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Agroforestry Potential for Climate Change Adaptation in Buru Regency

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Abstract

General Background: Climate change poses significant challenges to tropical forest ecosystems and dependent communities, particularly through rising temperatures, altered rainfall patterns, and land-use pressures. **Specific Background** In eastern Indonesia, especially Buru Regency, these dynamics threaten ecosystem stability and land productivity, necessitating adaptive land management approaches such as agroforestry. **Knowledge Gap** However, limited empirical evidence exists regarding the biophysical characteristics and structural variability of agroforestry systems within concession-based forest management areas. **Aims** This study aims to analyze vegetation structure, species diversity, and development potential of climate-based agroforestry systems in the PBPH area of PT. Gema Hutani Lestari. **Results** The findings reveal four canopy strata (A–D) in both Wamtihut and Walsekat hamlets, indicating typical tropical forest stratification, with Wamtihut showing higher structural complexity, greater species richness (nine tree species), and moderate diversity ($H' = 1.72$), while Walsekat exhibits lower diversity ($H' = 1.06$) and strong dominance of *Pterocymbium javanicum* ($IVI = 143.10$). Horizontal distribution patterns include solitary, grouped, and random formations, reflecting ecological variation and land-use intensity. Notably, the absence of seedlings in both sites indicates a regeneration gap. **Novelty** This study provides integrated quantitative and qualitative evidence linking vegetation structure, diversity indices, and agroforestry potential within a concession-based tropical forest landscape. **Implications** The results highlight the need for integrated agroforestry management, institutional strengthening, and community participation to support ecosystem resilience and climate change adaptation in Buru Regency.

Highlights:

- Multi-layer canopy composition differs markedly between two hamlets, indicating contrasting ecological conditions.
- One location shows moderate heterogeneity, while the other is dominated by a single pioneer species.
- Lack of natural regeneration signals potential long-term sustainability risks.

Keywords: Agroforestry, Climate Change Adaptation, Vegetation Structure, Species Diversity, Tropical Forest

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Introduction

Climate change is a global challenge that significantly impacts the stability of tropical forest ecosystems and the livelihoods of communities dependent on forest resources. The 2023 IPCC report confirms that a 1.5°C global temperature increase since the pre-industrial era and changes in rainfall patterns increase the risk of ecosystem degradation, disrupted vegetation regeneration, and unstable land productivity. [1] These impacts have implications for land degradation, loss of carbon stocks, decreased agricultural productivity, and weakened food and economic security, especially in developing countries that depend on the agriculture and forestry sectors.

Indonesia, as one of the countries with the largest tropical forest cover in the world, is highly vulnerable to climate change. Data from the Ministry of Environment and Forestry [2] shows that the Forestry and Other Land Use (FOLU) sector remains a significant contributor to greenhouse gas emissions due to deforestation and forest degradation. Furthermore, rising temperatures, changing rainfall patterns, and increasing intensity of floods and droughts pose significant challenges to sustainable land productivity and the well-being of rural communities. Research by Rosenzweig et al. (2021) warns that without effective adaptation and mitigation strategies, agricultural productivity in the tropics could decline drastically in the next two decades.

As part of the archipelago in Eastern Indonesia, Maluku faces the stark impacts of climate change. The most prominent impacts are rising temperatures, shifting rainfall patterns, and the threat of rising sea levels, which threaten coastal areas and small islands. These impacts directly impact the agriculture and fisheries sectors, which are the primary livelihoods of the community. Traditional agricultural systems, which rely on stable seasons, are beginning to be disrupted by climate uncertainty, while marine activities face high risks from extreme waves.

Method

This study employed a mixed methods approach [3], combining quantitative and qualitative descriptive methods. This approach was used to obtain a comprehensive overview of agroforestry potential and analyze its feasibility and development strategies in the PT. G PBPH area in Buru Regency. Quantitative methods were used to analyze biophysical, social, and economic data through questionnaires, field measurements, and laboratory testing. Qualitative methods were used to explore perceptions, preferences, and institutional policies through in-depth interviews and focus group discussions.

