

Carbon Storage of the Grassland Areas of Ikalahan Ancestral Domain, Nueva Vizcaya, Philippines

Florencia Pulhin

Southeast Asia



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PO Box 161, Bogor 16001, Indonesia

Tel: 62 251 625415, fax: 62 251 625416
Email: icraf-indonesia@cgiar.org
ICRAF Southeast Asia website: <http://www.worldagroforestrycentre.org/sea>

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Abbreviations

ABD	Bulk density
CDM	Clean Development Mechanism
DW	Dry weight
IFAD	International Fund for Agricultural Development
KEF	Kalahan Educational Foundation
ODW	Oven-dry weight
RUPES	Rewarding Upland Poor for Environmental Services they provide
SFW	Sample fresh weight
SOC	Soil organic content
SODW	Sample oven-dry weight
TFR	Total fresh weight

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Abstract

Sample plots measuring 1m x 1m were established in the 11 sites of the Ikalahan Ancestral Domain, Nueva Vizcaya, Philippines. Grass samples inside the plots were collected, weighed and oven dried for biomass density determination and carbon content analysis. Likewise, soil samples within the sample plots are collected to assess the bulk and carbon densities of the mentioned ecosystem. Results of the study show that biomass density of the grasslands in the area ranges from 2.75 Mg/ha to 11.60 Mg/ha or an average of 6.60 Mg/ha. In terms of carbon content, carbon analysis of the grass samples indicate that grassland areas in the Domain contain around 34% carbon. Soils in the grasslands have carbon density values ranging from 35.36 Mg/ha to 47.22 Mg/ha. On the average, carbon density of the grassland areas amounts to 41.42 Mg/ha. Total carbon density of the grassland areas ranges from 36.59 Mg/ha to 52 Mg/ha. Average total carbon density of the grasslands is about 44 Mg/ha. In terms of percentage, analysis shows that a large percentage of the total carbon density of the grasslands is found in the soil. This carbon pool contributes around 91 – 99% of the total carbon density. On the other hand, the grass component contributes a very small percentage of a mere 1 – 9%. Results indicate that soil is a major sink of carbon because it does not only absorb large amount of carbon but it also holds carbon for a longer period of time compared with vegetation.

1. Background

A study of the carbon storage of the grassland areas in Ikalahan Ancestral Domain was commissioned to an independent body in 2006 to assist the Kalahan Educational Foundation (KEF) to participate in the carbon market particularly for the Clean Development Mechanism (CDM). The purpose of this study is to assess the carbon storage of the grassland areas in the Domain. The main result of the study has three parts: 1) biomass densities of the grassland; 2) carbon content of the grassland area and soil organic content; and 3) total carbon densities. The study was funded by the International Fund for Agricultural Development (IFAD) under the Rewarding Upland Poor for providing Environmental Services (RUPES) Project Phase 1.

2. Objectives

- To determine the biomass density of the grassland areas in Kalahan;
- To ascertain the carbon content of the grass samples collected;
- To find out the carbon density of the soils in grasslands; and
- To estimate the total carbon density of the grassland.

3. Study Site

The study was conducted inside the Ikalahan Ancestral Domain, Nueva Vizcaya in the northern part of the Philippines with a total area of 50,000 ha. The target areas are grassland areas in 11 barangays or villages (table 1). All the sampled barangays are located at N16°120'E with elevation ranging from 500-1300 masl.

The domain is one of the pilot sites of RUPES project in the Philippines. Under the project, RUPES Kalahan team examines and tests payments from carbon sequestration, biodiversity and watershed protection.

Table 1. Site profile of the sampled sites.

SITE (barangays)	LOCATION	ELEVATION (masl)	SPECIES PRESENT
1. Buyasyas	N16 ⁰ 120'E	992.25	Cogon, Malatungao, Talahib, Talnag, Tiger grass
2. Canabuan	N16 ⁰ 120'E	673.5	Cogon, Dilang baka, Hagonoi, Malatungao, Napier, Tambo
3. Canarem	N16 ⁰ 120'E	614.25	Bayabas, Cogon, Hagonoi, Malatungao, Malvaceae sp.
4. Anayo	N16 ⁰ 120'E	592.5	Carabao grass, Cogon, Coronitas, Dilang baka, Dilang-aso, Guava, Hagonoi, Kalmot pusa, Kudzu, Malatungao, Napier
5. Balete, Sta. Fe	N16 ⁰ 120'E	673.25	Cogon, Malatungao, Talahib
6. Balete, Aritao	N16 ⁰ 120'E	541.5	Bayanti, Carabao grass, Cogon, Coronitas, Guava, Hagonoi, Ladao, Lantana, Malatungao, Tibig, Talahib, Wild oregano
7. Tactac	N16 ⁰ 120'E	893	Carabao grass, Cogon, Guava, Kalmot pusa, Talahib
8. Atbu	N16 ⁰ 120'E	836	Cogon, Coronitas, Dilang aso, Guava, Hagonoi, Hauili, Ladao, Malatungao, Napier grass, Talahib
9. Sta. Rosa	N16 ⁰ 120'E	1350.5	Benguet pine, Cogon, Malatungao, Napier grass, Pteridaceae sp., Silver fern, Talahib
10. Kapinyahan	N16 ⁰ 120'E	671.5	Carabao grass, Cogon, Hauili, Talahib
11. Putlan	N16 ⁰ 120'E	514.75	Cogon, Talahib

4. Methodology

Sample plots. Barangays with large areas of grassland were identified and established sample plots. In each barangay, two strips were laid on the ground. Each strip contained five sampling points with 50 meters interval. In each sampling points, a 1m x 1m frame plot was laid. All grasses inside the sampling frames were collected for biomass determination. Soil samples were collected at 30cm depth. For bulk density determination, samples were collected from an undisturbed spot inside the sampling frame. A ring metal with a height of 5 cm and diameter of 3 cm was carefully pushed into the undisturbed soil and sampled the 0-5 cm depth layer.

Biomass values. Fresh grass samples were weighed and a sample of 300 grams from each plot was set aside for oven drying.

Biomass values for grass were calculated using the following formula:

$$\text{ODW} = \frac{\text{TFW} - (\text{TFW} * (\text{SFW} - \text{SODW}))}{\text{SFW}}$$

where,

ODW = total oven dry weight

TFW = total fresh weight

SFW = sample fresh weight

SODW = sample oven-dry weight

Carbon density calculation. To calculate the carbon density, the following formula was used.

$$\text{C Density} = \text{Biomass Density} \times \% \text{Carbon}$$

Soil carbon analysis. Soil samples were placed in labeled plastic bags, air dried and taken to the Soils Laboratory of the Soil Science Department of the College of Agriculture, University of the Philippines Los Baños for analysis. Method used for the analysis was the Walkley-Black method (PCARR, 1981).

