



# Gastropoda Diversity in Polyculture Agricultural Ecosystem of Nansan Village, Insana District, North Central Timor Regency- East Nusa Tenggara Province (NTT)

Blasius Atini <sup>1\*</sup>, Aloysius Rusae <sup>1</sup>

<sup>1</sup> University of Timor, Jalan El Tari Km 09 Kelurahan Sasi, Kefamenanu, East Nusa Tenggara, Indonesia 151006

\* Correspondence: [atini12blasius@gmail.com](mailto:atini12blasius@gmail.com)

## Abstract

**Background:** The research was carried out in the polyculture area of Nansan Village, North Central Timor Regency. This study aims to determine the diversity of Gastropoda species and determine the influence of environmental factors on the Gastropoda life in the polyculture agricultural ecosystem of Nansan Village. **Methods:** The method used in this research is the quadratic method by placing plots along the transect line. The data analysis technique for Gastropoda diversity was using the Shannon-Winner diversity formula. **Results:** From the study results, it was found that six types of Gastropoda, namely *Achatina fulica*, with a diversity index ( $H'$ ) of (3.51) were classified as high. *Laevicaulis alte Bowd* with a diversity index ( $H'$ ) of (1,15) was moderate. *Felicaulis sp* with a diversity index ( $H'$ ) of (1,25) was classified as average, *Bradybaena similaris Frussac* with a diversity index ( $H'$ ) of (1,26) was classified as moderate. *Achatina variegata Bowd* with a diversity index ( $H'$ ) of (0.92) is low. *Doraceras leave sp* with a diversity index ( $H'$ ) of (0.87) is common. Species diversity shows the pattern of adaptation to ecosystem conditions is quite good, and vice versa if the type of Gastropoda is common. **Conclusions:** the environment has a role in diversity variations in Nansan Village, Insana District, and North Central Timor Regency.

**Keywords:** diversity; Gastropoda; polyculture ecosystem; Nansan



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## Introduction

Gastropoda in general, has a role as a counterweight in the ecosystem, as raw materials for medicines, as feed for humans and domestic livestock, and used as decoration and as modeling (Anggriani et al., 2018). Gastropoda diversity conditions need to be maintained and preserved to support and well maintained. Environmental degradation and ecosystem management patterns that are not based on sustainable ecosystems will cause Indonesia's diverse wealth to experience extinction in the future (Nababan et al., 2017). Thus, its utilization and management efforts need to be supported by comprehensive information and knowledge about these Gastropoda animals, which includes the value of diversity.

Gastropoda functions importantly in their environment because they occupy all the niches of the environment as eaters, prey, and recyclers. Therefore, the presence of Gastropoda in a place also determines the fertility of a climate, including on a plantation. The lack of research related to the role of animals in agriculture when in fact, agriculture in Indonesia is numerous and widespread.

Gastropoda research in Indonesia has emphasized the diversity of gastropods in its natural environment (Prahoro & Sisco P, 2017; Bancin et al., 2020), while research on

Gastropoda in agricultural ecosystems has not been studied much. Indonesia has a wealth of biodiversity. Therefore, it is used by the community to be empowered in their lives. This makes Indonesia one of the largest agricultural countries in the world. Indonesia as a rustic country is proof that this country is a fertile country with abundant natural resources, so the novelty of this study is about Gastropoda in agricultural systems.

This study looks at Gastropoda diversity in the Agricultural Ecosystem of Nansean Village Polyculture Insana District, North Central Timor Regency-East Nusa Tenggara Province. The results of this study can be utilized by the agricultural party to measure the fertility of the farm and anticipate its management to maintain or increase fertility.

## Method

This investigation uses the research method of square sampling. Research methods used with a certain proportion of habitat are calculated directly (Pertiwi *et al.*, 2019). Sampling is carried out using the placement of tiles along the transect line. On each transect are laid observation plots of as many as six pieces with a plot size of 2 x 2 m = 4 m<sup>2</sup> with a distance between plots of 10 m.

The research was conducted in the polyculture farming area of Nansean Village from January-June 2021. This study used tools and materials: roller meters, raffia ropes, medium-size jars (volume + 3 liters), tube-shaped, digital cameras, stationery, machetes, peg wood, and gloves gastropoda (snails), alcohol 70%.

