



## Tree Inventory and Carbon Stock Assessment of Agroforestry Farm in Barangay Magapuy, Bayombong, Nueva Vizcaya, Philippines

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**Abstract:** Mitigating Climate Change is a crucial effort in conserving biodiversity, food security, and public health. Embracing advanced technologies and management practices, such as agroforestry, plays a vital role in mitigating global temperature rise, which is the most pressing environmental issue worldwide. The agroforestry system plays a key role in sequestering carbon dioxide, mitigating climate change through absorbing carbon dioxide in the atmosphere and converting it into food by plants in the process called photosynthesis. This study consequently aims to assess the trees present in the area and generate data to determine the carbon stocks located at Magapuy, Bayombong, Nueva Vizcaya. The study employed methods that includes measuring diameter at breast height (DBH), merchantable height (MH), and total height (TH). Furthermore, purposive sampling techniques were used in this study. The result shows that a total of 114 tree species were recorded and classified by biogeographic origin, including native (57.9%), naturalized (24.6%), cultivated (9.6%), endemic (7.0%), and one cryptogenic species. The results revealed that 66 tree species with DBH  $\geq$  5 cm accumulated an aboveground biomass of 207.20 Mg/ha and a corresponding carbon stock of 96.86 Mg/ha. *Gmelina arborea* had the highest individual carbon contribution. Additionally, 44 species with DBH < 5 cm stored a total of 12,487.44 Mg/ha of carbon, further emphasizing the carbon sequestration potential of young and regenerating trees. These findings confirm that agroforestry systems not only home of a mixed species, including native, endemic and threatened species, but also serve as effective carbon sinks. In general, the study highlights the importance of agroforestry as a nature-based solution for biodiversity conservation, climate resilience, and sustainable rural development.

**Keywords:** Agroforestry; Biodiversity conservation; Climate change; Carbon stock; Food security.

### INTRODUCTION

The agroforestry system in the Philippines has already been practiced since time immemorial. This approach is characterized by a broad range of systems that involve the incorporation of trees or shrubs into croplands. Its holistic approach has been seen to be effective for soil and water conservation (Medina et al., 1994), while providing food and income to the people (Lasco et al., 2015). The Intergovernmental Panel on Climate Change (IPCC) has

recognized the importance of agroforestry as a tool for mitigating the effects of climate change (Shukla et al., 2019). These huge interconnected problems necessitate diverse and integrated solutions, such as shifting away from conventional agriculture and toward more sustainable agro-ecological techniques like agroforestry (Wezel et al. 2014; Ewert et al. 2023; as cited by Kleijn et al. 2025).

Furthermore, knowing plant species in an agroforestry system is critical for successful management. Tree species inventory serves as a vital tool in forest and agroforestry

management by generating key data on species composition, diversity, and abundance. This information is used to make educated decisions about biodiversity protection, ecosystem monitoring, and sustainable land use planning (Brown, 1997; Hairiah et al., 2001). Finally, according to Gibbs et al. (2007), inventories serve as a foundation for estimating aboveground biomass (AGB) and carbon stocks, which are critical advancement in relation to climate change mitigation initiatives such as REDD+ (Reducing Emissions from Deforestation and Forest Degradation).

In this study, researchers examine and determine the tree species and accumulated carbon stock to support national strategies for sustainable development, forest restoration, and rural livelihood improvements (Lasco et al., 2015; DENR-FMB, 2016).

### Objective of the Study

Generally, this study aims to provide a tree species inventory and determine the carbon stock potential of trees in Agroforestry farm of Barangay Magapuy, Bayombong, Nueva Vizcaya.

Specifically, this research was to:

1. determine and document the tree species composition including noteworthy and ecologically significant tree species.
2. estimate the carbon storage potential of agroforestry trees in Magapuy area.

