Biodiversity index of fruit trees cultivated by communities around marginal land in Jombang Regency, East Java Province, Indonesia

Zulfikar 1,2, E Arisoesilaningsih 3, S Indriyani 3, A A R Fernandes 4

1 Student of Doctoral Program, Biology Department of Faculty of Mathematics and Natural Sciences, Brawijaya University, Malang, Indonesia
2 Lecturer of Informatics Department, KH. A. Wahab Hasbullah University, Jombang, Indonesia
3 Lecturer of Biology Department, Brawijaya University, Malang, Indonesia
4 Lecturer of Statistics Department, Brawijaya University, Malang, Indonesia

Corresponding author: zulfikardia@gmail.com

Abstract. Marginal land conditions are a major problem in reducing the level of diversity of species due to decreased soil, climate, and water quality and topography. This study aims to analyze the diversity index and the dominance of fruit tree species cultivated by surrounding communities. The research method uses nested sampling in 4 (four) sub-districts, each of which is taken three sample villages and each of them is made of three transect plots measuring sample plots 20 x 20 m² (trees), 10 x 10 m² (poles), and 5 x 5 m² (sapling). Data analysis using the Biodiversity R application program with version R 3.6.1. The results of the analysis of the growth rates of the best tree species were found in Plaso Regency because they had the highest growth rates of trees, poles, and saplings. The diversity of fruit tree species is based on the distribution of the highest H index value of 1.47 and the lowest of 0.58 and includes areas that have an abundance of moderate species. Fruit tree species that have the highest importance value index are Mangifera indica (mango) 70.26% with a tree density of 139 individuals per hectare, then Dimocarpus longan (longan) 40.24% with a tree density of 153 individuals per hectare. The results of this study indicate that the community structure of fruit trees in degraded lands is more dominated by plants from the Sapindaceae and Anacardiaceae families which generally grow spread in the 4 sub-districts studied.

Keywords: biodiversity index, fruit tree species, and marginal land

1. Introduction
The high decline in vegetation diversity as a result of changing land conditions becomes critical giving serious attention to efforts to preserve and protect agro-ecosystems. Agro ecosystem management has not only focused on increasing the number and enrichment of species and improving agro ecosystem habitats but in recent years has shifted to the environmental services provided by these ecosystems or agro ecosystems [1]. Variations in fruit tree biodiversity under environmental gradients are the main ecological research topics and are explained as interactions between climate, productivity, biotic interactions, habitat heterogeneity, and history. Understanding the spatial patterns of biodiversity, and how they respond to disturbances, is an important step for conservation initiatives [2]. Changing forest cover to cultivation, settlement, shrub or open land has the potential to become critical because closure
that was previously open meetings has become more open which has a negative impact on the existence of plant communities [3]. Plant communities in an area are a function of time; although altitude, slope, latitude, rain, and humidity play important roles in the formation of plant communities and their composition so that their existence is a determinant of ecological quality [4].

Biodiversity is closely related to soil fertility, wherein many locations there has been a significant decrease in soil fertility due to intensified agricultural practices which also have a negative impact on organic matter, soil physical properties and soil hydrology. Schulte identified that soils perform various synchronization of ecosystem services or soil functions in relation to the food supply, fiber and fuel production, water purification, carbon sequestration, nutrient cycling, and habitat provision for organism diversity, supply and maintain water quality for Public [5]. Good soil function provides hope for the sustainability of agro ecosystems with a diversity of fruit trees that have high biodiversity variations. Biodiversity plays an important role in many of the processes that take place in ecosystems, including those expressed by Smith including (a) storage and nutrient cycling; (b) carbon storage; (c) water purification; and (d) the balance and distribution of important components that comprise ecosystems such as detritivore, pollinator, parasite, and predator [6]. Changes in biodiversity according to Stirling and Wilsey have important effects on the stability of land fertility, productivity, tropic structure, and displacement of ecosystem components [7]. Therefore, monitoring of changes in the structure and composition of fruit tree vegetation needs to be done regularly so that the general condition of the ecosystem is known for the diversity of the surrounding vegetation. One way to monitor changes in fruit tree vegetation diversity related to the structure and composition of vegetation in ecosystems is through analysis of the biodiversity index.

