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CONTRIBUTION OF MANGO (*MANGIFERA INDICA*) TO CARBON SEQUESTRATION IN BARANGAY MACUTAY AND ROMUALDEZ, RIZAL, KALINGA

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Abstract: *The study was conducted in Barangay Macutay and Romualdez, Rizal, Kalinga. The study aimed to determine the soil fertility and contribution of mango plantations to carbon sequestration.*

The methodologies used includes interview, measurement of trees at the diameter at breast height (dbh), collection of soil samples, gathering of corner points with the use of GPS and processing of data in Arc GIS 9.3. Above ground biomass was computed through the allometric equation developed by Brown, (1997).

Result showed that Barangay Romualdez had higher aboveground biomass and carbon stock which is equal to 37.78t/ha, and 17t/ha compared to Barangay Macutay (28.97t/ha, 13.04t/ha).

In terms of soil chemical properties, the two sites revealed that pH, Nitrogen, and Phosphorus are moderately low while potassium was high which has a mean of 396.25ppm.

Key words: *Above-ground biomass, Carbon Sequestration, Soil fertility, Mangifera indica, Allometric equations.*

INTRODUCTION

The IPCC Third Assessment Report (2001) presented new and stronger evidence that most of the warming observed in the last 50 years is due to human activities and warming is expected to continue this century and alter atmospheric composition. It was also predicted that by the year 2100, the average surface temperature will increase by between 1.4 to 5.8°C while sea level is expected to rise by 0.09 to 0.88 cm, resulting in flooding of low-lying areas. CO2 is the most abundant greenhouse gas and is responsible for more than half of the radiative forcing associated with the greenhouse effect (Dixon *et al.* 1993, Moura-Costa 1996).

Forest ecosystems play an important role in climate change because they can be both sources and sinks of CO2 (Trexler and Haugen 1994). At present, the world's tropical forests are found to be a net source of C due to anthropologic activities including deforestation with an emission of 1.6 Gt (1 Gt = 109 tons), in the year 1990 alone. In fact, Philippine forests, through massive deforestation, were found to have contributed about 3.7 Pg (1 Pg = 1015 tons) of C to the atmosphere from year 1500 to the modern era (Lasco and Pulhin 1998). Other causes could be mainly human-induced activities including fossil fuel burning and changes in land use and land cover (IPCC 1995).

Efforts to mitigate climate change are now underway like the greenhouse gas inventory for the LUCF sector in the Philippines, Thailand and Indonesia as reported by Magcale-Macandong (2000). While the industrial sector is trying to reduce their fossil emission as manifested in the Philippine Clean Air Act, Kyoto Protocol and other related environmental laws and policies, the forestry sector is also trying to find what forest management system is able to address such a problem without jeopardizing the socio-economic development of the forest inhabitants. In line with this noble cause, agroforestry or the combination of crops with trees is seen as one strategy in mitigating climate change.

IMPORTANCE OF THE STUDY

This study attempts to assess the carbon stock of mango plantations in Barangay Macutay and Romualdez, Rizal, Kalinga. Data generated from it could provide valuable information to policy makers who may formulate policies that would enhance the well being of the mango plantation owners. This study provides researchers in the province the baseline information on carbon reserve of the mango plantations.

The importance of planting and managing plantations contributes to the additional sink for carbon. It is in this regard that quantification is necessary to determine the contribution of mango plantations as sink of carbon.

OBJECTIVES OF THE STUDY

Generally, the study assessed the carbon stock of mango species in Barangay Macutay and Romualdes, Rizal, Kalinga.

Specifically, the study aimed to:

1. Determine aboveground biomass and carbon stocks found within plantation sites; and
2. Determine the soil fertility of the plantation sites.

TIME AND PLACE OF THE STUDY

The study conducted from January to May 2016 at Barangay Macutay and Romualdez, Rizal Kalinga.

SCOPE AND LIMITATION OF THE STUDY

The study focused on the assessment of carbon stock and soil fertility of mango plantation in Brgy. Macutay and Romualdez, Rizal, Klinga.

Below are the limitations of the study

Carbon stock assessment. Carbon stock was computed using the allometric equation used by Brown, (1997) instead of obtaining destructive samples.

