP is right in the sense that the areas are generally barren and eroded (Figures 9-11) requiring immediate forest cover to reduce soil erosion particularly in sloping areas. The formation of gullies as a result of excessive surface runoff aside from soil erosion is evident in the pictures.

Figure 9. Topography and Land Cover of NGP Site 1 (Google Earth).

Figure 10. Topography and Land Cover of NGP Site 2 (Google Earth)

Figure 11. Topography and Land Cover of NGP Site 3.

Due to the absence of adequate vegetation in the mountains of Sta. Cruz, the stream yield is reduced during summer and its condition is already silted indicating that substantial quantity of soil has already been deposited. Leaving the areas without vegetation would further reduce the capacity of the streams to store rainwater. Thus, making it difficult for the municipality to sustain its water supply for domestic use and for irrigation.

Due to the barren condition of the mountains of Sta. Cruz and the need to generate sustainable stream flow supply, provide wood supply, and supply of other environmental services, the restoration of degraded lands into forested condition is very important and must be pursued to reduce the present rate of land degradation.

2. Province of Dinagat Islands, Minadanao

1. Location of Dinagat Island

The coordinates of Dinagat Islands in latitudes and longitudes are shown in Table 7. The relative location of the province with respect to other provinces is shown in Figure 12 based on Google Earth (2015).

Table 7. Geographic Coordinates of Dinagat Islands[105]

Selected Outermost Points	Latitude	Longitude	Remarks
Northernmost Point	10°28'15.6173"	125°42'23.5890"	Desolation Point

105 Province of Dinagat Islands. 2015. *General profile.* PDI: Dinagat Islands Provincial Website. Retrieved 21 January 2015 from http://dev.dinagatislands.gov.ph/executive/ppdo-main/socio-economic-profile-2/general-profile/

Easternmost Point	9°53'37.1657"	125°42'20.3417"	Along Dinagat Sound
Southernmost Point	9°51'12.0722"	125°39'51.1642"	Along Gaboc Channel
Westernmost Point	10°08'14.3014"	125°28'16.6544"	Tungo Point

Figure 12. Relative Location of Dinagat Islands (Google Earth, 2015)

Dinagat Islands is one of the five provinces in Region XIII or Caraga Region.[106] North and West of Dinagat Islands is the Surigao Strait, while the Philippine Sea bounded Dinagat Island on the East. On the South East is the Dinagat sound, on the South is the Gaboc Channel and Nonoc Island, South West is the Awasan Bay, Hanigad Island and Hikdop Island.[107]

2. Population and population density

The population of Dinagat province for 2015 is estimated at 137,708 based on the average population growth rate of 1.72% (2000-2010) from the 2010 population. There are more people in Basilisa and San Jose and less people in Loreto and Tubajon (Table 8).

[106] Regalado FGB. September 2014. *Philippine standard geographic codes.* Makati, Philippines: National Statistical Coordination Board, Philippine Statistics Authority. A PDF file. Retrieved 21 January 2015 from http://www.nscb.gov.ph/activestats/psgc/PSA-MAKATI-PSGC_SUM-SEPT2014.pdf.

[107] Arroyo GM. 2 October 2006. *Republic act no. 9355: an act creating the province of Dinagat Islands.* Metro Manila, Philippines: Thirteenth Congress, Third Regular Session. A PDF file. Retrived 21 January 2015 from http://www.congress.gov.ph/download/ra_13/RA09355.pdf.

Table 8. Population and Population Density (2010-2015).

Municipalities and Cities	Population		Pop Density (2010)	Pop Density (2015)
	2010	2015		
Basilisa	33,880	36,794	3.7	4.0
Cagdianao	15,047	16,341	0.6	0.7
Dinagat	12,786	13,886	0.9	1.0
Libjo	17,567	19,078	1.0	1.1
Loreto	8,920	9,687	0.3	0.4
San Jose	31,035	33,704	11.2	12.1
Tubajon	7,568	8,219	0.8	0.9
Total	**126,803**	**137,708**		

3. Land area

The land area of the municipalities in Dinagat Islands is shown in Table 9. The municipalities of Loreto and Cagdianao have 24% each in land area while San Jose and Basilisa have the lowest land area.

Table 9. Land Area of Municipalities and Cities

Municipalities and Cities	Land Area (ha)	Percent Land Area
Basilisa	9,268	8.9
Cagdianao	24,948	24.1
Dinagat	13,994	13.5
Libjo	18,057	17.4
Loreto	25,587	24.7
San Jose	2,780	2.7
Tubajon	9,000	8.7
Total	**103,634**	100.0

source: NSO

4. Land use and land cover

The land uses and land cover types of Dinagat Islands are shown in Figure 13. The remaining close canopy forests are located in the eastern side of the main island and it is estimated to be about 20% of the total land area of Dinagat. The open canopy forests are adjacent to the close canopy forests and approximately 15% of the total land area. The rests are agricultural lands, grasslands, cultivated lands and mangroves.

Dinagat Island is divided into two general classifications such as alienable and disposable land, and timberland. Its alienable and disposable land is 15,836 hectares which is found in flat lands or areas with zero to 3% slopes. The timberlands with 62,660.36 hectares are found in mountainous slopes of the province.

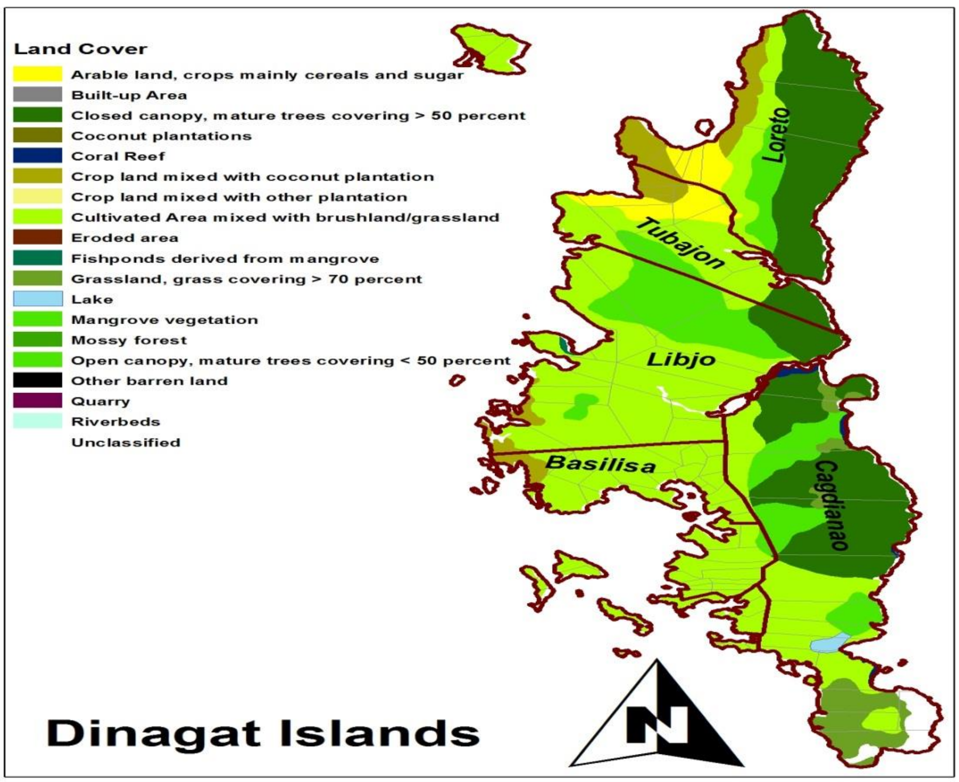

Figure 13. Land Cover of Dinagat.

5. Climate

Dinagat Islands has no dry season. Rainfall is very prominent from November to January. This classification is the Climate Type II. Moreover, the Northeast Monsoon and trade winds or cyclonic storms directly affect the area.[108] The total annual rainfall for 204 days is 2,830.60 m. Temperature in January is 23.9°C to September with 33.06°. In 2004, the average annual minimum temperature is 25°C while the maximum is 31.06°C.[109] The average temperature in the island for the year 2014 is 27.25°C while the total precipitation is 3438 mm averaging to 286.5 mm per month.[110] "The average annual humidity is 81% and the average velocity is one meter per second.[111]

6. Flora and Fauna

Dinagat Islands is part of the Eastern Mindanao Biodiversity Corridor (EMBC). It is a corridor approach to biodiversity conservation to help in the sustainable growth and development of fauna and flora. The island is one of the Key Biodiversity Areas. The threats to the biodiversity in the island are mining and quarrying, timber extraction, illegal and over fishing, industrial development, land conversion, and population pressure.[112] The chain of 1,000-m. high, forested mountains runs north to south through the interior, in which the interior forest has fruit trees, palm and bamboo.[113]

7. Topography

The highest points of the island are both found in the Municipality of Loreto namely, Mt. Kambinliw and Mt. Redondo (famous for its natural bonsai forest). The topographic map showing the mountainous areas in Dinagat Islands is shown in Figure 14.

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[108] Province of Dinagat Islands. 2015. General profile. PDI: Dinagat Islands Provincial Website. Retrieved 21 January 2015 from http://dev.dinagatislands.gov.ph/executive/ppdo-main/socio-economic-profile-2/general-profile/.

[109] denfermace8538. 20 January 2010. Dinagat Islands socio economic fact book. Retrieved 11 February 2015 from http://www.scribd.com/doc/25455336/Dinagat-Islands-Socio-Economic-Fact-Book#scribd.

[110] AccuWeather, Inc. 2015. Dinagat, PH local weather. Retrieved 21 January 2015 from http://www.accuweather.com/en/ph/dinagat/262993/january-weather/262993?monyr=1/1/2014&view=table,.

[111] denfermace8538. 20 January 2010. Dinagat Islands socio economic fact book. Retrieved 11 February 2015 from http://www.scribd.com/doc/25455336/Dinagat-Islands-Socio-Economic-Fact-Book#scribd.

[112] Philippine Eagle Foundation. 2008. 1. Introduction [Eastern Mindanao Biodiversity Corridor]. A PDF file. Retrieved 21 January 2015 from http://s3.amazonaws.com/zanran_storage/www.geo.umass.edu/ContentPages/430367241.pdf.

[113] _______. n. d. Towns and cities: general information (Dinagat Islands). Biyahero Philippine Travel Portal. Retrieved 11 February 2015 from http://www.biyahero.net/index.php?option=com_sobi2&sobi2Task=sobi2Details&catid=86&sobi2Id=2027&Itemid=56.

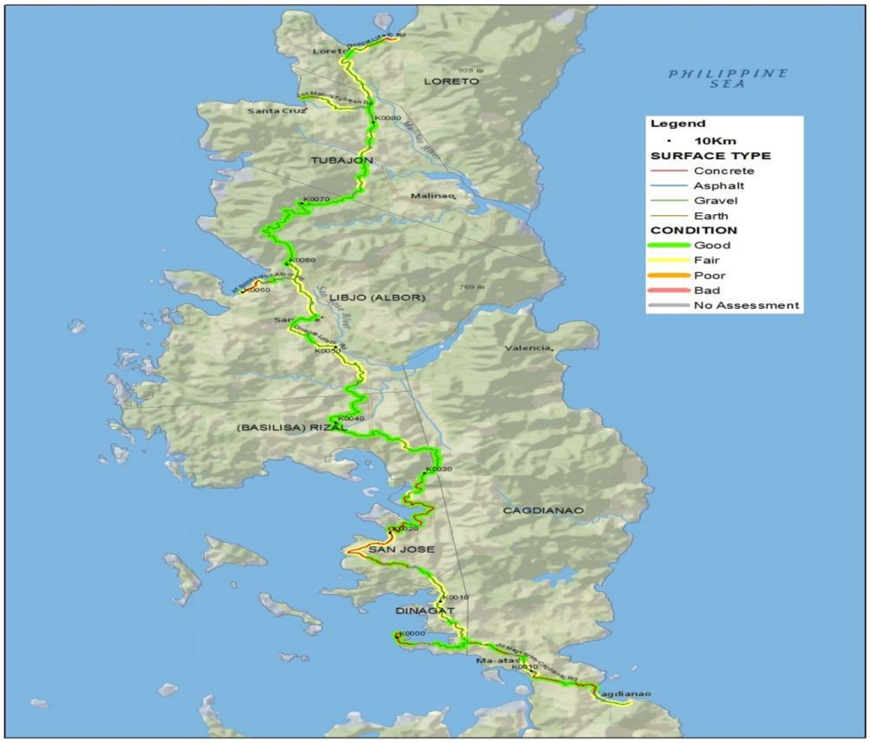

Figure 14. Topographic Map of Dinagat Islands in Relief Form.

The terrain in the province is oriented from flat to rugged to mountainous whereas elevation of the eastern part of the province reaches 900 meters from sea level. While the lands adjacent to the ocean were considered as having a broken relief or low elevation, Mt. Kambinliw and Mt. Redondo are the mountains where the highest peak is located.

8. Water resources

There is also a cold and hot spring in the said municipality. There is a waterfall in Bankaw Mountain Resort and a lagoon known as the Tambongon Lagoon. These are situated in the Municipality of Tubajon. These are also the so-called Ouano Lagoon and Blue Lagoon in the Municipality of Libjo.[114]

9. Soils and geology

The island has three rock formations: (a) *pato* or duck, (b) *bao* or turtle, (c) *Punta Kalabera* or Skull Point. The rock islands lack fine sandy beaches.[115] The soil is primarily Dinagat clay loam

[114] Denfermace8538. 20 January 2010. Dinagat Islands socio economic fact book. Retrieved 11 February 2015 from http://www.scribd.com/doc/25455336/Dinagat-Islands-Socio-Economic-Fact-Book#scribd.

[115] Philippine Eagle Foundation. 2008. 1. Introduction [Eastern Mindanao Biodiversity Corridor]. A PDF file. Retrieved 21 January 2015 from http://s3.amazonaws.com/zanran_storage/www.geo.umass.edu/ContentPages/430367241.pdf.

— 70% kabatohan, 20% loam and 10% of Bolinao clay steep; friable and slightly granular in nature.[116] It is rich in metallic and non-metallic resource which includes chromite, aluminous laterite ore and nickeliferous laterite. There is also a small amount of rock phosphate, limestone, siliceous and gold deposits.[117] The one fourth of the land areas of Municipality of Dinagat only had cogon in the vegetation because of the presence of ore. For the Municipality of Cagdianao, the study of Mines and Geo-science Bureau (MGB) showed that the area is "absolutely hazard for large infrastructure projects" because of the "strike-slip fault extending from Poblacion to Barangay Mataas".[118]

10. Wildlife (Flora and Fauna)

Dinagat Islands has two endemic mammal species[119] — Batomys russatus and the endangered Crateromys australis, both from Family Muridae[120]. Some bird species in Loreto that are threatened by hunting are the Mindanao bleeding-heart *Gallicolumba crinigera* (vulnerable), Mindanao Writhed Hornbill *Aceros leucocephalus* (near threatened) and the Philippine Cockatoo *Cacatua haematuropgyia*. Other bird species in the island are the Kalaw *Rufous hornbill* (near threatened), Malaysian Plover *Charadrius peronii* (near threatened), Balud *Ducula poliocephala* (near threatened), Mindanao Broadbill *Eurylaimus steeri* (vulnerable), Tabon *Megapodius cumingii* (least concern), and little slaty flycatcher *Ficedula basilanica* (vulnerable), and Pipit *Hypothymis coelestis* (vulnerable).[121] Some fish species have high exploitation rate or fishing mortalities in the Dinagat waters as reported in the Convention on Biological Diversity.[122]

[116] Denfermace8538. 20 January 2010. Dinagat Islands socio economic fact book. Retrieved 11 February 2015 from http://www.scribd.com/doc/25455336/Dinagat-Islands-Socio-Economic-Fact-Book#scribd.

[117] Denfermace8538. 20 January 2010. Dinagat Islands socio economic fact book. Retrieved 11 February 2015 from http://www.scribd.com/doc/25455336/Dinagat-Islands-Socio-Economic-Fact-Book#scribd.

[118] Pangga Dinagat. 2012. Geography of Dinagat. Official Website of the Municipality of Dinagat, Dinagat Islands, Philippines. Designed and developed by karlspace.web.solutions. Retrieved 11 February 2015 from http://www.dinagat.gov.ph/index.php/about-dinagat/geography-of-dinagat.

[119] Kapoor S. 2007. Eastern Mindanao biodiversity corridor – Philippines. A PDF file. Retrieved 26 January 2015 from https://library.conservation.org/Published%20Documents/2009/Eastern%20Mindanao%20Biodiversity%20Corridor-Philippines-2007.pdf.

[120] World Wildlife Fund. 2015. Southeastern Asia: Philippines. Retrieved 27 Janauary 2015 from http://www.worldwildlife.org/ecoregions/im0129.

[121] Panopio JK and Pajaro M. July 2014. State of the Philippine Birds. Haribon Foundation for the Conservation of Natural Resources, Incoporated. A PDF file. Retrieved 21 January 2015 from http://www.haribon.org.ph/media-manager/files/State-of-the-Philippine-Birds-July-2014.pdf.

[122] Protected Areas and Wildlife Bureau- Department of Environment and Natural Resources. 2009. 4th Philippine national report to the convention on biological diversity. A PDF file. Retrieved 26 January 2015 from http://www.ph.undp.org/content/dam/philippines/docs/environment/4th%20Philippine%20National%20Report%20to%20the%20Convention%20on%20Biological%20Diversity.pdf. 10p

The forest species common in Dinagat are Bakauan Babae and Bakauan Lalake in mangrove areas. In terrestrial, dipterocarps, milliaceae, rosaceae are common. Specific tree species found in the area are Malabitanghol, Marang, Ulayan Agoho, Banay-banay, Bitanghol, Molave, Nato, Narra, Sagimsim, Tiga and Wakatan, Camagong, Kalumpit, Talisai and Manga-manga**.**

11. Environmental profile of the Municipality of Basilisa

The environmental profile of the Dinagat study site is similar to the environmental profile of the Dinagat province presented in the previous sections. Rainfall, temperature, soil and geology are the same with that of the province.

1. Location of Basilisa

The location map of Basilisa relative to Dinagat province is shown in Figure 15. Basilisa is situated at the west side bellow mid-section (red color) of Dinagat. It is facing the sea to the west, the municipality of Cadianao to the east, and the municipality of Libjo to the north.

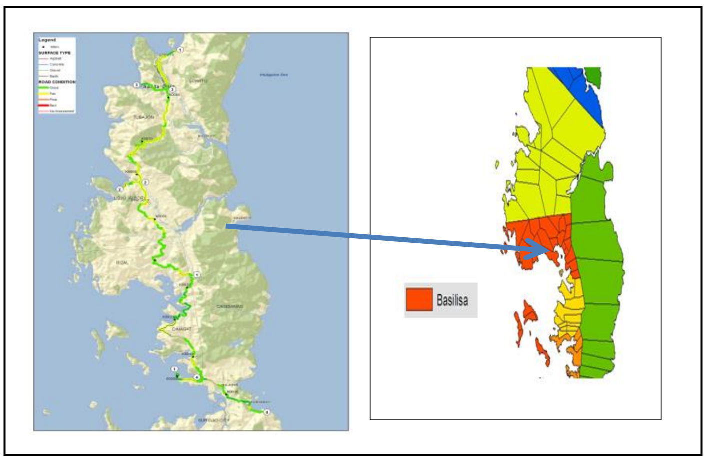

Figure 15. Location Map of the Municipality of Basilisa, Dinagat

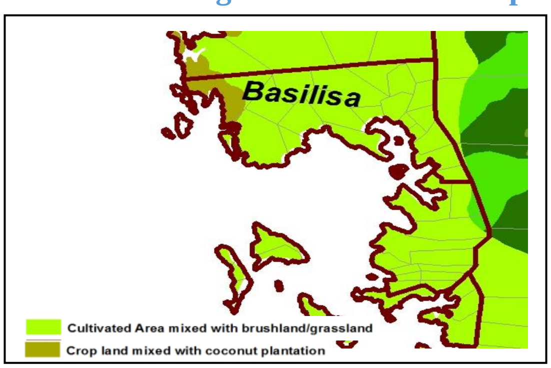

Figure 16. Land Cover of Basilisa.

2. Vegetative cover of Basilisa

There are only two main land cover types in Basilisa. These are cultivated crop land mixed with grassland and brushland, and cropland mixed with coconut plantation. Cultivated crop land is about 95% of the total land area of Basilisa while cropland with coconut is only about 5% of the area of Basilisa (Figure 16 and Figure 17).

Due to the sparse forest stands, the production of environmental services is minimal requiring forest restoration as a priority activity for Basilisa.

Thus, making the NGP appropriate in the area.

3. Forest species

The forest land of Basilisa based on Figure 9 is of the brushland type wherein patches of small trees mixed with grasses (cogon and talahib) are very common. The species found in the brushland area are mostly tibig, anabiong, sili-sili, takip asin, and katmon. These tree species are considered pioneer species that grow whenever a forest canopy is cleared.

Figure 17. Topography of Basilisa, Dinagat (Google Earth)

4. Topography

Interpreting Figure 18 showed the terrain of Basilisa. The terrain is composed of hills to small mountains and its slope ranges from about 18% to 50% from the seaside going up to the mountains. Among the municipalities of Dinagat, Basilisa has more flatter to rolling terrain than the other municipalities which generally are mountainous.

Figure 18. Topography of Basilisa, Dinagat.

5. Soil and geology

The soil is type of Basilisa is clay to clay loam. The soil is reddish in color. It is fine to granular, a characteristic of clay[123]. The geological foundation of Basilisa is not known as of this writing.

6. Water resources

The major source of water for irrigation and drinking water of Basilisa is a small river that traverses the watersheds of Basilisa. However, due to the inadequate vegetation in Basilisa, stream yield is intermittent throughout the year. During dry season, the supply of stream yield is reduced[124].

3. Province of Negros Occidental

Negros Occidental is located in the North western portion of Negros Island. It is bounded on the north by the Visayan Sea, and on the south by the Sulu Sea. In the southeast, it is bounded by Panay Island. On the east, it is bounded by Tanon Strait and Negros Oriental.

The province is composed of 13 cities and 19 municipalities.

[123] According to the PENRO of Dinagat Province.

[124] According to an interview with the PENRO of Dinagat during the assessment survey.

1. *Geographical Map of Negros Occidental*

The location map of Negros Occidental is shown in Figure 19.

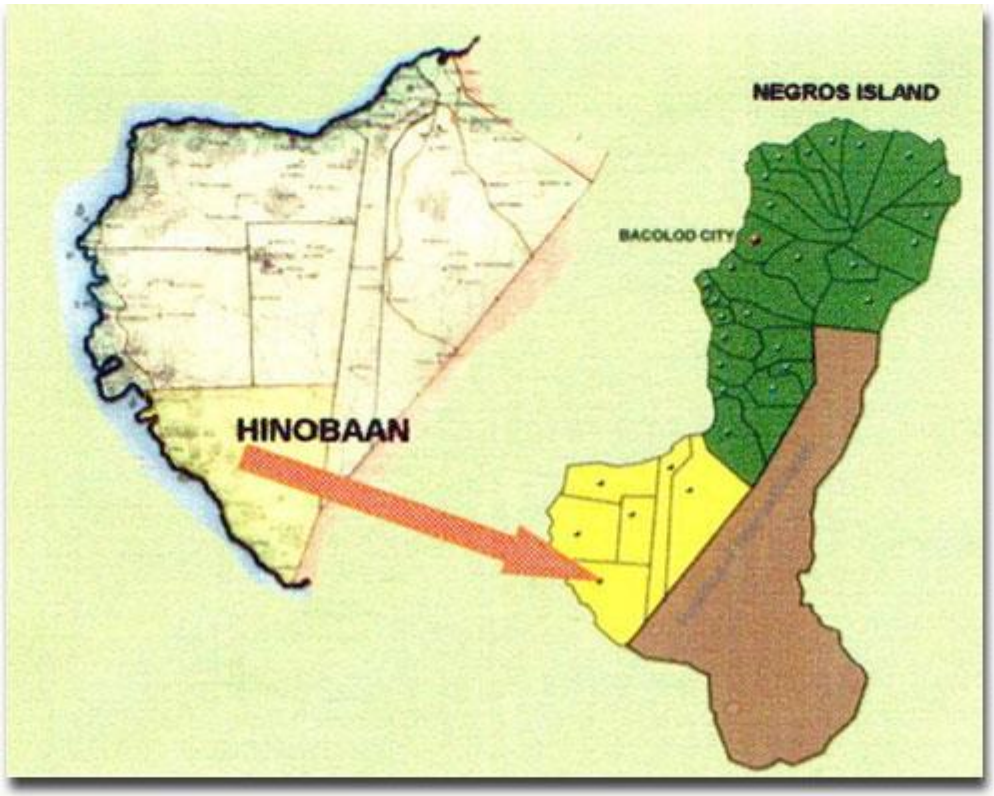

Figure 19. Geographical Map of Negros Occidental

2. Population and population density

The top 3 municipalities/cities in terms of population are highlighted with yellow color while those topping the top 3 population densities are highlighted with green color (Table 10). The municipalities/cities with the lowest population are highlighted gray while those with the lowest population densities are highlighted with blue color.

Table 10. Population and Population Density of Negros Occidental.

Municipality/City	Population in 2010[125]	Population in 2015	Land Area (as of 2007, in hectares)	Population Density in 2010	Population Density in 2015
1. Bacolod city (capital)	511,820	548,671	16,267	31.5	33.7
2. Bago city	163,045	174,784	40,120	4.1	4.4
3. Binalbagan	65,431	70,142	18,996	3.4	3.7
4. Cadiz city	151,500	162,408	52,457	2.9	3.1
5. Calatrava	79,009	84,698	50,450	1.6	1.7
6. Candoni	21,336	22,872	19,170	1.1	1.2
7. Cauayan	96,921	103,899	52,000	1.9	2.0
8. Enrique b. Magalona (saravia)	59,434	63,713	11,325	5.2	5.6
9. City of escalante	93,005	99,701	19,276	4.8	5.2
10. City of himamaylan	103,006	110,422	36,704	2.8	3.0
11. Hinigaran	81,925	87,824	15,492	5.3	5.7
12. Hinoba-an (asia)	54,624	58,557	41,450	1.3	1.4
13. Ilog	54,423	58,341	28,170	1.9	2.1
14. Isabela	59,523	63,809	17,876	3.3	3.6
15. City of kabankalan	167,666	179,738	69,735	2.4	2.6
16. La carlota city	63,852	68,449	13,729	4.7	5.0
17. La castellana	71,013	76,126	18,522	3.8	4.1
18. Manapla	52,687	56,480	11,286	4.7	5.0

[125] http://www.census.gov.ph/content/2010-census-population-and-housing-reveals-philippine-population-9234-million

19. Moises padilla (magallon)	39,257	42,084	14,410	2.7	2.9
20. Murcia	75,207	80,622	27,914	2.7	2.9
21. Pontevedra	47,945	51,397	11,250	4.3	4.6
22. Pulupandan	25,350	27,175	2,300	11.0	11.8
23. Sagay city	140,740	150,873	33,034	4.3	4.6
24. San carlos city	129,981	139,340	45,150	2.9	3.1
25. San enrique	23,189	24,859	2,884	8.0	8.6
26. Silay city	120,999	129,711	21,480	5.6	6.0
27. City of sipalay	67,403	72,256	37,978	1.8	1.9
28. City of talisay	97,571	104,596	20,118	4.8	5.2
29. Toboso	41,658	44,657	11,733	3.6	3.8
30. Valladolid	36,416	39,038	4,803	7.6	8.1
31. City of victorias	88,299	94,657	13,392	6.6	7.1
32. Salvador benedicto	23,624	25,325	17,050	1.4	1.5
Pgr = 1.44%[126]					

3. Land classification

The Province of Negros Occidental has a total land area of 792,607 hectares of which 68% or 540,385.62 hectares are classified as A & D, while 32% or 252,221.38 hectares are classified as Forestland. Its forested area is 68,857.87 hectares[127]. The areas for protection and production forest are 104,877.06 and 147,344.00 hectares, respectively[128].

Negros Occidental has three (3) watersheds namely: Bago River Watershed Forest Reserve, Ilog-Hilabangan Watershed Forest Reserve, and Kabankalan Watershed Forest Reserve covering a total area of 72,569 hectares and located in the Cities of Bago and San Carlos, Kabankalan and Himamaylan[129]

It has a total area of 32,000.00 hectares natural park, the Mt. Kanla-on Natural Park established under Republic Act No. 9154 dated August 11, 2001. The park is situated in the cities of Bago, La Carlota, and San Carlos and in the Municipalities of La Castellana and Murcia and in the City

[126] Ibid

[127] http://r6.denr.gov.ph/index.php/about-us/regional-profile

[128] Ibid

[129] Ibid

of Canlaon and Municipality of Vallehermoso, Province of Negros Oriental with an area of 24,557.60 hectares[130].

4. Forest cover

The land use and land cover map of Negros Occidental is shown in Figure 20. The remaining close canopy forest in Negros Occidental is very small (dark geen areas) located in Cadiz city and in the municipality of Murcia. Open canopy forest is quite larger than the close canopy forests (light green areas) and adjacent to the close canopy forest. Most of the areas of the province are agricultural lands, crop lands and grasslands.

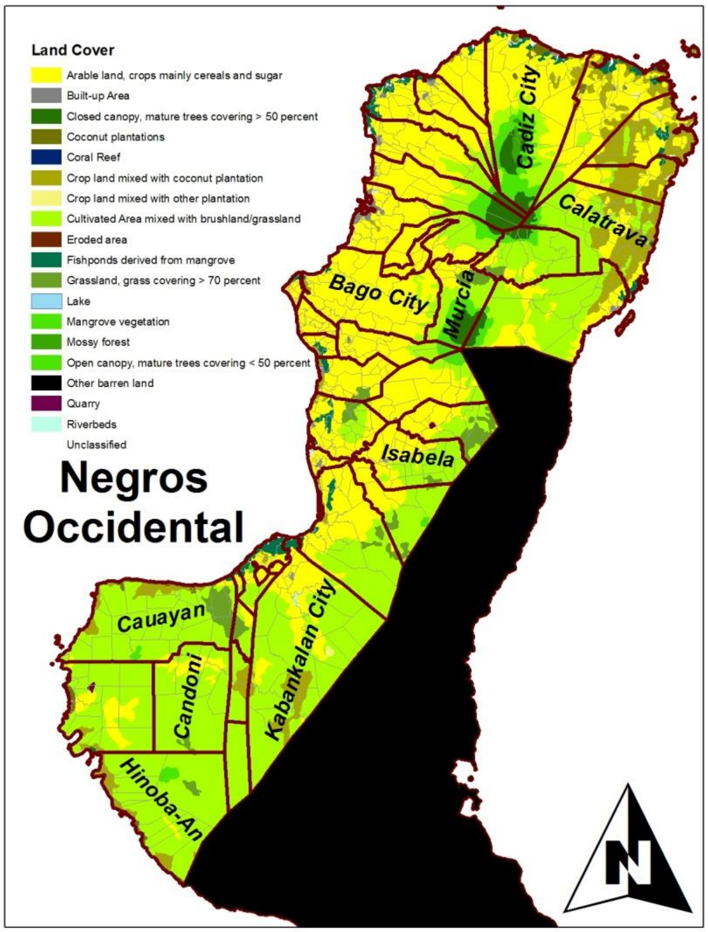

Figure 20. Land Cover of Negros Occidental.

[130] Ibid

5. Climate

Months from June to November are the rainy months December to May are the dry season. The province's annual rainfall ranges from 1,967mm to 2,500 mm. The hottest months are from March to June with April having the highest temperature.

6. Topography

Negros Occidental's terrain is moderately sloping to rolling lands. Slope range from 0-18% comprises about 71% of the total provincial area of 563,100 hectares. The northern and western parts of the province have flat lands to gently rolling slopes. Steep slopes from 18 to over 30 percent constitute 20.1% or 229,510 hectares.

The Negros Occidental's mountains along the coastline are irregular in terrain than its neighbor province of Negros Oriental. The northern and western parts are largely flat lands and moderately sloping. Mt. Kanla-on, with an elevation of about 2,700 meters, is the highest in the Central Philippines. The other mountains that are also high in elevations are Mt. Manadalagan and Mt. Silay,with elevations at about 2,055 meters to 1,677 meters, respectively. There are other volcanoes of the province. These are Mt. Solitario in the north and Mt. Malapantao in the southern end.

7. Water sources

There are six river basins in the province. These are the Danao river basin, Himoga-an river basin, Malogo river basin, Bago river basin, Binalbagan river basin and Ilog river basin. Himoga-an river basin stretches from the eastern slope of a chain of volcanic mountain ranges in the northern part of Negros Island. Danao river basin cuts from the northeast cordillera and drains into Tanon Strait at Escalante. Malogo or Silay river basin originates at the western slope of Mt. Silay and drains into Guimaras Strait. Bago river basin upstream slope is located in the northeast of Mt. Kanla-on. Also, it drains into Guimaras Strait. Ilog river basin is the largest among the six basins in the province. It starts from the southeastern portion of Mt. Kanla-on and drains into Panay Gulf.

The areas that are vulnerable to flooding during heavy rainfall are those near the river banks and plain areas where the stream overflow over flat lands at the downstream watersheds of these basins. Thus, damaging agricultural crops and other properties of affected communities.

There are no watershed maps showing the water sources in Negros Occidental in the internet.

8. Environmental profile of the Municipality of Hinoba-an, Negros Occidental

The environmental profile is similar with that of the province in terms rainfall, temperature, soil and geology and types of vegetation. They differ in land cover types. Hinoba-an has only 2.1% of its land area under forest cover and 87% croplands mixed with grassland and brushland (Table 11). Insights from its very small fraction of remaining forest cover and the large portions of cultivated mixed with grassland and brushland, showed that Considering that any reforestation projects are mostly focused on grasslands and brushlands, such areas are available in Hinoba-an will define the extent of grasslands or brushlands that would be targeted for reforestation.

Hinoba-an is an agricultural municipality having most of its area planted with food crops. The forested land in Hinoba-an is only 2.1% of the total land area of the municipality and it is an open canopy forest. This implies that the open canopy forest has an inadequate number of tree density that makes it short of producing the expected goods and environmental services for the population and other economic activity requirements.

Eighty-six percent accounted for cultivated area mixed with grasslands and brushlands. This is a high number of potential areas that should be given priority attention for reforestation (Table 11).

Table 11. Land Use and Land Cover Types, Hinoba-an.

Land Use and Land Cover Types	Area (Ha)	% Area
Arable land, crops mainly cereals and sugar	435.44	0.9
Coconut plantations	628.5	1.4
Coral Reef	6.42	0.0
Crop land mixed with coconut plantation	3471.85	7.5
Cultivated Area mixed with brushland/grassland	40051.88	86.6
Fishponds derived from mangrove	0.02	0.0
Grassland, grass covering > 70 percent	687.02	1.5
Open canopy, mature trees covering < 50 percent	980.98	2.1
Total area	46262.11	100.0
Basic data source used in the GIS analysis: DA-BAR		

1. Topography of Hinobaan

Interpretation of the aerial photograph of Hinobaan taken by Google Earth showed that the topography is relatively plain to moderately sloping in the western side near the sea to its mid-portion and mountainous on the east, north and south. On the east, the mountain gradually peaked and then it sloped down reaching the foot of another mountain. On the south-western side is a small mountain near the sea (Figure 21).

Figure 21. Topography of Hinobaan, Negros Occidental (Google Earth)

2. Land cover

The land cover of Hinobaan as interpreted in Figure 20 indicates that its forest cover is a small component of the municipality and that majority of its areas is cropland or cultivated areas. Patches of forest cover are located in the mountainous areas on the east and on the south. These are the areas that are colored dark green. The rests are croplands or cultivated areas.

3. Soil

The areas that are heavily eroded in Hinobaan are shown in Figure 22. These are the white to gray colored areas in between cultivated areas. The extent of eroded areas is large compared to the forested portion. There are no erosion maps in the internet that can be attached here showing other information on the soil characteristics. Likewise, there is also no map on the internet indicating the type of geology in Hinobaan.

Figure 22. Eroded Areas in Hinobaan, Negros Occidental (Google Earth).

4. Forest species

Some of the indigenous forest species that grow in Hinobaan are Toog, Nato, Bakan, Bakawan, Bayog, Balete, Guisok, Kalingag, Lauan, Malatambis, Makaasim, Sambulawan, Taguilomboy, Takpan, and Tuai. The pioneer species growing in the area are Tibig, Kulispakatan, Tambalau, Binunga, Banato and Himamao[131]. These species will be validated during the assessment survey.

5. Water sources

There is no existing watershed map showing the water sources of Hinobaan. It is suspected that Hinobaan draws its water needs from existing live creeks, in deep wells near the seashore and directly from rains. Maps of water sources will be collected during the environmental assessment survey.

VIII. Results and Discussions

1. Zambales NGP sites

1.1. Survey, Mapping and Planning (SMP)

Before any project starts, there should be preparatory activities to be conducted so that the maximum potential of the project will be obtained, especially those projects having a large amount of budget. Such activities include the survey and mapping of the site and planning for the design and activities which are deemed appropriate as evaluated through the survey.

a. Coverage of Survey and Mapping

The requirements of the Survey and Mapping based on the National Greening Program Implementation Manual (2012) are summarized in Table 12.

[131] According to interview with the foresters in the CENRO/PENRO.

Table 12. Coverage and Specifications of the Survey and Mapping Requirements of the NGP.

Indicator	Description
Boundary	GPS survey and GIS mapping
Physical	Topographic, drainage system, Infrastructure (roads and trails)
Biological	No specifications on what types of biological indicators
Soil	No specifications on what types of parameters to survey
Vegetation	
Watershed	Soil erosion reduction, landslides, floods, rockfall, streambank erosion

To further improve the survey and mapping requirements defined in the NGP Manual, the following are recommended for consideration to address new goals or objectives of the NGP (Table 13).

Table 13. Recommended Improvement for the Survey and Mapping Requirements for the NGP.

Indicator	Recommended Inclusion for Further Improvement
Boundary	
Physical	Survey and map only the suitable areas from planting. Exclude rocky/stony areas, shallow soil depth areas, water-lagged, very steep slope areas where seedlings will not survive.
Biological	Identify, survey and map areas of indigenous plants species already growing and map wildlife habitat.
Soil	Include in the survey soil pH, soil fertility and soil depth

Vegetation	Include stands of indigenous and exotic trees from pioneer, intermediate, and climax species including their regenerants.
Watershed	Same indicators as defined in the watershed rehabilitation guidelines
New Goals/Objectives of Reforestation Program (based on NGP)	
Disaster risks	Survey and map areas which are vulnerable to natural disasters.
Climate change vulnerable areas	Survey and map of the areas that are vulnerable to climate-related impacts (rain-induced, high temperature, drought, and El Niño and La Niña and extreme rainfall events).
Social, economic	All forms of threat to the project site

1.2. Feasibility Study

From SM, the process jumped to site development planning without passing through the feasibility study aspect. One of the important of the feasibility study is to evaluate which reforestation design is best for a given site. It is also a venue for evaluating which of the alternative species is best or which species should be combined according to their compatibility on actual ground condition.

Feasibility study is not a compulsory requirement of the NGP reforestation projects. Nowhere in the NGP guidelines that this should be undertaken. In foreign-funded reforestation projects, feasibility studies or site appraisal reports are important basis for evaluating whether such project will be feasible and viable considering all possible relevant factors. It is also the basis for evaluating alternative designs and selecting the best one that will be translated into site development plan.

The CENRO accepted that FS is a necessary component of the planning process. However, they were overtaken by instructions coming from central and regional top management to focus on reforestation activities in the field.

1.3. Planning

The coverage of the NGP in terms of its planning requirements is indicated in Table 14. It requires a site development plan with the following contents:

Table 14. Site Development Planning Requirements of the NGP.

Content	Description of the Content	Recommended Inclusion for Further Improvement of the Process
I. Introduction		
A. Project scope and rationale		
	*Indicate reason and purpose for the project and what it seeks to accomplish.	
B. Project development objectives		
	*indicate specific purpose of forest plantation to be established (if for production or protection)	For production forest, include a community-based entrepreneurial development objectives that will process the wood into finished products that will be marketed. Income generated shall be shared to the workers and the DENR to finance on continuing basis the forest restoration and wood processing and marketing. For environmental protection, include DRR and CCA/M.
II. Project Site description		
A. Physical Characteristics		
	Location	
	*Indicate province, municipality, barangay, sitio where project is situated including area;	
	*Indicate also manner of access to area	

	Climate	
	*indicate climatic type, rainfall volume, and other relevant meteorological data	
	Topography and drainage	
	*describe in general terms the topography (e.g. Moderate, flat, rugged terrain)	
	* indicate slope categories (e.g. i: 0-15%; ii: over 15-30%; iii: over 30-50%; iv: over 50%)	
	*indicate existence of bodies of water (e.g. Rivers, streams, creeks, etc.)	
	Geology, soils and erosion	
	*describe the geological characteristics of the area, soil type, and extent/ location of erosion	
	Vegetation/ Land use	
	describe existing vegetation (species distribution), and land use (e.g. Grassland, brushland, kaingin, forest, etc)	Include legal land use status with required certification from the DENR field office
B. Socio-economic Characteristics		
	Local Population	
	*Indicate number/ profile of people residing in the area	
	Income profile/ Source of livelihood	
	*Indicate their income bracket and source of livelihood	
	Land tenure status	
	*Indicate nature/basis of occupancy	
III. Site development		

activities		
A. Construction of nursery facilities		
	*indicate number/type of nurseries, sheds, bunk houses, and other facilities to be constructed	
B.Nursery Operations		
	Choice species	
	*identify species of trees and other perennials to be planted, including cover crops in case of protection forests to be developed	
	Procurement of seeds/ planting materials	
	*Indicate mode of procuring/ seed source and other planting materials	
	Seedling production	
	*Indicate total number of seedlings to be raised, species, nurseries, techniques, schedule of activities	To address DRR, use root trainer pots for vertical growing and deep penetration of the root system to make them sturdy and strong when planting in the forestation sites.
C. Plantation establishment		
	Plant design	
	*Prepare an appropriate plant design showing the detailed distribution, spacing, and number of species of trees and other perennials to be planted taking into account slope categories	Different design depends on end use: for timber production, protection forest, watershed rehabilitation, soil conservation, DRR and CCA/M vulnerable areas. Design of species mix and spacing per unit area per design.
	Site Preparation	
	*Discuss site preparation techniques/ methods to be employed in relation to project	

	development objectives	
	*Indicate schedule	
	Planting/ Replanting	
	*Discuss planting techniques/ methods to be used,	
	*Indicate planting/ replanting schedule	
	Intercropping	
	*Indicate species of food crops to be planted, if any, and method if intercropping	
D. Plantation maintenance and protection		
	Weeding and cultivation	
	*Discuss method/ frequency of weeding/ cultivation to be employed	
	Fertilizer Application	
	*Indicate kind of fertilizer to be used, techniques, and frequency of application	
	Fire prevention and control	
	*Describe the strategies for fire prevention and control	
	*Indicate specifications for fireline/ firebreak to be established	
	Pest and Disease Control	
	*Indicate strategies for pests and disease control, including contingency measures in case of pests/disease outbreak in established plantations	
E. Infrastructure Support		Include a reforestation access road and foot path, water system (rain water harvesting, impounding ponds, etc).

Compliance to Survey and Mapping (SM)

Due to the immediate implementation of the NGP reforestation projects in Zambales, Dinagat and Negros Occidental and the need to catch up with the rainy season to start planting, there was not much time and resources allocated for SM and SDP. The activities that were conducted and those that were not are indicated in Table 15.

Table 15. Level of SM and SDP Compliance to SM and SDP Guidelines at the NGP Site.

Activity	Method	Conducted?	Remark
Boundary survey	GPS	Yes	Well defined coordinates making the boundary accurately established on the map and on the ground.
Boundary mapping	GIS	Yes	
Soil survey (Important Indicators)			
a. Soil type		Yes	
b. Soil fertility		No	Determines the right levels of NPK fertilizers to be recommended for application.
c. Soil depth		No	Determines the right species that can grow based on the depth of soil layers suitable to grow plants.
d. Soil pH		No	Determines where the soil is acidic or basic. It is an indicator of acidity-tolerant or basic-loving plant species. Also determines liming of acidic soil to make it plantable.
Survey of DRR vulnerable areas		No	Determines DRR design and specific deep-rooted species recommended for planting on site.
Mapping of DRR vulnerable areas		No	
Vegetation survey/species site matching		No	Existing species in the area serves as basis for identifying the plant species to be planted.
Mapping of species-site matching		No	Delimit the area where a plant species or groups of plant species are suitable.
Survey of non-plantable areas			To be avoided or not to be planted

in the surveyed polygon		No	such as rocky/stony areas, acidic soil, shallow soil layer, water-lagged, very steep slopes, etc.