Plant cover in an area consisting of several plant communities that form vegetation. Vegetation is a system that consists of a large group of plants that grow and inhabit an area [8]. Vegetation is also as a whole plant from an area that functions as a land cover area, which consists of several types such as herbs, shrubs, trees, which live together in a place and interact with one another, as well as the environment and provide external appearance vegetation [9][10]. Vegetation analysis which includes calculating the biodiversity index and the level of species dominance according to Susanto is a way to study the composition or composition of species and shapes or structures of vegetation [10]. The vegetation unit studied in the vegetation analysis is a plant community which is a concrete association of all plant species that occupy a habitat. The results of the analysis of plant vegetation diversity indices are presented descriptively about species composition and community structure [11]. The structure of a community is not only influenced by the relationship between species but also by the number of individuals of each species of organism.

Biodiversity in the structure of plant communities has qualitative and quantitative characteristics so that the description of the structure of plant communities can be done qualitatively with qualitative parameters or quantitatively with quantitative parameters [11]. A quantitative study of vegetation according to Win provides a description of vegetation, prediction, and classification of its patterns as well as knowing the uses and values of species [12]. This analysis indicates species diversity which illustrates the distribution of individual species in a habitat. However, a very important issue in the analysis of a community's diversity index is how to analyze data obtained from measurements in the field, especially quantitative data from all plant species that comprise the community, what quantitative and qualitative parameters are needed, data presentation, and interpretation of data in order can express floristic composition and the characteristics of plant communities as a whole and as a whole. Based on the existing problems, it is necessary to analyze the diversity of tree species cultivated by people who are in critical lands, namely: (1) analyzing the diversity index of fruit tree species in Plandaan District, Ploso District, Kabuh District and Kudu District in Jombang Regency; (2) determine the level of dominance of fruit tree vegetation in the Jombang Regency research location. The parameters measured in this study are the type and number of individual fruit tree plant species, species richness, diversity level with Simpson's index, and abundance with the Shannon-Wiener index.
2. Materials and Research Methods

The material used in this study is the yard and plantation community units in which there is the biodiversity of fruit trees developed by the community around residential units (villages). The equipment used is roll meters, rope, machetes, measuring tape, poles, compasses, hagameter, GPS, cameras, personal use, field books, questionnaires, recording equipment, and writing instruments.

Research using descriptive-quantitative methods. Sampling was carried out in the Northern Region, a part of the Kendeng young limestone mountain, most of which have horizontal and partially hilly physiology, covering the Districts of Plandaan, Kabuh, Ploso, and Kudu. Sampling locations from each sub district from the number of villages that exist as shown in Figure 1. A random sampling of 10% of 53 villages was obtained so that 11 sample villages were obtained. Research targets are household units (HH), obtained by (1) proportional random sampling in each village, (2) inventory of potential respondents, (3) random determination of 10-15 HH/village units to obtain plot area data and gardens, types of fruit trees cultivated, and (4) random determination of 11-yard community units for field observations. Each land community unit was arranged with a plot size of 20 x 20 m², totaling 3 plots with a distance between 10 m plots so that the transect length was 80 m so that 1,200 m² was obtained per unit.

![Figure 1. Making plot transects, sample plot size 20 x 20 m² (trees), 10 x 10 m² (pole) and 5 x 5 m² (sapling).](image)

The measurement of the biodiversity index used to express the relationship between abundance and species dominance in a community consists of two components, namely:

a. A number of species and species growth rates in the community.

b. The species diversity index used for estimation of fruit tree diversity [13]:

1) Patrick's index for species richness: \( R = S \)

2) Diversities Simpson’s Index:

\[
D = \sum \left( \frac{n}{N} \right)^2 \quad \text{and} \quad D = \frac{\sum n(n-1)}{N(N-1)}
\]

Where, \( n \) = total number of certain species, \( N \) = total number of species. The range of \( D \) values between 0 and 1 where the index value 0 represents infinite diversity and 1 that there is no diversity.

3) Diversities Shannon–Wiener’s Index:

\[
H' = -\sum_{i=1}^{s} p_i \ln(p_i)
\]
Where $S$ is the number of species recorded in sample plots, and $P_i$ is an important value in each species.

c. Type dominance can be calculated through the Importance Value Index (IVI) which uses the sum of relative density ($RDi$), relative frequency ($RFi$), relative cover ($RCi$).

Note: $RDi = $ Relative density ($\%$), $RFi = $ Relative frequency ($\%$) $RCi = $ Relative cover ($\%$), $IVI = RDi + RFi + RCi$

Data analysis used the Biodiversity R application version R.3.6.1 for the calculation of diversity index and One Way Anova test.