The diameter limit used in assessing the biomass was 10 cm and above although some studies used 5 cm and above such as Sales (2005) and others. This is due to the facts that Brown (1997) is the author of the allometric equation used under this study and the same suggested the 10 cm diameter limit. Lasco and Sales (2003) actually suggested the same diameter limit.

METHODOLOGY

Site of the Study

The sites include the mango plantations in Brgy. Macutay and Romualdes,Rizal Kalinga, with an approximate area of 1.6 has. and 8 has. respectively.

Like the rest of Northern Luzon, the Province of Kalinga is subjected to the northeast trade winds from November to March and the Southwest trade winds from June to October. The climate falls under type II with more or less evenly distributed rainfall throughout the year. On the average, June to January is the wet months while February to May is relatively dry. The highest rainfall occurs in August and the lowest in March.

Rapport Building

Before the official conduct of the study, the researcher conducted courtesy calls to the owners and discusses the objectives of the research and obtains permission.

Field and Laboratory Methods

Carbon Stock Assessment

A 100% quantification of carbon stock found within above ground biomass was conducted. Diameters having a dbh of 10 cm and above were recorded, and for those which do not reach the dbh was measured at the first big branch.

Above ground biomass was computed using the following allometric equation (adopted from Brown, 1997).

$Y=\exp[-2.134+2.530*\ln(D)]$

Where Y=biomass per tree in Kg

D=dbh in centimeters

In=natural logarithmic

Carbon Stock= Biomass x 0.45

Mapping

Corners of individual parcel of farms of the respondents were taken using GPS. This data was process through the ArcGIS 9.3.

Inventory

Trees with diameter of 10 cm and above were recorded as followed from Brown 1997. This data was encoded and process through Microsoft Excel to facilitate computation.

Soil Chemical Properties

Soil samples were collected from different part of the plantation area with dimensions of 25 cm x 25 cm and 30 cm depth. Representative samples were obtained for air drying. 10 samples were collected in every plantation. These samples were placed in labeled plastic bags and transported to the soil laboratory of the Bureau of Soils- Department of Agriculture Tuguegarao City, Cagayan for the analysis of pH, organic matter (nitrogen), phosphorus and potassium.

Data Analyses

Simple descriptive statistics was used such as frequency counts, percentage, ranking and means to analyze the data gathered.

RESULTS AND DISCUSSIONS

Diameter Class Distribution in the Study Sites

Table 1 presents the diameter class distribution in the study sites to give better picture of the sites.

Table 1. The diameter class (cm) distribution of Mango stands in Barangay Macutay and Rumualdez, Rizal, Kalinga

Diameter class (cm	Number of plants per barangay		Total
	Barangay Macutay	Barangay Romualdez	
10-20	149	2	151
21-30	192	83	275
31-40	24	118	142
41-above		196	196
TOTAL	365	399	**764**

The age of mango plantations in Barangay Macutay and Romualdez is 10 and 16 years respectively. As shown in table 1, Barangay Romualdez has the higher diameter which indicates that the mango planted is older than the plantation sites in Barangay Romualdez.

Aboveground Biomass Estimation

The aboveground biomass of *Mangifera indica* trees in the two barangays in Rizal, Kalinga was observed in Barangay Romualdez to have the higher aboveground biomass which is equal to 37.78t/ha, while Barangay Macutay have a lower biomass which is equal to 28.97. The diameter of the trees had an influence on the above-ground tree biomass obtained from the plantation. Perez and Kanninen (2003) revealed that the total above-ground biomass is influenced by the diameter and age class of a plantation. As the diameter of trees increases with age, the above-ground biomass also increases respectively resulting in increases of total above-ground biomass.

The aboveground biomass of the study is comparable to the findings of (Guiabao March 2016) in four mango plantations in Barangay Bagbag Bulbul, Rizal, Kalinga. He estimated for site 1, site 2, site 3, and site 4 were 7.2, 18.51, 12.29, and 16 t/h respectively.

