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Full Length Research Article

Impact of *Acacia mangium* Willd. Plantation on Species Composition at Bugoy's Peak, Barangay Bonbon, Butuan City, Philippines

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ABSTRACT

Acacia mangium is a fast-growing tree species widely used in agroforestry and reforestation. However, it has raised concerns due to its potential ecological impacts when introduced outside its native range. This study assessed the effect of *A. mangium* plantations on species composition and seedling recruitment at Bugoy's Peak, Barangay Bonbon, Butuan City, Philippines. A total of 13 plots were established using a nested quadrat design to evaluate tree diversity and regeneration patterns. Biodiversity indices and statistical tools were employed to analyze species abundance and composition within the plantation area. Results indicated that *A. mangium* did not exhibit signs of invasive dominance in the site. On the contrary, the presence of regenerating native species across plots suggests that local conditions may support coexistence and recruitment despite the presence of an introduced species. These findings highlight the importance of site-specific assessments in evaluating the ecological impact of non-native tree species and offer valuable insights for sustainable plantation management in biodiverse landscapes.

1. Introduction

The composition of plant species is crucial for maintaining biodiversity. The functional makeup of plants can effectively represent biodiversity, influencing species richness and conservation priorities across many biomes (Wan et al. 2023). This functional makeup maintains ecosystem processes, provides habitats and resources for organisms, and promotes the long-term sustainability and resilience of ecosystems (Brondizio et al. 2019). Biological invasions are known to modify ecosystem structure and function, leading to declines in native biodiversity, changes in species composition, and disruptions of natural regeneration processes (Fartyal et al. 2025; Gaertner et al. 2014; Negi et al. 2023). Invasive alien plant species (IAPS) are a global issue, as they compete with native vegetation, diminish biodiversity, and harm ecosystem services, socioeconomic status, and human health (Heriyanto et al. 2023; Rai and Singh 2020).

Acacia mangium has shown potential for restoring degraded lands and improving soil fertility through nitrogen fixation (Koutika and Richardson 2019). Studies have revealed that *A. mangium* plantations can increase plant diversity and biomass compared to natural savanna areas, although with a shift in species composition (Toledo and Nascimento 2019). The tree also supports a diverse arthropod community, with higher abundance and diversity of insects and spiders on the adaxial leaf surface (Gomes et al. 2021). As *A. mangium* saplings grow and increase ground cover, they attract more pollinating insects, tending ants, and predators, indicating a positive impact on ecosystem recovery (Lima et al. 2021). However, *A. mangium* is highly invasive in many regions where it has been introduced, potentially threatening local biodiversity (Koutika and Richardson 2019). Therefore, careful risk assessments and management strategies are necessary when using *A. mangium* for restoration projects. Despite these concerns, some studies suggest that the invasive potential of *A. mangium* may be overstated. In a 25-year study in East Kalimantan, Indonesia, *A. mangium* density decreased over time, allowing native tree species to re-emerge among the stands (Sutedjo and Warsudi 2017).

The study was conducted at Bugoy's Peak, a locally known elevated area situated in Barangay Bonbon, Butuan City, within the Caraga Region of the Philippines. While not an officially designated geographical feature, Bugoy's Peak is widely recognized in the local community as a recreational and observational site. The area supports a variety of plant species and is frequented by hikers and nature enthusiasts. However, concerns have been raised about the ecological impacts of *A. mangium*, an invasive species native to Australia, Indonesia, and Papua New Guinea. *A. mangium*, an invasive species used in reforestation, has significant ecological impacts. It increases total litterfall production and alters nutrient cycling in invaded forests, potentially facilitating further invasion (Jaafar et al. 2022). *A. mangium* plantations modify soil physicochemical properties, enhancing organic matter content, nitrogen levels, and water retention (Hamad-Sheip et al. 2021).

The present study aims to assess the influence of *A. mangium* and land use patterns on the woody plant composition of Bugoy's Peak, Barangay Bonbon, Butuan City. While *A. mangium* is widely regarded as an invasive species in various tropical regions, its impact appears to vary depending on the environmental context. In this study, its effects were not as ecologically disruptive as reported elsewhere, highlighting the importance of site-specific assessments. The findings contribute to a deeper understanding of how introduced species and land use changes interact to shape local vegetation. These insights can inform context-appropriate conservation strategies and sustainable land management practices, helping to preserve native plant diversity and maintain ecological balance in upland environments.

2. Materials and Methods

2.1. Location of the Study

Bugoy's Peak is located in Barangay Bonbon, Butuan City (**Fig. 1**). Bonbon is situated in the northeastern part of the Agusan Valley, bounded by Agusan del Norte, Agusan del Sur, and Butuan Bay. It is designated for the Extended National Greening Programme (E-NGP), which aims to promote *A. mangium* plants. The area is situated next to Mount Mayapay and contrasts with the surrounding agricultural lands, particularly the rice fields, which are located far from the research site. It was previously used as a park, taking advantage of its high elevation to offer expansive views that enhanced its appeal as a location for observation.