## METHODOLOGY

### Study site

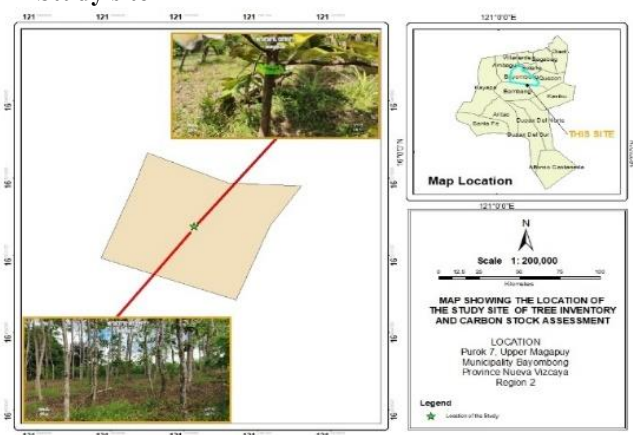


Figure 1. Geographical Location of the Study Area

The study was conducted in Barangay Magapuy, located in the Municipality of Bayombong, Nueva Vizcaya. Geographically, the site is positioned at 16°26'27" North latitude and 121°08'14" East longitude, with an estimated elevation of approximately 313.5 meters (1,028.5 feet) above sea level. Magapuy is a rural community situated within the Northern Sierra Madre Mountain range, characterized by gently sloping terrain and mixed-use landscapes, including agricultural fields and scattered patches of native vegetation. The area is experiencing a tropical monsoon climate, with an

average annual temperature of approximately 26.5°C. Seasonal differences are notable, featuring a distinct rainy season from May to October and a dry season from November to April (Setiawan, 2020) in which can significantly impact tree growth and biomass accumulation.

### Research Design and Sampling Techniques

The study uses a quantitative research design, and purposive sampling technique given that the agroforestry farm in the Magapuy area is small, with an area of 1 hectare. A field survey method coupled with actual collection of trees were conducted. Trees with DBH < 5 cm were measured the merchantable height (MH), total height (TH), and collecting coordinates for each tree’s location within the farmland.

### Species Collection and Identification

All trees within the agroforestry farm were measured their diameter, merchantable and total height. For non-tree species, such as bamboo, palms, shrubs, and lianas, an opportunistic sampling method was also used. The vernacular name of the species was asked to the owner. However, for species that were difficult to identify, reliable online references such as the Plants of the World Online (POWO), Co’s Digital Flora of the Philippines (CDFP) and the Global Biodiversity Information Facility (GBIF) were utilized for identification. Additionally, expert consultation was sought to verify and confirm the accurate identification of the collected species, ensuring the reliability of the data.

### Data Interpretation and Analysis

#### Basal Area and Merchantable Volume of a Tree

To calculate a tree's basal area, use the  $\pi = 3.1416$  formula. For the volume, the Regional Volume Equations stipulated by the Forest Management Bureau of the Department of Environment and Natural Resources (FMB-DENR), are specifically designed for Philippine forestry contexts. The used regional equation where Nueva Vizcaya belongs is region 2. For dipterocarp species  $0.00005203(D^2H)$  were used, while for non-dipterocarp species is  $0.00005109(D^2H)$ .

#### Importance Value Index (IVI)

The (IVI) quantifies how dominant a species, within an ecosystem. It is typically determined using a combination of factors, including basal area, relative density, relative dominance, and relative frequency (Kimmerer, 2015). In addition, IVI is a basic method in forestry for evaluating species composition and creating site inventories. To compute each species’ importance value, the formula established by Curtis and McIntosh (1951) was applied.

$$Density (D, tree/m^2) = \frac{Number\ of\ individuals}{area\ sampled}$$

$$Relative\ density = \frac{density\ for\ a\ species}{total\ density\ for\ a\ species} \times 100$$

$$\text{Frequency} = \frac{\text{Number of species in which species occur}}{\text{total number of plots sampled}}$$

$$\text{Relative Frequency} = \frac{\text{frequency value for a species}}{\text{total frequency for all species}} \times 100$$

$$\text{Dominance} = \frac{\text{basal area or volume of species}}{\text{area sampled}}$$

$$\text{Relative Dominance} = \frac{\text{dominance of species}}{\text{total dominance for all species}} \times 100$$

$$\text{Importance Value Index} = \text{Relative Density} + \text{Relative Frequency} + \text{Relative Dominance}$$

### Assessment of Endemicity and Conservation Status

Species' endemicity and conservation status was determined using various online sources such as Plants of the World Online, Co's Digital Flora of the Philippines, International Union for Conservation of Nature Red list of Threatened Species (2025-1) and the Updated List of Threatened Philippine Plants and Their Categories (DENR Administrative Order No. 2017-11).