The requirements of the site development plan are presented in Table 15. However, during the surveys and scoping, the CENRO of Masinloc, Zambales and Hinobaan, Negros Occiedental and the PENRO in Dinagat mentioned that their efforts were concentrated on the supervision and monitoring of the site preparation activities to make the reforestation areas ready for the fast approaching rainy season which was the start of the planting season. This was also necessary to meet the target of the CENRO for that year as defined in the road map prepared by the central office. As replacement to the site development plan, the CENRO prepared a brief but concise SMP, work and financial plan and contracts where the activities to be undertaken, targets and budgets are indicated. These were considered as replacement to the site development plan. On the spatial and temporal requirements of the activities that should be indicated on the SDP, the CENROs and the PENRO reiterated that it is part of the SMP and that in terms of the temporal requirements of the reforestation activities, it is a common knowledge that seedling production maybe conducted at any time of the year provided that there are water system. Site preparation timing is always conducted few months before the onset of the rainy season. Planting during the rainy season and protection and maintenance were mostly concentrated during the dry season.

Compliance to DRR and CCA/M, although indicated in the goals/objectives of the NGP, were not given emphasis on the NGP guidelines in terms of the necessary indicators to be addressed in the field. These were acknowledged by the DENR field offices as important which should be addressed in future similar projects provided that the central office will give them the instruction on what specific indicators to focus on in the field. The lack of specific instructions on DRR and CCA/M from the central office resulted on some deficiencies in the specific designs and plans for integration into the SMP or the SDP.

Also, in the site development planning, areas that are considered non-plantable that were overlooked during the SM should be marked on the ground and on the map. Such areas should not be planted to avoid wastage of seedlings and manpower, and low survival. In cases where such areas are included in the polygon of the surveyed sites, replacement may be considered in adjacent areas along or near the boundary of the NGP site.

1.4. Plantation quality assurance

This process is intended to ensure that all reforestation activities are properly conducted and that the quality of outputs is necessary resulting in the development of a quality forest in the future. This process had been used in successful private reforestation companies in the Philippines. This process is being considered as one of the best practices benchmark where NGP field-based operations can be compared with.

The NGP reforestation projects in Sta. Cruz Zambales do not have a system but some of the activities that may lead to assuring a quality plantation are being performed. Table 16 describes the practices of the CENRO relative to plantation quality assurance.

Table 16. Practices of the CENRO Masinloc Zambales in Ensuring Plantation Quality.

Presence of a regular inspection system to ensure that planted seedlings are growing well.	Activity	Practice
	a. Activity implementation inspection	No regular inspection. Inspection is done only during billing and payment of the services of the PO members.
	b. Activity output inspection	No record showing inspection of output of every activity.
	c. Proper sequential implementation of forest restoration activities	No record of sequential implementation of activities with inspection of quality of every activity and its output
	d. Payment deduction due to poor quality of seedlings	Practiced
	e. Payment deduction due to low survival rate	Practiced

1.5. Capability building

The PO members who worked in the NGP did not have any training regarding the reforestation activities of the NGP. Accordingly, they have been trained in similar reforestation projects in the past and they are knowledgeable on the different reforestation activities. Table 17 describes the capability of the PO members.

Table 17. Training of the PO Members that Worked in the NGP Projects.

Training of the workers on important technical aspects of the NGP	Topic	NGP Site
	1 Seedling production	No formal training only demonstration on site during the activity
	2. Site preparation	Demonstration on site during the activity
	3. Planting	Demonstration on site during the activity
	4. Protection and maintenance	Demonstration on site during the activity
	5.. Replanting	Demonstration on site during the activity
	2. Orientation on monitoring and evaluation of the condition of the established forest plantation	No orientation
	3. Orientation on billing procedure	No orientation
	4. Orientation on prescribed bookkeeping and accounting procedure	No orientation

3. Reforestation Processes

1.1. Seedling production

In the NGP site of 99 hectares in Guinabon, the seeds came from wildlings and seeds collected by the respondents which are the members of the clusters. The seeds are germinated in nurseries while the wildling are cultured and conditioned in the nursery. The nurseries are located on the household' backyard. When the seedlings are matured enough for planting, they are reported to the DENR CENRO office for inspection to see whether the seedlings are ready for outplanting in the NGP sites (Table 18).

Seed growers are also the planters and all of them are residing in the community close to NGP sites. The main nursery are located usually near at the Chairman's house and nursery satellites are located 50 meters from the NGP site the water source.

On the other hand, the NGP site in Babuyan with an area of 150 hectares and the NGP-BFI site in Binonton with 131 hectares had their seeds requirements collected by the respondents and grown in the nursery.

The NGP-BFI used a detailed process of seed collection usually once a month or every 2 months. There is no problem on collection because the species to be collected are said to be abundant around.

After 2- 5 months, the respondents from NGP site in Guinabon said that they outplanted their seedlings. While those in the Binonton NGP-BFI site and the Babuyan site stick on the schedule of 5 months before planting to make sure that the standard height and diameter of the seedlings are met. The standard height to plant is said to be 22 - 30 cm and diameter of 3 to 5 are based on the requirements of the DENR.

Site 99 and site 150 do not really have the standard number of leaves, they consider 3-10 leaves as good. While BFI on the other hand stick on the standard number of leaves per species. They assigned a Quality Control Officer to inspect the seedlings before the release for planting.

Table 18. Responses of Respondents on Seedling Production, Sta. Cruz, Zambales.

Question	NGP Site 99	NGP Site 150	NGP-BFI Site Bfi
Sources of Seedlings			
From Seeds Collected by Respondent		100%	100%
Both from Wildlings And Seed Collected by Respondents	100%		
How many months did you take care of the seedlings in the nursery up to outplanting in the NGP planting			

sites?			
Mahogany	2-5 months	-	-
Auri	2-5 months	5-6 months	-
Eucalyptus	2-5 months	-	5 months
Acacia mangium	2-5 months	5-6 months	5 months
Callicarpa	-	-	5 months
Banaba	-	-	5 months
Agoho	-	-	5 months
Banguet pine	-	-	5 months
Narra	-	-	5 months
Tanguile/Oyong	-	-	5 months
Ipil-ipil	-	-	5 months
What were the qualities of seedlings that were hauled to planting sites?			
Ht of Seedlings (cm)			
22 - 30			100%%
25 - 30	100%		
26 - 30		100%	
Diameter of Seedlings (mm)			
3 to 5	100%	100%	100%
Number of Leaves of Seedlings			
Mahogany	3 to 10	-	-

Auri	3 to 10	5 to 10	-
Eucalyptus	3 to 10	-	15 to 20
Acacia mangium	3 to 10	5 to 10	10 to 15
Callicarpa	-	-	5 to 10
Banaba	-	-	5 to 10
Agoho	-	-	n/a
Banguet pine	-	-	5 to 10
Narra	-	-	5 to 10
Tanguile/Oyong	-	-	5 to 10
Ipil-ipil	-	-	5 to 10

1.2. Site preparation

On the site preparation, the clusters had 1 month before rainy season to do all the cleaning of the ground. Brushing on the plantable sites were based the best practices benchmark in brushing based on previous reforestation projects implemented before NGP. The size of strip and ring-brushed areas is not less than 1m strip and 0.5 meter radius ring. Stakes are erected in every planting hole for marking of the commodity to be planted. The size of the planting hole in NGP site in Guinabon of 99 hectares and Babuyan NGP site of 150 hectares ranges from 4 inches to 5 inches square a depth of 4 to 5 inches, while in the NGP-BFI site of 131 hectares maintained a bigger hole size of 6 inches square with a depth of no less than 6 inches.

As to replacement of the original soil taken from each hole, they said that they did not make use of this because they are provided with fertilizers.

1.3. Planting

Based on the KII/FGD in Zambales, Planting of seedlings starts during rainy season and majority said that they stop planting by first week of dry season. They extended planting to meet their targets. Most of them, transport their seedlings from the nursery to the planting site through manual hauling using rattan basket. In the process, damage to seedlings cannot be avoided. Strip brushing, ring weeding, hole digging and planting were conducted simultaneously to save on time and take advantage of their presence in the field. In planting they removed the plastic bag by cutting it as much as possible without disturbing the balled soil. However, there were times that it cannot be avoided to disturb the soil during plastic removal. About 30 to 50% of planted seedlings had more or less affected their balled soil due to the need to plant all the seedlings brought to the site during the day. This happened during the establishment of the NGP plantations in the Guinabon and Babuyan sites (Table 19).

Soils used in filling the hole were mostly coming from what had been taken out during hole digging. Fertilizer application is done by putting in about 5-10 grams of complete fertilizer per hole. The respondents were not aware whether the seedlings' root collar had the right level with the ground surface.

Based on the answers of the respondents, the team came up with an observation that they did not have the standard way of planting because they were receiving instructions only from the PO Chairman. This affected the survival rates of the plantings.

Table 19. Summary of Planters' Responses in Sta. Cruz, Zambales.

	SITE 99	***SITE 150***	***SITE BFI***
Start of Planting			
During Rainy Season	100%	100%	100%
Stop of Planting			
One week before the end of Rainy Season	7%		40%
First week of Dry Season	93%	100%	60%
Soil Fertility Additives			
Forest Top Soil/Humus			40%
Fertilizer	5-10 grams per hole depending on budgeted	5-10 grams per hole depending on budgeted fertilizers	60% about 50 to 100 grams per hole mixed

	fertilizers		with humus.
Removal of Soil from the plastic bag			
Cut and removed with minimal breakage of the balled soil	50%	50%	40%
Cut and removed disturbing the balled soil	50%	50%	60%
How deep did you plant the seedlings?			
Root collar same level with the ground surface			40%
Root collar 3-4 inches below the ground surface	7%	43%	60%
Root collar 2 inches above the ground surface	93%	57%	
Did you firmly plant the seedlings on the ground?			
Yes	80-85%	80-85%	85-90%
No			
Did you erect a stake in every planted hole?			
Yes	100%	100%	100%
No			
After planting the seedlings did you provide some forms of mulch to collect and save soil moisture?			
Yes	20%		40%
No	80%	100%	60%

1.4. Protection and maintenance

The protection and maintenance of NGP Site 99 and NGP 150 are not really a must for POs/Clusters because they only have the chance to visit the site if it's along the way going to their own farms. The inner portions of the plantation are seldom inspected. The NGP-BFI site, however, has its own fire fighters to prevent forest fire. Their site inspection is almost every day. They even have their own equipment on fire prevention. The responses of the respondents on specific questions are summarized in Table 20.

Inspection of the plantation to assess the health condition of the individual seedlings is necessary to improve the survival rate. Knowing the right problems on site enables the NGP partners and the extension officers to identify and implement the right corrective measures. The frequency of inspection or visit to the plantations are indicated in Table 20.

Table 20. Summary of Responses of Protection and Maintenance Partners.

Frequency of Plantation of Inspection After Planting	Number of Times/Week
Site 99	Twice to 5 times week along the way
Site 150	2 to 7 times per Week along the way
NGP- BFI	7 times per Week in almost all portions

Inspection of the forest plantations is hindered by the absence of reforestation road network and readily passable footpath. All the 3 sites are not readily accessible. This infrastructure is not only useful in the regular inspection of the established reforestation sites but also necessary during the plantation establishment phase. Seedling transport will be facilitated if there are existing reforestation road network in the area. Likewise, the transport of manpower, supplies and materials will be easier. Thus, delivering such inputs to forest plantation protection and maintenance activities on time. In times of forest fire, fast mobility of forest fire protection patrols will be facilitated it there are reforestation road network.

Low survival of the planted seedlings during the initial planting periods was attributed by the respondents to lack of reforestation roads because they resorted to manual seedling transport from the central nursery to the planting area. In the process, damages to seedlings due to improper handling was not be avoided.

b. Common problems that cause survival rate reduction

The ranking of the common plantation problems that relate to the reduction of survival rate are shown in Table 21. The respondents ranked forest fire due to grazing is the most common problem in all the 3 sites. The next common problem is drought in NGP Site 99 and NGP-BFI Site while in NGP Site 150, second is improper planting. Third most common problem is improper planting in NGP Site 99, transport of seedlings in NGP Site 150 which resulted in substantial damage to seedlings, and rat and “anay infestation in NGP-BFI site (Table 21).

Combining all these problems contributes to low survival rates.

Table 21. Common Plantation Development Problems with Ranking.

What were the common problems that caused the reduction of survival rates in the NGP planted areas? (Ranking)	Site 99	Site 150	BFI
Drought	2	6	2
Grass fires due to grazing	1	1	1
Kaingin-making	7	5	4
Wildlife hunting	6	4	5
Treasure hunting	5	7	6
Improper planting	3	2	7
Inferior Seedlings Planted	4	8	8
Others: Trucking/Handling of seeds (Transportation)	-	3	-
Others: Daga/Anay	-	-	3

Forest and grass fires are common threats to all the 3 sites which prompted the CENRO and the PO/Clusters to come with their own fire prevention and control system. Based on FGD conducted, grass fire is a pasture cultural practice by most households with cattle in the barangays to renew young shoots for forage every year.

Because the vegetative cover in the uplands is mostly cogon, which is highly flammable, it is easier for the grass fire to spread over the planted areas during dry season. The respondents added that several grass fire sightings that affected reforestation sites in the upland areas of Sta. Cruz in previous years.

The respondents believe that to minimize grass fire there is a need for Foot Patrol Teams and Bantay Gubat to be budgeted as part of the protection and maintenance cost of the plantations. Furthermore, the introduction of site-based water system to serve the watering requirement of the plantations during dry season is a must. Also, firelines or firebreaks using plants with multiple benefits, should be integrated into the site development plan and most importantly budgeted.

When asked on what the NGP-partners did to control the spread of grass fires based on their experiences, their answers are summarized in Table 22.

Table 22. NGP-Partners Actions to Prevent and Control Forest Fires.

Respondent	Action of NGP-Partners	
NGP Site	Measures conducted to prevent forest or grass fires	Measures conducted to control forest or grass fires
Guinabon Site 99 Hectares	Foot patrol/Bantay Gubat	Water application
Babuyan Site 150 Hectares	None	Water application
NGP-BFI 130 Hectares	Fire Fighting Crew and Fireline establishment	Firelines Beater, Using power sprayer

c. Other protection and maintenance activities

The other activities that were performed by the NGP partners are summarized in Table 23.

Table 23. Other Protection and Maintenance Activities Conducted by the NGP Partners.

What were the protection and maintenance activities did you perform?	Activity
Site 99	Ring-weeding, Fertilizer application, Fire break or fire-line construction, Replanting, Watering, Forest/grass fire protection, Foot Patrol
Site 150	Ring-weeding, Fertilizer application, Firebreak or fire line construction, Forest/grass fire protection
NGP- BFI	Ring-weeding, Mulching, Fertilizer application, Fire break or fire-line construction, Replanting, Watering, Forest/grass fire protection, Foot Patrol

d. Estimated survival rates from the respondents' point of views

According to the Cluster leaders and POs as far as they can remember, survival rates from Site 99 ranges from 50 - 90% but most likely skewed to the 50%. On the other hand, Site 150 has 50% survival rate while the NGP- BFI have 90 - 95% but mostly likely skewed to 90 %(Table 24).

Table 24. Perceived Survival Rates of NGP Plantations in 2014 After Replanting According to the Respondents.

During the last inspection that you conducted, what was the survival rate of the planted NGP site before replanting?	SIte 99	Site 150	NGP-BFI
Mahogany	-	-	-
Auri	90%	50%	-
Batino	80%	-	-
Eucalyptus	50%	-	90-95%
Acacia mangium	80%	50%	90-95%
Callicarpa	-	-	90-95%
Banaba	-	-	90-95%
Agoho	-	-	90-95%
Banguet pine	-	-	90-95%
Narra	-	-	90-95%
Tanguile/Oyong	-	-	90-95%
Ipil-ipil	-	-	90-95%

e. NGP-partners suggestions on how to further improve survival rate

According to priority ranking (1 is high priority), the respondents by NGP site prioritized their selections on what should be done to improve survival rates and health conditions of the plantations (Table 25).

Table 25. Respondents Suggestions to Improve Survival Rates and Health Conditions of the NGP Plantations.

Based on your observations, what should be done to improve the conditions (survival rate and health conditions) of the NGP plantations in order to have a good quality NGP forests in the future? Prioritize your answers.	NGP Site 99	NGP Site 150	NGP-BFI 130
Straight 3 years contract to PO with responsibility to protect and maintain what they have planted.	4		3
Allocate additional budget for water system to be used in watering the plantations during drought.	3	2	5
Since most of the grassland and brushland areas in the site are already deteriorated apply soil fertility enhancing organic materials to support plant growth.	2	3	4
Prioritize reforestation along the periphery of forest lines and along creeks expanding uphill.	1	4	2
Others: Fund for Lookout / Bantay gubat	-	5	
Others: Additional equipment like power sprayer and two way radio.	-	1	1

2. *Survival Rates of the NGP Plantations*

There are two formulas used in the estimation of survival rates of the NGP plantations using data collected during the inventory of the 3 NGP sites in Sta. Cruz, Zambales. These are discussed in the following sections.

2.1. Survival Rate Formulas

There are two formulas used in the estimation of survival rates of the NGP plantations. These are the DENR survival rate formula and the IST formula.

1. The DENR formula presented in a matrix format.

Accounting Entry Tile	Reforestation Management Period (Year)				
	2011	2012	2013	2014	2015
Seedling Opening Stock (SOS)	SOS	SCS (2011)	SCS (2012)	SCS (2013)	SCS (2014)
Mortality (Reduction) (M)	M	M	M	M	M
Net Surviving Seedling (NSS)	NSS= SOS-M	SOS-M	SOS-M	SOS-M	SOS-M
Additional Seedling (AS) or Replanting (R)	R (2011)	R (2012)	R (2013)	R (2014)	R (2015)
Seedling Closing Stock (SCS)	SCS= NSS+R	SCS= NSS+R	SCS= NSS+R	SCS= NSS+R	SCS= NSS+R
Survival Rate	SCS/SOS*100	SCS/SOS*100	SCS/SOS*100	SCS/SOS*100	SCS/SOS*100

Figure 23. Survival Rate Using DENR Formula in Matrix Format

Dead seedlings are replaced through replanting. Usually, replanting is designed to complete the original number of seedlings planted or just to maintain the minimum survival rate requirement of 85%. Since the DENR is not certain on the level of dead seedlings on the following year, DENR requires a replanting level to complete the original seedling density that was planted and paid. In some cases, the total original number of seedling planted is exceeded with an allowance to make sure that the final living seedling is above or equal the required minimum.

The cost of seedlings for replanting including labor is budgeted but the cost of labor for replanting is allocated a minimal budget. In some cases, the labor cost is a counterpart of those that did the planting or some sort of a back job.

After a year's replanting, the survival rate is remeasured and replanting again is conducted. This process is repeated 3 times from the 1st year to the 3rd year of the plantation.

After the 3rd year, the activities to be undertaken are forest management activities including forest protection and maintenance of the plantation. Thinning may be done to remove trees that are suppressed and cannot grow any longer. This will provide growth in diameter and height and higher wood volume of the trees that are left to grow. Leaving the forest plantation as is to undergo natural elimination process is another option until it reaches maturity. In this case forest protection should come in to protect the plantations. Otherwise, it will cut by illegal loggers.

Replanting is limited to some extent and work only under the following conditions:

a. Replanting the same species will not survive if replanted under the canopy of the originally planted seedlings especially when sunlight cannot reach them.
b. Replanting the same species may survive if planted along the edge of the plantations for them to receive sunlight.
c. Replanting indigenous forest species such as premium and dipterocarp species that survive under partial shade or partial sunlight is a better option rather than planting the same fast growing species.

2. The Impact Study Team Formula (IST) in matrix format

Accounting Entry Title	**Reforestation Management Period (Year)**				
	2011	2012	2013	2014	2015
Seedling Opening Stock (SOS)	SOS	SCS (2011)	SCS (2012)	SCS (2013)	SCS (2014)
Mortality (Reduction) (M)	M	M	M	M	M
Net Surviving Seedling (NSS)	NSS=SOS-M	NSS=SCS-M	NSS=SCS-M	NSS= SCS-M	NSS=SCS-M
Additional	R (2011)	R (2012)	R (2013)	R (2014)	R (2015)

Seedling (AS) or Replanting (R)					
Seedling Closing Stock (SCS)	SCS(2011)=NSS+R	SCS(2012)=NSS+R	SCS (2013)=NSS+R	SCS(2014)=NSS+R	SCS(2015)=NSS+R
Survival Rate	SR= NSS/(SOS+R1) *100	SR=NSS/(SOS+R1+R2)*100	SR=NSS/(SOS+R1+R2+R3)*100	SR=NSS/(SOS+R1+R2+R3+R4)*100	SR=NSS/(SOS+R1+R2+R3+R4+R5)*100

Figure 24. Survival Rate Accounting Matrix.

The features of the formula are:

- It integrates efficiency of reforestation activities as a function of the summation of the annual replanting and the original density of seedlings planted and paid in a reforestation project area.
- Efficiency is given by zero mortality or replanting.
- Efficiency levels may play between 0 to 15% (DENR Prescribed maximum mortality) of the original total seedling density. Conversely, inefficiency levels may play between 15% and above mortality of the original total density.
- It eliminates additional cost in replanting and seedling production when the mortality or replanting value is zero. Thus, the unspent budget becomes a saving which will accrue to those who work in the protection and maintenance.

3. *Forest species planted in NGP sites*

3.1. Sta. Cruz, Zambales

There are 3 fast growing species planted in Guinabon, Babuyan and Binonton NGP reforestation sites. These are Auriculiformis *(Acacia auriculiformis)*, Mangium *(Acacia mangium)* and Eucalyptus *(Eucalyptus europhylla)*. Auriculiformis and Mangium are nitrogen-fixing species, while Eucalyptus europhylla[132] is an exotic species and not a nitrogen fixer. However, it had

[132] **Stanley C. Malab.** Current Status of Eucalyptus Plantations in the Northwestern Philippines. FAO. Reports submitted to the regional expert consultation on eucalyptus. Volume II. *Eucalyptus urophylla***.** This is one of the species recommended by the Panel of the Advisory Committee on Technology Innovation as a fuelwood species for humid regions, especially in areas where rainfall is more than 1,000 mm per year. It grows best on deep, well drained, medium to heavy non calcareous soils at altitudes of 300 m to 3,000 m. The wood is less dense than those of other species, but is also used as building poles and fence posts. It gives a high pulp yield of 20 to 30 m^3/ha/yr under favorable conditions (NAS, 1983). The species that has proven better growth is *Eucalyptus camaldulensis based on the PFDPIN project in implemented in Ilocos Norte***.** This species is the most widely planted *Eucalyptus* in

shown an average growth performance in PFDPIN reforestation project in Pasuquin, Ilocos Norte at 297 cm in height and 25.93 mm in diameter 5 years after planting with a survival rate of 47%.[133] On the other hand, *E. camaldulensis* had a survival rate of 52-75% on the same site. Observations in the ASEAN-NEW ZEALAND project in Mayantoc, Tarlac planted in early 1990s, showed *E. camaldulensis* has a diameter range of 50-60 cm and total height range of 25-30 meters today[134]. The other characteristics of *E. camaldulensis* is its ability to coppice and suitable for a long dry season and resistance to drought and fire. A forest fire control experiment in PFDPIN showed that *E. camaldulensis* is fire resistant. Observations showed a 100% survival with 5 to 10 new shoots grown one month after the fire. The coppices were about 260 cm in height and 24 mm in diameter five months after the plantation was burned (PFDPIN, 1992). In different sites in Binga-Ambuklao watershed, burned plantations of *E. camaldulensis* had survival rate of 48% to 53% 5 to 6 months after it was burned. In another observation in Pantabangan, Nueva Ecija showed 48% after 8 months the plantation was burned (Agpaoa , 1980) as reported by Malab.

Another species integrated with the fast growing species is Agoho, which is considered indigenous in the Philippines. Agoho naturally grows in sandy soil and in beach areas. According to CENRO Masinloc, there are areas in the mountains where Agoho trees can be found.

3.2. Basic Profile of the NGP Sites

There are 3 NGP sites in Sta. Cruz, Zambales. These are:

Description of the Area: The area is a grassland area. The types of grasses growing on site are cogon, talahib and other shrubs. Its terrain is rolling to steep slope. Soil is compacted, orange to red in color. The area is rocky and prone to erosion. In some plots, grasses taller than the planted seedlings.

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the world. It is resistant to fire and has a broad range of adaptability from tropical to subtropical climates. It also has the ability to grow on relatively poor soils. The wood is sometimes used for paper pulp. When fully dry, it is an outstanding fuel. Highly valued in Australia, it is also useful for general construction. In the Philippines, this species was found as a good wood substrate for the culture of 'shiitake' mushroom, the most important mushroom in Japan (Zamora, 1986). Annual wood yield ranges from 17 to 30m^3/ha in good sites. It can be regenerated by coppicing even up to six or more rotations (NAS, 1980). This species is very dominant around the Mediterranean (Spain has 114,000 ha while Morocco has 87,000 ha). Plantations are also found in Pakistan, Uruguay, Argentina and Kenya (NAS, 1983), and recently in the Philippines, (PFDPIN, 1992).http://www.fao.org/docrep/005/ac772e/ac772e0k.htm

[133] Measured in PFDPIN (1992) as reported by Malab.S.

[134] Region 3 Forester. Asean New Zealand Afforestation/Reforestation Project in Mayantoc, Tarlac.

This NGP site is exposed to extreme temperature and intense sunlight and because of this plus the thick cogon, it is very prone to forest fire.

Natural forest species considered as pioneer and intermediate species naturally growing in the area are
Binayoyo, Balinghasai and Batino.

The NGP site is close to a river situated at the lower elevation at the western side of the site.

Area Planted : 99 hectares
Date of Planting: 2011
Date of Replanting: 2013 and 2014
Location: Guinabon, Sta. Cruz, Zambales

Description of the Area: The area is a grassland area. The grasses growing are cogon, talahib and other shrubs. The site has a rolling to steep terrain. Soil is compacted, orange to red in color, characteristics of a clay soil. The area is rocky and prone to erosion. In some plots, grasses are even taller than the planted seedlings. This NGP site is exposed to high to very high temperature and sunlight. The area is prone to grass and forest fire.

Binayuyu, Balinghasai and Batino are some of the species naturally growing in the area. There is a river at the bottom of the area.

Area Planted: 150 hectares
Date of Planting: 2013
Date of Replanting: 2014
Location: Babuyan, Sta. Cruz, Zambales

Description of the area: Grassland; cogon, talahib and other grasses are present in the area. Agoho, Benguet and Mindoro Pine are naturally occuring in the area. If observed in a panoramic view the spacing of the planted seedlings is very noticeable. Rugged terrain, with varying slopes. The area is rocky and very rich in minerals such as marble, nickel and chromite since it is near the mining area in the province. The soil is relatively compacted and dry since it is exposed to extreme sunlight and temperature, however, there are also patches of forest observable in the area. Exposed to extreme sunlight and temperature. Fire Breaks was also established in the area.

Area Planted: 131 hectares
Date of Planting: 2013
Date of Replanting: 2014
Location: Binonton, Sta. Cruz, Zambales

3.3. Survival Rates

1. Guinabon NGP site: 99 hectares

1.1. Survival Rate Using DENR Formula

This NGP site was planted during the rainy season of 2011. Planters were contracted from Barangay Guinabon on a yearly basis.

Using the usual method of calculating survival rate based on annual number of live seedlings over the original number of seedlings planted is shown in Table 26.

Seedling mortality occurred the following year's dry season. This was the first time the planted seedlings were exposed to real field condition which resulted to seedling shock. On the same year, came the rainy season, the dead seedlings were replaced through replanting. This process was repeated on an annual basis.

Following top management instruction, the DENR field offices successfully brought back the original density of seedlings planted in the area through replanting increasing the survival rate from a low of 29% in 2013 to a high of 88% in 2015 without replanting the mortality. The DENR field offices did a tremendous effort in increasing the survival rate above the acceptable minimum level of 85% by replanting every year.

At 88% survival rate, the Guinabon NGP site has passed the minimum survival rate prescribed by DENR assuming that no further mortalities resulted after the assessment period considering that there are still about 3 dry months to follow where the seedlings will still be exposed to high temperature.

From the point of view of efficiency, summing all the replanted seedlings from 2012 to 2014 yielded 73,111 seedlings replanted. This already has exceeded the original seedling density of 49,500 by 48%. Assuming that the mortality in 2015 will be replanted this rainy season, the total seedling replanted will now be 78,961 seedlings, exceeding the original seedling density by 160%. This may be translated into another 99 hectares plus 59.4 hectares planted assuming each has perfect survival rate. Also, the cost of establishing the forest plantations would be increased by 160%.

Table 26. Survival Rates Using DENR Formula, 99-Ha NGP Site, Sta. Cruz, Zambales, 2015.

Account Entry Title	Reforestation Management Period				
	2011	2012	2013	2014	2015

Seedling Opening Stock (SOS) [135]	49500	49500	49500	49500	49500
Mortality (Reduction)[136]	0	9900	35318	27893	5850[137]
Net Surviving Seedling	0	39600	14182	21607	43650
Additional Seedling or Replanting	0	9900	35318	27893	0
Seedling Closing Stock	0	49500	49500	49500	43650
Survival Rate	100	80	28.65	43.65	88.18

1.2. Survival Rate Using IST Formula

The IST formula is not meant to make the DENR formula inferior. It is meant to offer another system that has in it an efficiency consideration. It is upon the discretion of the DENR to use it for assessing reforestation efficiency.

The calculations of the SRs using the formula are intended to demonstrate the site to site implications on reforestation and not intended to downgrade the efforts of the DENR field offices as well as the community stakeholders who participated in the NGP in trying their best to really put growing seedlings on the ground. In fact, this study speak well of their dedications of performing their task of reforesting their area no matter how hard it is. The results of the IST formula should not be taken against them but rather serving as an inspiration to work harder so that in the future we see a quality forest standing.

The survival rates calculated using the IST formula are shown in Table 27. Using the same figures used in Table 26, the survival rates are lower than the estimates calculated using the DENR formula. The reduction is substantial and its implication points to further erosion of the efficiency of reforestation activities in establishing plantations. It is also making reforestation process too costly.

The ideal situation is to maintain the original density as a constant denominator with zero annual replanting. Doing this means that the original seedling density is perfectly growing without mortality and need for replanting.

[135] The figures are based on interview with the CENRO and Extension Officers, CENRO Masinloc, Zambales. Replanting targets were set on the planted seedling density of 500 seedlings/hectare instead of maintaining the minimum survival rate of 85%. This is necessary to give an allowance that will surely exceed the minimum survival rate of 85%.

[136] Based on the NGP records of CENRO Masinloc

[137] Based on actual count of dead seedlings and those seedlings with health problems

This approach of deriving the survival rates is logical because it integrates efficiency and effectiveness into the reforestation process. The lower the survival rates, the less efficient and effective the reforestation processes are in establishing living seedlings according to the required density. Having more dead seedlings that will require replacement is an indication that some things were missed in the planning and in the implementation of the reforestation activities.

Table 27. Survival Rates Using IST Formula,

NGP Site of 99 Hectares, 2015.

Accounting Entry Title	Reforestation Management Period				
	2011	2012	2013	2014	2015
Seedling Opening Stock	49500	49500	49500	49500	49500
Mortality (Reduction)		9900	35318	27893	5850
Net Surviving Seedling		39600	14182	21607	43650
Additional Seedling or Replanted		9900	35318	27893	0
Seedling closing stock		49500	49500	49500	43650
Survival Rate	100.00	66.67	14.97	17.62	35.60

The survival rates calculated using the IST formula are 17%, 48%, 60% and 60% lower than the survival rates derived using the DENR formula, for 2012, 2013, 2014 and 2015, respectively. The reason for the low survival rates is due to the accumulated annual replanting which increased the denominator of the formula. Unlike in the DENR formula where the denominator is fixed to the seedling closing stock, the survival rate is higher for not accounting the total number seedlings already planted on the ground.

2. **Babuyan 150 Hectares**

2.1. Survival rate using DENR formula

The 150 hectares planted in 2013 has a total density of 75,000 seedlings. Notice that the mortality (reduction) in 2014 according to the records of the CENRO was 15,500 seedlings. This yielded a survival rate of 79% for 2014. Due to the relatively lower mortality in 2015, counted at 9,617 dead seedlings, the survival rate is increased to 87% in 2015. If the dead seedlings in 2015 will be replaced on the ground, it will increase the survival rate to another level subject to the prevailing condition after the replanting (Table 28).

Table 28. Survival Rates Using DENR Formula,

NGP Site of 150 Hectares, 2015.

Accounting Entry Title	Reforestation Management Period				
	2011	**2012**	**2013**	**2014**	**2015**
Seedling Opening Stock	0	0	75000	75000	75000
Mortality (Reduction)	0	0		15500[138]	9617[139]
Net Surviving Seedling	0	0		59500	65383
Additional Seedling or Replanted	0	0		15500	0
Seedling Closing Stock	0	0		75000	65383
Survival Rate	0	0		79.33	87.18

2.2. IST Survival Rate Formula

Using this method reduces the survival rates of the 150 hectares NGP reforestation area. The 2014 survival rate is reduced to 66% and the 87% survival rate in 2015 to 72%. Comparing the 99 hectares with the 150 hectares shows that the reforestation activities were probably better implemented in the 150 hectares than in the 99 hectares where the DENR field offices learned a lot from it. Another reason is perhaps the issuance of the NGP Manual of Implementation in 2012 which guided the conduct of reforestation activities (Table 29).

Table 29. Survival Rates Using IST Formula,

NGP Site of 150 Hectares, 2015.

Accounting Entry Title	Reforestation Management Period				
	2011	**2012**	**2013**	**2014**	**2015**
Seedling Opening Stock	0	0	75000	75000	75000
Mortality (Reduction)		0		15500	9617
Net Surviving Seedling		0		59500	65383
Additional Seedling or Replanted		0		15500	0
Seedling Closing Stock		0		75000	65383
Survival Rate		0		65.75	72.25

[138] Based on the records of CENRO Masinloc.

[139] Based on the study's assessment of the survival rate in the 150 hectares.

The estimates of the survival rates of the IST formula are 17.11% lower in 2014 and 17.12% lower in 2015 compared to the DENR formula estimates. The same reason why the estimates are lower to that of the Guinabon survival rates.

3. Binonton NGP-BFI site - 130 hectares

This site is a joint undertaking of the NGP through the CENRO and the Bukidnon Forest, Inc. under the USEC for Field Operations according to the CENRO. The difference of this project with the first 2 NGP sites are: a) The NGP-BFI site has personnel in planting and protection and maintenance that are budgeted for a longer period giving longer work security to the workers with assured income for not less than 3 years .

The same species were planted in the 99 hectares in Guinabon and 150 hectares in Babuyan NGP site.

3.1. Survival rate using DENR formula

Among the 3 sites, this project has the highest survival rate using the DENR formula (Table 30). The second year is always critical to the plantation because it is the first time the seedlings are exposed to real field condition. This happened in all NGP sites in Sta. Cruz, Zambales. The calculated survival rate for 2014 is 86% and in 2015 the survival rate has further increased to 90%. This site passed the minimum survival rate requirement of 85%.

The high survival rates are attributed to the NGP-partners who are in the plantilla of the BFI for at least 3 years and are technically equipped to handle reforestation activities anytime. It is their primary responsibility to take care of the forest plantations unlike those in the 2 sites where the NGP-partners are the members of the People's Organizations who are contracted on annual basis due to fund limitation.

Table 30. Survival Rates Using DENR Formula, NGP-BFI Site- 130 Hectares, 2015.

Accounting Entry Title	Reforestation Management Period				
	2011	2012	2013	2014	2015
Seedling Opening Stock	0	0	65500	65500	65500
Mortality (Reduction)[140]		0		9055	6455
Net Surviving Seedling		0		56445	59045
Additional Seedling Replanted		0		9055	0
Seedling Closing Stock		0		65500	59045
Survival Rate		0		86.18	90.15

[140] Based on the heights of seedlings measured during the inventory where 0.3m to 0.5m are believed to be 2 years old and <0.3m seedlings are 1 year old.

3.2. Survival rate using IST formula

The survival rates are shown in Table 31. Comparing with the survival rates with those derived using the DENR formula indicates that the IST estimates are lower by 12.14% in 2014 and 11.24% in 2015. The survival rate in 2015 is below the 85% prescribed minimum survival rate by DENR. The Binonton NGP-BFI site is more efficient compared to the Guinabon and Babuyan NGP sites as indicated by its survival rate at 80%.

Table 31. Survival Rates Using IST Formula, NGP-BFI Site-130 Hectares.

Accounting Entry Title	Reforestation Management Period				
	2011	2012	2013	2014	2015
Seedling Opening Stock	0	0	65500	65500	65500
Reduction (Mortality)		0		9055	6455
Net Surviving Seedling		0		56445	59045
Additional Seedling or Replanting		0		9055	0
Seedling Closing Stock		0		65500	59045
Survival Rate		0		75.71	80

3.3. Weighted average survival rate

Using the DENR formula and the IST formula for deriving the weighted average survival rate for the 3 NGP sites in Sta. Cruz, Zambales, and the results are shown in Table 32 (DENR Formula) and Table 33 (IST Formula).

On the average, the 3 NGP sites have a weighted average survival rate of 88.29% determined through the DENR Formula indicating a passing mark compared to the 85% minimum survival rate prescribed by DENR.

Table 32. Weighted Survival Rate (Using DENR Formula) of the NGP Sites in Sta. Cruz, Zambales.

NGP Site	Survival Rate (%) (2015)	Weighted Sum	Weighted Average Survival Rate (%)
Guinabon NGP Site 99 Hectares	88	8,712.00	
Babuyan NGP Site 150 Hectares	87	13,050.00	
Binonton NGP-BFI Site 130 Hectares	90	11,700.00	
		33,462.00	
			88.29

On the other hand, if the weighted average survival rate is computed using the IST Formula, the weighted average survival rate is reduced to 65.33%. This means that the 3 NGP sites were not efficient in the implementation of the reforestation activities and that there are more rooms for further improvement. Instead of opting to do replanting most of the time, the DENR field offices must implement the best practices in reforestation activities that minimize high seedling mortalities (Table 33).

Table 33. Weighted Average Survival Rate (Using IST Formula) of the NGP Sites in Sta. Cruz, Zambales.

NGP Site	Survival Rate (%) (2015)	Weighted Sum	Weighted Average Survival Rate (%)
Guinabon NGP Site 99 Hectares	35.6	3,524.40	
Babuyan NGP Site 150 Hectares	72.25	10,837.50	
Binonton NGP-BFI Site 130 Hectares	80	10,400.00	
		24,761.90	
			65.33

3.4. Species that suffered most

The percent species mortality of the NGP plantations is shown in Table 34. The information given in the table is useful in deciding whether a given species is going to be used for planting or replanting in the same sites or in totally new areas. Species with high percentage mortality should be avoided or as much as possible discover why such species did not survive. Among the species that showed small percentage of mortality is Agoho, the only indigenous species in the group. Eucalyptus europhyla is an exotic species from Australia. According to the review of literature, it has a low survival rate in the Philippines. Based on the table below, it is second in percentage mortality in all the 3 NGP sites. It is surprising to note that Auriculformis, a species that can grow in any field condition has the highest percentage mortality among the species planted. Some of the probable reasons for this are: a) the seedlings were not hardened enough in the nursery and therefore not ready for planting; b) transport and handling from the nursery to the site causing damage to the seedlings; c) improper site preparation and planting. The exact reasons why this happened should be an interesting problem area for research.

Table 34. Percentage Mortality of Species Planted in the NGP Sites, Sta. Cruz, Zambales.

Species	99 Hectares		150 Hectares		130 Hectares	
	Number	%	Number	%	Number	%
Auriculiformis	2479	42	1859	19		
Eucalyptus	1926	33	4818	50	1864	29
Agoho	886	15	1347	14	891	14
Mangium	559	10	1534	16	3700	57
Others (Batino)			59	1		0
Total	5850	100	9617	100	6455	100

3.5. Methods to increase survival rate

Since most of the species planted in the NGP sites are fast growing species, the following may help the DENR field offices and the community stakeholders in increasing the survival rates:

a) Do not plant unhardened and low quality seedlings (succulent stems and branches, few leaves, undersize stem and height).

b) In replanting especially under the canopy of the plantations, use indigenous forest species that are partial shade-loving and suitable in the area. If replanting is done outside the canopy, use the same fast growing species but selecting the species with the highest survival rate.

c) Prepare well the site, especially the size of the hole and depth. The hole size should be sufficient to capture rainwater, store it in the soil particles and make it available to seedlings during the dry season. Mix with the soil cleaned/sterilized worn out cloth to increase water absorptive capacity of the soil. Surrounding the hole about 20cm away from the edge, dig a circular canal to catch surface runoff. Cover it with a mulch to prevent soil moisture evaporation. This will provide the water requirements of the plants.

d) If intense sunlight is anticipated during the dry season, provide seedling shades using any available materials on site such as leaves of shrubs, palm, native bananas, cogon, and talahib. This is part of the protection and maintenance activities that are budgeted.

d) Rocky soil underneath the soil surface which was not seen during the SMP due to lack of a soil survey should be replaced in adjacent areas with thick soil layer;

d) During dry season assign members of the People's Organization or community to establish an entrance-exit guard house along the boundary where access paths are located. Man this 24/7 to monitor and to prevent the entry of hunters and shifting cultivators, forest products gatherers. Conduct regular IEC to the barangays. Secure an authority to the barangay leaders for the enforcement of barangay ordinances protecting the NGP plantations.

e) Inculcate to the minds of the members of the communities through regular education campaign the importance of the reforested areas in providing them sustainable supply of water and other environmental services and benefits. Thus, the need to take care of the plantations without pay is important.

f) Conduct a study to understand very well the site characteristics and the species, and come up with options that would result to better growth performance. The expertise of the ERDB and ERDS should come in to assist the DENR field offices along this matter.

4. Stumpage Build-up of the NGP Plantations

4.1. 99-ha timber plantation

Due to the mixed heights and diameters of the species in the 99-ha NGP sites resulting from the replanting activities, the trees were stratified according to heights. This was done to derive a more realistic estimate of the volume of the trees rather than averaging all the trees. The remnants of the first planting in 2011 are the dominant trees in the area. Their heights range from 5-9 meters. The dominant trees are the first layer of the canopy. There are only 413 dominant trees in the area.

The other stratum is the co-dominant trees. Their heights are from 2-4.9 meters. This stratum is the second layer and they are below the dominant trees. There are only 5,195 co-dominant trees in the area.

The third layer is composed of the seedlings/saplings equal to and below 2 meters in heights. The seedlings/saplings are under the canopy of the second layer. There are plenty of these seedlings/saplings in the 99-ha area numbering 42,512 seedlings or samplings.

a. Dominant trees (413 trees)

There are 413 trees that belong to the first planting in 2011. These are the dominant trees in the 99-ha plantation measured in 2015 during the assessment period. Using the diameter and height growth rates of the trees in 5 years, a linear projection of the diameters and heights of the trees each year from year 1 to year 30 was conducted. Based on these parameters, the volumes of the trees were computed. The results are shown in Table 35. The projection assumes that none of the trees will die within the 30 year period.

Table 35. Stumpage Buildup of Dominant Trees in the 99-Ha NGP Plantation, Sta. Cruz, Zambales, 2015.

