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Ethnobotany and conservation of indigenous edible fruit plants in South Aceh, Indonesia

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Abstract. *Suwardi AB, Navia ZI, Harmawan T, Syamsuardi, Mukhtar E. 2020. Ethnobotany and conservation of indigenous edible fruit plants in South Aceh, Indonesia. Biodiversitas 21: 1850-1860.* The traditional knowledge system is immensely important in the context of plant resource conservation, utilization, and environmental management. The objectives of this study, therefore, were to document local knowledge on the diversity, utilization and sustainable management of indigenous fruit yielding species in the South Aceh region of Indonesia. This research was based on extensive field surveys, plant collection, and interviews with the local people, and a total of 56 indigenous edible fruit species belonging to 24 families were identified. Furthermore, the recognized varieties have numerous applications and serve multiple use categories. For example, they have been adopted as food (56 species), by medicine (16 species), construction materials (14 species), furniture (13 species) and firewood (12 species). These indigenous edible fruits are mostly used in the treatment of cough, stomach ache, diarrhea, fever, and digestive problems, and the following species are commonly traded in traditional markets *Durio zibethinus, Garcinia mangostana, Mangifera indica, Mangifera foetida, Mangifera odorata, Baccaurea macrophylla,* and *Baccaurea lanceolata*. The agricultural expansion activities in South Aceh region are assumed to present significant threats to the sustainability of indigenous edible fruit species. Conservation of indigenous fruit plants can be performed through the preservation of traditional knowledge and the promotion and domestication of indigenous fruit plant species.

Keywords: Ethnobotany, indigenous edible fruit, traditional uses, South Aceh

INTRODUCTION

Sumatra Island is considered to be one of the regions with high biodiversity and endemicity (Ismaini et al. 2015). Of the five major islands in Indonesia, the tropical mountain forests of this island support plant communities of higher diversity, compared to other parts of the world (Whitten et al. 1997), supporting the third-largest number of endemic species in specific taxa (Roos et al. 2004). Furthermore, Sumatra is regarded as a hotspot of tropical fruit plant diversity, with a total of 148 recorded species (Uji 2004), which are classified into at least four genera belonging to four families of high economic value. These genera are *Mangifera* (Anacardiaceae), *Garcinia* (Clusiaceae), *Nephelium* (Sapindaceae) and *Durio* (Malvaceae) (Winarno 2000). Watson (1984) recorded nine varieties of rambutan (*Nephelium lappaceum*) in Aceh province. Rahmawati and Hayati (2013) have also identified as many as twenty varieties of banana (*Musa paradisiaca*) in Aceh Besar District, while a total of 31 durian (*Durio* sp.) species were recognized in Indonesia, with one species endemic to Sumatra (Yap et al. 1995; Navia and Chikmawati 2015). In addition, 35 species of the genus Baccaurea, which grow wild on numerous islands in Indonesia, including Sumatra, have also been identified (Gunawan et al. 2016).

These indigenous fruit species play a significant role in the daily life of people living in developing countries, due to their ability to serve as sustainable resources (Mwema et al. 2012; Mabaya et al. 2014; Khruomo and Deb 2018). These major forest products provide an alternative source of nutrition (Muok et al. 2001; Suwardi et al. 2020), including essential vitamins, minerals, and fiber required to maintain health. Furthermore, fruits also influence a wide range of agricultural systems as a source of wild food, which plays an important socio-economic role in medicine, shelter, fibers and traditional ceremonies (FAO 1999). There is also a high potential to elevate the economic situation as a source of cash income, which provides food security to the indigenous people (Deb et al. 2013). Worldwide, locals tend to store extensive knowledge related to the use of local plants as food and other specific applications (Sundriyal et al. 1998). Therefore, the adoption of a large number of wildlife species to satisfy varied needs primarily requires the prevalence of vegetation diversity in the specific region (Katewa 2003).

Rural communities in the South Aceh region have q tradition of collecting and utilizing several species of edible wild plants. Through this practice, the locals have acquired substantial traditional knowledge of edible properties and nutritional significance of local biodiversity which may be adopted in combat against food insecurity and malnutrition

(Johns et al. 1996). This wisdom has been transmitted through generations (Pilgrim et al. 2008), although, modernization, has been implicated in the reduction of knowledge as well as the use of biodiversity (Ong et al. 2012; Wiryono et al. 2017). Many earlier studies have demonstrated the inability of older generations to transfer traditional knowledge to the young (Quinlan and Quinlan 2007; Sousa et al. 2012; Saynez-Vaquest et al. 2016), leading to alienation of the younger generation from their immediate environment and the ultimate loss of information related to nature. In addition, the presence of wild edible fruit plants is also threatened by the expansion of the agricultural sector (Balemie and Kebebew 2006; Amente 2017). The objectives of this study, therefore, were to document local knowledge on the diversity, utilization and sustainable management of indigenous fruit yielding species in the South Aceh region of Indonesia.

