Vol.7 Issue No. 6 December 2011
Print ISSN 2244-4432 • Online ISSN 2984-7125
National Peer Reviewed Journal
DOI: https://doi.org/10.59120/drj.v7i6.643

Carbon Sequestration Capacity of Sudlon Watershed in Barangay Central, Mati City, Davao Oriental

Marie Jhun A. Goc-ong
Bachelor of Science in Environmental Science, Major in Resource Management
Davao Oriental State College of Science and Technology, Mati City,
Davao Oriental, Philippines

Abstract

The study was conducted to quantify the biomass and carbon storage of the vegetative cover of Sudlon Watershed in Barangay Central, Mati, Davao Oriental. The specific objectives of this study were to determine the total area of the vegetative cover, to determine the vegetative structures, to identify the status of the vegetation, and to provide recommendations in relation to the management of the watershed. Actual surveying of the area as to the hectarage of various vegetative covers of the area was done with the aid of a Global Positioning System (GPS). The determined hectarage was then used in extrapolating the biomass and carbon sequestration capacity of the vegetative cover of the area. The Geographic Information System software was used to come up with a vegetation map of the area. The watershed area in Brgy. Central covers 879.21 ha., comprising agroforestry farms, Tree Plantation, Secondary-growth Forest, Cogon area, and the human settlement of Purok Malipayon and Sitio Banahaw. Their extent is as follows: Agroforestry farms, occupying the largest area, covers 492.36 ha., secondary-growth forest or thickets covers 195.97 ha., tree plantation covers 178.65 ha., and cogon area with 10.02 ha. Human settlement of Purok Malipayon covers 0.69 ha. While that of Sitio Banahaw covers 1.52 ha. The agroforestry farm, having occupied the largest area, has the greatest biomass (25,664.15 tons) and thus the carbon sequestration capacity (12,830.84 tons). In total, the watershed area contains an estimated biomass of 44,969.03 tons and 22,483.38 tons of carbon sequestration capacity.

Keywords: Biomass, Carbon, Sequestration, Sudlon, Watershed

Introduction

Carbon sequestration is the process through which carbon dioxide from the atmosphere is absorbed by trees, plants, and crops and stored as biomass in the form of trunks, branches, foliage and roots. It is also determined by the uptake of atmospheric carbon dioxide by forests, oceans, and grasslands during photosynthesis. Plants are important because of its role in absorbing carbon dioxide from the environment and helping to prevent climate change. According to Suratman (2008) as cited by Lagare (2010), the Philippines has high potential to mitigate climate change among tropical countries because of its big and wide enough area of forest. Although all plants absorb carbon dioxide, trees are best at

sequestering carbon dioxide due to their large size and extensive root structure. In this respect, watersheds are important as trees are the usual dominant vegetation (Birdsey, 1996). Aside from this, watersheds are one of the most effective ways in controlling soil erosion because through their vegetation they shield the soil from the falling rain and reduces rain flow velocity. They also provide a rough surface that slows the runoff and promotes infiltration. They increase the soil's capacity to absorb water through the plant's root system. Because of the important role of vegetation in watershed areas, watersheds are often the subject of reforestation activities. In this particular study, the capacity of Sudlon Watershed to sequester carbon dioxide was examined by identifying the kind and extent of vegetative cover in the area. According to Lasco & Pulhin (1997), different vegetative cover has differing capacities to absorb carbon dioxide. With this information, decisions in future reforestation activities in the area will be better guided. The general objective of this study is to quantify the biomass and carbon storage of the vegetative cover of Sudlon Watershed in Barangay Central, Mati, Davao Oriental. Specifically, the study aims to determine the total area of the vegetative cover, assess its vegetative structure, identify the current status of the vegetation, and provide appropriate recommendations for the effective management and conservation of the watershed. The study was conducted to provide an overview of the potential roles of watershed vegetation in Sudlon, Barangay Central, Mati, Davao Oriental, in sequestering carbon from the atmosphere. It will also provide information to the community, especially to the Barangay and Municipal officials, as well as to the people living in the area, for them to understand the role of watershed vegetation in carbon sequestration.