Gastropoda is grouped with existing subclasses, and analysis is then carried out to identify the types of gastropods that live in plantation areas. Identification of the types of gastropoda is made by comparing the types of gastropoda found with the specimen images in the book and matching the characteristics of gastropoda found with the features of the specimen in the book, and using the determination key to find out the diversity of gastropoda using Shanon wiener formula, namely:  $H' = - \sum p_i \log p_i$

## Result

### *Types of Gastropoda found in the Nansean Village Polyculture Plantation*

The types of Gastropoda found at the entire plantation site can be seen in Table 1. below:

**Table 1.** Types of Gastropoda Animals on the farm of Nansean Village

Order	Family	Species	Σ Individual
Pulmonata	Achatinidae	<i>Achatina fulica Bowd</i>	139
Pulmonata	Veronicellidae	<i>Laevicaulis alte Bowd</i>	41
Pulmonata	Felicidae	<i>Felicaulis sp</i>	40
Stylomatophora	Bradybaenidae	<i>Bradybaena similaris Frussac</i>	32
Pulmonata	Achatinidae	<i>Achatina variegata Bowd</i>	19
Basoatopora	Agridimanidae	<i>Doraceras laeve sp</i>	10
	Total		291

### *Value of Type Diversity*

Based on the results of the analysis of the calculation of the value of the diversity of Gastropoda species of agricultural ecosystems, Nansean Village, Insana Subdistrict can be presented the values and categories of the variety of Gastropoda types as in the following table:

**Tabel 2.** Value of Gastropoda Species Diversity in Nansean Village Polyculture Agricultural Ecosystem

Order	Family	Species	Indeks Shanon-Weiner	Category
<i>Pulmonata</i>	<i>Achatinidae</i>	<i>Achatina fulica Bowd</i>	3,51	Tall
<i>Pulmonata</i>	<i>Veronicellidae</i>	<i>Laevicaulis alte Bowd</i>	1,15	Keep
<i>Pulmonata</i>	<i>Felicidae</i>	<i>Felicaulis sp</i>	1,25	Keep
<i>Stylomatophora</i>	<i>Bradybaenidae</i>	<i>Bradybaena similaris Frussac</i>	1,26	Keep
<i>Pulmonata</i>	<i>Achatinidae</i>	<i>Achatina variegata Bowd</i>	0,92	Low
<i>Basoatopora</i>	<i>Agridimanidae</i>	<i>Doraceras laeve sp</i>	0,87	Low

### Environmental Factors

Factors that affect the diversity of Gastropoda types include temperature, humidity, and degree of acidity. Based on the results of measurements of environmental factors in the agricultural area of Nansean Village obtained the following results:

**Tabel 3.** Value of Gastropoda Species Diversity in Nansean Village Polyculture Agricultural Ecosystem

Environmental Factors	Information
Temperature	24°c
Moisture	82%
pH	6,5

### Discussion

#### *Types of Gastropoda found in the Nansean Village Polyculture plantation*

The types of Gastropoda found at plantation sites are:

- ***Achatina fulica Bowd (Snail)***  
This gastropoda has a cone-shaped characteristic in the form of a circular tube-like cone (coil). At the apex is the oldest pointed part. The shape of the body corresponds to the shape of the graft, and at the ends, there is a pair of long tentacles measuring 3 cm and a pair of short tentacles measuring 1 cm, and at each end of the tentacle, there is an eyepiece that functions as a sensing device. The means of locomotion in these Gastropoda use feet that are wide and flat on the ventral part of the body (Daud *et al.*, 2018).
- ***Laevicalvis alte Bowd (Leech snail)***  
Leech snails have the characteristics that the body is oval, elongated, and slightly weaned with a size of 5 cm. The surface of the dorsal body is black, and the surface of the ventral body is yellowish-white and coated with mucus. The primary habitat of damp places is mainly under the shade of vegetation or grass (Hirano *et al.*, 2019).
- ***Felicaulis sp. (Shellless snail/slug)***  
Characteristics of this type of Gastropoda are soft in stature, does not have a shell, the body is oval, elongated, and slightly weaned with a size of 8-10 cm, the surface of the dorsal body is light brown. The ventral surface is yellow and coated with mucus. It can be in damp places, especially in the shade of plants (Rosario *et al.*, 2019).
- ***Bradybaena simylaris Frussac (Shrub Snail)***  
This type of gastropoda has a soft stature; the surface of the shell is brown and flat, on the head, there is a pair of long tentacles of approximately 2 cm and a pair of short tentacles of a size of 0.5 cm, each end of the tentacle has an ocular lens that functions as a tool to assist vision. The primary habitat is in damp places, behind rocks and vegetation litter (Serniotti *et al.*, 2019).
- ***Achatina variegata Bowd (Leaf snail)***  
Characteristics of this type of Gastropoda are soft stature, elongated pointed-shaped

shell, and the posterior surface layer of the smooth and white shell with yellow patches. There are a pair of tentacles 3 cm long and short tentacles with a size of 1 cm on the head.