MATERIALS AND METHODS

Study area

The topography of South Aceh District is highly varied, ranging from lowlands to hills with very steep slopes. The total land area is 4,173.82 km^2, which extends from north to west, with an altitude of about 2 to 74 km^2. This region experiences a dry season from January to July and rainy season from August to December. Rainfall ranges from 1,677 to 4,552 mm per year, which is distributed into 101-225 rainy days per year. The total population of South Aceh is 230,254 comprising of three indigenous tribes, namely Aceh (60%), Aneuk Jamee (30%) and Kluet (10%). This District has 18 sub-districts, which are divided into 260 villages. The present study was conducted in a total of six villages belonging to two sub-districts, namely Kluet Selatan and Kluet Tengah, selecting three villages from each of them. The villages are Pasi Lembang, Ujung Pandang and Rantau Binuang of Kluet Selatan and Koto, Lawe Melang, and Malaka of Kluet Tengah (Figure 1).

Data collection

The information on edible fruit species was acquired through participatory observations and semi-structured, in-depth interviews, conducted with the informants, based on the provided by Alexiades and Sheldon (1996). The study involved a total of 120 informants (20 persons from each village), selected on the basis of the intended snowball sampling method, having different background characteristics such as sex, age group, marital status and educational levels (Table 1).

The voucher specimens of all indigenous fruit plants were collected, along with the recording of their local names, parts used, habits in the field, quantity harvesting, price, and additional information on trade. Furthermore, the botanical identification was performed at the Herbarium of Andalas University, Padang, West Sumatra. The botanical names were updated as per The Plant List (*www.theplantlist.org*) and the International Plant Name Index (*www.ipni.org*).

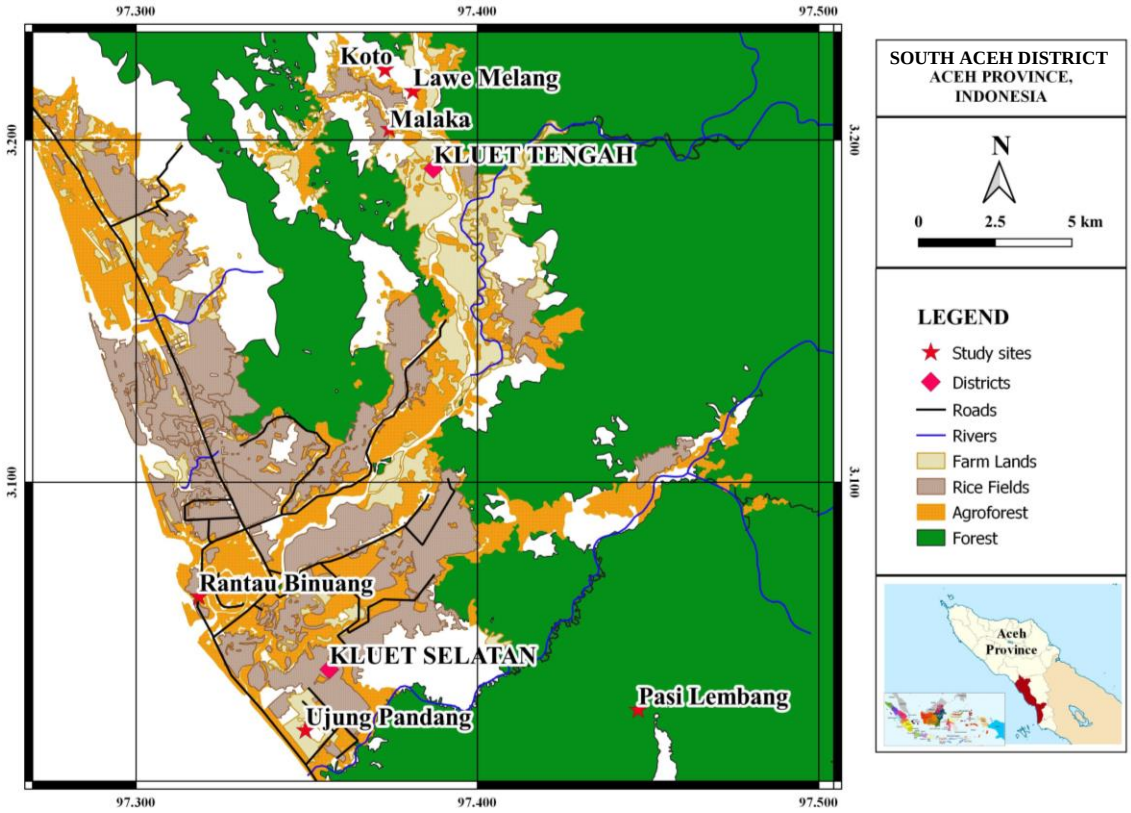

Figure 1. Map of South Aceh District, Aceh Province, Indonesia, showing the study locations

