

Diversity of Fruits in Kutai Kartanegara District, East Kalimantan Province

Rustam Baraq Noor^{1,*} Marjenah² Paulus Matius³

¹ Doctoral Program in Forestry Science, Mulawarman University, Jl. Ki Hajar Dewantara, Campus of Gn. Kelua Jl. Penajam Samarinda 75119, East Kalimantan, Indonesia

² Laboratory of Silviculture, Faculty of Forestry, Mulawarman University Campus of Gn. Kelua Jl. Penajam Samarinda 75119, East Kalimantan, Indonesia

³ Laboratory of Forest Ecology and Dendrology, Faculty of Forestry, Mulawarman University Campus of Gn. Kelua Jl. Penajam Samarinda 75119, East Kalimantan, Indonesia

*Corresponding Author: rusbnoor@gmail.com

ABSTRACT

Diversity of Fruits in Kutai Kartanegara District, East Kalimantan. The diversity of local and exotic fruits investigated in this study was located in four sub-districts: Samboja, Tenggarong Seberang, Kota Bangun/Muara Wis and Tabang, and Kutai Kartanegara District, ranging from coastal areas to mountainous areas. This study aimed to find out the diversity of fruits and their ability to make adaptations. The data were collected through a survey. It was found that there were 38 fruit plant species in the coastal areas (Samboja), 49 fruit plant species in the middle areas (Tenggarong Seberang – Kota Bangun/Muara Wis), and 46 fruit plant species in the mountainous areas (Tabang). The research findings also showed that fruits with generative propagation dominated fruit varieties planted in the yards and the gardens. In terms of the ability to adapt, among 54 species of local and exotics fruits in this survey, there were five species of local fruits which were always found, including *Artocarpus cempeden*, *Durio zibhetinus*, *Durio kutjensis*, *Lansium domesticum*, and *Nephelium lappaceum*; and five species of exotic fruits, including *Gnetum gnemon*, *Mangifera indica*, *Manilkara zapota*, and *Annona muricata*. The middle zonation is the areas of tropical fruit development.

Keywords: Adaptation, Habitat, Diversity of Species, Zonation

1. INTRODUCTION

The Kutai Kartanegara District, as one of the districts in East Kalimantan, has a great diversity of fruit plants, but only some of them can be identified to their growth positions, status, totals, and growth conditions. Fruit plants existing in Kutai Kartanegara District's forest ecosystem are diverse, consisting of local fruits (endemic) and non-local fruits (exotic) or introduced fruit plants.

The endemic plant species are the types of plants that are only found in one place or region and not found in other areas [1]. Examples of this species are lai (*Duriokutejensis*), durian species, which was first found in Kutai, and keledang (*Artocarpus lanceifolius*), which only grows in Kalimantan Island. Introduced species is the species which is developed outside its original habitat (region) because of human intervention, either intentionally or unintentionally [2], for example, matoa

(*Pometia pinnata*), which comes from Papua,[3] and breadfruit (*Artocarpus altilis*).

These local and exotic fruit plants' ability to adapt is mostly influenced by external factors such as soil, climate, and elevation [4]. Take an example of keledang fruit, mainly found in the middle and downstream areas far away from river banks. Its diversity and distribution are also determined by the tribes and culture of the community [5]. The division of fruit habitat zonation in this research consisted of coastal areas, central areas, and mountainous KutaiKartanegara District areas.

2. MATERIALS AND METHODS

2.1. Research Locations

This research was conducted from July 2015 to December 2016, in which the data were collected by using a survey technique. The research locations

included local endemic and exotic fruit farms either planted in the gardens or the community's yards living in Kutai Kartanegara District's regions. The areas were divided into three zones:

1. Coastal zonation with an elevation of 0-7 m asl, covering Samboja Sub-District (Amborawang Laut Village and Salok Api Darat Village).
2. Middle zonation with the elevation of 7 to 25 m asl, covering Tenggara Seberang Sub-district, (Loa Raya Village, and Bangun Rejo Village), Kota Bangun Sub-district (Kota Bangun 1,2,3), and MuaraWis Sub-district (Lebak Cilong Village).
3. Mountainous zonation with an elevation of 100 – 500 m asl, covering Tabang Sub District (Sidomulyo Village, Tabang Lama Village, and BillaTalang Village).

3. RESEARCH OBJECT

This research's object was the habitats of the fruit trees growing naturally and being planted from the original species of East Kalimantan Province (local endemic) and the varieties of fruits whose seeds came from outside East Kalimantan Province and cultivated in KutaiKartanegara District.

