The Distribution and Strategies of Plants to Grow around Laguna Lake in Ternate

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Keywords: Distribution, Strategy, Plant growth, Laguna Lake.

Abstract: Distribution is a spacing pattern of individuals in a population relative to one another. There are various individuals' distribution patterns. They are commonly known as uniform, random, and clumped distribution patterns. The present research was designed as an ex post facto research which aimed to observe an existing phenomenon and recount past events to investigate factors that contributed to the occurrences. This research was conducted in an area of 7.500 m^2which was dug into 50 plots of 20x20m. Random plotting method was employed to collect the data. The number of individual targeted plants which appeared in the observation plots were calculated. Each of the plants' species was identified. The distribution patterns and the growth strategies of the individuals were determined based on the Morisita Index values. The results indicated that Laguna Lake areas were mostly surrounded by durian (*Durio zibethinus* L), nutmeg (*Myristica fragrans* Hout), breadfruit (*Artocarpus communis* L), and mango (*Mangifera indica* L.). The distribution patterns of the plants consisted of random distribution pattern (durian (*Durio zibethinus* L.), breadfruit (*Artocarpus communis* L.), and mango (*Mangifera indica* L.)) and clumped distribution pattern (nutmegor *Myristica fragrans* Hout.). In relation to plant growth strategies, the K-theory was introduced (growth strategy). Environmental factors including the soil pH, light intensity, water current, and mineral content also influenced the distribution patterns and growth strategies of the targeted plants.

1 INTRODUCTION

Plants are living creatures that can produce their own food with chlorophyll. In Biology, there are around 350.000 types of plants recorded in Plantae kingdom. Out of the number, 258.650 are categorized into flowering plants and 18.000 are mossy plants. Most of the Plantae kingdom individuals are autotroph organisms that can obtain energy by harnessing sunlight through photosynthesis (Ariebowo M, 2009).

Plants have a stationary property which does not allow them to move independently. Therefore, they multiply through vegetative or generative reproduction. Leaf, root, and stems constitute the main parts of a plant. However, grass, trees, bamboo, and shrubs also belong to one of the plants' categories. In a community, plants with the same type can grow together in either the same or different locations (Tolangara, 2017).

2 RESEARCH METHOD

The present research employed an ex post facto design which aimed to observe an existing phenomenon and recount past events to investigate factors that contributed to the occurrences (2012). This research was carried out from March to July 2018 in the areas around Laguna Lake of Ngade, South Ternate.

The research procedures consisted of an observation of the plants' distribution patterns and an observation of the plants' growth strategies. The observation spots lied on an area of 7.500m^2 (150m long and 50m wide). Two transect lines were drawn from the lakeside to a particular spot that had been determined earlier. The spacing of each transect was 30m. Each transect line contained 5 observation plots of 20x20m. Thus, there were 10 plots randomly assigned on the land. The targeted plants of this research were the plants that grew under mother trees of which sizes could reach stem diameter (Ø) ≤ 10 cm and height < 2m with small percentages of canopy cover. These plants were

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identified based on their categories. The number of individuals found in each category was calculated and the height and the stem diameter of each plant were recorded. The areas on which the targeted plants were found were marked with stakes that had been painted on top. Environmental parameters such as the soil pH, soil moisture, soil texture, and light intensity were measured to support the findings.

3 FINDINGS AND DISCUSSION

3.1 FINDINGS

3.1.1 The Distribution Patterns of the (Targeted) Plants

The number of individuals of each species (durian, nutmeg, breadfruit, and mango) found in each observation plot was recorded in Table 1.

Table 1: Number of Individuals Found in Each Observation Plot.

No.	Local Name of the Plant	Scientific Name of the Plant	Plot										Total Number
			I	II	III	IV	V	VI	VII	VIII	IX	X	
1.	Durian	*Durio zibethinus* L	3	1	1	4	0	1	6	0	0	2	18
2.	Nutmeg	*Myristica fragrans* Hout	1	4	2	4	3	1	1	8	7	2	33
3.	Breadfruit	*Artocarpus communis* L	0	2	0	0	1	0	0	0	0	1	4
4.	Mango	*Mangiferaindica* L.	0	0	0	1	0	2	2	0	0	0	5
Total			4	7	3	9	4	4	9	8	7	5	60

The information presented in Table 1 was then used to analyze the distribution patterns of each plant category with Morishita Index, such as shown in Table 2.

Table 2: The Results of the Analysis of the Plants' Distribution Patterns.