3. Research Sites

This research was conducted in Jombang Regency, East Java Province in January - April 2019. The research location was determined by purposive sampling, this technique is one of the sampling techniques using certain considerations [14]. Based on that, the researcher determines the location using consideration of vegetation density conditions and geographic location at the study site by making indirect visual observations using the Google Earth application and conducting surveys and direct observations at the research location.

![Research Location Map of Jombang Regency, East Java (Source: BAPPEDA of Jombang Regency in 2018)](image)

Based on geographic appearance and thickness general vegetation in the research area, determined 4 locations (A, B, C, and D), which is divided into 11 units of plant communities with coordinates, slope, elevation, and land area as shown in Table 1.
Table 1. Study sites 11 sub locations with coordinate position, height and slope with each area used 1,200 m² as a research plot.

| Sites | Slope (%) | Altitude (m asl) | Latitude | Longitude | Village | Land (m²) | area |
|-------|-----------|-----------------|----------|-----------|---------|-----------|------|
| A1    | 23.5      | 56.00           | 07°27’21.3” | 112°10’41.6” | Bangsri | 56.000    |      |
| A2    | 23.5      | 68.00           | 07°27’21.1” | 112°10’41.4” | Puri Semandeng | 3.240    |      |
| A3    | 18.0      | 67.00           | 07°27’21.1” | 112°10’42.5” | Gebang Bunder | 4.000    |      |
| B1    | 14.5      | 62.00           | 07°25’55.9” | 112°13’10.2” | Mangunan | 3.650    |      |
| B2    | 16.0      | 56.00           | 07°24’46.5” | 112°15’42.2” | Kabuh | 3.880    |      |
| B3    | 14.5      | 56.00           | 07°24’06.7” | 112°15’42.3” | Karangpakis | 3.230    |      |
| C1    | 2.5       | 63.00           | 07°29’10.5” | 112°10’17.6” | Pager Tanjung | 3.450    |      |
| C2    | 2.25      | 62.00           | 07°28’55.8” | 112°10’33.8” | Kebon Agung | 4.700    |      |
| C3    | 0.45      | 55.00           | 07°27’21.0” | 112°13’31.0” | Jati Banjar | 3.600    |      |
| D1    | 0.09      | 44.00           | 07°26’15.8” | 112°17’52.5” | Sidokaton | 3.375    |      |
| D2    | 0.05      | 43.00           | 07°26’33.8” | 112°15’53.2” | Randuwatang | 3.680    |      |

4. Research Results

4.1. Growth Rate of Fruit Tree Species

Based on the results of the analysis of fruit tree species growth that in Plandaan sub-district there was no rate of growth of trees, but there was an average growth rate of the highest sapling of 41.65 individuals per hectare in the villages of Puri Semanding and Gebang Bunder. The same thing was also found that no tree growth was found in Kabuh village, Kabuh sub-district. The highest pole growth rate is in Kebon Agung village, Ploso sub-district, which is 49.98 individuals per hectare, followed by Sidokaton village, Kudu district, which is 44.4 individuals per hectare.

Table 2. Average growth rates of tree, pole, and fruit tree species at the sub-district and village-level research sites on critical land in Jombang Regency.

| Sub-district | Average growth rate (individual.ha⁻¹) | Village location | Average growth rate (individual.ha⁻¹) |
|--------------|----------------------------------------|-----------------|-------------------------------------|
|              | tree                                   | pole            | sapling                             |
|              | Bangsri                                | Puri Semandeng  | Gebang Bunder                        |
| Plandaan     | 0.00a                                  | 11.08a          | 37.90b                              |
|              | 0.00a                                  | 24.99ab         | 41.65ns                             |
| Kabuh        | 2.75ab                                 | 15.66ab         | 23.99ab                             |
|              | 2.75ab                                 | 19.41a          | 33.32ns                             |
| Ploso        | 12.91c                                 | 34.24b          | 27.74ab                             |
|              | 11.08ab                                | 30.49ab         | 38.82ns                             |
| Kudu         | 8.33bc                                 | 37.49b          | 15.24a                              |
|              | 13.38b                                 | 44.40ab         | 8.33ns                              |
| F value      | 12.05                                 | 2.403           | 3.007                               |
| Pr>F         | 2.6810<sup>***</sup> * 0.0416*         | 0.0463*         | 0.00049<sup>***</sup> 0.0416*       |