The study was limited only to the carbon sequestration capacity of Sudlon Watershed, Mati, Davao Oriental. The determination was limited only to the vegetative cover within the area, according to the assumptions provided by Lasco & Pulhin (1997), which employs the areal extent of vegetative cover to estimate the biomass of vegetation and hence the carbon sequestration capacity of the area. With these assumptions, all attributes under study are presumed to be the same as those in the study of Lasco & Pulhin (1997). This study was conducted from December 2010 to January 2011 in Sudlon Watershed, Barangay Central, Mati, Davao Oriental.

In this study, the total area of the vegetative cover, status of the vegetation, and vegetative structure were examined, and these parameters were used to determine the capacity of Sudlon Watershed to sequester carbon dioxide as well as provide the basis for making recommendations for the management of the area.

Materials and Methods

Study area

The study was conducted in Sudlon Watershed, covering the area of Barangay Central in the Municipality of Mati. It has a total area of 879.21 hectares based on the digitized map using Geographic Information System (GIS) software version 3.1 (Figure 1).

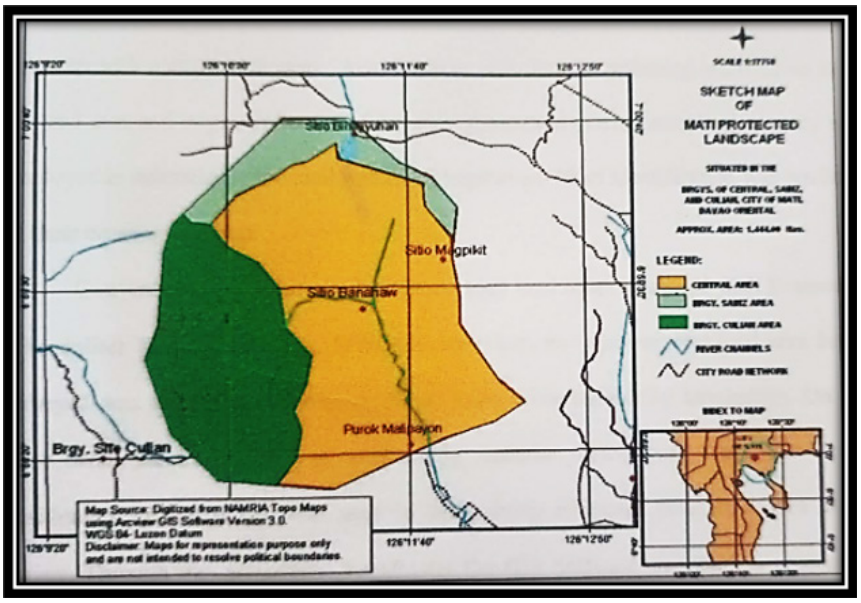


Figure1. Study area using GIS software version 3.1.

Sampling procedure

A courtesy letter was first given to the concerned agencies for protocol entries. Concerned Local Government Units (LGU's) and Barangay Local Government Units (BLGUs) were informed of the objectives of the study to recognize support and other conditions pertaining thereto.

Data gathering

Both primary and secondary data were used in achieving the objectives of this study. Primary data were taken through an actual survey within the study area. This was done by getting the coordinates of the vegetated area using the Global Positioning System (GPS) and employing the Geographic Information System (GIS) to process the data and come up with a vegetative map. An actual survey was done to gather information on the land uses and vegetative cover of the area. A hundred percent sampling intensity was employed in determining the total watershed vegetation. Plant identification was confined to their taxonomic group. Conventional procedure in delineating total land areas was used with Engineer's (Theodolite) Transit Surveying. With this procedure, an accurate total land area being surveyed was determined (surveying errors were corrected during tabulation). On the other hand, for the purpose of establishing a resource management map, the Global Positioning System (GPS) was used in determining the estimated total land area under survey. Through the geographic coordinates, the GIS Software was used to process these data to come up with a thematic map with respective desired attributes such as total17 area and type of vegetation. The procedures were applied in two specific situations as defined below. Further, actual surveying was accompanied by a professional surveyor.

Situation 1. Areas with flat to moderate terrain.