Age	Bole HT	Average Dia	Vol/Tree	Total Trees	Total Wood Volume
1	0.91	1.66	0.00	413.00	0.08
2	1.82	3.31	0.00	413.00	0.65
3	2.73	4.97	0.01	413.00	2.19
4	3.64	6.63	0.01	413.00	5.19
5	4.55	8.28	0.02	413.00	10.13
6	5.46	9.94	0.04	413.00	17.50
7	6.37	11.60	0.07	413.00	27.79
8	7.28	13.25	0.10	413.00	41.48
9	8.19	14.91	0.14	413.00	59.07
10	9.10	16.57	0.20	413.00	81.02
11	10.01	18.23	0.26	413.00	107.84
12	10.92	19.88	0.34	413.00	140.01
13	11.83	21.54	0.43	413.00	178.01
14	12.74	23.20	0.54	413.00	222.33
15	13.65	24.85	0.66	413.00	273.45
16	14.56	26.51	0.80	413.00	331.87
17	15.47	28.17	0.96	413.00	398.07
18	16.38	29.82	1.14	413.00	472.53
19	17.29	31.48	1.35	413.00	555.74
20	18.20	33.14	1.57	413.00	648.18
21	19.11	34.79	1.82	413.00	750.36
22	20.02	36.45	2.09	413.00	862.73
23	20.93	38.11	2.39	413.00	985.81
24	21.84	39.76	2.71	413.00	1120.06
25	22.75	41.42	3.07	413.00	1265.99
26	23.66	43.08	3.45	413.00	1424.06
27	24.57	44.73	3.86	413.00	1594.78
28	25.48	46.39	4.31	413.00	1778.62
29	26.39	48.05	4.78	413.00	1976.07
30	27.30	49.71	5.30	413.00	2187.62

b. Second layer co-dominant trees (5,195 trees)

The co-dominant trees are those with heights ranging from 2 – 4.9 meters in the plantations. They are the next layer below the dominant trees which have heights equal to or greater than 5 meters. The projected diameters and heights are fitted to small woods only that can be used for fuelwood and pulpwood unless fertilizer applications using the right amount as required to pump the trees to their normal growth rates. Also, silvicultural treatments designed to open more spaces for sunlight for faster food production that can be used by the plants.

The potential stumpage buildup of the co-dominant trees in the plantation is shown in Table 36. Assuming that the survival rate of the co-dominant trees will be maintained in 30 years, it will have a total volume of 564 cum suitable for pulpwood, fuelwood, and decorative materials.

Table 36. Potential Stumpage Buildup of the Second Layer Co Dominant 5,195 Trees of the 99-Ha NGP Site

AGE	Bole HT	Average DIA	Vol/Tree	Total Trees	Total Vol
(Yr)	(m)	(cm)	(Cum)	(No.)	(Cum)
1	0.35	0.38	0.00	5195	0.02
2	0.70	0.76	0.00	5195	0.17
3	1.05	1.15	0.00	5195	0.56
4	1.41	1.53	0.00	5195	1.34
5	1.76	1.91	0.00	5195	2.61
6	2.11	2.29	0.00	5195	4.52
7	2.46	2.67	0.00	5195	7.17
8	2.81	3.06	0.00	5195	10.71
9	3.16	3.44	0.00	5195	15.25
10	3.51	3.82	0.00	5195	20.92
11	3.87	4.20	0.01	5195	27.84
12	4.22	4.58	0.01	5195	36.14
13	4.57	4.96	0.01	5195	45.95
14	4.92	5.35	0.01	5195	57.40
15	5.27	5.73	0.01	5195	70.59
16	5.62	6.11	0.02	5195	85.68
17	5.98	6.49	0.02	5195	102.76
18	6.33	6.87	0.02	5195	121.99
19	6.68	7.26	0.03	5195	143.47
20	7.03	7.64	0.03	5195	167.33
21	7.38	8.02	0.04	5195	193.71
22	7.73	8.40	0.04	5195	222.72

23	8.08	8.78	0.05	5195	254.49
24	8.44	9.17	0.06	5195	289.15
25	8.79	9.55	0.06	5195	326.82
26	9.14	9.93	0.07	5195	367.63
27	9.49	10.31	0.08	5195	411.70
28	9.84	10.69	0.09	5195	459.16
29	10.19	11.08	0.10	5195	510.14
30	10.54	11.46	0.11	5195	564.75

c. Third layer of trees layer (42,512 seedlings/saplings)

Majority of plants in the 99-ha NGP sites totaling 42,512 seedlings or saplings will have stumpage buildup within 30 years as projected in Table 37. The projected wood volume in 30 years is only 14.7 cum per hectare at 440 trees per hectare (500 trees original density *88% survival rate). This is significantly lower than the 9-year old A. auriculiformis yielding 45 cum per hectare in Nueva Ecija (Lasco and Pulhin, 1999).

Table 37. Potential Stumpage of the Third Layer of 42,512 Seedlings/Saplings in the 99-Ha

Age (Yr)	Bole Height	Average Dia	Vol/Tree	Total Trees	Total Wood Volume
1	0.36	0.21	0.000	42512	0.05
2	0.71	0.41	0.000	42512	0.41
3	1.07	0.62	0.000	42512	1.37
4	1.43	0.83	0.000	42512	3.26
5	1.78	1.03	0.000	42512	6.36
6	2.14	1.24	0.000	42512	10.99
7	2.50	1.45	0.000	42512	17.46
8	2.85	1.65	0.001	42512	26.06
9	3.21	1.86	0.001	42512	37.10
10	3.56	2.07	0.001	42512	50.90

11	3.92	2.27	0.002	42512	67.74
12	4.28	2.48	0.002	42512	87.95
13	4.63	2.69	0.003	42512	111.82
14	4.99	2.90	0.003	42512	139.66
15	5.35	3.10	0.004	42512	171.77
16	5.70	3.31	0.005	42512	208.47
17	6.06	3.52	0.006	42512	250.05
18	6.42	3.72	0.007	42512	296.83
19	6.77	3.93	0.008	42512	349.10
20	7.13	4.14	0.010	42512	407.17
21	7.49	4.34	0.011	42512	471.35
22	7.84	4.55	0.013	42512	541.94
23	8.20	4.76	0.015	42512	619.26
24	8.56	4.96	0.017	42512	703.59
25	8.91	5.17	0.019	42512	795.25
26	9.27	5.38	0.021	42512	894.55
27	9.62	5.58	0.024	42512	1001.79
28	9.98	5.79	0.026	42512	1117.28
29	10.34	6.00	0.029	42512	1241.31
30	10.69	6.20	0.032	42512	1374.20

4.2. 150-ha and the 131-ha NGP plantations

The Babuyan and the Binonton NGP sites are still young (2 years and 1 year old). At least each of the plantations should have no less than 3 years to be able to derive the growth rates of the planted trees in terms of diameter and height. From these growth rates, a linear extrapolation may be used to estimate the volume of trees in the future.

As a reference, the stumpage of the 99-ha may be used as a basis for estimating the stumpage of the 150- ha Babuyan NGP site and the 131- ha NGP-BFI site. If the survival rates of the 2 NGP sites will be maintained, the stumpage buildup for Babuyan will be 1% lower than that of the Guinabon NGP site. However, if the Binonton NGP site is considered, the stumpage buildup will be 2% higher than the Guinabon estimate on stumpage. These estimates were based on the difference of the survival rates of 3 NGP sites. These estimates will happen only if the survival rates will be maintained within the 30-year period.

4.3. Measures to further improve the growth of the NGP plantations

a. Conduct intensive fertilizer application to all the plants by putting the right type and quantity of fertilizers. To avoid leaching and erosion of applied fertilizer to plants, conduct the application during the dry season and water each plant when the soil is nearly dry. Do not over water because this will leach out the fertilizer.

b. Watch for insects that feed on the leaves of the plants. Get rid of the insects using manual or biological approaches. Chemical application should be ruled out because it is detrimental to health and to the environment.

c. Regularly conduct inspection of the individual plants to determine their health conditions and apply the right methods to be used to solve whatever problems that affect their health.

d. During dry season, guarding the plantation from forest fire is a must. Establish fire protection sectors that should be manned 24/7. If possible, establish a site-based fire protection quarter/office inside the NGP site purposely to have focus and to be able to implement immediate action in putting off forest fires.

e. Take advantage of the shades of the canopies of the NGP trees by interplanting shade-loving intermediate and climax indigenous forest species that are growing in the area. Because there is already sufficient shades, dipterocarp species together with other indigenous species may be interplanted.

f. No thinning should be conducted until the time when the intermediate and climax species have totally acclimatized and adapted on the site condition. When they reached the sapling stage, they may be released to more sunlight by pruning some of the branches of the fast growing species. In crowded trees, thinning may be done.

5. Environmental Impacts of NGP Plantations

5.1. Soil

1. Soil baseline characteristics

To be able to determine the contribution of plant species to soil moisture, soil carbon, soil fertility (NPK), and to reduction of soil acidity, the initial contents of the soil where the forest species are planted must be measured first. The soil baseline characteristics for the NGP sites are shown in Table 38. The averages of the soil moisture contents of the NGP sites at ages 1,2, and 3 years old yielded an average of 21.6% for the 3-year old NGP forest plantation, 19.17% in the 2-year old NGP plantation and 19.48% for the 1-year old NGP plantation. The difference between the 2-year old and the 1-year old forest plantation is the higher survival rate of the 1-year old than the 2-year old plantation where more plants store water into the soil. Considering the other indicators such as organic matter (OM), soil acidity (pH), Nitrogen (N), Organic Carbon (OC), Phosphorus (P) and Potassium (K) indicate that the NGP plantations have already started building humus through the positive OM, recharged the soil with OC thus helping in carbon sequestration and further enriched soil fertility through the positive NPK results. In terms of soil pH, the NGP plantations have not reversed yet the acidic soil.

Comparing the NGP sites' baseline soil characteristics with that of the control sites (grasslands), the moisture contents in the 3 NGP sites exhibited higher values compared to the soil moisture contents of the control sites taken at the same soil depths. This means that the control sites which have cogon as soil cover have negligible soil moisture content compared with those planted with forest species. In terms of pH, the control sites are more acidic than the NGP sites.

In terms of the other soil indicators, the differences between the average of the control sites and the averages of the soil indicators in various slope classes within each of the NGP plantations show whether the NGP sites have already exceeded the control site. If the difference is negative, the NGP plantation has not yet contributed much to the soil in terms of the soil indicator. However, if the difference is positive, it has already given more to the soil than that of the grassland. Negative N, OC, P and K happened when the grasses were cut and removed on site and did not decay on site. Whereas, in the control sites, the dead leaves of the grasses are left to rot on site having more of the N, OC, P, and K. This condition is temporary because the NGP plantations are still young. Within 5-10 years, the situation will turn around where the NGP sites will be producing more N, OC, P, and K than the control sites (grassland).

Table 38. Soil Baseline Characteristics of NGP Sites and Comparison with Control (Grassland) Area.

Site	Area	Plot No.	Slope Class	%MC	%OM	pH	%N	%OC	P(ppm)	K(me/100g)	Weight of Soil Samples (grams)
Guinabon, Sta. Cruz Zambales	99Ha	1	19-36%	13.8	1.8577	4.7	0.0929	1.0801	1.5798	2.7986	350
		12	>55%	30.5	3.1183	5.4	0.1559	1.8129	1.4481	2.3256	300
		14	>55%	26.79	2.6538	5.2	0.1327	1.5429	1.8445	0.8146	350
		17	0-18%	25.57	0.9952	5.2	0.0498	0.5788	1.7561	0.854	380
		19	19-36%	18.45	1.3269	5.2	0.0663	0.7715	1.5359	1.2088	300
		5	37-55%	14.78	3.0519	4.6	0.1526	1.7744	1.8445	1.0643	285
Total				**129.89**	**13.0038**	**30.3**	**0.6502**	**7.5606**	**10.0089**	**9.0659**	
Average				**21.6483**	**2.1673**	**5.0500**	**0.1084**	**1.2601**	**1.6682**	**1.5110**	**327.5**
Babuyan, Sta. Cruz Zambales	150HA	1	0-18%	25.54	2.6538	4.4	0.1327	1.5429	1.9331	1.1168	350
		2	19-36%	21.99	2.5212	4.3	0.1261	1.4658	1.4481	0.5913	300
		3	37-55%	14.68	1.725	5	0.0863	1.0029	1.5359	1.8	300
		4	19-36%	12.44	2.3885	4.7	0.1194	1.3886	2.5583	1.2088	310
		6	0-18%	21.23	1.0615	4.5	0.0531	0.6172	1.8888	0.7358	300

Total				**95.88**	**10.35**	**22.9**	**0.5176**	**6.0174**	**9.3642**	**5.4527**	
Average				**19.176**	**2.07**	**4.58**	**0.10352**	**1.20348**	**1.87284**	**1.09054**	312
Binonton, Sta. Cruz Zambales	131Ha	1	37-55%	21.07	3.1183	4.6	0.1559	1.8129	1.6679	1.3008	250
		10	0-18%	22.59	2.1231	5.4	0.1062	1.2343	1.8003	1.1825	320
		3	37-55%	20.85	3.3173	4.2	0.1659	1.9287	2.0219	1.4847	300
		6	19-36%	17.68	2.3885	5.3	0.1194	1.3886	2.1108	1.7212	285
		8	37-55%	25.99	6.701	4.3	0.335	3.8959	2.4236	1.0511	250
		9	>55%	8.71	2.6538	5.3	0.1327	1.5429	2.0663	1.3665	300
Total				**116.89**	**20.302**	**29.1**	**1.0151**	**11.8033**	**12.0908**	**8.1068**	
Average				**19.48167**	**3.383667**	**4.85**	**0.169183**	**1.967217**	**2.015133**	**1.35113333**	**284.17**
Site	**Area**	**Plot No.**	**Randomly Selected Sampling Points**	**%MC**	**%OM**	**pH**	**%N**	**%OC**	**P(ppm)**	**K(me/100g)**	
Control Sites for all NGP Sites		Plot 1	Grassland Site 1	0	5.374	4.7	0.2687	3.1244	2.1999	0.3679	
		Plot 2	Grassland Site 2	0	3.8484	4.7	0.1924	2.2373	1.5798	0.8803	
		Plot 3	Grassland Site 3	0	1.0615	4.6	0.0531	0.6172	1.6679	1.6161	
			Average	0.0000	3.4280	4.6667	0.1714	1.9930	1.8159	0.9548	

Guinabon vs.Control			Difference	21.6483	-1.2607	0.3833	-0.0630	-0.7329	-0.1477	0.5562	
Babuyan vs. Control			Difference	19.1760	-1.3580	-0.0867	-0.0679	-0.7895	0.0570	0.1358	
Binoton vs. Control			Difference	19.4817	-0.0443	0.1833	-0.0022	-0.0257	0.1993	0.3964	

2. Litter falls, NPK and OC yields of NGP sites

Evidences that the NGP plantations are giving off N, P, K, and OC to the soil are indicated in Table 39. In the 3-year old NGP plantations, Auriculiformis and Mangium as nitrogen-fixer give higher N than Agoho (native species) and Eucalyptus (exotic species). Mangium has higher Phosphorus and Potassium than Agoho, Auriculiformis, and Eucalyptus. OC is just 0.2% of the weight of the litter fall by species. For Agoho, the OC is 0.2gram. In the 2-year old and 1-year old NGP plantations, the trend is similar to that of the 3-year old NGP plantation. To reiterate, the litter fall NPK levels are additions to the NPK in the soil. Similarly the OC from the litter fall is an addition to the existing OC in the soil. As the NGP plantations mature, there will be more NPK and OC added into the soil.

Table 39. Litter Falls and NPK Yields of NGP Sites, Sta. Cruz, Zambales.

NGP Sites	Leaf Litter Samples	Year Planted	%N	%P	%K	Weight of Sample (g)
Guinabon, Sta. Cruz, Zambales	Agoho	2011	0.77	0.02	0.04	100
	A. auricauliformis	2011	1	0.01	0.25	300
	A. mangium	2011	1.16	0.1	0.31	380
	Eucalyptus	2011	0.69	0.01	0.2	300
		Total	3.62	0.14	0.8	1080
		Average	0.905	0.035	0.2	270
	Agoho	2013	0.77	0.01	0.09	85
	A. auricauliformis	2013	0.69	0.01	0.07	300

Babuyan, Sta. Cruz, Zambales	A. mangium	2013	1	0.04	0.13	300
	Eucalyptus	2013	0.39	0.01	0.17	300
	Total		2.85	0.07	0.46	985
	Average		0.7125	0.0175	0.115	246.25
Binonton, Sta. Cruz, Zambales	Agoho	2014	0.77	0.01	0.1	150
	A. auricauliformis	2014	0.65	0.01	0.07	350
	A. mangium	2014	0.84	0.06	0.14	320
	Eucalyptus	2014	0.35	0.01	0.17	310
	Total		2.61	0.09	0.48	1130
	Average		0.6525	0.0225	0.12	282.5

3. Comparison of the NPK of the NGP sites and the control sites (grasslands)

Comparing the NPK of the NGP sites to that of the control site, %N is a lot higher in Guinabon site than the control sites. However, when it comes to P and K, the control site surpasses the Guinabon Site. Same observation goes with Babuyan and Binonton sites. The high %N content present in all NGP sites were caused by the N-rich trees planted there.

Table 40. NPK of the Control Sites (Grassland), Sta. Cruz, Zambales, 2015.

Site	Species	Randomly Selected Sampling Points	%N	P(ppm)	K(me/100g)
Control Sites for all NGP Sites	Grasses (Cogon & Talahib)	Grassland Site 1	0.2687	2.1999	0.3679
		Grassland Site 2	0.1924	1.5798	0.8803
		Grassland Site 3	0.0531	1.6679	1.6161
		Average	0.1714	1.8159	0.9548

4. Impact to Soil Accretion

Soil accretion is the build up of soil due to the capacity of the base of plant to trap soil particles that are carried away through surface runoff. It is also contributed by the build up of humus as it mixes with the soil. Forest during the process of growth increases soil accretion as more litter falls are formed into humus and mixed with the soil. The averages per tree soil accretion impact of each of the 3 NGP sites are presented in Table 41.

Comparing the NGP sites with the control sites (grassland) in terms of soil accretion or erosion indicates that the grassland control site have a net soil erosion.

Table 41. Impact to Soil Accretion of NGP Sites, Sta. Cruz, Zambales.

NGP Site	Area (Hectares)	Year Planted	Soil Accretion (Cm/plant)	Control Site Soil Erosion
Guinabon	99	2011	0.27	-2.188
Babuyan	150	2013	0.16	-2.195
Binonton	131	2013	0.35	-0.655

5. Impact to Temperature

The impact of the NGP reforestation sites to temperature in the uplands of Sta. Cruz, Zambales are shown in Table 42.

Among the three NGP reforestation sites, Guinabon site has the highest reduction in temperature at 3.1 degrees Celsius. This is due to the relatively higher heights of the older age planted forest species which have more leaf area which is responsible in producing more oxygen through the process of photosynthesis. The other site with the next higher temperature reduction is that of the Binonton site. It also reduced temperature at 3.1 degrees Celsius. This is attributed to the higher survival rate of the NGP plantation in Binonton compared to Guinabon. The higher number of live trees in Binonton at 2 years old compensates for more plants performing photosynthetic activity resulting in cooler temperature. The Babuyan site has the least temperature reduction because it has the lowest number of surviving trees compared to the 2 sites. The other reason is that it is relatively younger in age dominated by very young stands of forest plantation where photosynthetic activities are limited by the young trees.

In general, all the NGP sites showed positive reduction in temperature when compared to the grassland proving that forest produces cooler temperature. This will contribute to reducing warming initially at the site level and may scale up to a provincial level if all the degraded lands will be reforested.

Table 42. Impact of the NGP Forest Plantations to Temperature.

NGP Sites	Area (Has)	Year Planted	Age (Years)	Average Temperature (C0)	Control Site	Temperature Difference
Guinabon	99	2011	3	31.9	35	3.1
Babuyan	150	2013	2	33.4	35.9	2.5
Binonton	131	2013	1	33.7	36.8	3.1

6. NGP compliance to disaster risk reduction

One of the NGP's objectives is to address DRR concerns in the uplands through its NGP reforestation sites. Although NGP did not specify the DRR indicators in the planning stage and in the monitoring; whether its DRR objective will be achieved, this study points to some readily measurable DRR indicators that may be included in the future in the monitoring and evaluation of the NGP sites. These indicators are shown in the methodology.

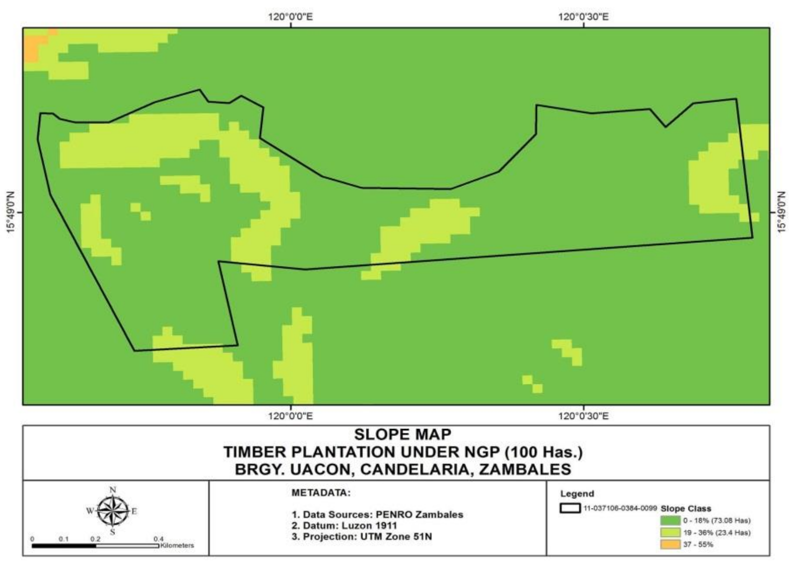


Figure 25. Slope Map of Guinabon, Sta. Cruz, Zamables.

a. Vulnerable areas to disaster in the Guinabon NGP site

The highest slope in the site belongs to the slope range of 19-36% (color yellow green) with an area of 23 hectares. The biggest portion of the site (color green) has a slope range of 0-18%. This has an area of 73 hectares. Given the DRR risky slopes, there are no DRR concerns in the 99 hectares Guinabon NGP site. Thus, there is no need to have a specific design for DRR to address a rain-induced disaster to reduce the occurrence of landslides (Figure 24).

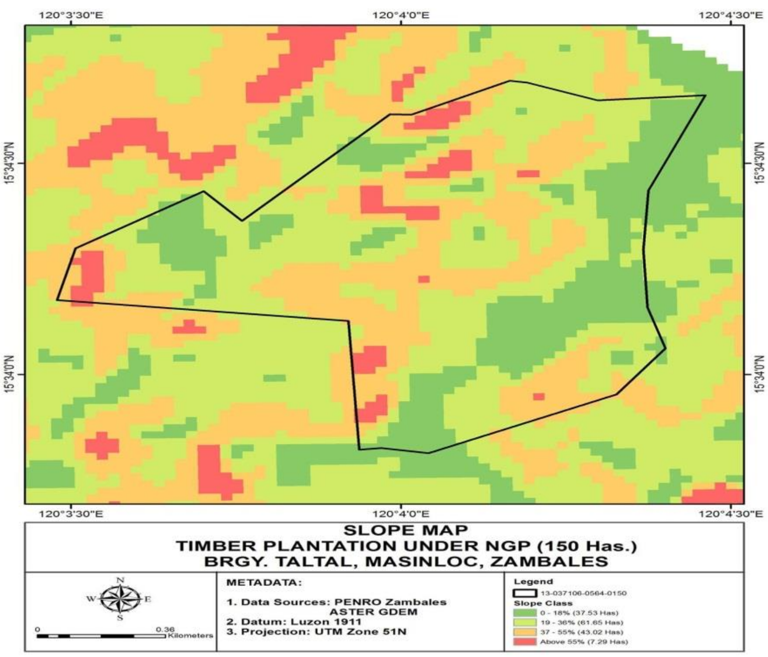


Figure 26. Slope Map of Babuyan, Sya. Cruz, Zambales.

b. Vulnerable areas to disaster in Babuyan NGP site

The areas which are DR-sensitive under a rain-induced disaster are in the slope ranges of 37-55% with 43 hectares (orange) and >55% with 7 hectares (red) in Figure 25. A total of 50 hectares considered sensitive to rain-induced disaster which needs to be addressed in the design and in the implementation.

c. Vulnerable areas to disaster in Binonton NGP-BFI site

The slope map of the Binonton site was not provided by the management. Anyway, slopes that are 37-55% and >55% are DRR-sensitive areas, which need different species from those planted ones and special site planning because vulnerable areas will have to be addressed.

d. Specific recommendations to make NGP compliant to DRR.

For the 3 NGP sites, to make them DRR compliant, there is a need to integrate the following:

a. Conduct a more detailed topographic profiling survey of the areas under 37-55% slope and those equal to and greater than >55% areas. The detailed topographic profiling survey is intended for designing a specific DRR measures that are suitable to the DRR-sensitive sites.
b. The DRR measure may vary from vegetative to structural methods or combination of the methods whichever is the most suitable method to be applied.

c. Species to be planted in close spacing are those that are deep-rooted or root -trained species.

d. Gullies, landslides and eroded areas may be installed with closely planted deep- rooted or root-trained trees.

7. Carbon sequestration

The carbon sequestration capacities of the NGP plantations in Sta. Cruz, Zambales are shown in the following sections. Table 43 shows the present carbon sequestration capacities of the three sites.

Table 43. Carbon Sequestration of NGP Sites at Assessment Period, Sta. Cruz, Zambales.

Indicator	99-ha NGP Site, Guinabon		150-ha NGP Site, Babuyan		131-ha NGP-BFI Site in Bononton	
	Density	Quantity	Density	Quantity	Density	Quantity
Diameter(cm)		1.0067		1.1747		0.8924
Total Height (m)		1.3129		1.4746		1.2909
Bole Height (m)		0.9847		1.1059		0.9682
Volume/Tree (Cum/tree)		0.0008		0.0014		0.0026
Crown Volume (Cum/tree)		0.0001		0.0002		0.0004
Root Volume (Cum/tree)		0.0001		0.0002		0.0003
Total Biomass (Cum/tree)		0.0010		0.0018		0.0033
Wood Density (Ton/tree)		0.0007		0.0012		0.0023
Carbon Sequestration (Tons/tree)		0.0002		0.0004		0.0007
Carbon Sequestration (Tons/ha)	440.90	0.0925	435.88	0.1613	450.7	0.3153
Total Sequestration (Ton/Total Site Area)	43650.00	9.1585	65383.00	24.1982	59045.0	41.3062

a. Potential carbon sequestration of the 99-ha NGP plantation

The potential carbon sequestration capacity of the 99-ha NGP plantation is shown in Table 44. The potential stumpage of the area is used. The crown volume is estimated at 15% of the total volume and the root volume is 13% of the total volume. These three factors are added to derive the total biomass in volume. To get the wood density, a factor of .7 ton per cum of wood is used to convert the volume from cum to ton. To derive the carbon sequestered, a factor of 0.35 carbon per ton of wood is used. This factor is for softwood species. The last two columns of the table present the carbon sequestration (total and per hectare) for a given year. The carbon values are very low due to the many small trees resulting from the series of replanting.

Table 44. Potential Carbon Sequestration of the Dominant Trees in 99-Ha NGP Plantation.

Age	Bole HT	Average DIA	Total Trees	Total Vol	Total Biomass	Total Biomass Density	Carbon Sequestration	Annual Carbon Seq Rate
1	0.91	1.66	413.00	0.08	0.10	0.07	0.03	
2	1.82	3.31	413.00	0.65	0.83	0.58	0.20	0.18
3	2.73	4.97	413.00	2.19	2.80	1.96	0.69	0.48
4	3.64	6.63	413.00	5.19	6.64	4.65	1.63	0.94
5	4.55	8.28	413.00	10.13	12.96	9.07	3.18	1.55
6	5.46	9.94	413.00	17.50	22.40	15.68	5.49	2.31
7	6.37	11.60	413.00	27.79	35.57	24.90	8.72	3.23
8	7.28	13.25	413.00	41.48	53.10	37.17	13.01	4.29
9	8.19	14.91	413.00	59.07	75.60	52.92	18.52	5.51
10	9.10	16.57	413.00	81.02	103.71	72.60	25.41	6.89
11	10.01	18.23	413.00	107.84	138.04	96.63	33.82	8.41
12	10.92	19.88	413.00	140.01	179.21	125.45	43.91	10.09
13	11.83	21.54	413.00	178.01	227.85	159.49	55.82	11.92
14	12.74	23.20	413.00	222.33	284.58	199.21	69.72	13.90
15	13.65	24.85	413.00	273.45	350.02	245.01	85.75	16.03
16	14.56	26.51	413.00	331.87	424.79	297.36	104.07	18.32
17	15.47	28.17	413.00	398.07	509.53	356.67	124.83	20.76
18	16.38	29.82	413.00	472.53	604.83	423.38	148.18	23.35
19	17.29	31.48	413.00	555.74	711.34	497.94	174.28	26.09
20	18.20	33.14	413.00	648.18	829.68	580.77	203.27	28.99
21	19.11	34.79	413.00	750.36	960.45	672.32	235.31	32.04
22	20.02	36.45	413.00	862.73	1104.30	773.01	270.55	35.24
23	20.93	38.11	413.00	985.81	1261.83	883.28	309.15	38.60
24	21.84	39.76	413.00	1120.06	1433.68	1003.58	351.25	42.10
25	22.75	41.42	413.00	1265.99	1620.46	1134.32	397.01	45.76
26	23.66	43.08	413.00	1424.06	1822.80	1275.96	446.59	49.57
27	24.57	44.73	413.00	1594.78	2041.32	1428.92	500.12	53.54
28	25.48	46.39	413.00	1778.62	2276.63	1593.64	557.78	57.65

29	26.39	48.05	413.00	1976.07	2529.37	1770.56	619.70	61.92
30	27.30	49.71	413.00	2187.62	2800.16	1960.11	686.04	66.34

b. Potential carbon sequestration of the co-dominant trees

There are 5,195 co-dominant trees in the 99-ha NGP plantation. Using the same assumptions as in Table 44, their potential carbon sequestration at any given time is presented in Table 45.

Table 45. Potential Carbon Sequestration of the Co-Dominant Trees in the 99-Ha, NGP Plantation.

Age (Yr)	Bole HT	Average DIA	Trees	Tot al Volume	Total Biomass Volume	Total Biomass Density	Carbon Seq	Annual Carbon Seq Rate
1	0.35	0.38	5195	0.02	0.02	0.02	0.01	
2	0.70	0.76	5195	0.17	0.20	0.14	0.05	0.04
3	1.05	1.15	5195	0.56	0.66	0.46	0.16	0.11
4	1.41	1.53	5195	1.34	1.57	1.10	0.38	0.22
5	1.76	1.91	5195	2.61	3.06	2.14	0.75	0.37
6	2.11	2.29	5195	4.52	5.28	3.70	1.29	0.55
7	2.46	2.67	5195	7.17	8.39	5.87	2.06	0.76
8	2.81	3.06	5195	10.71	12.52	8.77	3.07	1.01
9	3.16	3.44	5195	15.25	17.83	12.48	4.37	1.30
10	3.51	3.82	5195	20.92	24.46	17.12	5.99	1.62
11	3.87	4.20	5195	27.84	32.56	22.79	7.98	1.98
12	4.22	4.58	5195	36.14	42.27	29.59	10.36	2.38
13	4.57	4.96	5195	45.95	53.74	37.62	13.17	2.81
14	4.92	5.35	5195	57.40	67.12	46.99	16.45	3.28
15	5.27	5.73	5195	70.59	82.56	57.79	20.23	3.78
16	5.62	6.11	5195	85.68	100.20	70.14	24.55	4.32
17	5.98	6.49	5195	102.76	120.18	84.13	29.44	4.90
18	6.33	6.87	5195	121.99	142.66	99.86	34.95	5.51
19	6.68	7.26	5195	143.47	167.79	117.45	41.11	6.16
20	7.03	7.64	5195	167.33	195.70	136.99	47.95	6.84
21	7.38	8.02	5195	193.71	226.54	158.58	55.50	7.56
22	7.73	8.40	5195	222.72	260.47	182.33	63.82	8.31
23	8.08	8.78	5195	254.49	297.63	208.34	72.92	9.10
24	8.44	9.17	5195	289.15	338.16	236.72	82.85	9.93
25	8.79	9.55	5195	326.82	382.22	267.55	93.64	10.79

26	9.14	9.93	5195	367.63	429.95	300.96	105.34	11.69
27	9.49	10.31	5195	411.70	481.49	337.04	117.96	12.63
28	9.84	10.69	5195	459.16	536.99	375.90	131.56	13.60
29	10.19	11.08	5195	510.14	596.61	417.63	146.17	14.61
30	10.54	11.46	5195	564.75	660.48	462.33	161.82	15.65

c. Potential carbon sequestration of the 3rd layer

Grasses sequester carbon so with small trees and seedlings. In the 99-ha NGP plantations there are 42,512 small seedlings and saplings. While growing, they also sequester carbon probably similar to those in the first and second layer assuming that survival rate will be maintained within the growing period. The projected carbon sequestration of the 42,512 seedlings or saplings will increase as they grow from year 1 to year 30 (Table 46).

Comparing the carbon sequestration on a per hectare basis with forest plantations in Luzon shows that the estimate in year 30 is only 3.82 tons per hectare (369.38 tons/42,512 plants * (500 plants per hectare * 88% survival rate) whereas a similar 9-year old A. auriculiformis reforestation projects had 19.1 to 20.7 tons per hectare in Nueva Ecija (Lasco and Pulhin, 1999).

Table 46. Potential Carbon Sequestration of the 3rd Canopy Layer of the 99-Ha NGP site.

Age (Yr)	Bole Height	Average Dia	Total Trees	Total Volume	Total Biomass Volume	Total Biomass Density	Carbon Seq.	Annual Carbon Seq. Rate
1	0.36	0.21	42512	0.05	0.07	0.05	0.01	
2	0.71	0.41	42512	0.41	0.52	0.36	0.11	0.10
3	1.07	0.62	42512	1.37	1.76	1.23	0.37	0.26
4	1.43	0.83	42512	3.26	4.17	2.92	0.88	0.51
5	1.78	1.03	42512	6.36	8.14	5.70	1.71	0.83
6	2.14	1.24	42512	10.99	14.07	9.85	2.96	1.24
7	2.50	1.45	42512	17.46	22.35	15.64	4.69	1.74
8	2.85	1.65	42512	26.06	33.36	23.35	7.00	2.31
9	3.21	1.86	42512	37.10	47.49	33.24	9.97	2.97
10	3.56	2.07	42512	50.90	65.15	45.60	13.68	3.71
11	3.92	2.27	42512	67.74	86.71	60.70	18.21	4.53
12	4.28	2.48	42512	87.95	112.57	78.80	23.64	5.43
13	4.63	2.69	42512	111.82	143.13	100.19	30.06	6.42
14	4.99	2.90	42512	139.66	178.76	125.13	37.54	7.48
15	5.35	3.10	42512	171.77	219.87	153.91	46.17	8.63

16	5.70	3.31	42512	208.47	266.84	186.79	56.04	9.86
17	6.06	3.52	42512	250.05	320.07	224.05	67.21	11.18
18	6.42	3.72	42512	296.83	379.94	265.96	79.79	12.57
19	6.77	3.93	42512	349.10	446.84	312.79	93.84	14.05
20	7.13	4.14	42512	407.17	521.18	364.82	109.45	15.61
21	7.49	4.34	42512	471.35	603.33	422.33	126.70	17.25
22	7.84	4.55	42512	541.94	693.69	485.58	145.67	18.98
23	8.20	4.76	42512	619.26	792.65	554.85	166.46	20.78
24	8.56	4.96	42512	703.59	900.60	630.42	189.13	22.67
25	8.91	5.17	42512	795.25	1017.93	712.55	213.76	24.64
26	9.27	5.38	42512	894.55	1145.03	801.52	240.46	26.69
27	9.62	5.58	42512	1001.79	1282.29	897.61	269.28	28.83
28	9.98	5.79	42512	1117.28	1430.11	1001.08	300.32	31.04
29	10.34	6.00	42512	1241.31	1588.88	1112.21	333.66	33.34
30	10.69	6.20	42512	1374.20	1758.98	1231.28	369.38	35.72

d. Carbon sequestration of Babuyan and Binonton NGP sites

The Babuyan and the Binonton NGP sites are still young (2 years and 1 year old) to estimate their potential carbon capture capacities. If their survival rates will be maintained up to the 15-year, their carbon sequestration rates would be quite higher than the 99-ha NGP plantations due to higher survival rates. This is so because, they have the same species, same site quality and same management system under the CENRO.

5. Impact to wildlife

Listed below are fauna spotted or observed by local residents in the area. Most of fauna species are birds. According to the respondents there are more birds, followed by reptiles and then mammals. Philippine Eagle has been spotted in the mountains close to the NGP sites. The more fauna in the NGP sites the faster would be the dispersal of seeds of indigenous forest species. Thus, increasing the biodiversity of the area.

CLASS	FAMILY	SCIENTIFIC NAME	COMMON NAME	LOCAL NAME
Avifauna	Accipitridae	*Pithecophaga jefferyi*	Philippine Eagle	kali
Avifauna	Anatidae	*Turnix ocellatus*	Spotted Button Quail	pugo
Avifauna	Bucerotidae	*Buceros hydrocorax*	Rufous Hornbill	kalaw
Avifauna	Bucerotidae	*Penelopides manillae*	Tarictic Hornbill	kanaway
Avifauna	Columbidae	*Chalcophaps indica*	Emerald Dove	alimuking
Avifauna	Columbidae	*Treron axillaris*	Green Pigeon	pagao
Avifauna	Estrildidae	*Lonchura oryzivora*	Java Sparrow	bilit tsina

Avifauna	Halcyonidae	*Alcedo cyanopectus*	Indigo-Banded Kingfisher	salaksak
Avifauna	Hirundinidae	*Hirundo rustica*	Barn Swallow	salsalapingaw
Avifauna	Monarchidae	*Hypothymis azurea*	Black Naped Monarch	bilit-tuling
Avifauna	Picidae	*Picoides maculatus*	Philippine Pygmy Woodpecker	sawsawit/anluage
Avifauna	Psittaculidae	*Tanygnathus lucionensis*	Blue Naped Parrot	bulilising
Avifauna	Rhipiduridae	*Rhipidura nigritorquis*	Pied Fantail	lawlawigan
Avifauna	Tytonidae	*Tyto sp.*	Grass Owl	sagang
Avifauna	Upupidae	*Upupa epops*	Hoopoe	balog
Mammals	Hipposideridae	*Hipposideros diadema*	Roundleaf Bat	kurarapnit
Mammals	Muridae	*Rattus house rat*	Asian House Rat	bao
Mammals	Muridae	*Rattus exulans*	Polynesian Rat	utot
Mammals	Muridae	*Rattus tanesumi*	Asian House Rat	utot/marabutit
Mammals	Pteropodidae	*Cynopterus brachyotis*	Common Shortnosed Fruit Bat	paniki
Reptiles	Colubridae	*Ahaetulla prasina*	Asian Vine Snake, Oriental Whipsnake	bartin
Reptiles	Colubridae	*Boiga dendrophila*	Mangrove Snake	karasaen
Reptiles	Colubridae	*Dendrelaphis pictus*	Painted Bronzeback	ulig/manukak
Reptiles	Crotalidae	*Tropidolaemus wagleri*	Wagler's Pit Viper	barten
Reptiles	Dicroglossidae	*Occidozyga laevis*	Puddle Frog	tukak
Reptiles	Gekkonidae	*Gecko monarchus*	Spotted House Gecko	tika
Reptiles	Microhylidae	*Kaoula baleata*	Smooth Fingered	pilat
Reptiles	Rhacophoridae	*Polypedates macrotis*	Brown-Striped Tree Frog	pilat
Reptiles	Rhacophoridae	*Nyctixalus pictus*	Peter's Tree Frog	tukak saba
Reptiles	Scincidae	*Dasia grisea*	Brown Tree Skink	banyas
Reptiles	Varanidae	*Varanussalvator*	Monitor Lizard	alebot/alibot

3. Dinagat NGP Sites

1. Survey, Mapping and Planning

Although the conduct of SMP is one of the requirements of NGP implementation, it was not considered due to lack of time and budget to cover a detailed survey. It focused on GPS boundary survey and GIS mapping. It did not conduct soil survey and analysis, vegetation survey, DRR survey and species-site matching. Forest species recommended for planting were based on existing forest cover in the area and through the recommendation of the Ecosystems

Research and Development Bureau. There were no indication that alternative species evaluation was conducted to find out those that best survived in the area.

2. *Capability building*

According to the respondents, they were trained on planting and protection and maintenance activities for 1 day each topic by technical staffs of the DENR in 2011, 2012 and 2014. Details of the training are shown in Table 47.

Table 47. Training Provided to the Planters in the NGP Site.

1. Before the start of implementing the NGP activities in the reforestation area, were there trainings conducted to re-orient the contractors or workers on the establishment, protection, maintenance and other reforestation activities?				
Title of Trainings	Year	Attendee	Number of days of training with demonstration	Resource Persons
On-the-ground training				DENR Personnel
Planting	2012	30-64 pax	1	Foresters/Agroforestry Specialist
Maintenance and Protection	2011-2014	30 pax	1	Foresters/Agroforestry Specialist

The respondents commented that due to the many attendees, a 1 day training for planting is not sufficient if all the steps in how to properly plant seedlings were discussed and demonstrated. Similarly the training on protection and maintenance which covers several activities was inadequate. To benefit those that were not involved in the first training, a 4-day re-echo training was conducted by the leaders that were trained by the DENR. The details of the training are described in Table 48.

Table 48. Re-echo Training Conducted by PO Leaders.

2. Were the workers trained by their officers on the same subject matters taught to them during their trainings?			
Title of training	Approach of training	Attendee and their functions in the NGP	Remark
Planting	orientation and demonstration	60 pax planters	The training was conducted in one day only,
Site Preparation	orientation and demonstration	60 pax wprkers assigned in site preparation	The training was conducted in one day only
Seedling production	orientation and demonstration	60 pax nursery operation	The training was conducted in one day only
Maintenance and Protection	orientation and demonstration	60 pax workers assigned in protection and maintenance	The training was conducted in one day only

To validate the skills learned by the workers in planting and protection and maintenance, they were asked to rate how they performed in actual implementation of the reforestation activities. Their answers are summarized in Table 49.

Table 49. Self Evaluation Rating of Respondents' Performance in the Conduct of Reforestation Activities.

How did the trained workers demonstrate their learning in the training?
(whether skills gained were applied in the actual conduct of NGP

activities)	
Reforestation Activity	**Respondents' Assessment**
Nursery operations or seedlings production	Not all activities, only about 80-100% were conducted according to what were taught in the training.
Site preparation	Poorly undertaken, lower than 50% of the skills gained were implemented due to difficulty of work environment in the reforestation site.
Planting	More than 80%, but not exceeding 90%, of the planting activities were thoroughly carried out. There were activities conducted without following required procedures.
Protection and maintenance	Compliance to required activities is between 80-90% due lack of supervision.

3. Plantation quality assurance

According to the KII respondents, the Extension Officers of the PENRO conducted evaluation of the quality of the seedlings produced by the workers and the acceptance ratings range from 80 to 90% of the seedlings conformed to the prescribed minimum standards. Some workers were given high quality ratings of their seedlings produced from 95-100%.

Likewise, they also inspected the qualities of the other reforestation activity outputs whether these are consistent with the prescribed standards of the NGP.

However, there is no system implemented by the DENR that will ensure the quality of the NGP plantations except those regular validation activities of survival for billing purposes.

4. Seedling production

All seedling requirements for planting in the NGP sites are being grown in the PENRO nursery. According to the PENRO this is necessary to maintain the quality of the seedlings because they have the technical background and experience in seedling production. All seedlings for replanting were grown by the NGP-partners or contractors. The sources of planting materials are from seeds and wildlings. The seeds and wildlings collected were from the following indigenous species: Nato *(Palaqium luzoniense)*, Saguimsim (*Syzgium brevistylum*), Mountain Agoho (*Casuarina equisetifolia*) , Kalumpit *(Terminalia microcarpa)*, Tiga, Mangkono *(Xanthostemon verdugonianus)*, Narra *(Pterocarpus indicus)*, Molave *(Vitex parviflora)*, Agoho *(Casuarina equisetifolia)*, Yakal, Red Lauan *(Shorea negrosensis)*, Wakatan, Mangium *(Acacia mangium)*, White Bitanghol *(Callophyllum blancoi)*, Siguimsim sibat, Talisay *(Terminalia catappa)*, Marang *(Artocarpus odoratissimus)*, Kulipapa (Vitex quinata). Table 50 shows the assignments of the NGP-partners and the PENRO in raising the required seedlings for the NGP reforestation sites.

Table 50. Sources of Planting Materials in Dinagat.

	NGP	***NON-NGP***
Sources of Seedlings		
From seeds collected by respondents for replanting	About 50%	
From wildlings collected by respondents for replanting	About 50%	
From wildings collected by respondents for planting		About 100%
Procurement from private nurseries (wildlings, seeds collected by private nurseries) for planting in NGP sites	About 50-100%	
PENRO nurseries for species to be planted in NGP sites	About 100%	

The growing periods of the indigenous species raised in the nurseries according to the respondents are shown in Table 51. Wildlings collected are conditioned in the nurseries to have new roots before planting. The minimum numbers of months to condition the wildlings are provided in the table. Plant materials from seeds of indigenous species require relatively longer periods to prepare the seedlings to attain the desired qualities for planting in the reforestation sites.

