Abundance Of Soil Fauna In Beneng Taro (*Xanthosoma undipes* K. Koch) AT Various Altitudes.

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Abstract. Beneng Taro (*Xanthosoma undipes* K. Koch) is a local food crop from Gunung Karang, Banten, with high nutritional potential whose productivity is closely related to soil biological conditions. This study evaluated soil fauna abundance and diversity in talas beneng cultivation areas across three elevations: highland (851-858 m asl), midland (590-602 m asl), and lowland (343 m asl). A quantitative exploratory approach was applied using pitfall traps with ten replications per site and composite soil sampling at 0-20 cm depth. Soil chemical properties (pH, C-organic, N-total, and C/N ratio) were analyzed, and diversity was calculated using the Shannon-Wiener index. A total of seven soil fauna orders were recorded, with Hymenoptera dominating all sites. The midland exhibited the highest abundance (67 individuals), while the lowland showed the highest diversity index (H'=1.077 medium category). Variations in abundance and diversity were associated with differences in soil pH, nitrogen availability, and C/N ratio, which influenced decomposition rates and nutrient dynamics. The findings indicate that elevation-related environmental factors significantly shape soil fauna communities and highlight the importance of soil fertility management to support sustainable talas beneng cultivation.

Keywords: *Abundace, Altitude, Beneng taro, Soil Chemical Properties, Soil Fauna.*

INTRODUCTION

Beneng taro (*Xanthosoma undipes* K. Koch) is a local biodiversity resource that grows naturally in Mount Karang, Pandeglang Regency, Banten Province, and is known as "beneng," derived from the words *besar* (big) and *koneng* (yellow), referring to its very large corm size, which can reach approximately 81.3 cm in length and 30 cm in diameter, with plant height ranging from 100–350 cm and petiole length up to 139 cm (Yursak *et al*., 2021). Its high protein and carbohydrate contents, along with the yellowish color of the corm, indicate strong potential for development as a food source to support food security and serve as an alternative staple to rice (Wahjusaputri *et al*., 2018). However, beneng taro contains relatively high levels of oxalic acid that may cause an itchy sensation when consumed, although the oxalic acid content tends to be lower in cultivated plants compared to those growing wild (Hermita *et al.*, 2017).

The optimal growth of beneng taro is strongly influenced by soil conditions, including fertility, structure, and nutrient availability, considering that soil is a layer of the Earth's crust composed of minerals and organic matter that functions as the primary growing medium and habitat for various organisms. In ecological systems, soil contains both abiotic and biotic components that interact with one another, forming reciprocal relationships among soil, plants, animals, and microorganisms as an inseparable unit (Wulandari, 2024). One of the important biotic components is soil fauna, which plays a crucial role in improving soil structure and supporting litter decomposition processes, thereby contributing to overall soil productivity, and whose presence is often used as a biological indicator of soil fertility due to its sensitivity to organic matter, moisture, pH, and microbial activity (Roslianti *et al.,* 2020).

Studies on soil fauna in cultivated local crop systems, including beneng taro, remain limited, as most previous research has focused on forest ecosystems, paddy fields, or major plantation crops, resulting in a lack of comprehensive information regarding soil fauna dynamics in beneng

taro cultivation systems. Ferdiansyah *et al.*, (2024) reported that soil insects found in beneng taro cultivation areas belonged to the families Formicidae, Gryllidae, Tetrigidae, Scarabaeidae, Anisolabidae, and Muscidae, which function ecologically as predators, herbivores, pollinators, and decomposers that contribute to maintaining ecosystem balance. Nevertheless, the study was restricted to soil insect groups and did not comprehensively describe overall soil fauna abundance or its relationship with environmental factors such as differences in elevation.

Elevation, as an abiotic factor, influences the distribution of soil fauna through variations in altitude, slope, and microclimatic changes, as an increase of 100 meters above sea level generally results in a decrease in air temperature of approximately 0.6^0 C, thereby affecting the biological activity of soil organisms (Wasis *et al.*, 2023). These changes in temperature and humidity influence plant growth and the dynamics of soil fauna inhabiting the soil, meaning that variations in elevation may create differences in soil biological characteristics. Therefore, this study aims to analyze soil fauna abundance in beneng taro cultivation areas based on differences in elevation in order to obtain an overview of soil biological conditions and support sustainable land management in accordance

with the ecological characteristics of the Mount Karang region.