### Above-Ground Biomass and Carbon Stock Estimation

To estimate the aboveground biomass (AGB) of individual trees, allometric equations were selected based on tree size. The AGB was determined using size-dependent allometric equations. The Chave et al. (2014) equation,  $AGB = 0.0673 \times (\rho \times D^2 \times H) 0.976$ , was used for trees with a diameter at breast height (DBH)  $\geq 5$  cm. This equation is highly accurate and applicable to moist tropical forests. For trees with  $DBH < 5$  cm, a simplified equation from Brown (1997),  $AGB = 0.0509 \times D^2 \times H$ , was utilized. Wood density estimates ( $\rho$ ) for each species were gathered from reliable sources such as Zanne et al. (2009) and Reyes et al. (1992). The carbon stock storage potential was determined by multiplying AGB by 0.47, which is the default carbon proportion recommended by the IPCC. This figure assumes that about 47% of dry biomass is carbon. The resulting carbon stock levels are measured in kilograms of carbon (kgC).

## RESULTS AND DISCUSSION

### Tree composition

The agroforestry farm located in Barangay Magapuy, Bayombong, Nueva Vizcaya, shows a diverse assemblage of tree species that produce both edible fruits and timber. 562 tree individuals were documented, representing, 35 families, 88 genera, and 114 morphospecies. The Fabaceae family was the most dominant, with 15 genera and 15 morphospecies, highlighting its strong presence in the area. Other well-represented families included Moraceae, Dipterocarpaceae, and Euphorbiaceae, all of which added significantly to the site's plant diversity.

In addition, among the recorded species, *Gmelina arborea* Roxb. ex Sm. was the most dominant, with 285 individuals. Followed by *Vitex parviflora* A.Juss. accounting

for 14 individual species, and *Mangifera indica* L., composed of 12 trees. The DBH of all surveyed trees varied widely, from 5.0 cm to 49.8 cm. *M. indica* had the largest average DBH at 49.08 cm, and also included the tallest tree, reaching 12 meters, with an average height of 11.75 meters. These results support earlier studies (Tadesse et al., 2019), which found that *M. indica* and *Artocarpus heterophyllus* are commonly planted in agroforestry or home garden systems, often alongside timber species like *G. arborea*.

### Intermediate and Understory Species

The intermediate or mid-canopy layer in agroforestry systems plays a critical role in ecological functioning and farm productivity. Studies have shown that the inclusion of shade-tolerant, high-value crops beneath taller trees reduces soil erosion, improves organic matter input, and stabilizes microclimatic conditions, key factors in maintaining long-term soil fertility (Delgado & Canters, 2012).

**Table 1.** Top ten understory species found in the area

	Scientific Name	Family Name	Habit
1	<i>Embelia philippinensis</i> A.DC.,	Primulaceae	Woody Vine
2	<i>Colocasia esculentum</i> (L.)	Araceae	Herbaceous
3	<i>Xanthosoma violaceum</i> Schott	Araceae	Herbaceous
4	<i>Manihot esculenta</i> Crantz	Euphorbiaceae	Shrub
5	<i>Ananas comosus</i> (L.) Merr.,	Bromeliaceae	Herbaceous
6	<i>Saccharum officinarum</i> L.,	Poaceae	Grass
7	<i>Breynia androgyna</i> (L.),	Phyllanthaceae	Shrub
8	<i>Hylocereus undatus</i> (Haw.)	Cactaceae	Hemiepiphyte cactus
9	<i>Vitex negundo</i> L.,	Lamiaceae	Small tree
10	<i>Blumea balsamifera</i> L.	Asteraceae	Shrub

**Table 1** shows the top ten understory vegetation in the area. Ten species were documented, reflecting a diverse range of plant forms and ecological functions. The recorded vegetation includes various growth habits such as herbaceous plants, grasses, shrubs, or small trees, and vines. Species include *Colocasia esculenta* and *Xanthosoma violaceum* (Araceae), *Ananas comosus* (Bromeliaceae), and *Saccharum officinarum* (Poaceae). These low-growing species serve multiple purposes; they are commonly cultivated as food crops and enhance ground cover by minimizing soil erosion and maintaining soil moisture. The shrub species such as *Manihot esculenta*, *Breynia androgyna*, and *Blumea balsamifera* contribute to food production, soil enhancement, and traditional medicine. *Vitex negundo*, a small medicinal tree, adds to the vertical structure of the farm (Garg, 2024). Climbing species like

*Embelia philippinensis* and *Hylocereus undatus* further increase structural complexity and support ecological interactions such as pollination and seed dispersal. Overall, the diverse understory integrates food, medicinal, and structurally varied plants supporting soil protection, nutrient cycling, and sustainable productivity in line with agroforestry principles (Nair, 1993; Kumar & Nair, 2004).