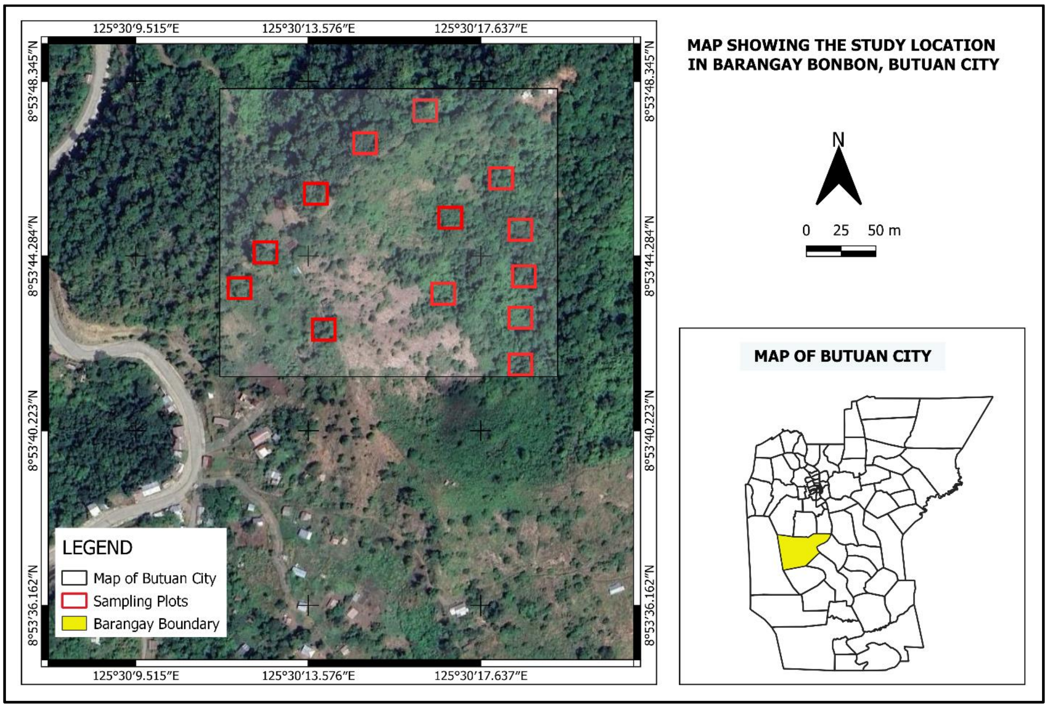

Fig. 1. Location of the study.

2.2. Sampling Design and Data Collection

A nested quadrat sampling design was employed in the study area to systematically assess tree species composition, including the presence of the potentially invasive species *Acacia mangium*. A total of 13 quadrats, each measuring 10 m × 10 m, were randomly established. Within each 10 m × 10 m plot, all tree species with a diameter at breast height (DBH) greater than 5 cm were identified and recorded. DBH refers to the diameter of a tree trunk measured at 1.3 meters above ground level, a standard criterion for classifying mature trees. To document sapling regeneration, a 5 m × 5 m sub-quadrat was nested within each 10 m × 10 m plot, where all woody plants with DBH less than 5 cm but taller than 0.5 m were recorded.

For seedling assessment, a 1 m × 1 m quadrat was further nested within the 5 m × 5 m plot. All young plant individuals with a height of less than 0.5 meters, which were not yet eligible for DBH measurement, were recorded as seedlings. This classification was based on the guidelines set by the Department of Environment and Natural Resources – Biodiversity Assessment and Monitoring System (DENR-BAMS) (**Fig. 2**).

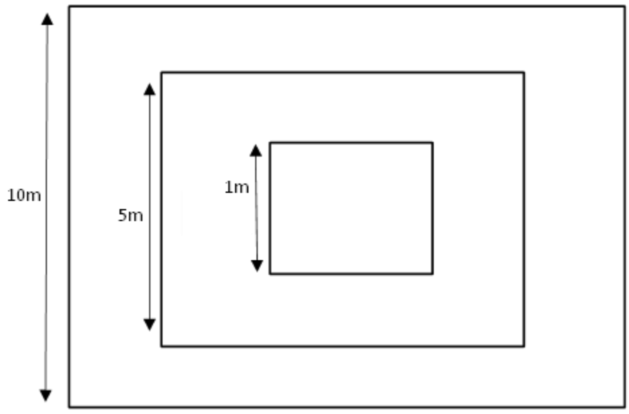

Fig. 2. Nested quadrat sampling design for species diversity assessment (DENR BAMS).

2.3. Species Identification

All of the species inside the quadrat were identified and listed. For specimens that were difficult to identify in the field, we used the GeoCam app to capture geotagged photographs, which helped us document and revisit the exact location and features of each specimen. Unknown species present in the sample area were taxonomically identified using relevant online resources (World Flora Online and Philippine Native Tree Enthusiasts) and with the assistance of taxonomist experts from the College of Forestry at Caraga State University.

2.4. Shannon Diversity Index

Species of trees with the highest number will be considered the most dominant species. Equation 1 was used for the Shannon Wiener Index.

$$H' = \Sigma pilnpi \tag{1}$$

where *pi* is the proportion of individuals belonging to the *i-th* species relative to the total number of individuals in the sample. Higher values of *H'* indicate greater diversity.