Table 2. Aboveground biomass and Carbon stock of Barangay Macutay and Barangay Romualdez

STUDY SITES	AREA (has.)	AGE (YEAR)	Aboveground Biomass (tons)	Biomass (tons/has)	Total carbon(tons)	Carbon stock(t/ha)
Barangay Macutay	4.38	10	126.9	28.97	57.10	13.04
Barangay Romualdez	17	16	644.12	37.78	289	17
TOTAL			**771.02**	**66.75**	**346.1**	**30.04**

Aboveground Carbon Stock Estimation

Biomass is used to provide an estimate of the carbon reservoirs in ecosystems based on the fact that about half of it is Carbon. Biomass density (expressed as dry matter per unit area) indicates the potential amount of CO_2 that can be released to the atmosphere when vegetation is burned or cleared.

Parallel to the rise in concern about climate change, there is also considerable interest in the role and importance of mango plantations for carbon sequestration and storage. Plantations had been providing various and enormous environmental services to the surroundings or adjacent communities. The huge amount of carbon stock is a manifestation that considerable volume of such element has been stored and kept from intensifying the global warming phenomenon. Such contribution must also be responsible for the pleasant microclimatic condition of the area giving the local people a human-friendly and habitable place to stay.

The sequestered aboveground carbon of *Mangifera indica* trees within the two barangays showed (table 2) that Barangay Romualdez has the higher carbon content (17 t/ha), and lower in Barangay Macutay (13.04 t/ha). The present findings corroborated results from (Jana, 2009) in selected forest lands; he estimated for *Shorea robusta*, *Albizzia lebbek*, *Tectona grandis* and *Artocarpus integrifolia* were 5.22, 6.26, 7.97 and 7.28 tC/ha respectively.

Soil Chemical Characteristics of the Two Study sites

Table 3 showed the chemical soil characteristics of the study area. Brady (1978) noted that while soil analysis indicates the capacity of a soil to supply nutrients to the plants, it does

not adequately and in some cases does not at all characterize the mobility of nutrients in the soil.

Table 3

STUDY SITES	pH	Nitrogen (ppm)	Phosphorus (ppm)	Potassium (ppm)
Barangay Macutay	5.25	1.1	3.5	222.5
Barangay Romualdez	5.15	2.1	4	570
Mean	**5.2**	**1.58**	**3.75**	**396.25**

Soil pH

The most universal effect of pH on plant growth is nutritional. The soil pH influences the rate of plant nutrient release by weathering, the solubility of all materials in the soil, and the amount of nutrient ions stored on the cation exchange sites. Usually the optimum pH is somewhere between 6.0 and 7.5 because all plant nutrients are reasonably available in that range. Comparison among the study sites revealed that site in Barangay Macutay has a soil pH of 5.25, while site in Barangay Romualdez has a soil pH of 5.15. Based on FAO (1973) as cited by Gascon (1998) and Rodolfo (2012), the two sites have moderately acidic soils. Based from the soil analysis conducted, it showed that the two sites have moderately acidic soil.

Total Nitrogen

Nitrogen is a primary nutrient needed by the plants. Its presence in higher amount indicated soil fertility (Thompson & Troeh, 1978, cited by Gascon, 1998; cited by Rodolfo, 2012). The study revealed that the site in Barangay Romualdez had higher nitrogen in terms of nutrients to be 2.1ppm compared to the site in Barangay Macutay which is equal to 1.1ppm. The sites have nitrogen level described as moderate (FAO Staff, 1973, cited by Gascon, 1998).

Available Phosphorus

In many natural ecosystems, phosphorus is the more likely limiting element (Odum, 1971 as cited by Navasero, 1993; Gascon, 1998).

The site in Barangay Romualdez had higher level of Phosphorus with 4ppm while the site in Barangay Macutay has a 3.5ppm. Based on Phosyn Chemicals Limited (1987, cited by Palijon, 1998), the guideline level for phosphorus is 50 ppm. The study revealed that the study sites were low in phosphorus which has a mean of 3.75ppm.

Available Potassium

Potassium (K) availability in the soil depends largely on the density of standing biomass (Raves 1978, Mohr & Van Baren, 1954 cited by Navasero, 1993; cited by Gascon, 1998).

Result of the study revealed that the site in Barangay Romualdez had higher soil potassium content (570ppm) compared to the site in Barangay Macutay which is equal to 222.5ppm.

Based on Phosyn Chemicals Limited (1987, as cited by Palijon, 1998), the guideline level for potassium is 200 ppm. It was observed that the two sites exceed the guideline level for potassium which indicates that the sites have high potassium content.

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