The importance of tropical edible fruit plants for tribal communities in East Aceh region, Indonesia

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Abstract. The study investigated the diversity and use of tropical edible fruits consumed by tribal communities in East Aceh, Indonesia. The plant materials were randomly collected from four villages in two subdistricts, while local knowledge was gathered through a survey and in-depth interviews. Data were collected by surveying 80 people, 20 from each of four study areas, simple random sampling selected for this study. A total of 32 tropical edible fruit plant species were found in the study area. The fruits are rich in macro and micro-nutrients. Besides being a source of food, they can also be used as remedies for various diseases. This plant has the potential to be used as a commercial crop to increase food shortages, tribal economy, and to regenerate degraded lands. In addition, this study could contribute to educating the younger generation on the importance of tropical edible fruit plants.

1. Introduction

More than 700 edible fruits are known to grow in the humid tropics and therefore more than 100 of them have been cultivated by local people. These species are both native and introduced. Approximately 30 tropical fruits have a high economic value and are the best fruits that are commercially marketed throughout the world. Tropical fruits play a significant role in the lives of rural communities in developing countries [1–5] as a source of nutrition [6–11], medicine [12, 13] and household income [9, 14]. In addition, tropical fruits are also major sources of traditional beverages, food recipes, oil, medicines, spices, condiment, rituals, feed, firewood, construction, and ritual materials for rural people [5, 9, 15–18].

The home garden is commonly viewed as a land-use system involving the intentional management of multipurpose trees and shrubs [19] and rich in biodiversity, including wild and cultivated plants [20, 21]. In many aspects, including the economy, ecology, and culture, this area plays an important role in rural communities [11, 22–24]. The plants in the home garden provide a source for a wide variety of food, medicinal, and ceremonial materials. Furthermore, the home garden has an ecological function to store water, prevent erosion [23, 25], protect biodiversity [26, 27], and carbon storage [27].

The rural communities in the East Aceh region contain large home gardens, planted with various vegetables, fruits, and tubers. Vegetables and tubers rich in fiber, nutrition, and bioactive components are very crucial for the sustainability of human wellbeing [12, 28]. Fruit plants, however, are rich in nutrients to ensure food quality and diversity and can also provide household incomes [2–6, 16, 29,
This study aimed to assess the contribution of the tropical edible fruit plants for tribal communities in the East Aceh Region, Indonesia.

2. Materials and methods

The study was conducted from January to April 2021 in two subdistricts namely Madat (5°06′32.7″N 97°30′54.8″E) and Peunaron (4°34′20.6″N 97°39′48.8″E). These study areas have climatic conditions generally lowland, hilly, partly swampy, and partly mangrove forests, with an altitude of 0-308 m above sea level, and the average daily temperature of the area is 29°C [31].

2.1. Data collection

A field survey was conducted in two subdistricts, namely Peunaron (Arul Pinang and Peunaron Baru village) and Madat (Madat and Paya Deumam Peut village), East Aceh District. East Aceh District is generally lowland, hilly, partly swampy, and partly mangrove forests, with an altitude of 0-308 m above sea level. A total of 80 respondents (20 individuals from each village) were randomly sampled. The interview was conducted face to face in the Indonesian language and each interview lasted between 15 and 50 minutes. The interview uses a questionnaire composed of several sections, including plant species, vernacular names, number of individuals, habits, and use.

The samples of plants were collected in the home garden along with reporting their vernacular names, the number of species, and use. The identification of plant species is carried out at the Biology Laboratory Samudra University, Aceh, Indonesia. The botanical names have been updated using The Plant List (www.theplantlist.org), and Plants of the World online (http://www.plantsoftheworldonline.org).

2.2. Data analysis

2.2.1. Frequency index. To compare the relative importance of each plant species, the frequency index was calculated. According to [32], the frequency index is a numerical expression of the percentage frequency of citation for a single plant species by informants. The following formula was used to calculate the frequency index [33]:

\[ FI = \frac{FC}{N} \times 100 \]

where FC is the number of informants who mentioned the use of the plant species, and N is the total number of informants in each area. The frequency index was high when many informants mentioned a particular plant and low when there were few reports.