Table 1. Background characteristics of respondents

Items	Alternatives	Number (Total = 120)	Percentage
Sex	Male	52	43.3
	Female	68	56.7
Age	26-35	25	20.8
	36-45	35	29.2
	46-55	38	31.7
	>55	22	18.3
Education status	Elementary School	52	43.3
	Secondary School	39	32.5
	High School	18	15.0
	University	11	9.2
Marital status	Single	28	23.3
	Married	80	66.7
	Widowed	12	10.0

Data analysis

Two quantitative parameters, namely informant consensus factor (ICF) and relative frequency of citation (RCF) were used to analyze the qualitative ethnobotanical information collected from informants, as shown below:

Informant consensus factor (ICF)

An informant consensus factor (ICF) is used to assess the homogeneity of local knowledge, which is calculated using the formula of Cornara et al. (2014) as follows:

$$ICF = \frac{[Nur - Ns]}{[Nur - 1]}$$

Where; Nur is the number of reports of usefulness for each category, and Ns is the number of species used by all informants for certain categories.

ICF values range from 0 to 1. A high ICF value (close to 1) indicates that relatively few plant species are used by a large proportion of the informants while a low value indicates the disagreement of the informants on the use of plant species in the different categories.

Relative frequency of citation (RFC)

Relative frequency of citation (RFC) is a quantitative index that provides the local importance of the investigated species, which is calculated using the following the formula described by Tardiõ et al (2008):

$$RFC = \frac{FC}{N}$$

Where; *FC* is the frequency of citation and *N* is the total number of respondents who participated in interviews. The RFC value ranges from 0 (where none of the informants mentions the plant as being useful) to 1 (where each informant reports the plant as being useful).

RESULTS AND DISCUSSION

Diversity of indigenous edible fruit plants and their uses

The results show that the flora of the study area is rich in useful species, which includes a total of 56 indigenous fruit plant species, classified in 34 genera and 24 families. The average number of species identified by each age group of the respondent ranged from 10.5 ± 2.11 (26-35 years) to 32.22 ± 4.01 (> 55 years). Respondents of age group 36-45 years identified 20.3 ± 2.26 species, while of 45-55 years identified 25.7 ± 3.16 species. Besides indicating a really large variation between age categories, this also reflects a direct relation between the age of respondents and the number of species known. Some plants were recognized by respondents, of all ages, and such widely known species include langsat (*Lansium parasiticum*), rambai (*Baccaurea motleyana*), durian (*Durio zibethinus*), rambutan (*Nephelium lappaceum*), and sirsak (*Annona muricata*). On the contrary, some other species were familiar to less than 20% of the respondents. berangan bukit (*Castanopsis costata*), tampoi (*Baccaurea pyriformis*), durian burung (*Durio acutifolius*), Pala hutan (*Myristica elliptica*), beri hutan (*Rubus buergeri*), (*Elaeocarpus beccarii*), simpur (*Dillenia indica*), balek angin (*Mallotus philippensis*), kedondong (*Spondias dulcis*), kuranji hutan (*Dialium platysepalum*), and jentik (*Baccaurea polyneura*) are some examples for such less known species. This study supports the earlier finding that knowledge of the use of local plants is dependent on the participants' age (Begossi et al. 2002).

In addition to edible purposes, the fruit yielding plants were also used for various other purposes like medicinal, firewood, construction, furniture making, and fodder. The number of species used for each of these purposes with the corresponding ICF values is shown in Table 2.

The highest informant consensus values were obtained for food and firewood (ICF = 0.99), followed by medicinal plants, construction material, and furniture (ICF = 0.98) while it was least for the plants used for fodder (ICF = 0.97). The highest ICF value of food reveals that indigenous fruit plants play an important role in the sustenance of the people of the region. The various fruit plants provide essential vitamins and minerals for a healthy life. In addition, indigenous fruit trees also provide economic benefits for people in the South Aceh region. The use of reported plants during this investigation is similar to previous studies where plants are used mainly as food (Li et al. 2015; Aryal et al. 2018; Rana et al. 2019). Miranda et al. (2011) and Poderoso et al. (2012) identified the primary relationship between the performance of a plant resource and a specific food resource. A higher number of plants used by local people for firewood indicate their dependence on available plant resources for energy. Most rural communities in the South Aceh region are still using wood for cooking purposes. This is consistent with the report by Dwiprabowo (2010) and Munawaroh et al. (2011) that firewood is widely used as an energy source by households and domestic food industries in rural areas.