For bulk density, samples collected were placed in aluminum foil and were taken to the laboratory for fresh weight determination and oven drying. Bulk density was computed using the following formula:

$$\text{B. D.} = \frac{\text{DW}}{\text{V}}$$

where,

B.D. = bulk density of the soil (g/cm³)

DW = dry weight of the soil (g)

V = volume of the cylinder (cm³)

The dry weight of the soil and the equivalent carbon stock was determined using the following formulae:

Soil mass at specified depth (Mg)

= Bulk density at specified depth (Mg/m³) x 10,000m² x depth (m)

Soil carbon at specified depth (Mg)

= Soil mass at specified depth (Mg) x %organic carbon at specified depth /100

5. Results and Discussions

Plant species. Cogon (*Imperata cylindrica*) is the most commonly found plant species in all the sites. Two other species namely malatungao and talahib (*Saccharum spontaneum*) are relatively common in the sites. Other species present in the area include bayanti, carabao grass (*Axonopus compressus*), coronitas, dilang baka, dilang-aso, guava, hagonoi, hauili, kalmot pusa, kudzu, malatungao, napier (*Pennisetum purpureum*), guava, hagonoi, ladao, lantana, tibig, and wild oregano.

Biomass density. The computed biomass density of grasslands in the domain ranges from 2.75 Mg/ha to 11.60 Mg/ha. On the average, the area has biomass density of 6.60 Mg/ha (Table 2). Of the 11 barangays that are sampled, grasslands in Buyasyas have the highest biomass density while the lowest are found in Balete, Sta Fe area. It is worthy to note however, that grasslands in Kapinyahan have nearly the same biomass density as that of the grasslands in Buyasyas since they have on the average biomass density of 11.60 Mg/ha. Biomass densities of the sampled sites are in the following order: Buyasyas > Kapinyahan > Canabuan > Tactac/Putlan > Sta Rosa > Anayo > Canarem, >Balete (Aritao) > Atbu > Balete (Sta Fe).

Compared with the biomass density values obtained from the grassland areas of the PNOC Leyte Geothermal Reservation, the domain is two to three times lower than the biomass density obtained from the grassland area of Leyte depending on the dominant species studied (Lasco et al. 1999). For example, old swards of cogon in Leyte have biomass density ranging from 8.81 Mg/ha to 14.39 Mg/ha or an average of 11.50 Mg/ha. Talahib species on the other hand, has biomass density value ranging from 21.86 Mg/ha to 36.79 Mg/ha or an average of about 27 Mg/ha. Also, the obtained biomass density from this study is lower than the value reported by Fearnside (1996) for pastures and agricultural areas. Accordingly, these areas have average total biomass of 43.5 Mg/ha.

On the other hand, the values obtained from this study are a lot higher when compared with biomass density values obtained from grassland ecosystem in Kaliwa watershed, Tanay, Rizal (biomass density ranging from 0.91 Mg/ha to 4.13 Mg/ha). On the average, biomass density of grasslands in Kaliwa watershed is only 1.92 Mg/ha.

Lugo and Brown (1992) mentioned that different values of biomass of a system are resulted from the different degrees of anthropogenic and natural disturbances. Grassland areas experiencing little or less disturbance exhibit higher biomass densities while areas that are frequently burned have lower biomass densities.

Table 2. Biomass densities of the of the grassland areas in the domain.

LOCATION	BIOMASS DENSITY (Mg/ha)
Buyasyas	11.60
Canabuan	9.02
Canarem	4.32
Anayo	4.92
Balete, Sta. Fe	2.75
Balete, Aritao	3.56
Tactac	7.21
Atbu	3.49
Sta. Rosa	7.11
Kapinyahan	11.36
Putlan	7.21
Mean	6.60

Carbon content of grasslands. Carbon content of grass samples in the domain ranges from 22% to 40% (Table 3). On the average, grasslands have carbon content of 34.09%. Results imply that only 34% of the grasses are carbon. Highest carbon content was obtained from the grass samples of Tactac while lowest carbon content was recorded from the samples of Balete, Sta Fe. Grass samples from Tactac and Balete, Sta Fe have mean carbon content of 39.82% and 22.02%, respectively. More than half of the eleven sampled sites have carbon content of 35% or greater. These are Anayo, Tactac, Atbu, Sta Rosa, Kapinyahan and Putlan.

Compared with other studies conducted (Lasco et al. 1999), the percent carbon obtained from the plant tissues is far lower than the carbon content of grasslands of Leyte and Tanay, Rizal. Grass samples of Leyte have mean carbon content of 44% while those of Kaliwa watershed in Tanay, Rizal contain about 43.7% carbon.

Table 3. Carbon content of the grasslands in the domain.

LOCATION	CARBON CONTENT (%)
Buyasyas	31.52
Canabuan	30.38
Canarem	31.84
Anayo	34.58
Balete, Sta. Fe	22.02
Balete, Aritao	34.46
Tactac	39.82
Atbu	39.46
Sta. Rosa	37.44
Kapinyahan	35.04
Putlan	38.48
Mean	34.09

a. Aboveground carbon density

Similar to the trend observed in the biomass densities, grassland areas in Balete, Sta Fe have the lowest carbon density. On contrary, highest carbon density is found in the grasslands of Kapinyahan (Table 4). Grasslands in Buyasyas only rank second in terms of carbon density because the carbon content of the grass samples amounts only to 31.52%. While the grass samples from Buyasyas and Kapinyahan have almost the same biomass densities, grass samples from Kapinyahan exhibit higher carbon density than that of Buyasyas because carbon content of grass samples from Kapinyahan is about 4% higher. Carbon densities of the sampled grasslands in 11 barangays do not follow the same order as the biomass densities. This is due to the varying carbon content obtained from the grass samples. Carbon densities of the sampled barangays are in the following order: Kapinyahan > Buyasyas > Tactac > Putlan > Canabuan > Sta Rosa > Anayo > Atbu/Canarem > Balete (Aritao) > Balete (Sta Fe).

Aboveground carbon density of the grassland areas in the 11 barangays range from 1.23 Mg/ha to 3.98 Mg/ha. Average carbon density in the grasslands of the domain amounts to 2.25 Mg/ha. Compared to the carbon densities obtained in the grasslands of the PNOG Geothermal Leyte, calculated carbon densities from this study is a lot lower. Carbon density of cogon and talahib in Leyte is 5.11 Mg/ha and 11.45 Mg/ha, respectively. Furthermore, the results of this study are inconsistent with the IPCC default value of 10 Mg/ha for crop lands and pasture areas (IPCC, 1996). However, it is worthy to note that values obtained from this study are higher than those obtained from the grasslands of the Kaliwa watershed (0.84 Mg/ha).

Table 4. Aboveground carbon densities of the grassland areas in the domain.

LOCATION	CARBON CONTENT (%)	CARBON DENSITY (Mg/ha)
Buyasyas	31.52	3.66
Canabuan	30.38	2.74
Canarem	31.84	1.38
Anayo	34.58	1.70
Balete, Sta. Fe	22.02	0.61
Balete, Aritao	34.46	1.23
Tactac	39.82	2.87
Atbu	39.46	1.38
Sta. Rosa	37.44	2.66
Kapinyahan	35.04	3.98
Putlan	38.48	2.77
Mean	34.09	2.25

b. Soil bulk and carbon densities

The bulk densities of the soil in all the sampled sites ranged from 0.7487 g/cc to 1.0347 g/cc. Lowest bulk density is exhibited by the grasslands in Sta Rosa while the highest bulk density is found in Balete, Sta Fe. It should be noted that almost all of the barangays sampled have bulk densities ≥ 0.9 g/cc. Representing around 82% of the total sampled areas, sites belonging to this group includes Buyasyas, Canabuan, Canarem, Anayo, Balete (Sta Fe), Balete (Aritao), Atbu, Kapinyahan, and Putlan. The remaining 18% of the total sampled sites have soil bulk densities of 0.75 g/cc only. This group includes Sta Rosa and Tactac (Table 5). Results indicate that soil bulk density values derived from the grasslands of the domain are relatively high. Ecosystems with high soil bulk density values indicate that such areas are disturbed and more compact which is typical characteristic of the grassland areas in the Philippines.