The growth of individual trees was measured by referring to the plant's phase vegetative growth, marked by the time right before the trees were flowering and the phase of generative growth, marked by the time when the trees were flowering [6]. The vegetative growth phase of the plant is generally called an immature plant (IP), and the generative growth phase of the plant is usually called a mature plant (MP) [7].

4. DATA COLLECTION

The data were collected using a selected random sampling technique based on the criteria of normal growth at two different phases, namely immature plant (IP) and mature plant (MP). The fruit plants surveyed were the types of fruit plants that had a status of least concern species (LC) acknowledged by the local community, including local endemic and exotic fruits [8]. The principles of determining the criteria are as follows:

1. Criteria 1 (always found), this criterion refers to the condition in which a total of more than 25 fruit trees was found in the research location in the form of spreading and cluster population. The survey location was the village in one sub-district.
2. Criteria 2 (entirely rarely found), this criterion refers to the condition in which fewer than 25 fruit trees were found in the research locations in the form of spreading or cluster population. The research location was the village in one sub-district.
3. Criteria 3 (rarely found), this criterion refers to the condition in which less than ten fruit trees were found in the research location both in the forms of spreading and cluster population. The survey location covered villages in one sub-district.
4. Criteria 4 (very rarely found), this criterion refers to the condition in which a total of less than five fruit trees were found in the research locations in the forms of spreading or cluster population. The research area was the village in one Sub-district.
5. Criteria 5 (not found), the fruit plants were not found when the survey was being conducted in the research locations, namely in the village in one sub-district.

The data concerning vegetative growth or immature plants (IP) and generative growth or mature plants (MP) of the sample plants were analyzed in the form of comparison tables of the three zones by using the following formula. Similarity Index (SI) and Dissimilarity Index (DI) were calculated using Sorenson's formula (1948) in Odum (1996) [9] as follows:

$$S = 2C / (A + B + C) \times 100 \%$$

where:

S = Species Similarity Index

A = The total number of species found only in the coastal zone

B = The total number of species existing only in the middle area

C = Total number of species existing in the coastal zone and the middle

Table 1. The Recapitulation of Local and Exotic Fruit Species Abundance in Kutai Kartanegara District

Zones of Location	Categories of Fruit Plants		Seasonality	
	Local	Exotic	IP	MP
Samboja	33	21	35	19
Tenggarong Seberang	33	21	35	19
Kota Bangun/MuaraWis	33	21	36	18
Tabang	31	23	36	18

5. FINDINGS AND DISCUSSION

Fruit plant abundance displayed in table 1 indicated the domination of local fruit plants in all survey locations. It is evident that endemic fruit plants could survive because of the edaphic factor, namely the compatibility between soil and climate in Kutai

Kartanegara District. This condition occurs because the endemic fruit plants live and grow in their original habitats. It is widely known that durian and lai are endemic plants of the Kalimantan forest[10].

Table 2. Rating Criteria of Fruit Plant Species Identification based on Location Zone

Locations	Criteria/ Total	Locations	Criteria/Total	Locations	Criteria/ Total	Locations	Criteria/Total
Samboja	1(10)	Tgrseb	1(7)	Ktbgn	1(15)	Tabang	1(9)
Samboja	2(10)	Tgrseb	2(14)	Ktbgn	2(19)	Tabang	2(12)
Samboja	3(9)	Tgrseb	3(14)	Ktbgn	3(8)	Tabang	3(20)
Samboja	4(9)	Tgrseb	4(12)	Ktbgn	4(7)	Tabang	4(5)
Σ	38	Σ	47	Σ	49	Σ	46

Table 2 above, which is based on the zones of fruit plants in Kutai Kartanegara District, shows that the coastal zone of Samboja had 38 species. In comparison, the central areas of TenggarongSeberang – Kota Bangun – MuaraWis and the mountainous areas of Tabang had 47 and 49 species, respectively. This indicates a decline in the number of fruit plant species, mostly local endemic fruit plants such as lahung, karantongan, asampajang, and rawa-rawa. On the other hand, exotic fruit plants such as matoa, breadfruit, orange, avocado, sapodilla, and soursop were frequently found so that exotic fruit plants in the coastal area of Samboja were reasonably abundant. This condition was also found in the community’s lands in CibunarVillage, Rancakalong Sub-district, Sumedang District, West Java, as was reported by [11].