Results and Discussion

A. Conditions of the Research Location

The research location is in Wamtihut Hamlet, Waedanga Village, and Walsekat Hamlet, Lemanpoli Village. Administratively, Lemanpoli and Waedanga Villages are two villages within the Fena Leisela District, Buru Regency, Maluku Province. Both villages are located in the hilly to central mountainous areas of Buru Island, characterized by undulating to steep topography and relatively dominant forest cover. The geographical position of the two villages indicates a close spatial relationship, especially in the transition zone between the ridge and the small river valley, which naturally serves as a boundary marker. The boundaries between Lemanpoli and Waedanga Villages generally follow natural features, particularly watersheds and seasonal watercourses. To the north and northwest, Lemanpoli Village borders Waedanga Village directly through a hilly area with medium to high elevations. This border zone is largely secondary forest and limited cultivation areas, including traditional community use areas such as mixed gardens. Topographically, the area is located on a mountain slope with an elevation of more than 1,300–1,450 meters above sea level and a medium to steep slope.

Meanwhile, to the south and southeast, Waedanga Village borders Lemanpoli Village in a transition zone from the ridge to the valley. This area is characterized by more varied contours with relatively steeper slopes than the northern region. The elevation is more than 1,200–1,400 meters above sea level. [4] Spatially, the border area is a fragmented area categorized as Other Use Areas (APL) located around the PBPH work area of PT. G. This APL fragmentation is characterized by a mosaic of land uses consisting of secondary forest, mixed community gardens, subsistence agricultural land, and scrubland. This condition indicates both pressure on land use and opportunities for more integrated management sustainable. Fragmentation of Other Use Areas (APL) in the border area of Lemanpoli Village and Waedanga Village encouraged PBPH PT. G to develop a concession partnership scheme with the local community through agroforestry development. This approach aims to integrate the interests of production, conservation, and improving community welfare while optimizing the use of fragmented land, maintaining the ecological function of the hilly area, and minimizing the potential for tenurial conflicts. Thus, the border area between the two villages not only functions as an administrative boundary but also has a strategic role as a space for sustainable forest management based on PBPH partnerships in Buru Regency.

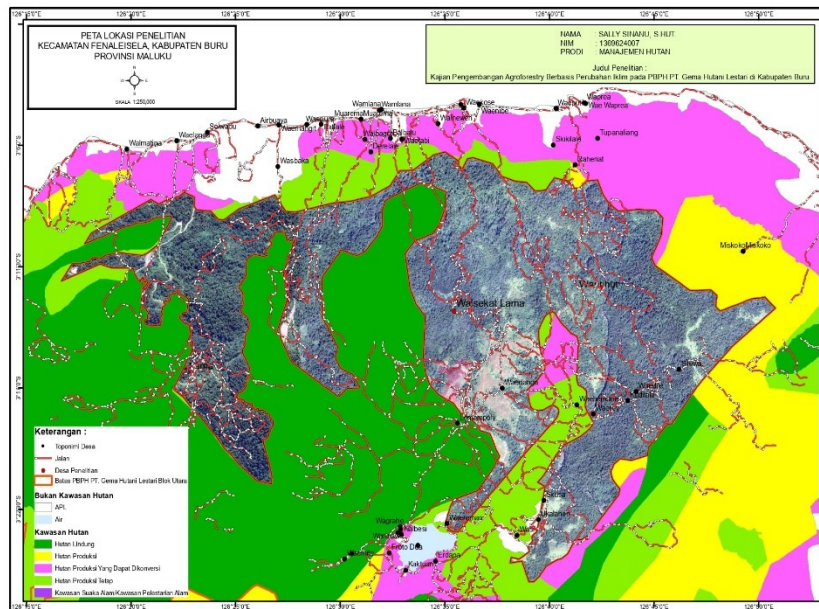


Figure 1. Research location

B. Biophysical Conditions of the Research Area

The biophysical conditions in the research area include vegetation, soil, microclimate, and insects, which play a vital role as a unified ecological system in supporting agroforestry sustainability. Vegetation components reflect the structure and species composition of the land cover and determine the ecosystem's ability to support plant productivity. Meanwhile, soil conditions reflect the level of fertility, nutrient content, and infiltration capacity, which influence vegetation growth and yield. Microclimate aspects influence the balance of temperature, humidity, and light intensity beneath the stand, which are important factors in plant adaptation to climate change. On the other hand, the presence of insects, both as pollinators and natural predators, serves to maintain ecosystem stability and is an indicator of the health of the agroforestry environment. Thus, these four biophysical components interact with each other and form a strong ecological foundation for the development of an adaptive agroforestry system in the PT. G BPBH area on Buru Island.

