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Short Communication: The fruit plant species diversity in the home gardens and their contribution to the livelihood of communities in rural area

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Department of Biology Education, Faculty of Teacher and Training Education, Universitas Samudra. Jl. Meurandeh, Kota Langsa 24416, Aceh, Indonesia. Tel.: +62-641-426535. ♥email: adi.bsw@gmail.com

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Abstract. *Elfrida, Mubarak A, Suwardi AB. 2020. Short Communication: The fruit plant species diversity in the home gardens and their contribution to the livelihood of rural communities in Tenggulun Sub-district, Aceh Tamiang, Indonesia. Biodiversitas 21: 3670-3675.* Home gardens have a significant potential to improve food security and offer a contribution to household income for communities in rural areas. The aim of this study was to assess the diversity of fruit plant species in the home gardens and their contribution to the livelihood of rural communities in Tenggulun Sub-district, Indonesia. The study was conducted in three villages of Tenggulun Sub-district, Aceh Tamiang District, namely Tenggulun, Selamat, and Simpang Kiri. Extensive field surveys, plant collections, and interviews with local communities were conducted, involving 350 households, using random sampling methods. A total of 39 fruit plant species consisting of 23 genera and 17 families were recorded at the three villages. Sixteen species, i.e., *A. muricata, A. jiringa, Artocarpus integer, Averrhoa bilimbi, Baccaurea motleyana, Carica papaya, Citrus aurantifolia, Citrus hystrix, Garcinia mangostana, Mangifera indica, Manilkara zapota, Musa x paradisiaca, Nephelium lappaceum, Psidium guajava, Spondias pinnata,* and *Syzygium aqueum* were the most frequently recorded in all of the villages. In addition to being used as food, the fruit plants in the study area were also used as medicines, fodder, fuelwood, and household items. The fruit plant species have a significant role in supporting household livelihoods to improve food security and potentially offer a household income for the rural community in the study area.

Keywords: Home garden, fruit plants, species diversity, species richness, Tenggulun

INTRODUCTION

Home garden is generally described as a land-use system encompassing the purposeful management of multipurpose trees and shrubs in close relationship with annual and perennial crop plants and, usually, livestock within individual house compounds, the entire tree-animal crop unit being widely managed by the family labor force (Wiersum 2006). It is rich in biodiversity, including wild plants and the cultivated ones (Kumar and Nair 2004; Moreno-Calles et al. 2010), and plays an important role in rural communities in many aspects, including the economy, ecology, and culture (Méndez et al. 2001; Senanayake et al. 2009; van Heezik et al. 2014). The plants in the home garden provide a source for a variety of medicinal and ceremonial materials. Therefore, it becomes a valuable source of direct or indirect income for the owner. In addition, home garden has an ecological function to conserve water, prevent erosion (Senanayake et al. 2009; Larios et al. 2013), conserve biodiversity (Kehlenbeck and Maass 2004; Kaswanto and Nakagoshi 2012), and store carbon (Kaswanto and Nakagoshi 2012). Home garden is also used by the community as a place to transfer local knowledge about ecology and utilization of plants (Méndez et al. 2001; Thomas et al. 2008).

The rural communities in the Tenggulun Sub-district generally have large home gardens, planted with various species of vegetables, fruits, and tuberous plants. Vegetables and tubers rich in fiber, nutrition, and bioactive compounds are very important for maintaining human health (Kusharto 2006; Suwardi et al. 2018), while fruit plants are rich in nutrition to ensure food quality and dietary diversity and can also provide household income (Bvenura and Sivakumar 2007; Mwema et al. 2012; Mabaya et al. 2014; Navia et al. 2015; Khruomo and Deb 2018; Abebe et al. 2019; Suwardi et al. 2019; Suwardi et al. 2020a). However, home gardens in the Tenggulun Sub-district have not been evaluated for their species composition. Therefore, the composition of fruit plants in the home gardens and their contribution to the livelihoods of local communities need to be investigated. This may fill the information gap on fruit plant species through assessing fruit tree species diversity in the home gardens and their contribution to the livelihood (Abebe et al. 2019). The aim of this study was to assess the diversity of fruit plant species in the home gardens and their contribution to the livelihood of rural communities in Tenggulun Sub-district, Indonesia.

MATERIALS AND METHODS

Study area

The study was conducted in the Aceh Tamiang District, Aceh Province, Indonesia consisting of three villages, namely Tenggulun, Selamat, and Simpang Kiri (Figure 1). Tenggulun Sub-district is one of the twelve sub-districts of

Aceh Tamiang District, located at 4°00'47.3"N and 97°55'51.0"E. It is 28 km from Kuala Simpang, the capital of the Aceh Tamiang District. Its population is 291,112, of whom 146,794 are men and 144,318 women. A total of 3,802 households live in the Selamat, Tenggulun, and Simpang Kiri Village. The climate type of the Tenggulun Sub-district is humid tropic, with mean annual rainfall ranging from 406 mm to 2886 mm, and the average daily temperature of 29°C. The altitudes of Tamiang District range from 500 m to700 m and the topography of the study area is mountainous (Central Bureau of Statistics of Aceh Tamiang District 2019).

Data collection

Information on fruit plant species was obtained through participatory observations and semi-structured interviews with informants. A total of 350 households (Table 1) were selected using a random sampling method. The interview took place face to face in the Indonesian language, and each interview lasted between 20 and 30 minutes.

Samples of all fruit plants were collected together with the recording of their vernacular names, number of individuals, habits, and use. In addition, botanical identification was performed at the Biology Laboratory, Samudra University, Aceh, Indonesia. The botanical names have been updated using The Plant List (www.theplantlist.org) and the International Plant Name Index (www.ipni.org).