The middle zones (Tenggarong Seberang, Kota Bangun, MuaraWis) had the highest level of diversity. There were 47 species found in Tenggarong Seberang, and 49 species were found in Kota Bangun/Muara Wis. That is why there were many fruit plants with the age of more than 50 years and with the stem circumference of >150 cm found in Lebak Cilong Village, Kecamatan Muara Wis. Even there was a fruit plant which reached a stem circumference of 8 meters with a height of 30

meters and with the age of hundreds of years. Figure 1 shows the real condition of a durian tree when this survey was being conducted.



Figure 1 A durian tree aged hundreds of years found in Lebak Cilong Village, Muara Wis Sub District, Kutai Kartanegara

The type of climate existing in the mountainous zone of the Tabang region had an impact on the season of the fruits, and it considerably contributed to the production stock of fruit commodity for the areas of Tenggarong or coastal areas such as Samarinda and Balikpapan.

Table 3. The Percentage of Species Similarity of Fruit Plants in Each Zone in KutaiKartanegara Based on Criteria 1

Zones	Coastal Area (%)	Middle Area (%)	Mountainous Area (%)
Coastal Area (%)	100.00	88.46	65.12
Middle Area (%)		100.00	90.20
Mountainous Area (%)			100.00

According to the first criteria, the percentage of species similarity of fruit plants in each habitat zone can be explained as follows. The species of fruit plants growing in the coastal area zone (Samboja) was 100% similar to that in the coastal area zone (Samboja). The species of fruit plants existing in the coastal area zone (Samboja) was 88.461%, identical to the species growing in the middle area zone (TenggarongSeberang and Kota Bangun). This indicates that there was a similarity in species existing in these two different zones, namely cempedak (*Artocarpus champaden*), durian (*Durio zibethinus*), kuwini (*Mangifera odorata*), lai (*Durio kutejensis*), and rambutan (*Nephelium lappaceum*). These fruit plants were also found in coastal and mountainous habitats (Samboja and Tabang). The fact that there was a similarity of fruit plants in the different zones according to Criteria 1 was due to the similarity of rainfalls which occurred between 2011 and 2015 with 183.35 mm/month (420.0 mm in December and 164.0 mm in October) in the coastal area (Samboja) and 181.9 mm/month in the middle area (Tenggarong

Seberang) and Kota Bangun, while the rainfall in the mountainous areas (Tabang) was 390.9 mm/month (283.6 mm in January and 48.8 mm in August and the rainfall of 637.5 mm in December and 257.0 mm in July. The differences in rainfalls in the two different zones, namely between the coastal zone of Samboja and the mountainous zone of upstream, impacted the similarity with the percentage of 65.116%. This is evident that the amount of rainfall in one region would affect the types of fruit plants living in the area. The same finding was reported by [12] in Ethiopia, that the number of plants had a positive correlation with the amount of rainfall.

The difference in habitat elevations (coastal, middle, mountainous areas) does not affect fruit production in KutaiKartanegara. This condition was proven by the research finding by [13] that the ketapang plant, which grew at the elevation of 0-90 m a.s.l., was found in Samarinda, Balikpapan, and Kutai Kartanegara did not show a significant difference in the production of ketapang fruit.

Table 4. The Percentage of Species Similarity of Fruit Plants in Each Zone in KutaiKartanegara Based on Criteria 2

Zones	Coastal Area (%)	Middle Area (%)	Mountainous Area (%)
Coastal Area (%)	100.00	89.86	83.08
Middle Area (%)		100.00	95.65
Mountainous Area (%)			100.00

Table 5. The Percentage of Species Similarity of Fruit Plants in Each Zone in KutaiKartanegara Based on Criteria 3

Zones	Coastal Area (%)	Middle Area (%)	Mountainous Area (%)
Coastal Area (%)	100.00	92.31	93.10
Middle Area (%)		100.00	89.19
Mountainous Area (%)			100.00

Table 6. The Percentage of Species Similarity of Fruit Plants in Each Zone in KutaiKartanegara Based on Criteria 4

Zones	Coastal Area (%)	Middle Area (%)	Mountainous Area (%)
Coastal Area (%)	100	93.33	92.86
Middle Area (%)		100.00	83.33
Mountainous Area (%)			100.00

The similarity of plant species in the second, third, and fourth criteria was caused by the fact that the fruit plant species were found in all paths of the research locations. Although the species was not dominant in number, it was still found in the research locations. For example, in the coastal zone of Samboja, fruit plants dominated the second criteria with a total of 8 species for exotic fruits and two species for local endemic fruits. Exotic fruit plants dominated the third criterion with seven, and fruit plants dominated local endemic fruits with two species. The fourth criterion was seven local endemic species and two exotic species. The same condition also occurred in the middle zones, including Tenggaraong, Kota Bangun/MuaraWis, and the mountainous zones of Tabang.