RESEARCH METHODOLOGY

This study is categorized as a quantitative descriptive research using an exploratory approach. The research was conducted from August 2025 to October 2025. Soil fauna and soil samples were collected from three different locations based on altitude variations. The first location was in Kaduengang Village, Cadasari District, at an altitude of approximately 851-858 m above sea level (m asl), with coordinates -06.26193250, 106.07127920.

The second location was in Juhut Village, Karang Tanjung District, situated at an altitude of around 590–602 m asl, with coordinates -06.28811150, 106.08371660. The third location was in Telaga Warna Village, Pabuaran District, located at an altitude of approximately 343 m asl, with coordinates -06.21813990, 106.04965990. The tools used in this study included stationery, trays, raffia rope, gauze, hoes, tweezers, camera, mobile phone, measuring tape, ruler, soil borer, plastic cups, plastic bottles, gloves, soil tester, stereo microscope, and laptop. The materials used consisted of detergent, water, mica sheets, stakes, label papers, plastic bags, 70% alcohol, and soil from the study site.
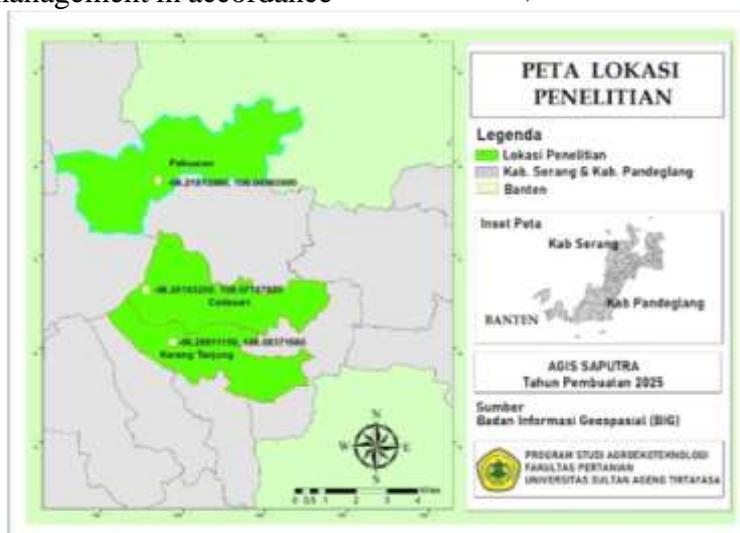

Figure 1. Map of the Research Location

Methods

Soil samples were collected from predetermined observation points using a soil auger at a depth of 0-20 cm, with five sampling points taken for laboratory analysis, then homogenized into a single composite sample and placed in labeled plastic bags weighing approximately 1 kg. The composite samples were analyzed for soil pH, total nitrogen (N-total), organic carbon (C-organic), and the C/N ratio at the ICBB Laboratory of PT Biodiversitas Bioteknologi Indonesia. At the same locations, pitfall traps were installed with ten replications spaced 10 meters apart, each equipped with a 15x15 cm cover positioned approximately 15 cm above the soil surface and provided with small holes near the upper edge to minimize rainwater accumulation and overflow.

The traps were set in the morning and left in place for 24 hours, after which the captured soil fauna were collected and transferred into labeled sample bottles containing 70% alcohol to prevent specimen deterioration and ensure proper preservation. The identification process was assisted by the Google Lens and Picture Insect applications and conducted at the Laboratory of Basic Sciences and Plant Protection, Faculty of Agriculture, Sultan Ageng Tirtayasa University. Soil fauna diversity was subsequently analyzed using the Shannon–Wiener Index (1949) formula to determine the diversity level of the observed communities:

$$H' = -\sum\left(\frac{ni}{N} \ln \frac{ni}{N}\right)$$

Description:
H'   = Diversity Index
Ni   = INP of the i-th species / number of individuals of the i-th species
N   = Total INP / total number of individuals
The H' values were classified as follows:
< 1   : low diversity
1<H'< – 3   : medium diversity
H'>3   : high diversity
The collected data were subsequently processed using *Microsoft Excel*.