Table 1. Shannon Diversity Index categorization (Fernando et al. 1998)

Relative Values	Shannon (H') Index
Very high	3.5–5.0
High	3.0–3.49
Moderate	2.5–2.99
Low	2.0–2.49
Very low	1.9 and below

2.5. Vegetation Analysis

Vegetation analysis was computed using descriptive statistics to determine the relative dominance, relative frequency, relative density, and the importance value of each species in the study area. Dominant species exist in the greatest number or size. It was computed using Equations 2–8, the widely used formula developed by Curtis and McIntosh (1951) and Mishra (1968).

$$Dominance = \frac{Basal\ area\ of\ a\ species}{Area\ sampled} \tag{2}$$

$$Frequency = \frac{Number\ of\ plots\ a\ species\ occurs}{Total\ number\ of\ plots} \tag{3}$$

$$Relative\ frequency\ (\%) = \frac{Number\ of\ trees\ per\ species}{Frequency\ of\ all\ trees} \times 100\% \tag{4}$$

$$Density\ (ind/ha) = \frac{Total\ number\ of\ individuals\ of\ a\ species}{Total\ number\ of\ areas\ sampled} \tag{5}$$

$$Relative\ density\ of\ each\ species\ (\%) = \frac{Density\ of\ each\ species}{Frequency\ of\ all\ trees} \times 100\% \tag{6}$$

$$Relative\ dominance\ (\%) = \frac{Basal\ area\ of\ each\ species}{Basal\ area\ of\ all\ species} \times 100\% \tag{7}$$

$$Importance\ value\ (\%) = Relative\ density + Relative\ dominance + Relative\ frequency \quad (8)$$

2.6. Data Analysis

Biodiversity indices, specifically the Shannon-Wiener Diversity Index and Evenness Index, were calculated using PAST statistical software (Version 2.14). Additionally, site-level biodiversity metrics based on species richness and abundance within each quadrat were generated using the BioPro software.

3. Results and Discussion

3.1. Species Composition, Distribution, and Importance of Trees (DBH > 5 cm)

The assessment of woody plant species with DBH > 5 cm in the study area discovered a mixture of exotic and native species with varying levels of abundance, frequency, and dominance (**Table 2**). A total of 12 species belonging to different families were recorded. Among the recorded species, mangium (*A. mangium*) is a dominant species, surpassing other tree species in terms of relative density (3.87%), relative frequency (17.21%), relative dominance (17.05%), and with a species importance value (SIV) of 38.13. On the contrary, bintoko (*M. latifolia*) and mango (*M. indica*) show lower relative densities (0.08%), relative frequency (0.81%), relative dominance (0.85%), and SIV (1.74), suggesting they are less common. In Brazil, *A. mangium* was found to have a negative impact on native species richness in a secondary forest fragment (Silva and Matos 2024). A study in the Philippines by Tulod et al. (2017) found no significant differences in total regeneration density between exotic plantations and natural forests, but observed variations in sapling and seedling densities, suggesting that *A. mangium* can support the establishment of native species in its understory and potentially contribute to biodiversity conservation.

Table 2. Woody plants with a DBH of > 5 cm at Bugoy's Peak, Barangay Bonbon, Butuan City

Common name	Scientific name	RD (%)	RF (%)	RDom (%)	SIV (%)
Anislag	*Flueggea flexuosa*	0.92	6.45	9.84	17.21
Antipolo	*Artocarpus blancoi*	0.38	4.07	4.05	8.5
Balite	*Ficus benjamina*	0.15	1.62	1.6	3.37
Bintoko	*Melicope latifolia*	0.08	0.81	0.85	1.74
Binunga	*Macaranga tanarius*	0.23	2.44	2.46	5.13
Pakiling	*Ficus odorata*	0.15	1.62	1.6	3.37
Gmelina	*Gmelina arborea*	0.31	3.25	3.31	6.87
Lunas kahoy	*Micromelum minutum*	0.15	1.62	1.6	3.37
Malapapaya	*Polyscias nodosa*	1.23	13.17	13.15	27.55
Mango	*Mangifera indica*	0.08	0.81	0.85	1.74
Pulayo puti	*Syzygium simile*	0.46	4.88	4.91	10.25
Mangium	*Acacia mangium*	3.87	17.21	17.05	38.13

Notes: RD = relative density, RF = relative frequency, RDom = relative dominance, SIV = species importance value.

The extensive distribution of *A. mangium* observed in the study area provides context for evaluating its impact on native species composition and seedling recruitment. Following *A. mangium*, malapapaya (*P. nodosa*) has the second-highest relative density (1.23%), relative frequency (13.17%), relative dominance (13.15%), and SIV (27.55%), indicating its prevalence in the area. In the Philippines, *P. nodosa* is a native and pioneering species, playing a key role in initiating ecological succession. In a study conducted by Jawani et al. (2022), *P. nodosa* was recommended as a primary species for establishing the microclimatic conditions in denuded areas to accelerate forest restoration, particularly in the Philippines, where extreme deforestation is prevalent. Aside from *P. nodosa*, other native species identified include anislag (*F. flexuosa*), antipolo (*A. blancoi*), lunas kahoy (*M. minutum*), balite (*F benjamina*), bintoko (*M. latifolia*), binunga (*M. tanarius*), pakiling (*F. odorata*), and pulayo puti (*S. simile*). The presence of these species is consistent with earlier findings by Galicia (2022) and Marquez et al. (2021), who reported similar occurrences of native species such as *F. odorata* and *M. tanarius* in mixed forest systems. Dominant species often possess greater resource capture abilities and competitive success, which in turn influence the distribution and composition of subordinate species (Škornik et al. 2024). The high importance value of *A. mangium* reflects its intentional establishment in the area, where it not only thrives but also has the potential to facilitate microhabitat improvements and promote the regeneration of native species. Mangium plantations promote natural regeneration and stabilize microclimates, affecting the establishment and growth of native species (Lee et al. 2006).