- ***Doraces leaves sp (Land snail)***

Characteristics of this type of gastropoda, namely Soft, has a pair of short tentacles, which is 1 cm long, has a thin shell, and is white with brown patches. Agricultural ecosystems consume legume crops, cassava plants, eggplant pumpkin plants, and tomatoes. The primary habitat is humid places (Rosady *et al.*, 2016).

#### **Value of Type Diversity**

Table 2 shows the types of Gastropoda that have a medium category diversity index. The three types of gastropods, namely *Laevicaulis alte* Bowd with a diversity value of 1.15 *Felicaulis sp* with a diversity value of 1.25, and *Bradybaena similis* Frussac with a diversity value of 1.26. This shows that bio-ecologically has stability in living habitats due to adaptation patterns, feed suitability, and resistance to extreme conditions in the ecosystem, this is in line with by Setyaningrum *et al.* (2019).

The diversity value belonging to the high category is found in the *Achatina fulica Bowd* type, with a diversity value of 3.51. The high diversity value of *Achatina fulica Bowd*, due to the availability of food at the time of research, became a positive influence on supporting the reproductive process. The existence of a very life-supporting environment is when researching temperatures of 24°C humidity of 82% and PH 6.5 environmental characteristics are suitable for the type of *Achatina fulica Bowd*. These animals are also quite resistant to exposure to chemical pesticides. In addition, the gastropod body has a coat which is one of the protective organs for the body as a whole. Gastropoda types belong to the low category. There are two types, namely *Achatina variegata Bowd* with a diversity value of 0.92 and *Doraceras leave sp* with a diversity value of 0.87. Research conducted by Gea *et al.* (2020) in the waters of the village of tayando yamtel showed that gastropod results have many types when in a supportive environment. Low diversity index due to feeding conditions at the time of lack of research, having resistance levels or susceptibility to exposure to Kimia pesticides carried out by farmers in managing polyculture agricultural ecosystems (Inkhavilay *et al.*, 2019).

Ecosystem management that emphasizes low habitat causes the gastropod group animals to move places. Management of agricultural ecosystems in pest control efforts must have a policy on using chemical pesticides not to hurt the environment and the presence of pests. Organisms that are not targeted will also have an impact; this is emphasized by Páll-Gergely *et al.* (2020) and Uribe *et al.* (2016) that the use of chemical pesticides in pest control in agricultural ecosystems must be carried out if pest attacks increase. Patterns of the use of chemical pesticides with analysis of economic thresholds will provide stability of life to the ecosystem.

#### **Environmental Factors**

Research conducted by Mathius *et al.* (2018), factors that affect Gastropoda diversity consist of physical factors, namely air temperature and water temperature, chemical factors, namely water pH, soil pH, and salinity, as factors that determine the number of Gastropoda in one place.

Table 3 presents an air temperature at the study site of 24°C, while the humidity of the air averages 82%. The exact temperature for the life processes of each type of terrestrial Gastropoda found ranges from 22°C – 28°C (Benbellil-Tafoughalt & Koene, 2015), while the humidity ranges from 70% - 80%. The exact pH for the life of terrestrial gastropods ranges from 6-7 (Umanailo *et al.*, 2021).

Table 3 shows that the temperature in the agricultural area of Nansean Village belongs to the category of optimum temperature and availability of feed or food so that Gastropoda types can live and multiply well or reproduce. In contrast, the pH of the soil in the plantation area is quite suitable for biological activity. Farmers who use it cause the

level of Gastropoda diversity to be low because some types of gastropoda are susceptible to exposure to chemical pesticides. In addition, the habitat of Gastropoda living is less supportive due to certain types of animals that are more optimal for living and humid conditions and are protected by plants. Food conditions that are not available in color and quantity are also quite influential on the low diversity of Gastropoda.

## Conclusions

Gastropoda types found at the research site include six types, namely *Achatina fulica* Boewd, *Laevicaulis alte* Bowd, *Felicaulis sp*, *Achatina variegata* Bowd, *Bradybaena similaris* Frussca, and *Doraceras laeve sp*. Gastropoda type diversity at the research site is categorized as having high, medium and low diversity where the type of *Achatina fulica* Boewd has the highest diversity value, which is 3.51 and the *Felicaulis sp*. type has a diversity value of 1.52 (medium), while *Doraceras laeve sp* has the lowest diversity value, which is 0.87. Physical and environmental factors at the research site include temperature, humidity, and pH in the optimum category that allows gastropods to develop correctly.

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## Declaration statement

The authors reported no potential conflict of interest.

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