Table 2. Use-wise number of species and their Informant consensus factor (ICF)

Category of use	Cited plants	Citations	ICF
Food	54	4,896	0.99
Medicinal	16	639	0.98
Firewood	12	1,376	0.99
Construction material	14	630	0.98
Furniture	13	546	0.98
Fodder	8	224	0.97

Plants used as food

Many species of the indigenous edible fruit plants used by the local people of South Aceh region are easily recognized in the surroundings, including Mango (*M. indica*), Mangosteen (*G. mangostana*), Guava (*P. guajava*), Soursop (*A. muricata*) and Rose apple (*S. aqueum*). Furthermore, numerous wild species are less preferred by the community, due to the conservation of acidic characteristics, spicy tastes, and also the presentation is relatively small sizes, although some are also highly favored, including kepong (*B. lanceolata*), bacang (*M. foetida*) and durian daun (*D. oxleyanus*).

Based on RFC values, indigenous fruit plants are commonly found as cultivated plants to have the highest RFC values (RFC = 1,00). A total of eighteen (18) species, namely *A. occidentale, A. muricata, A. integer, A. bilimbi, A. carambola, B. motleyana, C. aurantifolia, C. maxima, D. longan, D. zibethinus, G. mangostana, L. parasiticum, M. foetida, M. indica, M. zapota, N. lappaceum, P. guajava*, and *S. aqueum* (1.00 or 100%) which is recognized by all respondents. As many as 16 fruit plant species are recognized only by less than 50% of respondents with an RFC value of 0.01-0.50. Plants with low RFC value, some are difficult to find in the surrounding villages, for example, *B. brevipes, B. lanceolata*, and *M. elliptica*. This study is consistent with Silalahi et al. (2018) that plants difficult to find in the surrounding area of community residences are generally not well known and have low RFC values.

Plants used as traditional medicines

Local people in the study region, particularly individuals living close to the forest areas, tend to use the fruit-producing plants as traditional medicines for the treatment of various illnesses (Table 4).

As a result of the study, 16 of the 56 species of fruit plants used by local people in the South Aceh region as traditional medicines. Plant parts used among Aceh, Kluet, and Aneuk Jamee tribes to treat various illnesses were primarily leaves (7%), fruits (2%), barks (1%), and roots (1%). The majority of tribal communities in the world use leaves for herbal medicine (Ullah et al. 2013; Yabesh et al. 2014; Prabhu et al. 2014; Vijayakumar et al. 2015). The leaves were mostly used because they are very easily collected than flowers and fruits, etc. (Giday et al. 2009). The most commonly used ethnomedicine plant remedies were coughs (5 plant species), dysentery, diarrhea, fever (4 plant species), swelling, boils and pain (4 plant species), stomach pain (2 plant species), toothache and anthelmintic (2 plant species each), and rheumatism, colds, headache, hypertension, dengue fever, bleeding gums and pimples (1 plant species each).

Local people in the South Aceh region apply more than one plant species in the management of disease from ancient times, and most tend to possess one or more ethnomedicinal purposes. In addition, traditional medicine is widely adopted in the treatment of mild ailments, including coughs, stomach ache, diarrhea, fever, and other digestive problems, which have collectively been affiliated with unhygienic conditions, unhealthy food quality, and the deprivation of clean drinking water. The locals have no proper access to timely and appropriate modern treatment for prevalent diseases, hence the steady dependence on readily accessible traditional herbal medicines. Based on some studies, a few species contain bioactive compounds with medically applicable features (Pedraza-Chaverri et al. 2008; Abbasi et al. 2013; Bunawan and Dusik 2013; Silalahi et al. 2015; Mohanty and Pradhan 2015; Murmu et al. 2016; Wiryono et al. 2017; Handayani 2018; Suwardi et al. 2018; Sanjayrao and Sanjay 2019; Suwardi et al. 2019b). These preparations are generally produced in the form of infusions, stews, paste, juices, and dry powders, on the basis of dosages that are not standardized (Hazarika et al. 2012). Therefore, it is necessary to establish the safety, effectiveness, and preservation of these highly valuable indigenous edible fruits, and also critically study the claimed therapeutic values of reported species.

A total of 56 species of fruit plants are used as food by the local communities of the study area (Table 3).

Trade of indigenous fruit plant products

Rural communities in South Aceh are collecting indigenous fruit plants for sale in the traditional market, or some of them have been sold along the roadsides around the villages. The fruit was mostly harvested from the remaining forest patches, home gardens, and crop fields. Species, trade part, average quantity and market price of indigenous fruit plants were sold by rural communities in South Aceh is shown in Table 5.

