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Population Structure Durian (*Durio zibethinus* L.) on Barito Riverbank Sungai Gampa Village Barito Kuala Regency

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Abstract
Study of population structure is important in determining the status of a plant. Durian (*Durio zibethinus* L.) is commonly used by the village community of Sungai Gampa as a boundary for rice fields, in addition to its fruit and seeds, which are edible. The study aims to describe the population structure of durian (*Durio zibethinus* L.) based on life-history phases (pre-reproductive, reproductive, and post-reproductive) along the banks of the Baritoriver in the village of Sungai Gampa. This is a quantitative descriptive study using data collection via a total census within transect belts along 3,000 meters of the Baritoriver bank. The results show that the pyramid formed is a polygonal pyramid with a wide base, meaning that the population of young individuals is greater than that of adult individuals. In addition, durian is included in the "non-critical" category because there are 53.33 adult individuals per km^2.

INTRODUCTION

Population structure studies are crucial for determining the status or condition of a plant population in a habitat, allowing conservation efforts to be undertaken (Gauthier et al., 2017). A population is a collective group of organisms of the same species occupying a specific space or location (Odum, 1993). Population structure encompasses density and distribution patterns, plant demographics, stage and age, fecundity, age structure, and stage structure (Hardiansyah, 2012; Iannelli & Milner, 2017; Bender, 2019). Rapidly growing populations typically contain a high proportion of young individuals.

Various studies show that each species has different regeneration dynamics (Vergarechea et al., 2019; Díaz-Yáñez et al., 2024). For instance, Hutabarat et al. (2024) explained that the areca nut (*Areca catechu* L.) population in Simpang Warga Village formed a pitcher pyramid indicating impaired regeneration. Meanwhile, Irianti et al. (2024) revealed that species like Mangifera indica have a wide-base pyramid, whereas Cocos nucifera showed impaired regeneration. AJ et al. (2024) also described the population of pulai (*Alstonia scholaris*) in the Sari Embun Lake area, which exhibited a stable population survival pattern.

Sungai Gampa Village, located in Rantau Badauh District, Barito Kuala Regency, is situated right on the banks of the Barito River. These tidal swamp ecological conditions support the growth of various woody plants, including durian (*Durio zibethinus* L.). Durian belongs to

the Bombacaceae family, growing up to 5 – 50 meters with rough, peeling bark (Van Hau et al., 2023; Wiangsamut, 2024). While Borneo is famous for its high endemism of wild Durio species, the local community in Sungai Gampa Village has specifically cultivated and verified *Durio zibethinus* L. over generations due to its economic value and palatable fruit (Seng et al., 2020; Sujang et al., 2024).

Intriguingly, the local community utilizes durian trees intentionally as landmarks and physical boundaries for their rice fields (Chua, 2020; Julis et al., 2025; Khoo & Idrus, 2025). Since the root system of *Durio zibethinus* forms a deep, strong taproot, it stabilizes the muddy riverbanks and rice field dikes from erosion caused by the Barito River's tidal currents. Furthermore, durian trees serve a dual purpose: providing shade and acting as a long-term economic safety net (Ketsa et al., 2020). The harvest significantly boosts the local seasonal economy, while the fallen fruits and seeds provide subsistence food (Sibhatu & Qaim, 2017). However, scientific data mapping its population structure remains absent. Therefore, this research aims to clearly describe the specific population structure of *Durio zibethinus* L. based on its life-history phases (pre-reproductive, reproductive, and post-reproductive) to provide a basis for sustainable management and local conservation.

RESEARCH METHODS

This type of research is a quantitative descriptive study with systematic data collection using a transect technique following the flow of the Barito River (Figure 1). The population in this study was all durian plants on the banks of the Barito River in Sungai Gampa Village with samples including durian plants located at a distance of 3000 meters following the direction of the river and 50 meters from the river bank. This quantitative descriptive study was conducted over a two-month period from August to September 2025. Data collection used a systematic belt transect technique following the flow of the Barito River. The total length monitored was 3,000 meters along the riverbank, with a belt width extending 50 meters inland from the high-water riverbank line.