Table 51. Growing Periods of the Indigenous Species in the Nurseries before Outplanting.

How many months did you take care of the seedlings in the nursery up to

Outplanting in the NGP reforestation sites?			
Indigenous Species	**NGP Site**	**Non-NGP Site**	**Covered Activity**
Nato	3 months	-	Conditioning wildlings
Saguimsim	6 months	-	Seed germination to hardening
Mountain Agoho	2 months	-	Conditioning wildlings
Kulitapa	12 months	-	Seed germination to hardening
Kalumpit	7 months	-	Seed germination to hardening
Tiga	6 months	-	Seed germination to hardening
Mangkono	12-24 months	-	Seed germination to hardening
Narra	3 months	-	
Molave	7 -12 months	-	Seed germination to hardening
Agoho	5 to 12 months	3 months	Seed germination to hardening
Yakal	9 months	-	Seed germination to hardening
Red Lauan	12 months	-	Seed germination to hardening
Wakatan	-	3 months	Conditioning of wildlings
Mangium	-	3 months	Conditioning of wildlings
White Bitanghol	-	3 months	Conditioning of wildlings
Mangkono	-	3 months	Conditioning of wildlings
Saguimsim	-	3 months	Conditioning of wildlings
Saguimsim sibat	-	3 months	Conditioning of wildlings
Talisay	-	3 months	Conditioning of wildlings
Marang	-	3 months	Conditioning of wildlings
Kulipapa	-	3 months	Conditioning of wildlings
Bitanghol	-	3 months	Conditioning of wildlings

Dinagat also contributed to the Treevolution actvity of DENR in Mindanao part. They aimed to plant within one hour at least more than a million, to beat the record of India in planting more than 1 millon in one day. However, while many participated, the quality of the plantings resulted to survival rates close to the minimum requirement of 85%.

5. Site preparation

In clearing the area to be planted, the most common method is strip or contour brushing. This was conducted by the PENRO workers and technical staff following the common size of strip with a width of 1 m and in every spot, cleaned around a 0.5 m radius.

Strip brushing starts during the dry season or during the rainy season simultaneously with planting. The holes are prepared with a size similar to that of the plastic bag or sometimes bigger. This is also true in the Non-NGP sites.

6. Planting

Planting is done by volunteers as part of the social mobilization of NGP in Dinagat during the rainy season. Instructions in the proper planting of the seedlings were given to the volunteers before planting using the best practices learned from DENR’s past reforestation projects. To maintain good growth of the planted seedlings, vermicast fertilizer was applied.

In the case of the Non-NGP sites, the application of vermicast, compost and urea is practiced. However, this did not result to significantly higher survival rates as most of the non-ngp plantations have lower survival rates compared to the 85%.

After planting the seedlings, stakes produced from Ipil-ipil and bugang poles (1 m. Height) were placed beside the seedlings.

Seedlings that were planted in the NGP sites possess the prescribed qualities shown in Table 52.

Table 52. Qualities of Seedlings Suitable for Planting.

What were the qualities of the seedlings that were hauled to planting sites?			
	Ht of Seedlings	**Diameter of Seedlings**	**Number of Leaves of**

Species	(inches)		(cm)		Seedlings	
	NGP Site	Non-NGP Site	NGP Site	Non-NGP Site	NGP Site	Non-NGP Site
Nato	8 to 9	-	0.3	-	5 to 7	-
Saguimsim	3 to 5	-	0.3	-	8 to 10	-
Mountain Agoho	5 to 6	-	0.6	-	2 to 3	-
Kulitapa	5 to 7	-	0.3	-	10 to 12	-
Kalumpit	5 to 7	-	0.3	-	15 to 20	-
Tiga	5 to 7	-	0.3	-	8 to 10	-
Mangkono	3 to 5	-	0.3	-	8 to 10	-
Narra	5 to 7	10 to 12	0.55	0.8	15 to 17	15 to 20
Molave	6 to 7	-	0.8	-	6 to 7	-
Agoho	5 to 6	4 to 5	0.6	any	5 to 6	no idea
Yakal	3 to 5	-	0.3	-	5 to 7	-
Red Lauan	5 to 7	-	0.8	-	5 to 8	-
Wakatan	-	5 to 10	-	0.3	-	7 to 15
Mangium	-	4 to 5	-	0.3	-	4 to 10
White Bitanghol	-	10 to 12	-	0.3	-	10 to 15
Mangkono	-	8 to 10	-	0.3	-	12 to 15

Saguimsim	-	8 to 10	-	0.8	-	7 to 15
Saguimsim sibat	-	10 to 12	-	0.5	-	10 to 15
Talisay	-	8 to 10	-	0.5	-	
Kulipapa	-	10 to 15	-	0.8	-	8 to 10
Bitanghol	-	8 to 12	-	0.4	-	10 to 15

7. Protection and maintenance

Members of religious organization operating in the area were hired to conduct protection and maintenance activities including replanting. When asked on the protection and maintenance activities that they performed, they enumerated the activities with the descriptions of how they conducted such activities in the field (Table 53). They have no way of determining whether the activities were effective or not because there were no monitoring done. They can only validate the effectiveness of the activities if these are provided with fundings.

Table 53. Protection and Maintenance Activities Conducted by the Workers.

	NGP and Non-NGP Respondents
Activity	**Workers' Description**
Ring weeding	Cutting of grasses and weeds around the planted seedlings.
	Grass roots were not extracted on site.
	Frequency of ring weeding depends on the budgeted schedule regardless of the thickness of weeds/grasses.
Fertilizer application	Applied one teaspoon full of complete fertilizer to seedlings with signs of nutrients deficiency.
Fireline/firebreak	Removal of a strip of grasses to reduce the volume of dried

construction	matter that may serve as fuel during forest fires.
	It is also designed to cut the flow of fire by removing the grasses.
Replanting	Planting seedlings on the spots of dead seedlings.
Watering	Done during dry season to provide moisture to seedlings in order to survive.
	Difficult to implement because water source is located below the planated area and one has to hike a longer distance.
IEC	House to house campaign informing households the importance of the forest and the need to protect it from forest fires.
Patrolling	Making the workers visible in the planted area to inspect the condition of and to know what is going on in the plantation.

a. *Threats to NGP plantations*

According to the respondents, there are some threats to the NGP plantations that they have to prepare for. These are only two most critical threats:

1. Grass fire or forest fire
2. Fuelwood cutting and gathering
3. Shifting cultivation
4. Drought, high temperature, prolonged dry season, and El Nino.

When asked on how they responded to these, they used information and education campaign in communities requesting the households not to throw lighted materials or conduct slash and burn near the NGP sites to prevent forest fire; and conduct of regular foot patrol to spot, deter and put off forest fires. These activities are being implemented by the workers under the guidance of the extension officers of the PENRO.

In the case of fuelwood cutting and gathering and shifting cultivation, the workers claimed that they have no other alternative livelihood and they are forced to do it because they have to earn a living. If DENR will provide them sustainable work in reforestation, they will voluntarily stop these illegal practices.

To lessen the impact of drought, high temperature, El Nino, the workers used the ferns by bending their leaves as live mulch. They said that cutting the ferns' leaves add to dry matter that may add fuel to forest fires.

b. Respondents' estimates of survival rates in the NGP and Non-NGP sites

According to the respondents, they did a good job in maintaining the NGP sites assigned to them for protection and maintenance. Thus, on a per species basis, the survival rates that they can remember are summarized in Table 54.

Table 54. Survival Rates of NGPO Plantations before Replanting.

During the last inspection that you conducted, what was the survival rate of the planted NGP site before replanting?	NGP SITE	NON-NGP SITE
Narra	80%	100%
Nato	80%	-
Saguimsim	80%	100%
Bagutambis	80%	-
Mangkono	80%	97.50 %
Mangga	-	97.50 %
Sudiang	-	100%
Agoho	-	80%
Acacia	-	80%
Bitanghol	-	80%
Dayuk-dayuk	-	100%

c. Suggestions of the respondents to maintain high survival rate

The respondents suggested to increase the budget for planting, protection and maintenance to include forest officers and bantay gubat that will assist them in protecting the NGP plantations from forest or grass fires and to continue monitoring the condition of the reforested areas. Accordingly, indigenous forest species that were planted are too sensitive to sunlight and they should be provided with shades while still seedlings because they easily get stressed. Thus, to improve their survival rates, intensive care of every seedling should be practiced during the dry season up to the time that they have already survived and acclimatized in the reforestation area. This is usually 3 to 4 years old depending on the species.

8. NGP and Non-NGP sites in Dinagat

The NGP reforestation projects that were assessed and evaluated are:

1. NGP site in Brgy. Diegas, Basilisa with 80 hectares area planted with indigenous forest species

   Description of the Area: Area is dominated by Agsam (ferns), ferns are usually used as mulch to the seedlings. Seedlings are usually small. Soil is Ultramafic: brown to reddish in color, granulated to fine texture. Strips of forest area can be found inside the area (dominated of Mangkono *(X. verdugonianus)*, Sili-sili, and Sagimsim *(S.brevistylum)*,). Seedlings are planted along the contour. The area was planted with the following species: Sagimsim *(S.brevistylum)*, Nato *(P. luzoniense)*, and Mangkono *(X. verdugonianus)*. The slope is generally rolling to sloping.

   Area Planted: 80 hectares
   Date of Planting: 2013
   Date of Replanting: No record

   The species planted in this NGP site are shown in Table 55:

   Table 55. Indigenous Forest Species Planted in the 80-Ha NGP Site.

Common Name	Scientific Name
Bahai	*Ormosia calavensis*
Mangkono	*Xantosthemon verdugonianus*
Nato	*Palaqium luzoniense*
Sagimsim	*Syzgium brevistylum*
Sili-sili*	

2. NGP site in Brgy Diegas and Geotina, Basilisa with 66 hectares area planted with indigenous forest species

   Description of the Area: Area is dominated by Agsam (ferns), ferns are usually used as mulch to the seedlings. Seedlings are usually small. Soil is Ultramafic: brown to reddish in color, granulated soil texture. Seedlings are planted along the countour. Area is relatively steep and very prone to erosion.

Area Planted: 66 hectares
Date of Planting: 2014
Progeny record: None

The species planted in this NGP site are shown in Table 56:

Table 56. Indigenous Forest Species Planted in the 66-Ha. NGP Site.

Common Name	Scientific Name
Agoho	*Casuarina equisetifolia*
Akle	*Albizia acle*
Anilau	*Colona serratifolia*
Bagalunga	*Melia dubia*
Bagon	*Melia dubia*
Bagtikan	*Parashorea malaanonan*
Balobo	*Diplodiscus paniculatus*
Bitanghol	*Calophyllum blancoi*
Bitaog	*Calophyllum inophyllum*
Bilayan	
Dalingdingan	*Hope foxworthyi*
Guijo	*Shorea guiso*
Hauili	*Ficus septica*
Iga	
Kalantas	*Toona calantas*
Malatapai	*Alangium longiflorum*
Narra	*Pterocarpus indicus*
Nato	*Palaqium luzoniense*
Panau	*Dipterocarpus gracilis*
Sagimsim	*Syzgium brevistylum*
Saplungan	*Hopea plagata*

Subiang	*Bridelia insulana*
Taluto	*Pterocymbium tinctorium*
Tapinag	*Sterculia crassiramea*
Tuai	*Bischofia javanica*
Yakal	*Shorea astylosa*

3. NGP site in Brgy. Diegas with 44 hectares area planted with indigenous forest species.

   Description of the Area: The area is part of the "TREEVOLUTION PROGRAM" of the PENRO, plants are not properly spaced on the strip, but the dsitance between strips is relatively uniform. According to the guide that we have the area is a site for small scale mining of chromite particularly on the top of the mountain, and it is obvously eroded. Generally the area is rolling to steep slope. Grasses like cogon and talahib are also present in the area.

   Area planted: 44 hectares
   Date of Planting: 2014
   Progeny Record: None

   The species planted in this NGP site are shown in Table 57.

Table 57. Indigenous Forest Species Planted in the 44-Ha. NGP Site.

Common Name	Scientific Name
Agoho	*Casuarina equisetifolia*
Akle	*Albizia acle*
Bagalunga	*Melia dubia*
Bagtikan	*Parashorea malaanonan*
Bahai	*Ormosia calavensis*
Balobo	*Diplodiscus paniculatus*
Banai-banai	*Rodermachera pinnata*
Bitanghol	*Calophyllum blancoi*
Bitaog	*Calophyllum blancoi*
Dalingdingan	*Hopea foxworthyi*

Guijo	*Shorea guiso*
Hauili	*Ficus septica*
Iga	
Kalantas	*Toona calantas*
Malatapai	*Alangium longiflorum*
Mangga	*Mangifera indica*
Mangkono	*Xanthostemon verdugonianus*
Panau	*Dipterocarpus gracilis*
Sagimsim	*Syzgium brevistylum*
Sili-sili*	
Subiang	*Bridelia insulana*
Taluto	*Pterocymbium tinctorium*
Tapinag	*Sterculia crassiramea*
Tuai	*Bischofia javanica*
Yakal	*Shorea astylosa*

The Non-NGP sites are reforestation projects of the mining companies in Dinagat province

1. Mining reforestation areas in Brgy. Bayanihan, Libjo, Dinagat – 54 hectares planted with indigenous forest species. The species planted are shown in Table 58:

Table 58.Indigenous Forest Species Planted in the 45 Ha. Non-NGP Site.

Common Name	Scientific Name
Agoho	*Casuarina equisetifolia*
Akle	*Albizia acle*
Bagalunga	*Melia dubia*
Bagon	
Bagtikan	*Parashorea malaanonan*

Bahai	*Ormosia calavensis*
Balobo	*Diplodiscus paniculatus*
Banai-banai	*Rodermachera pinnata*
Bitanghol	*Calophyllum blancoi*
Bitaog	*Calophyllum blancoi*
Bilayan	
Dalingdingan	*Hopea foxworthyi*
Guijo	*Shorea guiso*
Hauili	*Ficus septica*
Iga	
Kalantas	*Toona calantas*
Malatapai	*Alangium longiflorum*
Mangga	*Mangifera indica*
Mangkono	*Xanthostemon verdugonianus*
Panau	*Dipterocarpus gracilis*
Sagimsim	*Syzgium brevistylum*
Sili-sili*	
Subiang	*Bridelia insulana*
Taluto	*Pterocymbium tinctorium*
Tapinag	*Sterculia crassiramea*
Tuai	*Bischofia javanica*
Yakal	*Shorea astylosa*

2. CMC Reforestation area – several sites with an aggregate area of 142.36 hectares planted with indigenous species shown in Table 59.

Table 59. Indigenous Forest Species Planted in the Non-NGP CMC Reforestation Projects.

Common Name	Scientific Name
Agoho	*Casuarina equisetifolia*
Akle	*Albizia acle*
Bagalunga	*Melia dubia*
Bagtikan	*Parashorea malaanonan*
Bahai	*Ormosia calavensis*
Balobo	*Diplodiscus paniculatus*
Banai-banai	*Rodermachera pinnata*
Bitanghol	*Calophyllum blancoi*
Bitaog	*Calophyllum blancoi*
Bilayan	
Dalingdingan	*Hopea foxworthyi*
Guijo	*Shorea guiso*
Hauili	*Ficus septica*
Iga	
Kalantas	*Toona calantas*
Malatapai	*Alangium longiflorum*
Mangga	*Mangifera indica*
Mangkono	*Xanthostemon verdugonianus*
Panau	*Dipterocarpus gracilis*
Sagimsim	*Syzgium brevistylum*
Sili-sili*	
Subiang	*Bridelia insulana*
Taluto	*Pterocymbium tinctorium*

Tapinag	*Sterculia crassiramea*
Tuai	*Bischofia javanica*
Yakal	*Shorea astylosa*

9. Survival Rates of the NGP Forest Plantations

9.1. NGP Site-80 hectares

1. Survival rates using DENR formula

The PENRO did a bold step in using indigenous forest species in the NGP reforestation areas in Dinagat province even without an adequate knowledge on the specific cultural requirements of the individual species. Their experience will pave the way for the use of indigenous forest species and implementation of the reforestation practices degraded forestlands where indigenous forest species are preferred in biodiversity areas in the country. Their performance will be watched by those engage in similar projects.

For the 80 hectares, the survival rates (SR) using the DENR formula are shown in the Table 60.

Table 60. Survival Rates Using DENR Formula, 80-Ha. Basilisa, 2015.

Accounting Entry Title	Reforestation Management Period				
	2011	2012	2013	2014	2015
Seedling Opening Stock	0	0	40000	40000	40000
Mortality (Reduction)		0	10313	21877	5702
Net Surviving Seedling		0	29687	18123	34298
Additional Seedling or Replanting		0	10313	21877	0
Seedling Closing Stock		0	40000	40000	34298
Survival Rate		0	74.22	45.31	85.75

Note: Since there were no records on mortality in 2013 and 2014, this study used the number of seedlings with a height range of 0.31 to 0.6cm as the total mortality and replanted in 2014.

2. *Survival rates using the IST Formula*

Using the same data in Table 60 but using the IST formula in computing for the survival rates, the results are shown in Table 61. The survival rates are way below the survival rates calculated using the DENR formula. This means that from the point of view of efficiency, there is sufficient room for the project to attain efficiency by trying its best to identify what went wrong in the reforestation process and correct this. It is best to work on the original seedling density by maximizing survival rather through proper site assessment and evaluation, feasibility study of design options, planning, care and protection and maintenance rather than continuing replanting.

Table 61. Survival Rates Using IST Formula, 80-Ha. Basilisa, 2015.

Accounting Entry Title	**Reforestation Management Period**				
	2011	2012	2013	2014	2015
Seedling Opening Stock	0	0	40000	40000	40000
Mortality (Reduction)		0	10313	21877	5702
Net Surviving Seedling		0	29687	18123	34298
Additional Seedling or Replanting		0	10313	21877	0
Seedling Closing Stock		0	40000	40000	34298
Survival Rate		0	59.00	25.10	55.43

Comparing the survival rate standard prescribed by DENR for indigenous forest species, the dinagat survival rates are higher than the survival rates of dipterocarp species in Kalimantan, Indonesia. This could be due to the continuous replanting in NGP sites. Huss and Sutisna (2003) studied the survival rates of diptetocarp seedlings. The species studied were Hopea mengarawan with a survival rate of 19%, Shorea leprosula (14%), Shorea ovalis (15%), Shorea johorenis (5%), Shorea smithiana (12%), and Dipterocarpus conutus (25%) from germinated seedlings[141].

Widiyanto, et al (**2014)** studied the survival of early performance of 23 dipterocarp species planted in logged-over rainforest. Out of the 23 species**, s**even species

[141] Jurgen Huss and Maman Sutisna. Conversion of Exploited Natural Dipterocarps into Semi-Natural Production Forest. Restoration of Tropical Forest Ecosystems: Proceedings of ... Helmut Lieth, M. Lohmann - 2013 - Technology & Engineering Support of natural Dipterocarp regeneration by soil preparation*https://books.google.com.ph/books?isbn=9401728968.*

showed high survival rates (71 to 85%), nine species moderate (50 to 70%) and seven species low (38 to 48%).[142] Based on these literatures, it is necessary to rethink the minimum survival rates for indigenous forest species.

9.2. NGP Site- 66 hectares

1. Survival rates using DENR formula

The survival rates are shown in Table 62. For 2014 the survival rate is 46% and 88% in 2015. To save on replanting, the DENR field offices may assess and evaluate where they missed some important activities that should have been carried out to minimize mortality. Knowing this would lead to the identification and implementation of corrective measures. Instead of spending so much on replacement of mortality, the amount to be spent is better used to maintain the original seedling density by knowing and implementing what are necessary to be done.

Table 62. Survival Rates Using the DENR Formula, 66-Ha. Basilisa, 2015.

Accounting Entry Title	Reforestation Management Period				
	2011	2012	2013	2014	2015
Seedling Opening Stock	0	0	0	33000	33000
Mortality (Reduction)		0	0	17810	3905
Net Surviving Seedling		0	0	15190	29095
Additional Seedling or Replanting		0	0	17810	0
Seedling Closing Stock		0	0	33000	29095
Survival Rate		0		46.03	88.17

Note: Since there were no records on mortality in 2013 and 2014, this study used the number of seedlings with a height range of 0.31 to 0.6cm as replanted in 2014.

[142] *Widiyatno et al. 2014*. Early Performance Of 23 Dipterocarp Species Planted In Logged-Over Rainforest *Journal of Tropical Forest Science* 26(2): 259–266 (2014)

2. *Survival rate using the IST formula*

Using the same data in Table 63, the calculated survival rates using the IST formula are shown in Table 63. To improve the SR, it is necessary to reduce the levels of the annual replanting by being effective in maintaining the original number of seedlings planted by doing the right things at the very start. This means that real data on the site characteristics should be known, use this to identify the indigenous forest species that can be combined and grown, select only the species where cultural technologies are already existing and proven to work effectively and efficiently, evaluate the combinations to see whether these are technically and economically feasible, train the NGP-partners so that they execute the right ways of doing reforestation activities, supervise their work and check whether these are within standards or best practices benchmark, and regularly inspect the plantations 24/7 to protect by all means the investments.

Table 63. Survival Rates Using the IST Formula, 66-Ha. Basilisa, 2015

Accounting Entry Title	Reforestation Management Period				
	2011	2012	2013	2014	2015
Seedling Opening Stock	0	0	0	33000	33000
Mortality (Reduction)		0	0	17810	3905
Net Surviving Seedling		0	0	15190	29095
Additional Seedling or Replanting		0	0	17810	0
Seedling Closing Stock		0	0	33000	29095
Survival Rate		0	0	25.09	57.26

9.3. *NGP Site- 44 hectares*

1. *Survival rates using the DENR formula*

The SRs are shown in Table 64. This NGP site meets the minimum required survival rate. The same observation with the other sites holds through in this NGP site. Also, the same suggestions for improving survival rate are reiterated.

Table 64. Survival Rates Using the DENR Formula, 44-Ha, Basilisa, 2015.

Accounting Entry Title	Reforestation Management Period				
	2011	2012	2013	2014	2015
Seedling Opening	0	0	0	27000	27000

Stock					
Mortality (Reduction)		0	0	13644	3901
Net Surviving Seedling		0	0	13356	23099
Additional Seedling or Replanting		0	0	13644	0
Seedling Closing Stock		0	0	27000	23099
Survival Rate		0	0	49.47	85.55
Note: Since there was no record on mortality in 2014, this study used the number of seedlings with a height range of 0.1 to 0.3 cm as the mortality and replanting in 2014.					

2. ***Survival rates using IST formula***

Using the IST formula results to the SRs in Table 65. The results are lower than that of the DENR formula. This reduction in SR compared to the DENR formula is due to the annual replanting to replace the mortality that is added to the original seedling density planted in the NGP area. The annual replanting measures the inefficiency of reforestation management in this site. Instead of making the original planted seedlings alive, reforestation management opted to replant without any assurance of success in the following year since the site factors will still be the same.

Table 65. Survival Rates Using IST Formula, 44-Ha.Basilisa, Dinagat.

Accounting Entry Title	Reforestation Management Period				
	2011	2012	2013	2014	2015
Seedling Opening Stock	0	0	0	27000	27000
Mortality (Reduction)		0	0	13644	3901
Net Surviving Seedling		0	0	13356	23099
Additional Seedling or Replanting		0	0	13644	0
Seedling Closing Stock Planted		0	0	27000	23099
Survival Rate		0	0	32.86	56.83

3. Weighted survival rates of NGP sites

The weighted averages of the 3 NGP sites using the DENR formula and IST formula we computed. The results are 86.54 using the DENR formula and 63.20 with the IST formula (Table 66).

Table 66. Weighted Survival Rates of NGP Sites Based on the DENR and IST.

		Simple Average		Weighted Sum		Weighted Average	
NGP Site	**Area**	**DENR**	**IST**	**DENR**	**IST**	**DENR**	**IST**
80-ha Basilisa	80	85.75	55.43	6860.00	4434.4		
66-ha Basilisa	66	88.17	57.26	5819.22	3779.16		
44-ha Basilisa	44	85.55	56.83	3764.20	2500.52		
Sum	190			16443.42	10714.08	86.54	63.20

9.4. Non-NGP reforestation projects

1. Survival rates using DENR formula

The calculated survival rates of the Non-NGP sites mostly reforested by mining companies are 59% in 2013, 50% in 2014, and 70% in 2015 (Table 67). The total number of seedlings planted and replanted is 51775. This is 191% of the original seedling density planted.

Table 67. Survival Rates Using DENR Formula of the 54 Ha. Non-NGP Sites, Dinagat.

Accounting Entry Title	Reforestation Management Period				
	2011	2012	2013	2014	2015
Seedling Opening Stock	0	0	27000	27000	27000
Mortality (Reduction)		0	11171	13604	8027
Net Surviving Seedling		0	15829	13396	18973
Additional Seedling or Replanting		0	11171	13604	0

Seedling Closing stock		0	27000	27000	18973
Survival Rate		0	58.63	49.61	70.27
Note: Since there were no records on mortality in 2013 and 2014, this study used the number of seedlings with a height range of 0.31 to 0.6cm as replanted in 2013 and those with a height range of 0.1 to 0.3 cm as the mortality in 2014					

2. *Survival rates using IST formula*

The calculated SRs are 41% in 2013, 26% in 2014 and 47% in 2015 (Table 68). The SRs are lower by 29.2% in 2013, 47.8% in 2014 and 33.5% in 2015 compared with the SRs calculated through the DENR formula.

Table 68. Survival Rates Calculated Using the IST Formula, 54-Ha. Non-NGP Site, Dinagat.

Accounting Entry Title	Reforestation Management Period				
	2011	2012	2013	2014	2015
Seedling Opening Stock	0	0	27000	27000	27000
Mortality (Reduction)		0	11171	13604	8027
Net Surviving Seedling		0	15829	13396	18973
Additional Seedling or Replanting		0	11171	13604	0
Seedling Closing Stock		0	27000	27000	18973
Survival Rate		0	41.47	25.87	46.73

3. *Survival rates of other non-NGP sites*

The survival rates of the non-NGP forest plantations in Dinagat are shown in Table 69.

Table 69. Survival Rates of Sampled CMC Areas, Dinagat.

CMC Area (Ha)	54	11	10	34	10	6.5	6.2	6.8	3.5	Average
DENR formula										
2013	58.63	58.63	78.98	47.93	75.54	98.00	72.33	72.00	79.95	71.33
2014	49.61	49.61	87.51	48.61	48.34	95.83	46.41	51.09	53.19	58.91

2015	70.27	70.27	74.66	71.64	69.81	83.13	75.08	75.21	69.76	73.31
IST formula										
2013	41.47	41.47	65.26	31.52	60.70	96.08	56.65	56.25	66.60	57.33
2014	25.87	25.87	65.55	23.89	27.45	90.26	25.60	28.88	31.88	38.36
2015	46.73	46.73	66.37	47.32	46.03	79.80	48.89	50.51	47.51	53.32

4. Weighted survival rate of non-NGP sites

The average survival rates (WSR) of the non-NGP sites were used in deriving the WSR in 2013, 2014, and 2015. The results are indicated in Table 70. The 2015 WSR is higher than the WSR in 2014 and 2013, which means that all the non-NGP sites have better protection and maintenance activities than the 2014 and 2013. Of the 3 years, 2014 has the lowest WSR, which indicates that mortality is high and protection and maintenance did not perform well to reduce the mortality of seedlings.

Table 70. Weighted Survival Rates of Non-NGP Sites.

2015			**Weighted Sum**		**WSR**	
Area	**DENR**	**IST**	**DENR**	**IST**	**DENR**	**IST**
54.0	70.27	46.73	3794.58	2523.42		
11.0	70.27	46.73	772.97	514.03		
10.0	74.66	66.37	746.60	663.70		
34.0	71.64	47.32	2435.76	1608.88		
10.0	69.81	46.03	698.10	460.30		
6.5	83.13	79.8	540.35	518.70		
6.2	75.08	48.89	465.50	303.12		
6.8	75.21	50.51	511.43	343.47		
3.5	69.76	47.51	244.16	166.29		
142.0			10209.44	7101.90	71.90	50.01
2014			**Weighted Sum**		**WSR**	
Area	**DENR**	**IST**	**DENR**	**IST**	**DENR**	**IST**
54.0	49.61	25.87	2678.94	1396.98		
11.0	49.61	25.87	545.71	284.57		
10.0	87.51	65.55	875.10	655.50		
34.0	48.61	23.89	1652.74	812.26		

10.0	48.34	27.45	483.40	274.50		
6.5	95.83	90.26	622.90	586.69		
6.2	46.41	25.6	287.74	158.72		
6.8	51.09	28.88	347.41	196.38		
3.5	53.19	31.88	186.17	111.58		
142.0			7680.10	4477.18	54.09	31.53
2013			**Weighted Sum**		**WSR**	
Area	**DENR**	**IST**	**DENR**	**IST**	**DENR**	**IST**
54.0	58.63	41.47	3166.02	2239.38		
11.0	58.63	41.47	644.93	456.17		
10.0	78.98	65.26	789.80	652.60		
34.0	47.93	31.52	1629.62	1071.68		
10.0	75.54	60.7	755.40	607.00		
6.5	98.00	96.08	637.00	624.52		
6.2	72.33	56.65	448.45	351.23		
6.8	72.00	56.25	489.60	382.50		
3.5	79.95	66.6	279.83	233.10		
142.0			8840.64	6618.18	62.26	46.61

5. *Forest species that suffered most*

In the 80-ha NGP site, the top 3 indigenous forest species with the highest frequency of dead seedlings are Sagimsim *(S. brevistylum)*, Nato *(P. luzoniense)* and Mangkono *(X. verdugonianus)* (Table 71). There is a need to assess the activities implemented concerning these species starting from the collection of seeds or wildlings, nursery operations, growth enhancement in the nursery, seedlings transport from the nursery to the planting site, stocking method at the planting site, and how site preparation, planting and protection and maintenance were implemented by the NGP-partners. Also, it is worth looking at how the project was designed and planned.

Table 71. Species that Suffered Most in the 80-Ha. NGP Site.

Species	Frequency	%
Sagimsim *(S. brevistylum)*	7542	54
Nato *(P. luzoniense)*	5124	37
Mankgono *(X. verdugonianus)*	1063	8
Bahai *(O. calavensis)*	148	1
Sili-sili *(R. tuberosa)*	115	1

In the same manner in the 66-ha. NGP site, Nato *(P. luzoniense)*, Narra *(P. indicus)*, Sagimsim *(S. brevistylum)*, Agoho *(C. equisetifolia)* and Yakal *(S. astylosa)* are the top species that composed the mortality in 2015 (Table 72). Again, the reasons why this happened in the 66-ha NGP site is worth investigating by the PENRO so that next time around any errors uncovered can be avoided in the future.

Table 72. Species that Suffered Most in the 66-Ha. NGP Site

Species	Frequency	%
Nato	2587	24
Narra	1692	15
Sagimsiman	920	8
Agoho	739	7
Yakal	429	4
YakalSaplongan	270	2
Guijo	222	2
Bagalunga	153	1
Akle	111	1
Bagtikan	52	0

In like manner, the percentages of dead species in the 44-ha. NGP site are show in Table 73. Just like in the other NGP sites, Nato *(P. luzoniense)*, Sagimsim *(S. brevistylum)*, Narra *(P. indicus)* and Mangkono *(X. vedugonianus)* are the species with high mortality (Table 73). The same action needed to investigate why these species are not making good in terms of survival in the area.

Table 73. Species that suffered most in the 44-ha NGP Site.

Species	**Frequency**	**%**
Nato	2105	30
Sagimsiman	1532	22
Narrra	1045	15
Mankgono	460	6
Agoho	383	5
Yakal-Saplungan	358	5
Yakal	207	3
Guijo	190	3
Akle	183	3
Bahai	116	2

6. *How to increase survival rate of indigenous forest species*

There are ways how to further increase the survival rate of indigenous forest species planted in the NGP sites. These are:

1. Most indigenous forest species are partial- shade loving, provide first a nurse crop usually nitrogen-fixing species of the pioneer species that grow faster than the intermediate and climax species. Plant these nitrogen-fixing species ahead for one year, then when there is sufficient shade already, plant the desired intermediate and climax species.
2. If the seedlings are already planted and they are showing signs of stress due to intense sunlight, provide man-made cover to the affected seedlings. Shrubs may be used to cover the seedlings.
3. Mulch the seedlings using locally available materials such as cogon and other shrubs cut during site preparation and protection and maintenance. A thick mulch is better in preventing soil moisture to evaporate.
4. Water the seedlings early morning or late in the evening.
5. Apply the right amount of fertilizer. The recommended quantity of fertilizer is from 250-300 gm per seedling.
6. Construct a canal about 1 foot wide and 1 foot deep circling the hole where the seedling is planted. During rainy season, the canal will collect rainwater. This rainwater will gradually release to the seedling during summer.

10. NGP impact to the environment

1. *Soil baseline characteristics*

For subsequent soil fertility analysis of the NGP sites to determine the species' NPK contribution to the soil, the figures in the table provide a benchmark for assessing the present level of soil fertility during the assessment period. Some of these NPK levels will be used by the species planted but will also be replenished. To ascertain the NPK exchanges between the soil and the plants requires the research centers of the DENR to do a research on this.

The Nitrogen, Phosphorus and Potassium content of the soil samples from the different sites are shown in Table 74. Generally, Phosphorus has the highest value among the three major nutrients. When it comes to total percent of N in the soil, soil sample from Steep Boa has the highest percentage of 0.427%; while sample from Rolling mixed area has the lowest with 0.045%. Percent available Phosphorus is highest in Controlled F soil sample with 6.624% and lowest, in Rolling mixed area which is less than the lower limit of detection (0.006%). Percent exchangeable Potassium is highest in Steep Boa with 0.321% and lowest, again, in Rolling Mixed area with 0.001%.

Comparing the averages of the NGP sites and Non-NGP sites with the control site (grassland) showed that only the 80-ha and the 44-ha NGP sites had indicated positive effect in terms of Nitrogen and Potassium. Whereas, the moisture content of the 80-ha NGP site indicated a positive effect while the 66-ha and 44-ha NGP sites showed negative effect to soil moisture content.

One possible explanation is the age of the NGP plantations. The 80-ha NGP site is already mpre than 2 years old while the 66-ha and 44-ha NGP sites are only one year old each. The older plantation has more litterfalls that contribute to nitrogen and thicker humus and soil that absorb moisture. While the 66-ha and 44-ha-NGP sites have less litter falls and thinner humus and soil. Thus, their soil moisture absorptive capacities were negative compared to the control sites (grassland).

Table 74. NPK Base Characteristics of NGP Sites, Basilisa, Dinagat Province.

Soil Sample Location	N%	P	K	Weight of Soil Sample (g)	Moisture Content	Organic Carbon	Organic Matter
80-HA NGP SiTE							
Steep Boa	0.427	4.436	0.321	380	7.31	1.7711	3.0448
Rolling Katmonan	0.265	4.315	0.07	300	4.93	1.3982	2.4038
P7S1	0.238	1.325	0.089	400	3.93	1.8643	3.2051
Rolling mixed Area	0.045	<LLD (0.006)	0.001	420	3.47	1.9575	3.3653
Average	0.2362	3.0107	0.1027	375	4.910	1.7478	3.0048
66-HA NGP Site							
NGP Area 2-Steep	0.075	3.97	0.042	300	4.1900	1.5750	2.5692
NGP Area 2-Flat	0.075	2.31	0.093	300	4.2950	1.3500	2.2022
NGP Area 2-Rolling	0.208	4.644	0.07	350	4.5330	1.5750	2.5692
NGP Area 2-Relatively Flat	0.314	4.485	0.094	450	4.9440	2.0250	3.3033
Average	0.168	3.8523	0.0748	350	4.4905	1.6313	2.6610
44-HA NGP Site							
NGP Area 3-Steep	0.103	4.485	0,076	500	3.9830	0.8478	1.3829
NGP Area 3-Flat	0.06	4.771	0.039	450	3.7090	0.7630	1.2446
NGP Area 3-Rolling	0.229	4.236	0.121	400	4.9330	0.6782	1.1064
Average	0.13067	4.49733	0.05333	450	4.2083	0.7630	1.2446
Non-NGP Sites							
Relatively flat(CMC Plantation)	0.237	4.488	0.096	320	4.1270	1.4914	2.5641
NN3P1	0.205	3.5	0.039	350	4.8820	1.6313	2.8044
Average	0.221	3.994	0.068	335	4.5045	1.5613	2.6843

Control Sites (Grassland)	N	P	K	Weight of Soil Sample	Moisture Content	Organic Carbon	Organic Matter
Steep slope	0.216	4.325	0.059	500	4.419	2.135	3.6684
Flat area	0.305	5.584	0.094	450	5.266	1.868	3.2096
Rolling area	0.2	6.624	0.096	400	4.072	1.941	3.3350
Very Steep slope	0.143	6.056	0.124	400	4.633	1.93	3.3161
Average	0.216	5.64725	0.09325	438	4.5975	1.9685	3.3823
Difference between NGP sites and Control Area							
80-Ha vs. Grassland	0.02017	-2.63658	0.00942		0.31	-0.221	-0.378
66-HA vs. Grassland	-0.048	-1.795	-0.0185		-0.107	-0.337	-0.721
44-HA vs. Grassland	-0.08533	-1.14992	-0.03992		-0.389	-1.206	-2.138
Non-NGP Sites Vs Grassland	0.005	-1.653	-0.026		-0.093	-0.407	-0.698
Note: The organic matter of the 80-ha NGP site was projected using Hinobaan data where the % organic matter is based on the % organic carbon. This is given by the formula, % organic matter= %Organic Carbon (Dinagat) * %Organic matter/%Organic Carbon (Hinobaan)							
The ratios used are:							
1. 80-ha NGP site =1.7192							
2. 66-ha NGP site =1.6312							
3. 44-ha NGP site = 1.6312							
4. Grassland(control site) = 1.7182							

2. Litter fall impact to soil

For NGP plantations with an age range of 2-3 years old, the indigenous forest can already contribute to soil fertility. These are proven by the figures in Table 75.

There were many indigenous forest species planted in the NGP reforestation areas in Dinagat, due to limitation in funding for soil laboratory analysis, only the species that are common in Dinagat were submitted for NPK analysis. The litter fall contribution of each species is 300 grams for Sagimsim *(S. brevistylum)*, 250 grams for Nato *(P. luzoniense)*, 290 grams for Narra *(P. indicus)*, 350 grams for Mangkono *(X. verdugonianus)*, and 450 grams for Agoho *(C. equisetifolia)*.

The levels of contribution of these species to soil fertility are given by multiplying the NPK percentages to the weights of the litter fall coming from a 2-year old plantation. The results showed that among the species , Narra *(P. indicus)* contributes the highest at 1.212, Mangkono *(X. verdugonianus)* is second at 0.927, and then Agoho *(C. equisetifolia)* at 0.911. For phosphorus , Nato *(P. luzoniense)* shed off the highest at 0.102, followed by Narra *(P. indicus)* and then Agoho *(C. equisetifolia)*. For potassium, Sagimsiman *(S. brevistylum)*has the highest at 0.138, followed by Narra *(P. indicus)* at 0.103 and then Mangkono*(X. verdugonianus)* (Table 75).

Table 75. NPK Contribution of Species' Litter Fall in NGP Sites, Dinagat.

Leaf Litter Samples	Year Planted	%N	%P	%K	Weight of Samples (g)
Sagimsim	2013	0.545 ± 0.008	0.018 ± 0.002	0.138 ± 0.011	300
Nato	2014	0.59 ± 0.039	0.105 ± 0.005	0.09 ± 0.009	250
Narra	2014	1.212 ± 0.024	0.062 ± 0.003	0.103 ± 0.003	290
Mangkono	2014	0.927 ± 0.011	0.029 ± 0.002	0.091 ± 0.002	350
Agoho (oldest)	2004	0.911 ± 0.030	0.022 ± 0.002	0.050 ± 0.004	450

As the species grow through time, increase in species' litter fall is expected. This will have corresponding increase of NPK on the ground, if not totally carried down through soil erosion during rainy season. To compute for the NPK contribution of the species planted on the NGP sites, say N of Mangkono *(X. verdugonianus)*, the nitrogen contribution is 0.927%. This is multiplied by the litter fall sample taken from the NGP plantation.

3. NGP impact to soil accretion and temperature

Two of the NGP sites in Dinagat that were assessed and evaluated according to impacts to soil accretion or erosion and temperature at the site level exhibited negative impact yet to soil accretion. These sites have steep slopes and that surface runoff cannot be effectively controlled yet by the small seedlings of the indigenous forest species that were planted. These are the sites with negative sign. The NGP site with accretion impact of 0.07cm per planted seedling is the 80-ha site. Also, the non-NGP reforestation projects established by the mining companies in Dinagat did not show positive soil accretion impact due to their steep slope locations.

In terms of the temperature impact of the NGP sites, all three sites have lower temperature compared to the grassland areas with a temperature difference of 0.95 for the 80-ha. Site, 0.38

for the 66-ha site, and 0.48 for the 44-ha site. These temperature gradients indicate that through the NGP plantations warming first at the site level can be reduced. As more forest is established nationwide and as they grow older, temperature would be reduced substantially. It is expected that with nationwide reforestation of degraded uplands, the trend of climate change would be reversed, at least at the micro-site level to start with (Table 76).

Table 76. NGP Impact to Soil Accretion and Temperature, Dinagat, 2015.

Reforested Site	NGP Reforested Area		Grassland		Difference	
	Soil Accretion or Erosion	**Temperature**	**Soil Accretion or Erosion**	**Temperature**	**Soil Accretion or Erosion**	**Temperature**
80-Ha. NGP Site	0.07	31.55	-0.1	32.5	0.17	0.95
66-Ha. NGP Site	-0.35	33.12	-0.45	33.5	0.10	0.38
44-Ha. NGP Site	-0.11	33.02	-0.32	33.5	0.21	0.48
Non-NGP Sites						
46-Ha	-0.03	31.21				

4. *NGP impact to DRR*

1. 80-ha NGP site

Vulnerability to DRR

The 80-ha. NGP site is situated in Brgy. Diegas, Basilisa, Dinagat Island. The green colored –patches show the land areas under the gentle slope classification with slope gradient of 0-18%, that is 3.78 hectares or 6.8% of the total area of the site.

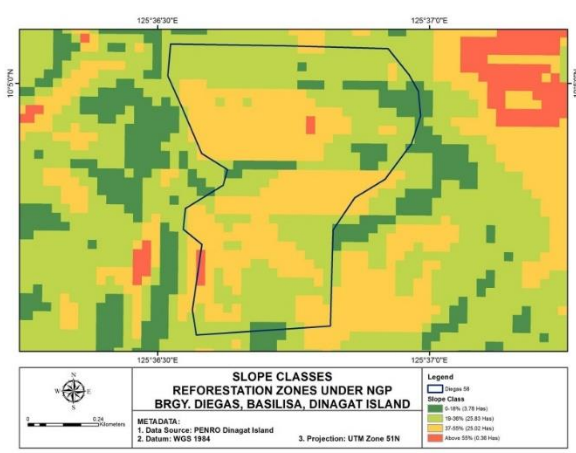
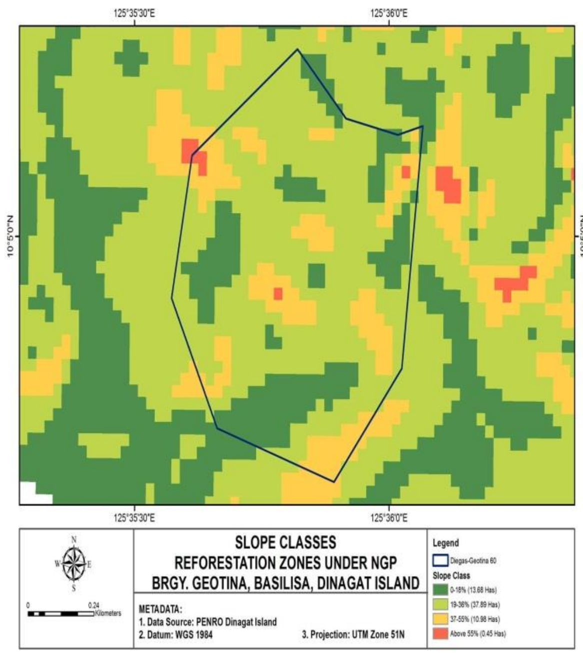


Figure 27 . Map Showing the Highly Vulnerable Slopes, NGP Site. Dinagat

Yellow-green patches represent those areas under the moderate classification with 19-36% slope gradient, which is 25.63 hectares or 46.6% of the total area. Forty-five percent of the total area, that is, 25.02 hectares belong to the steep slope classification, with slope gradient ranging from 36-55%. Very steep slope class covers the 0.36 hectares, although the percentage is very negligible. These are the areas that are highly vulnerable to disasters which should be addressed in the reforestation design (Figure 27).