**Basal Area and Merchantable Volume**

**Table 2.** Top ten tree species with the highest DBH, BA, and Merchantable volume.

No.	Scientific Name	Family Name	DBH (cm)	BA (m <sup>2</sup> )	Merchantable Volume (cu.m)
1	<i>Gmelina arborea</i> Roxb. ex Sm.	Lamiaceae	4141.300	1346.990	2077060.98
2	<i>Mangifera indica</i> L.	Anacardiaceae	434.800	14.848	766.894
3	<i>Artocarpus heterophyllus</i> Lam.	Moraceae	160.000	2.011	62.256
4	<i>Ficus nota</i> (Blanco) Merr.	Moraceae	115.200	1.042	23.459
5	<i>Macaranga tanarius</i> (L.) Müll.Arg.	Euphorbiaceae	80.630	0.511	12.688
6	<i>Vitex parviflora</i> A. Juss.	Lamiaceae	77.500	0.472	20.406
7	<i>Ficus septica</i> Burm.f.	Moraceae	58.500	0.269	4.546
8	<i>Persea americana</i> Mill.	Lauraceae	53.600	0.226	5.005
9	<i>Syzygium polycephaloides</i> (C.B.Rob.) Merr.	Myrtaceae	48.100	0.182	1.466
10	<i>Pterocarpus indicus</i> Willd.	Fabaceae	43.300	0.147	1.581

**Table 2** presents the top 10 tree species with the highest cumulative values for (DBH), basal area (BA), and merchantable volume. These species make up most of the tree stand and contribute greatly to the area’s wood production and biomass. Their strong presence affects the structure of the agroforestry farm and provides important information for planning sustainable use and conservation efforts. **Table 2** shows that the species *G. arborea* (Lamiaceae) emerged as the most dominant, with an exceptionally high cumulative DBH of 4,141.30 cm, basal area of 1,346.99 m<sup>2</sup>, and a merchantable volume of 2,077,060.98 cubic meters. This high number of dbh of the species is a cumulative total of all the measured *G. arborea* in the area, and it is expected since the area was once established as a *G. melina* plantation, then converted to agroforestry. Following *G. Arborea*, *M. indica* (Anacardiaceae) and *A. heterophyllus* (Moraceae) made

significant contributions to overall timber volume, with merchantable quantities of 766.89 m<sup>3</sup> and 62.26 m<sup>3</sup>, respectively. These species, while generally valued for fruit production, also provide secondary timber resources, reinforcing their multifunctional role in agroforestry systems (Magcale-Macandog et al., 2021). Meanwhile, *Pterocarpus indicus* recorded the smallest DBH (43.300), basal area (0.147 m<sup>2</sup>), and merchantable volume (1.581 m<sup>3</sup>).

**Importance Value Index**

**Table 3.** Top 10 tree species with the highest importance value index.

	Scientific Name	RDen	RDom	RFre	IV
1	<i>Gmelina arborea</i> Roxb. ex Sm.	50.71	98.51	5.94	155.16
2	<i>Artocarpus heterophyllus</i> Lam.	1.96	0.15	4.95	7.05
3	<i>Vitex parviflora</i> A. Juss.	2.49	0.03	2.22	5.00
4	<i>Annona muricata</i> L.	1.42	0.00	2.48	4.89
5	<i>Macaranga tanarius</i> (L.) Müll.Arg.	0.89	0.04	3.47	4.89
6	<i>Ficus septica</i> Burm.f.	0.89	0.02	3.96	4.87
7	<i>Mangifera indica</i> L.	2.14	1.09	1.49	4.71
8	<i>Pterocarpus indicus</i> Willd.	1.07	0.01	2.97	4.05
9	<i>Canarium ovatum</i> Engl.	1.25	0.00	2.48	3.72
10	<i>Nephelium lappaceum</i> L.	1.96	0.01	1.49	3.45