During our survey at the traditional market in some sub-districts around the study site, we noticed mangoes (*M. indica*), durian (*D. zibethinus*), kuwini (*M. odorata*), longan (*D. longan*), pummelo (*C. maxima*), guava (*P. guajava*), and bilimbi (*A. carambola*) for sale, but according to traders, wild fruit like tampoi (*B. brevipes*), tampoi (*B.* lanceolata), jentik (*B. polyneura*), and rukam (*F. rukam*) were occasionally marketed. These wild varieties possess a similar aroma, flavor, and taste with cultivated fruits (Suwardi et al. 2019a). Most indigenous fruit plants play a significant role in enhancing the health and ensuring food security in rural communities of South Aceh region. These are also known to serve as a feasible source of vitamins and minerals essential for maintaining good health (Saka et al. 1994) and improving the guarantee of food (Mojeremane and Tshwenyane 2004). Furthermore, the findings indicate that as many as 68% of all respondents sold the indigenous forms, which provides possible benefits and boost household income. However, of all the participants selling indigenous edible fruits, about 48% receive less than 20,000,000 Indonesian Rupiah (IDR) per year (1 USD= 14,000 IDR at the moment of this study), while approximately 36% earn between IDR 20,000,000 and 30,000,000 per year.

Tabel 3. Indigenous fruit plants used as food

Botanical Name	Family	Common name	Part use	Use	RFC
Aleurites moluccana (L.) Wild	Euphorbiaceae	Candlenut, kemiri	Fruit	The nut is often cooked, while the chewed seeds are used as a substitute for soap	0.93
Anacardium occidentale L.	Anacardiaceae	Cashew nut, jambu mete	Fruit	The fruit is consumed raw	1.00
Annona muricata L.	Annonaceae	Soursop, sirsak	Fruit	The fruit is consumed raw	1.00
Annona squamosa L.	Annonaceae	Sugar apple, buah nona	Fruit	The fruit is consumed raw	0.73
Archidendron jiringa (Jack) Neil.	Leguminosae	Jengkol	Fruit, young shoots	Fresh fruit is eaten as raw vegetables or made into "rendang," while the young shoots are consumed as a vegetable	0.82
Artocarpus altilis (Parkinson) Forsberg	Moraceae	Bread fruit, sukun	Fruit, seed	Fresh and ripened fruit are taken raw, while the immature type is used as vegetables. Moreover, the seeds are eaten after boiling, baking, roasting or frying, while the immature seeded fruit is cooked as a vegetable with coconut milk	0.73
Artocarpus camansi (Parkinson) Fosberg	Moraceae	Breadnut, kluwih	Fruit	Both fresh and ripened fruits are eaten raw, while the immature forms are used as vegetables	0.85
Artocarpus integer (Thunb.) Merr.	Moraceae	Cempedak	Fruit, seed	The ripened fruit is consumed raw, while the fresh forms are used as vegetables, and the seed is eaten after boiling, baking, roasting or frying	1.00
Artocarpus elasticus Reinw. ex Blume	Moraceae	Terap	Fruit, seed	Fruits are ingested raw, while the seeds require initial roasting	0.63
Averrhoa bilimbi L.	Oxalidaceae	Bilimbi, belimbing wuluh	Fruit	The fruit is dried and used as a cooking spice	1.00
Averrhoa carambola L.	Oxalidaceae	Carambola, belimbing	Fruit	This is consumed raw	1.00
Baccaurea brevipes Hook.f.	Phyllantaceae	Tampoi hutan	Fruit	This form is taken raw	0.21
Baccaurea macrophylla (Mull. Arg) Mull. Arg	Phyllantaceae	Lang khae, tampoi	Fruit	The fruit is eaten raw	0.27
Baccaurea lanceolata (Miq.) Mull.Arg	Phyllantaceae	Tampoi, kepong	Fruit	This variety is ingested raw	0.61
Baccaurea motleyana (Müll.Arg.) Müll.Arg.	Phyllantaceae	Rambai	Fruit	The fruit is eaten raw, made into drinks, and sometimes pickled to be served with curries	1.00
Baccaurea polyneura Hook.f.	Phyllantaceae	Jentik	Fruit	This variety is consumed raw	0.18
Baccaurea pyriformis Gage	Phyllantaceae	Tampoi	Fruit	The fruit is eaten raw	0.10
Bischofia javanica Blume	Euphorbiaceae	Java cedar	Fruit	This is also ingested raw	0.54
Castanopsis costata (Blume) A.DC.	Anacardiaceae	Berangan bukit	Fruit	The nuts are edible	0.09
Citrus aurantifolia (Christm. & Panzer) Swingle	Rutaceae	Lime, jeruk sambal	Fruit	The fruit is eaten raw	1.00
Citrus maxima (Burm.) Merr	Rutaceae	Pummelo, jeruk	Fruit	The fruit is eaten raw	1.00
Dialium platysepalum Baker	Fabaceae	Kuranji hutan	Fruit	The fruit is eaten raw	0.18
Dillenia indica L.	Dilleniaceae	Simpoh, simpur	Fruit	The juicy fruit is usually used in curries, preserves, and drinks	0.13
Dimocarpus longan Lour.	Sapindaceae	Longan, lengkeng	Fruit	The fruit is eaten raw	1.00
Durio griffithii (Mast.) Bakh	Malvaceae	Durian hutan	Fruit	The fruit is eaten raw	0.10
Durio oxleyanus Griff.	Malvaceae	Durian daun	Fruit	The fruit is eaten raw	0.73
Durio zibethinus Murr.	Malvaceae	Durian	Fruit, seed	The fruit is eaten raw or made into “Dodol durian,” while the seeds are consumed after boiling, baking, roasting or frying	1.00

