Diversity of yard plants in the buffer zone of the Cyclop Nature Reserve, Jayapura City, Papua Province, Indonesia

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Abstract. The Cyclop Mountains are located on the island of Papua, Indonesia which has a high biodiversity conservation status. Cyclop has many springs and is very important for the service needs for people in Jayapura City and Regency. The high disturbance in conservation areas is a problem for the community at this time. This study aims to analyze the diversity of garden plant species and their benefits around community settlements in buffer zones. The results showed that sweet potatoes and cassava were very dominantly planted around the yard of the house. Cassava and sweet potatoes are used as food besides being consumed by them but also used as animal feed.
Key Words: functional diversity, type of yard size, food sources, disturbance in conservation areas, sweet potato, cassava.

Introduction. Cyclop Mountains Nature Reserve facing management, land, ecosystem and hydrological problems. The main issue is the intense pressure due to demographic growth on conservation areas, and the impact on watersheds marked by widespread critical land and reduced availability of clean water. Residents who live in buffer zones undertake massive shifting cultivation activities. They grow agricultural crops for human consumption and the rest is used as livestock feed; this kind of management is practiced because raising livestock can have quite a high economic impact in that context. On a small scale the forest and land are used for yard by planting various kinds of plants that have a certain benefit value. The yard meant here is an open land that is located around the house of residence but also lands that are managed by generations of people who are inherited based on lineage and are recognized in local culture institutions. Yard contains a land ownership perspective and is closely related to the distribution of plants that have economic benefits that are intentionally planted and developed by local communities (Antoh et al 2019). The diversity of plants and their potential are used so far by traditional communities with local wisdom. Agricultural production undertaken in Papua is still traditional. They are looking for just one day's needs. Camoeron et al (2012) stated that the development of domestic agriculture now needs to be developed towards the development of green infrastructure. There is still a lot of community yard management in Papua with ethnic and cultural diversity that has not been studied in depth, including plants cultivated on plots by the local community.

The facts show that even though our country is more dominated by the sea area, however most Indonesian people depend on agriculture. Agricultural activities as part of community contributions to food have not been able to answer the problem of food as a whole and there even is still a lack of food fulfillment independently in Indonesia. For this reason, the yard study is an alternative to the national food security strategy with an agricultural intensification approach. Community land is intensified with food cultivation activities that can meet community needs of carbohydrates, animal and vegetable protein sources, including the needs of vegetables and fruits (horticulture).

This research is expected to improve the function of the yard as a provider of basic needs namely food for the welfare of the local community. To improve yard

management, studies are needed regarding the development of plots for food sustainability, in order to obtain products in the yard with adequate quality and quantity of plants and livestock in terms of food security, but also for other values that can be accommodated in the development of garden plots for health, energy and sustainability. The sustainable productive yard development model provides a solution to the high use of forests and land in the Cyclops mountain range in Jayapura, Papua, Indonesia.

Material and Method. The ecological character of the yard is characterized by eleven aspects, namely: yard size and area, zoning, orientation and accessibility, land use patterns, plant elements (related to type, function, number, strata or height, cropping pattern), livestock and fish elements (related type, quantity, and origin of livestock and fish), supporting factors for soil fertility, water sources, aspects of utilization, management aspects related to intensity, labor, time and cost (Arifin et al 2001).

Measurement of yard area. Area of yard is measured from yard length (m) multiplied by yard width (m). Measurement of yard area is one indicator followed in this study. Yard measurements are based on yard plans.

Observation and quantification of yard plants amount and types. The composition of types and functions of front yard, side yard and backyard plants were observed and recorded, and plants identification was performed that can be widely used based on local names and scientific names. Next the classification was made based on the functions and uses of these plants, both directly and in the form of ecosystem services. Measurement of the composition and diversity of garden plants was performed with yard plant vegetation analysis by calculating the index of importance (INP), but previously the density, frequency and dominance of yard plants was calculated.

Vegetation analysis. Yard products analyzed included plants found in the yards by screening all villages in the city of Jayapura. The plants analyzed were limited to plants that have a function as starch-producing food plants, vegetable plants, fruit plants, medicinal plants, herbs, and plants for other uses. Analysis of plant diversity was analyzed by the Shannon-Wiener method (Alavalpati & Mercer 2010). To find out the type of yard plants with dominant consequences in the yard, it is necessary to calculate the value of the summed dominance ratio (SDR). Calculation of SDR values results in the existing condition of yard plants.

Data was collected through survey methods including observation, documentation, and direct measurements in the field.

