



## Estimation of diversity and potential utilization of agroforestry plants in Batara Village, Timor-Leste

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**Abstract.** *In the context of conservation, the government of Timor-Leste and its partners work together to implement an agroforestry program to address the problem of forest loss which continues to be graded every year. This study aimed to estimate the level of plant species diversity and the potential utilizations of agroforestry for the local community in Batara Village, Timor-Leste. Data collection was carried out on agroforestry land owned by farmers in Batara Village from December 2021 to January 2022. The method used was plot establishment (total of 8 plots or agroforestry land) with sizes of 10 m x 10 m for seedlings, 40 m x 40 m for a sapling, 60 m x 60 m for pole, and 113,14 m x 113,14 m for a tree. Data on potential utilization were interviewed with 39 respondents consisting of one chief of the village, two chiefs of sub-village, one traditional shop, and 35 people from the agroforestry community of Batara Village. The diversity of plant species resulted in 42 species and 25 families, specifically 33 species of seedlings and understorey, 19 species of saplings, 17 species of poles, and 15 species of trees. Agroforestry can contribute in economic aspect (56,28%), ecological aspect (32,95%), social aspect (24,18%), and cultural aspect (6,51%).*

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## INTRODUCTION

Forest threats in Timor-Leste are so significant, hence the government and its partners are implementing an agroforestry program to address the problems that cause forest loss. Timor-Leste's forest area is 61% of its total land area (925.000 ha), but 0,5% of Timor-Leste's forest is degraded every year (Paudel *et al.* 2022). Factors contributing to Timor-Leste's forest degradation are forest fire, land shifting, commercialization of firewood, deforestation, and illegal logging of important/certain species (RDTL 2013).

The agroforestry program is implemented to rehabilitate natural forests that have been degraded due to land-use change by communities living around the forest. Changes in forest land use cause environmental degradation, especially problems related to the hydrological function of the area or basin (Widianto *et al.* 2003). According to Paudel *et al.* (2022), agroforestry aims to establish and improve the management of natural resources, including forests, land, and water, to provide sustainable ecosystem services for local communities. Foresta *et al.* (2000) explain that agroforestry combines forestry science, agronomy, and forestry business with rural development to create harmony between agricultural intensification and forest conservation. Agroforestry

systems integrate trees, crops, and animals to increase soil fertility, minimize erosion, improve water quality, promote biodiversity, and absorb carbon (Pokharel *et al.* 2022).

It is the optimal and sustainable use of land by integrating forestry and agricultural activities in the same land management by considering communities' physical involvement, and socio-economic and cultural conditions (Hardiyanti 2021). Agroforestry can improve the welfare of the people, especially farmers around the forest, by prioritizing the active participation of the community in repairing the damaged environment and continuing to maintain it (Irwanto 2008). This system is not only a source of timber and forest products that provide economic benefits but also a habitat for fauna and flora, as well as environmental benefits (Widianto *et al.* 2003). It can also increase profits by increasing crop diversity, increasing agricultural productivity, preventing land degradation and soil erosion, as well as reducing the risk of crop failure and the need for fertilizers (Paudel *et al.* 2022). It plays an important role in environmental services, including maintaining forest functions in supporting watersheds (DAS), reducing greenhouse gas concentrations in the atmosphere, and maintaining biodiversity (Widianto *et al.* 2003).

Agroforestry project interventions are carried out to rehabilitate forest ecosystems by considering community needs to achieve plant rehabilitation goals. So far, many agroforestry practices have been implemented in various places in Timor-Leste, but not yet on a large scale, especially in Batara Village. Problems that arise as a result of land-use change. This study aimed to estimate the level of plant species diversity and the potential utilizations of agroforestry for the local community in Batara Village, Timor-Leste.

## METHOD

### Location and Period

Data collection was carried out in Batara Village, Laklubur Sub-District, Manatuto Regency, Timor-Leste. This study was conducted from December to January 2022.