RESULTS AND DISCUSSION

Abundance of Soil Fauna

The analysis of soil fauna abundance across different altitudes revealed variations in both composition and the number of individuals at each research site. These variations indicate that environmental factors such as temperature, humidity, and the availability of organic matter at each elevation have a significant influence on the activity and distribution of soil fauna. The observation data presented in **Table 1.** show that each altitude zone-highland, midland, and lowland-possesses distinct ecological characteristics, which consequently affect the abundance and diversity levels of the identified soil fauna orders.

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Table 1. Soil Fauna Population Based on Altitude

Ordo	Abundance		
	Plateau	**Midland**	**Lowland**
Hymenoptera	20	46	18
Orthoptera	2	7	10
Hemiptera	1	0	0
Araneae	2	0	1
Diptera	0	13	0
Coleoptera	0	1	1
Blattodae	0	0	2
Total Abundance	**25**	**67**	**32**

Note: Planteau (851-858 mdpl), Midland (590–602 mdpl), Lowland (343 mdpl).

Based on **Table 1**, the order Hymenoptera (**Figure 2**) was identified as the most dominant group of soil fauna across all research sites. The presence of this order at nearly all elevation levels indicates that Hymenoptera possess a high degree of adaptability to varying soil environmental conditions in different landscapes. Hymenoptera are also recognized as one of the most abundant soil fauna groups in various types of agricultural land and land-use systems, such as heavy soils, intercropping areas, and eucalyptus plantations (Maiyaki *et al*., 2019).

Figure. 2.
Ordo Hymenoptera

Figure 3.
Ordo Orthoptera

Figure 4.
Ordo Diptera

Besides Hymenoptera, other orders such as Orthoptera (**Figure 3**), Diptera (**Figure 4**), and Coleoptera were also found in all three zones, but in smaller numbers and with varying distribution patterns. Fauna from these orders generally act as decomposers, helping to break down organic remains from plants and animals into finer particles. According to Yang *et al*., (2022), the presence of soil fauna is essential for the efficiency of decomposition processes and nutrient cycling.

Diversity of Soil Fauna

Based on the calculations in **Table 2**, the soil fauna diversity index values show variation among locations at different altitudes. The Kaduegang site, located in the highland area, has a diversity index value of 0.711386, categorized as low. This value indicates that in the highlands, the number of soil fauna species found is relatively limited, with a possible dominance of one or two particular species. This suggests that highland conditions tend to support the existence of soil fauna in smaller numbers, although some species are able to adapt to the specific environmental characteristics of higher elevations.

In the midland area, represented by Juhut, the diversity index is recorded at 0.875092, which is also classified as low. This value is slightly higher than that of the highland, indicating an increase in the number of species found, although it still falls within the low diversity range. This difference implies that the midland zone may offer more favorable environmental conditions for moderate soil fauna activity, both in terms of available habitat space and the stability of its micro-ecosystem.

Meanwhile, in the lowland area located in Pabuaran, the diversity index reaches 1.077022, categorized as medium. This higher value shows that the lowland supports a more diverse and balanced community of soil fauna. Variations in diversity across different elevations may be influenced by several ecological factors, including micro-temperature, moisture levels, and the intensity of surface vegetation activity that shapes microhabitat conditions for soil organisms. According to Sulistyorini *et al*., (2021) under such conditions, a denser canopy cover generally

reduces the amount of sunlight reaching the forest floor. This situation helps maintain higher soil moisture, slows the decomposition of litter, and is often associated with an increase in soil fauna abundance. Thus, the lower the elevation of an area, the greater its tendency to support a higher level of soil fauna diversity due to more stable conditions that promote optimal organismal activity.

The Relationship Between Soil Chemical Properties and Soil Fauna Abundance

The results of the analysis of soil chemical properties, including parameters such as pH, organic carbon (C-organic), total nitrogen (N-total), and the C/N ratio, showed variations across the different study locations. The relationship between soil quality parameters, including chemical properties, and soil fauna is complex, as both influence each other in terms of composition, diversity, and ecological function (Ahmad *et al*., 2024).