C. Vegetation Structure in Wamtihut and Walsekat Hamlets

The vegetation structure in the research area was analyzed based on vertical canopy stratification which divides the vegetation into four strata, namely stratum A (>30 m), stratum B (20–30 m), stratum C (10–20 m), and stratum D (<10 m). This division of strata refers to the concept of tropical forest vegetation stratification developed by Kartawinata (1980; 1991) and is widely used in forest ecology and agroforestry studies in Indonesia [5]. The results of the study indicate that the vegetation structure in the research area of Wamtihut Hamlet and Walsekat Hamlet is composed of four canopy strata, namely strata A, B, C, and D, with differences in the number and composition of species in each stratum. The following description presents the condition of the canopy strata based on the results of the field inventory in table 1.

Table 1. Vegetation Canopy Strata of Wamtihut and Walsekat Hamlets

No	Header Strata	Amount and Type	
		Wamtihut	Walsekat
1	A	3: Uhun (<i>Pterocymbium javanicum</i>), Samama (<i>Anthocephalus macrophyllus</i>), and Red Meranti (<i>Shorea selanica</i>).	2: Uhun (<i>Pterocymbium javanicum</i>) and Red Meranti (<i>Shorea selanica</i>)
2	B	8: Uhun (<i>Pterocymbium javanicum</i>), Nyatoh (<i>Palaquium obovatum</i>), Palboti (<i>Chisocheton sp</i>), Red Meranti (<i>Shorea selanica</i>), Samama (<i>Anthocephalus macrophyllus</i>), Red Wood (<i>Pterocarpus indicus</i>), Buffalo Wood (<i>Castanopsis buruana</i>), and Banyan (<i>Ficus benjamina</i>)	3: Uhun (<i>Pterocymbium javanicum</i>), Red Meranti (<i>Shorea selanica</i>), and Palboti (<i>Chisocheton sp</i>)
3	C	9: Red Meranti (<i>Shorea selanica</i>), Forest Belo Wood (<i>Diospyros celebica</i>), Palboti (2: Uhun (<i>Pterocymbium javanicum</i>), and Jackfruit (

No	Header Strata	Wamtihut	Amount and Type	Walsekat
4	D	<p><i>Chisocheton sp</i>), Beringin (<i>Ficus benjamina</i>), Gomu (<i>Artocarpus camansi</i>), Salawaku (<i>Falcataria moluccana</i>), Jackfruit (<i>Artocarpus heterophyllus</i>), Buffalo Wood (<i>Castanopsis buruana</i>), and Mango (<i>Mangifera indica</i>).</p> <p>10: Durian (<i>Durio zibethinus</i>), Clove (<i>Syzygium aromaticum</i>), Langsa (<i>Lansium domesticum</i>), Water Apple (<i>Syzygium aqueum</i>), <i>Melastoma malabathricum</i> L. (senduduk/harendong), <i>Clidemia hirta</i> (L.) D. Don (koster/harendong bulu), <i>Piper aduncum</i> L. (forest betel/forest coffee), <i>Chromolaena odorata</i> (L.) RM King & H. Rob. (krokos/kirinyuh), <i>Pteridium aquilinum</i> (L.) Kuhn (eagle fern), and <i>Nephrolepis biserrata</i> (resam fern), Cassava <i>Manihot esculenta</i>, Sweet Potato (<i>Ipomoea batatas</i>), Caladium (<i>Colocasia esculenta</i>)</p>	Amount and Type	<p><i>Artocarpus heterophyllus</i>).</p> <p>8: Walsekat Hamlet, canopy stratum D is composed of 8 (eight) species, namely: Durian (<i>Durio zibethinus</i>), Clove (<i>Syzygium aromaticum</i>), <i>Melastoma malabathricum</i> L., (senduduk/harendong), <i>Clidemia hirta</i> (L.) D. Don (koster/harendong bulu), <i>Piper aduncum</i> L., (forest betel/forest coffee), <i>Chromolaena odorata</i> (L.) RM King & H. Rob. (krokos/kirinyuh), <i>Pteridium aquilinum</i> (L.) Kuhn (eagle fern), and <i>Nephrolepis biserrata</i> (resam fern), Cassava <i>Manihot esculenta</i>, Sweet Potato (<i>Ipomoea batatas</i>), Caladium (<i>Colocasia esculenta</i>)</p>

In the canopy strata A, which is the topmost canopy layer (> 30 m), the vegetation in Wamtihut Hamlet consists of 3 (**three**) **types of trees**, namely: Uhun (*Pterocymbium javanicum*), Samama (*Anthocephalus macrophyllus*), and Red Meranti (*Shorea selanica*). Meanwhile, in Walsekat Hamlet, canopy strata A consists of 2 (**two**) **types**, namely: Uhun (*Pterocymbium javanicum*) and Red Meranti (*Shorea selanica*). The types in this strata are large-diameter trees that form the upper canopy layer.