2.2.2. Diversity index. Fruit plant species diversity in the study area was determined using the Shannon-Wiener index (H') calculated using the following formula [34].

\[ H' = -\sum_{i=1}^{s} (P_i) \ln (P_i) \]

where \( H' \) = Shannon-Wiener Diversity Index, \( s \) = number of species \( P_i \) = the proportion of individuals or abundance of the \( i \) species expressed as the proportion of the total abundance \( \ln \) = natural logarithm of \( P_i \).

3. Results and discussion

3.1. Floristic composition of fruit plant species

A total of 32 fruit plant species represented by 23 genera and 19 families were recorded at the four villages (Table 1). The highest number of fruit plant species is with 26 species in Arul Pinang Village, followed by 23 species in Paya Deumam Peut, and 20 species in Madat and Peunaron Baru. The number of species found in this study is greater than that found in Langsa City, Aceh [35], and North Sumatra, Indonesia [36] with as many as 30 species, 18 species in the Burie District, Ethiopia [30], 15 species in Ciputat Subdistrict, Tangerang, Indonesia [37], 13 species in Southwestern Ethiopia [38],
and 4 species in the Bulen District, Northwestern Ethiopia [39] fruit plant species growing in the home garden. However, the number of fruit plant species found in this study is smaller than those found in Tenggulun Subdistrict, Indonesia as many as 39 species [11], 57 species in Jabon Mekar Village, Bogor District, Indonesia [40], 40 species in Hintalo Wejerat District [41], and in Kerala, India, i.e. 86 species [42]. This difference in fruit plant diversity species was influenced by the scale of the home garden and local culture within the study area [9, 10, 43]. The marked link between home garden scale and abundance of species have been observed in Prasetyo in Indonesia [40], Das and Das in India [44], and Sunwar in Nepal [45].

Table 1. Species, genus, and family of fruit plant species in the study area

| Botanical name                  | Family             | Vernacular name | Plant type | Economic value | Location | Total |
|---------------------------------|--------------------|-----------------|------------|----------------|----------|-------|
| *Anacardium occidentale* L.     | Anacardiaceae      | Jambu mete      | Tree       | consumption    | AP, PD, M| 4     |
| *Ananas comosus* (L.) Merr.    | Bromeliaceae       | Nanas           | Herb       | consumption    | AP       | 3     |
| *Annona muricata* L.           | Annonaceae         | Sirsak          | Tree       | consumption    | PD       | 29    |
| *Annona squamosa* L.           | Annonaceae         | Srikaya         | Tree       | consumption    | AP, PB, PD| 3     |
| *Artocarpus heterophyllus* Lamk.| Moraceae           | Nangka          | Tree       | consumption    | AP, PB, PD, M| 5     |
| *Averrhoa bilimbi* L.          | Oxalidaceae        | Belimbing wuluh | Tree       | consumption & sell | AP, PB, PD, M| 6     |
| *Averrhoa carambola* L.        | Oxalidaceae        | Belimbing besar | Tree       | consumption    | AP, PD, M| 1     |
| *Carica papaya* L.             | Caricaceae         | Pepaya          | Herb       | consumption    | AP, PB, PD| 7     |
| *Citrus aurantifolia* (Christm.&Panzer) Swingle | Rutaceae | Jeruk Nipis     | Tree       | consumption & sell | AP, PB, PD| 2     |
| *Citrus hystrix* DC.           | Rutaceae           | Jeruk purut     | Tree       | consumption    | PB, PD   | 1     |
| *Citrus limon* (L.) Burm.f.    | Rutaceae           | Jeruk lemon     | Tree       | consumption    | AP, PB, PD, M| 3     |
| *Citrus maxima* (Burm.) Merr.  | Rutaceae           | Jeruk bali      | Tree       | consumption & sell | PD, M | 2     |
| *Cocos nucifera* L.            | Areceae            | Kelapa          | Tree       | consumption    | AP, PB, M| 1     |
| *Durio zibethinus* Murr.       | Malvaceae          | Durian          | Tree       | consumption    | AP, PB   | 4     |
| *Garcinia mangostana* L.       | Clusiaceae         | Manggis         | Tree       | consumption    | AP       | 7     |
| *Lansium domesticum* Corr.     | Meliaceae          | Duku            | Tree       | consumption    | AP       | 5     |
| *Litchi chinensis* Sonn.       | Sapindaceae        | Kelengkeng      | Tree       | consumption    | AP, PB, PD, M| 13    |
| *Mangifera foetida* Lour       | Anacardiaceae      | Mancang         | Tree       | consumption    | AP       | 16    |
| *Mangifera indica* L.          | Anacardiaceae      | Mangga          | Tree       | consumption    | AP, PB, PD, M| 4     |
| *Manilkara kauki* (L.) Dubard  | Sapotaceae         | Sawo            | Tree       | consumption    | AP, PD, M| 8     |
| *Muntingia calabura* L.        | Muntingiaceae      | Ceri            | Tree       | consumption    | AP, PB, M| 4     |
| *Musa acuminata* Colla         | Musaceae           | Pisang ayam     | Herb       | consumption    | AP, PB, PD, M| 10    |
| *Musa x paradisiaca* L.        | Musaceae           | Pisang kepok    | Herb       | consumption    | AP, PB, PD, M| 3     |
| *Nephelium lappaceum* L.       | Sapindaceae        | Rambutan        | Tree       | consumption    | PB, PD, M| 9     |
| *Passiflora edulis* Sims       | Passifloraceae     | Markisa         | Climber    | consumption    | AP, PD, M| 4     |
| *Psidium guajava* L.           | Myrtaceae          | Jambu biji      | Tree       | consumption    | AP, PB, PD| 5     |
| *Punica granatum* L.           | Lythraceae         | Delima          | Tree       | consumption    | AP, PB, PD| 4     |
| *Sandoricum koetjape* (Burm.f.) Merr. | Meliaceae | Boh Situi      | Tree       | consumption    | AP, PD, M| 7     |
| *Syzygium aqueum* (Burm.f.) Alston | Myrtaceae        | Jambu air       | Tree       | consumption    | PB, PD, M| 16    |
| *Syzygium malaccense* (L.) Merr. & L.M.Perry | Myrtaceae | Jambu bol mirah | Tree       | consumption    | AP, PB, M| 3     |
| *Syzygium samarangense* (Blume) Merr. & L.M. Perry | Myrtaceae | Jambu mirah     | Tree       | consumption    | AP, PB, PD, M| 5     |
| *Tamarindus indica* L.         | Fabaceae           | Asam            | Tree       | consumption    | PB       | 5     |