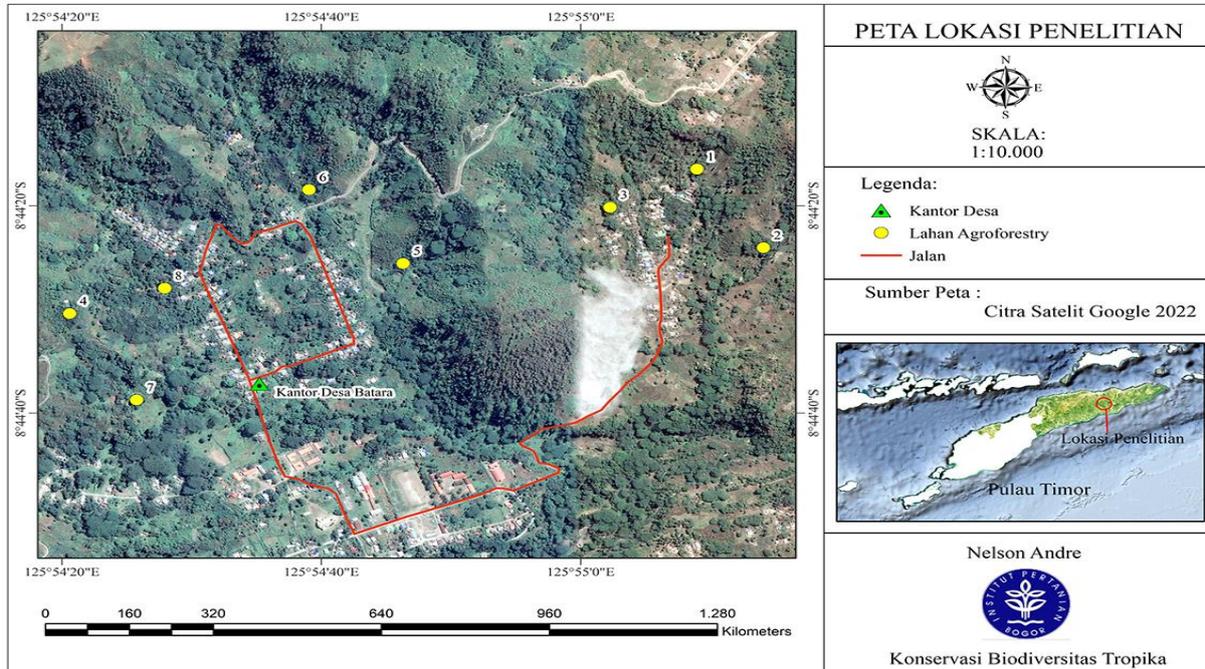
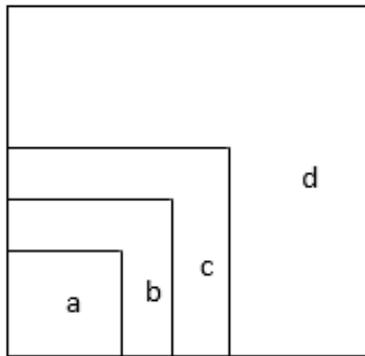


Figure 1 Study location

### Data Collection

Data on potential utilization were interviewed with 39 respondents consisting of one chief of the village, two chiefs of sub-village, one traditional shop, and 35 people from the agroforestry community of Batara village. Vegetation data were obtained through a vegetation inventory using the single plot method with the

suggested subplots and the census method. With this method, samples were established from a single large plot and the sub-plots (Figure 2). This method can be used if the terrain, soil pH, and soil moisture content of the plant flora in the study area are all quite similar (Kusuma 2007; Nahlunnisa *et al.* 2016). However, with the varying sizes of agroforestry farmers' lands, they can be divided into three groups, namely group I agroforestry land with a size of 25 m x 25 m (3 agroforestry land), group II agroforestry land with a size of 50 m x 50 m (3 agroforestry land) while group III uses a single plot that is 113,14 m x 113,14 m (2 agroforestry land/plots). The single plot layout and its size are shown in Figure 2.



Description:

- a. Seedlings (10 m x 10 m) =  $h \leq 1,5$  m
- b. Saplings (40 m x 40 m) =  $h > 1,5$  m and  $d < 10$  cm
- c. Poles (60 m x 60 m) =  $d: 10 - < 20$  cm
- d. Trees (113,14 m x 113,14 m) =  $d \geq 20$  cm

Notes:

- h= high
- d= diameter

Figure 2 Single-plot method layout

Data collected at seedling and saplings level was the name of the species and the number of individuals of each. At the level of poles and trees the data measured were the name of the species, the number of individuals of each species and the diameter at breast height (130 cm above the floor).

### Data Analysis

Data from the diversity of plant species can be analyzed using the formula: Species diversity can be measured using the Margalef formula (Magguran 1988):

$$Dmg = (S - 1)/\ln(N)$$

Where:

- Dmg = Species richness index
- S = Number of species found
- N = Total number of individuals of all species

The value of species diversity is determined by using the Shannon-Wiener index formula (Magguran 1988):

$$H' = -\sum_{i=1}^s Pi \ln Pi$$

- H' = Species diversity index
- Pi = Proportion of the species in the community

The evenness of species can be measured by using Evenness formula (Odum 1993):

$$E = H'/\ln S$$

- E = Species evenness index
- H' = Shannon-Wiener diversity index
- S = number of species found

Meanwhile, the potential fulfillment of community needs is analyzed descriptively. The data were processed using SPSS and Microsoft Excel software.