Elaeocarpus beccarii Aug.DC.	Elaeocarpaceae	Medang	Fruit	The fruit is eaten raw	0.11
Flacourtia rukam Zoll. & Moritzi	Flacourtiaceae	Rukam	Fruit	The fruit is eaten raw	0.73
Garcinia mangostana L.	Clusiaceae	Mangosteen, manggis	Fruit	The fruit is eaten raw	1.00
Garcinia parvifolia (Miq.) Miq.	Clusiaceae	Manggis hutan	Fruit	The fruit is eaten raw	0.71
Garcinia xanthochymus Hook.f. ex T.Anderson	Clusiaceae	Asam gelugur	Fruit	The fruit is eaten raw, cooked and also as a flavoring in other foods	0.86
Lansium parasiticum (Osbeck) K.C.Sahni & Bennet	Meliaceae	Lansat	Fruit	The fruit is eaten raw	1.00
Leea rubra Blume	Leeaceae	Red tree-vine	Fruit	The fruit is consumed to treat dysentery	0.13
Litsea cubeba (Lour.) Pers.	Lauraceae	Medang	Fruit	The fruit is consumed as a spice ingredient	0.10
Lithocarpus wallichianus (Lindl. ex Hance) Rehder	Fagaceae	Mempening	Seed	The seed is usually cooked before eating, although they are sometimes ingested raw	0.23
Mallotus philippensis (Lam.) Müll.Arg.	Euphorbiaceae	Balek angin	Seed	The seed is usually cooked before consumption	0.13
Mangifera caesia Jack.	Anacardiaceae	Binjai	Fruit	The fruit is eaten raw	0.73
Mangifera foetida Lour.	Anacardiaceae	Bacang	Fruit	The fruit is eaten raw	1.00
Mangifera indica L.	Anacardiaceae	Mango, mangga	Fruit	The fruit is eaten raw	1.00
Mangifera odorata Griff.	Anacardiaceae	Kuwini	Fruit	The fruit is eaten raw	1.00
Manilkara kauki L.	Sapotaceae	Caqui, sawo kecik	Fruit	The fruit is eaten raw	0.85
Manilkara zapota (L.) P. van Royen	Sapotaceae	Sawo	Fruit	The fruit is eaten raw	1.00
Monocarpia euneura Miq.	Annonaceae	Not know	Fruit	The fruit is eaten raw	0.45
Myristica elliptica Wall	Myristicaceae	Pala hutan	Fruit	The fruit is used as a spice	0.10
Myristica fragrans Houtt	Myristicaceae	Pala	Fruit	The fruit is used as a spice	0.57
Nephelium lappaceum L.	Sapindaceae	Rambutan	Fruit	The fruit is eaten raw	1.00
Passiflora foetida L.	Passifloraceae	Goat-scented passionflower, rambusa	Fruit	The fruit is eaten raw	0.73
Physalis minima L.	Solanaceae	Sunberry, ciplukan	Fruit	The fruit is eaten raw	0.57
Psidium guajava Blanco	Myrtaceae	Guava, jambu biji	Fruit	The fruit is eaten raw or made into a drink	1.00
Rubus buergeri Miq	Rosaceae	Beri hutan	Fruit	The fruit is eaten raw	0.10
Salacca acehensis Mogea & Zumaidar	Rosaceae	Salak	Fruit	The fruit is eaten raw	0.33
Spondias dulcis Parkinson	Anacardiaceae	Golden apple, kedondong	Fruit	The fruit is eaten raw	0.17
Syzygium aqueum (Burm. f.) Alston	Myrtaceae	Rose apple, jambu air	Fruit	The fruit is eaten raw	1.00
Syzygium densiflorum Wall. ex Wight & Arn.	Myrtaceae	Jambu hutan	Fruit	The fruit is eaten raw	0.74
Syzygium samarangense (Blume) Merr. & L.M. Perry	Myrtaceae	Java apple, jambu air	Fruit	The fruit is eaten raw	0.79