2. 66-ha NGP site

Vulnerability to DRR

Figure 28. Slope Class Map of the 66-Ha. NGP Site, Dinagat.

The 66-ha. NGP reforestation zone is located in Brgy. Geotina, Basilisa, in Dinagat Island (Figure 28). It is bounded by the polygon in the figure. The gentle slope areas are the green patches. About 22% of the total area or 13.68 hectares are under this slope class. Moderate slope areas are represented by the yellow-green areas, and comprising the 60% of the site, which is 37.89 hectares. Steep slopes are represented by yellow patches and is 17% of the total area or 11 hectares. Very steep slopes are those in red patches. This area is only 1% of the total area of the site.

In terms of vulnerability to landslide, only the yellow green areas and the red areas are vulnerable. The reforestation designs in these areas are different from areas situated in gentle to moderate slopes because of the need to reduce risk of landslides from possible rain-induced disasters.

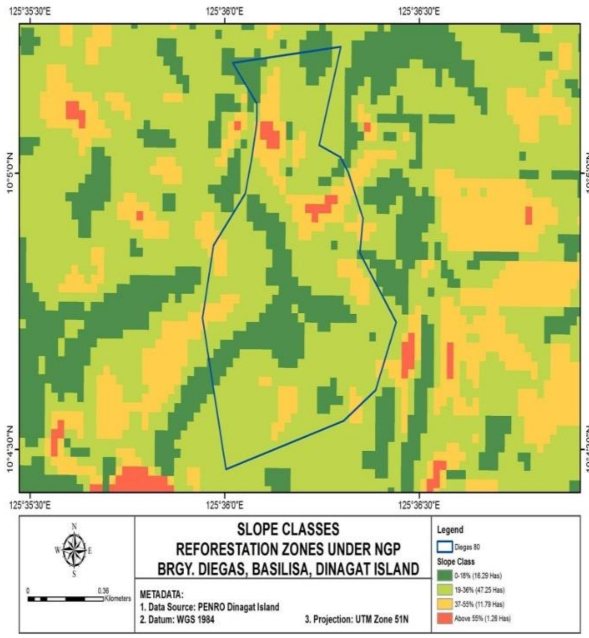
The reforestation design may include planting in close spacing of deep-rooted or root-trained forest species so that when they grow older, their root system will be able to hold soil particles from erosion or even landslides.

Hedge rows of nitrogen-fixing species of shrubs and small trees may also be planted along the contours in very close spacing to control soil erosion.

3. 44-ha. NGP site

Vulnerability to rain-induced disasters

Figure 29. Slope Class of the 44-Ha. NGP Site. 44-ha. NGP site



The 44-ha.NGP site is located in in Brgy. Diegas, Basilisa, in Dinagat Island. The green patches represent the gentle slopes with 16.29 hectares or 21% of the total area.

Moderate slope areas are represented by the yellow-green with an area of 47.25 hectares or 61% of the area.

Steep slopes are represented by yellow patches with an area of 12 hectares or 16% of the total.

Very steep slopes are the red patches with less than one hectare or 2% of the total area of the site.

The areas that are highly vulnerable to rain-induced disaster are those located in steep slopes and very steep slopes. This is only a little more than 12 hectares.

Just like the other NGP sites, such vulnerable areas should be treated separately with those timber production forests to be established under the NGP in order to address DRR objectives (Figure 29).

5. NGP compliance to climate change

1. Carbon sequestration of the 3 NGP sites

The carbon sequestration estimate for the 3-year old 80-ha. NGP site in Basilisa, Dinagat is shown in Table 77. Due to young age, the carbon capture is still insignificant at 0.014 ton of carbon. How many tons of carbon is expected in the future if the indigenous forest will grow and survive.

Table 77. Present Carbon Sequestration of the 3 NGP Sites in Dinagat.

Particular	Variable/Unit	NGP Site 1	NGP Site 2	NGP Site 3
Area planted	hectares	80	66	44
Survival rate	percent	68	75	73
Original seedling density	Number	40000	33000	27000
Age	years	3	2	2
Species		Indigenous	Indigenous	Indigenous
Diameter (cm)	cm	0.49	0.89	0.54
Total Ht (meter)	m	0.94	0.34	0.43
BHT (less 25% of THT) (meter)		0.70	0.25	0.33
Volume/Tree	0.7854*D^2*BHT	0.050	0.545	0.000011
Crown Volume	(15% of Vol/Tree)	0.008	0.082	0.000002
Root Volume	(13% of Vol/tree)	0.007	0.071	0.027988
Total Biomass	(1+2+3)	0.065	0.697	0.275578
Wood Density	Biomass(1 cum) = 0.7 ton	0.045	0.488	0.192905
Carbon Seq	(wood density * 0.3) tons	0.014	0.146	0.057871

2. Potential carbon sequestration of the 80-ha. NGP indigenous forest

The carbon sequestration estimates are shown in Table 78. The density of trees per hectare to be maintained from year 4 to year 10 is 500 trees. On the 11th year when the branches of trees are already overlapping, thinning will be conducted cutting one half of the 500 trees or leaving 250 trees. These 250 trees will be allowed to grow for the next 20 years up to year 30, on this year another thinning activity will be conducted, cutting 125 trees per hectare and leaving another 125 trees to grow up to the year 59 and then final thinning by removing 25 trees per hectare, leaving 100 trees up to year 100.

A growing period of 100 years is selected for indigenous forest although there are indigenous species that are growing beyond 100 years like narra, nato, yakal and other dipterocarps.

The potential carbon sequestration of the 80-ha is given by the summation of the thinned volume at several periods and the growing stock.

The information given in the table are the projected diameter[143], bole height (BHT)[144], wood volume per hectare[145], total tree density per ha[146], total wood volume of the forest[147], crown volume[148], root volume[149], total biomass[150], wood density[151], carbon sequestration[152] and annual carbon sequestration rate[153].

Indigenous forest species have higher carbon per wood content but their growth rate is slower compared to fast growing species. This is the reason why the forest' growing period is 100 years.

Table 78. Potential Carbon Sequestration of the 80-Ha. NGP Site, Using a Simulated Forest, Dinagat, 2015

Age(Years)	Average Dia	Bole Height	Density per Ha	Vol/Ha	Total Biomass per Ha	Total Biomass(80-ha)	Total Biomass Density	Carbon Seq	Annual Carbon Seq
4	4.00	3.00	500	1.885	2.41	193.02	135.11	54.05	
5	5.01	3.50	500	3.443	4.41	352.56	246.79	98.72	44.67
10	10.07	6.00	500	23.894	30.58	2446.74	1712.72	685.09	178.44
15	15.26	8.50	250	38.850	49.73	3978.19	2784.73	1113.89	204.29
20	20.53	10.25	250	84.797	108.54	8683.17	6078.22	2431.29	294.84
25	25.79	11.50	250	150.146	192.19	15374.92	10762.44	4304.98	431.51
30	31.10	12.75	250	242.119	309.91	24792.96	17355.08	6942.03	594.98
35	36.46	14.00	125.0	182.747	233.92	18713.31	13099.32	5239.73	393.13
40	41.88	14.95	125.0	257.447	329.53	26362.62	18453.83	7381.53	425.32
45	47.35	15.45	125.0	340.112	435.34	34827.44	24379.21	9751.68	507.43
50	52.88	15.95	125.0	437.834	560.43	44834.22	31383.95	12553.58	596.64
55	58.46	16.45	125.0	551.875	706.40	56512.03	39558.42	15823.37	693.16
60	64.03	16.95	100.0	545.848	698.68	55894.79	39126.35	15650.54	-3150.60
65	69.40	17.45	100.0	660.170	845.02	67601.37	47320.96	18928.38	686.74
70	74.78	17.95	100.0	788.367	1009.11	80728.74	56510.12	22604.05	767.94

[143] Average diameter taken during measurement divided by the age of the forest (year planted to year of evaluation)
[144] Same as the diameter.
[145] Wood volume/ha = 0.7854*D^2*BHT*density/ha
[146] Actual count of the number of trees at a given survival rate. Taken during the assessment and evaluation.
[147] Total wood volume= total wood volume/ha * total area.
[148] Crown volume = 15% of wood volume (15% is based on actual assessment and accounting of the natural forest in San Vicente Palawan).
[149] Root volume = 13% of the wood volume (based on the San Vicente Palawan forest assessment and accounting)
[150] Total wood biomass = wood volume + Crown Volume + Root Volume)
[151] Wood density = 0.7 ton/cubic meter * total biomass
[152] Carbon sequestration = 0.4 carbon content of species * total biomass
[153] Annual carbon sequestration increment = previous year carbon – present year carbon

75	80.16	18.45	100.0	931.153	1191.88	95350.03	66745.02	26698.01	853.24
80	85.55	18.95	100.0	1089.245	1394.23	111538.65	78077.06	31230.82	942.66
85	90.94	19.45	100.0	1263.362	1617.10	129368.32	90557.82	36223.13	1036.21
90	96.34	19.95	100.0	1454.229	1861.41	148913.02	104239.11	41695.65	1133.92
95	101.74	20.45	100.0	1662.569	2128.09	170247.03	119172.92	47669.17	1235.79
100	107.15	20.95	100.0	1889.111	2418.06	193444.92	135411.44	54164.58	1341.84

3. Potential carbon sequestration of the 66-ha. NGP indigenous forest

The carbon sequestration potential of the 66-ha indigenous forest is shown in Table 79. The same assumptions in the 80-ha hold through in this NGP site. The last 2 columns show the total annual carbon intake and the annual carbon increment from year 4 to year 100. The figures in the table will only happen if the NGP site will be managed well and become a forest in the future

Table 79. Potential Carbon Sequestration of the 66-Ha. NGP Site, Dinagat.

Age(Years)	Average Dia (Cm)	Bole Height (m)	Tree Density per Ha	Volume (Cum/Ha)	Total Biomass per ha (Cum)	Total Biomass 66-ha (Cum)	Total Biomass Density (tons)	Carbon (tons)	Annual Carbon Increment (tons)
4	4.00	3.00	500	1.885	2.41	159.24	111.47	44.59	
5	5.01	3.50	500	3.443	4.41	290.86	203.61	81.44	36.85
10	10.07	6.00	500	23.894	30.58	2018.56	1412.99	565.20	147.21
15	15.26	8.50	250	38.850	49.73	3282.01	2297.41	918.96	168.54
20	20.53	10.25	250	84.797	108.54	7163.61	5014.53	2005.81	243.25
25	25.79	11.50	250	150.146	192.19	12684.31	8879.02	3551.61	356.00
30	31.10	12.75	250	242.119	309.91	20454.20	14317.94	5727.17	490.86
35	36.46	14.00	125.0	182.747	233.92	15438.48	10806.94	4322.78	324.33
40	41.88	14.95	125.0	257.447	329.53	21749.16	15224.41	6089.76	350.89
45	47.35	15.45	125.0	340.112	435.34	28732.64	20112.85	8045.14	418.63
50	52.88	15.95	125.0	437.834	560.43	36988.23	25891.76	10356.70	492.23
55	58.46	16.45	125.0	551.875	706.40	46622.43	32635.70	13054.28	571.86
60	64.03	16.95	100.0	545.848	698.68	46113.20	32279.24	12911.70	599.25
65	69.40	17.45	100.0	660.170	845.02	55771.13	39039.79	15615.92	566.56
70	74.78	17.95	100.0	788.367	1009.11	66601.21	46620.85	18648.34	633.55
75	80.16	18.45	100.0	931.153	1191.88	78663.77	55064.64	22025.86	703.92
80	85.55	18.95	100.0	1089.245	1394.23	92019.39	64413.57	25765.43	777.70
85	90.94	19.45	100.0	1263.362	1617.10	106728.86	74710.20	29884.08	854.88
90	96.34	19.95	100.0	1454.229	1861.41	122853.24	85997.27	34398.91	935.48
95	101.74	20.45	100.0	1662.569	2128.09	140453.80	98317.66	39327.06	1019.52

100	107.15	20.95	100.0	1889.111	2418.06	159592.06	111714.44	44685.78	1107.02

4. Carbon sequestration of the 44-ha. NGP indigenous forest

The carbon sequestration of this forest is indicated in Table 80. The diameters and heights of the trees are similar with those in the 80-ha and 66-ha NGP sites. Thus, tree volume and area volume per hectare are also the same. They only differ in the total area where the indigenous forest species are grown. In the table the total biomass volume, total biomass density and carbon sequestration are computed using 44 hectares.

Table 80. Potential Carbon Seuqestration of the 44-ha NGP Site, Dinagat.

Age(Years)	Dia	BHT	Density per Ha	Vol/Ha	Total Biomass	Total Biomass,44-ha	Wood Density	Carbon Seq	Annual Carbon Seq
4	4.00	3.00	500	1.885	2.41	106.16	74.31	29.73	
5	5.01	3.50	500	3.443	4.41	193.91	135.74	54.29	24.57
10	10.07	6.00	500	23.894	30.58	1345.71	942.00	376.80	98.14
15	15.26	8.50	250	38.850	49.73	2188.01	1531.60	612.64	112.36
20	20.53	10.25	250	84.797	108.54	4775.74	3343.02	1337.21	162.16
25	25.79	11.50	250	150.146	192.19	8456.21	5919.34	2367.74	237.33
30	31.10	12.75	250	242.119	309.91	13636.13	9545.29	3818.12	327.24
35	36.46	14.00	125.0	182.747	233.92	10292.32	7204.63	2881.85	216.22
40	41.88	14.95	125.0	257.447	329.53	14499.44	10149.61	4059.84	233.93
45	47.35	15.45	125.0	340.112	435.34	19155.09	13408.57	5363.43	279.09
50	52.88	15.95	125.0	437.834	560.43	24658.82	17261.17	6904.47	328.15
55	58.46	16.45	125.0	551.875	706.40	31081.62	21757.13	8702.85	381.24
60	64.03	16.95	100.0	545.848	698.68	30742.13	21519.49	8607.80	-1732.83
65	69.40	17.45	100.0	660.170	845.02	37180.76	26026.53	10410.61	377.71
70	74.78	17.95	100.0	788.367	1009.11	44400.81	31080.57	12432.23	422.37
75	80.16	18.45	100.0	931.153	1191.88	52442.52	36709.76	14683.90	469.28
80	85.55	18.95	100.0	1089.245	1394.23	61346.26	42942.38	17176.95	518.46
85	90.94	19.45	100.0	1263.362	1617.10	71152.58	49806.80	19922.72	569.92
90	96.34	19.95	100.0	1454.229	1861.41	81902.16	57331.51	22932.60	623.65
95	101.74	20.45	100.0	1662.569	2128.09	93635.87	65545.11	26218.04	679.68
100	107.15	20.95	100.0	1889.111	2418.06	106394.70	74476.29	29790.52	738.01

5. **Methods of increasing carbon sequestration capacity of the NGP forest?**

There are ways how to improve growth rate of forest in order to increase wood volume and carbon sequestration. These methods may be applied to the NGP forest in Dinagat and other areas that planted indigenous forest species.

These are:

1. When the branches of the trees are already overlapping with each other, perform thinning operations. Thinning will require the following:
    a. Cutting of suppressed trees – those trees that are stunted in growth.
    b. Maintain trees that are dominant and co-dominant trees in the forest.
    c. Cutting of trees that are branchy, crooked, thin, and with damage.
    d. Maintain an even distribution of trees in the forest to receive even sunlight.
2. Conduct thinning before the growth rate of the trees will pick up.
3. Thinning may be done in different periods by observing the different ages of the forest where the crowns will overlap. For the final forest trees density of indigenous species, the maximum number of trees per hectare that will make the final forest is 45-100 trees per hectare depending on the species composition.
4. Apply fertilizer after the thinning with the right amount required by each tree. This is based on the result of the soil survey.

11. Impact to wildlife

Fauna spotted or observed by local residents in the area in the NGP sites in Basilisi, Dinagat Islands. Just like in other NGP sites, the forest plantations attracted fauna. Top in the list are species of birds, followed by mammals, then reptiles and amphibians. Fauna species are instrumental to the dispersal of seeds from adjacent forest to the NGP sites. Thus, improving the biodiversity of the NGP sites in Basilisa, Dinagat (Table 81).

Table 81. Fauna Spotted by Respondents in NGP Sites.

No.	Class	Family Name	Scientific Name	Common Name	Filipino/Local Name
1	Amphibia	Bufonidae	*Bufo marinus*	Giant marine/common toad	kamfrog
2	Amphi	Ichthyophiida	*Ichthyophis weberi*	Philippine caecilians	hanlulubog

No.	Class	Family Name	Scientific Name	Common Name	Filipino/Local Name
	bia	e			
3	Amphi bia	Rhacophorida e	*Polypedates leucomystax*	Common tree frog	bake
4	Aves	Accipitridae	*Accipiter soloensis*	Chinese Goshawk	Sakbit
5	Aves	Bucerotidae	*Aceros leucocephalus*	Writhed hornbill	kalaw
6	Aves	Alcedinidae	*Alcedo atthis*	Common Kingfisher	Susulbot/tingkarol
7	Aves	Rallidae	*Amaurornis phoenicurus*	White-breasted Waterhen	Korawakwak/Ti-ok/Tariwakwak/Salikuak
8	Aves	Anatidae	*Anas luzonica*	Philippine Duck	Pato del Monte/Papan/Dumaras
9	Aves	Anatidae	*Anas poecilorhyncha*	Spot-billed duck	Bibi ihas
10	Aves	Sturnidae	*Aplonis panayensis*	Asian Glossy Starling	Dalansiang
11	Aves	Nectariniidae	*Arachnothera longirostra*	Little spiderhunter	
12	Aves	Ardeidae	*Ardea cinerea*	Grey heron	Tallabong
13	Aves	Ardeidae	*Ardea purpurea*	Purple heron	Lapay
14	Aves	Ardeidae	*Ardea sumatrana*	Great-billed heron	Talabong
15	Aves	Strigidae	*Bubo philippensis*	Philippine Eagle-Owl	Kuwago
16	Aves	Ardeidae	*Bubulcus ibis*	Cattle egret	Tabon
17	Aves	Bucerotidae	*Buceros hydrocorax*	Rufous Hornbill	Tawsi or Kalaw
18	Aves	Procellariidae	*Calonectris leucomelas*	Streaked-shearwater	Kannaway
19	Aves	Caprimulgida e	*Caprimulgus manillensis*	Philippine Nightjar	Kandarapa/Tukaro
20	Aves	Cuculidae	*Centropus bengalensis*	Philippine Coucal	Kokok
21	Aves	Alcedinidae	*Ceyx lepidus*	Variable dwarf-kingfisher	Tikarol
22	Aves	Alcedinidae	*Ceyx melanurus*	Philippine Dwarf-Kingfisher	Biding
23	Aves	Columbidae	*Chalcophaps indica*	Common emerald dove	Alimokon
24	Aves	Choropseidae	*Chloropsis flavipennis*	Yellow throated-leafbird	Antolihaw
25	Aves	Apodidae	*Collocalia mearnsi*	Philippine swiftlet	Sayaw

No.	Class	Family Name	Scientific Name	Common Name	Filipino/Local Name
26	Aves	Muscicapidae	*Copsychus saularis*	Oriental Magpie Robin	Dominiko
27	Aves	Campephagidae	*Coracina coerulescens*	Blackish cuckoo-shrike	
28	Aves	Campephagidae	*Coracina mindanensis*	Black-bibbed Cuckoo-shrike	Kocok
29	Aves	Phasianidae	*Coturnix chinensis*	Blue-breasted Quail	Bontog
30	Aves	Dicruridae	*Dicrurus annectans*	Crow-billed drongo	uwak
31	Aves	Picidae	*Dryocopus javensis*	White-bellied Woodpecker	Hambalatoc
32	Aves	Columbidae	*Ducula aenea*	Green Imperial-Pegion	Balud/Baud
33	Aves	Cuculidae	*Eudanamys scolopacea*	Common Koel	Bahaw
34	Aves	Caprimulgidae	*Eurostopodus macrotis*	Great Eared Nightjar	Layakan/Tahaw
35	Aves	Muscicapidae	*Ficedula hyperythra*	Snowy-Browed Flycatcher	
36	Aves	Rallidae	*Gallinula chloropus*	Common moorhen	Carab
37	Aves	Rallidae	*Gallirallus striatus*	Barred Rail	Korowakwak/Tikling
38	Aves	Phasianidae	*Gallus gallus*	Red Junglefowl	Manok
39	Aves	Alcedinidae	*Halcyon smyrnensis*	White-throated kingfisher	Kasay-kasay
40	Aves	Hirundinidae	*Hirundo rustica*	Barn swallow	Sayaw
41	Aves	Campephagidae	*Lalage melanoleuca*	Black-and -white Triller	Gitgit
42	Aves	Apodidae	*Mearnsia picina*	Philippine needletail	Gitgit
43	Aves	Locustellidae	*Megalurus timoriensis*	Tawny grassbird	
44	Aves	Timaliidae	*Mixornis gularis*	Striped tit-babbler	Tamsi or siwit
45	Aves	Picidae	*Mulleripicus pulverulentus*	Great slaty woodpecker	balatok
46	Aves	Strigidae	*Otus megalotis*	Philippine Scops-Owl	Botbot Kuwaw/Kuago
47	Aves	Pachycephalidae	*Pachycephala philippinensis*	Yellow-Bellied Whistler	
48	Aves	Bucerotidae	*Penelopides panini*	Tarictic hornbill	Talosi
49	Aves	Accipitridae	*Pernis ptilorhynchus*	Oriental honeybuzzard	Bonog

No.	Class	Family Name	Scientific Name	Common Name	Filipino/Local Name
50	Aves	Columbidae	*Phapitreron amethystina*	Amethyst Brown-Dove	Limukon/Kuro-kuo
51	Aves	Columbidae	*Phapitreron cinereiceps*	Dark-eared brown dove	Alimukol
52	Aves	Columbidae	*Phapitreron leucotis*	White-eared Brown Dove	Kuro-kuro/Limukin/Bato-Batong Tulog
53	Aves	Rallidae	*Porzana cinerea*	White-Browed crake	Tighik
54	Aves	Columbidae	*Ptilinopus leclancheri*	Black-Chinned Fruit-Dove	Manatad
55	Aves	Columbidae	*Streptopelia chinensis*	Spotted dove	Tokmo
56	Aves	Columbidae	*Treron vernans*	Pink-Necked Green Pigeon	Punay
57	Aves	Turnicidae	*Turnix sylvatica*	Small Buttonquail	Tikling
58	Mammals	Muridae	*Crateromys australis*	Dinagat Bushy-tailed Cloud Rat	Bising, Visin-lagsoy
59	Mammals	Cynocephalidae	*Cynocephalus volans*	Philippine Flying Lemur	Kaguang, Kagwang
60	Mammals	Pteropodidae	*Cynopterus brachyotis*	Short-nosed Fruit bat	Kwaknit
61	Mammals	Cercopithecidae	*Macaca fascicularis*	Long-tailed Macaque	Tsonggo
62	Mammals	Viverridae	*Paradoxurus hermaphroditus*	Common Palm Civet	Musang
63	Mammals	Pteropodidae	*Pteropus vampyrus*	Large Flying Fox	Paniki
64	Mammals	Pteropodidae	*Rousettus amplexicaudatus*	Common Rousette	Kwaknit
65	Mammals	Tarsiidae	*Tarsius syrichta*	Philippine Tarsier	Mago, Malmag, or Mamag
66	Reptilia	Scincidae	*Dasia grisea*	Brown tree skink	tabili
67	Reptilia	Colubridae	*Dendrelaphis pictus*	Painted Bronzeback	hanlulukay
68	Reptilia	Gekkonidae	*Hemidactylus frenatus*	Lizard	Butiki/tiki
69	Reptilia	Viperidae	*Tropidolaemus wagleri*	Wagler's pit viper	cobra
70	Reptilia	Varanidae	*Varanus salvator*	Monitor lizard	Bayawak/halo

12. Stakeholders’ observations regarding NGP implementation

- The Social Mobilization campaign (treevolution) enjoins various stakeholders to plant the seedlings along the NGP sites. It was a cost-efficient measure since vast area of NGP sites was planted simultaneously and also brings together different stakeholders to join efforts for reforestation. Although some farmers noted that there are malpractices by students and other participants on planting the seedlings causing them to replace more.
- Centralized transaction for seedling operations since PENRO controls the planting and distribution of seedlings
- Relatively, uniform in planting is practiced within NGP sites but slightly differs with the Mining Co.-operated NGPs
- Soil survey and analysis is not a priority due to lack of technical capacity and facility
- There are few comments from the planters on the payment system since there are few instances of delayed release of funds
- The PENRO and the farmers complain the little budget for protection and maintenance (P3000)
- Mostly on-site demonstrations by the PENRO technical officers serve as trainings for the farmers.
- There are no Seed Production Area or Seed Orchard for sourcing seeds or wildings for seedling production
- Intense problem with high temperature primarily causing the mortality of the seedlings.
- Farmers find it hard to bring water from creek to uphill and it costs so much energy and time. Making it difficult to water many seedlings as possible.
- Technical officer lamented the high cost of potential water system to be constructed in the upland but it is necessary.
- There are also certain problems with local agricultural farmers on land conflicts and right-of-way.
- Forest fires hit part of the Sagimsim plantation damaging a hectare of Saguimsim according to PENRO Technical Officer
- According to the PENRO Technical Officer, the slow rate of growth of the seedlings is due to high mineral content of the soil.

4. Hinobaan NGP Sites

1. Survey, mapping and planning (SMP)

In Hinoba-an, there were no SMP or feasibility study of the NGP reforestation sites. Just like the other NGP sites in Zambales and Dinagat the reason given was the urgency of accomplishing more important site-based activities such as seedling production and preparation of the site for planting.

The activities that were conducted are boundary or perimeter survey using GPS and mapping of the surveyed NGP sites using GIS. Other important activities that were not conducted are feasibility study, SMP, soil survey, vegetation survey and analysis, species- site matching, survey of CCA/M and DRR-related area.

On species-site matching, species recommended for planting were based on the forest species growing in adjacent forested areas.

2. Capability building

According to the KII and FGD respondents, there was no formal training provided to the workers of the NGP sites. Demonstration on how to conduct the different reforestation activities were done on site in every start of the activities. The respondents claimed that they were trained in similar projects of the DENR before and that training them on how to raise seedlings, prepare the site for planting, plant the seedlings and protect and maintain the planted seedlings is not necessary anymore because they are experienced in reforestation projects.

3. Plantation quality assurance

According to the KII/FGD respondents, the field officers of the DENR were present during site preparation, planting and protection and maintenance to oversee implementation of the reforestation activities. However, after planting, they do not have a regular inspection of the conditions of the plantations. Inspection comes only when it is time for billing and payment. The frequency of site visit and inspection is quarterly according to the respondents.

Based on the answers of the respondents, there is no clear system on how the field officers of the DENR will ensure the desired quality of the plantation.

4. Site preparation

Site preparation and planting are conducted simultaneously during the rainy season. Planting holes have varying sizes ranging from the size of the plastic bag to about 4-6 inches and 6 deep. When asked on whether they did clear the grass roots inside and within the vicinity of the holes, some estimated that only about 30%-50% were cleared, while others had no idea.

They also prepared access roads and foot paths and temporary satellite nursery for temporary storage of seedlings on site before planting.

5. **Seedling production**

The seedlings planted in the NGP sites came from NGP contractors. The estimated duration of propagating, tending and taking care of the seedlings in the nursery to prepare them for planting on site ranges from 4-10 months depending on the species while non-NGP sites grow them for 10 months (Table 82).

Table 82. Sources of Planting Materials, Duration of Propagation up to Outplanting, Hinobaan.

Answer to Question	*NGP*	*NON-NGP*
Sources of Seedlings		27%
From Seeds Collected by Respondent		50%
From Wildlings Collected by Respondents		13%
Procured from Private Nurseries		8%
Procured from MENRO		2%
Procured from NGP contractor	100%	-
How many months did you take care of the seedlings in the nursery up to outplanting in the NGP planting sites?		
Rambutan	10 months	-
Nangka	10 months	-
Lanzones	10 months	-
Red Lauan	10 months	-
White Lauan	10 months	-
Tagwangin	10 months	-
Alawihan	10 months	-
Lamio	10 months	-
Mahogany	5-10 months	10 months
Gemelina	4-10 months	10 months
Mango	4-10 months	-
Ipil-ipil	5-10 months	-

Alipata	5-10 months	-
Manguim	5-10 months	-
Eucalyptus	5-10 months	-
Banuyo	5-10 months	-
Coffee	-	10 months
Cacao	-	10 months

The qualities of the seedlings planted on sites as described by the KII/FGD respondents are shown in Table 83.

Table 83. Qualities of Seedlings Planted, Hinobaan.

What were the qualities of seedlings hauled to planting sites?						
Species	***Ht of Seedlings (inches)***		**Diameter of Seedlings (cm)**		**Number of Leaves of Seedlings**	
	NGP Site	**Non-NGP Site**	**NGP Site**	**Non-NGP Site**	**NGP Site**	**Non-NGP Site**
Rambutan	-	24-30	-	4	-	15-20
Nangka	-	20-30	-	2.5-4	-	15-20
Lanzones	-	20-30	-	2.5-4	-	15-20
Red Lauan	-	24-30	-	2.5-4	-	15-20
White Lauan	-	24-30	-	2.5-4	-	15-20
Tagwangin	-	24-30	-	4	-	15-20
Alawihan	-	24-30	-	4	-	15-20
Lamio	-	24-30	-	4	-	15-20
Mahogany	15-24	24-30	1.3	4	10	15-20
Gemelina	15-24	24-30	1.3	4	10	15-20
Mango	-	24-30	-	4	-	15-20
Ipil-ipil	-	24-30	-	4	-	15-20

Alipata	-	24-30	-	4	-	15-20
Manguim	-	24-30	-	4	-	15-20
Eucalyptus	-	24-30	-	4	-	15-20
Banuyo	-	24-30	-	4	-	15-20
Coffee	15-24	-	1.3	-	10	-
Cacao	-	-	1.3	-	10	-

Non-NGP sites collected their seedlings from wildlings and private nurseries. Nangka and Lanzones are procured from private nurseries and other species are from the natural forest around the site. On the other hand, seedlings to be used in NGP sites are procured by NGP contractors.

6. Planting

The start of planting in the NGP and non-NGP sites (Table 84) showed that planting is done during the rainy season in NGP sites while in the non-NGP sites, about 91% of the respondents mentioned that planting is done during the dry season and about 9% said that they conduct planting even during the dry season. Planting is ended one week before the end of the rainy season in the NGP sites while in the non-NGP sites, they extended planting even during the dry season. Other practices of the workers are indicated in the table.

Table 84. Planting Practices of Workers in NGP and Non-NGP Sites.

Question	*NGP*	*NON-NGP*
Start of Planting		
During Rainy Season	100%	91%
During Dry Season	-	9%
Stop of Planting		
Two weeks before end of the rainy season		63%
One week before the end of rainy season	100%	9.50%
First week of dry season		9.50%

One month before dry season		18%
Soil Fertility Additives		
Compost	17%	-
Forest Top Soil/Humus	65%	91%
Fertilizer	15%	-
None	-	9%
Removal of Soil from the plastic bag		
Cut and removed without breaking the soil ball	9%	91%
Cut and removed disturbing the soil ball	91%	9%
How deep did you plant the seedlings?		
Root collar same level with the ground surface	100%	82%
Root collar 3-4 inches below the ground surface		18%
Did you firmly plant the seedlings on the ground?		
Yes	100%	82%
No		18%
Did you erect a stake in every planted hole?		
Yes	100%	100%
No		
After planting the seedlings did you provide some forms of mulch to collect and save soil moisture?		
Yes	100%	-
No	-	100%

In filling soil fertility additive in the planting hole, planters in the NGP sites use all kinds of fertile soil. But the well established plantation of Non-NGP sites used forest top soil/humus. As they plant the seedlings, the planters in the NGP sites slit the base of the plastic bag without removing it or breaking the soil ball. Seedlings are planted up to the root collar on the same level with the ground surface, same as what the Non-NGP did. Planting the seedling firmly on the ground and erecting a stake every seedling, is also a common practice. They use 1 meter of split bamboo for staking. In addition, after planting, they provide dried leaves for mulching to collect and save soil moisture that may help for higher survival rates.

Coffee and cacao was planted first due to a commodity-based approach of NGP during the first phase of implementation. But a high mortality of coffee was reported forcing the PO to request for change in commodity for future planting. This happened due to absence of an SMP and feasibility to evaluate the survival and growth potentials of the species to be recommended.

There was a variety of species of fruit trees planted. In the non-NGP sites, rambutan, langka, lanzones, red lauan, white lauan, tagwangin, alawin, lamio, gmelina (Gmelina arborea), mahogany (Swietinia macrophyla) were selected for planting in the the non-NGP sites. In the NGP sites, manguim (Acacia mangium) , mahogany (Swietinia macrophyla), coffee (Cofea robusta) and cacao were planted.

7. Protection and maintenance

After planting in the NGP site, they inspect the planted areas on a quarterly basis to check the growth of the seedlings and to check whether there are seedlings that died and those that are not growing well because of some health problems or affected by extremely high temperatures and drought. They reported that there was an instance during the dry season where about 1.5 hectares already planted with seedlings died because of drought. Because of this experience they realized that during summer they should be placing mulch to the seedlings after planting at least to lessen the mortality of seedlings. They use live fern leaves as mulch and partial shades by bending them without cutting. Accordingly, there are plenty of fern plants that on the NGP site.

Forest fires and grass fires are not common in the area. For the respondents, fire breaks, fire lines are not necessary for integration into the protection and maintenance activities because forest fires or grass fires are not frequent in the area. Most areas affected are those in the buffer zone. To continuously inform the residents in the nearest barangays, information and education campaign is always undertaken during dry season in coordination with the barangay officials.

In terms of the soil fertility of the sites, the respondents reported to the KII/FGD team that applications of additional fertilizer is necessary because the NGP sites are not fertile anymore considering that such sites have been exposed to changing weather conditions for so long. Unfortunately the absence of a soil survey in the sites, made it difficult to estimate the level of fertilizers to be applied per seedling.

When asked on their expectation on the survival rate of the area they planted, they said that it is about 70% survival rate.

Species planted in the NGP sites:

There are only two species planted in the NGP sites. These are coffee (Cofea robusta) in the 119 ha NGP site and A.mangium in the 100 ha NGP site.

Description of the area: Both the coffee and A. manium plantations are located in area where the terrain is steep to very steep.

8. *Survival rates*

1. *NGP Site – 119 ha coffee plantation*

1.1. Survival rates using the DENR formula

This is the survival rates for the 119 hectares coffee plantation under the NGP in Bacuyangan, Hinobaan, Negros Occidental. Coffee is one of the favoured species for planting in the municipality because the POs believed that they will benefit from it. According to the validation team of the DENR that conducted the survival rate sampling in 2014, they counted 18,305 dead seedlings which they replanted during the year. The validation team commented in their report that the site is not suitable for coffee and cacao basing on the number of dead seedlings. Nevertheless, through yearly replanting the mortalities are replaced so that every time there is a survival rate validation, the survival rate appeared at least above the required survival rate. The total mortality in 2015 is 17079 seedlings which is to be replanted during the rainy season.

The survival rates are shown in Table 85. In 2014, the survival rate is 69% and 86% in 2015.

Table 85. Survival Rates Using DENR Formula for the 119-Ha. NGP Site

Accounting Entry Title	Reforestation Management Period				
	2011	2012	2013	2014	2015
Seedling Opening Stock	0	0	119000	119000	119000
Mortality (Reduction)		0		18305	17079
Net Surviving Seedling		0		100695	101921
Additional Seedling or Replanted		0		18305	
Ending Seedling Planted		0		119000	101921
Survival Rate		0		100	85.6

1.2. Survival rates using IST formula

The survival rate of the coffee plantation using the IST formula is shown in Table 86. Just like the recommendations in the other areas, instead of relying on replanting most of the time, it is better to concentrate on the protection and maintenance of the original planting by implementing all possible and effective cultural systems applicable to the species. This may be applied after studying the causes of the mortalities and addressing these with the right solutions. The DENR may refocus its research thrust by looking at the causes why the seedlings are dying after planting.

Table 86. Survival Rates Using IST Formula, 119-Ha. Coffee NGP Site in Hinobaan.2015.

Accounting Entry Title	Reforestation Management Period				
	2011	2012	2013	2014	2015
Seedling Opening Stock	0	0	119000	119000	119000
Mortality (Reduction)		0		18305	17079
Net Surviving Seedling		0		100695	101921
Additional Seedling or Replanted		0		18305	
Ending Seedling Planted		0		119000	101921
Survival Rate		0		73.3	66.01

2. ***NGP site - 85-ha timber plantation***

2.1. Survival rates using the DENR formula

This NGP site was planted with Mangium *(Acacia mangium)* a timber producing species that grows well in Mindanao. The density of seedling planted in the area is 42,500 (Table 87). The annual mortalities from 2013 to 2015 are estimated according to field observations on the heights of the seedlings in the absence of survival rate validation report (please see footnote). The annual mortalities are not that high in 2013 and 2014 resulting in 99% survival rates for both years. However, in 2015, there were dead seedlings counted plus those with a height range of 0.3m – 0.35m seedlings considered newly replanted. Equating this number as the mortality for 2015 resulted in the reduction of the survival rate to 85%. Validating the forest plantation on the following year will determine the survival rate for that year.

Table 87. Survival Rates Using DENR Formula, 85-Ha. NGP, Hinobaan.

Accounting Entry Title	Reforestation Management Period				
	2011	2012	2013	2014	2015
Seedling Opening Stock	0	0	42500	42500	42500
Mortality (Reduction)		0	625[154]	629[155]	6250[156]

[154] Based on the height range of 0.8-1.3m of seedlings/saplings replanted in 2013 and about 2 years old already in 2015. The total number of seedlings under this height range is 625.

Net Surviving Seedling		0	41875	41871	36250
Additional Seedling or Replanting		0	625	629	0
Seedling Closing Stock		0	42500	42500	36250
Survival Rate		0	98.53	98.52	85.28

2.2. Survival rates using the IST formula

The results of the computation showed that the reduction is minimal compared to the other NGP sites. The reason is due to the relatively small number of mortalities during the previous years. This is a case where maintenance of the original plant density during the first 2 years, thus minimizing mortality, will have no drastic reduction to the survival rates of the forest plantation (Table 88).

Table 88. Survival Rates Using IST Formula, 85-Ha. Hinobaan.

Accounting Entry Title	Reforestation Management Period				
	2011	2012	2013	2014	2015
Seedling Opening Stock	0	0	42500	42500	42500
Mortality (Reduction)		0	625[157]	629[158]	6250[159]
Net Surviving Seedling		0	41875	41871	36250
Additional Seedling or Replanting		0	625	629	0
Seedling Closing Stock		0	42500	42500	36250
Survival Rate		0	97.10	95.70	81.85

[155] Based on the height range of 0.4m – 0.7m of seedlings/saplings replanted in 2014. These seedlings/saplings are about 1 year old in 2015.The total seedling under this height range is 629.

[156] Based on the actual count of dead seedlings and those with poor health condition in 2015 during the assessment period plus those with a height of 0.3m – 0.35m as newly replanted seedlings in 2015. The counted dead seedlings 6250..

[157] Same definition in Table 87.

[158] Same definition in Table 87.

[159] Same definition in Table 87.

2.3. Weighted survival rate of NGP sites

The weighted survival rates of the NGP sites using DENR and IST are shown in Table 89. Using the DENR formula, Hinobaan has a weighted survival rate of 86%while the IST formula yields 73%, the highest among the 3 provinces. The reforestation project management of the NGP site in Hinobaan that planted A. Mangium did well in keeping the mortality to a minimum during the first 2 years.

Table 89. Weighted Survival Rates of NGP Sites.

		Survival Rate		Weighted Sum		Weighted Survival Rate	
NGP Site	Area	DENR	IST	DENR	IST	DENR	IST
Coffee	116	86.46	66.12	10029.36	7669.92		
A. Mangium	85	85.28	82.8	7248.8	7038		
	201			17278.16	14707.92	85.96	73.17

3. Non-NGP Sites

To compare the NGP sites in terms of survival rate and growth performance with aged forest plantations, two established forests in one of the watersheds in Hinobaan were inventoried. These forests were established way back in the early 1990 and planted with mixed fast growing species.

3.1. 100 ha. watershed forest (Gmelina Timber Production)

The original ground cover of this area is also cogon grass. It was planted with the same purpose to revive the water productivity of the watershed. The site was planted in 1992 with Gmelina (*Gmelina arborea*) by the DENR. After 23 years, the area is now regenerated with other pioneer species.

There were no data on the original density of trees planted in 1992. So, it considered the present density inventoried as of assessment period. From 1992 to 2015, there were no records on mortalities and replanting. Thus, the survival rate calculation will not make of use of the survival rate accounting matrix used in NGP sites. The method is based on analyzing the present stand and relating this backward to what most likely transpired in the past.

The results of the analysis are hereby stated. There are 17,378 trees inventoried. Of these trees, 11,742 trees are Gmelina *(Gmelina arborea)* and 5,636 trees are pioneer species. The pioneer species must have occupied the spaces where the Gmelina *(Gmelina arborea)* trees were growing before. Although there is no record to support this, it is highly possible that through natural elimination process, the planted seedlings were weeded out by the pioneer species. Thus, considered as the mortality rate in 2015. Based on these figures and assumptions, the survival rate of the plantation is 68% (Table 90).

Table 90. Survival Rate of the 100-Ha Non NGP Site, Hinobaan Watershed.

Species	Number of Trees
Total density[160]	17378
Pioneer species[161]	5636
Remaining planted species[162]	11742
Survival rate (%)[163]	68

3.2. 109 ha. watershed forest (Agroforestry)

The original ground cover of the area is cogon grass. To reduce soil erosion and to sustain the function of the watershed for water production, the DENR planted mixed fast growing species such as Gmelina *(Gmelina arborea)*, Ipil-ipil *(Leucaena leucocephala)* and mahogany *(Swietenia macrophyla)*, and fruit trees such as jackfruit *(Artocarpus heterophyllus)*, coffee (*Cofea robusta*), and rambutan *(Nephelium lappaceum)*. After 20 years, the forest is now transformed naturally into a second growth agroforest where pioneer species are growing together with the planted species. The planted portion of the watershed has an area of 109 hectares and this was planted in 1995. Table 91 shows the survival rate in the 109 hectare Non-NGP site in Hinobaan.

Table 91. Survival Rate of the 109 Ha. Non NGP Site, Hinobaan Watershed, 2015.

Species	Number of Trees
Forest plantation species[164]	4320
Pioneer species (natural growing)[165]	7547

[160] Total density is the actual count of surviving planted trees and pioneer species.

[161] Pioneer species is the actual count of pioneer species in the area. This is also assumed to be the number of mortality of the planted seedlings

[162] Remaining planted species = total density – fruit trees.
[163] Survival rate = remaining planted species / total density * 100
[164] Forest plantation species are the remaining plants counted at assessment period.

Fruit trees[166]	9242
Total agroforest density[167]	21109
Remaining planted species[168]	13562
Survival rate (%)[169]	64

3.3. Weighted survival rate of non-NGP site

The weighted survival rate of the two non-NGP sites, one site a 23-year old gmelina plantation and a 20-year old agroforestry plantation is 65.91% (Table 92). There were no data on mortality and replanting from the time the plantations were planted to the present period. So, the IST survival rates were not calculated together with the weighted survival rate.

Table 92. Weighted Survival Rate Based on the DENR Formula of Non-NGP Site.

Non-NGP Site	Area (Ha)	Survival rate (%)	Weighted Sum	Weighted Survival Rate (%)
Gmelina	100	68	6800	
Agroforestry	109	64	6976	
	209		13776	65.91

4. Stumpage buildup

4.1. 23 years old non-NGP reforestation project

The 23 years old, 100 ha Non-NGP site planted with Gmelina is estimated to have a present stumpage of 729.4 cum/ha or a total wood volume of 72,940 cum for 100 hectares. The stumpage is the actual volume of the gmelina plantation at 68% survival rate based on a density

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[165] Pioneer species are natural growing in the area, not planted, assumed to have occupied planted spaces for both forest plantation species and fruit trees.