## RESULTS AND DISCUSSION

### Plant Density

The tree density of a species represents the number of individuals of that species in a certain unit area. Therefore, the tree density illustrates the number of species in the study area. Tree density is associated with the development of competition for acreage, light, water, and nutrients needed by plants. The density of plants at a location or observation area can illustrate the availability and potential of plants in that location. The total density of individual plants/ha in the agroforestry land of Batara village can be seen in the Figure 3.

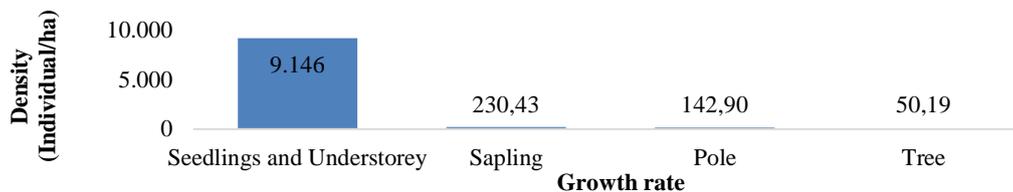


Figure 3 Average density of individual plants/ha at each growth rate

Figure 3 shows the results of the average density of individual plants/ha at each growth stage. A comparison of densities in each growth phase showed that the seedling and understorey phases had the highest density of 9.146 individuals/ha, followed by the weaning phase with 230,43 individuals/ha. The pole phase was 142,90 individuals/ha, and the smallest number was 50,19 individuals/ha on trees. This indicates that the regeneration process in plants is very good because, with a lot of regeneration at the seedling and understorey level, it can make a significant contribution to the environment and the needs of people's lives sustainably in the future. According to Dendang and Handayani (2015), An inverted J-shaped curve shows that the state of the forest is in a normal/balanced state, with population regeneration at good seedling, sapling, pole, and tree levels. On the other hand, according to Suwardi *et al.* (2013), the availability of resources in standard forest types forms a very stable inverted J curve to ensure the sustainability of resources in the future.

The people of Batara Village are very active in implementing agroforestry programs because agroforestry can contribute to income and can respond to the community's needs for food, shelter, and medicine. The high density of plants in the seedling and understorey levels gives hope to farmers because many of these plants contribute to soil improvement, especially to avoid erosion and flood hazards, water conservation, and improving the welfare of the local community. The presence of tree species in the agroforestry land of Batara village reflects the ability of dense plants to reproduce. The success of the area of each type of vegetation is caused by all physical environmental factors (temperature, light, soil structure, humidity), biological factors (inter-species interactions, competition, parasites), and the exchange of water availability as well as an optimal adaptability to chemical properties, including oxygen, pH, and nutrients in the soil (Gunawan *et al.* 2011).

The high seedlings and understorey density was also caused by fallen flowers from large trees and the planting of tree inserts by agroforestry farmers in vacant or unprotected/shaded places by other large trees. Communities tend to plant species that have direct benefits, such as the *Calliandra haematocephala*, *Casuarina equisetifolia*, *Paraserianthes falcataria*. This plant is known to fertilize the soil and provide shade for main crops such as coffee plants and animal feed (Rukmana 2014; Septiawan *et al.* 2017). Legume plants can also be used as ground cover crops used to control the soil from erosion and flooding, as well as the physical and chemical soil properties improvement.

Vegetation has a major impact on all aspects of life, including changes in forest cover. If the vegetation is at a low-density level, this causes the loss of forest waste as some of the forest vegetation is no longer there. The lack of trees will result in a lower run-off, allowing water to flow more quickly into the river channels (Yanti *et al.* 2020). Understorey also functions as a barrier to rainwater splashes that directly fall to the soil surface and penetrate the infiltration of water into the soil. The plants cultivated on agroforestry land by the

local farmers are *Calliandra haematocephala* and *Glyricidia sepium*. Those species will play an active role in resisting erosion when used as hedges.

**Diversity of Plant Species**

The diversity of plant species is vegetation that can grow in various places that provide benefits for humans, animals and environment. Vegetation can contribute to improving water and soil ecosystems. The results of the analysis of vegetation on agroforestry land in Batara Village found various types of plants, starting from the level of seedlings, saplings, poles, and trees. These results indicate that the agroforestry area of Batara Village contains 42 species from 25 families which 33 species were found at the seedling and understorey levels, 19 species at the sapling level, 17 species at the pole level, and 15 species at tree level. At the seedling and understorey levels were dominated by *Calliandra haematocephala*, the sapling level was dominated by *Casuarina equisetifolia*, the pole level was dominated by *Bambusa vulgaris* Schard, and the tree level was dominated by *Musa paradisiaca*, L. The plant diversity index in the form of the Margalef index, Shannon-Wiener, and evenness index can be presented in the Table 1.