Canopy strata (20-30 m) in the Wamtihut Hamlet research area consists of 8 (**eight**) **tree species**, namely: Uhun (*Pterocymbium javanicum*), Nyatoh (*Palaquium obovatum*), Palboti (*Chisocheton sp*), Red Meranti (*Shorea selanica*), Samama (*Anthocephalus macrophyllus*), Red Wood (*Pterocarpus indicus*), Buffalo Wood (*Castanopsis buruana*), and Banyan (*Ficus benjamina*). In Walsekat Hamlet, the B canopy strata is only composed of 3 (three) **species**, namely Uhun (*Pterocymbium javanicum*), Red Meranti (*Shorea selanica*), and Palboti. [6]

In the canopy strata C (10-20 m), the research area in Wamtihut Hamlet consists of 10 (**ten**) **types of trees**, consisting of Red Meranti (*Shorea selanica*), Forest Belo Wood (*Diospyros celebica*), Palboti (*Chisocheton sp*), Banyan (*Ficus benjamina*), Gomu (*Artocarpus camansi*), Salawaku (*Falcataria moluccana*), Jackfruit (*Artocarpus heterophyllus*), Buffalo Wood (*Castanopsis buruana*), and Mango (*Mangifera indica*). This stratum includes medium to small trees that form the lower middle canopy layer. In Walsekat Hamlet, canopy stratum C only consists of 2 (**two**) **species**, namely Uhun (*Pterocymbium javanicum*), and Jackfruit (*Artocarpus heterophyllus*).

In the canopy strata D (< 10 m), namely the lower vegetation layer, Wamtihut Hamlet is recorded as having 10 (**ten**) **species**, which include: Durian (*Durio zibethinus*), Clove (*Syzygium aromaticum*), Langsa (*Lansium domesticum*), Water Apple (*Syzygium aqueum*), *Melastoma malabathricum* L. (senduduk/harendong), *Clidemia hirta* (L.) D. Don (koster/harendong bulu), *Piper aduncum* L. (forest betel/forest coffee), *Chromolaena odorata* (L.) RM King & H. Rob. (krokos/kirinyuh), *Pteridium aquilinum* (L.) Kuhn (eagle fern), and *Nephrolepis biserrata* (resam fern), Cassava *Manihot esculenta*, Sweet Potato (*Ipomoea batatas*), Taro (*Colocasia esculenta*). In Walsekat Hamlet, canopy stratum D is composed of 8 (**eight**) **species**, namely: Durian (*Durio zibethinus*), Clove (*Syzygium aromaticum*), *Melastoma malabathricum* L., (senduduk/harendong), *Clidemia hirta* (L.) D. Don (koster/harendong bulu), *Piper aduncum* L., (forest betel/forest coffee), *Chromolaena odorata* (L.) RM King & H. Rob. (krokos/kirinyuh), *Pteridium aquilinum* (L.) Kuhn Kuhn (eagle fern), and *Nephrolepis biserrata* (resam fern), Cassava *Manihot esculenta*, Sweet Potato (*Ipomoea batatas*), Caladium (*Colocasia esculenta*). The canopy structure A-D in Wamtihut and Walsekat hamlets can be seen in Figure 2.