Code of Significance: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘’ 1
Values followed by different letters indicate significant differences (Pr <0.05) and were significantly (Pr <0.001), ns = not significantly different (Pr> 0.05) on the results of One Way Anova.
While the lowest pole growth rate is in Bangsri village, Plandaan sub-district, which is 2.75 individuals per hectare. The highest tree growth rates were in Kebon Agung and Jati Banjar villages in Ploso sub-district, and Sidokaton village in Kudo sub-district respectively 13.38. In detail, the total growth rate of fruit trees originating was observed in 11 study areas shown in Figure 3.

The analysis of One Way Anova at the village level shows that tree growth rates show significant differences at level (α) 0.001 and pole growth at level (α) 0.05. While the growth rate of saplings does not provide a significant difference as shown in table 2. If viewed from the average growth rate of trees, although three villages have high values, namely Kebon Agung, Jati banjar and Sidokaton villages, the values are not significantly different from the villages of Pager Tanjung, Karangpakis, Manguman and Randuwatang. On the growth of the pole shows that the highest value in the village of Kebon Agung, but not significantly different from the villages of Pager Tanjung, Sidokaton, Randuwatang, Kebon Agung and Puri Semanding.

Based on the analysis of the best growth rate of fruit tree species based on the highest number of tree, pole and sapling growth found in Kebon Agung, Sidokaton and Pager Tanjung villages where two villages are in Ploso sub-district and one village in Kudo sub-district.

![Figure 3. Distribution of the average difference in fruit tree vegetation growth starting from the growth rate of saplings, poles and trees per hectare in 11 villages in 4 sub-districts in critical land in Jombang with a level (α) 0.05](image)

Based on the level of observation per district, the largest average tree growth is in the Subdistrict of Ploso, which is 12.91 individuals per hectare, and no average tree growth was found in the Plandaan sub-district. The highest average pole growth rate is in Kudo sub-district, which is 37.49 individuals per hectare and the lowest is in Plandaan Sub-district, which is 11.08 individuals per hectare. At the sapling growth rate an average value of 37.90 individuals per hectare was found in the Plandaan sub-district, the lowest was in the Kudo sub-district which was 15.24 individuals per hectare. In detail the value of the growth rate of fruit trees in each district can be seen in Figure 4.

In figure 4 it can be seen that in Plandaan sub-district has the highest level of growth of stakes whose value is not significantly different from Kabuh and Ploso sub-districts and is significantly different from Kudo sub-district. The highest pole growth rate is in Kudo sub-district and is not significantly different from Ploso and Kabuh sub-districts, but significantly different from Plandaan sub-district. While the growth rate of the highest value pole is in the sub-district of Ploso and is not significantly different from the Subdistrict of Kudo and is significantly different from the sub-districts of Kabuh and Plandaan. When viewed from the growth rate of the best fruit trees that grow in critical
land is in the sub-district of Ploso because in general, it has the highest growth rates of trees, poles, and saplings compared to other districts.

![Figure 4. Distribution of the average difference in fruit tree vegetation growth starting from the level of growth of saplings, poles, and trees per hectare in 4 districts in critical land in Jombang at the level (α) 0.05](image)

### 4.2. Species Diversity Index

The diversity of fruit tree species cultivated by the community based on village-level from 11 locations that were sampled as research shows that the highest average species richness is in Kebon Agung and Gebang Bunder villages, each valued at 5 individuals per hectare, the average species richness the lowest is in Kabuh village, which is 2 individuals per hectare.

**Table 3.** Average value of species richness and biodiversity index of fruit tree species in the sub-district and village research sites on critical land in Jombang Regency