Areas with flat to moderate terrain, regardless of their size, can be accessed and surveyed since they have minimal risks to the surveyor. Fieldwork required a surveyor to actually cruise the boundaries of the surveyed area to determine data such as geographical coordinates and record all observable attributes he objectively desires to determine. These data were then processed using GIS software. The resulting delineated total area is only an estimate since GPS contains

error in determining geographic coordinates; thus, the output map area may not be so accurate. However, to attain a lower degree of error, GPS geographic coordinate readings were stabilized to five to nine meters accuracy.

Situation 2. Areas with stiff to very stiff terrains.

Risks associated are too high in the conduct of surveying in these kinds of areas. However, procedures stipulated in situation one (1) can be modified. These can be done in steps as follows:

Step 1. Development of a contour map of the area with a two-second grid interval.

Using GIS software, a contour map with a two-second grid interval was developed and printed. The contour map will guide the surveyor to determine the field geographic configuration and its various characteristics, such as vegetative cover types and their extent. On the other hand, grid intervals were used to locate the surveyor's position in the field, and the distance estimation for a two-second interval is equal to sixty meters.

Step 2. Establishment of control points as observation points.

Observation points were established at the top ridge of watershed divides and along the main river channel. These are where the surveyor did the cruising and established observation points. Top ridge observation points were established to see all physical configurations of the watershed area since it is located at the highest elevation of the watershed divides. On the other hand, observation points along the river channel were established to observe the inner composition of various vegetative types that cannot be seen at the top ridge points. Using GPS, the surveyor locates and plots his position on the developed contour map. The located and plotted positions become the observation points. From the developed contour map, the surveyor did the estimation of the vegetative cover extent and boundaries and listed its attributes and characteristics. Vegetative cover extent points were marked by estimation on the contour map. These points were now considered as the geographical boundary points. After surveying was done, the developed contour map with marked boundaries was transcribed using GIS software. Results such as vegetative type boundaries and their corresponding attributes and area in hectares were then provided.

Data analysis

Data for area determination were processed using Geographic Information System (GIS). Coordinates taken at all geo-referenced corner points were used as an input to the GIS to determine the total area of watershed vegetation under survey. The output was a map of watershed vegetation cover of all study areas. The determined hectarage was used in extrapolating biomass and carbon sequestration of the watershed vegetation area. Determination of biomass and carbon sequestration of the watershed vegetation under study was based on the study of Lasco & Pulhin (1997) entitled "Philippine Forestry and Carbon Dioxide Sequestration: Opportunities for Mitigating Climate Change". To get the capacity of the area to sequester carbon, the following formula was used.

1. For Agroforestry farms

B_{tp} = 83.4t/ha

$B_af = B_{tp}$ x 0.5 = 83.4t/ha x 0.5 = 41.7t/ha

Buvaf = 25% (B_af) 25% (41.7t/ha) = 10.425t/ha

To get the biomass of agroforestry farms:

Btaf = Baf + Buvaf = 41.7t/ha + 10.425t/ha

Print ISSN 2244-4432 • Online ISSN 2984-7125 DOI: https://doi.org/10.59120/drj.v7i6.643

Btaf = 52.125/ha
Thus, to calculate the carbon content:
Ctaf = Btaf x 0.5 = 52.125/ha x 0.5-26.06 t/ha

Where:
Btp = biomass of tree plantation
Baf = of agroforestry farms
Buvaf = biomass of understory vegetation
Btaf = total biomass of agroforestry

2. For tree plantations:
Btp =83.4t/ha
Buvtp = 25% * (Btp) = 25% (83.4t. ha) = 20.85t/ha
To get the total biomass of tree plantations:
Bttp = Btp + Buvtp = 83.4t/ha + 20.85t/ha
Bttp =104.25t/ha x 0.5=52.125t/ha

Where:
Btp = biomass of tree plantations
Buvtp = biomass of under vegetation
Bttp = total biomass of tree plantations
Cttp = total Carbon Sequestration of tree plantations.
Secondary-growth Forest
Ctsgf = 2.8t / ha
To get the total biomass of secondary-growth forest
Ctsgf = Btsgf x 0.5
2.8t / h * a = Btsgf x 0.5
0.5 0.5
5.6t / ha = Btsg