Table 1 Level diversity indeks of seedlings and understorey

Agroforestry Land	Number of species	Number of individuals/unit	Margalef Index	Shannon-Wiener index	Evenness Index
I	9	199	1,511 <sup>lw</sup>	1,944 <sup>md</sup>	0,885 <sup>hg</sup>
II	4	130	0,616 <sup>lw</sup>	1,269 <sup>md</sup>	0,915 <sup>hg</sup>
III	12	430	1,814 <sup>lw</sup>	1,201 <sup>md</sup>	0,483 <sup>md</sup>
IV	7	272	1,070 <sup>lw</sup>	1,416 <sup>md</sup>	0,727 <sup>hg</sup>
V	8	252	1,266 <sup>lw</sup>	1,370 <sup>md</sup>	0,659 <sup>md</sup>
VI	6	103	1,079 <sup>lw</sup>	1,412 <sup>md</sup>	0,788 <sup>hg</sup>
VII	5	182	0,769 <sup>lw</sup>	1,012 <sup>md</sup>	0,629 <sup>md</sup>
VIII	20	981	2,758 <sup>md</sup>	2,635 <sup>md</sup>	0,879 <sup>hg</sup>
Total	71	2.549			

Description: lw = low, md = medium, hg = high

The results showed 33 species of seedling and understorey levels with a total of 2.549 individuals. The higher number of species richness in the agroforestry land VIII (2,758). This indicates good plant regeneration. The process of plant regeneration can provide support for improving the conditions of the natural environment around it and can meet the needs of people in the future. This data shows that differences in the area of agroforestry land affect the number or number of plant species present. Species richness in an area is influenced by two factors, the number of species and the population of all species (Sriastuti *et al.* 2018). The species abundance index (e) is influenced by the value of species diversity and the total number of species. A higher species abundance value indicates that the stand species are more evenly distributed in the area and vice versa (Toni *et al.* 2017).

The results of the research on the analysis of vegetation on the agroforestry gardens or lands owned by farmers in Batara village could be found 19 species of sapling plants on the agroforestry land with a total of 724 individuals from all existing species (Table 2). This data is due to the area of agroforestry land, so there are few types of stake levels available, and it also depends on the species chosen by the agroforestry farmer to plant. According to Haryanto *et al.* (2015) if a community consists of many species, the species diversity of the community will be high. On the other hand, if the community consists of a small number of species and only a small number of species dominate, then the species diversity is low. Differences in population and species between locations affect the diversity and evenness indices. A higher diversity index indicates an increase in the number of species found, and a higher homogeneity index shows a more even distribution of individuals within the area (Farma *et al.* 2018).

Table 2 Level diversity indeks of sapling

Agroforestry Land	Number of Species	Number of Individuals/unit	Margalef Index	Shannon Wiener index	Evenness Index
I	3	44	0,529 <sup>lw</sup>	0,953 <sup>lw</sup>	0,868 <sup>hg</sup>
II	2	5	0,621 <sup>lw</sup>	0,673 <sup>lw</sup>	0,971 <sup>hg</sup>
III	5	46	1,045 <sup>lw</sup>	0,549 <sup>lw</sup>	0,341 <sup>lw</sup>
IV	11	201	1,886 <sup>lw</sup>	1,527 <sup>md</sup>	0,637 <sup>md</sup>
V	8	87	1,567 <sup>lw</sup>	1,350 <sup>md</sup>	0,649 <sup>md</sup>
VI	4	117	0,630 <sup>lw</sup>	1,075 <sup>md</sup>	0,776 <sup>hg</sup>
VII	8	147	1,403 <sup>lw</sup>	1,549 <sup>md</sup>	0,745 <sup>hg</sup>
VIII	9	77	1,842 <sup>lw</sup>	1,911 <sup>md</sup>	0,870 <sup>hg</sup>
Total	50	724			