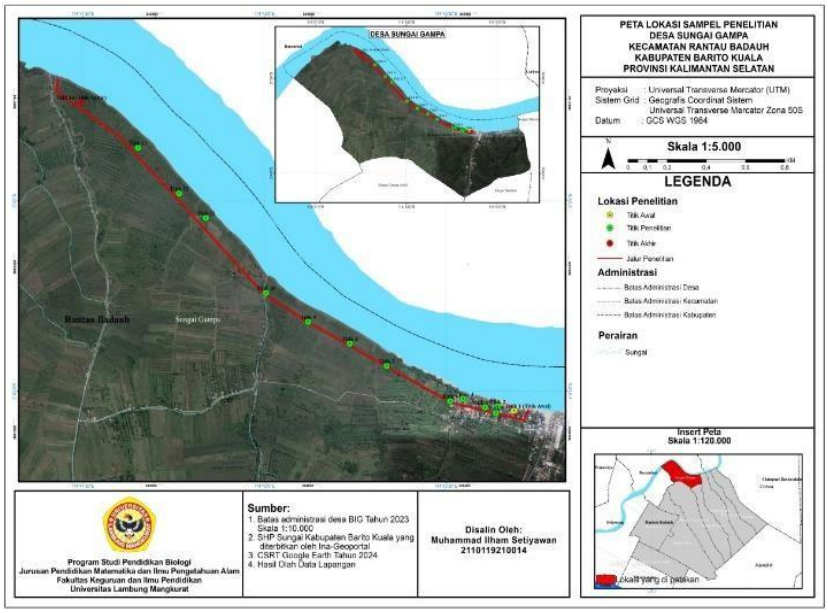


Figure 1. Map of Sungai Gampa Village, Barito Kuala River

The research was divided into four stages:

1. Observation & Field Sampling: Mapping out the 3,000 m² times 50 m² area (total area of 15.00 Ha).
2. Total Census Data Collection: Every single durian individual within the transect boundary was recorded. The population structure was categorized based on life-history phases:
    - Pre-reproductive: Immature, young trees that have never flowered or fruited.
    - Reproductive: Mature trees that are currently flowering/fruiting or have previously borne fruit.
    - Post-reproductive: Old trees that are structurally damaged, dying, or completely leafless.
3. Environmental Measurements: Abiotic factors were measured concurrently using field instruments, including Lux meters for light intensity, soil pH meters, soil moisture probes, and water parameters. Biotic factors were recorded through structured interviews with 10 key informants (local farmers and village elders) to capture historical planting periods, cultivation spacing, and tree mortality causes.
4. Data Analysis: Age structure data were compiled into population density tables (standardized to individuals per Hectare (Ind/Ha) and individuals per square kilometer (Ind/km²) and visually projected as an age pyramid. Plant rarity status was evaluated using the International Union for Conservation of Nature (IUCN) criteria based on adult density per km².

This research was divided into four stages: observation, sampling, data collection, and data analysis. Data were analyzed descriptively using relevant literature to strengthen the research findings, including plant status analysis using the *International Union for the Conservation of Nature and Natural Resources* (Monge-Ganuzas et al., 2024). IUCN categorizes "endangered" if there are less than 5 individuals per km², the "critical" category if there are less than 25 individuals per km², and the "non-critical" category if there are more than 25 individuals per km².

RESULTS AND DISCUSSION

The results of the morphological observations of durian in the Barito River, Sungai Gampa Village are presented in Figure 2.

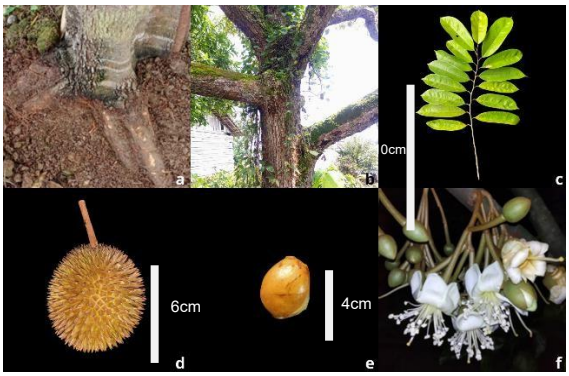


Figure 2. Durian morphology: a. roots; b. stems and branches; c. leaves; d. fruit; e. seeds; f. flowers.