Where:
Ctsgf = total carbon sequestration of secondary-growth forest
Btsgf = total biomass of secondary growth forest

Ctsgf = Btsgf x 0.5
2.8t / h * a = Btsgf x 0.5
0.5 0.5
5.6t / ha = Btsg
Where:
Ctsgf = total carbon sequestration of secondary-growth forest
Btsgf = total biomass of secondary growth forest

Results and Discussion

Vegetative Cover Sudlon Watershed in Barangay Central covers a total area of 879.2063 hectares. Of these, 869.0016 ha. or 98.84% has vegetative cover, while 10.2047 ha. or 1.16% is occupied by human settlement housing residents of Purok Malipayon and Sitio Banahaw. In the vegetated area, various types of vegetative cover were found, and these are: agroforestry farm, tree plantation, secondary-growth forest, and cogon area.

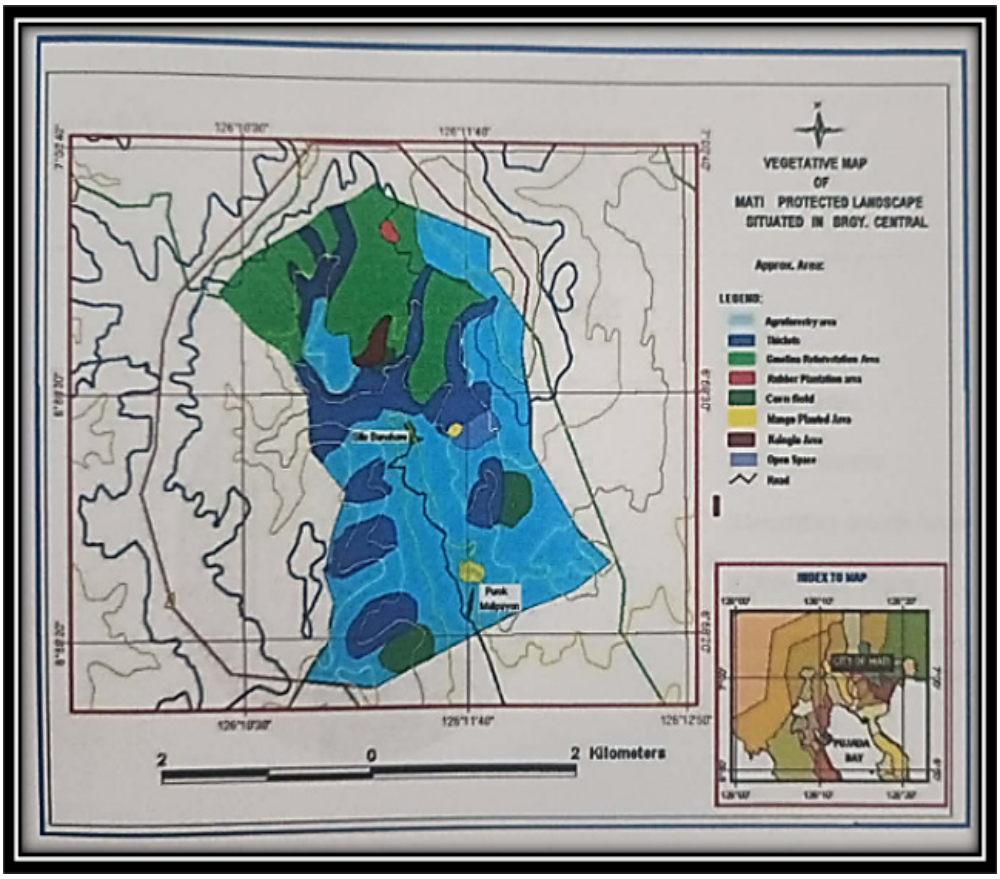


Figure 3. Vegetative map of the area.

The agroforestry farm occupies a large portion of the area, covering 492.3578 ha and comprising 56% of the total watershed.