**Legend:** Rden-Relative Density; Rdom – Relative Dominance; RF – Relative Frequency; IV – Importance Value

**Table 3** shows the IVI of tree species in Magapuy. Among all the recorded species, such as *G. arborea* exhibits the highest IV of 155.16, surpassing other species in all components: relative density (50.71%), relative dominance (98.51%), and relative frequency (5.94%). On the other hand, species such as *A. heterophyllus* and *V. parviflora* have relatively low IVs of 7.05 and 5.00, respectively. Moreover, *C. ovatum* and *N. lappaceum* obtained the lowest IVs of 3.72 and 3.75, respectively. Although they occur in the farm, their lower density and basal area suggest they play more supportive or secondary roles. The IV assessment shows a community heavily dominated by *G. arborea*, an exotic species introduced in the Philippines widely utilized with fast-growing ability, for food and timber. The area shows a mix of secondary species contributing to functional diversity, economic utility, and ecological resilience. According to Herbohn et al. (2015), found that a mixed-structure plantation with *G. arborea*, slower-growing dipterocarps, and fruit trees produces both short-term yields and multi-layered, long-term carbon stock, while also improving ecological stability.

**Noteworthy Species**

Noteworthy species are those with ecological, economic, cultural, or scientific significance, often due to their rarity, endemism, or conservation status. As mentioned by the Convention on Biological Diversity (2006), such species,

especially those that are rare, endangered, endemic, or culturally important, require special attention in biodiversity conservation efforts.

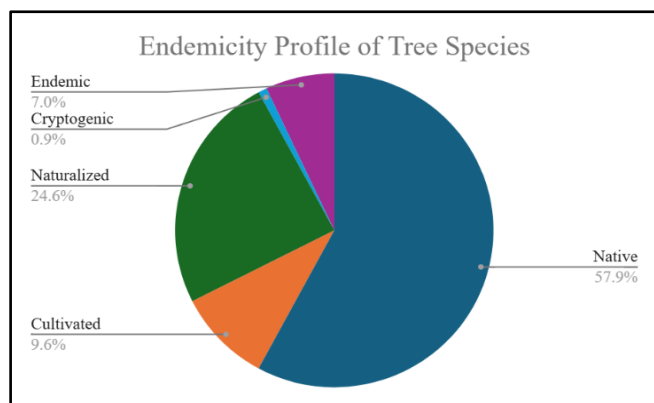


Figure 2. Summary of Endemic Species

The total trees identified in the area is about 114 and classified based on their biogeographic origin as shown in figure 2. This diversity reflects due to influenced of both natural processes and human activities. The majority are native species, with 66 (57.9%). These species occur naturally in the Philippines, although they can also be found in other countries. *V. parviflora*, *S. polycephaloides*, *P. indicus*, *N. lappaceum*, *C. ovatum*, and *L. speciosa* are notable native plants with ecological and economic worth. Naturalized species account for 28 (24.6%), such as *G. arborea*, *M. indica*, and *S. macrophylla*. Eleven species (9.6%) are cultivated exotics, intentionally planted for agricultural or ornamental purposes, such as *Theobroma cacao* and *Persea americana*, though their dominance may affect native biodiversity. Eight endemic species (7.0%), including *Sindora supa* and *Tectona philippinensis*, highlight the site's conservation value due to their restricted distribution and vulnerability. One species was identified as cryptogenic, requiring further investigation to determine its origin.

### Threatened Species

The IUCN (2023), defines threatened species as "facing a high risk of extinction in the wild in the medium-term, based on population size, rate of decline, geographic range, degree of population decline, and habitat fragmentation. There are two types of conservation schemes used in this study, for national and local. To mention, the International Union for Conservation of Nature (IUCN 2025-1) and the Updated National List of Threatened Philippine Plants and Their Categories (DENR AO 2017-11) respectively. In the Philippines, local threatened species were assessed based on DENR Administrative Order No. 2017-11, which provides a list of threatened Philippine flora and is categorized by their conservation status and ecological importance (DENR-BMB, 2017).