Table 5 further shows the percent soil organic carbon (SOC) of the grasslands of the domain. Percent SOC of the grasslands sampled range from 3.58 to 6.42. Highest percent SOC is observed in Sta Rosa while the lowest percent SOC is manifested by the grasslands in Balete, Aritao. On the average, percent SOC is valued at 4.66.

In terms of soil carbon density, soils in the grasslands of the domain have values ranging from 35.36 Mg/ha to 47.22 Mg/ha. Highest SOC is found in the grasslands of Barangay Sta Rosa while the lowest SOC is revealed by those found in Barangay Balete, Sta Fe. Average carbon density of the grassland areas amounts to 41.42 Mg/ha.

Compared with other studies conducted, carbon density values obtained from this study is lower than those derived from the studies conducted in Leyte and Tanay, Rizal. Soil carbon density values of the grasslands in Leyte and Tanay, Rizal are 52.70 Mg/ha and 55 Mg/ha, respectively.

Table 5. Soil bulk and carbon densities of grassland areas in the domain

LOCATION	BULK DENSITY (g/cc)	SOC (%)	CARBON DENSITY (Mg/ha)
Buyasyas	0.8920	4.43	38.71
Canabuan	0.9476	4.01	37.92
Canarem	1.0022	4.42	44.20
Anayo	0.8973	5.12	45.78
Balete, Sta. Fe	1.0347	5.00	51.48
Balete, Aritao	0.9870	3.58	35.36
Tactac	0.7501	5.51	41.32
Atbu	0.8866	4.24	37.69
Sta. Rosa	0.7487	6.42	47.22
Kapinyahan	0.8653	4.64	40.02
Putlan	0.9271	3.89	35.90
Mean	0.9035	4.66	41.42

c. Total carbon density

Figure 1 shows the total carbon density of the grassland areas in the domain. Of the 11 sampled sites, grasslands in Balete, Sta Fe are found to have the highest carbon density around 52 Mg/ha. Lowest total carbon density is found Balete, Aritao amounting to 36.59 Mg/ha. Average total carbon density of the grasslands in the Domain is about 44 Mg/ha. The 11 barangays sampled are in the following order in terms of total carbon density: Balete, Sta Fe > Sta Rosa > Anayo > Canarem > Tactac > Kapinyahan > Buyasyas > Canabuan > Atbu > Putlan > Balete, Aritao.

Compared with the total carbon density values derived from the PNOC Geothermal Reservation in Leyte and the Kaliwa watershed in Tanay, Rizal, values obtained from this study is lower. Total carbon density of grasslands in the PNOC Geothermal Leyte amounts to 63.53 Mg/ha while value obtained from Kaliwa watershed in Tanay, Rizal is 55.84 Mg/ha.

Percent contribution of the grass and soil components to the total carbon density of the grasslands of the domain is shown in Table 6. Results indicate that bulk of the total carbon density of the grassland areas is contributed by the soil. As shown in Table 5, soil contributes around 91 – 99% of the total carbon density while the grass samples contribute a mere 1 – 9%. Results obtained are consistent with the results derived from the other studies conducted. For instance, in the studies conducted in Leyte total carbon density attributed by the soil is around 83% while only 17% is contributed by the aboveground carbon pool. In Tanay, Rizal on the other hand, 98% of the total carbon density is provided by the soil and a very small percentage of two percent is given by the grass samples. Results indicate that soil is really a significant sink of carbon because compared with vegetation, soil stores more organic carbon and holds it at longer periods of time.

The capacity of the soil to store soil organic carbon is influenced by a number of factors. These include: (1) mean annual precipitation; (2) degree of forest disturbance; and (3) extent of land use change (Lugo and Brown, 1993). According to Birdsey (1992), conversion of forests to agriculture production reduces carbon content by 40 percent.

To enhance the role of soil in carbon sequestration, Dixon et. al. (1993) recommended a number of strategies. These were: 1) forestation to reduce erosion; (2) maintaining or improving soil fertility; (3) concentrating on tropical agriculture and reducing shifting agriculture; (4) removing marginal lands from agricultural production; and (5) retaining forest litter and debris after silvicultural or logging activities.

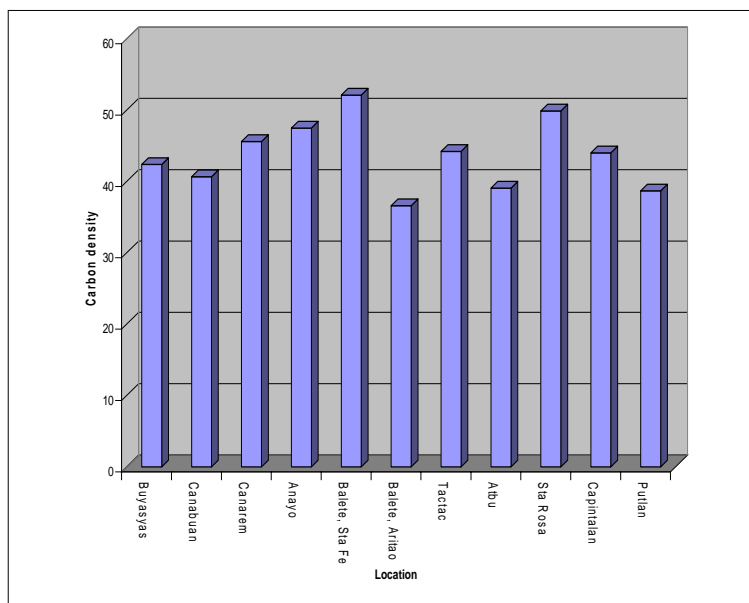


Figure 1. Total carbon density of grassland areas in the domain.

Table 6. Percent contribution of the grass and soil to the total carbon density of the grasslands in the domain.

LOCATION	CARBON DENSITY				
	GRASS	PERCENT	SOIL	PERCENT	TOTAL
Buyasyas	3.66	8.64	38.71	91.36	42.37
Canabuan	2.74	6.74	37.92	93.26	40.66
Canarem	1.38	3.03	44.2	96.97	45.58
Anayo	1.7	3.58	45.78	96.42	47.48
Balete, Sta Fe	0.61	1.17	51.48	98.83	52.09
Balete, Aritao	1.23	3.36	35.36	96.64	36.59
Tactac	2.87	6.49	41.32	93.51	44.19
Atbu	1.38	3.53	37.69	96.47	39.07
Sta Rosa	2.66	5.33	47.22	94.67	49.88
Kapinyahan	3.98	9.05	40.02	90.95	44
Putlan	2.77	7.16	35.9	92.84	38.67

6. Implication carbon mitigation efforts

Based on the results obtained from the study, grassland areas in the domain store very small amount of carbon. Thus, they do not significantly contribute to carbon sequestration since they undergo a cycle of grass-fire-grass cycle. Most often, grasslands in the Philippines are burned thereby releasing huge amount of carbon into the atmosphere. Unless this ecosystem is protected and properly managed, grassland cannot at all contribute in mitigating climate change in the Philippines.