6. CONCLUSION

- 1 The variety of biodistribution of 54 fruit plant species in Samboja, Tenggaraong Seberang, Kota Bangun, Muara Wis, and Tabang, Kutai Kartanegara District was classified into four families, namely Anacardiaceae, Bombaceae, Moraceae, and Anonaceae. There were five local endemic fruit species that were always found in each research location, namely durian (*Durio zibethinus*), rambutan (*Nephelium lappaceum*), cempedak (*Arthocarpuschampaden*), kuwini (*Mangifera odorata*), lai (*Durio kutejensis*). In addition, five exotic fruit species were frequently found, namely belinju (*Gnetumgnemon*) mango (*Mangifera indica*), sapodilla (*Manilkara zapota*), soursop (*Annona muricata*), breadfruit (*Arthocarpus altilis*).
2. The coastal zone (Samboja) had a diversity of 38 species, slightly smaller in number compared to the middle zones (Tenggaraong Seberang-Kota Bangun-MuaraWis) with a total of 49 species or the mountainous zone (Tabang) with a total of 46 species. The level of similarity among all locations was higher than 50 %.
3. There is a possibility to establish alternative areas for the development of exotic fruits outside their original habitats, such as belinju (*Gnetum gnemon*), longan (*Dimocarpus longan*), soursop (*Annona muricata*), breadfruit (*Arthocarpus altilis*), and matoa (*Pometia pinnata*).
4. It is suggested that the rejuvenation of fruit plants should be through excellent generative propagation to live more than 50 years.
5. Middle Zones (Tenggaraong, Kota Bangun, MuaraWis) are the recommended areas for the alternative development of tropical fruits. Both local/endemic and exotic fruits

REFERENCES

- [1] Sudarmono, Endemic Land of Serpentine Plants, Biodiversitas, 8(4), 2007, pp. 330-335. (Text in Indonesia)
- [2] N.I. Vavilop, Studies of the origin of cultivated plant. (Russian) Bulletin of Applied Botany and Plant Breeding, 14, 1926, pp. 1-245.
- [3] BPTP Papua, Get to know Matoa closer, West Papua Institute for Agricultural Technology Studies.Manokwari, 2009, Accessed on March 11, 2015. (Text in Indonesia)
- [4] Zulkarnain, Basics of Horticulture, Bumi Aksara, Jakarta, 2009, p. 336. (Text in Indonesia)
- [5] P. Matius, Setiawati, F. Pambudhi, Technical Guidelines for the Construction of Fruits (Lembo) by Customary Heads, Cooperation Project between Animal Husbandry and Fisheries, West Kutai Regency with UPT Social Forestry (Center for Social Forestry) Universitas Mulawarman, Samarinda, 2014, p. 94. (Text in Indonesia)
- [6] M. Gardjito, Saifudin, Postharvest handling of tropical fruits, Penerbit Kanisius, Jakarta, . 2011, p 208. (Text in Indonesia)
- [7] M. Pardamean, Complete Guide to Management and Palm Oil Mill, Penerbit Agro Media, Jakarta, 2008, p. 226. (Text in Indonesia)
- [8] IUCN, Red List of Ecosystems, 2013. <https://www.iucn.org/theme/ecosystem-management/our-work/red-list-ecosystems>, Diakses 8-oktober 2018
- [9] E.P. Odum, Basics of Ecology, T. Samingan, Penerjemah, Gajah MadaUniversity Press, 1996, p. 697.
- [10] H. Sunarjono, Introduction of Important Fruit and Fruit Plant Types in Indonesia, Sinar Baru, Bandung, 1985, p. 96.
- [11] Y. Suryana, J. Iskandar, Study of Local Knowledge of Medicinal Plants in Yard Agroecosystems and Change Dynamics in Cibunar Village, Rancakalong District, Sumedang District, West Java, Bio Natural-Journal of Life and Physical Sciences, 15(3), 2014.
- [12] S. di Falco, M. Bezabih, M. Yesuf, Seeds for livelihood: Crop biodiversity and food production in Ethiopia (Analysis), Ecological Economics. 69, 2010, pp. 1695-1702.
- [13] Marjenah, N.P. Putri, The Effect of Elevation on Ketapang Fruit Production (*Terminalia cattapa* Linn.) as a Raw Material for Making Biodiesel, Journal of Tropical Forests, 5(3), 2017, pp. 251-255.