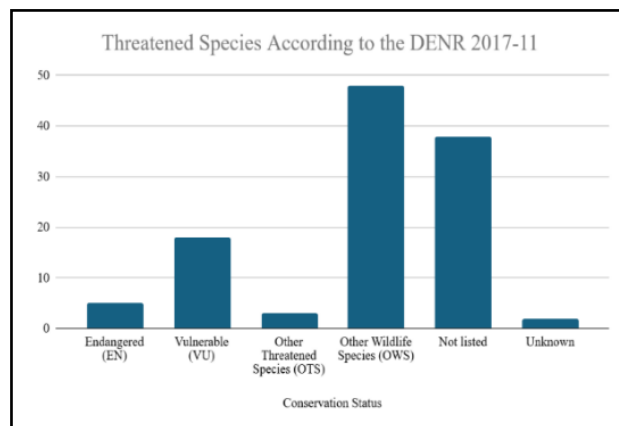


Figure 3. Conservation status of species according to DAO 2017-11

The conservation status criteria established under DENR Administrative Order No. 2017-11, are as follows: Endangered (EN), Vulnerable (VU), Other Threatened Species (OTS), Other Wildlife Species (OWS), Not Listed, and Unknown. The Unknown category and those not listed are excluded from the DAO 2017-11 assessment, but are included in this study, as shown in Figure 3. The Unknown and unlisted species have minimal or unclear taxonomic information, which prevents accurate categorization. These unverified records highlight the need for more taxonomic research and continuing biodiversity monitoring to ensure that no potentially endangered species are overlooked (DENR-BMB, 2017). As for Endangered (EN), a total of 5 species (4.4%) were classified, including *Vitex parviflora*, *Madhuca betis*, *Azelia rhomboidea*, *Sindora supa*, and *Tectona philippinensis*. These species are under very high risk of extinction due to population declines and restricted distributions. Their occurrence within the site underscores the area's potential importance for species recovery and in situ conservation (DENR-BMB, 2017). In addition, 18 species (15.8%) were identified as Vulnerable. These include *Pterocarpus indicus*, *Shorea contorta*, *Cynometra inaequifolia*, and *Dracontomelon dao*. In the medium term, these species have a high risk of extinction since they are not as critically endangered species, they nevertheless require strong conservation efforts and frequent monitoring to avoid further decline. Three (3) species (2.6%) were identified as Other Threatened Species (OTS): *Canarium ovatum*, *Ziziphus talanae*, and *Dillenia reifferscheidia*. These species, while not classified as EN or VU, are still considered at risk, often due to habitat disturbance, overharvesting, or localized distribution. They warrant special management attention to avoid escalation to higher threat categories. Moreover, a total of 38 species (33.3%) were not listed in the current conservation list. The species includes *Broussonetia papyrifera*, *Senna spectabilis*, *Pithecellobium*, and others, which may be widespread species or those for which there is insufficient conservation data. Lastly, 2 species (1.8%) were classified as Unknown due to unresolved taxonomic

information, making their conservation status undetermined at present.

### IUCN Red List of Threatened Species (2025-1)

For the global scheme, the International Union for Conservation of Nature's (IUCN) Red List of Threatened Species (2025-1), categorizes 114 species as Critically Endangered, Endangered, Vulnerable, Near Threatened, Least Concern, Lower Risk, Not Evaluated, Data Deficient, or unknown.