To enhance the role of the grasslands in the domain in terms of carbon sequestration, they should be developed to tree plantations or agroforestry areas. Based on the results of the studies conducted on the various land uses in the Philippines, tree plantations and agroforestry systems have carbon densities of 232.97 MgC/ha (Lasco et al, 2000) and 181.46 MgC/ha (Zamora,1999), respectively. If these grassland areas are converted either into tree plantation or agroforestry, this ecosystem will definitely store huge amount of carbon. Thus, if the local communities managing the domain decide to get involved in the CDM forestry project, they will be able to gain considerable carbon credits since carbon in tree plantations and agroforestry areas are far higher than the carbon in the grasslands (baseline).

7. Conclusion

Prior to the implementation of a carbon sink project, carbon under the baseline condition must be assessed first. This is to ensure that additionality will occur once such project is carried out. In Ikalahan Ancestral Domain, vast tract of grassland areas are available for development of reforestation or agroforestry project. Such project can be given financing under the scheme of the CDM if found eligible. Thus, this study is done to assess the carbon storage of the grassland areas in the domain.

In conclusion, grasslands in the domain store some amount of carbon in their biomass and soil. However, potential of the area to store and sequester more carbon can be achieved if these areas are converted into tree plantations or agroforestry farms. Based on estimates, tree plantations and agroforestry systems in the Philippines have carbon densities five to six times more than the grasslands.

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Appendix

Table 1. Biomass and carbon densities of sampling points in grasslands of Barangay Buyasyas, Imugan, Nueva Vizcaya.

SAMPLE CODE	TOTAL FRESH WEIGHT (Mg)	SAMPLE FRESH WEIGHT (Mg)	OVEN DRY WEIGHT (Mg)	TOTAL DRY WEIGHT (Mg)	BIOMASS DENSITY (Mg/ha)	CARBON DENSITY (Mg/ha)
BG1	1850	225	175	1.44	14.39	6.48
BG2	2675	350	299	2.29	22.85	10.28
BG3	2075	250	198	1.64	16.43	7.40
BG4	1850	300	230	1.42	14.18	6.38
BG5	375	375	200	0.20	2.00	0.90
BG6	300	300	220	0.22	2.20	0.99
BG7	400	225	161	0.29	2.86	1.29
BG8	1950	300	232	1.51	15.08	6.79
BG9	1800	250	198	1.43	14.26	6.42
BG10	1550	300	228	1.18	11.78	5.30
Mean	1482.50	287.50	214.10	1.16	11.60	5.22

Table 2. Biomass and carbon densities of sampling points in grasslands of Barangay Canabuan, Imugan, Nueva Vizcaya.

SAMPLE CODE	TOTAL FRESH WEIGHT (Mg)	SAMPLE FRESH WEIGHT (Mg)	OVEN DRY WEIGHT (Mg)	TOTAL DRY WEIGHT (Mg)	BIOMASS DENSITY (Mg/ha)	CARBON DENSITY (Mg/ha)
CG1	475	475	92	0.09	0.92	0.41
CG2	425	425	175	0.18	1.75	0.79
CG3	410	410	133	0.13	1.33	0.60
CG4	875	300	138	0.40	4.03	1.81
CG5	850	175	212	1.03	10.30	4.63
CG6	575	100	222	1.28	12.77	5.74
CG7	675	300	155	0.35	3.49	1.57
CG8	2500	300	130	1.08	10.83	4.88
CG9	380	380	228	0.23	2.28	1.03
CG10	2350	200	362	4.25	42.54	19.14
Mean	951.50	306.50	184.70	0.90	9.02	4.06

Table 3. Biomass and carbon densities of sampling points in grasslands of Barangay Canaraem, Imugan, Nueva Vizcaya.

SAMPLE CODE	TOTAL FRESH WEIGHT (g)	SAMPLE FRESH WEIGHT (g)	OVEN DRY WEIGHT (g)	TOTAL DRY WEIGH T (g)	BIOMASS DENSITY (Mg/ha)	CARBON DENSITY (Mg/ha)
CaG1	650	300	195	0.42	4.23	1.90
CaG2	440	300	145	0.21	2.13	0.96
CaG3	640	300	228	0.49	4.86	2.19
CaG4	440	300	172	0.25	2.52	1.14
CaG5	700	300	122	0.28	2.85	1.28
CaG6	540	250	191	0.41	4.13	1.86
CaG7	675	300	181	0.41	4.07	1.83
CaG8	550	300	132	0.24	2.42	1.09
CaG9	2000	300	200	1.33	13.33	6.00
CaG10	660	300	120	0.26	2.64	1.19
Mean	729.50	295.00	168.60	0.43	4.32	1.94

Table 4. Biomass and carbon densities of sampling points in grasslands of Barangay Anayo, Imugan, Nueva Vizcaya.

SAMPLE CODE	TOTAL FRESH WEIGHT (g)	SAMPLE FRESH WEIGHT (g)	OVEN DRY WEIGHT (g)	TOTAL DRY WEIGHT (g)	BIOMASS DENSITY (Mg/ha)	CARBON DENSITY (Mg/ha)
AG1	750	300	158	0.40	3.95	1.78
AG2	375	300	189	0.24	2.36	1.06
AG3	300	300	145	0.15	1.45	0.65
AG4	450	300	152	0.23	2.28	1.03
AG5	675	300	89	0.20	2.00	0.90
AG6	475	300	129	0.20	2.04	0.92
AG7	700	125	161	0.90	9.02	4.06
AG8	700	300	99	0.23	2.31	1.04
AG9	850	150	152	0.86	8.61	3.88
AG10	1250	150	182	1.52	15.17	6.83
Mean	652.50	252.50	145.60	0.49	4.92	2.21

Table 5. Biomass and carbon densities of sampling points in grasslands of Barangay Balete, Sta. Fe, Imugan, Nueva Vizcaya.

SAMPLE CODE	TOTAL FRESH WEIGHT (g)	SAMPLE FRESH WEIGHT (g)	OVEN DRY WEIGHT (g)	TOTAL DRY WEIGHT (g)	BIOMASS DENSITY (Mg/ha)	CARBON DENSITY (Mg/ha)
BaG1	125	125	92	0.09	0.92	0.41
BaG2	600	300	155	0.31	3.10	1.40
BaG3	375	300	212	0.27	2.65	1.19
BaG4	340	300	218	0.25	2.47	1.11
BaG5	425	300	172	0.24	2.44	1.10
BaG6	225	225	161	0.16	1.61	0.72
BaG7	350	300	160	0.19	1.87	0.84
BaG8	650	300	220	0.48	4.77	2.15
BaG9	590	300	200	0.39	3.93	1.77
BaG10	590	300	189	0.37	3.72	1.67
Mean	427.00	275.00	177.90	0.27	2.75	1.24

Table 6. Biomass and carbon densities of sampling points in grasslands of Barangay Balete, Aritao, Nueva Vizcaya.