[166] Fruit trees are the remaining fruit trees counted.

[167] Total agroforestry density is the sum of the remaining forest plantation species + fruit trees and pioneer species. This summed to 21,109 trees.

[168] Remaining planted species is the sum of remaining forest plantation species + counted fruit trees.

[169] Survival rate = remaining planted species / Total agroforest density * 100

of 500 trees/ha or equivalent to 340 trees/ha (assessed in 2015). While the volume in 23 years looks high, the reality in Mindanao is that a 10 year old Gmelina plantation can already yield 250-300 cum/ha. However, in this plantation the yield at 10 years old is only 59.9 cum/ha which is rather very low (Table 93).

It is also uncertain whether the Gmelina trees are still healthy when cut at the age of 23 years old or already affected with center rot. If not, beyond 10-15 years old, the wood may become brittle which makes it unfit for construction or furniture materials. Under this condition, the wood may be used for pulp and paper, particle board, fuelwood and charcoal making. This of course has to be proven through research by the ERDB or the regional research center of the DENR.

Table 93. Gmelina's Stumpage Buildup of the 23 Years Old Non-NGP Forest Plantation, Hinobaan, Negros Occidental, 2015.

Age	**Base Dia**	**Total Height**	**Top Dia**	**Bole Height**	**Average Dia**	**Volume/Tree**	**Total Trees/Ha**	**Volume/Ha**	**Total Vol (100Ha)**
(Yr)	(cm)	(m)	(cm)	(m)	(cm)	Cum	No.	Cum/ha	Cum
1.0	2.6	0.6	2.3	0.4	2.4	0.0	340.0	0.1	6.0
2.0	5.1	1.1	4.6	0.8	4.9	0.0	340.0	0.5	48.0
3.0	7.7	1.7	6.9	1.1	7.3	0.0	340.0	1.6	161.9
4.0	10.3	2.3	9.1	1.5	9.7	0.0	340.0	3.8	383.7
5.0	12.9	2.9	11.4	1.9	12.2	0.0	340.0	7.5	749.4
6.0	15.4	3.4	13.7	2.3	14.6	0.0	340.0	12.9	1294.9
7.0	18.0	4.0	16.0	2.7	17.0	0.1	340.0	20.6	2056.3
8.0	20.6	4.6	18.3	3.0	19.4	0.1	340.0	30.7	3069.4
9.0	23.2	5.1	20.6	3.4	21.9	0.1	340.0	43.7	4370.3
10.0	25.7	5.7	22.9	3.8	24.3	0.2	340.0	59.9	5994.9
11.0	28.3	6.3	25.2	4.2	26.7	0.2	340.0	79.8	7979.2
12.0	30.9	6.8	27.4	4.6	29.2	0.3	340.0	103.6	10359.2
13.0	33.4	7.4	29.7	4.9	31.6	0.4	340.0	131.7	13170.8
14.0	36.0	8.0	32.0	5.3	34.0	0.5	340.0	164.5	16450.0
15.0	38.6	8.6	34.3	5.7	36.5	0.6	340.0	202.3	20232.8
16.0	41.2	9.1	36.6	6.1	38.9	0.7	340.0	245.6	24555.1
17.0	43.7	9.7	38.9	6.5	41.3	0.9	340.0	294.5	29453.0
18.0	46.3	10.3	41.2	6.8	43.7	1.0	340.0	349.6	34962.3
19.0	48.9	10.8	43.5	7.2	46.2	1.2	340.0	411.2	41119.1
20.0	51.5	11.4	45.7	7.6	48.6	1.4	340.0	479.6	47959.2
21.0	54.0	12.0	48.0	8.0	51.0	1.6	340.0	555.2	55518.8
22.0	56.6	12.5	50.3	8.4	53.5	1.9	340.0	638.3	63833.7
23.0	59.2	13.1	52.6	8.7	55.9	2.1	340.0	729.4	72940.0
Base DIA is the diameter taken close to ground									
Total HT is the height from the base to the tip of the tree									

Top DIA is the diameter at the first branch of the tree
Bole HT is the clear stem height from base to the first branch
Average DIA is the average diameter (Base DIA+Top DIA)/2
Volume/tree = 0.7854*ADIA^2*BHT
All the column titles apply to other tables on stumpage determination

4.2. 20 years old 109 ha agroforestry project

The stumpage buildup for wood production comes from the plantation species (gmelina, mahogany and Ipil-ipi)l components. While there are pioneer species growing side by side with the plantation species, these were not considered for wood production. Instead, the pioneer species are better reserved for environmental services.

Gmelina component

Gmelina is one of the fast growing exotic species planted for lumber production, pulpwood, and wooden decorative materials. It is also a good material for door jams, furniture, and cabinets. Its wood residues are good for particle board, wood wool, and pulp and paper. It is planted in pure stand or mixed with other species in agroforestry.

The computation of the stumpage buildup of tree component of the agroforestry project is separated from the fruit tree component for 2 reasons: 1) Only the 1,809 trees were the remnants of the old planting 20 years after; and 2) the fruit trees were enrichment planting, probably planted about 4-5 years ago based on their diameters and heights (Table 94).

Table 94. Gmelina's Stumpage of the 20 Years Old 109 Ha Agroforestry Project, Hinobaan, Negros Occidental, 2015.

Age	Base Dia	Total Height	Top Dia	Bole Height	Ave. Dia	Vol/Tree	Total Trees	Total Volume
(Yr)	(cm)	(m)	(cm)	(m)	(cm)	(Cum)	(No.)	(Cum)
1	1.42	0.39	1.22	0.26	1.32	0.00	1809	0.06
2	2.83	0.77	2.44	0.52	2.64	0.00	1809	0.51
3	4.25	1.16	3.67	0.77	3.96	0.00	1809	1.72
4	5.66	1.55	4.89	1.03	5.28	0.00	1809	4.08
5	7.08	1.94	6.11	1.29	6.60	0.00	1809	7.98
6	8.50	2.32	7.33	1.55	7.92	0.01	1809	13.78
7	9.91	2.71	8.56	1.81	9.23	0.01	1809	21.88
8	11.33	3.10	9.78	2.06	10.55	0.02	1809	32.67
9	12.74	3.48	11.00	2.32	11.87	0.03	1809	46.51
10	14.16	3.87	12.22	2.58	13.19	0.04	1809	63.80
11	15.58	4.26	13.45	2.84	14.51	0.05	1809	84.92

12	16.99	4.64	14.67	3.10	15.83	0.06	1809	110.25
13	18.41	5.03	15.89	3.35	17.15	0.08	1809	140.18
14	19.82	5.42	17.11	3.61	18.47	0.10	1809	175.08
15	21.24	5.81	18.34	3.87	19.79	0.12	1809	215.34
16	22.66	6.19	19.56	4.13	21.11	0.14	1809	261.34
17	24.07	6.58	20.78	4.39	22.43	0.17	1809	313.47
18	25.49	6.97	22.00	4.64	23.75	0.21	1809	372.11
19	26.90	7.35	23.23	4.90	25.06	0.24	1809	437.63
20	28.32	7.74	24.45	5.16	26.38	0.28	1809	510.43
21	29.74	8.13	25.67	5.42	27.70	0.33	1809	590.89
22	31.15	8.52	26.89	5.68	29.02	0.38	1809	679.39
23	32.57	8.90	28.12	5.93	30.34	0.43	1809	776.31
24	33.98	9.29	29.34	6.19	31.66	0.49	1809	882.03
25	35.40	9.68	30.56	6.45	32.98	0.55	1809	996.94
26	36.82	10.06	31.78	6.71	34.30	0.62	1809	1121.42
27	38.23	10.45	33.01	6.97	35.62	0.69	1809	1255.86
28	39.65	10.84	34.23	7.23	36.94	0.77	1809	1400.63
29	41.06	11.22	35.45	7.48	38.26	0.86	1809	1556.12
30	42.48	11.61	36.67	7.74	39.58	0.95	1809	1722.71

Mahogany component

Mahogany is a good source of lumber for furniture and panel materials. It is good for veneer and plywood materials. The only problem with it is that it is an invasive alien species. Meaning, if planted together with other equally important wood species, it will outgrow and kill those other species. So no other species will grow and survive under it. It is therefore not advisable to interplant this species in any agroforestry systems. It is only suitable in timber production areas. Nevertheless, since it is already in this agrofoforestry system, estimating its potential stumpage is important for two reasons for assessing a)its potential carbon sequestration capacity; and b) its potential to produce wood materials as a reserve for the local wood industry because it is situated in a watershed in Hinobaan.

The volume of the mahogany component in this agroforestry system is shown in Table 95. There are 1,217 trees of Mahogany in the 109 hectares agroforestry project. These trees are growing together with the Gmelina, fruit trees, pioneer species and ipil-ipil component. In 10 years period, the Mahogany will have 54 cum and in 20 years, it will yield 432 cum.

Table 95. Mahogany's Stumpage Buildup in the Agroforestry Project.

Age	Bole Height	Average Dia	Volume perTree	Total Trees	Total Volume

(Yr)	(m)	(cm)	Cum per tree	No.	Cum
1	0.54	1.02	0.00	1217	0.05
2	1.08	2.04	0.00	1217	0.43
3	1.63	3.06	0.00	1217	1.46
4	2.17	4.08	0.00	1217	3.46
5	2.71	5.10	0.01	1217	6.75
6	3.25	6.13	0.01	1217	11.66
7	3.79	7.15	0.02	1217	18.52
8	4.34	8.17	0.02	1217	27.65
9	4.88	9.19	0.03	1217	39.37
10	5.42	10.21	0.04	1217	54.00
11	5.96	11.23	0.06	1217	71.88
12	6.50	12.25	0.08	1217	93.32
13	7.05	13.27	0.10	1217	118.64
14	7.59	14.29	0.12	1217	148.18
15	8.13	15.31	0.15	1217	182.26
16	8.67	16.33	0.18	1217	221.19
17	9.22	17.36	0.22	1217	265.31
18	9.76	18.38	0.26	1217	314.94
19	10.30	19.40	0.30	1217	370.40
20	10.84	20.42	0.35	1217	432.02
21	11.38	21.44	0.41	1217	500.12
22	11.93	22.46	0.47	1217	575.02
23	12.47	23.48	0.54	1217	657.05
24	13.01	24.50	0.61	1217	746.53
25	13.55	25.52	0.69	1217	843.79
26	14.09	26.54	0.78	1217	949.15
27	14.64	27.56	0.87	1217	1062.93

Ipil-ipil component

Ipil-ipil wood is good for pulpwood, fuelwood, and charcoal. The pith of Ipil-ipil wood is good for wood parquet used for flooring. It is one of the nitrogen-fixing species and its leaves can be used as green fertilizer. It is an important component of any agroforestry systems to supply nitrogen to crops.

The total number of Ipil-ipil trees inside the 109 ha. agroforestry plantation is 1,559 trees. Considering its wood component, it is estimated that it can provide 22 cum in 5 years, 126 cum in 10 years and 594 cum in 15 years provided that the number of trees will be maintained (Table

96). It will still grow to about 4,759 cum in 30 years assuming that there will be no dominant species that will cover the individual trees.

Table 96. Ipil-ipil's Stumpage Buildup of the Agroforestry Project.

Age	Bole Height	Average Dia	Volume per Tree	Total Tree	Total Vol
(Yr)	(m)	(cm)	Cum per tree	No.	Cum
1	0.73	1.40	0.00	1559	0.18
2	1.46	2.81	0.00	1559	1.41
3	2.19	4.21	0.00	1559	4.76
4	2.93	5.61	0.01	1559	11.28
5	3.66	7.02	0.01	1559	22.04
6	4.39	8.42	0.02	1559	38.08
7	5.12	9.82	0.04	1559	60.47
8	5.85	11.22	0.06	1559	90.26
9	6.58	12.63	0.08	1559	128.51
10	7.31	14.03	0.11	1559	176.28
11	8.05	15.43	0.15	1559	234.64
12	8.78	16.84	0.20	1559	304.62
13	9.51	18.24	0.25	1559	387.30
14	10.24	19.64	0.31	1559	483.73
15	10.97	21.05	0.38	1559	594.96
16	11.70	22.45	0.46	1559	722.06
17	12.43	23.85	0.56	1559	866.09
18	13.16	25.25	0.66	1559	1028.09
19	13.90	26.66	0.78	1559	1209.14
20	14.63	28.06	0.90	1559	1410.28
21	15.36	29.46	1.05	1559	1632.57
22	16.09	30.87	1.20	1559	1877.08
23	16.82	32.27	1.38	1559	2144.86
24	17.55	33.67	1.56	1559	2436.96
25	18.28	35.08	1.77	1559	2754.45
26	19.02	36.48	1.99	1559	3098.38
27	19.75	37.88	2.23	1559	3469.81
28	20.48	39.28	2.48	1559	3869.80
29	21.21	40.69	2.76	1559	4299.41
30	21.94	42.09	3.05	1559	4759.69

5. *Soil accretion and erosion and temperature*

The impacts of the reforestation projects, NGP and non-NGP, to soil accretion or erosion and temperature are indicated in Table 97. The NGP sites which are 2-3 years old have negative soil accretion levels which mean that both have not yet totally reverted soil erosion to accretion. This is attributed to the fact that both reforestation projects are still young and the seedlings planted are not capable yet of significantly reducing soil erosion. Comparing each NGP reforestation project to the control showed that the coffee plantation has reduced soil erosion to a height of 5.89 cm from the soil erosion rate of the grassland area. Similarly, the A. mangium plantation has also reduced soil erosion to a height of 5.35 cm compared to the soil erosion rate of grassland. While the coffee plantation has higher impact to reducing soil erosion than the A. mangium plantation, the difference is attributed to the presence of more underbrush vegetations in the coffee plantations than in the A. mangium plantation as observed during the assessment. While there is a difference in soil erosion impact of the two types of reforestation, the difference is negligible and not significant.

Comparing the non-NGP sites, the agroforestry project and the mixed forest tree plantation project, which are already 20 years and 23 years old, respectively, the soil erosion impacts are high at 5.78 cm (agroforestry) and 6.15 cm (mixed forest plantation).

The 23 years old mixed forest species reforestation project has already reverted soil erosion to accretion although the level is still insignificant. This is due to the rough terrain in the area and high intensity of rainfall. A night before measurement, there was a high intensity of rainfall that fell on the sites[170] and perhaps this explains why both NGP and non-NGP sites have registered negative soil accretion except the 23 year old mixed species forest plantation. Also, high slopes accelerate surface runoff that causes soil erosion.

Comparing both reforestation projects with the control sites showed that there is already an improvement in soil accretion from 5.62 cm in the NGP site to 5.965 cm in the non-NGP site.

The insight from this experience indicates that soil erosion control system, whether vegetative or structural or combination, has to be integrated in reforestation projects especially in high slope areas and where rainfall intensity is high. This could also be a lesson for reforestation planners that due to climate change, the design should now take into consideration measures to effectively control excessive soil erosion in rough terrain reforestation sites. Furthermore, even low vulnerable areas to rain-induced disasters should now be installed with the most appropriate soil erosion and land slide control measures.

Table 97. Soil Accretion and Temperature Impacts of NGP and Non-NGP Reforestation Projects, Hinobaan, Negros Occidental. 2015.

Indicator	Area	Soil	Average

[170] Reported by Forester Marvin Arlegui, the Field Survey Team Leader in Hinobaan NGP and Non-NGP sites assessment.

		Accretion/tree	Temperature
NGP Site			
Coffee plantation	119	-0.11	33
Acacia mangium	100	-0.65	34.1
Average		**-0.38**	**33.55**
Non-NGP Site			
Agroforestry area	109	-0.22	32.31
Mixed species plantation	100	0.15	34.1
Average		**-0.035**	**33.205**
Control grassland			
Plot 1		-1.8	36.5
Plot 2		-1.2	36.3
Plot 3		0.1	36.5
Plot 4		-0.7	36.2
Plot 5		-0.5	35.9
Plot 6		-0.1	35.7
Plot 7		-0.2	36.5
Plot 8		-0.2	36.8
Plot 9		-0.9	35.4
Plot 10		-0.5	36.9
Average		**-6**	36.27
Comparison of Plantation Types to Control			
Coffee plantation vs. Control		5.89	-3.27
Acacia mangium plantation vs. Control		5.35	-2.17
Non-NGP Agroforestry Vs. Control		5.78	-3.96
Non-NGP Mixed forest species plantation Vs. Control		6.15	-2.17
Comparison of Project Site to Control			
NGP site Vs. Control		5.62	-2.72
Non-NGP site Vs. Control		5.965	-3.065

6. Reforestation impact to temperature

Both reforestation projects have positive reduction in temperature. Between NGP sites, the coffee plantation although the plants are still young has lower temperature than the A. mangium plantation. The reason behind is the exposure or aspect of the slopes where the NGP sites are facing. Areas exposed to the east, north-east, west to north-west have high temperature exposure. Thus, the A. mangium has higher temperature than the coffee plantation because it is facing the east compared to the coffee plantation. Similarly the mixed forest species plantation non-NGP site is also facing the east. Thus, receiving most of the sunshine. This gives a higher temperature compared with the coffee plantation and the agroforestry plantation (non-NGP site).

Comparing both the NGP and non-NGP reforestation projects to the control sites showed that these are cooler by -2.72 degrees Celsius in the NGP site and -3.065 degrees Celsius in the non-NGP sites. The difference between the NGP and non-NGP sites is attributed to the condition that older forests are cooler than younger forests. The explanation to this is that in the older forests there is higher photosynthetic activity than in young plantation. Furthermore, the larger the canopy area in older plantation the better is the sunlight trapping effectiveness of the canopy. Thus, creating cooler temperature under the forest canopy. It is expected that as the forest and agroforest plantations grow, their effectiveness in tempering temperature would be further enhanced (Table 97).

7. Carbon sequestration

7.1. NGP reforestation projects

The present capacity of the NGP plantations to sequester carbon is 36.17 tons of carbon for the A.mangium plantation at age 3 and 0.0066 ton for the coffee plantation (Table 97). These estimates are as good as the present survival rates of the NGP sites. Any reduction in the future will have a corresponding deduction in the carbon sequestration capacity of the two sites.

Since coffee is a small tree, its carbon sequestration would not increase so much as the A. mangium plantation. The only way to increase the carbon capture of the coffee trees is to integrate other bigger fruit trees or forest species that will not interfere with the normal growth rate of the coffee trees.

Table 98. Carbon Sequestration of NGP Mangium Plantation, Hinobaan, Negros Occidental, 2015.

NGP Site Profile	A.Magium	Coffee
Total tree density	35307	51445
Area	100	119
Age	3	2
Diameter	4.35	0.2152418
Total HT	3.46	0.2220739
Bole Ht	2.59	
Total volume	115.34	0.0000010
Crown Biomass Factor	17.30	0.0000001
Root Biomass Factor	14.99	0.0000001
Total Biomass	147.63	0.0532102
Wood density factor (wt to Cum)1	103.34	0.0266051
Approximate carbon factor	0.35	0.2500000
Total carbon sequestered	36.17	0.0066513

7.2. Non-NGP reforestation projects

a. 100 ha gmelina plantation

The present carbon sequestration capacity of the 100ha-gmelina plantation is shown in Table 99. The last two columns contain the level of carbon capture and annual carbon rate at any given time from year 1 to year 30. The plantation's carbon sequestration at present after 23 years is 228.74 tons/ha and 28.55 tons carbon capture rate (22,874 tons/100 ha) and (2,855.7 tons/100 ha). This is quite high compared to the 55.8 tons/ha in Leyte and also 38 tons/ha to 54 tons in Mindanao (Lasco, et al, 1999) of the same species with ages ranging from 7 to 9 years old plantations[171].

Table 99. Carbon Sequestration of the 23-Year Old 100ha Non-NGP Gmelina Plantation, Hinobaan, Negros Occidental. 2015.

Age (Yr)	Bole Height	Average Diameter	Tree Density/Ha	Wood Vol/Ha	Total Wood Vol (100ha)	Total Biomass Volume	Total Biomass Density	Carbon Sequestration	Annual Carbon Sequestration Rate
1.0	0.4	2.4	340.0	0.1	6.0	7.7	5.4	1.9	0.0
2.0	0.8	4.9	340.0	0.5	48.0	61.4	43.0	15.0	13.2
3.0	1.1	7.3	340.0	1.6	161.9	207.2	145.0	50.8	35.7
4.0	1.5	9.7	340.0	3.8	383.7	491.1	343.8	120.3	69.6
5.0	1.9	12.2	340.0	7.5	749.4	959.2	671.4	235.0	114.7
6.0	2.3	14.6	340.0	12.9	1294.9	1657.5	1160.2	406.1	171.1
7.0	2.7	17.0	340.0	20.6	2056.3	2632.0	1842.4	644.8	238.8
8.0	3.0	19.4	340.0	30.7	3069.4	3928.8	2750.2	962.6	317.7
9.0	3.4	21.9	340.0	43.7	4370.3	5594.0	3915.8	1370.5	408.0
10.0	3.8	24.3	340.0	59.9	5994.9	7673.5	5371.4	1880.0	509.5
11.0	4.2	26.7	340.0	79.8	7979.2	10213.4	7149.4	2502.3	622.3
12.0	4.6	29.2	340.0	103.6	10359.2	13259.8	9281.8	3248.6	746.4
13.0	4.9	31.6	340.0	131.7	13170.8	16858.6	11801.0	4130.4	881.7
14.0	5.3	34.0	340.0	164.5	16450.0	21056.0	14739.2	5158.7	1028.4
15.0	5.7	36.5	340.0	202.3	20232.8	25898.0	18128.6	6345.0	1186.3
16.0	6.1	38.9	340.0	245.6	24555.1	31430.6	22001.4	7700.5	1355.5
17.0	6.5	41.3	340.0	294.5	29453.0	37699.8	26389.9	9236.5	1536.0
18.0	6.8	43.7	340.0	349.6	34962.3	44751.7	31326.2	10964.2	1727.7

[171] Rodel D. Lasco and Florencia B. Pulhin (2003). Philippine Forest Ecosystems and Climate Change: Carbon stocks, Rate of Sequestration and the Kyoto Protocol. Annals of Tropical Research 25(2): 37-51

19.0	7.2	46.2	340.0	411.2	41119.1	52632.4	36842.7	12894.9	1930.8
20.0	7.6	48.6	340.0	479.6	47959.2	61387.8	42971.5	15040.0	2145.1
21.0	8.0	51.0	340.0	555.2	55518.8	71064.1	49744.9	17410.7	2370.7
22.0	8.4	53.5	340.0	638.3	63833.7	81707.2	57195.0	20018.3	2607.6
23.0	8.7	55.9	340.0	729.4	72940.0	93363.2	65354.2	22874.0	2855.7
24.0	9.1	58.3	340.0	828.7	82873.6	106078.2	74254.7	25989.1	3115.2
25.0	9.5	60.8	340.0	936.7	93670.4	119898.1	83928.7	29375.0	3385.9
26.0	9.9	63.2	340.0	1053.7	105366.4	134869.0	94408.3	33042.9	3667.9
27.0	10.3	65.6	340.0	1180.0	117997.7	151037.1	105725.9	37004.1	3961.2
28.0	10.6	68.0	340.0	1316.0	131600.1	168448.2	117913.7	41269.8	4265.7
29.0	11.0	70.5	340.0	1462.1	146209.7	187148.5	131003.9	45851.4	4581.6
30.0	11.4	72.9	340.0	1618.6	161862.4	207183.9	145028.7	50760.1	4908.7

7.3. 109 ha agroforestry plantation

Gmelina component

The capacity of the agroforestry plantation to sequester carbon is presented in Table 100. The oldest component of the plantation is the Gmelina trees numbering 1,809 trees in the whole area. The other vegetations are fruit trees believed to be planted 4-5 years ago. The carbon sequestration of the fruit trees is treated separately and presented in another table.

The 1,809 trees are already 20 years old. Their total carbon sequestration stock is only 160 tons or 44.4 tons/ha at 500 trees/ha. The carbon sequestration rate at age 20 is 22.83 tons/year and still increasing while the trees are growing up to 30 years. The carbon sequestration rate compared to studied gmelina plantation indicates that this site has lower sequestration rate compared to the 55.8 tons/ha to 88.1 tons/ha in Leyte (Lasco, et al, 1999) but quite higher compared to the 38.6 tons/ha to 39.3 tons/ha studied in Mindanao (Kawahara, et al, 1981 as reported by Lasco and Pulhin)[172]

Table 100. Carbon Sequestration of the 20 Years Old 109 Ha Gmelina Plantation in the Non-NGP Site, Hinobaan, Negros Occidental, 2015.

Age	Bole Height	Average Dia	Total Trees	Total Volume	Total Biomass Volume	Total Biomass Density	Carbon Seq	Annual Carbon Seq Rate
(Yr)	(m)	(cm)	(No.)	(cum)	(cum)	(ton)	(ton)	(ton/year)
1	0.26	1.32	1809	0.06	0.08	0.06	0.02	0.00
2	0.52	2.64	1809	0.51	0.65	0.46	0.16	0.14
3	0.77	3.96	1809	1.72	2.21	1.54	0.54	0.38
4	1.03	5.28	1809	4.08	5.23	3.66	1.28	0.74

[172] Ibid.

5	1.29	6.60	1809	7.98	10.21	7.15	2.50	1.22
6	1.55	7.92	1809	13.78	17.64	12.35	4.32	1.82
7	1.81	9.23	1809	21.88	28.01	19.61	6.86	2.54
8	2.06	10.55	1809	32.67	41.81	29.27	10.24	3.38
9	2.32	11.87	1809	46.51	59.54	41.68	14.59	4.34
10	2.58	13.19	1809	63.80	81.67	57.17	20.01	5.42
11	2.84	14.51	1809	84.92	108.70	76.09	26.63	6.62
12	3.10	15.83	1809	110.25	141.12	98.79	34.58	7.94
13	3.35	17.15	1809	140.18	179.43	125.60	43.96	9.38
14	3.61	18.47	1809	175.08	224.10	156.87	54.90	10.94
15	3.87	19.79	1809	215.34	275.63	192.94	67.53	12.63
16	4.13	21.11	1809	261.34	334.52	234.16	81.96	14.43
17	4.39	22.43	1809	313.47	401.24	280.87	98.30	16.35
18	4.64	23.75	1809	372.11	476.30	333.41	116.69	18.39
19	4.90	25.06	1809	437.63	560.17	392.12	137.24	20.55
20	5.16	26.38	1809	510.43	653.36	457.35	160.07	22.83
21	5.42	27.70	1809	590.89	756.34	529.44	185.30	25.23
22	5.68	29.02	1809	679.39	869.62	608.73	213.06	27.75
23	5.93	30.34	1809	776.31	993.67	695.57	243.45	30.39
24	6.19	31.66	1809	882.03	1129.00	790.30	276.60	33.15
25	6.45	32.98	1809	996.94	1276.08	893.26	312.64	36.04
26	6.71	34.30	1809	1121.42	1435.42	1004.79	351.68	39.04
27	6.97	35.62	1809	1255.86	1607.50	1125.25	393.84	42.16
28	7.23	36.94	1809	1400.63	1792.81	1254.96	439.24	45.40
29	7.48	38.26	1809	1556.12	1991.83	1394.28	488.00	48.76
30	7.74	39.58	1809	1722.71	2205.07	1543.55	540.24	52.24

Fruit tree component

The carbon sequestration of the fruit tree component of the agroforestry reforestation project (non-NGP) is shown in Table 101. There are 9242 fruit trees growing in the area. The fruit trees are jackfruit, coffee, and rambutan. Coffee and rambutan are generally small trees while jackfruit is a medium size tree. Fruit trees are not expected to yield higher wood volume than forest species. Nevertheless, they also sequester carbon. These are shown in the last two columns. There are no studies yet on the carbon sequestration of jackfruit, coffee and rambutan that could be used to compare the results in the table.

Table 101. Carbon Sequestration of the Fruit-Tree Plantation, Non-NGP Site, Hinobaan, Negros Occidental, 2015.

Age	BHT	ADIA	Total Tree	Total Volume	Total Biomass	Total Biomass	Carbon Seq	Annual Carbon

					Volume	Density		Seq Rate
(Yr)	(m)	(cm)	(No.)	(cum)	(cum)	(ton)	(ton)	(ton/year)
1	0.58	0.82	9242.00	0.34	0.44	0.31	0.11	
2	1.15	1.64	9242.00	1.37	1.75	1.23	0.43	0.32
3	1.73	2.46	9242.00	3.08	3.95	2.76	0.97	0.54
4	2.30	3.28	9242.00	5.48	7.02	4.91	1.72	0.75
5	2.88	4.10	9242.00	8.57	10.96	7.67	2.69	0.97
6	3.45	4.92	9242.00	12.33	15.79	11.05	3.87	1.18
7	4.03	5.74	9242.00	16.79	21.49	15.04	5.26	1.40
8	4.60	6.56	9242.00	21.93	28.07	19.65	6.88	1.61
9	5.18	7.38	9242.00	27.75	35.52	24.86	8.70	1.83
10	5.75	8.20	9242.00	34.26	43.85	30.70	10.74	2.04
11	6.33	9.02	9242.00	41.45	53.06	37.14	13.00	2.26
12	6.90	9.84	9242.00	49.33	63.15	44.20	15.47	2.47
13	7.48	10.66	9242.00	57.90	74.11	51.88	18.16	2.69
14	8.05	11.49	9242.00	67.15	85.95	60.17	21.06	2.90
15	8.63	12.31	9242.00	77.09	98.67	69.07	24.17	3.12
16	9.21	13.13	9242.00	87.71	112.26	78.58	27.50	3.33
17	9.78	13.95	9242.00	99.01	126.74	88.71	31.05	3.55
18	10.36	14.77	9242.00	111.00	142.08	99.46	34.81	3.76
19	10.93	15.59	9242.00	123.68	158.31	110.82	38.79	3.98
20	11.51	16.41	9242.00	137.04	175.41	122.79	42.98	4.19
21	12.08	17.23	9242.00	151.09	193.39	135.37	47.38	4.41
22	12.66	18.05	9242.00	165.82	212.25	148.57	52.00	4.62
23	13.23	18.87	9242.00	181.24	231.98	162.39	56.84	4.83
24	13.81	19.69	9242.00	197.34	252.59	176.82	61.89	5.05
25	14.38	20.51	9242.00	214.13	274.08	191.86	67.15	5.26
26	14.96	21.33	9242.00	231.60	296.45	207.51	72.63	5.48
27	15.53	22.15	9242.00	249.76	319.69	223.78	78.32	5.69
28	16.11	22.97	9242.00	268.60	343.81	240.67	84.23	5.91
29	16.68	23.79	9242.00	288.13	368.80	258.16	90.36	6.12
30	17.26	24.61	9242.00	308.34	394.68	276.27	96.70	6.34

Indigenous forest species (IFS) component

The carbon sequestration of the indigenous forest species component composed of 9105 trees is shown the last 2 columns (Table 102). At 500 density of trees per hectare, this is equivalent to 18.2 hectares. The wood volume is 90.7 cum/ha with a carbon sequestration of 28.7 tons/ha. The forest type is generally of the pioneer species approximating a secondary forest without dipterocarp species.The sequestration capacity is very much inferior with the carbon sequestration of secondary forest studied by Lasco and Pulhin in Leyte in 1999. This probably due to the absence of dipterocarp species in the area which are usually found in secondary forest.

Table 102. Carbon Sequestration of the Indigenous Forest Species, Non-NGP Agroforestry Plantation, Hinobaan, Negros Occidental, 2015.

Age	Bole Height	Average Dia.	Tree Density	Total Volume	Total Biomass Volume	Total Biomass Density	Carbon Seq	Annual Carbon Seq. Rate
(Yr)	(m)	(cm)	(No.)	(cum)	(cum)	(ton)	(ton)	(ton/year)
1	0.33	0.94	9105.00	0.21	0.26	0.19	0.06	
2	0.66	1.87	9105.00	1.65	2.12	1.48	0.52	0.45
3	0.99	2.81	9105.00	5.58	7.14	5.00	1.75	1.23
4	1.32	3.75	9105.00	13.22	16.92	11.85	4.15	2.40
5	1.65	4.68	9105.00	25.82	33.05	23.14	8.10	3.95
6	1.98	5.62	9105.00	44.62	57.11	39.98	13.99	5.89
7	2.31	6.56	9105.00	70.85	90.69	63.48	22.22	8.23
8	2.63	7.49	9105.00	105.76	135.38	94.76	33.17	10.95
9	2.96	8.43	9105.00	150.59	192.75	134.93	47.22	14.06
10	3.29	9.37	9105.00	206.57	264.41	185.09	64.78	17.56
11	3.62	10.30	9105.00	274.94	351.93	246.35	86.22	21.44
12	3.95	11.24	9105.00	356.95	456.90	319.83	111.94	25.72
13	4.28	12.18	9105.00	453.83	580.90	406.63	142.32	30.38
14	4.61	13.11	9105.00	566.82	725.53	507.87	177.76	35.43
15	4.94	14.05	9105.00	697.17	892.38	624.66	218.63	40.88
16	5.27	14.99	9105.00	846.10	1083.01	758.11	265.34	46.71
17	5.60	15.92	9105.00	1014.87	1299.03	909.32	318.26	52.93
18	5.93	16.86	9105.00	1204.71	1542.03	1079.42	377.80	59.53
19	6.26	17.80	9105.00	1416.85	1813.57	1269.50	444.33	66.53
20	6.59	18.73	9105.00	1652.55	2115.26	1480.68	518.24	73.91
21	6.92	19.67	9105.00	1913.03	2448.68	1714.08	599.93	81.69
22	7.24	20.61	9105.00	2199.54	2815.41	1970.79	689.78	89.85
23	7.57	21.54	9105.00	2513.32	3217.05	2251.93	788.18	98.40
24	7.90	22.48	9105.00	2855.60	3655.17	2558.62	895.52	107.34
25	8.23	23.42	9105.00	3227.63	4131.37	2891.96	1012.19	116.67
26	8.56	24.35	9105.00	3630.65	4647.23	3253.06	1138.57	126.39
27	8.89	25.29	9105.00	4065.89	5204.34	3643.04	1275.06	136.49
28	9.22	26.23	9105.00	4534.59	5804.28	4062.99	1422.05	146.99
29	9.55	27.16	9105.00	5038.00	6448.64	4514.05	1579.92	157.87
30	9.88	28.10	9105.00	5577.35	7139.01	4997.31	1749.06	169.14

Mahogany component

The carbon sequestration of the Mahogany trees is shown in Table 103. There are 1,217 mahogany trees in the agrofoforestry reforestation project. The carbon sequestration in year 10 is 16.94 tons with a carbon sequestration rate of 4.59 tons. As the mahogany trees grow up to year 30, carbon sequestration will also increase to 457 tons with a carbon capture rate of 44 tons/year.

Table 103. Mahogany's Carbon Sequestration of the Agroforestry Plantation, Hinobaan, Negros Occidental, 2015.

Age	Bole Height	Average Dia	Total Trees	Total Volume	Total Biomass Volume	Total Biomass Density	Carbon Seq	Annual Carbon Seq Rate/Yr
(Yr)	(m)	(cm)	No.	Cum	Cum	Ton	Ton	Ton
1	0.54	1.02	1217	0.05	0.07	0.05	0.02	
2	1.08	2.04	1217	0.43	0.55	0.39	0.14	0.12
3	1.63	3.06	1217	1.46	1.87	1.31	0.46	0.32
4	2.17	4.08	1217	3.46	4.42	3.10	1.08	0.63
5	2.71	5.10	1217	6.75	8.64	6.05	2.12	1.03
6	3.25	6.13	1217	11.66	14.93	10.45	3.66	1.54
7	3.79	7.15	1217	18.52	23.71	16.60	5.81	2.15
8	4.34	8.17	1217	27.65	35.39	24.77	8.67	2.86
9	4.88	9.19	1217	39.37	50.39	35.27	12.35	3.67
10	5.42	10.21	1217	54.00	69.12	48.39	16.94	4.59
11	5.96	11.23	1217	71.88	92.00	64.40	22.54	5.61
12	6.50	12.25	1217	93.32	119.45	83.61	29.26	6.72
13	7.05	13.27	1217	118.64	151.86	106.30	37.21	7.94
14	7.59	14.29	1217	148.18	189.67	132.77	46.47	9.26
15	8.13	15.31	1217	182.26	233.29	163.30	57.16	10.69
16	8.67	16.33	1217	221.19	283.13	198.19	69.37	12.21
17	9.22	17.36	1217	265.31	339.60	237.72	83.20	13.84
18	9.76	18.38	1217	314.94	403.13	282.19	98.77	15.56
19	10.30	19.40	1217	370.40	474.12	331.88	116.16	17.39
20	10.84	20.42	1217	432.02	552.99	387.09	135.48	19.32
21	11.38	21.44	1217	500.12	640.15	448.11	156.84	21.36
22	11.93	22.46	1217	575.02	736.03	515.22	180.33	23.49
23	12.47	23.48	1217	657.05	841.02	588.72	206.05	25.72
24	13.01	24.50	1217	746.53	955.56	668.89	234.11	28.06
25	13.55	25.52	1217	843.79	1080.05	756.04	264.61	30.50
26	14.09	26.54	1217	949.15	1214.91	850.44	297.65	33.04
27	14.64	27.56	1217	1062.93	1360.56	952.39	333.34	35.68

28	15.18	28.59	1217	1185.47	1517.40	1062.18	371.76	38.43
29	15.72	29.61	1217	1317.07	1685.85	1180.10	413.03	41.27
30	16.26	30.63	1217	1458.07	1866.33	1306.43	457.25	44.22

Ipil-ipil component

There are 1,559 Ipil-ipil trees in the agroforestry project. The trees are estimated to sequester carbon from year 1 to year 30. These are shown in the last 2 columns (Table 104). The total carbon sequestered for a given age of the Ipil-ipil trees is given in the second to the last column while the withi rate of increase of carbon is shown in the last column while carbon sequestration rate is indicated in the last column.

Table 104. Carbon Sequestration of the Agroforestry (Ipil-ipil) Non-NGP Site, Hinobaan, Negros Occidental, 2015.

Age	Bole Height	Average Dia	Total Tree	Total Vol	Total Biomass Volume	Total Biomass density	Carbon Seq.	Annual Carbon Seq. Rate
(Yr)	(m)	(cm)	No.	Cum	Cum	Ton	Ton	Ton per Year
1	0.73	1.40	1559	0.18	0.23	0.16	0.06	
2	1.46	2.81	1559	1.41	1.81	1.26	0.44	0.39
3	2.19	4.21	1559	4.76	6.09	4.26	1.49	1.05
4	2.93	5.61	1559	11.28	14.44	10.11	3.54	2.05
5	3.66	7.02	1559	22.04	28.21	19.74	6.91	3.37
6	4.39	8.42	1559	38.08	48.74	34.12	11.94	5.03
7	5.12	9.82	1559	60.47	77.40	54.18	18.96	7.02
8	5.85	11.22	1559	90.26	115.53	80.87	28.30	9.34
9	6.58	12.63	1559	128.51	164.49	115.15	40.30	12.00
10	7.31	14.03	1559	176.28	225.64	157.95	55.28	14.98
11	8.05	15.43	1559	234.64	300.33	210.23	73.58	18.30
12	8.78	16.84	1559	304.62	389.91	272.94	95.53	21.95
13	9.51	18.24	1559	387.30	495.74	347.02	121.46	25.93
14	10.24	19.64	1559	483.73	619.17	433.42	151.70	30.24
15	10.97	21.05	1559	594.96	761.55	533.09	186.58	34.88
16	11.70	22.45	1559	722.06	924.24	646.97	226.44	39.86
17	12.43	23.85	1559	866.09	1108.59	776.01	271.61	45.17
18	13.16	25.25	1559	1028.09	1315.96	921.17	322.41	50.81
19	13.90	26.66	1559	1209.14	1547.70	1083.39	379.19	56.78

20	14.63	28.06	1559	1410.28	1805.16	1263.61	442.26	63.08
21	15.36	29.46	1559	1632.57	2089.69	1462.79	511.98	69.71
22	16.09	30.87	1559	1877.08	2402.66	1681.86	588.65	76.68
23	16.82	32.27	1559	2144.86	2745.42	1921.79	672.63	83.97
24	17.55	33.67	1559	2436.96	3119.31	2183.52	764.23	91.60
25	18.28	35.08	1559	2754.45	3525.70	2467.99	863.80	99.56
26	19.02	36.48	1559	3098.38	3965.93	2776.15	971.65	107.86
27	19.75	37.88	1559	3469.81	4441.36	3108.95	1088.13	116.48
28	20.48	39.28	1559	3869.80	4953.35	3467.35	1213.57	125.44
29	21.21	40.69	1559	4299.41	5503.25	3852.27	1348.30	134.72
30	21.94	42.09	1559	4759.69	6092.40	4264.68	1492.64	144.34

The other components that were not measured are the grasses and the soils in the area.

7.4. Total carbon sequestration of the non-NGP agroforestry plantation

The total is given by the summation of the carbon sequestration by year of the 4 components (Table 105). In 10 years, the total carbon sequestration of the agroforestry plantation is 167.75 tons and in 20 years, 1299 tons of carbon. This is equivalent to 11.9 tons per ha. Comparing it with some agroforestry systems studied by Lasco and Pulhin (1999), this has a much lower carbon sequestration capacity than those estimated from 43.6 to 113 tons per ha in the Makiling forest.

Table 105. Total Carbon Sequestration of the Non-NGP Agroforestry Project, Hinibaan, Negros Occidental, 2015.

Age	Carbon Seq	Annual Carbon Seq Rate	Carbon Seq	Annual Carbon Seq Rate	Carbon	Annual Carbon Seq Rate	Carbon Seq	Annual Carbon Seq Rate	Carbon Seq	Annual Carbon Seq Rate	Carbon	Annual Carbon Seq Rate
	Gmelina		Fruit Trees		Pioneer Species		Mahogany		Ipil-Ipil		Total	
(Yr)	Tons	Tons/yr	Tons	Tons/yr	Tons	Tons/yr	Tons	Tons/yr	Tons	Tons/yr	Tons	Tons/yr
1	0.02	0	0.11		0.06		0.02		0.06		0.26	0.00
2	0.16	0.14	0.43	0.32	0.52	0.45	0.14	0.12	0.44	0.39	1.69	1.42
3	0.54	0.38	0.97	0.54	1.75	1.23	0.46	0.32	1.49	1.05	5.21	3.52
4	1.28	0.74	1.72	0.75	4.15	2.4	1.08	0.63	3.54	2.05	11.77	6.56
5	2.5	1.22	2.69	0.97	8.1	3.95	2.12	1.03	6.91	3.37	22.32	10.55
6	4.32	1.82	3.87	1.18	13.99	5.89	3.66	1.54	11.94	5.03	37.78	15.46
7	6.86	2.54	5.26	1.4	22.22	8.23	5.81	2.15	18.96	7.02	59.11	21.34
8	10.24	3.38	6.88	1.61	33.17	10.95	8.67	2.86	28.30	9.34	87.27	28.14
9	14.59	4.34	8.7	1.83	47.22	14.06	12.35	3.67	40.30	12.00	123.16	35.90

10	20.01	5.42	10.74	2.04	64.78	17.56	16.94	4.59	55.28	14.98	167.75	44.59
11	26.63	6.62	13	2.26	86.22	21.44	22.54	5.61	73.58	18.30	221.97	54.22
12	34.58	7.94	15.47	2.47	111.94	25.72	29.26	6.72	95.53	21.95	286.78	64.80
13	43.96	9.38	18.16	2.69	142.32	30.38	37.21	7.94	121.46	25.93	363.10	76.32
14	54.9	10.94	21.06	2.9	177.76	35.43	46.47	9.26	151.70	30.24	451.89	88.77
15	67.53	12.63	24.17	3.12	218.63	40.88	57.16	10.69	186.58	34.88	554.07	102.20
16	81.96	14.43	27.5	3.33	265.34	46.71	69.37	12.21	226.44	39.86	670.61	116.54
17	98.3	16.35	31.05	3.55	318.26	52.93	83.20	13.84	271.61	45.17	802.42	131.83
18	116.69	18.39	34.81	3.76	377.8	59.53	98.77	15.56	322.41	50.81	950.48	148.05
19	137.24	20.55	38.79	3.98	444.33	66.53	116.16	17.39	379.19	56.78	1115.70	165.23
20	160.07	22.83	42.98	4.19	518.24	73.91	135.48	19.32	442.26	63.08	1299.04	183.33
21	185.3	25.23	47.38	4.41	599.93	81.69	156.84	21.36	511.98	69.71	1501.42	202.40
22	213.06	27.75	52	4.62	689.78	89.85	180.33	23.49	588.65	76.68	1723.82	222.39
23	243.45	30.39	56.84	4.83	788.18	98.4	206.05	25.72	672.63	83.97	1967.15	243.32
24	276.6	33.15	61.89	5.05	895.52	107.34	234.11	28.06	764.23	91.60	2232.35	265.21
25	312.64	36.04	67.15	5.26	1012.19	116.67	264.61	30.50	863.80	99.56	2520.39	288.03
26	351.68	39.04	72.63	5.48	1138.57	126.39	297.65	33.04	971.65	107.86	2832.19	311.81
27	393.84	42.16	78.32	5.69	1275.06	136.49	333.34	35.68	1088.13	116.48	3168.69	336.50
28	439.24	45.4	84.23	5.91	1422.05	146.99	371.76	38.43	1213.57	125.44	3530.85	362.16
29	488	48.76	90.36	6.12	1579.92	157.87	413.03	41.27	1348.30	134.72	3919.61	388.75
30	540.24	52.24	96.7	6.34	1749.06	169.14	457.25	44.22	1492.64	144.34	4335.89	416.28

7.5. NGP Impacts to soil fertility, Organic Matter, Organic Carbon and Moisture Content.

The NGP impacts to nitrogen, phosphorus, potassium, organic matter and organic carbon and moisture contents are indicated in Table 106. Two readings on soil moisture contents in the control sites were marked with a question mark to indicate that there was a heavy rain during the nigh previous to the gathering of soil samples. This makes the data gathered irregular.