Table 4. Indigenous edible fruit plants used as traditional medicines

Botanical Name	Family	Common name	Part use	Diseases treated	RFC
Aleurites moluccana	Euphorbiaceae	Candlenut, Kemiri	Bark	Dysentery	0.19
Anacardium occidentale	Anacardiaceae	Cashew nut, Jambu mete	Leave	Toothache	0.09
Annona muricata	Annonaceae	Soursop, Sirsak	Leave	Rheumatism, coughs, and colds	0.90
			Fruit	Fever, headache, and hypertension	
Archidendron jiringa	Leguminosae	Jengkol	Leave	Toothache	0.18
Artocarpus altilis	Moraceae	Breadfruit, Sukun	Leave	Fever	0.13
Averrhoa bilimbi	Oxalidaceae	Bilimbi, Belimbing Wuluh	Leave	Fever, itches, boils, and cough	0.88
			Fruit	Pimples and cough	
Dillenia indica	Dilleniaceae	Simpoh, Simpur	Fruit	Coughs	0.13
Flacourtia rukam	Flacourtiaceae	Rukam	Fruit	Diarrhea	0.18
Leea rubra	Leeaceae	Red Tree-Vine	Leave	Wounds	0.07
			Fruit	Dysentery	
Litsea cubeba	Lauraceae	Medang	Root	Swelling and pain	0.82
			Leave	Swelling and pain	
			Fruit	Fever, coughs, and stomach-ache	
Mallotus philippensis	Euphorbiaceae	Balek angin	Leave	Diarrhea	0.09
			Fruit	Anthelmintic	
Garcinia mangostana	Clusiaceae	Mangosteen, Manggis	Bark	Diarrhea and dysentery	0.57
			Fruit	Diarrhea, dysentery and maintain digestive health	
Garcinia xanthochymus	Clusiaceae	Asam gelugur	Fruit	Fever and stomach problems	0.52
Passiflora foetida	Passifloraceae	Goat-Scented Passionflower, Rambusa	Fruit	Children’s anthelmintic	0.10
Physalis minima	Solanaceae	Sunberry, Ciplukan	Leaves	Boils	0.40
			Fruit	Bleeding gums, boils, and heartburn	
Psidium guajava	Myrtaceae	Guava, Jambu biji	Leave	Cough and diarrhea	0.58
			Fruit	Dengue fever	

Table 5. Economics value of indigenous fruit plants

Botanical name	Traded parts	Quantity (kg)	Market Price (IDR)
Aleurites moluccana	Fruit	200 ± 1.21	20,000
Annona muricata	Fruit	150 ± 0.65	3,000
Archidendron jiringa	Fruit	200 ± 1.53	5,000
Artocarpus integer	Fruit	500 ± 1.53	5,000
Averrhoa bilimbi	Fruit	200 ± 0.93	8,000
Averrhoa carambola	Fruit	100 ± 0.93	6,000
Baccaurea brevipes	Fruit	20 ± 1.06	5,000
Baccaurea macrophylla	Fruit	10 ± 0.91	5,000
Baccaurea lanceolata	Fruit	10 ± 0.18	5,000
Baccaurea motleyana	Fruit	100 ± 0.91	8,000
Baccaurea polyneura	Fruit	150 ± 1.18	12,000
Citrus aurantifolia	Fruit	150 ± 1.05	7,000
Citrus maxima	Fruit	50 ± 0.03	8,000
Dimocarpus longan	Fruit	200 ± 0.03	8,000
Durio oxleyanus	Fruit	50 ± 0.03	8,000
Durio zibethinus	Fruit	750 ± 0.13	15,000
Flacourtia rukam	Fruit	50 ± 1.20	3,000
Garcinia mangostana	Fruit	500 ± 1.06	10,000
Garcinia parvifolia	Fruit	50 ± 1.22	5,000
Garcinia xanthochymus	Fruit	500 ± 0.13	12,000
Lansium parasiticum	Fruit	500 ± 0.80	8,000
Mangifera caesia	Fruit	150 ± 1.11	8,000
Mangifera foetida	Fruit	250 ± 1.05	8,000
Mangifera indica	Fruit	350 ± 0.88	10,000
Mangifera odorata	Fruit	250 ± 0.87	8,000
Manilkara zapota	Fruit	150 ± 1.12	7,000
Myristica fragrans	Fruit	500 ± 1.08	17,000
Nephelium lappaceum	Fruit	150 ± 0.33	8,000
Psidium guajava	Fruit	250 ± 0.56	5,000
Syzygium aqueum	Fruit	350 ± 0.33	7,000
Syzygium samarangense	Fruit	250 ± 0.23	6,000

The locals also tend to use certain parts of edible fruit plants to support some daily living requirements, especially as medicine, construction materials, firewood, furniture, forages, craft, and cash offers (Motlhanka et al. 2008). Conversely, out of all species recorded, 8.6 % ad 39.3% were respectively traded for timber and firewood on the local market. Also, Mempening (*L. wallichianus*) was identified as another economically important and marketable species. Generally, the income obtained from the sale of wild plant species is particularly significant to low-income households that ought to improve food production with cash, in order to satisfy fundamental needs.