No.	Scientific Name of the Plant	$n_i\sum(X_i(X_i-1)$	$N(N-1)$	Id	Distribution Pattern
1.	*Durio zibethinus* L	864	3540	0,2441	Random
2.	*Myristica fragrans* Hout	4356	3540	1,305	Clumped
3.	*Artocarpus communis* L	8	3540	0,0023	Random
4.	*Mangifera indica* L.	20	3540	0,0056	Random
	Total	5248	14160	1,4825	

Table 2 suggested that the majority of the plants that lived around Laguna Lake had random and clumped distribution patterns. Durian, breadfruit, and mango trees were normally distributed randomly while individuals in the nutmeg population were more likely to have clustered together.

3.1.2 The (Targeted) Plants' Growth Strategies

The results of the research related to the targeted plants' (competition) strategies to grow side by side with other trees with a diameter of (Ø) $\leq$ 10 cm suggested different measurements of height and stem diameter depicted in Table 3.

Table 3: The Stem Diameter and Height of the Targeted Plants Compared to Mother Trees.

No.	Local Name of the Plant	Scientific Name of the Plant	Targeted Plant		Mother Trees	
			(Ø)≤ 10 cm	Height (cm)	Height (cm)	(Ø) ≥ 20 cm
1.	Durian	*Durio zibethinus* L.	5,096	79	390	35.04
2.	Nutmeg	*Myristica fragrans* Hout	3,822	28	280	31.85
3.	Breadfruit	*Artocarpus communis* L	5,096	84	400	38.22
4.	Mango	*Mangifera indica* L.	3,981	33	370	35.04

Table 3 indicated that the targeted plants were much smaller and thinner (in terms of stem diameter) than the mother trees that were growing around them. In other words, the other plants or the mother trees were dominating the areas, thus preventing the targeted plants to grow and thrive even though they belonged to the same category of plants. The results of a 10-week (5-month) observation suggested that the targeted plants were required to develop a new strategy to survive and grow healthily. These strategies could be measured through the development of the plants' height and stem diameter. The results were recorded in Figure 1 (durian), Figure 2 (nutmeg), Figure 3 (breadfruit), and Figure 4 (mango).

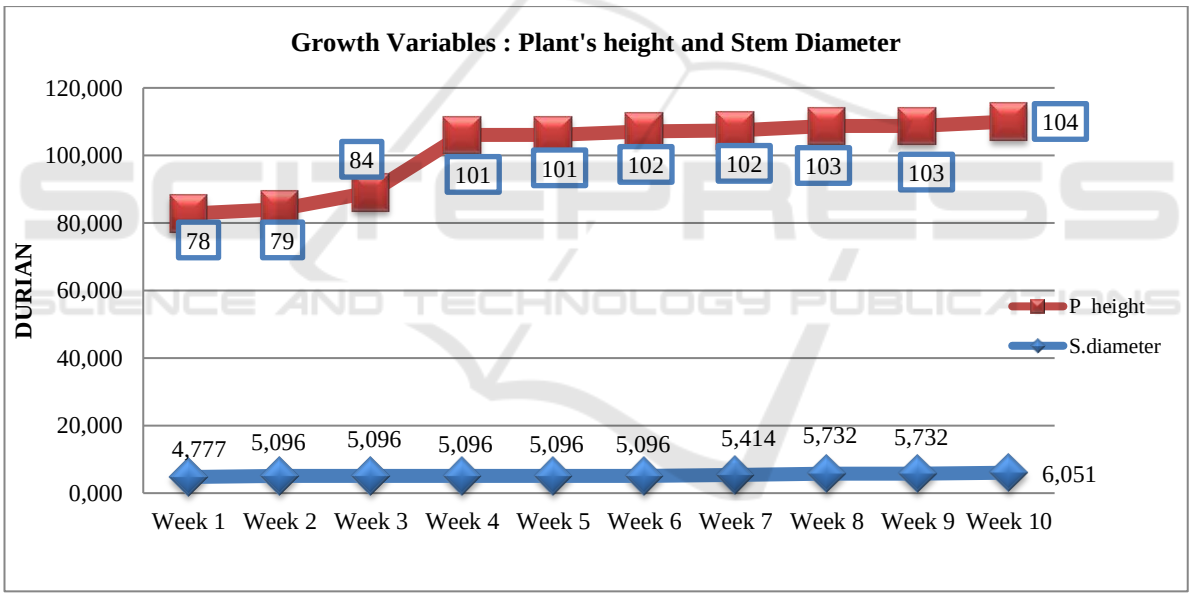

Figure 1: Durian Growth Variables: Height and Stem Diameter

Figure 1 showed that there was an increasing trend in durian growth variables (i.e. durian height and stem diameter). Even though the improvements were not too significant, the height and the stem diameter of the plant still experienced progress in terms of size within 10 weeks (5 months). Similarly, the development of nutmeg height and stem diameter was reported as follows.