The vegetative and reproductive morphology of *Durio zibethinus* L. on the Barito River banks matches standard taxonomic profiles. The plant features a brownish-white taproot system that anchors firmly into the riverbank soil. Stems are round, growing erect with sympodial branching and brown bark adorned with white lichen spots. Leaves are single, arranged oppositely, pinnate, smooth on the upper bright-green surface, and covered in golden scales on the underside. Flowers are bowl-shaped, displaying 5–6 green petals and golden crowns, attracting local pollinators. Fruits are round to irregular capsule-types with hard, sharp spines, enclosing oval white seeds (2 -4cm in diameter) covered in a fleshy aril.

The results of the study show that the population structure of durian (*Durio zibethinus* L.) on the banks of the Barito River, Sungai Gampa Village, Barito Kuala Regency has different characteristics in each phase (Table 1).

Table 1. Characteristics of each phase of the durian plant (*Durio zibethinus* L.)

Parameter	Phase Characteristics		
	Pre-Reproductive	**Reproductive**	**Post-Reproductive**
Height (m)	<7,8	7,8 – 8,5	3 – 8
Stem Diameter (m)		0,25 – 1,42	1,85 – 4,65
First Branch Height (m)	<0,25<1,7	2 – 3,5	1,6 – 4,7
Other Characteristics	Not yet bearing fruit/flowering	Has or has previously flowered/fruited	Damaged, dead, and leafless

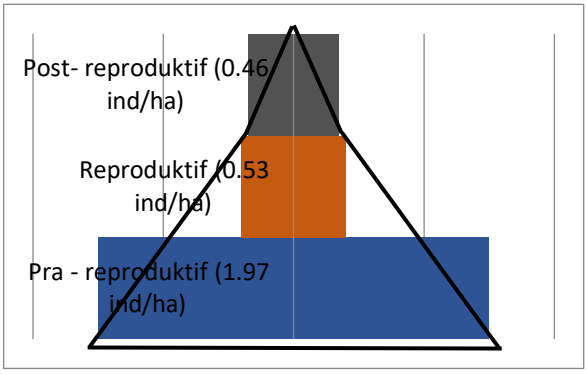
The calculation of the number of durian individuals on the banks of the Barito River, Sungai Gampa Village, which match the characteristics in Table 1 can be seen in Table 2.

Table 2. Population structure of durian plants (*Durio zibethinus* L.)

No.	Phase	Total Number Ind/15,20 Ha	Ind/Ha	Ind/km^2
1.	Pre-Reproductive	30	1,97	197,3
2.	Reproductive	8	0,53	53,3
3.	Post-Reproductive	7	0,46	46,0

Note: Densities are converted precisely (1 Ind/Ha = 100 Ind/km^2). Data adjusted for statistical uniformity.

Based on Table 2, the pre-reproductive phase heavily dominates the population, while the post-reproductive phase is the smallest. Plotting these figures generates a polygonal pyramid (wide-base pyramid). According to Odum (1993), a wide-base pyramid characterizes a rapidly growing and expanding population because regeneration is progressing successfully. The massive abundance of the pre-reproductive stage (197.33 Ind/km²) compared to the reproductive phase 53.33 Ind/km² highlights vigorous recruitment. Key informant interviews reveal that durian trees in Sungai Gampa take approximately 8 to 10 years to enter their first reproductive cycle due to the wet alluvial soil dynamics. The narrow gap between reproductive (53.33Ind/km²) and post-reproductive (4.67 Ind/km²) counts occurs because *Durio zibethinus* is a long-lived perennial woody tree. It remains in the active fruiting phase for decades before showing structural senescent decay (Figure 3).