Threats of indigenous fruit plants

Indigenous edible fruit plants, especially the wild varieties are threatened in their natural habitat by various human activities, including agricultural expansion, fire, fuelwood collection, and selective harvesting (Table 6). These events have led to numerous losses.

As a result, agricultural activities and fire were ranked first and second, followed by fuelwood collecting and selective harvesting were ranked third and fourth, respectively. This study similar to the report by Balemie and Kebebew (2006) and Amente (2017), has shown that agricultural expansion is the main threat to wild plant species. This has significantly affected many species of wild fruit, leading to a decline in the tree and subsequent overgrowth of newly-grown plant parts of the woody species.

Conservation strategies of indigenous fruit plants

Indigenous fruits like *B. polyneura*, *F. rukam*, *G. bancana*, and *G. ferrea* are underutilized in the South Aceh region. These fruits may be precious are not only sources of food and nutrients to the local communities, but could moreover obtain a means of income generation. Underutilize fruit resources can be used to combat malnutrition, hunger and reduce the impact on over-exploited fruits. The use of forest food plants like fruit plants that can contribute to food self-sufficiency could be one of the ways to combat food insecurity (Belem et al. (1996). Underestimation, underutilization and high population growth leading to deforestation must lead to the loss of diversity of wild fruit species (Ohiokpehai 2003; Bagra et al. 2006). In contrast, they have been exploited from the wild without any initiative to propagate them (Ondachi 1999). Furthermore, the sustainable management of these resources for the well being of the local communities and the conservation of biodiversity is of considerable importance and could equally contribute to the preservation of genetic diversity.

Table 6. Ranking of factors threats to indigenous edible fruit plants

Factor	Average Score						Total	Rank
	Pasi Lembang	Ujung Pandang	Rantau Binuang	Koto	Lawe Melang	Malaka		
Agricultural expansion	3.6	3.7	3.2	3.3	3.0	3.8	20.6	1
Fire	2.8	2.6	2.7	2.6	2.8	2.1	15.6	2
Fuel wood collection	1.2	1.2	1.4	1.3	1.2	1.3	7.6	4
Selective harvesting	1.5	1.3	1.4	1.6	1.4	1.3	8.5	3

Traditional knowledge can be used as a means for in-situ conservation (conservation in native habitats) efforts. There are several customary rules for people in Aceh, including local communities in South Aceh region, that have existed since ancient times. Throughout the study, the older people claimed that they already have rules on forest management as agricultural land. Land clearing must always pay attention to environmental aspects hence as not to possess a negative impact on the community. Local wisdom is also reflected in the prohibition of cutting trees within a radius of 200 m from the edge of the spring and left and right of the river in the swampy region, 100 m from the river banks and 50 m from the edge of the tributary. In Acehnese customs, there are restrictions on access to the forest or prohibited days usually associated with "*religious days*". It is also prohibited to cut fruit trees when agricultural fields are opened as a food source for animals. They assume that sufficient food for animals in the forest can prevent their crop damage, particularly due to animal disturbances. This local wisdom can conserve wild plants, including indigenous fruit plants, from extinct. Traditional knowledge on the conservation of indigenous plants in the South Aceh region has been passed down from the ancestors through generations, and the results show variation in the use of wild plants from one respondent to another. Furthermore, those aged > 55 years were much more knowledgeable about species and uses than other age groups, resulting from better practical experience, especially for the wild varieties. The elders to be the custodians of knowledge and transfer it to ensure it is not lost through generations (Van der Hoeven et al. 2013).

Promoting and domesticating fruit plant species may be used for ex-situ conservation (conservation outside native habitat) efforts. Throughout this way, they can also make a significant contribution to the conservation of the environment by stopping uncontrolled harvesting from the wild and helping to conserve the various species in their native habitats where they are most effective. Promoting and domesticating wild fruit species will not only improve the nutritional status and livelihoods of local communities but will also protect them from the loss of wildlife and environmental well-being (Ohiokpehai 2003; Rathore 2009). They can integrate indigenous fruit plants with an agroforestry concept on their orchid, home garden or farmland. The integration of trees on farmland is considered to have a positive impact on the physical and chemical components of the soil, thus protecting the farm from erosion, enhancing the microclimate and also providing fuelwood, charcoal and building materials for the farmer (Fadl and Gebauer 2004). The concept of ex-situ conservation has also been applied in different regions of Indonesia, such as the conservation of Kedawung (*Parkia timoriana*) in the Meru Betiri National Park (Zuhud 2007), the management of the Kemiri forest (*Aleurites moluccana*) in Maros District (Suprayitno 2011) and the ex-situ conservation of Damar Mata Kucing (*Shorea javanica*) in the form of community forests in Lampung (Pramono 2000). This type of conservation, alongside the conservation of indigenous fruit plants, can also provide economic benefits for local people in rural areas.

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