SAMPLE CODE	TOTAL FRESH WEIGHT (g)	SAMPLE FRESH WEIGHT (g)	OVEN DRY WEIGHT (g)	TOTAL DRY WEIGHT (g)	BIOMASS DENSITY (Mg/ha)	CARBON DENSITY (Mg/ha)
BeG1	290	290	201	0.20	2.01	0.90
BeG2	825	300	168	0.46	4.62	2.08
BeG3	475	300	239	0.38	3.78	1.70
BeG4	340	300	200	0.23	2.27	1.02
BeG5	325	300	159	0.17	1.72	0.78
BeG6	360	250	139	0.20	2.00	0.90
BeG7	160	160	108	0.11	1.08	0.49
BeG8	300	300	260	0.26	2.60	1.17
BeG9	1080	300	185	0.67	6.66	3.00
BeG10	1660	290	154	0.88	8.82	3.97
Mean	581.50	279.00	181.30	0.36	3.56	1.60

Table 7. Biomass and carbon densities of sampling points in grasslands of Barangay Tactac, Imugan, Nueva Vizcaya.

SAMPLE CODE	TOTAL FRESH WEIGHT (g)	SAMPLE FRESH WEIGHT (g)	OVEN DRY WEIGHT (g)	TOTAL DRY WEIGHT (g)	BIOMASS DENSITY (Mg/ha)	CARBON DENSITY (Mg/ha)
TG1	940	300	146	0.46	4.57	2.06
TG2	1220	300	188	0.76	7.65	3.44
TG3	1010	300	151	0.51	5.08	2.29
TG4	790	300	148	0.39	3.90	1.75
TG5	730	300	174	0.42	4.23	1.91
TG6	1250	300	197	0.82	8.21	3.69
TG7	1800	230	143	1.12	11.19	5.04
TG8	1100	300	219	0.80	8.03	3.61
TG9	650	300	181	0.39	3.92	1.76
TG10	2160	300	212	1.53	15.26	6.87
Mean	1165.00	293.00	175.90	0.72	7.21	3.24

Table 8. Biomass and carbon densities of sampling points in grasslands of Barangay Atbu, Imugan, Nueva Vizcaya.

SAMPLE CODE	TOTAL FRESH WEIGHT (g)	SAMPLE FRESH WEIGHT (g)	OVEN DRY WEIGHT (g)	TOTAL DRY WEIGHT (g)	BIOMASS DENSITY (Mg/ha)	CARBON DENSITY (Mg/ha)
AtG1	575	300	158	0.30	3.03	1.36
AtG2	450	300	189	0.28	2.84	1.28
AtG3	940	300	145	0.45	4.54	2.04
AtG4	190	190	152	0.15	1.52	0.68
AtG5	1010	300	89	0.30	3.00	1.35
AtG6	525	250	129	0.27	2.71	1.22
AtG7	490	300	161	0.26	2.63	1.18
AtG8	740	280	99	0.26	2.62	1.18
AtG9	805	300	152	0.41	4.08	1.84
AtG10	1310	300	182	0.79	7.95	3.58
Mean	703.50	282.00	145.60	0.35	3.49	1.57

Table 9. Biomass and carbon densities of sampling points in grasslands of Barangay Sta. Rosa, Imugan, Nueva Vizcaya

SAMPLE CODE	TOTAL FRESH WEIGHT (g)	SAMPLE FRESH WEIGHT (g)	OVEN DRY WEIGHT (g)	TOTAL DRY WEIGHT (g)	BIOMASS DENSITY (Mg/ha)	CARBON DENSITY (Mg/ha)
SRG1	440	300	169	0.25	2.48	1.12
SRG2	990	300	119	0.39	3.93	1.77
SRG3	1440	300	171	0.82	8.21	3.69
SRG4	2110	300	185	1.30	13.01	5.86
SRG5	1920	300	205	1.31	13.12	5.90
SRG6	460	300	169	0.26	2.59	1.17
SRG7	1870	130	110	1.58	15.82	7.12
SRG8	1390	300	117	0.54	5.42	2.44
SRG9	630	300	109	0.23	2.29	1.03
SRG10	560	300	227	0.42	4.24	1.91
Mean	1181.00	283.00	158.10	0.71	7.11	3.20

Table 10. Biomass and carbon densities of sampling points in grasslands of Barangay Kapinyahan, Imugan, Nueva Vizcaya.

SAMPLE CODE	TOTAL FRESH WEIGHT (g)	SAMPLE FRESH WEIGHT (g)	OVEN DRY WEIGHT (g)	TOTAL DRY WEIGHT (g)	BIOMASS DENSITY (Mg/ha)	CARBON DENSITY (Mg/ha)
CapG1	660	300	252.5	0.56	5.56	2.50
CapG2	610	300	134.3	0.27	2.73	1.23
CapG3	820	300	195	0.53	5.33	2.40
CapG4	900	300	252	0.76	7.56	3.40
CapG5	2170	300	253.5	1.83	18.34	8.25
CapG6	1000	260	229.8	0.88	8.84	3.98
CapG7	2050	230	224.5	2.00	20.01	9.00
CapG8	1530	300	107	0.55	5.46	2.46
CapG9	1780	260	235.5	1.61	16.12	7.26
CapG10	2890	300	245.5	2.36	23.65	10.64
Mean	1441.00	285.00	212.96	1.14	11.36	5.11

Table 11. Biomass and carbon densities of sampling points in grasslands of Barangay Putlan, Imugan, Nueva Vizcaya.

SAMPLE CODE	TOTAL FRESH WEIGHT (g)	SAMPLE FRESH WEIGHT (g)	OVEN DRY WEIGHT (g)	TOTAL DRY WEIGHT (g)	BIOMASS DENSITY (Mg/ha)	CARBON DENSITY (Mg/ha)
PCG1	510	300	243	0.41	4.13	1.86
PCG2	1100	300	205.5	0.75	7.54	3.39
PCG3	1013	300	162.9	0.55	5.50	2.48
PCG4	690	300	230	0.53	5.29	2.38
PCG5	800	300	203.3	0.54	5.42	2.44
PCG6	1200	300	240.3	0.96	9.61	4.33
PCG7	1670	300	167.4	0.93	9.32	4.19
PCG8	1050	300	280.4	0.98	9.81	4.42
PCG9	600	300	217.5	0.44	4.35	1.96
PCG10	1500	300	222.5	1.11	11.13	5.01
Mean	1013.30	300.00	217.28	0.72	7.21	3.24

Table 12. Carbon content of grassland samples in Barangay Buyasyas, Imugan, Nueva Vizcaya

SAMPLE CODE	CARBON CONTENT (%)
B6033	32.6
B6034	33.0
B6035	21.4
B6036	33.1
B6037	37.5
Mean	31.52

Table 13. Carbon content of grassland samples in Barangay Canabuan, Imugan, Nueva Vizcaya.

SAMPLE CODE	CARBON CONTENT (%)
B6038	34.2
B6039	18.1
B6040	35.5
B6041	26.6
B6042	37.5
Mean	30.38

Table 14. Carbon content of grassland samples in Barangay Canarem, Imugan, Nueva Vizcaya

SAMPLE CODE	CARBON CONTENT (%)
B6043	24.6
B6044	25.8
B6045	37.5
B6046	35.5
B6047	35.8
Mean	31.84

Table 15. Carbon content of grassland samples in Barangay Anayo, Imugan, Nueva Vizcaya.