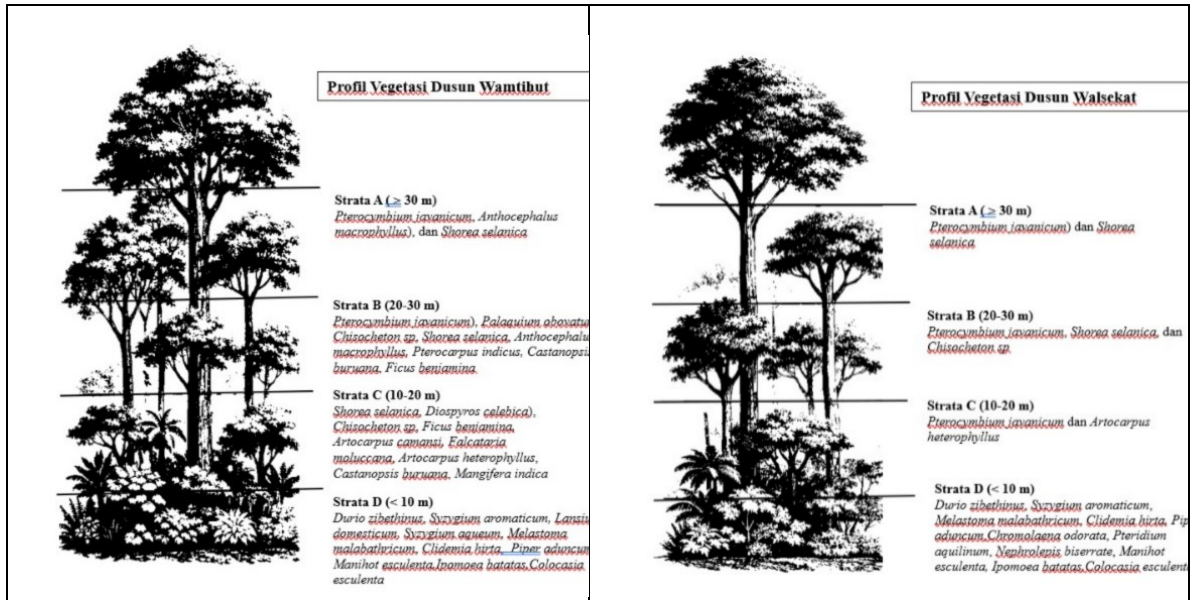


Figure 2. Vegetation Profile of Wamtihut and Walsekat Hamlets

Research results in Wamtihut and Walsekat hamlets indicate four strata of vegetation canopy (A–D) with significant differences in composition and number of species between the two locations. Wamtihut hamlet has a greater number of species in each stratum than Walsekat hamlet, indicating more complex structural diversity and strong canopy stratification.

Vegetation research in the natural forests of Buru Island, Indonesia, shows that the vegetation structure in tropical rainforests has a clear stratification pattern from the upper to lower canopy, with a large number of large tree species in the upper canopy layer and a high variety of species in the lower layer. This finding is consistent with the canopy stratum structure pattern found in Wamtihut and Walsekat, where strata A and B are dominated by large trees such as *Pterocymbium javanicum*, *Anthocephalus macrophyllus*, and *Shorea selanica*, while strata C and D show a dominance of middle to lower vegetation [7]

Thus, the vegetation stratification patterns at both sites not only reflect the local tree community conditions, but are also consistent with the characteristics of tropical forest vegetation reported in recent studies: upper strata dominated by large trees and more heterogeneous lower strata [8] [9] [10] In terms of horizontal vegetation distribution, the research results show that in Wamtihut and Walsekat Hamlets, there are three main patterns: solitary distribution, group distribution, and random distribution, with differences in the number and composition of species at each research location. These differences in distribution patterns illustrate variations in vegetation conditions based on field observations in Table 2.

Table 2. Distribution of Vegetation in Wamtihut and Walsekat Hamlets

No	Horizontal Distribution	Amount and Type	
		Wamtihut	Walsekat
1	Solitary	3: Jackfruit (<i>Artocarpus heterophyllus</i>), Durian (<i>Durio zibethinus</i>), and Clove (<i>Syzygium aromaticum</i>)	2: Jackfruit (<i>Artocarpus heterophyllus</i>), Durian (<i>Durio zibethinus</i>), and Clove (<i>Syzygium aromaticum</i>)
2	Group	3: Samama (<i>Anthocephalus macrophyllus</i>), Red Meranti (<i>Shorea selanica</i>), and Salawaku (<i>Falcataria moluccana</i>)	2: Cloves (<i>Syzygium aromaticum</i>) and Jackfruit (<i>Artocarpus heterophyllus</i>)
3	Random	13: Red Meranti (<i>Shorea selanica</i>), Samama (<i>Anthocephalus macrophyllus</i>), Banyan (<i>Ficus benjamina</i>), Uhun (<i>Pterocymbium javanicum</i>), gomu (<i>Artocarpus camansi</i>), Forest Belo Wood (<i>Diospyros celebica</i>), Palboti (<i>Pterocymbium javanicum</i>), Water Apple (<i>Syzygium aqueum</i>), and orange (<i>Citrus</i> sp.).	4: Uhun (<i>Pterocymbium javanicum</i>), Palboti (<i>Chisocheton</i> sp.), Water Apple (<i>Syzygium aqueum</i>), and orange (<i>Citrus</i> sp.).

No	Horizontal Distribution	Amount and Type	
		Wamtihu	Walsekat
		<i>Chisocheton sp</i>), Salawaku (<i>Falcataria moluccana</i>), Buffalo Wood (<i>Castanopsis buruana</i>), Mango (<i>Mangifera indica</i>), Langsa (<i>Lansium domesticum</i>), and Water Apple (<i>Syzygium aqueum</i>).	