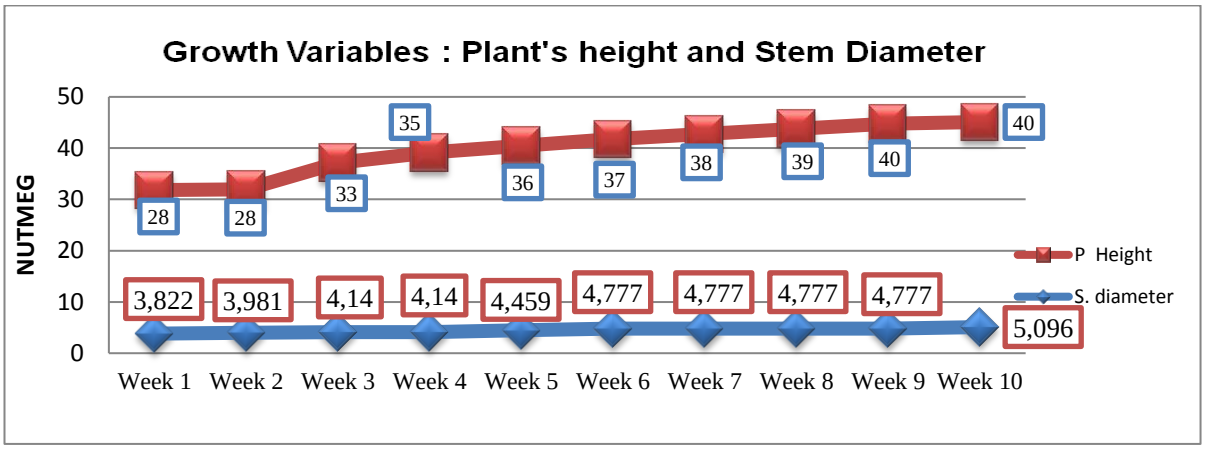

Figure 2: Nutmeg Growth Variables: Height and Stem Diameter

Figure 2 obviously showed that during the 10-week or 5-month observation, nutmeg growth variables (height and stem diameter) increased gradually. Likewise, breadfruit height and stem diameter growth were presented in Figure 3.

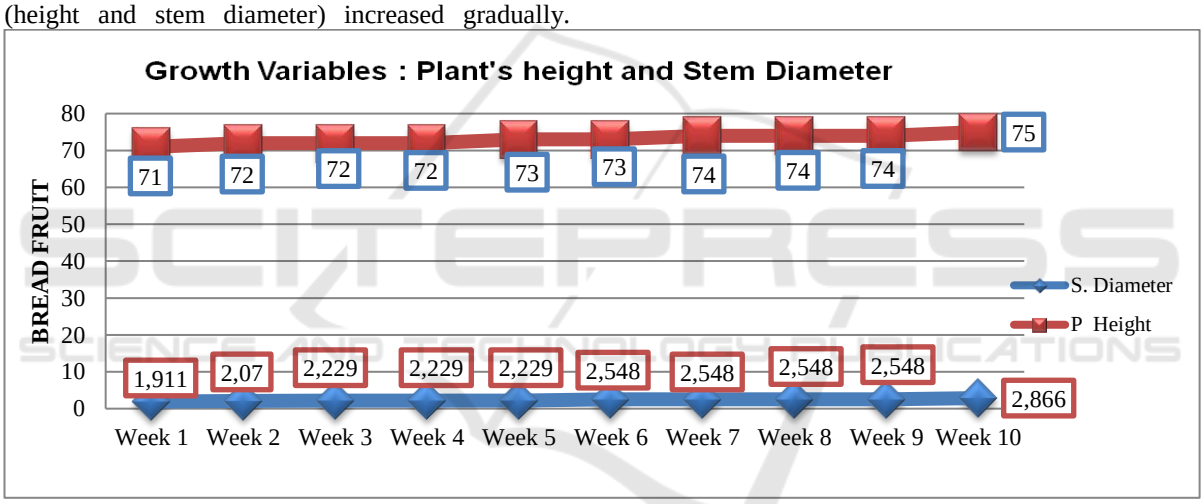

Figure 3: Breadfruit Growth Variables: Height and Stem Diameter.