During the research, environmental parameters were measured, including two factors: abiotic and biotic factors. The results of the parameter measurements can be seen in table 3.

Table 3. Results of environmental parameter measurements

No.	Environmental Parameter	Results of the measurements	Quality standard	Refernces
A.	**Abiotic Factors**			
1	Light intensity (lux)	10.944 - >20.000	5.500 - >20.000	Dharmono *et al*. (2017)
2	Wind speed (km/h)	0,0 – 1,8	0,0 – 1,4	Gowri (2007)
3	Soil pH	5,6 – 6,0	5,5 – 6,5	Michael (1995)
4	Water temperature (°C)	27 – 30	23 – 29	Gowri (2007)
5	Soil moisture (%) Water	90 – 100	80 – 100	Saro (2022)
6	Transparency (cm) Air	60 – 62	54 – 60	Hariani (2017)
7	Temperature (°C)	29 – 34	30 – 33	Hariani (2017)
8	Air humidity (%)	54,4 – 78,2	75 – 87	Gowri (2007)
9	Water pH	6,1 – 7,0	6,9	Gowri (2007)
B.	**Biotic Factors**			
1	Communities intentionally plant durian trees as boundaries in their rice fields.			
2	Bees and ants utilize the pollen and nectar of durian flowers.			

Based on the research results, the population structure of durian (*Durio zibethinus* L.) on the banks of the Barito River in Sungai Gampa Village forms an age pyramid with a wide base (polygon pyramid), which shows that the number of individuals in the pre-reproductive phase is much higher than the reproductive and post-reproductive phases. According to Odum (1993), the shape of the polygon pyramid d5escribes a growing population because regeneration is taking place well. The primary catalyst behind the thriving pre-reproductive population is human intervention. Rather than relying solely on wild seed dispersal, the local community actively practices agroforestry. Durian seeds from daily consumption are carefully germinated and replanted along the field edges.According to Resosoedarmo et al. (1992) population structure in plants is influenced by several factors, such as natality, mortality, habitat, and human activities.

Local farmers maintain a traditional planting spacing of approximately 8-10 meters between trees to prevent canopy overlapping and optimize light penetration. When an old, post-reproductive tree dies—typically caused by heavy wind snapping or occasional root rot from anomalous high-tide seasons—farmers immediately clear the remains and substitute it with fresh saplings. This active management ensures a continuous, healthy influx of young trees.

Beyond humans, the biotic matrix includes vital wildlife interactions. Local honeybees (*Apis dorsata*) and ants utilize the pollen and nectar of durian flowers, acting as primary pollinators. Additionally, local fruit bats (*Pteropodidae*) and squirrels assist in nocturnal pollination and cross-boundary seed movements, further solidifying the species' reproductive success.

The IUCN categorizes plant rarity based on the density of mature (adult/reproductive) individuals per square kilometer. The threshold defines "endangered" as 5 individuals/km², "critical" as < 25 individuals/km², and "non-critical" as > 25 individuals/km².

Our field data confirms that the riverbank population hosts 53.33 adult individuals/km. Because this far exceeds the 25-individual benchmark, the population of *Durio zibethinus* L. in Sungai Gampa Village officially falls under the "Non-Critical" (Least Concern) category. Continuous local farming ensures that extinction risks remain non-existent in this habitat.

CONCLUSION

Based on the research results, it can be concluded that the population structure of durian (*Durio zibethinus* L.) on the banks of the Barito River, Sungai Gampa Village, Barito Kuala Regency produces a polygonal pyramid shape or a pyramid with a wide base which indicates that the population of young individuals is larger than the population of adult individuals and the conservation status is in the "not critical" category.

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DECLARATIONS

Author Contributions

M.I.S and D, contributed to designing the study, preparing samples and test materials, conducting the study, and preparing the manuscript.

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Declaration of Interest

The authors declare that this research and the data obtained are not related to any party.

Data Sharing Statement

Data supporting this study's findings and conclusions can be provided to other parties upon relevant request.

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