Agricultural biodiversity in the yard (Fachrul 2007):

$$\text{a. Density} = \frac{\text{Total plants}}{\text{Total sample units}}$$

$$\text{Relative Density (\%)} = \frac{\text{Total of individuals of a species}}{\text{Total of individuals of all species}} \times 100$$

$$\text{b. Frequency} = \frac{\text{Total “sampling units” belong to one type}}{\text{Total sample units}}$$

$$\text{Relative Frequency (\%)} = \frac{\text{Frequency of total types}}{\text{Total frequency value of all types}} \times 100$$

$$\text{c. Domination} = \frac{\text{Basal number of one area}}{\text{Basal number of the entire area}}$$

$$\text{Relative Domination (\%)} = \frac{\text{Total of basal area of a type}}{\text{Total of closing value of all type}} \times 100$$

$$INP = FR + KR + DR$$

Where:

INP: important value index (Fachrul 2007)

FR: The relative frequency

DR: relative dominance

KR: relative density

$SDR = \frac{INP}{3}$ x 100%

SDR: summed dominance ratio (Fachrul 2007)

$H' = \sum_{i:1}^{S} pi \ln (pi)$

Where:

H '= Index Shannon-Wiener diversity
Pi = ni / n
Ni = Number of individuals kind of i
N = Number of individuals of all specie
ln = natural logarithm (natural number)
s = The number of the present species

Shannon-Wiener diversity index (Fachrul 2007)
H '> 3 Precautionary high abundant species
H'1≤H '≤3 Precautionary being abundant

Results. Diversity of types of garden plants in the buffer zone Cyclop nature reserve can be developed. Extensive data, number of species and number of individual yards are displayed in Table 1.

Table 1

Area, number of species and number of individuals in the yard in the buffer zone of the Cyclop Nature Reserve

	Yard area (m^2)	*∑ species*	*∑ individuals*
Maximum	1,595	207	2,045
Average	519.82	14	136
Minimum	80	6	43

The maximum yard area recorded was 1,595 m^2 with a total number of 207 species and total number of the individual plants of 2,045. The average community yard area as a whole in the Cyclop buffer area was 519.82 m^2 with a number of 14 species and 136 individual plants. Whereas the minimum yard area was of 80 m^2 with a total number of 6species found and 43 individual plants. Measurements of the average yard sample to display the index value of biodiversity, species dominance and strata of plants are presented in Table 2.

Table 2

Average area, biodiversity value, SDR and highest strata of 15 yards in the buffer zone of the Cyclop Nature Reserve, Jayapura City

Location (Village)	*Area (m^2)*	*H´*	*SDR*	*Plants*	*Dominant species*	*Family*	*Stratum*
Yabansai	189.46	1.8	8.1	Kale	*Ipomoea aquatica*	*Convolvulaceae*	I
Entrop	309	1.3	7.2	Sweet potato	*Ipomoea batatas*	*Convolvulaceae*	I
Angkasa	1,061	2.1	14.5	Cassava	*Manihot esculenta*	*Euphorbiaceae*	II

SDR - summed dominance ratio.

Discussion. The average broadest yard area was found in Angkasa (1,061 m^2) where the most dominant vegetable type cultivated by the community was Cassava (strata II). The people from the Angkasa sub-district are located in a large farming area. Communities in Angkasa Kelurahan develop intensive farming systems. Research related to the agricultural system in Thailand that compares chemically and organically growth chilli plants, shows rapid growth by developing organic farming systems (Benchasri & Simla 2017). An another study showed that the majority of farmers in Bieha District, South Burkina Faso, around 43% of farm households manage agricultural crops together with livestock in their yards intensively (Guuroh et al 2014). They no longer do shifting cultivation patterns but the land management system is implemented by them using manure. Cassava is cultivated by local residents in order to fulfill their domestic needs (food), but this plant is also used for livestock (feeding pigs). In average, people keep 5-10 pigs per family. Yard biodiversity is characterized by a variety of types of food both in terms of strata and plant functions. Food plants (medicinal plants, vegetables, fruits, spices, and starch-producing) as well as livestock cultivation in the yard are still the people's preference to support the availability of daily consumption (Azra et al 2014).

Besides the cassava plants that the community cultivates in the Angkasa sub-district for food, the community also planted other plants around their yard for their daily needs. Yard has a role in the socioeconomic life of farm households. According to Ashari et al (2012) the yard is called a living granary, a living stall or a living pharmacy. It is called the granary of life because at times food needs such as rice, corn, tubers and so on are available in the yard. Communities can harvest agricultural products from around their homes and can save costs. Other studies in Bulgaria show that small-scale agriculture provides large benefits with an extensive model (Dirimanova 2018). Another interesting aspect is that the development of the yard with agroforestry techniques is able to increase the income of farmers in Jabithenan district, north west of Ethiopia (Linger 2014).

The average area of a community's yard in Entrop is 309 m^2 or referred to as a narrow yard type. The type of plant developed in this village is sweet potato. Sweet potato plants cultivated by local people are a valuable food item but they also use these tubers for animal feed (for pigs). The residents' yard is narrow because it is indeed quite a dense community. People here are still familiar with shifting cultivation agriculture. Important regulations for managing and managing resources including water resources. However, regulations concerning water resources have also been opposed by many farming communities in Germany (Peth et al 2018). They only plant ketapang plants (*Terminalia catappa* L.) with shade functions and several types of herbs and medicinal plants around their yards. Other plants for the function of fruit, vegetables and starch-production are developed by them in their gardens at a distance of 2-3 km from their residence.

Conclusions. Kale, sweet potato and cassava are the dominant plants planted in the Cyclop buffer area. In addition, the people in Angkasa kelurahan are already familiar with intensive agriculture with settlements while the people in Entrop and Yabansai, Jayapura City are still adopting shifting cultivation systems and are vulnerable to contribute to ecosystem damage in the Cyclop Nature Reserve.

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