3.2. *Species Composition, Distribution and Importance of Trees (DBH < 5cm)*

In **Table 3**, the species malapapaya (*P. nodosa*), mangium (*A. mangium*), and pulayo puti (*S. simile*) exhibit higher densities compared to the others. These species play a crucial role in enhancing the total biomass and plant cover within the ecosystem (Arodudu et al. 2020). However, species like anislag (*F. flexuosa*), pagsahingin (*C. asperum*), lubeg (*S. lineatum*), and tibig (*F. nota*) demonstrate lower relative densities, implying a more limited distribution. The higher relative frequencies of malapapaya (*P. nodosa*), pulayo puti (*S. simile*), and mangium (*A. mangium*) suggest their widespread presence across the ecosystem, contributing significantly to various ecological processes. Other species, such as antipolo (*A. blancoi*) and pagsahingin (*C. asperum*), also exhibit significant dominance levels. Additionally, *P. nodosa* emerges as the most significant species based on the result, possessing the highest species importance value (SIV).

Table 3. Woody undergrowth with a diameter of less than 5 cm DBH at Bugoy's Peak, Barangay Bonbon, Butuan City

Common name	Scientific name	RD (%)	RF (%)	RDom (%)	SIV (%)
Anislag	*Flueggea flexuosa*	0.08	4.73	3.59	8.4
Antipolo	*Artocarpus blancoi*	0.23	9.05	10.31	19.59
Bintoko	*Melicope latifolia*	0.15	9.05	6.73	15.93
Malapapaya	*Polyscias nodosa*	0.70	28.38	31.39	60.47
Pulayo puti	*Syzigium simile*	0.54	23.65	24.22	48.41
Mangium	*Acacia mangium*	0.69	19.12	30.94	50.75
Pagsahingin	*Canarium asperum*	0.08	4.73	3.59	8.4
Lubeg	*Syzygium lineatum*	0.08	4.73	3.59	8.4
Tibig	*Ficus nota*	0.08	4.73	3.59	8.4

Notes: RD = relative density, RF = relative frequency, RDom = relative dominance, SIV = species importance value.

Table 4 shows that malapapaya (*P. nodosa*) stands out with the highest relative density (0.85) and relative frequency (53.81). This suggests that malapapaya plays a significant role in the ecosystem, potentially contributing to various ecological processes due to its abundance. Additionally, the malapapaya species importance value (SIV) of 29.6 further highlights its ecological significance. Pulayo puti also shows considerable relative frequency (41.94%) and relative dominance (22.22%). While its relative density is lower compared to malapapaya, pulayo puti (*S. simile*) still makes a significant contribution to the ecosystem's structure and function. On the other hand, species like bagon (*M. minutum*), binunga (*M. tanarius*), and lubeg (*S. lineatum*) exhibit lower relative densities, frequencies, and dominance percentages. Species exhibiting lower relative densities, frequencies, and dominance percentages may indicate a more restricted distribution. This could also suggest that their ecological impact is less pronounced, potentially due to their limited geographic range within the area.

Table 4. Regenerant species diversity and richness (1 × 1) m^2

Common name	Scientific name	RD (%)	RF (%)	RDom (%)	SIV (%)
Bagon	*Micromelum minutum*	0.08	7.67	3.29	11.04
Binunga	*Macaranga tanarius*	0.08	7.67	3.29	11.04
Malapapaya	*Polyscias nodosa*	0.85	53.81	35.05	89.71
Pulayo puti	*Syzygium simile*	0.54	41.94	22.22	64.70
Lubeg	*Syzygium lineatum*	0.08	7.67	3.29	11.04

Notes: RD = relative density, RF = relative frequency, RDom = relative dominance, SIV = species importance value.

3.3. Tree Species Diversity and Richness

Table 5 shows the abundance and distribution of various tree species within a 10 m × 10 m quadrat. It reveals considerable variation in the number of individuals among species, with some being highly abundant while others are rare. Proportional abundance values highlight the dominance of certain species, particularly malapapaya (*P. nodosa*), which is a native tree species in the Philippines.

Table 5. Tree species diversity and richness (10 × 10) m^2

Common name	Scientific name	Individuals	*pi*	ln	ln × *pi*
Anislag	*Flueggea flexuosa*	12	0.098	-0.233	0.009
Antipolo	*Artocarpus blancoi*	5	0.041	-0.095	0.002
Bagon	*Micromelum minutum*	2	0.016	-0.037	0
Balite	*Ficus benjamina*	2	0.016	-0.037	0
Bintoko	*Melicope latifolia*	1	0.008	-0.018	0
Binunga	*Macaranga tanarius*	3	0.024	-0.056	0.001
Pakiling	*Ficus odorata*	2	0.016	-0.037	0
Gmelina	*Gmelina arborea*	4	0.032	-0.075	0.001
Malapapaya	*Polyscias nodosa*	16	0.13	-0.307	0.017
Mango	*Mangifera indica*	1	0.008	-0.018	0
Pulayo puti	*Syzigium simile*	6	0.049	-0.114	0.002
Mangium	*Acacia mangium*	54	0.439	-1.034	0.193
Pagsahingin	*Canarium asperum*	3	0.024	-0.056	0.001
Alagasi	*Leucosyke capitellata*	7	0.057	-0.134	0.003
Lubeg	*Syzygium lineatum*	5	0.041	-0.095	0.002

The natural logarithm-transformed values offer insights into the distribution patterns and evenness of species within the community. Patterns of species diversity and species abundance distribution change in response to habitat (Zang et al. 2020). The data generally emphasizes the importance of considering species abundance and distribution for understanding ecosystem dynamics. In a recent study by Jiang et al. (2025), they demonstrated that reseeding native species improved community stability by enhancing species diversity, niche differentiation, and interspecific relationships. This underscores the practical importance of understanding species abundance distributions and ecological niches in ecosystem restoration efforts.