In solitary distribution, which is the distribution pattern of individual plants that grow separately and do not form groups, Wamtihut Hamlet is recorded as having 3 (three) types, namely: Jackfruit (*Artocarpus heterophyllus*), Durian (*Durio zibethinus*), and Cloves (*Syzygium aromaticum*). Meanwhile, in Walsekat Hamlet, solitary distribution was only found in two types, namely Cloves (*Syzygium aromaticum*) and Jackfruit (*Artocarpus heterophyllus*). Types with this distribution pattern are generally found as plants that stand alone in the observation area. Based on the results of the vegetation inventory, the vegetation composition in Wamtihut and Walsekat hamlets shows clear differences in terms of the number of species, families, and orders at each growth stage. In general, Wamtihut hamlet has a higher vegetation diversity than Walsekat hamlet. This is reflected in the relatively greater number of species across all growth strata in Wamtihut, particularly at the tree and pole levels, as shown in Table 3.

Table 3. Vegetation Composition of Wamtihut and Walsekat

No	Growth Class	Amount and Type	Number and Family	Number and Order
A. Wamtihut				
1	Tree	9: <i>Diospyros celebica</i> , <i>Pterocarpus indicus</i> , <i>Shorea selanica</i> , <i>Palaquium obovatum</i> , <i>Chisocheton sp</i> , <i>Falcataria moluccana</i> , <i>Anthocephalus macrophyllus</i> , <i>Castanopsis buruana</i> , <i>Pterocymbium javanicum</i>	8: Ebenaceae, Fabaceae, Dipterocarpaceae, Sapotaceae, Meliaceae, Rubiaceae, Fagaceae, Malvaceae	6: Ericales, Fabales, Malvales, Sapindales, Gentianales, Fagales
2	Pole	11: <i>Ficus benjamina</i> , <i>Casuarina equisetifolia</i> , <i>Syzygium aromaticum</i> , <i>Artocarpus camansi</i> , <i>Mangifera indica</i> , <i>Shorea selanica</i> , <i>Palaquium obovatum</i> , <i>Chisocheton sp</i> , <i>Falcataria moluccana</i> , <i>Anthocephalus macrophyllus</i> , <i>Castanopsis buruana</i>	9: Moraceae, Fagaceae, Myrtaceae, Anacardiaceae, Dipterocarpaceae, Sapotaceae, Meliaceae, Fabaceae, Rubiaceae,	8: Rosales, Fagales, Myrtales, Sapindales, Malvales, Ericales, Fabales, Gentianales,
3	Weaning	6: <i>Durio zibethinus</i> , <i>Syzygium aromaticum</i> , <i>Castanopsis buruana</i> , <i>Theobroma cacao</i> , <i>Artocarpus heterophyllus</i> , <i>Mangifera indica</i>	5: Malvaceae, Myrtaceae, Fagaceae, Moraceae, Anacardiaceae	5: Malvales, Fagales, Malvales, Rosales, Sapindales
4	Seedling	0	0	0
B. Walsekat				
1	Tree	3: <i>Shorea selanica</i> , <i>Chisocheton sp</i> , <i>Pterocymbium javanicum</i>	3: Dipterocarpaceae, Meliaceae, Malvaceae	2: Malvales and Sapindales
2	Pole	2: <i>Artocarpus heterophyllus</i> , <i>Citrus sp.</i>	2: Moraceae and Rutaceae	2: Rosales and Sapindales
3	Weaning	4: <i>Durio zibethinus</i> , <i>Syzygium aromaticum</i> , <i>Lansium domesticum</i> , <i>Syzygium aqueum</i>	3: Malvaceae, Myrtaceae, Meliaceae	3: Malvales, Myrtales, Sapindales
4	Seedling	0	0	0

In Wamtihut, the tree strata consists of 9 (nine) species belonging to 8 (eight) families and 6 (six) orders. These species include natural forest trees and trees of economic value, such as *Shorea selanica*, *Pterocymbium javanicum*, *Palaquium obovatum*, and *Falcataria moluccana*. The presence of various families such as *Dipterocarpaceae*, *Fabaceae*, *Rubiaceae*, and *Sapotaceae* indicates that the tree strata in Wamtihut are composed of relatively diverse vegetation components. At the pole level in Wamtihut Hamlet, 11 (eleven) species were recorded from 9 (nine) families and 8 (eight) orders. This stratum is dominated by species also found at the tree level, such as *Anthocephalus macrophyllus*, *Castanopsis buruana*, *Shorea selanica*, and *Palaquium obovatum*, as well as several types of fruit plants and economically valuable plants such as *Mangifera indica* and *Syzygium aromaticum*. The relatively high number of species at the pole level indicates that many tree species in Wamtihut have individuals in the middle growth phase. The differences in vegetation composition between Wamtihut and Walsekat generally indicate variations in ecological conditions and land management intensity. Wamtihut reflects a more complex and diverse vegetation structure, while Walsekat exhibits a simpler structure dominated by certain species. It is evident that communities often strip tree bark to kill the trees and make way for gardens. This pattern aligns with the conclusion of Santosa et al. (2023) that vegetation heterogeneity directly reflects the interaction between ecological factors and human activities in Indonesia's tropical forest landscape. [11]