SAMPLE CODE	CARBON CONTENT (%)
B6048	34.5
B6049	31.6
B6050	36.6
B6051	32.8
B6052	37.4
Mean	34.58

Table 16. Carbon content of grassland samples in Barangay Balete, Sta. Fe, Nueva Vizcaya

SAMPLE CODE	CARBON CONTENT (%)
B6053	14.3
B6054	31.0
B6055	14.1
B6056	21.0
B6057	29.7
Mean	22.02

Table 17. Carbon content of grassland samples in Barangay Balete, Aritao, Nueva Vizcaya.

SAMPLE CODE	CARBON CONTENT (%)
B6058	32.2
B6059	39.5
B6060	40.1
B6061	29.9
B6062	30.6
Mean	34.46

Table 18. Carbon content of grassland samples in Tactac, Imugan, Nueva Vizcaya.

SAMPLE CODE	CARBON CONTENT (%)
B6063	42.7
B6064	43.2
B6065	42.2
B6066	34.4
B6067	36.6
Mean	39.82

Table 19. Carbon content of grassland samples in Barangay Atbu, Imugan, Nueva Vizcaya.

SAMPLE CODE	CARBON CONTENT (%)
B6068	37.8
B6069	42.3
B6070	40.0
B6071	40.0
B6072	37.2
Mean	39.46

Table 20. Carbon content of grassland samples in Barangay Sta. Rosa, Imugan, Nueva Vizcaya.

SAMPLE CODE	CARBON CONTENT (%)
B6073	42.2
B6074	31.9
B6075	35.6
B6076	37.8
B6077	39.7
Mean	37.44

Table 21. Carbon content of grassland samples in Barangay Kapinyahan, Imugan, Nueva Vizcaya

SAMPLE CODE	CARBON CONTENT (%)
B6078	36.5
B6079	31.5
B6080	36.3
B6081	37.8
B6082	33.1
Mean	35.04

Table 22. Carbon content of grassland samples in Barangay Putlan, Imugan, Nueva Vizcaya.

SAMPLE CODE	CARBON CONTENT (%)
B6083	41.2
B6084	39.0
B6085	40.1
B6086	32.2
B6087	39.9
Mean	38.48

Table 23. Soil bulk and carbon densities of grassland areas in Barangay Buyasyas, Nueva Vizcaya.

CODE	HEIGHT (cm)	VOLUME	FINAL ODW (g)	BULK DENSITY (g/cc)	SOC (%)	CARBON DENSITY (Mg/ha)
B1	5.0	1000	101.00	0.9156	5.05	46.24
B2	5.0	1000	94.00	0.8521	5.05	43.03
B3	5.0	1000	98.00	0.8884	5.05	44.86
B4	5.0	1000	89.00	0.8068	5.05	40.74
B5	5.0	1000	68.00	0.6164	5.45	33.60
B6	5.0	1000	43.00	0.3898	5.45	21.24
B7	5.0	1000	80.00	0.7252	5.45	39.53
B8	5.0	1000	100.00	0.9065	5.45	49.41
B9	5.0	1000	101.00	0.9156	3.82	34.98
B10	5.0	1000	128.00	1.1604	3.82	44.33
B11	5.0	1000	121.00	1.0969	3.82	41.90
B12	5.0	1000	110.00	0.9972	3.82	38.09
B13	5.0	1000	119.00	1.0788	3.97	42.83
B14	5.0	1000	120.00	1.0878	3.97	43.19
B15	5.0	1000	121.00	1.0969	3.97	43.55
B16	5.0	1000	75.00	0.6799	3.97	26.99
B17	5.0	1000	115.00	1.0425	3.85	40.14
B18	5.0	1000	94.00	0.8521	3.85	32.81
B19	5.0	1000	94.00	0.8521	3.85	32.81
B20	5.0	1000	97.00	0.8793	3.85	33.85
Mean	5.0	1000	98.40	0.8920	4.43	38.71

Table 24. Soil bulk and carbon densities of grassland areas in Barangay Canabuan, Nueva Vizcaya.

CODE	HEIGHT (cm)	VOLUME	FINAL ODW (g)	BULK DENSITY (g/cc)	SOC (%)	CARBON DENSITY (Mg/ha)
C1	5.0	1000	108.00	0.9791	3.84	37.60
C2	5.0	1000	107.00	0.9700	3.84	37.25
C3	5.0	1000	109.00	0.9881	3.84	37.94
C4	5.0	1000	119.00	1.0788	3.84	41.43
C5	5.0	1000	95.00	0.8612	4.03	34.71
C6	5.0	1000	79.00	0.7162	4.03	28.86
C7	5.0	1000	118.00	1.0697	4.03	43.11
C8	5.0	1000	103.00	0.9337	4.03	37.63
C9	5.0	1000	127.00	1.1513	3.90	44.90
C10	5.0	1000	111.50	1.0108	3.90	39.42
C11	5.0	1000	99.00	0.8975	3.90	35.00
C12	5.0	1000	111.00	1.0063	3.90	39.24
C13	5.0	1000	91.00	0.8250	4.53	37.37
C14	5.0	1000	99.00	0.8975	4.53	40.66
C15	5.0	1000	109.00	0.9881	4.53	44.76
C16	5.0	1000	102.00	0.9247	4.53	41.89
C17	5.0	1000	101.00	0.9156	3.74	34.24
C18	5.0	1000	91.00	0.8250	3.74	30.85
C19	5.0	1000	110.00	0.9972	3.74	37.30
C20	5.0	1000	101.00	0.9156	3.74	34.24
Mean	5.0	1000	104.53	0.9476	4.01	37.92

Table 25. Soil bulk and carbon densities of grassland areas in Barangay Canarem, Nueva Vizcaya.

CODE	HEIGHT (cm)	VOLUME	FINAL ODW (g)	BULK DENSITY (g/cc)	SOC (%)	CARBON DENSITY (Mg/ha)
CA1	5.0	1000	118.00	1.0697	4.42	47.28
CA2	5.0	1000	109.00	0.9881	4.42	43.68
CA3	5.0	1000	104.00	0.9428	4.42	41.67
CA4	5.0	1000	118.00	1.0697	4.42	47.28
CA5	5.0	1000	121.00	1.0969	3.81	41.79
CA6	5.0	1000	122.00	1.1060	3.81	42.14
CA7	5.0	1000	98.00	0.8884	3.81	33.85
CA8	5.0	1000	137.00	1.2420	3.81	47.32
CA9	5.0	1000	102.00	0.9247	4.75	43.92

CA10	5.0	1000	112.00	1.0153	4.75	48.23
CA11	5.0	1000	118.00	1.0697	4.75	50.81
CA12	5.0	1000	103.00	0.9337	4.75	44.35
CA13	5.0	1000	109.00	0.9881	4.68	46.24
CA14	5.0	1000	109.00	0.9881	4.68	46.24
CA15	5.0	1000	100.00	0.9065	4.68	42.43
CA16	5.0	1000	121.00	1.0969	4.68	51.34
CA17	5.0	1000	99.00	0.8975	4.45	39.94
CA18	5.0	1000	103.00	0.9337	4.45	41.55
CA19	5.0	1000	104.00	0.9428	4.45	41.95
CA20	5.0	1000	104.00	0.9428	4.45	41.95
Mean	5.0	1000	110.55	1.0022	4.42	44.20