Figure 3 suggested that breadfruit height and stem diameter had improved during the observation period which lasted in 10 weeks (5 months). In other words, there was an upward trend in the breadfruit growth variables though it was not too significant. Mango trees could grow to a height of 140 cm and had a stem diameter of 7.643 cm. More detailed information on the development of mango height and stem diameter was presented in Figure 4.

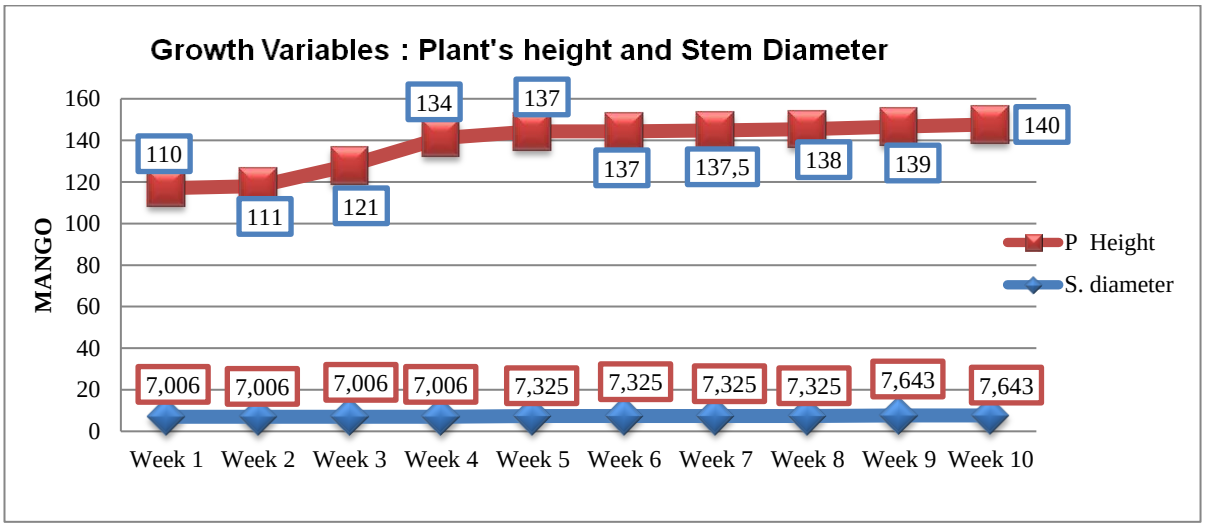

Figure 4: Mango Growth Variables: Height and Stem Diameter.

Figure 4 showed a considerable surge in the improvement of mango trees height and stem diameter within 10 weeks (5 months). However, the mango trees stem diameter seemed to grow slower than the height.

3.1.3 Environmental Factors that Affected the (Targeted) Plants' Growth

The results of the measurement of environmental parameters in Laguna Lake regions were presented as follows.

Table 4: The Measurement of the Environmental Parameters.

Environmental Parameters			
Soil pH	Soil Moisture	Soil Texture	Light intensity
5,6 – 6,6 (acidic–neutral)	20 – 50% (medium–high)	Sandy clay, muddy, and sandy-muddy	1,852 covered – 36,422 open (Candela)

Table 4 suggested that the pH scale of Laguna Lake soil ranged from 5,6 (acidic) to 6,6 (neutral). The soil moisture fell between 20-50%(medium-high) while the soil texture was more likely to be sandy clay, muddy, and sandy-muddy. Around 1,852(candela) was covered from luminous intensity and the other 36,422 constituted open areas(candela). These parameters were considered supportive of the growth of the targeted plants observed in this study.

3.2 Discussion

3.2.1 The Distribution Patterns of the (Targeted) Plants

Findings of this research have indicated that the majority of the targeted plants had random and clumped distribution patterns. A dispersion pattern is affected by the inward and outward movements of individuals in a population. According to Indriyanto (2006), there are three types of population movements, emigration (the one-way outward movement), immigration (the one-way inward movement), and migration (the periodical inward and outward movement). The distribution of a population can keep increasing or decreasing. These changes have become the main focus of the dispersed population ecology which were mainly caused by three interrelated factors, including natality, mortality, migration (emigration and immigration).

There are three commonly known patterns of individuals' distribution in a population (intern distribution). They are random, uniform, and clumped distribution patterns. Plants and animals follow the same basic patterns that are random, uniform, and distribution patterns. These patterns have a strong correlation with environmental conditions (Barbour et al., 1987 in Hasan S, et al. 2016).