Table 6 shows the species diversity and richness of tree species found in the 5 m × 5 m quadrat. It can be observed that malapapaya (*P. nodosa*), pulayo puti (*S. simile*), and mangium (*A. mangium*) are more abundant than others, with each having nine individuals recorded. This higher abundance might indicate that these species play a more significant role in the ecosystem or are better adapted to the environmental conditions of the sampled area. Dominant tree species are recognized for their significant role in shaping the structure and function of ecosystems. According to Smith and Knapp (2003), they can help sustain ecosystem productivity, even in the absence of less common species. Furthermore, dominant species may influence the distribution and abundance of neighboring species through mechanisms such as competitive exclusion and environmental filtering (Wei et al. 2020). Understanding the role of dominant species is crucial for predicting ecosystem responses to species loss, as well as for enhancing forest management practices (Duan et al. 2024). Moreover, species like anislag (*F. flexuosa*), pagsahingin (*C. asperum*), lubeg (*S. lineatum*), and tibig (*F. nota*) are less abundant, with only one individual recorded for each.

Table 6. Woody undergrowth species diversity and richness (5 × 5) m^2

Common name	Scientific name	Individuals	*pi*	ln	ln × *pi*
Anislag	*Flueggea flexuosa*	1	0.029	-0.083	0.001
Antipolo	*Artocarpus blancoi*	3	0.088	-0.254	0.008
Bintoko	*Melicope latifolia*	2	0.059	-0.17	0.003
Malapapaya	*Polyscias nodosa*	9	0.264	-0.761	0.056
Pulayo puti	*Syzigium simile*	7	0.206	-0.594	0.043
Mangium	*Acacia mangium*	9	0.265	-0.764	0.071
Pagsahingin	*Canarium asperum*	1	0.029	-0.083	0.001
Lubeg	*Syzygium lineatum*	1	0.029	-0.083	0.001
Tibig	*Ficus nota*	1	0.029	-0.083	0.001

Table 7 shows the abundance and proportional abundance (*pi*) of several tree species within a sampled area, along with their natural logarithm-transformed values. Primarily, malapapaya (*P. nodosa*) stands out with the highest number of individuals (11) and the highest proportional abundance (0.524), indicating its commonness within the ecosystem.

Table 7. Regenerant species diversity and richness (1 × 1) m^2

Common name	Scientific name	Individuals	*pi*	ln	ln × *pi*
Bagon	*Micromelum minutum*	1	0.048	-0.112	0.002
Binunga	*Macaranga tanarius*	1	0.048	-0.112	0.002
Malapapaya	*Polyscias nodosa*	11	0.524	-1.209	0.275
Pulayo puti	*Syzigium simile*	7	0.333	-0.741	0.111
Lubeg	*Syzygium lineatum*	1	0.048	-0.112	0.002

Recent findings have suggested that larger diversity in the tropics could be explained by larger niche spaces and greater niche packing (Pellissier et al. 2018). This mechanism could interact with differential diversification rates to amplify spatial differences in diversity (Etienne et al. 2019). Additionally, species such as bagon (*M. minutum*), binunga (*M. tanarius*), and lubeg (*S. lineatum*) have only one individual each, indicating a lower abundance. According to Hubbell

(2001), the importance of rare species in maintaining biodiversity and ecosystem resilience, even with low abundances, is evident in species such as bagon (*M. minutum*), binunga (*M. tanarius*), and lubeg (*S. Lineatum*), which can still contribute to overall ecosystem stability and function.

Table 8 shows the frequency of occurrence of *A. mangium* within two different plot sizes (10 m ×10 m and 5 m × 5 m) along with the total number of individuals recorded and the number of quadrats in which the species is present. In the 10 m × 10 m plot, *A. mangium* is present in 13 out of the total number of quadrats, with a total of 54 individuals recorded, representing a frequency of 20.97%. In the smaller 5 m × 5 m plot, *A. mangium* is present in 4 out of the total number of quadrants, with only 9 individuals recorded, resulting in a lower frequency of 6.45%.

Table 8. *A. mangium* frequency and occurrence in (10 × 10) m^2 and (5 × 5) m^2 plot

Plot	Tree species	Total	Number of quadrants in which the species is present	Frequency
10 m ×10 m	*Acacia mangium*	54	13	20.97%
5 m × 5 m	*Acacia mangium*	9	4	6.45%

This shows that *A. mangium* is more abundant and has a higher frequency of occurrence in the larger plot size compared to the smaller one. The difference in frequency between the two plot sizes could be attributed to various factors, such as differences in environmental conditions or spatial distribution patterns. Larger plot sizes capture more variability in species distribution and provide a more comprehensive understanding of community composition compared to smaller plot sizes (Bonham 1989).