Description: lw = low, md = medium, hg = high

Table 3 Level diversity indeks of pole

Agroforestry Land	Number of Species	Number of Individuals/unit	Margalef Index	Shannon Wiener index	Evenness Index
I	2	23	0,319 <sup>lw</sup>	0,692 <sup>lw</sup>	0,999 <sup>hg</sup>
II	3	65	0,479 <sup>lw</sup>	0,476 <sup>lw</sup>	0,433 <sup>md</sup>
III	3	35	0,563 <sup>lw</sup>	0,347 <sup>lw</sup>	0,316 <sup>lw</sup>
IV	6	59	1,226 <sup>lw</sup>	1,470 <sup>md</sup>	0,821 <sup>hg</sup>
V	5	29	1,188 <sup>lw</sup>	1,150 <sup>md</sup>	0,715 <sup>hg</sup>
VI	5	142	0,807 <sup>lw</sup>	1,052 <sup>sd</sup>	0,654 <sup>md</sup>
VII	8	60	1,710 <sup>lw</sup>	1,793 <sup>md</sup>	0,862 <sup>hg</sup>
VIII	12	70	2,589 <sup>md</sup>	1,471 <sup>md</sup>	0,592 <sup>md</sup>
Total	44	483			

Description: lw = low, md = medium, hg = high

Table 4 Level diversity index of tree

Agroforestry Land	Number of Species	Number of Individuals/unit	Margalef Index	Shannon Wiener index	Evenness Index
I	3	5	1,243 <sup>lw</sup>	1,055 <sup>md</sup>	0,960 <sup>hg</sup>
II	3	9	0,910 <sup>lw</sup>	0,727 <sup>lw</sup>	0,661 <sup>md</sup>
III	4	11	1,251 <sup>lw</sup>	1,169 <sup>md</sup>	0,843 <sup>hg</sup>
IV	5	11	1,668 <sup>lw</sup>	1,468 <sup>md</sup>	0,912 <sup>hg</sup>
V	8	28	2,101 <sup>lw</sup>	1,787 <sup>md</sup>	0,860 <sup>hg</sup>
VI	7	27	1,820 <sup>lw</sup>	1,464 <sup>md</sup>	0,752 <sup>hg</sup>
VII	11	111	2,123 <sup>lw</sup>	1,710 <sup>md</sup>	0,713 <sup>hg</sup>
VIII	12	110	2,340 <sup>lw</sup>	1,960 <sup>md</sup>	0,789 <sup>hg</sup>
Total	53	312			

Description: low = lw, med = medium, hg = high

Based on the research results on agroforestry land owned by farmers in Batara village, 17 pole-level plants were found, with a total of 483 individuals of all species encountered (Table 3). This data is due to the land area of the agroforestry itself because the land area can determine the number and many types of plants that exist in the observation location. Wealth indexes can vary by region. The value of species richness depends on the number of plant species found in the observation gardens of different areas and habitats (Nahlunnisa *et al.*

2016). The high and low plant diversity index in a place or region depends on the number of species and the abundance of each species (Hidayat 2017).

Based on observations of vegetation analysis at the tree level on agroforestry land owned by farmers in Batara village, 15 plant species with a total of 312 individuals of all species were found (Table 4). This data is because, in addition to the moderate diversity index value in all land uses, the low diversity of tree species is caused by the low number of species in each land use because all gardens have a different number of species (Endarwati *et al.* 2017).

### **Species Richness Index**

The species abundance indicator shows the number of species in the community. Based on the results of vegetation analysis at the seedling and understorey levels, the lowest margalef index was found in agroforestry land II (0,616) and the highest margalef index in agroforestry land VIII (2,758) with a total of 33 species, the lowest sapling level was found in agroforestry land I (0,529) and the highest in agroforestry land IV (1,886) with a total of 19 species. The lowest pole level was found in agroforestry land I (0,319) and the highest was in agroforestry land VIII (2,589), with a total of 17 species. In contrast, at the tree level, the lowest was found in garden II (0,910), and the highest was found in agroforestry land VIII (2,340), with a total of 15 species in the medium category. Based on the results of the vegetation analysis above, it can be stated that all species margalef starting from the level of seedlings, saplings, poles, and trees in Batara Village is included in the criteria of low to moderate species richness or margalef.

This can occur due to the presence of certain individuals or species that are dominant in the agroforestry land, as well as the influence of the agroforestry land area owned by the farmers themselves (that happens because it depends on the types of plants chosen by the agroforestry farmers because not all species are plants they choose to grow), resulting in less species richness. The value of this species richness can be caused by the area and different habitat conditions. Therefore, the species richness value for this indicator depends on the number of plant species found in the agroforestry garden or the observation site (Nahlunnisa *et al.* 2016). The low species diversity is due to the dominance of species on agroforestry land, as indicated by the presence of conspicuous individuals between one species and another (Muhammad 2021).