| Sub-district Location | Species richness (S) | Shannon-Weiner (H) | Simpson (D) | Village Location | Species richness (S) | Shannon-Weiner (H) | Simpson (D) |
|-----------------------|---------------------|-------------------|-------------|----------------|---------------------|-------------------|-------------|
|                       | Ind.ha⁻¹            | Index value       |             |                |                     |                   |             |
| Plandaan              | 4.11ns              | 1.29ab            | 0.70ab      | Bangsri        | 3.33ns              | 1.09ab            | 0.63ab      |
|                       |                     |                   |             | Puri Semanding | 4.00ns              | 1.31ab            | 0.71ab      |
|                       |                     |                   |             | Gebang Bunder  | 5.00ns              | 1.47ab            | 0.75b       |
| Kabuh                 | 2.78ns              | 0.90a             | 0.54a       | Manguan         | 3.00ns              | 0.97ab            | 0.58ab      |
|                       |                     |                   |             | Kabuh           | 2.00ns              | 0.58a             | 0.38a       |
|                       |                     |                   |             | Karangpakis     | 3.33ns              | 1.16ab            | 0.67ab      |
| Ploso                 | 4.22ns              | 1.33ab            | 0.71ab      | Pager Tanjung   | 4.67ns              | 1.45ab            | 0.75b       |
|                       |                     |                   |             | Kebon Agung     | 5.00ns              | 1.51b             | 0.76b       |
|                       |                     |                   |             | Jati banjar     | 3.00ns              | 1.02ab            | 0.61ab      |
| Kudu                  | 4.17ns              | 1.30ab            | 0.72ab      | Sidokaton       | 4.00ns              | 1.47ab            | 0.75b       |
|                       |                     |                   |             | Randuwatang     | 2.75ns              | 1.25ab            | 0.70ab      |
| **F value**           | 2.734               | 3.38              | 3.137       | **F value**     | 2.114               | 2.526             | 2.387       |
| **Pr(>F)**            | 0.0617*             | 0.0315*           | 0.0405*     | **Pr(>F)**      | 0.069*             | 0.0336*           | 0.0427*     |

*Code of Significance: 0 **0.001*** 0.01 '0.05 ' 0.1 '

Values followed by different letters indicate significant differences (Pr <0.05) and were significantly (Pr <0.001), ns = not significantly different (Pr> 0.05) on the results of One Way Anova.
The highest Shannon-Weiner index value is in Kebon Agung village which is worth 1.51 and the lowest is in Kabuh village worth 0.58. Based on the range of H values the index shows that there are nine villages with moderate species diversity index and the rest shows low species diversity index, which is in Mangunan Kabuh village. This means that in general on degraded land has moderate species diversity value. The highest Simpson index value is in the village of Kebon Agung worth 0.74 and the lowest in the village of Kabuh which is worth 0.38. The complete Simpson index values are shown in table 3. The results of species richness analysis showed that although the highest values were in Kebon Agung and Gebang Bunder villages and the lowest values were in Kabuh village, in general, they did not show any significant difference at the level ($\alpha$) = 0.05 as shown in figure 5.

![Figure 5](image)

**Figure 5.** Distribution of index values for fruit tree species diversity in the village level research area, the highest index value is in Kebon Agung village and the lowest in Kabuh village at a level of significant difference at the level ($\alpha$) of 0.05.

The results of the analysis of species diversity index at the district level found that the highest value of species richness was in Ploso sub-district which was 4.22 and the lowest in Kabuh sub-district was 2.78. The highest H index value was found in Ploso sub-district, which was 1.33 and the lowest was in Kabuh village, which was 0.90. The highest Simpson index value was obtained in Kudu sub-district which was worth 0.72 and the lowest was in Kabuh sub-district with a value of 0.54.

![Figure 6](image)

**Figure 6.** Distribution of fruit tree species richness in the study area at the village level which generally does not make a significant difference at the significance level ($\alpha$) = 0.05.
The subdistrict level research area shows that the lowest species diversity index both Simpson and Shannon-Wiener index is found in Kabuh sub-district. While the other three districts tend to give a higher index value, but the value is not significantly different. This shows that the diversity index in Kabuh sub-district is low and significantly different from the diversity index in Plandaan, Ploso and Kudu sub-districts. When viewed from the magnitude of the index value, the Shannon-Weiner index whose values are in the range of 1 to 3 which means that the three districts have an abundance of moderate species, and Kabuh sub-district has a low species abundance. The difference in the index value of the 4 districts is clearly seen in Figure 7.

Based on the distribution of species richness values, it shows that the four subdistricts studied did not have a significant difference in value, which means the species richness had the same value between subdistricts. In details can be seen in Figure 8.
4.3. Dominance of species

The calculation of the importance value index (IVI) from 4 districts as a research area for fruit plant species cultivated by communities around marginal land shows that the mango fruit tree has the highest IVI value then followed by longan. The lowest IVI is in melinjo, durian, coconut, and tamarind trees. Based on the magnitude of the tree density that the highest density is in the longan tree then followed by the mango tree. While the lowest tree density was also shown in melinjo, durian, coconut, and tamarind trees.