Table 9 shows the total number of individuals, the number of quadrats in which each species is present, frequency, and density for several tree species. Malapapaya (*P. nodosa*) stands out with the highest total number of individuals (11) and the highest frequency (11.29%). This means that malapapaya is relatively more abundant and widespread within the sampled area compared to other species. Additionally, malapapaya has a density of 0.85, indicating that, on average, there are 0.85 individuals of malapapaya per quadrat. Accordingly, understanding species diversity and abundance is crucial to the dynamics of tropical forests. In an ecological context, certain species may dominate in terms of density and frequency, while others may be relatively rare. These ecological patterns, shaped by conspecific negative density dependence and species-specific traits, have a significant impact on understanding coexistence, ecosystem functioning, and conservation prioritization (Cooper et al. 2023; Hordijk et al. 2024; LaManna et al. 2017).

Table 9. Seedling recruitment of native and indigenous tree species on every plot

Common name	Scientific name	Total	Number of quadrats in which the species is present	Frequency	Density
Bagon	*Micromelum minutum*	1	1	1.61%	0.08
Binunga	*Macaranga tanarius*	1	1	1.61%	0.08
Malapapaya	*Polyscias nodosa*	11	7	11.29%	0.85
Pulayo puti	*Syzigium simile*	7	6	9.68%	0.54
Lubeg	*Syzygium lineatum*	1	1	1.61%	0.08

Table 10 shows that the diversity indices reveal moderate dominance (D = 0.2313), low species diversity (Shannon Index H = 1.996), and moderate evenness (Evenness Index e^H/S = 0.4908) within the sampled ecosystem. This indicates that, despite the allelopathic effect of *A.*

mangium as previously reported by Ekayanti et al. (2015), it can still recruit a significant number of native species in the area. Certain factors may mitigate the invasive potential of *A. mangium*, allowing native species to thrive. Re-evaluating the invasive potential of *A. mangium* should be considered to integrate with local ecological factors for effective management. Rather than focusing on its allelopathic potential, more research should investigate how topography, climate, and soil characteristics interact to shape ecological dynamics. The harmonious coexistence of *A. mangium* and native species highlights the importance of considering local factors in invasive species control plans.

Table 10. Summary of diversity indices

Overall plot	Overall
Dominance_D	0.2313
Shannon_H	1.996
Evenness_e^H/S	0.4908

4. Conclusions

This study provides a quantitative evaluation of the influence of *A. mangium* on species composition and seedling recruitment in Bugoy's Peak, Barangay Bonbon, Butuan City. A total of 13 plots were surveyed using a nested quadrat design, resulting in the identification of 12 woody species with DBH > 5 cm and several regenerating individuals with DBH < 5 cm. Among these, *A. mangium* exhibited the highest species importance value (SIV) of 38.13, driven by a relative density of 3.87%, frequency of 17.21%, and dominance of 17.05%. However, the dominance of *A. mangium* was not overwhelming, as native species such as *P. nodosa* (malapapaya) showed substantial presence, particularly in the < 5 cm DBH class, with the highest SIV of 29.6 and relative frequency of 53.81%. Despite global concerns about *A. mangium*'s invasive nature, the study site showed no signs of monospecific dominance or displacement of native species. Instead, native trees such as *S. simile*, *A. blancoi*, *F. flexuosa*, and *M. tanarius* were present across plots, suggesting positive natural regeneration and coexistence. Diversity assessments revealed species richness and evenness, indicating a structurally diverse regenerating forest.

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Author Contributions

R.M.C.: Conceptualization, Methodology; N.B.V.: Supervision, Data Curation, Writing Original Draft Preparation; L.J.F.P.: Conceptualization, Data Analysis, Writing the Original Draft. V.L.C.: Review and Editing Methodology, Data Curation, Writing Original Draft Preparation; C.S.C.: Methodology, Data Curation, Writing-Original Draft Preparation; R.N.C.: Methodology, Data Curation, Writing – Original Draft Preparation; M.A.P.P.: Methodology, Writing – Original Draft Preparation.

Conflict of Interest

The authors declare no conflict of interest.

Declaration of Generative AI and AI-Assisted Technologies in the Manuscript Preparation

During the preparation of this work, the authors utilized Quilbot and Grammarly to enhance the clarity of the writing, making it easier for readers to understand and reducing the risk of plagiarism. After using the tools/service, the authors reviewed and edited the content as needed and took full responsibility for the publication's interest.

References

Arodudu, O., Holmatov, B., and Voinov, A. 2020. Ecological Impacts and Limits of Biomass Use: A Critical Review. *Clean Technologies and Environmental Policy*. Springer Publishing, U.S.

Bonham, C. D. 1989. *Measurements for Terrestrial Vegetation*. John Wiley and Sons, U.S.

Brondizio, E. S., Settele, J., Díaz, S., and Ngo, H. T. 2019. *Global Assessment Report on Biodiversity and Ecosystem Services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*. IPBES Secretariat, Bonn, Germany.