Species richness in an area is influenced by two factors, namely the number of species and the population of all species (Sriastuti *et al.* 2018). Of the total 25 plant families found in the agroforestry area of Batara village, most are the Fabaceae family than any other family, with 15 species or 17,9% of the total individuals. This shows that the Fabaceae family is very much needed or important for agroforestry farmers in Batara village because the Fabaceae family has benefits as a protector for coffee plants, as animal feed, fertilizer, and also as a producer of Firewood which is used by local farmers.

### **Diversity Index**

Based on the research results and the range of the diversity index of seedlings, saplings, poles, and trees on agroforestry land in Batara Village, it showed that the results of the vegetation analysis at the lowest seedling and understorey level were found in agroforestry land VII (1,012) and the highest yield was found in agroforestry land VIII (2,635). The lowest sapling level was in agroforestry land III (0,549), and the highest was found in agroforestry land VIII (1,911) which was in the range of  $1 < H' < 3$  which is the medium category, the lowest pole level was found in agroforestry land III (0,347) while the highest value was there agroforestry land VII (1,793), the lowest tree level diversity value was found in agroforestry land II (0,727), and the highest diversity value was found in agroforestry land VIII (1,960). However, overall the lowest diversity index was found at the pole level and the highest was found at the seedling and understorey levels. This indicates that there are not so many sapling levels in the third land or garden, while the VIII land or garden shows the highest diversity index at the seedling level because one of the factors is the area of land that allows the seedling and understorey levels to grow and reproduce freely. and not shaded.

Ainiyah *et al.* (2017) stated that vegetation has many benefits for the environment, including the fact that it helps prevent lumps of soil from being easily separated and eroded by rainwater and runoff. According to Indriyanto (2006) in Haryanto *et al.* (2015), if a community consists of many species, the species diversity of the community will be high. On the other hand, if the community consists of a small number of species and only a small number of species dominate, then the species diversity is low. Biodiversity can also be used to measure community stability, the ability of a community to remain stable in the face of confusion among its components (Hidayat 2017). In this study, the results of the calculation of the diversity index (H') fall into the low to a medium category, which means that diversity needs to be given attention, maintained, and preserved so that it can have a positive impact on agroforestry farming communities, especially in terms of increasing production yields, improving the environment either directly or indirectly.

Through this agroforestry program, and if the diversity is good, then the productivity will be moderate, the ecosystem condition will be quite balanced, and the ecological pressure is also moderate. This is according to Destaranti *et al.* (2017), who states that the number of species among the total number of individuals of all existing species, if it is included in the moderate category, this category can be interpreted as the community is going to a stable condition. High diversity affects the stability of species in the ecosystem. Species that show a high degree of stability are more likely to maintain their sustainability (Ainiyah *et al.* 2017). The resulting Shannon Wiener index value is high when the number of species is large, and the number of individuals of each species is large, while the Margalef index value is high when the number of species is large. Thus, the sensitivity of plant species diversity to the Margalef index is achieved by increasing the number of species (Nahlunnisa *et al.* 2016).

### **Species Evenness Index**

The evenness index is used to find out how much stability a species has in maintaining the opportunity to preserve its species. Based on the results of the calculation of the evenness index value at the seedling and understorey, the lowest was in agroforestry land III (0,483), and the highest was found in agroforestry land II (0,915), the lowest sapling level was in agroforestry land III (0,341), and the highest was found in agroforestry land II with an evenness value of 0,971. The lowest pole level was in agroforestry land III (0,316), and the highest was found in the agroforestry land I (0,999), the lowest tree level was found in agroforestry land III (0,604), and the highest was found in agroforestry land I (0,960). However, overall, based on the results of the analysis of the evenness index value of plants in agroforestry land in Batara village, the lowest was found at the sapling and pole levels in agroforestry land III with index values of 0,341 and 0,316. According to the Odum (1993) category, it still includes  $E < 0,4$  which means the evenness index is low.

The lower the evenness value, the stability of species diversity in the community will also be lower. Vice versa, the higher the evenness value, the more stable the species diversity in the community. According Magguran (1988) states that if the evenness index is above 0,6. It indicates the distribution of individuals of each species is even or stable, but if the evenness index is below 0,6. It means that the distribution of individuals of each species is uneven or a species is dominant. If the uniformity index value is low, then there is a lack of species uniformity in the community. In other words, certain species tend to dominate because different populations are relatively different. On the other hand, the higher the homogeneity index value, the more uniform the various populations, indicating that a particular species is not dominant (Sutrisna *et al.* 2018).