![Figure 9](image)

**Figure 9.** Distribution of IVI and tree density found in 4 sub-districts in critical land in Jombang Regency.

In the observation of the top ten IVI that were successfully analyzed showed that the highest IVI was mango and followed by longan, sapodilla, starfruit, sugar apple, guava, soursop, jackfruit, duwet and orange. Mango has an IVI value of 70.26 and longan of 40.24. Both of these species dominate the entire area studied, meaning that this species grows evenly in the area of degraded land.

**Table 4.** Top Ten Important Index Values Species of fruit trees in critical land in Jombang Regency

| Species                  | Local name | Family       | Density (ind/ha) | Frekuense (%) | IVI   |
|--------------------------|------------|--------------|------------------|---------------|-------|
| Mangifera indica         | Mango      | Anacardiace  | 139              | 21.83         | 70.26 |
| Dimocarpus longan        | Longan     | Sapindaceae  | 153              | 24.02         | 40.24 |
| Pouteria sapota (Jacq.) H. E. More&Steam | Sapodilla | Sapotaceae   | 42               | 6.55          | 25.75 |
| Averrhoa bilimbi L.      | Starfruit  | Oxalidaceae  | 33               | 5.24          | 23.47 |
| Annona squamosa          | Sugar apple| Annonaceae   | 42               | 6.55          | 18.70 |
| Psidium guajava          | guava      | Myrtaceae    | 42               | 6.55          | 18.45 |
| Annona muricata          | Soursop    | Annonaceae   | 31               | 4.80          | 12.69 |
| Artocarpus heterophyllus | Jackfruit  | Moraceae     | 19               | 3.06          | 9.90  |
| Syzygium cumini          | Duwet      | Myrtaceae    | 14               | 2.18          | 9.60  |
| Citrus reticulata        | Orange     | Rutaceae     | 17               | 2.62          | 7.65  |
The results of the analysis of the important value index at the district level in the top ten ranks found mango, longan, sapodilla, starfruit, srikaya, guava, soursop, jackfruit, duwet and finally orange. This means that ten types of fruit trees that grow and are cultivated by people on degraded land are dominated by these fruit tree species. Based on the dominating family are Anacardiaceae, Sapindaceae, Sapotaceae, Oxalidaceae, Annonaceae, Myrtaceae, Moraceae, and Rutaceae.

**Table 5. Two of the Important Value Index (IVI) which indicates the dominant species of fruit trees on their respective villages in four districts of critical land in Jombang**

| Subdistrict | Village     | Species     | RDi  | RFi  | RCi  | INP  |
|-------------|-------------|-------------|------|------|------|------|
| Plandaan    | Bangsri     | Longan      | 46.67| 30.00| 15.35| 92.02|
|             |             | Mango       | 20.00| 20.00| 29.39| 69.39|
|             |             | Longan      | 38.10| 20.00| 9.67 | 67.76|
|             | Semandeng   | Soursop     | 14.29| 20.00| 11.55| 45.84|
|             |             | Longan      | 33.33| 21.48| 23.59| 78.41|
|             | Bunder      | Mango       | 16.67| 21.41| 14.64| 52.72|
| Kabuh       | Mangunan    | Longan      | 40.00| 33.33| 75.46| 148.79|
|             |             | Mango       | 45.00| 33.33| 3.27 | 81.60|
|             |             | Sugar apple | 22.22| 24.97| 53.70| 100.89|
|             |             | Mango       | 44.44| 37.57| 5.39 | 87.40|
|             | Karangpakis | Avocado     | 27.78| 21.41| 29.73| 78.92|
|             |             | Longan      | 27.78| 21.48| 2.00 | 51.26|
| Ploso       | Pager Tanjung| Mango      | 23.33| 17.64| 52.47| 93.44|
|             |             | Longan      | 30.00| 17.64| 8.47 | 56.11|
|             | Kebon Agung | Mango       | 20.69| 13.64| 42.35| 76.68|
|             |             | Water apple | 17.24| 13.64| 6.58 | 37.46|
|             | Jati Banjar | Mango       | 34.62| 20.00| 65.95| 120.56|
|             |             | Longan      | 23.08| 20.00| 5.55 | 48.63|
| Kudu        | Sidokaton   | Sapodilla   | 28.00| 20.00| 49.00| 97.00|
|             |             | Mango       | 28.00| 20.00| 25.03| 73.03|
|             | Randuwatang | Bark        | 27.78| 25.00| 18.22| 71.00|
|             |             | Sapodilla   | 22.22| 16.67| 30.27| 69.16%|