The two NGP sites together with the non-NGP sites have positive impacts to NPK, organic matter, organic carbon and soil moisture when compared with the control site. On the other hand, one NGP site and another non-NGP site have negative organic matter when compared with the control site. It is possible that these sites were also hit by heavy rains that carried the organic matter from the soil through soil erosion.

Table 106. NGP Impact to Soil Fertility, Organic Matter, Organic Carbon and Moisture Content.

Area	Slope Class	N	P (mg/kg)	K	Weight (g)	Organic Matter (%)	Organic Carbon (%)	Moisture Content (%)

NGP-100 has	F	0.0680%	39.74	0.14	500	1.36%	0.79%	14.21
	R	0.0720%	25.12	0.14	450	1.44%	0.84%	16.93
	S	0.0785%	0.52	0.39	420	1.57%	0.91%	15.00
	VS	0.0935%	1.5	0.11	300	1.87%	1.09%	16.51
Average		**0.0780%**	**16.72**	**0.195**	**417.5**	**1.56%**	**0.90%**	**15.66**
NGP-119	F	0.2005%	0.42	0.88	350	4.01%	2.33%	12.25
	R	0.0525%	0.17	0.34	400	1.05%	0.61%	15.6
	S	0.1195%	0.53	0.2	400	2.39%	1.39%	24.88
Average		**0.1242%**	**0.37**	**0.47**	**383.33**	**2.48%**	**1.44%**	**17.57**
NON-NGP SO. CAMALONGAY 100 Has	F-R	0.1395%	1.59	0.29	790	2.79%	1.62%	20.32
	S-VS	0.1915%	1.11	0.35	620	3.83%	1.88%	21.65
Average		**0.1655%**	**1.35**	**0.32**	**705**	**3.31%**	**1.75%**	**20.98**
NON-NGP WATERSHED 109 Has	F-R	0.0885%	5.44	0.21	680	1.77%	1.03%	8.24
	S-VS	0.0875%	1.04	0.14	650	1.75%	1.02%	8.52
Average		**0.0880%**	**3.24**	**0.175**	**665**	**1.76%**	**1.03%**	**8.38**
Grassland/Control	F	0.1015%	0.07	0.08	380	2.03%	1.18%	3.18
	R	0.1290%	0.05	0.08	410	2.58%	1.50%	16.74?
	S	0.1320%	0.21	0.09	380	2.64%	1.54%	30.44?
Average		**0.1208%**	**0.11**	**0.083**	**390**	**2.42%**	**1.41%**	**3.18**
Comparison of NGP and Non-NGP sites to Control Sites								
NGP-100 ha.		-0.0428%	16.6100	11.1667%		-0.8567%	-0.4992%	12.4825
NGP-119 ha		0.0033%	0.2633	39.0000%		0.0667%	0.0367%	14.3967
Non-NGP 100 ha		0.0447%	1.2400	23.6667%		0.8933%	0.3433%	17.8050
Non-NGP109 ha		-0.0328%	3.1300	9.1667%		-0.6567%	-0.3817%	5.2000

7.6. Litter fall contribution to NPK

The NGP species contribute to NPK enhancement on the ground. A one year old mangium being a nitrogen fixer has the highest nitrogen contribution at 1.179% while a two year old coffee has only 1.061% nitrogen yield to the ground. Other species planted in non-NGP sites like durian in 2009 has 1.176% while gmelina planted in 1992 and 1995 has 0.738% and 0.783% nitrogen, respectively. Mahogany planted in 1992 and 2014 has .709% and .911% of nitrogen, repectively. While the older plantations appeared to have low nitrogen yields, the total litter fall per tree is higher than the younger ones per seedling. The actual annual NPK yield of every species is determined by multiplying the percentage with the total annual weight of litter fall per tree (Table 107).

Table 107. NPK Contribution of NGP and Non-NGP Plantations in Hinobaan, Negros Occidental.

Leaf Litter Analysis for Hinoba-an						
Leaf Sample	**Year Planted**	**%N**	**%P**	**%K**	**% OC**	**Wieght of Samples (g)**
Mangium	2014	1.179±0.030	0.040±0.002	0.334±0.15	39.249±0.143	200
Kape	2013	1.061±0.006	0.093±0.003	0.328±0.017	29.183±0.147	280
Durian	2009	1.176±0.007	0.092±0.001	0.648±0.043	35.561±0.202	110
Gmelina	1995	0.738±0.010	0.101±0.002	0.263±0.041	34.076±0.191	300
Gmelina	1992	0.783±0.011	0.051±0.0001	0.579±0.021	35.290±0.068	300
Mahogany	1992	0.709±0.022	0.041±0.001	0.184±0.001	38.914±0.096	300
Mahogany	2014	0.911±0.006	0.079±0.001	0.147±0.002	33.889±0.202	280

7.7. DRR compliance of NGP Sites

1. 100-ha Mangium plantation

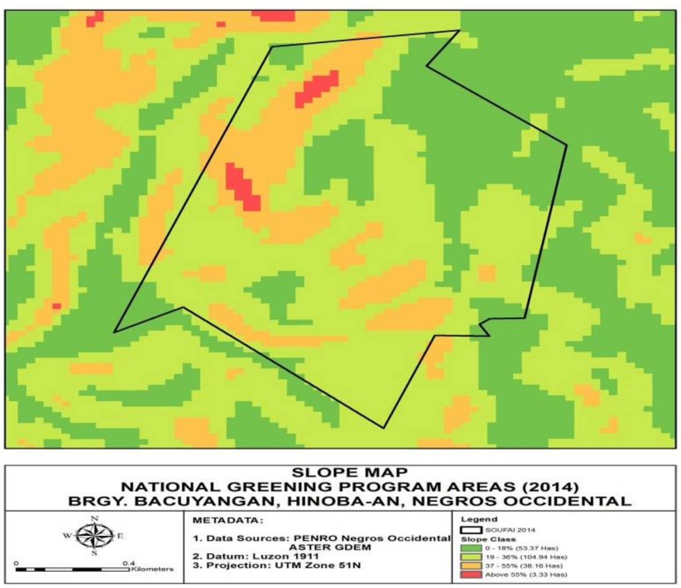
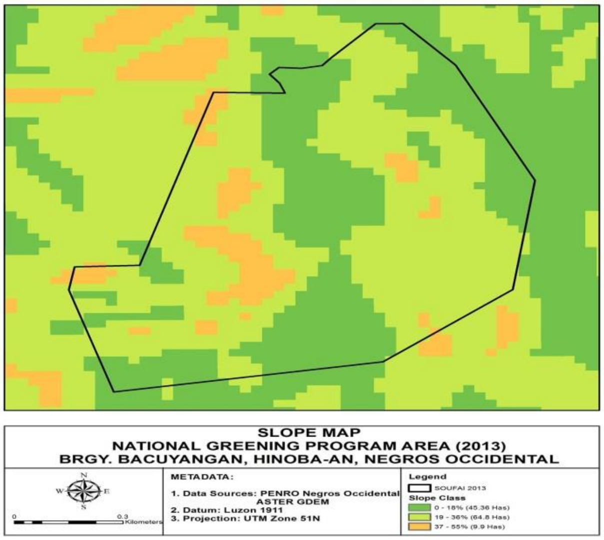


Figure 30. Slope Map of NGP Site, Hinobaan, Negros Occidental.

The DRR-sensitive areas in the NGP site are those colored orange and red. Their slopes are within the vulnerable areas to rain-induced landslides due to climate change. These areas should be designed, planned and implemented to address potential disaster risks due to climate change.

Slope Class	Area (Ha)	Vulnerability
0-18%	53	Not Vulnerable
19-36%	104.94	Low vulnerable
37-55%	38.16	Moderately vulnerable
>55%	3.3	Highly Vulnerable

2. 119-ha coffee plantation



Slope Class	Area (Ha)	Vulnerability
0-18%	45.36	Not Vulnerable
19-36%	64.5	Low vulnerable
37-55%	9.9	Moderately vulnerable
>55%	0	Highly Vulnerable

Figure 31. Slope Map of NGP Site, Hinobaan, Negros Occidental.

The slope map shows the relative locations of the different slope classes. Those located below 37% are not classified vulnerable to climate change and DRR. Areas above 37% are generally vulnerable. The DRR-sensitive area is colored orange. This is almost 10 hectares in the 37-55% slope. There are no areas above 55% slope.

In the case of the coffee plantation, there are 64.5 ha and 9.9 ha that are low vulnerable and moderately vulnerable, respectively. These areas need careful planning considering DRR and CCA/M. In these areas, other forest tree species may be interplanted with coffee to make the ground stable. The only problem during the feasibility study and design of the plantation is the identification of compatible tree species that are DRR and CCA/M compliant at the same time will allow the coffee to grow.

3. Recommended DRR measures for both NGP sites

The forest or agroforest plantation design may take a simple one where contour planting and wider spacing for timber production or fruit production will suffice to reduce soil erosion in the 0-18% slope. However, the effectiveness of planted trees in soil erosion control will take effect when the trees are already 5-10 years old or older. Coffee trees are small trees and not as effective in controlling soil erosion as bigger trees. Combining coffee species with bigger trees or hedgerows for erosion control is more effective than having a monoculture of coffee plants.

If the use of the forest or agroforest plantation is for multiple use, such as timber plus water or fruit plus water production in watershed, it is important to prevent or minimize soil erosion in its surroundings to reduce siltation of the water basin. In this case a provision for erosion control may be integrated into the plantation development plan. This may cover the 19-36% slope. The most common form of erosion control that may be used is the establishment of strips of hedgerows at given interval across the slope using suitable fruit-bearing annual or perennial crops intercropped with nitrogen-fixing species. The most common forest species for intercropping is Kakawate. It is mandatory that the hedgerow strips should follow the ground contours and the spacing of the hedgerow species should be as close as possible but not to sacrifice the normal growth rates of the species.

The procedures to be followed to integrate climate change and DRR concerns in the reforestation design are:

a. Conduct a topographic profiling of the area to be designed with DRR and CCA measures. Existing topographic map may be enhanced by taking in detailed features of the ground.
b. Draw a strip profile following the contour.
c. Analyze potential surface runoff movements from high elevation to low elevation, check on the lower elevation areas where surface runoff may find its way and settle down on water lag areas. When water lag areas can no longer carry its water load, it will collapse creating a landslide.
d. Areas within the strip must be planted with deep-rooted[173] or trained-root indigenous forest species. They should be planted close enough to reduce the speed of surface runoff and trap eroded soil. Select the species that is indigenous in the area.
e. To prevent landslides, reduce the volume of water in the water lag areas by making a canal big enough to drain the water.
f. In cases where vegetative method is not effective because of the long time lag between seedlings to matured trees, use structural method. Locally available materials like rocks and stone may be used in making ripraps or retaining walls, and check dams.
g. Combine the use of vegetative approach and structural approach when necessary.

4. *Recommended climate change adaptation and mitigation measures in reforestation projects*

For future reforestation projects, the following measures are recommended:

a. Plant indigenous forest species preferably medium wood density to hard wood density species. Forest species classified as premium ones have high carbon factor than softwood species. Most of the hardwood species such as Mangkono, Saplungan, Guijo, Yakal, Molave, Mabolo, Ipil, Tindalo and other dipterocarp species in general have carbon factor of 0.4 to 0.5. The only problem with these species is that they are slow grower. It may take longer time for them to reach their maximum carbon sequestration capacities.

b. In production forest, fast growing species with a rotation age of 8 years may sequester more carbon than indigenous forest species. This is explained by having several rotations

[173] Big trees are generally deep-rooted. Most dipterocarp species are deep-rooted ones.

within the growing period of indigenous forest species. Using a hypothetical example: Dipterocarp species, say in 50 years will only have 250 cum/ha wood volume equivalent to about 125 tons of carbon, while Gmelina at 10 years rotation yielding 90 cum/ha wood volume equivalent to about 45 tons of carbon. Multiply this by 4 times equals to 180 tons of carbon.

c. Plant species that are deciduous or shed-off their leaves annually. Dried leaves and other plant litter add up to soil carbon. Some of the deciduous species are Akle[174], Narra[175], Kalumpit[176] , Philippine Teak[177], Talisay[178], Ipil[179]. Molave[180]

d. Intensify protection of plantations to prevent forest fires or grass fires. Grass fires and forest fires cause carbon emission when they are burned.

5. Impact to wildlife

According to the KII respondents in the area, the species of fauna observed in the locations of the NGP sites are shown in Table 108. Through time these fauna species would bring in fruits and seeds of indigenous forest species from adjacent forests. Such seeds would regenerate the NGP sites in a matter of time.

Table 108. Fauna Species Observed by Residents in the NGP Site, Hinobaan, Negros Occidental, 2015.

No.	Class	Family Name	Scientific Name	Common Name	Filipino/Local Name
1	Amphibia	Ranidae	*Rana saguinea*	Southeast Asian Wood Frog	manwit
2	Amphibia	Rhacophoridae	*Polypedates macrotis*	Dark-Striped Tree Frog	paki
3	Aves	Podicipediformes	*Tachybaptus ruficollis*	Little Grebe	wild duck
4	Aves	Ardeidae	*Egretta garzetta*	Little Egret	tolabong

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174 Rafi.org.ph/greenin-**philippines**/green-almanac/akle/ https://www.google.com.ph/?gfe_rd=cr&ei=PfKwVemuMqbC8Afu65v4BQ#q=what+forest+species+shed-off+their+le

175 Ourhealingmoments.com/2011/03/24/**tree**-of-righteousness/ http://ourhealingmoments.com/2011/03/24/tree-of-righteousness/

176 www.bar.gov.ph › ... › October-December 2012 Issue (Vol. 14 No. 4)

177 http://www.pnh.com.ph/category/6-Plants-and-Orchids/28-Plant-Feature-Philippine-teak-page-1.html

178 http://writingonthepagesoflife.com/2014/11/04/falling/

179 www.worldagro**forestry**.org/**tree**db/AFTPDFS/Intsia_bijuga.PDF

180 http://www.marketmanila.com/archives/speculating-on-a-molave-tugas-tree

No.	Class	Family Name	Scientific Name	Common Name	Filipino/Local Name
5	Aves	Accipitridae	*Pithecophaga jefferyi*	Philippine Eagle	dapay
6	Aves	Phasianidae	*Coturnix chinensis*	Blue Breasted Quail	umbok
7	Aves	Rallidae	*Galliarallus torquatus*	Barred Rail	rail
8	Aves	Rallidae	*Amaurornis phoenicurus*	White Breasted Waterhen	kwak kwak
9	Aves	Pssittaculidae	*Tanygnathus lucionensis*	Blue-Naped Parrot	pikoy
10	Aves	Pssittaculdae	*Prioniturus montanus*	Montane Racquet-Tail	managing
11	Aves	Strigidae	*Strix seloputo*	Spotted Wood Owl	bukao
12	Aves	Dicruridae	*Dicrurus annectans*	Crow-Billed Drongo	uwak
13	Aves	Passeridae	*Passer montanus*	Eurasian Tree Sparrow	maya
14	Mamalia	Muridae	*Rattus tanezumi*	Asian House Rat	ilaga
15	Mamalia	Pteropodidae	*Cynopterus brachyotis*	Lesser Short-Nosed Fruit Bat	kulakwit
16	Mamalia	Suidae	*Sus scrofa*	Wild Boar	bakatin
17	Mamalia	Pteropodidae	*Pteropus hypomelanus*	Island Flying Fox	kabog
18	Reptilia	Gekkonidae	*Gecko gecko*	Tokay Gecko	tuko
19	Reptilia	Gekkonidae	*Hemidactylus frenatus*	Lizard	tiki
20	Reptilia	Colubinae	*Boiga dendrophila*	Mangrove Snake	manog
21	Reptilia	Colubridae	*Dendrelaphis pictus*	Painted Bronzeback	handulukay
22	Reptilia	Viperidae	*Tropidolaemus wagleri*	Pit Viper	dupong
23	Reptilia	Elapidae	*Ophiophagus hannah*	King Cobra	magkal
24	Reptilia	Varanidae	*Varanus salvator*	Monitor Lizard	halo
25	Reptilia	Scincidae	*Dasia grisea*	Brown Tree Skink	tabili

6. *Stakeholders' observations on NGP implementation*

a. No fire breaks or fire lines constructed to most areas since, according to planters, no fire incidences recorded in NGP sites yet. According to a law enforcer from CENRO, fire break to other areas are not as effectives as it should be since fires occur inside the buffer.

b. No soil analysis/survey was conducted to determine appropriate species

c. Problem with the release of budget and the transparency of budget distribution from contractor to planters, as they reported very late receipt of payment.

d. Farmers suggested that, not only increase the budget for operations but also to release it timely

e. Coffee and cacao fruit-tree species were planted first due to a commodity-based approach of NGP during the first phase of implementation. But a high mortality of coffee was reported. Because of this, the PO requested for change in commodity, for future planting.

f. Small-scale gold mining was seen near the site (though haven't verified if this is a conflicting issues on land use)
g. Hinoba-an has problem with water deficiency, during summer nights water distribution is switched off in the entire municipality. The water deficiency problem is the reason why the municipal government entered a co-partnership agreement with DENR declaring Alanaban as a watershed. The area was formerly tenured land under ISFP. The ISFP tenure holders are now called 'water tenders'. They are now employed by the municipality and work under the supervision of the forestry technicians of MENRO.
h. Very steep slopes pose a problem in watering and tending the planted seedlings. Planters do not practice watering and rely mainly on rainfall. Moreover, it inhibits to frequently patrol the site.
i. An operation of 2 chainsaw confiscation was co conducted. According to law enforcers, the illegal loggers claim the rights to harvest for they planted the trees but they lacked proper permit and documents to do so. The logged areas are under the custody of Philex mining.
j. Planters reported that some areas are low in soil fertility.
k. Seedlings are provided by the contractor.
l. There is a seedling production area in the NGP site

IX. Sites Evaluation

The bases of evaluating the NGP, non-NGP sites and control sites are presented in the following tables.

1. *Characteristics of NGP and non-NGP sites and control sites*

a. Sta. Cruz, Zambales

NGP Impacts	ZAMBALES			
	NGP			Control Site
Area	99	150	131	
Compliance to Guidelines				
SMP	No	No	No	NA
Survival Rate				
DENR Formula	88.00	87.00	90.00	NA
IST Formula	35.60	72.25	80.00	NA
Soil Accretion	0.27	0.16	0.35	
NPK (Soil)				
N	0.11	0.10	0.17	0.17
P	1.67	1.87	2.02	1.82
K	1.51	1.09	1.35	0.95
Soil Moisture	21.65	19.18	19.48	nd
Litterfall				

N	0.71	0.65	0.17	
P	0.02	0.02	1.82	
K	0.12	0.12	0.95	
Temperature	31.90	33.40	33.70	35.90
Carbon Sequestration	9.16	24.20	41.31	
Wildlife				
Class Amphibia	0.00			NA
Class Aves	15.00			NA
Class Mammalia	5.00			NA
Class Reptilia	11.00			NA
Stumpage build-up				
Dominant	2187.62	2165.74	2209.06	NA
Co-dominant	564.75	559.10	570.28	NA
Third layer	1374.20	1360.46	1387.67	NA

b. Basilisi, Dinagat

NGP Impacts	DINAGAT					
	NGP			Non-NGP		Control
Area	80	66	44	54	CMU	
Compliance to Guidelines						
SMP	85.75	88.17	85.55	54.12	66.50	NA
Survival Rate						
DENR Formula	85.75	88.17	85.55	54.12	66.50	NA
IST Formula	55.43	57.26	56.83	33.67	49.62	NA
Soil Accretion	0.07	-0.35	-0.11	-0.03		
NPK (Soil)						
N	0.24	0.17	0.13	0.237	0.205	0.22
P	3.01	3.85	4.50	4.488	3.5	5.65
K	0.10	0.07	0.05	0.096	0.039	0.09
Soil Moisture	4.910	4.4905	4.21	4.13	4.88	4.60
Litterfall						
N	0.84					
P	0.05					
K	0.09					
Temperature	31.55	33.12	33.02	31.21		
Carbon Sequestration	0.01	0.15	0.06			
Wildlife						

Class Amphibia	3.00			3.00		NA
Class Aves	54.00			54.00		NA
Class Mammalia	8.00			8.00		NA
Class Reptilia	5.00			5.00		NA
Stumpage build-up						
Dominant						NA
Co-dominant						NA
Third layer						NA

c. Hinobaan, Negros Occidental

NGP Impacts	HINOBAAN				
	NGP		Non-NGP		Control site
Area	119	85	100	109	
Compliance to Guidelines					
SMP	86.46	85.28	68.00	64.00	0.00
Survival Rate					
DENR Formula	86.46	85.28	68.00	64.00	0.00
IST Formula	66.12	82.80	0.00	0.00	0.00
Soil Accretion	-0.11	-0.65	0.15	-0.22	-6.00
NPK (Soil/Litter)					
N	0.00	0.00	0.00	0.00	0.00
P	0.37	16.72	1.35	3.24	0.11
K	0.47	0.20	0.32	0.18	0.08
Soil Moisture	15.66	17.58	20.99	8.38	3.18
Litterfall					
N	0.94				
P	0.07				
K	0.35				
Temperature	33.00	34.10	34.10	32.31	36.27
Carbon Sequestration	0.01	36.17	228.74	160.07	0.00
Wildlife					
Class Amphibia	2.00		2.00		NA
Class Aves	11.00		11.00		NA
Class Mammalia	4.00		4.00		NA
Class Reptilia	8.00		8.00		NA
Stumpage build-up					
Dominant			72940.00	2352.73	NA

Co-dominant					NA
Third layer					NA

2. *Experts' ratings on the NGP, non-NGP sites and control sites*

The NGP sites, non-NGP sites and control sites were rated using their characteristics by experts in reforestation. High positive characteristics by indicator are rated 5 while low positive characteristics are rate 1.

NGP Impacts	DINAGAT					HINOBAAN					ZAMBALES			
	NGP			Non-NGP	Control	NGP		Non-NGP		Control site	NGP			Control Site
Area	80	66	44			119	85	100	109		99	150	131	
Survival Rate														
DENR Formula	3	3	3	3	NA	5	5	3	3	NA	5	5	5	NA
IST Formula	5	5	5	5	NA	5	5	0	0	NA	5	5	5	NA
Soil Accretion	3	3	3	2	1	3	2	5	5	1	5	2	3	1
NPK (Soil/Litter)														
N	3	3	3	3	1	3	3	3	3	1	3	3	3	1
P	2	2	1	2	1	2	2	2	2	1	2	2	2	1
K	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Soil Moisture	5	5	5	3	1	5	3	5	5	1	5	4	5	1
Temperature	2	2	2	1	0	2	2	4	4	0	5	3	3	0
Carbon Sequestration	1	2	1	1	1	3	2	5	5	1	2	1	2	1
Wildlife	3	2	1	1	0	3	3	5	5	0	3	2	1	0
Total	28	28	25	22	6	32	28	33	33	6	36	28	30	6
Average	2.8	2.8	2.5	2.2	0.75	3.2	2.8	3.3	3.3	0.75	3.6	2.8	3	0.75

3. *Statistical evaluation among NGP site, Non-NGP site and Control site within the province.*

This evaluation did not materialize because of insufficeiency in the number of sites to compare with in the province. The number of data to lend itself to statistical analysis was not sufficient for an ANOVA analysis.

4. *Statistical evaluation among NGP site, Non-NGP site and Control site in the 3 provinces/municipalities.*

1. NGP vs. Non-NGP vs. Control

The indicators to be used in the statistical evaluation are survival rates (both DENR and IST formulas), soil accretion/erosion, temperature, NPK, soil moisture, carbon sequestration and wildlife.

In every indicator, the null hypothesis is, are the NGP sites, non-NGP sites, and control sites in the 3 municipalities the similar considering the same indicator. The alternate hypothesis is, are the NGP sites, non-NGP sites and control sites different from each other considering the same indicator.

1.1. DENR survival rates

The ANOVA is shown below, the p value= 0.0014, less than 0.05, therefore, reject the null hypothesis and accept the alternate hypothesis. This means that all the plantation sites are not statistically similar in terms of survival rates determined through the DENR formula. Therefore, the NGP sites and non-NGP sites in the 3 municipalities are statistically significant that they are different from each other.

Analysis of Variance

Source	SS	df	MS	F	Prob > F
Between groups	32.6785714	2	16.3392857	12.61	0.0014
Within groups	14.25	11	1.29545455		
Total	46.9285714	13	3.60989011		

Bartlett's test for equal variances: chi2(1) = 0.5562 Prob>chi2 = 0.456

1.2. IST survival rates

The ANOVA is shown below, the p value= 0.0003, less than 0.05, therefore, reject the null hypothesis and accept the alternate hypothesis. This means that all the plantation sites are not statistically similar in terms of survival rates determined through the IST formula. Therefore, the NGP sites and non-NGP sites in the 3 municipalities are statistically significant that they are different from each other.

Analysis of Variance

Source	SS	df	MS	F	Prob > F
Between groups	61.6071429	2	30.8035714	18.07	0.0003
Within groups	18.75	11	1.70454545		
Total	80.3571429	13	6.18131868		

1.3. Soil accretion

The ANOVA shows that the p value= 0.1537, greater than 0.05, therefore, the null hypothesis is accepted, thus rejecting the alternate hypothesis. This means that all the plantation sites are statistically similar in terms of soil accretion.

Analysis of Variance

Source	SS	df	MS	F	Prob > F
Between groups	7.60714286	2	3.80357143	2.23	0.1537
Within groups	18.75	11	1.70454545		
Total	26.3571429	13	2.02747253		

Bartlett's test for equal variances: chi2(1) = 2.6874 Prob>chi2 = 0.101

1.4. Nitrogen in the Soil/Litter

The null hypothesis is rejected because the p value of 0.0018 is less than 0.05. Thus, the NGP sites, non-NGP sites and control sites have significant difference in terms of nitrogen from litter fall/soil.

Analysis of Variance

Source	SS	df	MS	F	Prob > F
Between groups	6.42857143	2	3.21428571	11.79	0.0018
Within groups	3	11	.272727273		
Total	9.42857143	13	.725274725		

1.5. Phosphorus in the Soil/ Litter

There is a significant difference among the NGP, non-NGP and control sites. The p-value of 0.0449 is less than 0.05. This means that all the NGP, non-NGP sites and control sites are not similar in terms of Phosphorus in the soil/litter.

Analysis of Variance

Source	SS	df	MS	F	Prob > F
Between groups	1.23214286	2	.616071429	4.17	0.0449
Within groups	1.625	11	.147727273		
Total	2.85714286	13	.21978022		

Bartlett's test for equal variances: chi2(1) = 0.4836 Prob>chi2 = 0.487

1.6. Potassium

The data variation for potassium is not significant thus doing ANOVA does not make sense. This means that all the NGP sites and non-NGP sites have more or less the same evaluation data.

1.7. Soil moisture

There is significant difference among the NGP, non-NGP sites and control sites in terms of soil moisture. The p-value is 0.0073 less than 0.05 (please refer to the ANOVA table).

Analysis of Variance

Source	SS	df	MS	F	Prob > F
Between groups	21.4821429	2	10.7410714	7.94	0.0073
Within groups	14.875	11	1.35227273		
Total	36.3571429	13	2.7967033		

Bartlett's test for equal variances: chi2(1) = 3.7433 Prob>chi2 = 0.053

1.8. Temperature

In terms of temperature, the NGP and non-NGP sites have no significant difference at p value of 0.0938 greater than 0.05. This is probably due to the fact that both sites have the same vegetative cover types which have the same reducing effect to temperature.

Analysis of Variance

Source	SS	df	MS	F	Prob > F
Between groups	11.0892857	2	5.54464286	2.96	0.0938
Within groups	20.625	11	1.875		
Total	31.7142857	13	2.43956044		

Bartlett's test for equal variances: chi2(1) = 1.8429 Prob>chi2 = 0.175

1.9. Carbon sequestration

Considering the carbon sequestration capacity of the NGP sites and non-NGP sites, there is no significant difference. Thus, they are all similar. The p value is 0.2055, greater than 0.05 making the null hyphotesis accepted.

Analysis of Variance

Source	SS	df	MS	F	Prob > F
Between groups	6.5	2	3.25	1.83	0.2055
Within groups	19.5	11	1.77272727		
Total	26	13	2		

Bartlett's test for equal variances: chi2(1) = 5.7832 Prob>chi2 = 0.016

1.10 Wildlife

Similarly, when the number of wildlife families is considered, the p value is 0.15 greater than the 0.05. This means that the NGP and non-NGP sites have more or less similar impact to wildlife species in number. Thus, the null hypothesis is selected (see ANOVA table) in the following section.

```
                         Analysis of Variance
    Source              SS         df       MS            F     Prob > F
------------------------------------------------------------------------
Between groups     10.6785714      2    5.33928571      2.24     0.1530
 Within groups          26.25     11    2.38636364
------------------------------------------------------------------------
    Total          36.9285714     13    2.84065934

Bartlett's test for equal variances:  chi2(1) =   4.9202  Prob>chi2 = 0.027
```

5. Spearman's correlations of indicators

The results of the Spearman's correlations of indicators are presented in the following boxes.

DENR Survival Rates vs. Environmental Indicators		**p-value**	**correlation coefficient**
DENR Formula vs.	IST Formula	.003	.733**
DENR Formula vs.	Soil Accretion	.101	.457
DENR Formula vs.	N	.001	.764**
DENR Formula vs.	P	.003	.736**
DENR Formula vs.	Soil Moisture	.057	.520
DENR Formula vs.	Temperature	.009	.667**
DENR Formula vs.	Carbon Sequestration	.118	.438
DENR Formula vs.	Wildlife	.051	.530

α=0.05			

Conclusions:

There is positive strong linear relationship between DENR formula and IST formula.

There is positive strong linear relationship between DENR formula and N.

There is positive strong linear relationship between DENR formula and P.

There is positive strong linear relationship between DENR formula and Temperature.

IST Survival Rates vs. Environmental Indicators		**p-value**	**correlation coefficient**
IST Formula vs	DENR Formula	.003	.733**
IST Formula vs	Soil Accretion	.469	.211
IST Formula vs	N	.005	.701**
IST Formula vs	P	.057	.519
IST Formula vs	Soil Moisture	.122	.433
IST Formula vs	Temperature	.394	.248
IST Formula vs	Carbon Sequestration	.838	-.060
IST Formula vs	Wildlife	.561	.170

Conclusions:

There is a positive strong linear relationship between IST Formula and DENR Formula

There is a positive strong linear relationship between IST Formula and N

Soil Accretion vs. Environmental Indicators	**p-value**	**correlation coefficient**

Soil Accretion vs	DENR Formula	.101	.457
Soil Accretion vs	IST Formula	.469	.211
Soil Accretion vs	N	.003	.739**
Soil Accretion vs	P	.020	.610*
Soil Accretion vs	Soil Moisture	.000	.923**
Soil Accretion vs	Temperature	.000	.871**
Soil Accretion vs	Carbon Sequestration	.003	.738**
Soil Accretion vs	Wildlife	.000	.809**

Conclusions:

There is a positive strong linear relationship between Soil Accretion and P.

There is a positive very strong linear relationship between Soil Accretion and Soil Moisture

There is a positive very strong linear relationship between Soil Accretion and Temperature

There is a positive strong linear relationship between Soil Accretion and Carbon Sequestration.

There is a positive very strong linear relationship between Soil Accretion and Wild life.

Nitrogen vs Environmental Indicators		**p-value**	**correlation coefficient**
N vs	DENR Formula	.001	.764**
N vs	IST Formula	.005	.701**
N vs	Soil Accretion	.003	.739**
N vs	P	.000	.826**
N	Soil Moisture	.001	.794**

vs			
N vs	Temperature	.003	.734**
N vs	Carbon Sequestration	.075	.491
N vs	Wildlife	.003	.729**

Conclusions:

There is a positive strong linear relationship between N and DENR Formula.

There is a positive strong linear relationship between N and IST Formula.

There is a positive strong linear relationship between N and soil accretion

There is a positive very strong linear relationship between N and P

There is a positive strong linear relationship between N and Soil moisture

There is a positive strong linear relationship between N and Temperature

There is a positive strong linear relationship between N and wildlife

Phosphorus vs. Environmental Indicators		**p-value**	**correlation coefficient**
P vs	DENR Formula	.003	.736**
P vs	IST Formula	.057	.519
P vs	Soil Accretion	.020	.610*
P vs	N	.000	.826**
P vs	Soil Moisture	.026	.590*
P vs	Temperature	.007	.687**

P vs	Carbon Sequestration	.025	.595*
P vs	Wildlife	.002	.762**

Conclusions:

There is a positive strong linear relationship between P and DENR Formula.

There is a positive strong linear relationship between P and Soil accretion

There is a positive very strong linear relationship between P and N

There is a positive moderate linear relationship between P and Soil Moisture

There is a positive strong linear relationship between P and Temperature

There is a positive moderate linear relationship between P and Carbon Sequestration

There is a positive strong linear relationship between P and wildlife.

Soil Moisture vs. Environmental Indicators		p-value	correlation coefficient
Soil Moisture vs	DENR Formula	.057	.520
Soil Moisture vs	IST Formula	.122	.433
Soil Moisture vs	Soil Accretion	.000	.923**
Soil Moisture vs	N	.001	.794**
Soil Moisture vs	P	.026	.590*
Soil Moisture vs	Temperature	.002	.761**
Soil Moisture vs	Carbon Sequestration	.022	.605*
Soil Moisture vs	Wildlife	.007	.688**

Conclusions:

There is a positive very strong linear relationship between soil moisture and soil accretion

There is a positive strong linear relationship between soil moisture and N

There is a positive moderate linear relationship between soil moisture and P

There is a positive strong linear relationship between soil moisture and Temperature

There is a positive strong linear relationship between soil moisture and Carbon Sequestration

There is a positive strong linear relationship between soil moisture and wildlife

Temperature vs. Environmental Indicators		**p-value**	**correlation coefficient**
Temperature vs	DENR Formula	.009	.667**
Temperature vs	IST Formula	.394	.248
Temperature vs	Soil Accretion	.000	.871**
Temperature vs	N	.003	.734**
Temperature vs	P	.007	.687**
Temperature vs	Soil moisture	.002	.761**
Temperature vs	Carbon Sequestration	.008	.675**
Temperature vs	Wildlife	.001	.779**

Conclusions:

There is a positive strong linear relationship between temperature and denr formula

There is a positive very strong linear relationship between temperature and soil accretion

There is a positive strong linear relationship between temperature and N.

There is a positive strong linear relationship between temperature and P

There is a positive strong linear relationship between temperature and Soil moisture

There is a positive strong linear relationship between temperature and carbon sequestration

There is a positive strong linear relationship between temperature and wildlife.

Carbon sequestration vs. environmental indicators		p-value	correlation coefficient
Carbon Sequestration vs	DENR Formula	.118	.438
Carbon Sequestration vs	IST Formula	.838	-.060
Carbon Sequestration vs	Soil Accretion	.003	.738**
Carbon Sequestration vs	N	.075	.491
Carbon Sequestration vs	P	.025	.595*
Carbon Sequestration vs	Soil moisture	.022	.605*
Carbon Sequestration vs	temperature	.008	.675**
Carbon Sequestration vs	Wildlife	.001	.766**

Conclusions:

There is a positive strong linear relationship between carbon sequestration and soil accretion

There is a positive moderate linear relationship between carbon sequestration and P.

There is a positive strong linear relationship between carbon sequestration and soil moisture.

There is a positive strong linear relationship between carbon sequestration and temperature

There is a positive strong linear relationship between carbon sequestration and wildlife

Wildlife vs. Environmental Indicators		p-value	correlation coefficient
wildlife vs	DENR Formula	.051	.530
wildlife vs	IST Formula	.561	.170
wildlife vs	Soil Accretion	.000	.809**
wildlife vs	N	.003	.729**

wildlife vs	P	.002	.762**
wildlife vs	Soil moisture	.007	.688**
wildlife vs	temperature	.001	.779**
wildlife vs	carbon sequestration	.001	.766**

Conclusions:

There is a positive very strong linear relationship between wildlife and soil accretion

There is a positive strong linear relationship between wildlife and N

There is a positive strong linear relationship between wildlife and P

There is a positive strong linear relationship between wildlife and soil moisture

There is a positive strong linear relationship between wildlife and temperature

There is a positive strong linear relationship between wildlife and carbon sequestration

X. Conclusion and Recommendations

1. Sustaining the NGP Plantations

The NGP planted sites (with ages ranging from 1 to 3 years) that have been assessed and evaluated were found to have positive impacts on temperature reduction, soil accretion, soil fertility, soil moisture, carbon sequestration, and wildlife although such impacts are still negligible. It is envisioned that the positive environmental impacts will spread further as NGP forests grow under future conditions where forest plantations are well-maintained. Long-term and sustainable partnership among the DENR and the POs, particularly on effective protection and maintenance activities of young plantations, is imperative in producing mature forests. In line with this, it is equally important for the national government to continuously provide forest protection funds to the DENR and the POs especially in areas that are able to maintain the minimum survival rate or those with higher than minimum survival rates.

2. ***Indigenous forest species as replanting materials***

   In areas where replanting is necessary and an adequate shade is already present, the use of indigenous forest species for replanting must be considered instead of using the same species which do not have higher chance of surviving.

3. ***Proper execution of reforestation activities***

   The high mortality of planted seedlings in the NGP sites during the first and succeeding years proved that important guidelines, best practices, and standards were not properly undertaken in the field. Activities crucial to any reforestation projects are survey, mapping, and planning, feasibility study, capability building, plantation quality assurance, seedling production, site preparation, planting, and protection and maintenance. Proper execution of these activities will result in the right quality of outputs and will produce best quality forest plantations. It is therefore imperative that such activities be correctly implemented.

4. ***Changing the survival rate formula to the IST formula***

   The success of NGP plantation from the DENR's point of view is measured in terms of survival rate which is patched with series of replanting during the entire reforestation management period. The definition of survival rate is limited to the actual number of living seedlings as a percentage of the total density of seedlings planted and paid, regardless of the total number of seedlings replanted in the same area. The impact study team found that the DENR formula does not give the true survival rate because it is clouded by the replanting of seedlings. Due to this, an alternative formula is recommended by the team – the Impact Study Team (IST) Formula. This alternative formula provides a measure of efficiency in the management of reforestation projects by providing a true survival rate that is based on the total living seedlings as a percentage of the total number of seedlings planted and replanted in the area. The impact study team highly recommends the implementation of the formula in the NGP sites and all similar reforestation projects that will be implemented in the future.

5. ***Construction of a reforestation access road in all reforestation areas.***

   The NGP sites are usually located two to four travel hours from the CENRO and/or the communities, rendering the location hardly conducive especially during emergency cases such as forest fires. Reforestation access roads must be built in into the design of any reforestation project. These access road should be a single lane width provided with turnouts in every 250 meters exclusive for small vehicles such as compact pickup trucks, "kuliglig," tricycles, and motorcycles. To minimize expenses, it is recommended that only wheel tracks of the access road be cemented.

6. ***Establishment of a CENRO-sub-office***

Furthermore, a CENRO sub-office manned with reforestation and protection staff and PO members should be established at the center of reforestation areas in every barangay or clusters of barangays depending on the reforestation areas. The purpose is to have a DENR field office that is situated right on site and can make decisions and execute immediate actions in times of emergencies such as putting off forest or grass fires and assisting the barangays in community development.

7. ***Forest restorability assessment***

There was no time for a full blown SMP and FS in all the NGP sites sacrificing this because there was a need to meet the target of reforestation for the year. SMP and FS are important because these are the blueprints of the project. Without these two, reforestation will become a shut-gun approach which is not good. To prevent this to happen in future reforestation projects, the CENRO together with the BLGU should make a continuing assessment of the restorability of the potential sites into forest. The CENRO and the BLGU may share the cost of assessment. There are only 2 primary indicators of restorability that they will have to assess. These are existing vegetation and soil depth. If the vegetation and soil depth are favorable for forest restoration, then an SMP and FS will be conducted probably 3-5 months ahead of the scheduled implementation of a reforestation project.

8. ***Climate change and DRR vulnerability assessment***

DRR and CCA/M objectives of any reforestation project should outline clear instructions for design, SMP, and field implementation. The design during SMP should incorporate climate and disaster vulnerability assessment of the reforestation sites. Those areas that are highly vulnerable should be treated separately with those that are not vulnerable in terms of species and spacing. For vulnerable areas, the recommended species are deep-rooted trees or root-trained trees. Spacing should be close enough to have an intertwining root system when the trees grow older or a combination of vegetative approach and structural method. As a general rule, the design, species, and spacing should be capable of holding the soil from landslides.

9. ***Enhancement of reforestation design***

DENR has a research bureau and regional research centers which can assist the CENRO's in further enhancing the SMP and in enhancing reforestation projects. The research office can assist the CENRO's on the following:

a. Species-site matching (nitrogen-fixing pioneer, intermediate and climax species suitable to any site)
b. Conduct of forest restorability assessment.
c. Preparation of SMP and FS reports together with the CENRO and BLGU staffs.

d. Studies on the causes of seedling mortalities
e. Trial planting of indigenous species from the highest elevation to the lowest elevation of denuded areas. Growth performance evaluation should be assessed regularly by the same office.
f. Design of forest restoration in disaster risk areas and climate change adaptation and mitigation.

10. Monitoring impacts of reforestation projects

In the monitoring of the forest plantations, the CENROs and the Ecosystems Research and Development Bureau (ERDB) should establish a regular monitoring system for the forest plantations to include not only survival rates but also the environmental impact parameters presented in this report. In this regard, permanent plots should be established.

11. Review of literature of forest species

For the selection of forest species, a review of literature of the species to determine where they can grow and what the growth performance is would help the CENRO on species-site selection.

12. Methodology of environmental impact study

In case the DENR would be interested in an environmental impact assessment study in other NGP areas, the methodology used in this study may be used with modification on the sampling of the seedlings. A 30% sampling of the planted seedlings may be used instead of 100% inventory. The reason is that it is expensive to do a 100% inventory.

13. Statistical differences of the NGP sites, non-NGP sites and control sites

According to statistical evaluation using F-test or ANOVA, the sites are significantly different from each other considering survival rates (both DENR and IST formulas), Nitrogen, Phosphorus, and soil moisture. The sites have no significant difference in terms of temperature and carbon sequestration. Data on potassium are inadequate for an F-test or ANOVA. Since the statistical evaluation is a preliminary one, it will be recalculated when all the NGP sites, non-NGP sites and control sites in phase 2 will be completed.

14. Reiteration of specific recommendations

There are specific recommendations on the following topics. These are all discussed in every NGP municipality and reiterated in this section.

m. Improvement of the SMP guidelines
n. Improvement of survival rates
o. Assessment of the causes of mortality
p. Integration of DRR and CCA/M design in the NGP plantations and even in future reforestation program.