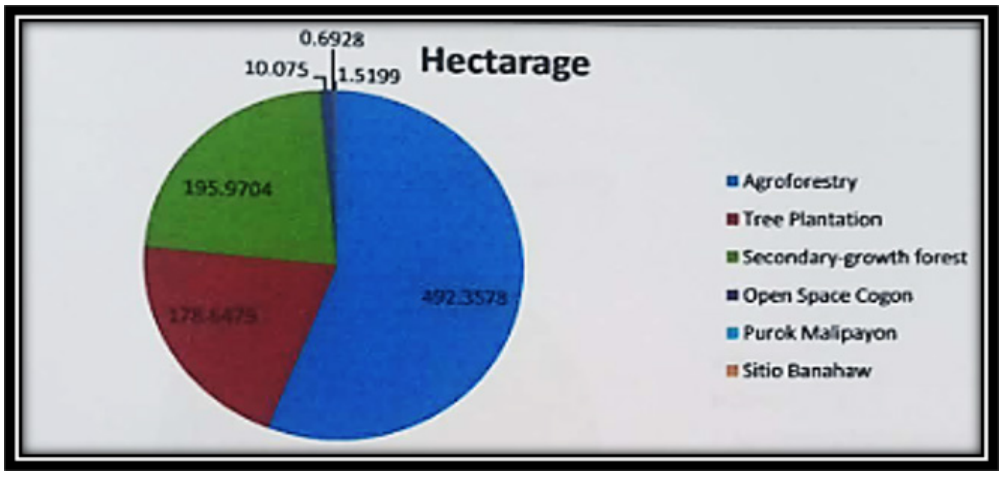


Figure 4. Vegetative covers with corresponding hectares.

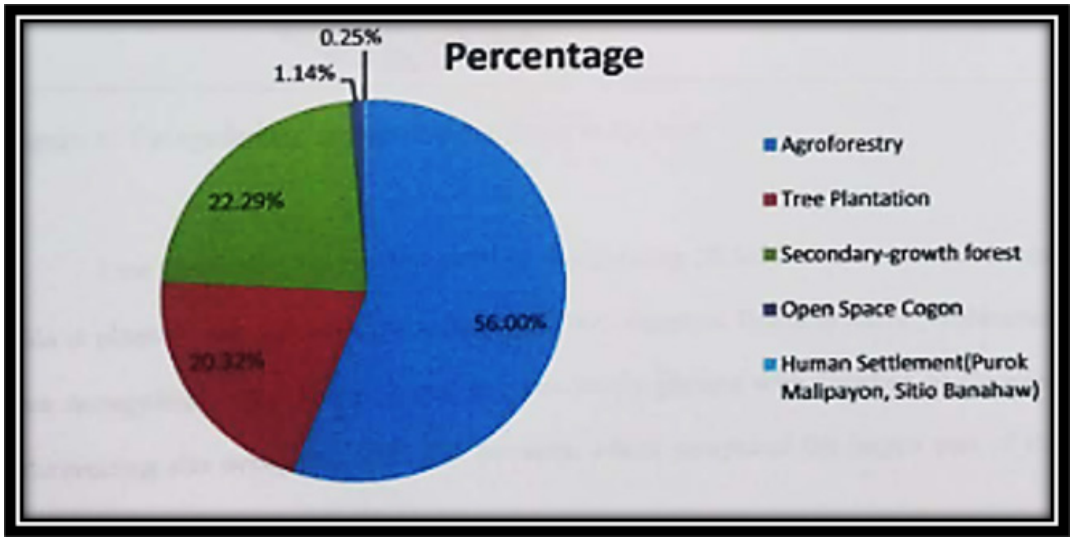


Figure 5. Vegetative covers with corresponding percentages.

Vegetative structure

The agroforestry farm, which forms the majority of the vegetative cover of Sudlon Watershed in Barangay Central, is planted with various crops, but a large portion of the area is planted with coconut and fruit trees.