Arsyad (2016) argues that if the entire natural factors contribute to the existence of a species in a certain place are limited, the distribution pattern of the species will be much easier to determine. This condition can be easily identified with the random distribution pattern which was also found in this research. The Morishita Index (Iδ) values of durian (Id=0.2441), breadfruit (Id=0.0027), and mango(Id=0.0056) suggested that these plants were distributed randomly in Laguna Lake areas while nutmeg (Id= 1.035) had a clumped distribution pattern. Odum(1993) agrees that random distribution pattern is often found in plant populations. A particular environment rarely shares similar characteristics with other environments in the same area. Therefore, this sort of competition becomes the most common interaction established among plants (Gibson, 2006). Each of the individuals struggles for similar resources, water, sunlight, space, and nutrition (Tolangara, 2017).

3.2.2 Growth (Competition) Strategies Developed by the (Targeted) Plants

The height and stem diameter of the targeted plants were observed for 10 weeks (5 months). These parameters were then compared to those of other plant species that grew in similar regions. The results were then used to determine the growth strategies developed by the targeted plants. No substantial improvement was found in the height and stem diameter of the targeted plants. Therefore, it can be concluded that there was a competition between the targeted plants and other plants species in the areas. This competition may be defined as one of the interaction forms established among the plants to fight over limited natural resources that are available in a limited space and a limited period of time which can adversely affect the plants' growth (Leksono, 2007).

The figures found in the previous sections presenting the targeted plants' height and stem diameter suggest a hindrance in the growth of durian, breadfruit, mango, and nutmeg observed in this study. The obstacles faced by the targeted plants to grow properly are the result of interspecific competition which usually occurs between different species of the same ecological area (Leksono,2007) where the dominant parties always secure the safest place. The interspecific competition between organisms can result in different growth abilities that allow the non-dominant plants to develop a strategy called the K-strategy (growth strategy) (Hardjosuwarno, 1993). Therefore, despite the fact that the plants may have received very little light, water, and nutrients, they are still able to develop the K-strategy (growth strategy) which is usually applied by terrestrial plants to survive in nature (Backer, 1987) in (Tolangara, 2012).

3.2.3 Environmental Factors that Affected the (Targeted) Plants' Growth

There are some environmental factors that may affect plant growth. These factors include the soil pH, soil texture, moisture, and light intensity. Based on the results of the observation conducted on the environmental parameters, it was found that the targeted plants (durian, breadfruit, nutmeg, and mango) grew under acidic-neutral conditions (pH between 5,6-6,6). A soil with a pH ranged between 5,6-6,6 normally contains high manganese, boron, copper, zinc, nitrogen, potassium, and sulfur and carry little phosphorus, calcium, and magnesium (Foth, 1994). This typical soil is considered healthy for plants. Therefore, it can be concluded that the targeted plants have been kept under the best soil condition.

The difference between plant spacing categories is easily seen from the criteria for the opening of the canopy. Meanwhile, planting density can be measured based on the volume, the base area and the number of trees per hectare. The planting density falls into three categories as follows:

1. High density, where there is more than 70% canopy cover,
2. Medium density, where there is around 40-70% canopy cover,
3. Low density, where there is less than 40% canopy cover (Leksono, 2007).

High density prevents plants to grow properly due to the hard competition to obtain sufficient sun rays, water, and minerals. There will be a hindrance in the plants' growth but it will not take a long time since the dominant parties will eventually win and the non-dominant groups will be left to die. On the other hand, low planting density can result in producing trees with a large canopy which have many short branches. A well-managed planting area always has an optimum condition that allows good absorption of sunlight and mineral nutrients. Therefore, forests with a less dense canopy layer usually harbor young trees or saplings. These open areas are mostly overgrown with weeds that may interfere with the growth of the main plant species or staple plants (Tolangara, 2017).

4 CONCLUSIONS

Based on the results of the current research and the discussion, some conclusions can be drawn as follows:

1. The targeted plants that can found in the research areas include durian (*Durio zibethinus* L), nutmeg (*Myristica fragrans* Hout), breadfruit (*Artocarpus communis* L), and mango (*Mangifera indica* L.).
2. The targeted plants that grow around Laguna Lake regions normally have random (durian, breadfruit, and mango) and clumped (nutmeg) distribution patterns.
3. To survive, durian, breadfruit, mango, and nutmeg observed in this study apply the-K strategy (growth strategy).
4. Environmental factors such as the soil pH, light intensity, water current, and mineral content also affect the development of the targeted plants observed in the present study.

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