Figure 3. Barked Uhun Tree (*Pterocymbium javanicum*)

D. Abundance and Diversity of Species in Wamtihut and Walsekat Hamlets

The abundance of species in the research area in Wamtihut Walsekat Hamlet can be seen in table

Table 4. Abundance and Diversity of Tree Species at the Wamtihut and Walsekat Levels

No	Type	K	D	F	KR	DR	FR	INP	$\pi = \frac{pi}{ni/N}$	$LN(\pi)$	H'
A. Wamtihut											
1	<i>Diospyros celebica</i>	1	0.03	0.04	6.67	0.60	6.67	13.94	0.024	-3.71357	-0.09057
2	<i>Pterocarpus indicus</i>	1	0.08	0.04	6.67	1.45	6.67	14.78	0.049	-3.02042	-0.14734
3	<i>Shorea selanica</i>	4	2.60	0.16	26.67	45.28	26.67	98.62	0.390	-0.94098	-0.36721
4	<i>Palaquium obovatum</i>	1	0.03	0.04	6.67	0.49	6.67	13.83	0.024	-3.71357	-0.09057
5	<i>Chisocheton sp</i>	3	0.52	0.12	20.00	8.97	20.00	48.97	0.171	-1.76766	-0.30180
6	<i>Falcataria moluccana</i>	1	0.28	0.04	6.67	4.92	6.67	18.25	0.049	-3.02042	-0.14734
7	<i>Anthocephalus macrophyllus</i>	2	1.19	0.08	13.33	20.69	13.33	47.36	0.220	-1.51635	-0.33286
8	<i>Castanopsis buruana</i>	1	0.04	0.04	6.67	0.72	6.67	14.06	0.024	-3.71357	-0.09057
9	<i>Pterocymbium javanicum</i>	1	0.97	0.04	6.67	16.87	6.67	30.20	0.049	-3.02042	-0.14734
	Amount	15	5.74	0.6	100.00	100.00	100.00	300.00			1.715604
B. Walsekat											
1	<i>Shorea selanica</i>	2	1.93	0.08	22.22	35.44	22.22	79.88	0.263158	-1,335	-0.35132
2	<i>Chisocheton sp</i>	3	0.57	0.12	33.33	10:36	33.33	77.02	0.263158	-1,335	-0.35132
3	<i>Pterocymbium javanicum</i>	4	2.96	0.16	44.44	54.21	44.44	143.10	0.473684	-0.74721	-0.35394
	Amount	9	5.46	0.36	100.00	100.00	100.00	300.00			1.056576

Based on Table 4, the tree-level vegetation structure in Wamtihut and Walsekat hamlets shows clear differences in terms of both abundance (abundance and INP) and species diversity (H'). These two parameters complement each other in describing. Institutional Aspects Are A Key Factor In Strengthening The Role Of Agroforestry As A Climate Change Adaptation Strategy In PBPH Areas. Integrating Agroforestry Practices Into PBPH Management Schemes Encourages Collaboration Between Companies, Communities, And Local Governments In Climate-Adaptive Landscape Management. Studies In Maluku Confirm That Institutional Support, Clear Management Access, And Recognition Of Local Agroforestry Practices Significantly Influence The System's Sustainability And Effectiveness In Mitigating The Impacts Of Climate Change [12] [13] Synthetically, Agroforestry In The PBPH Area Of Gema Hutani Lestari factory. Functions As An Ecosystem-Based Climate Change Adaptation System, Operating Through Microclimate Regulation, Increasing Soil And Water Resilience, Stabilizing Insect Diversity, And Strengthening Socio-Economic And Institutional Resilience. These Findings Confirm That Agroforestry Development In PBPH Concession Areas Is Not Only A Production Strategy But Also A Crucial Instrument In Reducing The Vulnerability Of Production