### **Potential Utilizations of Plants in Agroforestry**

Biodiversity has many benefits for the earth and people, including helping to maintain a healthy environment and providing important resources. These benefits are food, medicine, clothing, and shelter (Table 5). Apart from clothing and shelter, food is one of the basic human needs. There are two types of food, animal foods and plant foods. There are plant foods derived from lower plants and higher plants, and foods derived from higher plants can be obtained from forest products in the form of fruits, leaves, and seeds (Prabaningrum

et al. 2018). The people of Batara village are very dependent on nature for these things, and the biodiversity provides many creatures that support all the needs of the community.

Table 5 Benefits of agroforestry plants in Batara village

No	Local name	Scientific name	Utilizations
1	Aas	<i>Mangifera indica</i>	Food, For Sale
2	Abokat	<i>Persea americana</i>	Food, For Sale, Animal feed, Medicine
3	Kafé	<i>Coffea sp</i>	Drink, For Sale, Firewood
4	Derok Kupang	<i>Citrus sinensis</i>	Food, For Sale
5	Dambua	<i>Citrus maxima</i> (Burm) Merr	Food, For Sale
6	Mu	<i>Musa paradisiaca</i>	Food, For Sale, Animal feed
7	Ananas	<i>Ananas comosus</i>	Food, For Sale, Juice, Animal Feed
8	Talas	<i>Colocasia esculenta</i>	Food, For Sale, Animal feed
9	Weru	<i>Casuarina equisetifolia</i>	Building, Firewood
10	Betuk	<i>Bambusa vulgaris</i> Schrad	Buildings, Firewood, seed storage
11	Airu	<i>Eucalyptus urophylla</i>	Building, Firewood
12	Ailia	<i>Zingiber of finale</i>	Cooking seasoning, medicine
13	Goiabas	<i>Psidium guajava</i>	Food, For Sale, Medicine, fodder, Firewood
14	Sukar buti	<i>Chromolaena odorata</i>	Cover crops, fertilizers, medicines
15	Mahoni	<i>Swietenia mahagoni</i>	Ground cover, Firewood, building materials
16	Hilalo Malae	<i>Paraserianthes falcataria</i>	Protector, Firewood
17	Kaliandra	<i>Calliandra haematocephala</i>	Tree cover, organic fertilizer, Firewood
18	Gamal	<i>Glyricidia sepium</i>	The flower are edible, fertilizer, and firewood
19	Ai Kameli	<i>Santalum album, L.</i>	For Sale
20	Salak	<i>Salaca edulis</i>	Food, For Sale
21	Derok Kaho Mihis	<i>Citrus reticula</i>	Food, For Sale
22	Derok Wa'i	<i>Citrus aurantium</i> Dulcis	Food, For Sale
23	Kei Loro Monu	<i>Xanthosoma sagittifolium</i> (L.) Schott	Food, For Sale
24	Kabura	<i>Phegopteris connectilis</i> (Michx) Watt	Food, For Sale
25	Kotas	<i>Canna discolor</i>	Food, For Sale
26	Hilalo Metan	<i>Albija julibressin</i> Durazz	Protector, Firewood
27	Malus	<i>Piper betle</i> L.	Sell, medicines
28	Ai Uhik	<i>Manihot esculenta</i>	Food, For Sale, Animal Feed
29	Matabida	<i>Gmelina arborea</i> Roxb	Firewood, building materials, For Sale, animal feed
30	Nespereira	<i>Eriobotrya japonica</i>	For Sale
31	Petai Cina	<i>Leucaena Leucocephala</i>	Firewood, building materials, organic fertilizer, animal feed, protector
32	Ulur	<i>Arthocarpus heterophyllus</i>	Food, For Sale, animal feed
33	Nau Etan	<i>Arenga obtusifolia</i> Mart	Food, For Sale, Material construction
34	Ramek	<i>Acalypha pancheriana</i> Baill	Firewood, animal feed
35	Kaunoek	<i>Macaranga tanarius</i> (L.) Mull.Arg	Firewood, animal feed

No	Local name	Scientific name	Utilizations
36	Kun	<i>Ficus racemosa</i> , L.	Firewood
37	Hudenuk	<i>Tilia Americana</i> L.	Firewood
38	Umirik	<i>Aleurites moluccana</i>	For Sale, Firewood, medicines

Plants as a source of food and plant diversity are living things that have the potential to fulfill the needs of other living things, such as humans and animals. Plants also have an important role in improving environmental ecosystems (Ridhwan 2012). Some potential plants or plants that exist in Batara Village are very important in meeting the daily needs of the community and can also support income. Some plants include coffee plants, oranges, avocados, taro, and pineapples. The people of Batara village use various types of plants or plants for their daily needs, both consumed and marketed. Most of the population of Timor-Leste and especially the village of Batara consume rice as a staple food even though it is obtained from the market or other places. However, there are also other staple foods consumed by the residents of Batara Village, namely corn, taro, cassava, canna, banana, and sweet potato. Batara Village is rich in local food ingredients and also fruit-producing plants. It is estimated that there are six types of plants that produce fruit, such as *Kafé* (*Coffea* sp), *Dambua* (*Citrus maxima*), *Aas* (*Mangifera indica*), *Abokat* (*Persea americana*), and sweet oranges (*Citrus aurantiifolia* (Christm) Swingle), *Ananas* (*Ananas comasus*). The types of bulbous plants, such as sweet potato, taro, canna, and cassava.