Table 2. Diversity Index

Location	Diversity Index (H')	Category
Kaduengang (Plateau)	0.711386	Low
Juhut (Midland)	0.875092	Low
Pabuaran (Lowland)	1.077022	Medium

Note: Low diversity (< 1), Medium diversity (1<H'< – 3), High diversity (H'>3)

Table 3. Results of Soil Chemical Properties Analysis

Parameters of Soil Chemical Properties	Research Location		
	Plateau	Midland	Lowland
pH	6.0	5.8	6.4
C-Organik (%)	2.51	2.35	1.66
N Total (%)	0.21	0.26	0.21
C/N Ratio	12	9	8

Note: Results of Laboratory Analysis at ICBB, PT. Biodiversitas Bioteknologi Indonesia

Table 3. shows the results of several soil chemical analyses. The soil pH values at the three locations ranged from 5.8 to 6.4, which generally fall into the slightly acidic to neutral category. The lowland area had the highest pH value of 6.4, while the mid-altitude area showed a pH of 5.8, which was slightly more acidic compared to the other two locations. According to Ahmad *et al*., (2024) soil pH is a key soil quality parameter that influences soil fauna. In lowland areas, a more stable and near-neutral pH tends to support the activity of decomposers such as Hymenoptera and Coleoptera, thereby increasing soil fauna abundance. In contrast, at mid and high altitudes where the soil tends to be more acidic, soil fauna activity tends to decrease due to suboptimal chemical conditions for

metabolism and reproduction of soil organisms.

The highest organic carbon (C-organic) content was found in the highland area at 2.51%, followed by the mid-altitude area at 2.35%, and the lowest in the lowland area at 1.66%. Although the highest C-organic content was observed in the highlands, the diversity of soil fauna was relatively low. Conversely, in the lowlands with lower C-organic levels, the higher microbial activity and warmer temperatures allowed faster decomposition processes, thereby supporting a more diverse soil fauna community. According to Liu *et al*., (2019) soil organic carbon (C-organic) serves as the main energy source for soil fauna and microorganisms, and high C-organic content often has a positive impact

by enhancing soil fauna abundance and diversity.

The total nitrogen (N-total) content showed slight variation across altitudes, with the highest value recorded in the midland area at 0.26%, while both the highland and lowland areas had the same value of 0.21%. The higher N-total value in the midland indicates a more active nitrogen cycle, thereby supporting greater soil fauna abundance (67 individuals) as shown in **Table 1**. Adequate nitrogen availability can enhance microbial activity and provide a more favorable nutrient environment for decomposer fauna such as Hymenoptera and Diptera. In contrast, in the highland and lowland areas with lower N-total values, the abundance and diversity of soil fauna tended to decrease, with diversity index categories classified as low to medium. These results are consistent with the findings of Hu *et al*., (2022) which showed that nitrogen addition alters the overall abundance of soil fauna (with varying effects among taxa), thereby confirming the role of nitrogen in shaping soil community structure.

The C/N ratio varied across the study sites, with the highest value observed in the highland area (12), followed by the midland (9), and the lowest in the lowland area (8). A higher C/N ratio in the highlands indicates a slower decomposition process of organic matter, resulting in limited nutrient availability and consequently lower soil fauna abundance (25 individuals) as well as a lower diversity index value (H' = 0.71). In contrast, in the lowland area with a lower C/N ratio, the mineralization of organic matter occurs more rapidly and microbial activity increases, thereby supporting higher soil fauna diversity (H' = 1.07). This finding is consistent with Zhang *et al*., (2023) who reported that soil fauna activity reduces the C/N ratio in certain litter types and accelerates the release of carbon and nitrogen during decomposition, experimental evidence that the reduction of

the C/N ratio is associated with increased nutrient availability that supports soil fauna communities.

CONCLUSION AND RECOMMENDATIONS

The results of this study indicate that differences in altitude have a significant effect on the abundance and diversity of soil fauna in beneng taro (*Xanthosoma undipes* K. Koch). The lowland area exhibited a higher level of soil fauna diversity compared to the midland and highland areas, which is presumed to be influenced by more favorable soil chemical conditions such as near-neutral pH, sufficient total nitrogen content, and a lower C/N ratio that accelerates the decomposition and mineralization of organic matter. Conversely, in the highland area with more acidic pH and a higher C/N ratio, soil fauna activity tended to decrease due to limited nutrient availability. These findings emphasize that the balance between soil chemical properties and environmental conditions plays an essential role in shaping the structure of soil fauna communities, suggesting that soil fertility management considering these factors can support ecosystem sustainability and the productivity of beneng taro fields across different altitudinal zones.

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