Cooper, D. L., Lewis, S. L., Sullivan, M. J., Prado, P. I., Ter Steege, H., Barbier, N., Slik, F., Sonké, B., Ewango, C. E., De Aguiar, D. P., Ahuite Reategui, M. A., Aiba, S., Albuquerque, B. W., Dionízia, F., Alonso, A., Amani, C. A., Do Amaral, D. D., Do Amaral, I. L., Andrade, A., and Zent, S. 2023. Consistent Patterns of Common Species Across Tropical Tree Communities. *Nature* 625(7996): 728–734. DOI: 10.1038/s41586-023-06820-z

Curtis, J. J., and McIntosh, R. P. 1951. An Upland Forest Continuum in the Practice Forest Border Region of Wisconsin. *Ecology* 32(3): 476–496. DOI: 10.2307/1931725

Duan, J., Jia, Z., Ge, S., Li, Y., Kang, D., and Li, J. 2024. Dominant Species Composition, Environmental Characteristics and Dynamics of Forests with *Picea jezoensis* Trees in Northeast China. *Diversity* 16(12): 731. DOI: 10.3390/d16120731

Ekayanti, N., Indriyanto, I., and Duryat, D. 2015. The Effect of Allelopathy from the Trees of Earpod Wattle, Black Wattle, and Teak to the Growth of the Seedlings of Earpod Wattle, Black Wattle, and Teak. *Jurnal Sylva Lestari* 3(1): 81–90. DOI: 10.23960/jsl1381-90

Etienne, R. S., Cabral, J. S., Hagen, O., Hartig, F., Hurlbert, A. H., Pellissier, L., Pontarp, M., and Storch, D. 2019. A Minimal Model for the Latitudinal Diversity Gradient Suggests a Dominant Role for Ecological Limits. *The American Naturalist* 194(5): E122–E133. DOI: 10.1086/705243

Fartyal, A., Bhambra, G. K., Joshi, V., Joshi, C., Bargali, K., and Bargali, S. S. 2025. Assessing the Potential of Three Invasive Alien Plants as Possible Feedstock for the Production of Biochar and Crop Productivity. *Journal of Soil Science and Plant Nutrition* 25(2). DOI: 10.1007/s42729-025-02506-9

Fernando, E. S. 1998. *Forest Formations and Flora of the Philippines: Handout in FBS 21*. College of Forestry and Natural Resources, University of the Philippines at Los Baños. [Unpublished Manuscript].

Galicia, L., Barcellano, E., Dela Cruz, R., Galicia, R., Ong, H., Totaan, D., and Urmeneta, A. J. 2022. *Tree Diversity of Mount Arayat Protected Landscape*. Social Science Research Network, U.S.

Gomes, G. N., Leite, G. L. D., Soares, M. A., Guanãbens, R. E. M., Lemes, P. G., and Zanuncio, J. C. 2021. Arthropod Fauna on the Abaxial and Adaxial Surfaces of *Acacia mangium* (Fabaceae) Leaves. *Brazilian Journal of Biology* 83: e245536. DOI: 10.1590/1519-6984.245536

Gaertner, M., Biggs, R., Te Beest, M., Hui, C., Molofsky, J., and Richardson, D. M. 2014. Invasive Plants as Drivers of Regime Shifts: Identifying High-Priority Invaders that Alter Feedback Relationships. *Diversity and Distributions* 20(6): 733–744. DOI: 10.1111/ddi.12182

Hamad-Sheip, Y., Abdul-Hamid, H., Abiri, R., Saleh, M.-N., Mohamed, J., Jalil, A.-M., and Naji, H. R. 2021. Effect of *Acacia mangium* Canopy on Physicochemical Characteristics and Nutrient Concentrations of the Soil at Ayer Hitam Forest Reserve, Malaysia. *Forests* 12(9): 1259. DOI: 10.3390/f12091259

Heriyanto, N. M., Samsoedin, I., and Rochmayanto, Y. 2023. Plant Diversity and Carbon Stocks in Urban Green Open Space (Case Study in PT. Gajah Tunggal Tbk., Tangerang, Banten). *Jurnal Sylva Lestari* 11(1): 66–78. DOI: 10.23960/jsl.v11i1.618

Hordijk, I., Bialic-Murphy, L., Lauber, T. *et al*. 2024. Dominance and Rarity in Tree Communities Across the Globe: Patterns, Predictors and Threats. *Global Ecology and Biogeography* 33(10): e13889. DOI: 10.1111/geb.13889

Hubbell, S. P. 2001. *The Unified Neutral Theory of Biodiversity and Biogeography*. Princeton University Press, New Jersey, U.S.

Jaafar, S. M., Metali, F., Nafiah, S. N. S., Supri, N. E., Ahmad, N., Burslem, D. F. R. P., and Sukri, R. S. 2022. Differential Impacts of *Acacia* Invasion on Nutrient Fluxes in Two Distinct Bornean Lowland Tropical Rain Forests. *Forests* 13(12): 2101. DOI: 10.3390/f13122101

Jawani, R. M., Ramoncito, N. A., and Quimson, G. 2022. Evaluating the Functional Traits of the Pioneering Species: Insights to Forest Restoration. *Journal of Environmental Science and Sustainable Development* 5(1): 191–206. DOI: 10.7454/jessd.v5i1.1090

Jiang, H., Zhou, Y., Li, W., Lu, Q., Xu, D., Ma, H., Ma, X., and Tian, X. 2025. Reseeding Native Species Promotes Community Stability by Improving Species Diversity, Niche, and Interspecific Relationships in the Desert Steppe of Northwest China. *Ecology and Evolution* 15(2): e70929. DOI: 10.1002/ece3.70929

Koutika, L. S. and Richardson, D. M. 2019. *Acacia mangium* Willd: Benefits and Threats Associated with its Increasing Use Around the World. *Forest Ecosystems* 6(1): 15. DOI: 10.1186/s40663-019-0159-1