Total (ind) 199
3.2. Frequency of fruit tree species

Fruit plants grown in gardens typically differ widely depending on needs. The fruit plants which were found most frequently were 16 productive fruit plant species (Figure 1). There were 4 species of fruit plants most frequently observed in all research areas, namely *M. Indica*, *M. acuminata*, *M. paradisiaca*, *A. bilimbii*, and *A. heterophyllus*. Some fruit plant species, including the *M. Fœtida*, *L. domesticum*, and *G. Mangostana* are present only in the village of Alur Pinang. *Tamarindus indica* is only found in Peunaron Baru village, and *C. maxima* most commonly found in the village Paya Deumam Peut.

![Figure 1](image)

*Figure 1.* The frequency of each species in the study area. a. Arung Pinang village; b. Peunaron Baru village; c. Madat village; d. Paya Deumam Peut village

Based on the frequency value reported at the research site, it shows that *M. indica* has the highest quotation frequency value of 80-90% at all locations. Followed by *M. acuminata* at 70%, *M. paradisiaca* and *A. bilimbii* at 40% at the Alur Pinang village, while in Peunaron Baru *M. acuminata* and *C. Aurantifolia* at 70%, at the Madat village *M. acuminata* at 90% and *M. paradisiaca* at 70%, and in the Paya Deumam Peut village *C. maxima* at 90% and *M. paradisiaca* at 80%. *M. indica* and *M. acuminata* were the species of fruit plants most frequently recorded in the home garden. The most favorite in home gardens is fruit plants and vegetables that provide a source of food [46]. The study findings are the same as Navia et al [9] and Elfirida et al [11], as these plant species are widely grown
by rural communities in home plantations. Garden fruit plants have many advantages, including as a shade tree, ornamental plants, a source of nutrition for the family, and have a social role as they can share with the local community once harvested [8, 37].

3.3. Fruit plant species diversity
In Paya Deumam Peut, the highest diversity of fruit was in comparison with the other three locations (3.53) (Table 2). Based on the Shannon Diversity Index, plants in home gardens in all villages have H’ values between 2.37 and 3.53, respectively. It shows the index of the diversity of fruit plant species of the area was graded as medium to high [34]. However, Priyanti and Fauziah [37] reported another finding that the fruit diversity was low to medium in the home garden in Ciputat Subdistrict, Tangerang, Indonesia.