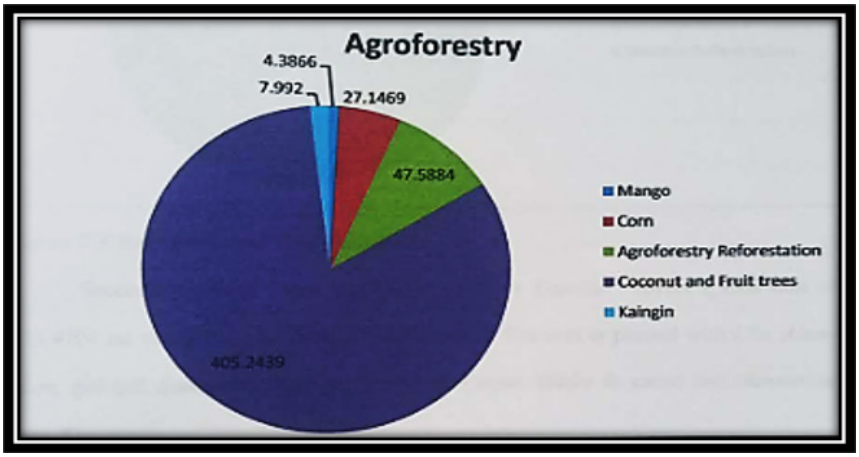


Figure 6. Categorization of agroforestry farms in the area.

Tree plantation covers 178.6479 ha. comprising 20.32% of the watershed area. This is planted with Rubber tree occupying 2.5627 hectares, Gmelina/Narra combination area occupying 6.2665 hectares, and the area solely planted with Gmelina or Gmelina reforestation site occupying 169.8187 hectares, which comprised the largest part of the area (Figure 7).

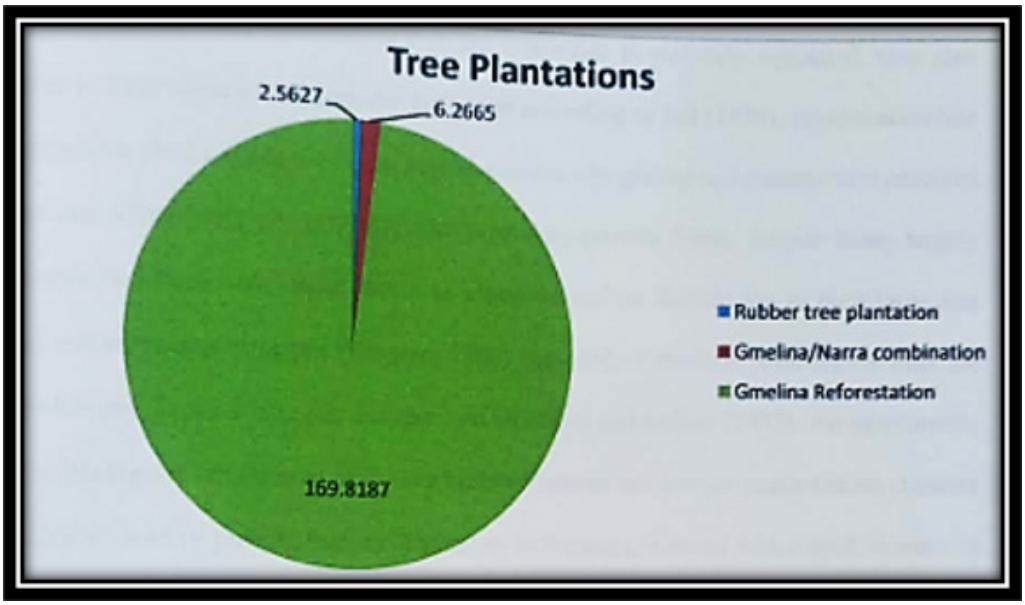


Figure 7. Categorization of tree plantations.

Secondary-growth Forest, also known as "Lati or Kalatian," covers a total area of 195.9704 ha. comprising 22.29% of the watershed. The area is planted with Lila, Alum-alum, Ipil-ipil, Sadimsim, Binungo, Anabyong, Cogon, Madre de cacao, and Mansanitas.