Forest Landscapes To The Impacts Of Climate Change On Buru Island And Maluku In General. The presence of species with moderate IVIs indicates that the Wamtihut community structure is relatively layered and heterogeneous. Species such as *Anthocephalus macrophyllus* are known as fast-growing species that often dominate the intermediate successional phase of disturbed land [14], thus indicating active regeneration dynamics. Meanwhile, species with low IVIs (13–30) such as *Diospyros celebica*, *Pterocarpus indicus*, and *Palaquium obovatum* reflect accompanying elements that contribute to the heterogeneity of vegetation structure. According to Matinahoru (2022), in traditional Maluku village systems, these species are often maintained for shade and soil conservation purposes, although they are not commercially dominant. This condition is reflected in the Shannon–Wiener Diversity Index (H') value of 1.72, which is classified as moderate. This value indicates that despite the dominance of one main species, the distribution of individuals among species remains relatively even. The proportion of *Shorea selanica* individuals ($\pi = 0.39$) did not drastically suppress diversity because there were still significant contributions from other species. This pattern is consistent with the findings of Sadeghi (2022) and Ekasari et al. (2024), who stated that tropical forests dominated by Dipterocarpaceae can still have moderate H' values if the canopy structure is multistrata and not absolutely dominated by a single species. In contrast, Walsekat Hamlet exhibited a simpler vegetation structure. Only three tree species were found, with a total of nine individuals and a basal area of 5.46 m². The highest IVI value was for *Pterocymbium javanicum* (143.10), followed by *Shorea selanica* (79.88), and *Chisocheton* sp. (77.02). The high dominance of *Pterocymbium javanicum* ($\pi = 0.47$) indicates an unequal distribution of individuals between species. This species is known as a light-tolerant pioneer species and is relatively adaptable to open or disturbed land conditions [15], so its dominance indicates potential disturbance or drier edaphic conditions than Wamtihut. The H' value in Walsekat, at 1.06, is considered low. Low diversity is not solely due to the small number of individuals, but rather to the homogeneity of composition and strong dominance by a single species. Ulfa et al. (2022) and Ruslim et al. (2025) explain that low H' values in tropical forests are generally associated with ecological pressures or early successional phases, where pioneer species dominate before the community reaches a more complex equilibrium. Comparing the two hamlets synthetically, it is clear that Wamtihut has a higher species abundance and a more complex community structure, with relatively moderate dominance and moderate diversity. Walsekat has a low species abundance, high dominance by pioneer species, and low diversity. These differences reflect different stages of successional dynamics. Wamtihut tends to be in the intermediate to advanced successional stage with a more layered stand structure, while Walsekat exhibits more homogeneous vegetation community characteristics and is likely in the early successional stage or has experienced more intensive disturbance. This pattern aligns with the dynamics of the Malesian island tropical forests described by Kooyman et al. (2019), where vegetation composition is influenced by disturbance history, local edaphic conditions, and the colonization of fast-growing species. Thus, the combination of abundance (VII) and diversity (H') analyses not only reflects the number and dominance of species but also provides an indication of ecological conditions and the level of ecosystem stability. Wamtihut Hamlet exhibits a more stable and potentially sustainable community structure, while Walsekat Hamlet requires attention to strengthening vegetation structure to increase the complexity and resilience of its ecosystem.

Conclusion

Agroforestry management in the Gema Hutani Lestari factory needs to be directed to maintain vegetation diversity with a tiered structure, through maintenance measures on a combination of annual and seasonal plants, in order to maintain microclimate stability, soil fertility, and the sustainability of insect life as part of a climate change adaptation strategy at the site scale. The biophysical conditions of agroforestry in the PBPH area of PT. G show differences in the level of ecosystem complexity between Wamtihut and Walsekat Hamlets. Wamtihut has a more complex vegetation structure with 9 tree species ($H' = 1.72$) and 11 species at the pole level ($H' = 2.26$), while Walsekat is more homogeneous with a high dominance of *Pterocymbium javanicum* (INP 143.10) and low diversity at the pole level ($H' = 0.64$). The absence of tree seedlings in both locations indicates a regeneration gap that has the potential to disrupt ecosystem sustainability. Insect diversity is classified as low-moderate ($H' = 2.726$ in Wamtihut; 2.628 in Walsekat) with a dominance of Formicidae and Diptera and a clumped distribution pattern ($Id > 1$), indicating the system is still quite resilient but vulnerable to ecological pressures. Socioeconomically, the agroforestry system remains traditional and subsistence, with low incomes and limited market access (80–100 km). The absence of formal institutions such as KTH or BUMDes leads to weak business management and minimal contribution to village..

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