Table 2. The Shannon diversity and evenness indexes of four villages in the study area

| Village               | Richness | Shannon (H’) |
|-----------------------|----------|--------------|
| Alur Pinang           | 48       | 3.13         |
| Peunaron Baru         | 38       | 2.47         |
| Madat                 | 40       | 2.37         |
| Paya Deumam Peut      | 73       | 3.53         |

3.4. Contribution of fruit plant species to livelihood for households
Fruit plants cultivated in community gardens are typically annuals and perennials. People grow these fruit plants for their consumption in order to meet household nutritional needs, this is in line with reported in Langsa City, Indonesia [35], Tenggulun Subdistrict, Aceh Tamiang District, Indonesia [11], and Burie District, Ethiopia [30], where fruit plant species were mainly used on their own in the home gardens. Fruit plants are rich sources of nutrition for the maintenance of human health, food quality, and food diversity [3, 5, 8, 13, 16]. Many rural communities have reported income from the traditional market sale of various fruits [9–11, 14]. These fruits in addition to being used as food, fruit plant species are also used as medicine (9 species), spices and condiment (5 species), firewood (5 species), fodder (3 species), and the household item (3 species) (Table 3).

Table 3. Other uses of the fruit plant species in the study area

| Use                | Species                                                                 |
|--------------------|-------------------------------------------------------------------------|
| Medicine           | Ananas comosus, Annona muricata, Averrhoa bilimbi, Carica papaya,       |
|                    | Citrus aurantifolia, Citrus limon, Garcinia mangostana, Psidium guajava,|
|                    | Tamarindus indica                                                      |
| Spices and condiment| Averrhoa bilimbi, Citrus aurantifolia, Citrus hystrix, Cocos nucifera,  |
|                    | Tamarindus indica                                                     |
| Fodder             | Musa acuminata, Musa x paradisiaca, Artocarpus heterophyllus           |
| Firewood           | Artocarpus heterophyllus, Durio zibethinus, Lansium domesticum,        |
|                    | Nephelium lappaceum, Syzygium aqueum                                   |
| Household items    | Durio zibethinus, Lansium domesticum, Nephelium lappaceum              |

Traditionally, as many as 48 % of respondents used several species as medicine, for example, A. comosus as treatment of digestive problem and A. bilimbi et C. aurantifolia to treat cough. The fruit of A. comosus has potential as an antibacterial agent such as Staphylococcus aureus [47], while A. bilimbi has bioactive compounds such as saponins [48, 49] are considered to have antitussive and expectorant effects in order to efficiently treat cough [50, 51]. C. aurantifolia has essential oil content with potential as antiviral agents [52]. The community uses several species as animal feed (20 %), such as A. heterophyllus, M. paradisiaca, M. acuminata, their leaves are used as feed for goats. This is confirmed by the high content of starch and energy that the livestock can metabolize to make digestion easier [53]. Firewood is the primary energy source in the study region for 71 % of respondents. Local
communities collect firewood from the home garden for cooks. They also gathering wood for various household devices and utensils such as tables, chairs, beds, doors, or windows. *D. zibethinus* is the most commonly used multipurpose by local people compatible with Elfrida et al [11] reported in the Aceh Tamiang district.

The findings of this study show the importance of fruit plants' role in supporting household livelihoods in different ways, including food supplies, medicines, animal feed, firewood, and household goods. Due to the high production and diversity of edible cultivated species, home gardens can also make a significant contribution to the food supply, tribal economy, and to regenerate degraded lands, especially for rural communities [54]. In addition, in this report, the considerable potential for enhancing food security and providing a contribution to household income needs to be supported by proper home garden management. Furthermore, the integration of scientific management into indigenous knowledge in East Aceh District can promote rural agriculture.

4. Conclusion
A total of 32 tropical edible fruit plant species were found in the study area. The fruits are rich in macro and micro-nutrients. Besides being a source of food, they can also be used as remedies for various diseases. This plant has the potential to be used as a commercial crop to increase food shortages, tribal economy, and to regenerate degraded lands. In addition, this study could contribute to educating the younger generation on the importance of tropical edible fruit plants.

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