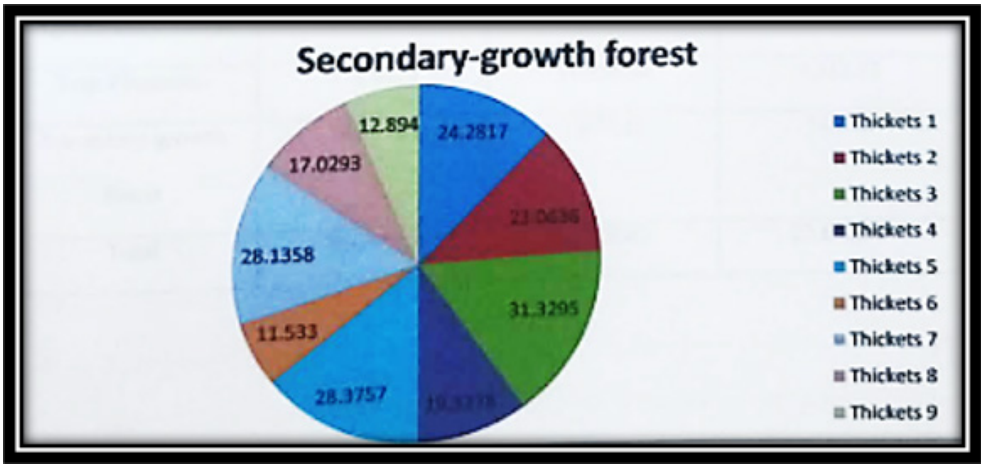


Figure 8. Categorization of Secondary-growth Forest.

Based on this observation that the watershed is variously vegetated, they also differ in their capacity to sequester carbon, as according to Lal (1999), sequestration rate depends on plant species, soil type, region, climate, topography, and management practices that can affect plant productivity. The secondary-growth forest, despite being largely occupied by trees with a greater ability to sequester carbon dioxide due to their large size and extensive root structure (Birdsey, 1996), has only a minimal contribution compared to the agroforestry farms. Using the assumptions of Lasco and Pulhin (1997), the agroforestry farm having the largest area will have higher biomass and carbon sequestration capacity (Table 1). In general, Sudlon Watershed in Barangay Central, with a total biomass of 44,969.03 tons, has a total carbon sequestration capacity of 22,483.38 tons (Table 1).

Print ISSN 2244-4432 • Online ISSN 2984-7125 DOI: https://doi.org/10.59120/drj.v7i6.643

Table 1. Vegetative covers in Sudlon Watershed with corresponding hectarage, total biomass, and total carbon sequestration capacity.

Vegetative cover	Hectarage	Total Biomass	Total Carbon Sequestration
Agroforestry Farms	492.36	25,664.15	12,830.84
Tree Plantation	178.65	18,624.04	9,312.02
Secondary-growth Forest	195.97	1,097.43	548.72
Total	**866.98**	**45,385.62**	**22,691.58**

Status of vegetative cover

Human influence is evident on the watershed ecosystem. A large part of the forest area is already farmed; there is human settlement on 2.21 ha. of land, while kaingin was observed to be practiced by some residents. Kaingin is the practice of clearing the land and burning the forest for the purpose of farming crops. It can erode soil fertility, and when this happens, kaingin farmers move to other areas (Noble, 1998). Secondary-growth Forest, also known as thickets, also served as a source of firewood for some residents in the area, and the practice can cause biomass or carbon loss.

With the above scenario, rehabilitation of degraded lands through the establishment of agroforestry and tree plantations can assist in the regeneration of the vegetation in the area and in enhancing its role in sequestering carbon dioxide from the atmosphere. These strategies have become popular in many places due to the combination of economic return and environmental benefits they provide (Aggangan, 2000). Consequently, based on the results obtained, the following should be done in the area. First, expansion of human settlement and kaingin must be stopped. Secondary-growth Forest with small, short-lived trees must undergo revegetation to maximize the absorption of carbon from the atmosphere. Third, long-lived tree species such as Pterocarpus indicus, Dracontomelon dao, and Paraserianthes falcataria must be used in rehabilitation and tree plantation. Long-lived tree species need or utilize more carbon in making their tissues; they store more carbon in their biomass; hence, they sequester more carbon from the atmosphere (Lasco & Pulhin, 1997). Fourth, strengthen the Information Education Campaign (IEC) relative to the importance of vegetation in carbon sequestration, so that the kaingin agricultural practice, which is destructive to the environment, is stopped.