Table 26. Soil bulk and carbon densities of grassland areas in Barangay Anayo, Nueva Vizcaya

CODE	HEIGHT (cm)	VOLUME	FINAL ODW (g)	BULK DENSITY (g/cc)	SOC (%)	CARBON DENSITY (Mg/ha)
A1	5.0	1000	103.86	0.9415	4.69	44.16
A2	5.0	1000	111.64	1.0121	4.69	47.47
A3	5.0	1000	119.39	1.0823	4.69	50.76
A4	5.0	1000	107.05	0.9705	4.69	45.51
A5	5.0	1000	105.30	0.9546	5.60	53.46
A6	5.0	1000	70.00	0.6346	5.60	35.54
A7	5.0	1000	105.68	0.9580	5.60	53.65
A8	5.0	1000	109.30	0.9908	5.60	55.49
A9	5.0	1000	105.30	0.9546	4.07	38.85
A10	5.0	1000	86.03	0.7799	4.07	31.74
A11	5.0	1000	98.10	0.8893	4.07	36.20
A12	5.0	1000	96.26	0.8726	4.07	35.52
A13	5.0	1000	95.53	0.8660	5.85	50.66
A14	5.0	1000	93.00	0.8431	5.85	49.32
A15	5.0	1000	87.72	0.7952	5.85	46.52
A16	5.0	1000	87.15	0.7901	5.85	46.22
A17	5.0	1000	104.35	0.9460	5.39	50.99
A18	5.0	1000	99.25	0.8997	5.39	48.50
A19	5.0	1000	91.09	0.8258	5.39	44.51
A20	5.0	1000	103.51	0.9384	5.39	50.58
Mean	5.0	1000	98.98	0.8973	5.12	45.78

Table 27. Soil bulk and carbon densities of grassland areas in Barangay Balete, Sta. Fe, Nueva Vizcaya.

CODE	HEIGHT (cm)	VOLUME	FINAL ODW (g)	BULK DENSITY (g/cc)	SOC (%)	CARBON DENSITY (Mg/ha)
BA1	5.0	1000	174.51	1.5820	4.33	68.50
BA2	5.0	1000	138.97	1.2598	4.33	54.55
BA3	5.0	1000	115.61	1.0481	4.33	45.38
BA4	5.0	1000	108.40	0.9827	4.33	42.55
BA5	5.0	1000	69.62	0.6311	4.97	31.37
BA6	5.0	1000	106.14	0.9622	4.97	47.82
BA7	5.0	1000	120.01	1.0879	4.97	54.07
BA8	5.0	1000	113.37	1.0277	4.97	51.08
BA9	5.0	1000	110.01	0.9973	5.44	54.25
BA10	5.0	1000	99.56	0.9026	5.44	49.10
BA11	5.0	1000	122.42	1.1098	5.44	60.37
BA12	5.0	1000	128.32	1.1633	5.44	63.28
BA13	5.0	1000	97.76	0.8862	5.16	45.73
BA14	5.0	1000	124.30	1.1268	5.16	58.14
BA15	5.0	1000	115.56	1.0476	5.16	54.06
BA16	5.0	1000	106.24	0.9631	5.16	49.70
BA17	5.0	1000	110.54	1.0021	5.10	51.11
BA18	5.0	1000	108.50	0.9836	5.10	50.16
BA19	5.0	1000	106.90	0.9691	5.10	49.42
BA20	5.0	1000	106.09	0.9617	5.10	49.05
Mean	5.0	1000	114.14	1.0347	5.00	51.48

Table 28. Soil bulk and carbon densities of grassland areas in Barangay Balete, Aritao, Nueva Vizcaya.

CODE	HEIGHT (cm)	VOLUME	FINAL ODW (g)	BULK DENSITY (g/cc)	SOC (%)	CARBON DENSITY (Mg/ha)
BE1	5.0	1000	80.22	0.7272	3.99	29.02
BE2	5.0	1000	106.79	0.9681	3.99	38.63
BE3	5.0	1000	120.44	1.0918	3.99	43.56
BE4	5.0	1000	96.28	0.8728	3.99	34.83
BE5	5.0	1000	97.14	0.8806	2.01	17.70
BE6	5.0	1000	124.59	1.1295	2.01	22.70
BE7	5.0	1000	119.07	1.0794	2.01	21.70
BE8	5.0	1000	104.08	0.9435	2.01	18.96
BE9	5.0	1000	114.54	1.0384	4.00	41.53

BE10	5.0	1000	109.24	0.9903	4.00	39.61
BE11	5.0	1000	143.56	1.3014	4.00	52.06
BE12	5.0	1000	124.24	1.1263	4.00	45.05
BE13	5.0	1000	106.38	0.9644	3.32	32.02
BE14	5.0	1000	71.59	0.6490	3.32	21.55
BE15	5.0	1000	102.46	0.9288	3.32	30.84
BE16	5.0	1000	120.35	1.0910	3.32	36.22
BE17	5.0	1000	102.30	0.9274	4.58	42.47
BE18	5.0	1000	110.38	1.0006	4.58	45.83
BE19	5.0	1000	114.54	1.0384	4.58	47.56
BE20	5.0	1000	109.24	0.9903	4.58	45.36
Mean	5.0	1000	108.87	0.9870	3.58	35.36

Table 29. Soil bulk and carbon densities of grassland areas in Barangay Tactac, Nueva Vizcaya.

CODE	HEIGHT (cm)	VOLUME	FINAL ODW (g)	BULK DENSITY (g/cc)	SOC (%)	CARBON DENSITY (Mg/ha)
T1	5.0	1000	90.91	0.8241	5.81	47.88
T2	5.0	1000	81.46	0.7385	5.81	42.90
T3	5.0	1000	62.17	0.5636	5.81	32.74
T4	5.0	1000	85.12	0.7716	5.81	44.83
T5	5.0	1000	83.27	0.7549	4.66	35.18
T6	5.0	1000	84.53	0.7663	4.66	35.71
T7	5.0	1000	79.70	0.7225	4.66	33.67
T8	5.0	1000	92.62	0.8396	4.66	39.13
T9	5.0	1000	65.37	0.5926	5.78	34.25
T10	5.0	1000	87.85	0.7964	5.78	46.03
T11	5.0	1000	86.78	0.7867	5.78	45.47
T12	5.0	1000	78.77	0.7141	5.78	41.27
T13	5.0	1000	90.70	0.8222	6.06	49.83
T14	5.0	1000	90.70	0.8222	6.06	49.83
T15	5.0	1000	83.27	0.7549	6.06	45.75
T16	5.0	1000	86.68	0.7858	6.06	47.62
T17	5.0	1000	82.76	0.7503	5.24	39.31
T18	5.0	1000	75.70	0.6863	5.24	35.96
T19	5.0	1000	89.52	0.8115	5.24	42.52
T20	5.0	1000	77.01	0.6981	5.24	36.58
Mean	5.0	1000	82.74	0.7501	5.51	41.32

Table 30. Soil bulk and carbon densities of grassland areas in Barangay Atbu, Nueva Vizcaya.