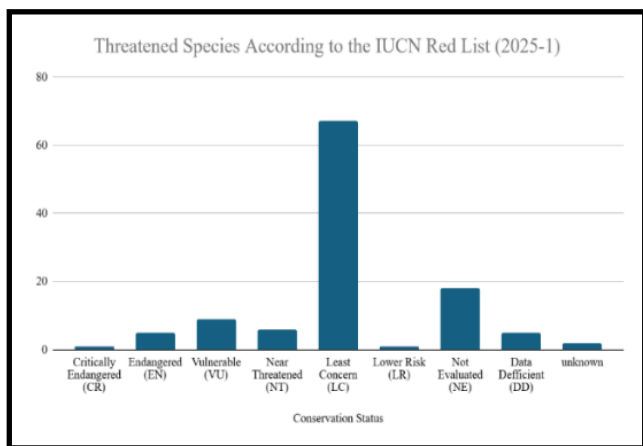


Figure 4. Conservation status of species according to IUCN 2025-1

The 114, tree species were assessed using the IUCN Red List categories, the majority were classified as Least Concern (LC), accounting for 67 species (58.8%), suggesting that a large portion of flora in the area is currently not at immediate risk. In contrast, the recorded Critically Endangered (CR) and Lower Risk (LR) categories, has only 1 species (0.9%). The solely documented Critically Endangered species, is the *Hopea malibato* faces an extremely high risk of extinction in the wild. The Lower Risk species of *Leucaena leucocephala* is widely distributed and cultivated globally (Orwa, 2009). Under the Endangered (EN) category, 5 species (4.4%) were recorded, including *P. indicus*, *C. arabica*, *S. macrophylla*, *N. kentii*, and *T. philippinensis*. These species are among with the very high risk of extinction due to severely restricted ranges and declining populations. Additionally, 9 species (7.9%) were classified as Vulnerable (VU), followed by 6 species (5.3%) categorized as Near Threatened (NT), indicating they are close to qualifying for a threatened status. A significant proportion of the species, 18 (15.8%), were classified as Not Evaluated (NE), revealing gaps in global biodiversity assessments and the need for additional research. Similarly, 5 species (4.4%) were designated as Data Deficient (DD) because there was insufficient evidence available to estimate their risk of extinction. Finally, two species (1.8%) were classed as Unknown, owing to unclear taxonomic identification, which necessitates additional field validation and scientific research.

### Aboveground Biomass and Carbon Stock Potential

66 species with a DBH of less than >5 cm was computed for above-ground biomass and carbon stocks. AGB obtained a total of 207.20 and carbon stock of 96.8562Mg/ha. *G. arborea* has recorded with the highest AGB and CS, with a (33.68177Mg/ha). Moreover, *V. parviflora*, *A. heterophyllus*, *Nlappaceum*, and *T catappa* have a carbon stock of 6.014315Mg/ha, 3.282428Mg/ha, 3.270585Mg/ha, and 3.216208Mg/ha, respectively. were higher than other tree species. The *Ficus pseudopalma* has a relatively low carbon stock of 0.028708Mg/ha. Meanwhile, for the tree species with < 5cm DBH, result shows that among 44 species listed, it contained a total of 12487.44Mg/ha of stored carbon, attributed to 5 species attain the highest carbon store in the area. These are the *G. arborea* with the highest sequestered carbon of 9203.029Mg/ha followed by *M. indica*, *A heterophyllus*, *F. nota*, and *M. tanarius* also has relatively high carbon stock with (2117.696), (336.2445), (229.524), and (111. 5689), respectively. However, *M. multiglandulosa* has the least carbon store with (0.7719Mg/ha). It indicates the least distribution of species in the area. Finally, the woody perennial crops, such as fruit trees, have demonstrated the ability to store carbon and contribute to climate change mitigation by boosting long-term carbon storage. It has also been shown to help local people with food production, income, and livelihoods (Ageyi et al., 2017; Tsedeke et al., 2021; Lasco et al., 2001).

### CONCLUSION

This study concludes that the agroforestry farm in Barangay Magapuy, Bayombong, Nueva Vizcaya, exhibits diverse tree species and potential for carbon storage. 114 of trees were recorded reflecting substantial species richness in a one-hectare farm area. The presence of native and introduced species, as well as diverse understory vegetation, demonstrates a functionally stratified and biologically active agroforestry system. Notable species, including *V. parviflora*, *P. indicus*, and *M. indica*, were studied for their ecological services, economic value. In addition, the study identified endemic and threatened species, such as *S. supra* and *T. philippinensis*, highlighting the site's role in in-situ conservation and biodiversity protection. The assessment of conservation status found that numerous species are already under threat, highlighting the urgent need for continuous conservation action. Potential carbon storage for tree species with DBH ≥ 5 cm, such as *G. arborea*, accounted for the highest individual contribution with 33.68 Mg/ha of carbon, followed by *V. parviflora*, *A. heterophyllus*, *N. lappaceum*, and *T. catappa*. For smaller trees with DBH < 5 cm, a total of 44 species collectively stored 12,487.44 Mg/ha of carbon, with *G. arborea* again exhibiting the highest sequestration at 9,203.03 Mg/ha. Other species with notable carbon storage include *M.indica*, *F. nota*, *A. heterophyllus*, and *M. tanarius*, while *M. multiglandulosa* showed the least at 0.77 Mg/ha. Finally, the study confirms that well-managed agroforestry systems offer valuable opportunities for conserving biodiversity, supporting rural livelihoods, and contributing to climate resilience.

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## Conflict of Interest

This paper has no conflicts of interest.

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