Conclusion

The area under study was found to have five major land uses, namely, Agroforestry farm, Tree plantation, Secondary-growth Forest, Cogon area, and Human settlement. Of these, four have significant vegetative cover namely Agroforestry farms, Tree Plantation, Secondary-growth Forest, and Cogon area. The Agroforestry farm occupied the largest area and hence, based on Lasco and Pulhin (1997) assumption, contains the greatest biomass and thus has the greatest capacity to sequester carbon. In total, the watershed area contains an estimated biomass of 45,385.62 and 22,691.58 carbon sequestration capacity.

Throughout the world, 3.3 billion tons/year of carbon is added to the atmosphere. Therefore, the vegetative cover of Sudlon Watershed sequesters 0.00000874 tons of carbon per year and removes 0.000874% of carbon in the atmosphere. Human influence on the watershed ecosystem of the Sudlon watershed along Brgy. Central is evident by the fact that a large part of the area is already farmed, human settlements exist, and kaingin is done in the area. With this situation, there is a need to look closely at the management of the watershed. Rehabilitation of degraded areas through the establishment of agroforestry and tree plantations can assist in the regeneration of the vegetation at the same time enhancing its role in sequestering carbon dioxide from the atmosphere.

References

Aggangan, R.T. 2001. Tree farming in the Philippines: Some issues and recommendation.

Anderson, J.M. and Ingram J.S.I. 1989. Tropical soil biology and fertility. A handbook of Method.

Anderson, J.M. and Spencer, J.F. 2001. Headward erosion versus Closed-basin Spillover as alternative causes of Neogene Capture of the ancestral Collordo River by the Gulf of California.

Andrews, P. 2008. Beyond the brink: Peter Andrews' radical vision for a sustainable Australia landscape.

Birdsey, R.A. 1996. Regional Estimates of Timber Volume and Forest Carbon for Fully Stocked Timberland, Average Management After Final Clearcut Harvest. In Forest Global Change.

Canadell JG, Raupach MR (2008). Managing Forests for Climate Change.

CSIRO An Analysis of Greenhouse Gas Mitigation and Carbon Biosequestration Opportunities from Rural Land Use. Canberra. 2009.

Department of Energy (DOE). 1999. Carbon Sequestration Research and Development, Office of Fossil Energy and Office of Science URL.

Heimann, M. and Reichstein, M. 2008. Terrestrial ecosystem carbon dynamics and climate.

Intergovernmental Panel on Climate Change (IPCC). 1995. Climate Change. Cambridge University Press, Cambridge.

Lagare, E.R. 2010. Carbon Sequestration of Mangrove Forest Ecosystem in Gulf Towns, Davao Oriental Undergraduate Thesis. (DOSCST Unpuplished thesis).

Laird, David A. 2008. The Charcoal Vision: A Win-Win-Win Scenario for Simultaneously Producing Bioenergy, Permanently Sequestering Carbon, while Improving Soil and Water Quality.

Lal, R. 1999. Global carbon pools and fluxes and the impact of agricultural intensification and Judicious land use. In prevention of land degradation, enhancement of carbon Sequestration and conservation of biodiversity through land uce change and sustainable land management with a focus on Latin America and the Caribbean. World Soil Resource Report 86. FAO, Rome

Lasco, R.D. and Pulhin, F.B. 1998. Philippine Forestry and Carbon Dioxide Sequestration: Oppurtunities for Mitigiting Climate Change Philippines: College of Forestry and Natural Resources, University of the Philippines, Los Banos.

Lasco, R.D. and Pulhin, F.B. 1997. Philippine Forestry and Carbon Dioxide Sequestration: Opportunities for Mitigating Climate Change Philippines: College of Forestry and Natural Resources, University of the Philippines, Los Banos.

Lasco, R.D. and Pulhin, F.B. 2003. Philippine forest ecosystem and climate change: Carbon stocks, rate of sequestration and the Kyoto Protocol.

Sagers, C.S. and Lyon, J. 1997. Gradient analysis in a riparian landscape: contrast among forest layers: Forest Ecology and Managemaent 96:13-26.

Trexler, M.C. and Haugen, C. 1994. Keeping it Green: Evaluating Tropical Forestry Strategies to Mitigate Global Warming. World Resources Institute, Washington DC