CODE	HEIGHT (cm)	VOLUME	FINAL ODW (g)	BULK DENSITY (g/cc)	SOC (%)	CARBON DENSITY (Mg/ha)
AT1	5.0	1000	68.00	0.6164	3.48	21.45
AT2	5.0	1000	98.00	0.8884	3.48	30.92
AT3	5.0	1000	99.00	0.8975	3.48	31.23
AT4	5.0	1000	91.00	0.8250	3.48	28.71
AT5	5.0	1000	98.00	0.8884	4.39	39.00
AT6	5.0	1000	85.00	0.7706	4.39	33.83
AT7	5.0	1000	109.00	0.9881	4.39	43.38
AT8	5.0	1000	122.00	1.1060	4.39	48.55
AT9	5.0	1000	99.00	0.8975	3.95	35.45
AT10	5.0	1000	95.00	0.8612	3.95	34.02
AT11	5.0	1000	102.00	0.9247	3.95	36.52
AT12	5.0	1000	109.00	0.9881	3.95	39.03
AR13	5.0	1000	96.00	0.8703	5.16	44.91
AT14	5.0	1000	94.00	0.8521	5.16	43.97
AT15	5.0	1000	85.00	0.7706	5.16	39.76
AT16	5.0	1000	115.00	1.0425	5.16	53.79
AT17	5.0	1000	105.00	0.9519	4.21	40.07
AT18	5.0	1000	109.00	0.9881	4.21	41.60
AT19	5.0	1000	90.00	0.8159	4.21	34.35
AT20	5.0	1000	87.00	0.7887	4.21	33.20
Mean	5.0	1000	97.80	0.8866	4.24	37.69

Table 31. Soil bulk and carbon densities of grassland areas in Barangay Sta. Rosa, Nueva Vizcaya.

CODE	HEIGHT (cm)	VOLUME	FINAL ODW (g)	BULK DENSITY (g/cc)	SOC (%)	CARBON DENSITY (Mg/ha)
SR1	5.0	1000	99.51	0.9021	3.25	29.32
SR2	5.0	1000	79.13	0.7173	3.25	23.31
SR3	5.0	1000	89.57	0.8120	3.25	26.39
SR4	5.0	1000	88.83	0.8053	3.25	26.17
SR5	5.0	1000	73.16	0.6632	7.46	49.48
SR6	5.0	1000	80.79	0.7324	7.46	54.64
SR7	5.0	1000	70.75	0.6414	7.46	47.85
SR8	5.0	1000	70.53	0.6394	7.46	47.70
SR9	5.0	1000	83.23	0.7545	5.69	42.93
SR10	5.0	1000	96.40	0.8739	5.69	49.73
SR11	5.0	1000	90.96	0.8246	5.69	46.92
SR12	5.0	1000	85.30	0.7733	5.69	44.00
SR13	5.0	1000	92.71	0.8405	7.49	62.95
SR14	5.0	1000	87.42	0.7925	7.49	59.36
SR15	5.0	1000	80.33	0.7282	7.49	54.54
SR16	5.0	1000	83.95	0.7610	7.49	57.00
SR17	5.0	1000	49.51	0.4488	8.19	36.76
SR18	5.0	1000	42.70	0.3871	8.19	31.70
SR19	5.0	1000	93.45	0.8472	8.19	69.38
SR20	5.0	1000	113.54	1.0293	8.19	84.30
Mean	5.0	1000	82.59	0.7487	6.42	47.22

Table 32. Soil bulk and carbon densities of grassland areas in Barangay Kapinyahan, Nueva Vizcaya.

CODE	HEIGHT (cm)	VOLUME	FINAL ODW (g)	BULK DENSITY (g/cc)	SOC (%)	CARBON DENSITY (Mg/ha)
CP1	5.0	1000	95.00	0.8612	3.88	33.42
CP2	5.0	1000	110.00	0.9972	3.88	38.69
CP3	5.0	1000	105.00	0.9519	3.88	36.93
CP4	5.0	1000	101.00	0.9156	3.88	35.53
CP5	5.0	1000	103.00	0.9337	5.13	47.90
CP6	5.0	1000	87.00	0.7887	5.13	40.46
CP7	5.0	1000	72.00	0.6527	5.13	33.48
CP8	5.0	1000	98.00	0.8884	5.13	45.58
CP9	5.0	1000	86.00	0.7796	4.61	35.94
CP10	5.0	1000	104.00	0.9428	4.61	43.46
CP11	5.0	1000	90.00	0.8159	4.61	37.61
CP12	5.0	1000	94.00	0.8521	4.61	39.28
CP13	5.0	1000	103.00	0.9337	4.76	44.45
CP14	5.0	1000	93.00	0.8431	4.76	40.13
CP15	5.0	1000	112.00	1.0153	4.76	48.33
CP16	5.0	1000	62.00	0.5621	4.76	26.75
CP17	5.0	1000	102.00	0.9247	4.83	44.66
CP18	5.0	1000	99.00	0.8975	4.83	43.35
CP19	5.0	1000	99.00	0.8975	4.83	43.35
CP20	5.0	1000	94.00	0.8521	4.83	41.16
Mean	5.0	1000	95.45	0.8653	4.64	40.02

Table 33. Soil bulk and carbon densities of grassland areas in Barangay Putlan, Nueva Vizcaya.

CODE	HEIGHT (cm)	VOLUME	FINAL ODW (g)	BULK DENSITY (g/cc)	SOC (%)	CARBON DENSITY (Mg/ha)
P1	5.0	1000	96.27	0.8727	3.02	26.36
P2	5.0	1000	108.05	0.9795	3.02	29.58
P3	5.0	1000	114.62	1.0391	3.02	31.38
P4	5.0	1000	108.93	0.9875	3.02	29.82
P5	5.0	1000	120.63	1.0936	3.84	41.99
P6	5.0	1000	120.27	1.0903	3.84	41.87
P7	5.0	1000	101.58	0.9209	3.84	35.36
P8	5.0	1000	109.08	0.9889	3.84	37.97
P9	5.0	1000	84.01	0.7616	3.84	29.24
P10	5.0	1000	98.40	0.8920	3.84	34.25
P11	5.0	1000	114.84	1.0411	3.84	39.98
P12	5.0	1000	102.21	0.9266	3.84	35.58
P13	5.0	1000	95.38	0.8647	4.44	38.39
P14	5.0	1000	81.16	0.7357	4.44	32.67
P15	5.0	1000	98.93	0.8968	4.44	39.82
P16	5.0	1000	93.53	0.8479	4.44	37.65
P17	5.0	1000	87.24	0.7909	4.33	34.24
P18	5.0	1000	97.85	0.8871	4.33	38.41
P19	5.0	1000	99.87	0.9054	4.33	39.20
P20	5.0	1000	112.61	1.0209	4.33	44.20
Mean	5.00	1000	102.27	0.9271	3.89	35.90

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United Nations Avenue, Gigiri - PO Box 30677 - 00100 Nairobi, Kenya
Tel: +254 20 7224000 or via USA +1 650 833 6645
Fax: +254 20 7224001 or via USA +1 650 833 6646
Southeast Asia Regional Programme - Sindang Barang, Bogor 16680
PO Box 161 Bogor 16001, Indonesia
Tel: +62 251 625 415 - Fax: +62 251 625 416
www.worldagroforestry.org