15. Recommendations for the second phase

Based on the experiences in the first phase, the following are the recommendations that should be considered in phase 2 of the environmental impact study component:

a. Make use of purposive sampling in determining the remaining 3 provinces to be covered in the study. Target those provinces with the oldest NGP sites (2011) and Non-NGP sites (6 years and above) in different ecosystems such as watershed, production forest, protection forest, mangrove, and agroforest areas.

b. To cover more NGP sites in each selected municipality in the remaining 3 provinces, reduce the sampling intensity from 100% to 30% in every NGP site. The reason is that there is uniformity in plantations. The survival rates assessed through 100% are similar to the survival rates assessed through a 30% sampling. The area affected in the reduction of the sampling intensity will enable the study to cover 2 additional different NGP sites in the same municipality.

c. In the same manner, reduce the sampling intensity of the Non-NGP sites from 100% sampling to 30% sampling intensity. The area covered in the reduction of sampling intensity will make 2 additional NGP sites. Thus, a total of 5 NGP sites and 1 Non-NGP site are to be sampled in the selected municipality.

d. In the original budget, the cost of soil and litter fall laboratory analysis was not included. This activity was subsidized by the study’s budget. It also resulted in the reduction of species for litter fall analysis due to the high cost of NPK analysis per sample. Some of the NGP sites have 10-15 indigenous forest species, which need to be assessed on their NPK impacts to the soil. This study component is requesting an additional budget for laboratory analysis for soils and litter fall by species.

e. Determination of the optimal area allocation for the different commodities in the NGP sites nationwide. This will make use of optimization mathematical models like linear programming or goal programming to determine the best mixture of forest and agroforest species and their area requirements that should be planted given the terrain condition, rainfall, temperature, available plantable area, forest restoration techniques, budget, and available labor. The model can have several variants by varying the objective functions subject to the same constraints. It will be processed using the following objectives: a) maximize revenue; b) minimize cost; c) minimize DRR/CC impacts; and d) maximize carbon sequestration. Additional funding for this study is needed.

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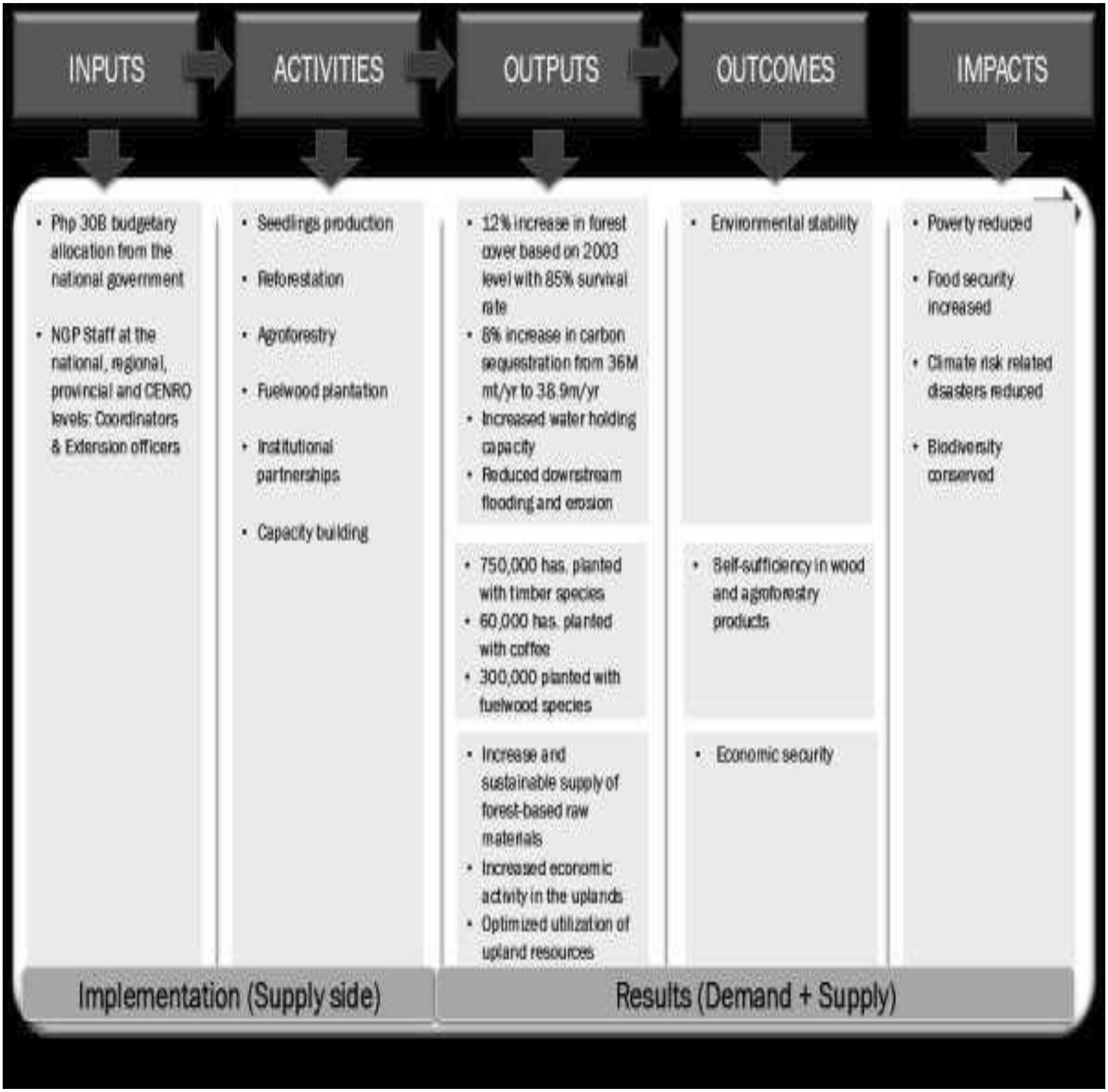

Appendix Figure 1. Theory of Change for the National Greening Programming (N. Lasmarias, 2015)

Appendix Table 1. Process Assessment and Evaluation for Survey, Mapping and Planning.

BASIS	PROCESS/ CRITERIA/ INDICATOR	FINDING		POSITIVE RATING		NEGATIVE RATING	
		Non-NGP Site	NGP Site	Non-NGP Site	NGP Site	Non-NGP Site	NGP Site
DENR Guidelines	Survey, mapping and planning						
	A. Survey						
	1. Boundary						
	2. Soil survey (pH, fertility and soil profile depth)						
	3. Vegetation survey						
	4. Species-site matching						
	5. Topographic updating survey or based on secondary information						
DRR Framework	6. DR areas						
	7. Climate risk areas such as						
	A. Rain-induced landslides						
	B. Flooding						
	C. Drought						
CCA/M Framework	8. Plantable sites						
	9. Non-plantable sites						
	B. Mapping						
	1. All the above survey outputs leading to the suitability map of different forest species that may grow in the area.						
	C. Planning						
	1. Feasibility design (evaluating alternative species that will mostly likely result in high survival rates with the highest benefit.						
	2. Forest restoration plan (answering what, when, where, how and how much)						

Best Practices Benchmark	1. Making climate change indicators such as rainfall, temperature, el nino and la nina projections as inputs to designing and planning the forest restoration plan.						
	2. Fitting forest restoration targets with household capacity to plant, protect and maintain established forest and on an optimal rainfall window conducive for establishing forests.						
	3. Transforming the Forest Restoration Plan into Task Plan that are easily understood by people in the barangays that will be engaged in the implementation of the plan.						
Note: 1. Finding by indicator contains qualitative and quantitative descriptions of the NGP and Non-NGP sites or contains binary entries. An entry of 1 means the activity indicator was conducted. Zero entry means the activity was not conducted. 2. Positive rating by indicator contains the numerical difference of the weight or rate between the NGP site and Non-NGP site. Positive is given when the NGP site's rating is higher than the Non-NGP site. It is also given when the NGP site rating is higher than the BPB (Best Practices Benchmark). 3. Negative rating by indicator contains the numerical difference of the weight or rate between the NGP site and the Non-NGP site. Negative rating is given when the NGP site rating is lower than the Non-NGP site. It is also given when the NGP site rating is below the BPB.							

Appendix Table 2. Process Assessment and Evaluation for Capacity Building of NGP Workers.

BASIS	CRITERIA/ INDICATOR	FINDING		POSITIVE RATING		NEGATIVE RATING	
		Non-NGP Site	NGP Site	Non-NGP Site	NGP Site	Non-NGP Site	NGP Site
	A. Training of the workers on important technical aspects of the NGP						
	1. Seedling production						
	2. Site preparation						
	3. Planting						
	4. Protection and maintenance						
	5. Replanting						
	B. Orientation on monitoring and evaluation of the condition of the established						
	C. Orientation on billing procedure						
	D. Orientation on prescribed bookkeeping and accounting procedure						
	E. Hands-on demonstration training how to plant						

Note:
1. Finding by indicator contains qualitative and quantitative descriptions of the NGP and Non-NGP sites or contains binary entries. An entry of 1 means the activity indicator was conducted. Zero entry means the activity was not conducted.
2. Positive rating by indicator contains the numerical difference of the weight or rate between the NGP site and Non-NGP site. Positive is given when the NGP site's rating is higher than the Non-NGP site. It is also given when the NGP site rating is higher than the BPB (Best Practices Benchmark).
3. Negative rating by indicator contains the numerical difference of the weight or rate between the NGP site and the Non-NGP site. Negative rating is given when the NGP site rating is lower than the Non-NGP site. It is also given when the NGP site rating is below the BPB.

Appendix Table 3. Process Assessment and Evaluation for NGP Plantation Quality Assurance.

BASIS	CRITERIA/ INDICATOR	FINDING		POSITIVE RATING		NEGATIVE RATING	
		Non-NGP Site	NGP Site	Non-NGP Site	NGP Site	Non-NGP Site	NGP Site
Best Practices Benchmark							
	a. Activity implementation inspection						
	b. Activity output inspection						
	c. Proper sequential implementation of forest restoration activities						
	d. Payment deduction due to poor quality of seedlings						
	e. Payment deduction due to low survival rate						

Note:
1. Finding by indicator contains qualitative and quantitative descriptions of the NGP and Non-NGP sites or contains binary entries. An entry of 1 means the activity indicator was conducted. Zero entry means the activity was not conducted.
2. Positive rating by indicator contains the numerical difference of the weight or rate between the NGP site and Non-NGP site. Positive is given when the NGP site's rating is higher than the Non-NGP site. It is also given when the NGP site rating is higher than the BPB (Best Practices Benchmark).
3. Negative rating by indicator contains the numerical difference of the weight or rate between the NGP site and the Non-NGP site. Negative rating is given when the NGP site rating is lower than the Non-NGP site. It is also given when the NGP site rating is below the BPB.

Appendix Table 4. Process Assessment and Evaluation for Seedling Production.

BASIS	CRITERIA/ INDICATOR	FINDING		POSITIVE RATING		NEGATIVE RATING	
		Non-NGP Site	NGP Site	Non-NGP Site	NGP Site	Non-NGP Site	NGP Site
	1. Sources of planting materials						
	a. Mother tree where seeds were taken						
	b. Mother tree where wildlings are taken						
	c. Mother tree where cloned are taken						
	d. Mother tree where planting materials where taken for procured seedlings						
	2. Growing period of seedlings raised in nursery						
	a. Seedlings from seeds						
	b. Seedlings from wildlings						
	c. Seedlings from cloning						
BPB	Quality of planting materials						
	1. Height of seedlings hauled to planting sites						
	2. Diameter of seedlings hauled to planting sites						
	3. Number of leaves of seedlings hauled to plantng sites						

Note:
1. Finding by indicator contains qualitative and quantitative descriptions of the NGP and Non-NGP sites or contains binary entries. An entry of 1 means the activity indicator was conducted. Zero entry means the activity was not conducted.
2. Positive rating by indicator contains the numerical difference of the weight or rate between the NGP site and Non-NGP site. Positive is given when the NGP site's rating is higher than the Non-NGP site. It is also given when the NGP site rating is higher than the BPB (Best Practices Benchmark).
3. Negative rating by indicator contains the numerical difference of the weight or rate between the NGP site and the Non-NGP site. Negative rating is given when the NGP site rating is lower than the Non-NGP site. It is also given when the NGP site rating is below the BPB.

Appendix Table 5. Process Assessment and Evaluation for Site Preparation.

BASIS	CRITERIA/ INDICATOR	FINDING		POSITIVE RATING		NEGATIVE RATING	
		Non-NGP Site	NGP Site	Non-NGP Site	NGP Site	Non-NGP Site	NGP Site
	1. Start of the preparation activities						
	2. Quality of strips and rings (size of planting strips/ rings)						
	3. Size of planting holes						
	4. Staking density per ha						
	5. Soil fertility enhancement (composting, humus addition, fertilizer application)						
	6. Water system constructed						
	7. Access roads and food path constructed						
	8. Satellite nurseries constructed in the planting site						

Note:
1. Finding by indicator contains qualitative and quantitative descriptions of the NGP and Non-NGP sites or contains binary entries. An entry of 1 means the activity indicator was conducted. Zero entry means the activity was not conducted.
2. Positive rating by indicator contains the numerical difference of the weight or rate between the NGP site and Non-NGP site. Positive is given when the NGP site's rating is higher than the Non-NGP site. It is also given when the NGP site rating is higher than the BPB (Best Practices Benchmark).
3. Negative rating by indicator contains the numerical difference of the weight or rate between the NGP site and the Non-NGP site. Negative rating is given when the NGP site rating is lower than the Non-NGP site. It is also given when the NGP site rating is below the BPB.

Appendix Table 6. Process Assessment and Evaluation for Planting NGP Sites.

BASIS	CRITERIA/ INDICATOR	FINDING		POSITIVE RATING		NEGATIVE RATING	
		Non-NGP Site	NGP Site	Non-NGP Site	NGP Site	Non-NGP Site	NGP Site
	1. Start of planting						
	a. End month of the dry season						
	b. Start month of the rainy season						
	c. Middle of the first month of the rainy season						
	2. Stop planting						
	a. Last month of the rainy season						
	b. First month of the following dry season						
	3. Filling fertile soil (compost, fertilizer, humus)						
	a. Soil from the hole only (no mixture with compost, fertilizer, humus)						
	b. Soil from hole with mixture (compost, fertilizer, humus)						
	c. Total soil replacement with compost, fertilizer mixed with soil, forest humus						
	4. Removing plastic bag properly by cutting one side and base without disturbing the soil						
	5. Depth of planting						
	6. Cover planted seedling with soil. Press the soil firmly.						
	7. Staking after planting						
BPB	1. Mulched seedlings after planting						

	2. Water sysem constructed (impounding pond per hectare, improvised drip method, ditch around seedlings or along plant lines, etc) for watering contingency during dry season						
	3. Planting healthy and quality seedlings						
Note: 1. Finding by indicator contains qualitative and quantitative descriptions of the NGP and Non-NGP sites or contains binary entries. An entry of 1 means the activity indicator was conducted. Zero entry means the activity was not conducted. 2. Positive rating by indicator contains the numerical difference of the weight or rate between the NGP site and Non-NGP site. Positive is given when the NGP site's rating is higher than the Non-NGP site. It is also given when the NGP site rating is higher than the BPB (Best Practices Benchmark). 3. Negative rating by indicator contains the numerical difference of the weight or rate between the NGP site and the Non-NGP site. Negative rating is given when the NGP site rating is lower than the Non-NGP site. It is also given when the NGP site rating is below the BPB.							

Appendix Table 7. Process Assessment and Evaluation for Protection and Maintenance.

BASIS	CRITERIA/ INDICATOR	FINDING		POSITIVE RATING		NEGATIVE RATING	
		Non-NGP Site	NGP Site	Non-NGP Site	NGP Site	Non-NGP Site	NGP Site
	1. Forest plantation assessment						
	a. Frequency of forest plantation assessment						
	b. Assessed forest plantation problems						
	2. Protection and maintenance activities						
	a. People's forest governance						
	i. IEC						
	ii. 24/7 patroling and guarding and forest fire protection						
	iii. Exit and entry management of planted areas						
	b. Technical activities						
	i. Fire line or fire breaks						
	ii. Grass density management						
	iii. Replanting						
	iv. Fertilizer input (frequency of application and quantity applied per hectare)						
	v. Others						

Note:
1. Finding by indicator contains qualitative and quantitative descriptions of the NGP and Non-NGP sites or contains binary entries. An entry of 1 means the activity indicator was conducted. Zero entry means the activity was not conducted.
2. Positive rating by indicator contains the numerical difference of the weight or rate between the NGP site and Non-NGP site. Positive is given when the NGP site’s rating is higher than the Non-NGP site. It is also given when the NGP site rating is higher than the BPB (Best Practices Benchmark).
3. Negative rating by indicator contains the numerical difference of the weight or rate between the NGP site and the Non-NGP site. Negative rating is given when the NGP site rating is lower than the Non-NGP site. It is also given when the NGP site rating is below the BPB.

Appendix Table 8. Environmental Impact Evaluation for NGP sites.

BASIS	CRITERIA/ INDICATOR	FINDING			POSITIVE RATING			NEGATIVE RATING		
		Non-NGP Site	NGP Site	Control Site	Non-NGP Site	NGP Site	Control Site	Non-NGP Site	NGP Site	Control Site
	1. Survival rate									
	2.NGP Impact to soil accretion/erosion									
	3.NGP Impact to soil indicators									
	a. Nitrogen									
	b. Phosphorous									
	c. Potassium									
	d. Organic Matter									
	e. Carbon									
	f. Soil moisture									
	4.NGP species nutrients contribution to soil									
	a. Nitrogen									
	b. Phosphorous									
	c. Potassium									
	d.Carbon									
	5.NGP Impact to temperature									
	6.NGP compliance to DRR									
	a. DRR design in slope 36-55%									
	i. Area planted with deep-rooted species									
	ii. % area planted over total area of NGP site									
	b. DRR design in slope >55%									
	1. Area planted with deep-rooted species									
	2. % area planted over total area of NGP site									
	c. DRR design in vulnerable streams/rivers/creeks									
	1. Area planted									
	2. Deep-rooted species planted									
	3. % planted area of 3.a									
	d. DRR design in existing gullies									
	1. Area planted									

	2. Deep-rooted species planted									
	3. % planted area of d.									
	e. DRR design in existing land slides									
	5.a. Area planted									
	5.b. Deep-rooted species planted									
	3.c. % planted area of 5.a.									
	NGP climate change to CCA measures									
	1. Construction of intercepting ditches to divert surface water from passing through planted areas									
	2. Planting of deep- rooted forest species in close spacing									
	3. Planting of hedge rows of kakawate and deep rooted forest species in between hedgerows.									
	4. Construction of diversion canals to deviate surface runoff from gully directions and planting of gullies with deep –rooted forest species to hold back the soil.									
	5. Provision of improvised water system such as rain water harvesting, drip method of watering seedlings, tapping of spring water, stream water for the NGP plantations. Planting of water loving plants or drought resistant species before desired forest species are planted									
	NGP climate change mitigation measures									
	1. Total carbon sequestration of softwood species planted									
	2. Total carbon sequestration of medium hardwood species planted									

	3. Total carbon sequestration of hardwood species planted									
	4.NGP Impact to biodiversity conservation									
	5. NGP Impact to wildlife									
	1. Flora									
	2. Fauna									
	6.Diversity of forest species planted in NGP site									
Note: 1. Finding by indicator contains qualitative and quantitative descriptions of the NGP and Non-NGP sites or contains binary entries. An entry of 1 means the activity indicator was conducted. Zero entry means the activity was not conducted. 2. Positive rating by indicator contains the numerical difference of the weight or rate between the NGP site and Non-NGP site. Positive is given when the NGP site's rating is higher than the Non-NGP site. It is also given when the NGP site rating is higher than the BPB (Best Practices Benchmark). 3. Negative rating by indicator contains the numerical difference of the weight or rate between the NGP site and the Non-NGP site. Negative rating is given when the NGP site rating is lower than the Non-NGP site. It is also given when the NGP site rating is below the BPB.										

Annex 1. KII/FGD Guide for Survey, Mapping and Planning

Key Informant Interview/Focus Group Discussion Guide

This guide is intended for the following respondents (PENRO, CENRO, NGP PENRO Coordinators, NGP CENRO Coordinators, Region NGP Coordinator, PO Officers, SMP contractor, if contracted to third party) engaged in SMP.

Name (Complete)	
Address	
Cellphone number	
Age	
Function in the NGP	
NGP site	
FGD/KII by	
Date of KII	

1. **Before the start of NGP implementation, was there a Survey, Mapping and Planning or feasibility study, or appraisal or comprehensive site development planning conducted in every NGP site?**

SMP activity	**Indicators measured (% sampled in the area if any)**			**Not considered**	**Reason for not including in the survey**
Soil survey	**Soil depth**	**Acidity**	**NPK**		

2. **On species-site matching, how did the SMP identify the right species that will grow and survive in the NGP sites?**

SMP Activity	Check appropriate activity	Remarks
Based on the soil survey result		
Based on forest species growing in the field		
Based on ERDB recommendation		
Combination of the above		
Others (pls specify)		

END OF FGD/KII GUIDE

Annex 2. KI/FGD Guide for Insuring the Quality of NGP Forest Plantations

Key Informant Interview/Focus Group Discussion Guide

This guide is intended for the following respondents (PENRO, CENRO, NGP PENRO Coordinators, NGP CENRO Coordinators, Region NGP Coordinator, PO Officers, NGA's counterpart) engaged in ensuring the quality of NGP plantations.

Name (Complete)	
Address	
Cellphone number	
Age	
Function in the NGP	
NGP site	
FGD/KII by	
Date of KII	

3. **After the conduct of a specific NGP activities, did the CENRO and site coordinators inspect the quality of NGP activity outputs according to quality standards?**

NGP Activity	% Quality Output	Remarks
Seedlings produced		
Site preparation		
1. Size of strip brushed		
2. Size of ring brushed		
3. Size of planting hole		

4. Actual number of stakes/ha		
5. Fertile soil filled in the hole		
6. Fertilizer applied		
Planting (actual density/ha)		
Protection and maintenance		
1. Replanting		
2. Fire breaks and fire lines		
3. Ring weeding		
4. Mulching		
5. Others		

4. Were the workers advised on what to undertake to correct the inadequacies in their performance based on no. 1 answers?

Inadequacies	% compliance of the workers	Any written agreements between DENR and the PO workers (describe agreement or attach agreement if any)

5. Did the DENR use the above quality standards in the payments of outputs of the workers?

NGP Activity	% Payment before compliance without deduction	% Payment before compliance with deduction	% Payment after compliance	Remark

6. How many months payment is made after planting the seedlings?

Species	Number of weeks/months payment is made	Reasons

7. Were there activities conducted to grade or cull out inferior quality of seedlings?

NGP Activity	% Culled Out	% Acceptable grade	Action

			recommended for culled seedlings
Seedlings at the nursery before hauling to NGP sites			
Seedlings at the NGP sites ready for planting			
Planted seedling after planting			
Health condition of planted seedlings			

END OF FGD/KII GUIDE

Annex 3. KII/FGD Guide for Capability Development of NGP Workers

Key Informant Interview/Focus Group Discussion Guide

This guide is intended for the following respondents (PENRO, CENRO, NGP PENRO Coordinators, NGP CENRO Coordinators, Region NGP Coordinator, PO Officers, NGA's counterpart) engaged in training the nursery workers, site preparation workers, planters, and protection and maintenance workers.

Name (Complete)	
Address	
Cellphone number	
Age	
Function in the NGP	
NGP site	
FGD/KII by	
Date of KII	

8. **Before the start field NGP activities, were there trainings conducted to re-orient the contractors on the establishment, protection, maintenance and management of the contractors (PO members, workers, etc.) of the different NGP activities?**

Title of Trainings	**Attendee**	**Number of days of training with demonstration**	**Resource Persons**

9. **Were the workers trained by their officers on the same subject matters taught to them during their trainings?**

Title of training	**Approach of training**	**Attendee and their functions in the NGP**	**Remarks**

10. How did the trained workers demonstrate their learnings in the training?

Learnings Absorbed and Practised	**Indicate approximate compliance of workers in their NGP activities (estimate compliance in terms of % consistency with instructions or guidelines of NGP)**			
	Below 50 %	**Average of 80%**	**Higher than 80%, but not more than 100%**	**100%**
Nursery operations				
Site preparation				
Planting				
Protection and maintenance				
Others				

11. What were the reasons for compliance below the average of 80%?

Reasons	**Rank Reasons**	**Remark**
Was not invited during the training conducted by the PO officers		
Not attentive during the training		
Resource persons were not effective in transferring the knowledge that they want to impact		
Insufficient subject matters discussed during the training.		

Training was purely lecture without actual demonstration how to conduct the activities in the field.		
Others (please specify)		

12. Were there follow up training to upgrade the skills and to address some inadequacies on the skills and knowledge of the NGP workers after the first year of NGP activities?

Title of Training	**Attendees**	**% of improvement in NGP activities resulting from increased survival rates of NGP plantations**	**Remarks**

END OF FGD/KII GUIDE

Annex 4. KII/FGD Guide for Seedling Growers

Key Informant Interview/Focus Group Discussion Guide

This guide is intended for the following KII respondents (20 seedling growers).). If the workers participated in all plantation establishment activities, increase the number of KII/FGD t0 50 respondents.

Name (Complete)	
Address	
Cellphone number	
Age	
Function in the	

NGP	
NGP site	
FGD/KII by	
Date of KII	

13. What is/are the sources of seedlings? (please check appropriate box/blank in the table below).

Species	From Seeds Collected by Respondent	From Wildings Collected by Respondent	From Cuttings Collected by Respondent	From Cloned Seedlings	Procured from Private Nurseries	Procured from DENR/ Personnel

14. How many weeks did you take care of the seedlings in the nursery up to outplanting in the NGP planting sites?

Species	From Seeds	From Wildlings	From Cuttings	From Cloned	Procured Seedlings	Procured from	Procured from DENR/Personnel

15. What were the qualities of seedlings that were hauled to planting sites?

Species	Ht of Seedlings (in cm)	Diameter of Seedlings (mm)	Number of Leaves of Seedlings

END OF FGD/KII GUIDE

Annex 5. KII/FGD Guide for Workers Engaged in Site Preparation

Key Informant Interview/Focus Group Discussion Guide

This guide is intended for the followingI respondents (20 plantation workers engaged in site preparation of NGP sites).). If the workers participated in all plantation establishment activities, increase the number of KII/FGD t0 50 respondents.

Name (Complete)	
Address	
Cellphone number	
Age	
Function in the NGP	
NGP site	
FGD/KII by	
Date of KII	

16. When did you start straight/contour strip/ring brushing of the plantable sites? (please check appropriate box/blank in the table below).

1 month before rainy season	2 weeks before rainy season	During dry season	During rainy season simultaneously with planting

17. Quality of the strip/ring brushed area?

1 meter strip	**0.5 meter radius ring**	**Grass roots all removed within strip/ring**	**Stakes erected in every planting hole**

18. What is the size of the planting hole?

Species	**Width or Diameter of Hole**	**Depth of Hole**

19. Did you add or fill compost, forest top soil or humus or fertile soil into the planting hole after hole digging? Please check appropriate column.

No compost or fertile soil	**With compost**	**With fertile soil**	**Forest top soil or humus**

20. Did you consider tapping and/or constructing a water system (pond, rain water harvesting system, etc.) in the plantation sites where water during dry season may be sourced for watering the planted seedlings?.

Please describe in this box the water system that you constructed.

21. Did you prepare access roads and foot paths to support planting in NGP sites?

Please describe in this box the access roads and foot paths that were constructed in the NGP sites?

22. Did you prepare temporary satellite nurseries in the NGP planting sites where seedlings were temporary stored before planting?

Please describe in this box

END OF FGD/KII GUIDE

Annex 6. KII/FGD Guide for Workers Engaged in Planting Seedlings in NGP sites

Key Informant Interview/Focus Group Discussion Guide

This guide is intended for the following respondents (20 plantation workers engaged in planting seedlings in the NGP sites). If the workers participated in all plantation establishment activities, increase the number of KII/FGD t0 50 respondents.

Name (Complete)	
Address	
Cellphone number	
Age	
Function in the NGP	

NGP site	
FGD/KII by	
Date of KII	

23. When did you start planting? (please check appropriate box/blank in the table below).

1st week of the rainy season	2nd week of the rainy season	During the rainy season	During the dry season

24. When did you stop planting?

2 weeks before end of the rainy season	1 week before end of the	1st week of the dry season	Others

	rainy season		

25. Did you fill soil fertility additive (compost, forest top soil/humus or fertilizer) in the hole during planting?

Species	**Type of fertile soil**		
	Compost	**Forest top soil/humus**	**Fertilizer**

26. Did you remove the plastic bag of the seedling without breaking the soil ball during planting?

Cut and removed without breaking the soil ball	Cut and removed disturbing the soil ball	Slit the plastic base only without removing it.	Others

27. How deep did you plant the seedlings?

Species	Root collar same level with the ground surface	Root collar 3-4 inches below the ground surface	Root collar 2 inches above the ground surface	Others

28. Did you firmly plant the seedlings on the ground?

Please describe process in this bon

29. Did you erect a stake in every planted hole?

Type of material used as stakes (split bamboo, timber pole or branch, etc.)	Length or height of stake

30. After planting the seedlings did you provide some forms of mulch to collect and save soil moisture?

Please describe in this box

END OF FGD/KII GUIDE

Annex 7. KII/FGD Guide for Workers Engaged in Protection and Maintenance of NGP Planted Sites

Key Informant Interview/Focus Group Discussion Guide

This guide is intended for the following respondents (20 plantation workers engaged in protection and maintenance of the planted NGP sites). If the workers participated in all plantation establishment activities, increase the number of respondents to 50 respondents.

Name (Complete)	
Address	
Cellphone number	
Age	
Function in the NGP	
NGP site	
FGD/KII by	
Date of KII	

31. After planting the NGP site, how often did you inspect the planted seedlings?

No inspection after planting	Weekly after planting	Monthly after planting	Quarterly after planting	Yearly after planting

32. What were the common problems that caused the reduction of survival rates in the NGP planted areas?

Types of Problem	Area Affected (in ha)	Rank of the problem	Remarks
1. Drought			
2. Grass fires due to grazing			
3. Kaingin-making			
4. Wildlife Hunting			
5. Treasure hunting			
6. Improper planting			
7. Inferior seedlings planted			
8. Others (pls specify)			

33. What were the protection and maintenance activities did you perform?

Species	Ring weeding	Mulching	Fertilizer application	Fire break or fire line construction	Replanting	Watering	Forest/grass fire protection	IEC	Foot patrol

34. During the last inspection that you conducted, what was the survival rate of the planted NGP site before replanting?

Species	Survival rate	Cause(s) of mortalities	What activities have you implemented to reduce seedling mortality (only those that directly affected reduction of mortalities)

35. How tall and thick the grasses and weeds in the NGP plantations before ring weeding?

Year Planted	Types of grass	Ht of grasses	Density of grasses

36. How many seedlings were replanted?

Species	Area replanted (hectares)	Number of seedlings replanted	Quality of replanted seedlings (ht, dia. # of leaves)	Year of replanting

37. Did you apply fertilizer during the inspection period to nutrient- deficit seedlings?

Species	Type of fertilizer			Conditions of seedlings after fertilization		
	Mykovam	NPK Inorganic fertilizer	NPK organic fertilizer	Dead	Improving in growth	Others

38. Forest or grass fires that affected the NGP plantations?

Species	Area Burned	Measures Conducted to prevent forest or grass fires	Measures conducted to control spread of forest or grass fires	Other Measures

39. Based on your observations, what should be done to improve the conditions (survival rate and health conditions) of the NGP plantations in order to have a good quality NGP forests in the future?

Suggestion			**Rank according to priority of implementation**		
Straight 3 years contract to PO with responsibility to protect and maintain what they have planted.					
Allocate additional budget for water system to be used in watering the plantations during drought. Zambales has only 3 months of rainy season and temperature is becoming intense.					
Since most of the grassland and brushland areas in Zambales are already deteriorated apply soil fertility enhancing organic materials to support plant growth					
Prioritize reforestation along the periphery of forest lines along creeks expanding uphill.					
Others					

END OF FGD/KII GUIDE

ANSWERS TO THE OBSERVATIONS AND COMMENTS OF DR. PACENSIA MILAN, NRM CONSULTANT, ON THE SCOPING AND PROCESSES ASSESSMENT AND EVALUATION OF THE NATIONAL GREENING PROGRAM: ENVIRONMENTAL COMPONENT

Observation/comments:

A. Based on the objectives of the study:

1. *"to validate the survival rate and growth performance of the NGP forest plantation", an objective assessment of such should be made because mortality is quite high in some areas, quality of seedlings was not paid any attention, and reforestation may be a failure if more of area covered under NGP are more production forests and less restoration forest.*

Answer:

The quality of seedlings planted in the NGP sites where assessed and evaluated according to compliance of the PO's to DENR standards of the seedlings to be planted. This is also the basis of payment of seedlings by DENR. Considering that this was the basis of payment, it follows that all seedlings planted satisfied the quality standards prescribed by the DENR. The second check on the quality of seedlings planted in the area was determined through FGD/KII of the seedling growers and planters. Results showed consistency between the survival rates and FD/KII results. This means that the perceptions/observations of the POs, seedling growers and planters were unbiased and objective. The third check was conducted during the field inventory of the seedlings where the health conditions of the seedlings were evaluated.

Ideally, evaluation of the quality of the seedlings should have been done during the seedling production stage and planting activities. This will ensure the planting of the right quality of seedlings because only those seedlings that will pass the standards will be transported to and planted in the reforestation sites. Unfortunately, the Environmental Impact Study came 5 years after the start of the NGP. The EIS should have started from the very first NGP field activity implementation to establish baseline information where impacts should be based upon. Perhaps, for future third party assessment and evaluation of reforestation projects, this should be synchronized with the schedules of reforestation activities.

On the survival of planted seedlings dependent solely on the quality of seedlings, aside from the quality of seedlings, there are other factors that contribute to the survival and growth performance of planted seedlings. These are site conditions include the characteristics of soils, climate (rainfall, temperature, and drought) of the site, appropriateness of species-site matching, and correctness of activities implemented before, during and after planting. Such factors should have been fully covered in the survey, mapping and planning (SMP). This, however, was not conducted in all the NGP sites. These aspects where discussed in the 3 NGP sites that were studied.

2. *"to assess the impact in improving environmental condition in terms of soil build up, water recharge, impact to DRR and CCA and biodiversity enhancement; there was no proper assessment of the pre-NGP status of the site especially in terms of soil analysis and vegetation study.*

Answer:

It is not necessary to conduct a pre-NGP status study as part of the Environmental Impact Study (EIS) because all the NGP sites covered in the EIS are grasslands. A pre-NGP study covering not only the soils and vegetation types, but also wildlife, hydrology, topography and other relevant factors should have been done by the DENR through the SMP based on their guidelines and not this EIS before the start of the NGP. These indicators are important in the identification of the right species suitable for planting that will most likely survive on site. Unfortunately the SMPs of the NGP sites covered only the boundary surveys using GIS, soil type only (without the other important soil properties), and topographic map, and dominant vegetative ground cover. In the absence of detailed relevant site information, the impacts of reforestation projects to soil build up and water recharge can be compared to the soil build up and water recharge of adjacent grassland areas. The difference gives the impacts of the reforestation projects.

In terms of the DRR impact, the risks that are commonly encountered in reforestation areas are rain-induced landslides, erosions and droughts. The forest species that are effective in minimizing landslides and erosions are those species with deep-rooted forest species. Forest species that can survived under drought condition are those that have inherent mechanisms to control plant respiration and conserve water. These factors were not considered in the identification of forest species recommended for planting in the NP sites.

The same species were planted in the same area regardless of slopes and elevations, soil characteristics, and end use (whether for timber production, protection, for disaster risk reduction (DRR) and climate change adaptation and mitigation CCA/M)). There should be different forest species for different site characteristics and end use.

Ideally, sloping areas should be planted with deep-rooted seedlings, while in flat areas, deep-rooted seedlings may not be necessary.

To address climate change-related issues, species which are high in density and at the same time fast growing are expected to have higher carbon sequestration rates. These were not considered in the NGP sites. The net impact is determined when compared to the carbon sequestration rates of the grasses in the NGP sites.

Observation/Comment:

I doubt if impact to DRR and CCA were even in the agenda of local partners or POs.

Answer:

Answer to this comment is best addressed in the social impact study of the NGP where the study is expected to determine the IECs conducted by the DENR field offices. In fairness, issues on DRR and CCA/M importance of reforestation might have been discussed by the NGP extension officers with the POs.

Observation/Comment

Likewise, the natural vegetation of the area was not considered in restoration. Planting was made depending on available seedlings, native plus exotic, and in instances where native species of trees were available, they were planted in monoculture.

Answer:

On the use of natural vegetation not used in restoration, this is correct. However, there were logical reasons forwarded by the DENR field personnel. These are:

1. Natural vegetation hardly survived in open areas or grasslands. Newly planted seedlings need partial shade in order to survive.

2. Planting materials/seeds from natural vegetation are insufficient to meet the NGP target. The NGP planned to plant indigenous forest species in protected areas (NIPAS) and combinations of indigenous forest species and fast growing forest plantation species in production forests during the planning stage. However, upon assessment of the supply of planting materials, there were not

many seeds from the natural forest because prior to NGP the same seedling production areas suffered from climate change-related events such as strong typhoons and droughts that changed the physiological processes of the forest species to bear fruits. The target areas for reforestation were so high that cannot be supplied with right quantity of planting materials from the natural forest.

To meet the forest plantation establishment targets to provide immediate forest cover to grasslands, the field offices considered contingent planting materials.

On diverse forest species, except for the NGP sites in Negros Occidental which planted in monoculture coffee in its agroforestry site and in another NGP site planted in monoculture of exotic fast growing species, the NGP sites in Zambales planted a combination of indigenous forest species and plantation species while Dinagat planted indigenous forest species. The NGP sites that were assessed planted indigenous forest species.

Observation/Comment:

How about wildlife recruitment? All the issues should be considered if such restoration is able to contribute biodiversity enhancement both flora and fauna. In this study, complete tree species listing and faunal observation and/or listing could have contributed to a correct assessment of the attainment of objective #2. What observations were noted with regard to monoculture and planting of exotic species?

Answer:

100% inventory was conducted in each of the NGP site. Thus, all forest species, whether exotic or indigenous were identified and counted. Also, 100% counting of the coffee plantation was conducted. The presence of fauna in the communities where the NGP sites are located were based on the KII/FGD with the community respondents. These are presented in the report.

Observation/Comment:

In addition, one of the provisions of NGP is to encourage "Rainforestation" or the use of "native trees in the protected areas» (EO 26 Annex 1). No mention on this is made in the study/report. Even in the methods of restoration, Rainforestation was not mentioned.

Answer:

Actually, NGP did address the use of indigenous forest species in protected areas. These are reported in the report particularly in the NGP sites in Zambales and Dinagat province.

Observation/Comment:

Lastly, impacts of NGP, DRR and CCA were not considered as noted by the choice of forest trees with deep rooting systems to hold more soil. There was no mention of this in the choice of seedlings to be raised in nursery. If the POs and partners understood this, this will enhance the success of NGP.

Answer:

This is mentioned in the report. As to the understanding of the POs, this is captured in the social study component.

Observation/Comment:

B. The secondary objective should have included how the DENR assisted the contractors in understanding the processes of EO 26 in the face of continuous decrease of forest cover and its impact on climate change.

Answer:

The social study component covers this concerns.

Observation/Comment:

C. If this Process Evaluation Phase of the Environmental Impact of the NGP is solely based on EO 26 signed February 24, 2011, it did not capture with due diligence the biodiversity conservation enhancement of the Executive Order as provided in the Declaration of Policy.

Answer:

The planting of different species in each of the NGP sites indicates biodiversity conservation enhancement. These are reported in the report.

Observation/Comment:

The following issues need to be addressed: a) whether the coverage of the NGP included private and A and D land;

Answer:

The NGP fund, being a government fund, is not eligible for financing reforestation projects of the DENR in A and Lands. This is against the law.

b) if Rainforestation or the use of native tree species was encouraged in protected areas

Answer:

Native or indigenous species were used in the forestation of protected areas (please see answer of similar question above)

c) for pre-NGP status of the area selected for restoration were studied in terms of soil status, vegetation assessment, flora and fauna inventory;

Answer:

Pre-NGP status supposedly studied and reported in the Survey, Mapping and Planning conducted by DENR. Unfortunately, the above concerns were not addressed due to the need to meet the targets, which are more important from the point of view of the DENR.

It is not also part of the Environmental Impact Study (EIS) report because this study started 5 years after the start of the NGP.

d) appropriate training of partner(s) NGOs, POs or community in nursery establishment, preparation of planting materials, species matching, quality of seedlings to be planted and purposive technical assistance from DENR personnel and other line agencies.

Answer:

The EIS reported the above concerns.

Observation/Comment:

D. *It is clear that certain provision of EO 26 was not followed/accomplished particularly in the issues of biodiversity conservation. Even in the list of species, there is no clear mention of the impact of NGP on this although one can reason out that impact cannot be measured in a short time. However, this report should have included a complete list of native tree species which is an indicator that there was this attempt to enhance forest genetic resources in the reforestation sites under NGP.*

Answer:

A list of native species before the NGP implementation is not available. Thus, there is no basis for a complete enumeration of native species. The EIS report included a list of the native species planted in the NGP sites. There were no other native species other than those that were planted in some of the NGP sites. The other species present were mostly cogon in between the planted seedlings.

Observation/Comment:

E. *There was an NGP Partnership's Agreement that considered highly the environmental aspect of NGP (see Annex 2). In the NGP Partnership Agreement signed among these partners, namely, DENR, PTFCF and FPE, these agencies jointly agreed to monitor the implementation of NGP particularly in use of native tree species and to create a roadmap that would insure the planting of Philippine native trees in all future reforestation project. However, it was further noted that up to 2015, the use of native trees was very negligible and current report in Region 8 and other regions states that mahogany and coffee were planted in uplands which are appropriate as Restoration Site.*

Answer:

The implementation of the partnership agreement is under the Institutional Study component.

Probably those areas planted with mahogany are production forest area while those areas planted with coffee are livelihood enhancement area to help the upland poor.

Observation/Comment:

F. Major NGP goals such as biodiversity conservation and climate change adaptation and mitigation is unclear to the POs evident on the manner of seedling production and the ratio of species type to number of seedlings planted. Baseline information, apart from being the reference for the succeeding monitoring and evaluation process, is also one of the bases for accounting NGP efforts to climate change adaptation and mitigation as planting trees does not necessarily accounts for mitigating and adapting the climate change. One cannot overstate the importance of a valid, well established baseline hand in hand with good, diligent record keeping for a proper analysis or computation say for the amount of carbon being sequestered by the trees planted and nurtured through the NGP program.

Answer:

To reiterate, the areas that were selected for NGP sites were grassland areas with cogon as the major type of vegetation. They did not clear a forested area only to be planted with NGP-preferred forest species. This is probably the reason why DENR had nothing to report on native tree species in their SMPs. At least in the NGP areas that were randomly selected for assessment and evaluation in this impact study. So, from their point of the view, the baseline vegetation is cogon. In terms of carbon sequestration, cogon has lesser carbon sequestration rate compared to tree species.

The other reason why baseline information survey was not pursued probably is because it is also an expensive and time consuming activity and what is more important is to meet their targets within the 6 years period.

Observation/Comment:

By large, the DENR-PTFCF-FPE partnership agreement for the implementation of the National Greening Program proved to be one of the biggest documented CSOs and National Government collaboration for forest restoration and development. Effort, time and resources have been continuously poured in by the CSOs in resources and services for the program which s trengthen further the clamor of monitoring and evaluation.

Answer:

Partnership with CSOs should be encouraged for a more successful implementation of any reforestation program. Sharing of technologies, manpower and financial resources between DENR and the CSOs is also encouraged.

Observation/Comment:

G. *In relation to the Information Education and Communication (IEC) strategy for NGP, gaps are still evident on a very little understanding of direct implementers of the program. Awareness on the NGP project seemed insufficient despite several IEC activities implemented.*

Answer:

This concern will be relayed to the Social Study component to further enrich their recommendations.

Observation/Comment:

The report is quite comprehensive and captures the goal of the entire study as a whole. However, much is still to be desired in understanding the over-all impact of NGP in increasing the forest cover and the environmental impact of National Greening Program in the country.

Answer:

The NGP is a 6-year forestation program. It envisioned to provide forest cover to 1.5 million hectares. Within the 6 years period, effort to protect and maintain the NGP forest plantations will be carried out by the DENR. Assuming that it will be able to maintain the desired minimum survival rate of 85% up to 2016, there will still be uncertainties beyond this period whether the next leadership of the government will still support protecting the NGP forest plantations in terms of continuous funding, funding for the protection of existing natural forests, and funding for the implementation of a well-planned forestation program for the next government.

Successful forestation, protection and maintenance program will contribute substantially to increase of forest cover in the country.