LaManna, J. A., Mangan, S. A., Alonso, A. *et al*. 2017. Plant Diversity Increases with the Strength of Negative Density Dependence at the Global Scale. *Science* 355(6331): 175–178. DOI: 10.1126/science.aam5678

Lee, Y. K., Lee, D. K., Woo, S. Y., Park, P. S., Jang, Y. H., and Abraham, E. R. G. 2006. Effect of *Acacia* Plantations on Net Photosynthesis, Tree Species Composition, Soil Enzyme Activities, and Microclimate on Mt. Makiling. *Photosynthetica* 44(2): 299–306. DOI: 10.1007/s11099-006-0022-9

Lima, J. S., Leite, G. L. D., Guanãbens, P. F. S., Soares, M. A., Silva, J. L., Mota, M. V. S., and Zanuncio, J. C. 2021. Insects and Spiders on *Acacia mangium* (Fabaceae) Saplings as Bioindicators for the Recovery of Tropical Degraded Areas. *Brazilian Journal of Biology* 84: e252088. DOI: 10.1590/1519-6984.252088

Marquez, C., Aguilos, R., Bacsal, R., Adornado, H., and Aguilos, M. 2021. Early Growth of 11 Native and Three Alien Tree Species in Northeastern Mindanao, Philippines. *Forests* 12(7): 909. DOI: 10.3390/f12070909

Mishra, R. 1968. *Ecology Work Book*. IBH Publishing Company, Calcutta, New Delhi, India.

Myster, R. W. 2010. Testing Dominance-Diversity Hypotheses using Data from Abandoned Plantations and Pastures in Puerto Rico and Ecuador. *Journal of Tropical Ecology* 26(2): 247–250. DOI: 10.1017/s0266467409990611

Pellissier, L., Barnagaud, J.-Y., Kissling, W. D., Sekercioğlu, C. H., and Svenning, J.-C. 2018. Niche Packing and Expansion Account for Species Richness–Productivity Relationships in Global Bird Assemblages. *Global Ecology and Biogeography* 27(7): 705–715. DOI: 10.1111/geb.12744

Negi, B., Khatri, K., Bargali, S. S., and Bargali, K. 2023. Impact of Invasive Ageratina Adenophora on Relative Performance of Woody Vegetation in Different Forest Ecosystems of Kumaun Himalaya, India. *Journal of Mountain Science* 20(9): 2557–2579. DOI: 10.1007/s11629-022-7862-z

Rai, P. K., and Singh, J. S. 2020. Invasive Alien Plant Species: Their Impacts on the Environment, Ecosystem Services and Human Health. *Ecological Indicators* 111: 106020. DOI: 10.1016/j.ecolind.2019.106020

Silva, E., and Matos, D. 2024. Effect of Functional Strategies and Abundance of *Acacia mangium* Willd on the Number of Native Species in a Secondary Forest Fragment in Southern Amapá, Brazil. *Boletim do Museu Integrado de Roraima* 15(2): 50–69. DOI: 10.24979/bolmirr.v15i2.1187

Smith, M. D., and Knapp, A. K. 2003. Dominant Species Maintain Ecosystem Function with Non-Random Species Loss. *Ecology Letters* 6(6): 509–517. DOI: 10.1046/j.1461-0248.2003.00454.x

Škornik, S., and Pipenbaher, N. 2024. A Link between Species Abundance and Plant Strategies for Semi-Natural Dry Grasslands. *Plants* 13(16): 2260. DOI: 10.3390/plants13162260

Sutedjo, S., and Warsudi, W. 2017. Measuring the Invasive Nature of *Acacia mangium* Species (*Acacia mangium* Willd.) in the Research and Education Forest of Bukit Soeharto. *ULIN: Journal of Tropical Forests* 1(1): 1–10.

Toledo, J. J., and Nascimento, H. E. 2019. Diversity, Composition and Biomass of Native Vascular Plants Regenerating under *Acacia mangium* Will. Plantations in Northern Amazonia. *Brazilian Journal of Botany* 42(3): 457–465. DOI: 10.1007/s40415-019-00533-7

Tulod, A. M., Casas, J. V., Marin, R. A., and Ejoc, J. A. B. 2017. Diversity of Native Woody Regeneration in Exotic Tree Plantations and Natural Forest in Southern Philippines. *Forest Science and Technology* 13(1): 31–40. DOI: 10.1080/21580103.2016.1266458

Wan, J., Pellissier, L., Wang, C., Yu, F., and Li, M. 2023. Plant Functional Composition as an Effective Surrogate for Biodiversity Conservation. *Basic and Applied Ecology* 74: 49–56. DOI: 10.1016/j.baae.2023.123134

Wei, S., Li, L., Lian, J., Nielsen, S. E., Wang, Z., Mao, L., Ouyang, X., Cao, H., and Ye, W. 2020. Role of the Dominant Species on the Distributions of Neighbor Species in a Subtropical Forest. *Forests* 11(3): 352. DOI: 10.3390/f11030352

Zang, Z., Zeng, Y., Wang, D., Shi, F., Dong, Y., Liu, N., and Liang, Y. 2022. Species-Abundance Distribution Patterns of Plant Communities in the Gurbantünggüt Desert, China. *Sustainability* 14(20): 12957. DOI: 10.3390/su142012957