Note: RDi = Relative density (%), RFi = Relative frequency (%) RCi = Relative cover (%), INP = RDi + RFi + RCi

When viewed from each village analyzed shows that the Plandaan sub-district was found to be dominated by species of longan, mango and soursop fruit trees. In Kabuh sub-district, the dominant species of longan, mango, sugar apple, and avocado trees are found. In the district of Ploso there are dominant species of mango, longan, and water guava. Kudu District found the dominant species of sapodilla, thorny palm, and mango as shown in table 5.

5. Discussion

The structure of tree communities in degraded lands is dominated by the Sapindaceae and Anacardiaceae tribes so that the land area has species characteristics that are able to grow on degraded land because species are one of the main analytic characteristics of plant communities [15]. Critical land in Jombang has 21 species that form plant communities that play a role in land conservation. Critical soils overgrown with fruit tree plants can form communities and play an important role in soil conservation, where the formation of plant communities is a collection of plant species that grow
together in certain locations with definite associations with each other [16]. More and more species of fruit plants are found in degraded land which indicates that there are successful conservation activities. The growth of fruit trees in degraded land at the study site showed that the abundance of species was most abundant in the Sapindaceae and Anacardiaceae families, with tree densities of 153 and 139 individuals per hectare. Geographically Sapindaceae and Anacardiace and several other species are spread evenly throughout Indonesia and tend to be better able to adapt to the environment. Some tribes such as Myrtaceae, Lauraceae, Anacardiaceae, Annonaceae, and Sapindaceae have an even distribution in Indonesia [17].

As an indicator to see the condition of the tree community is to observe the richness of fruit tree species. The results of the analysis of species richness index found variations in species richness, but from all locations analyzed gave a value of species richness that was not significantly different. This shows that species richness as an indicator of biodiversity of fruit tree species in degraded lands is low. In line with Peet's opinion that species are simple and easily interpreted indicators of biodiversity [18]. Knowledge of species composition and diversity of tree species is essential not only for understanding the structure of forest communities but also for planning and implementing community conservation strategies [15] [19]. An understanding of soil structure is a prerequisite to describe various ecological processes and also to model land functions and dynamics.

An addition, a very important growth indicator in seeing conservation success is the large value index value is important to see the dominance of tree species that grow on degraded land because this indicator determines tree architecture that is in direct contact with environmental conditions. Plant conditions generally vary based on environmental conditions [20]. Information about plant characteristics in the form of stand height, biomass, and productivity is important to know, especially on the growth of fruit trees. Growth of plant stands results in changes in plant organs both in size and biomass so that it impacts on changes in crop productivity [21].

Assessment of the composition and structure of marginal land communities is very helpful in understanding the status of tree populations, regeneration, and diversity for conservation purposes [22] because the nature of fruit tree communities on degraded land is highly dependent on the ecological characteristics of the location, species diversity, and regeneration status of tree species. Quantitative information about the composition, distribution, and abundance of fruit tree species is an important key for understanding the shape and structure of soil communities and also for planning and implementing community conservation strategies. Tree species richness and diversity are fundamental to soil biodiversity because trees provide resources and habitat for almost all other plant species [15]. In the case of marginal land ecosystems, trees are responsible for the overall physical structure of habitats, and hence, they fundamentally define the structural complexity and heterogeneity of the environment [19].

6. Conclusion
The results of the analysis of the growth rates of the best tree species were found in Plosos Sub-District which had the highest growth rates for trees, poles, and saplings. Based on the analysis of the species diversity index shows that both the village and sub district levels on degraded land provide a range of Shannon-Wiener index values between 1 and 3 which means that this area has an abundance of moderate species. The observed species richness did not show any significant difference in value from each of the areas studied. When viewed from the Simpson index value greater than 0.5 which means that fruit tree species tend not to have diversity. The most abundance of species is in the family Sapindaceae and Anacardiaceae, with a density of 153 trees and 139 individuals per hectare. Fruit tree species that predominate in all research locations on degraded land are mangoes and longan with important values of 70.26 and 40.24.

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