Plants as a source of clothing, in ancient times, farmers or the people of Batara Village used the leaves of the Sago Tree as a raincoat. The leaves are used as natural umbrellas, but now the sago trees are almost non-existent or extinct as a result of the conversion of forests to agricultural land and also the increasing population, the need for buildings such as traditional housing needs sago tree leaves for roofs. In the era of globalization, all people no longer use the sago palm leaves as a legal suit and umbrella. Plants as a Source of Boards, most Batara Village houses use wood, especially traditional ones. Wood is used to make doors, windows, roof mats, and poles. The types of plants used for their wood include *weru* (*Casuarina equisetifolia*), *airu* (*Eucalyptus urophylla*), *betuk* (*Bambusa vulgaris* Schrad), and other woods which are also used to make house walls. Plants as a source of medicines/health Batara Village has several species of plants, some of which are medicinal plants used directly by the local community to treat various diseases and bodily injuries. Many people still believe in and use some traditional medicines from the plant world.

According to Sada and Tanjung (2018) states that medicinal plants are plants that can be used by one or all parts of plants that contain active substances that are beneficial for health in curing various diseases. Plants that cultivated and uncultivated, can benefit farmers, one of which is medicinal plants. Medicinal plants are plants that previous people have long used as healers of health problems faced by the community (Susanti *et al.* 2018). The people of Batara Village have long recognized and utilized various kinds of natural resources around them. Based on the results of interviews conducted with 39 respondents of the farming community of Batara village to see the contribution of agroforestry (Figure 4).

From the economic, ecological, social, and cultural aspects, from an economic point of view, 56,28% of respondents stated that the existence of an agroforestry program could increase family income. From an ecological perspective, 32,95% of the respondents stated that the agroforestry program could create stable environmental conditions in the sense of reducing the level of erosion, and flooding, can deviate water, and maintaining soil fertility. In contrast, from a social perspective, 24,18% of respondents said that the agroforestry program could encourage farming communities to cooperate. Work together and help each other manage and pay attention to natural conditions while maintaining the environment to impact community survival in the future positively. From a cultural perspective, 6,51% of the community thinks that agroforestry can provide benefits to Batara Village culture.

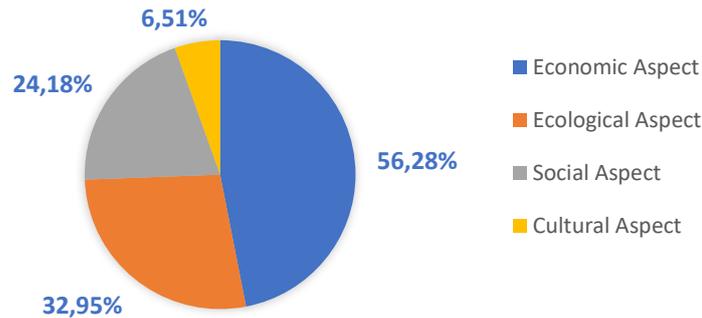


Figure 4 Respondents' perceptions of agroforestry's potential benefits are seen from the economic, ecological, social, and cultural aspects

## CONCLUSION

The diversity of plant species resulted in 42 species and 25 families, specifically 33 species of seedlings and understorey, 19 species of saplings, 17 species of poles, and 15 species of trees. At the seedling and understorey levels were dominated by *Calliandra haematocephala*, the sapling level was dominated by *Casuarina equisetifolia*, the pole level was dominated by *Casuarina equisetifolia*, and the tree level was dominated by *Paraserianthes falcataria*. The results of the plant inventory on agroforestry land in Batara Village showed that the highest species richness index and the diversity index were at the level of seedling and understorey ( $Dmg = 2,758$  dan  $H' = 2,635$ ), while the highest evenness index was at the level of the pole ( $E = 0,999$ ). Agroforestry can contribute in economic aspect (56,28%), ecological aspect (32,95%), social aspect (24,18%), and cultural aspect (6,51%). Agroforestry products is utilized by Batara village community for daily consumption purposes and some are sold in the local market.

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