Data analysis

Fruit tree species diversity in home gardens in the study area was determined using the Shannon-Wiener Index (H') calculated using the following formula (Barbour et al. 1987).

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

Where H' = Shannon-Wiener Diversity Index, s = number of species Pi= the proportion of individuals or abundance of the i species expressed as the proportion of the total abundance ln = natural logarithm of Pi.

Evenness (Equitability) index (J')

Evenness (Shannon equitability) index (J') calculated using the following formula (Marguran 2004).

$$J' = \frac{H'}{H_{max}} = \frac{H'}{\ln S}$$

Where; J' = Evenness, H' = Shannon-Wiener Diversity Index; S = total number of species in the sample; ln = natural logarithm.

Table 1. Sample distribution of respondents in the study area

Village	Total no. of households	The sample of households	Percentage (%)
Tenggulun	2,019	200	10
Selamat	1,285	100	8
Simpang Kiri	498	50	10
Total	3,802	350	

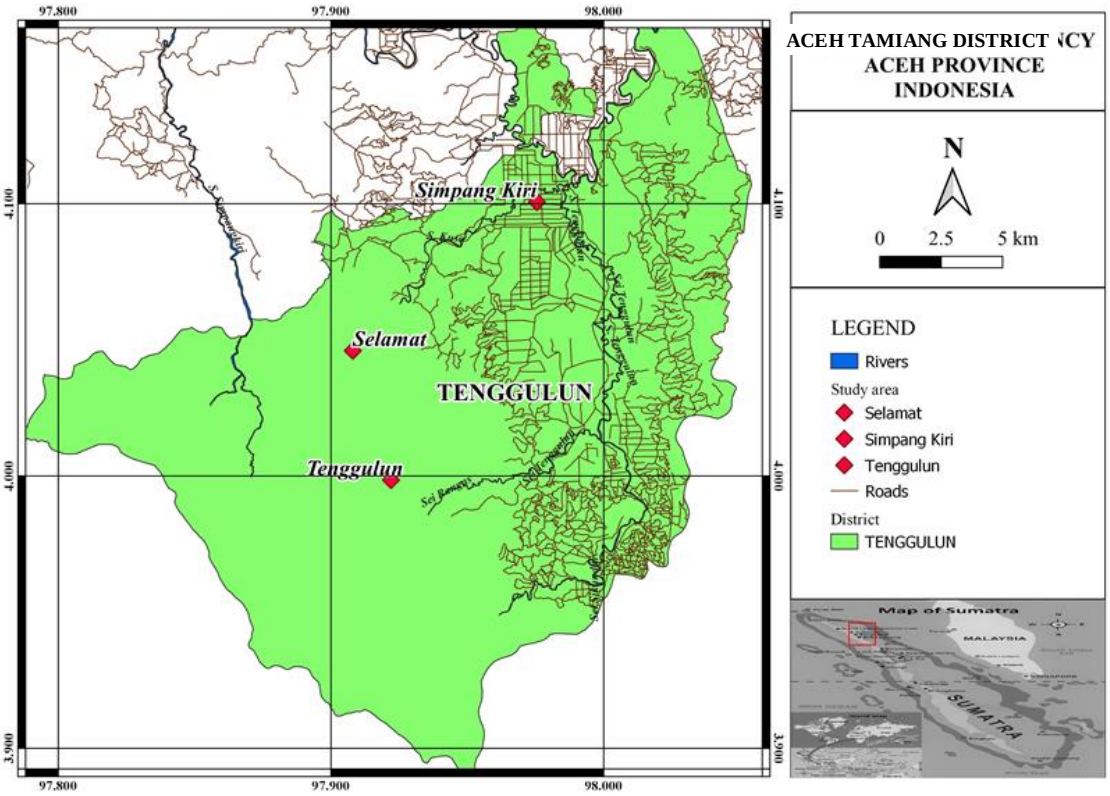

Figure 1. Map of Aceh Tamiang District, Aceh Province, Indonesia, showing the study area

RESULTS AND DISCUSSION

Floristic composition of fruit plant species

A total of 39 fruit plant species represented by 23 genera and 17 families were recorded at the three villages (Table 2).

The highest number of fruit plant species was recorded in Tenggulun, i.e., 34 species, followed by Selamat 27 species and Simpang Kiri 23 species. The number of species recorded in this study (39 species from 150 home gardens) was comparable to the 40 fruit plant species reported in the Hintalo Wejerat district (Tsegazeabe et al. 2012), but lower than that in Kerala, India, i.e., 86 species (George and Cristopher 2019) and in the Jabon Mekar village, Bogor District, Indonesia, i.e., 57 species (Prasetyo 2007). However, it was higher than the 30 species of fruit plants growing in the home garden of North Sumatra, Indonesia (Silalahi and Nismawati 2018), 30 species in Langsa, Aceh, Indonesia (Navia et al. 2017), 18 species in the Burie District, Ethiopia (Abebe et al. 2019), 13 species in South-Western Ethiopia (Mathewos et al. 2018), and 4 species in Bulen District, North-Western Ethiopia (Beyene et al. 2018). This variation in the diversity of fruit plant species was affected by the home garden size and the culture of the local community in the study area (Arora and Anjula 1996). The significant correlation between home garden size and species diversity was observed by Das and Das (2005) in India and Sunwar (2003) in Nepal.

Table 2. Species, genus, and family of fruit plant species in the study area

Botanical name	Family	Local name	Life form	Location
Anacardium occidentale L.	Anacardiaceae	Jambu mete	Tree	TG, SL
Annona muricata L.	Annonaceae	Sirsak	Tree	TG, SL, SK
Annona squamosa L.	Annonaceae	Srikaya	Tree	TG
Archidendron jiringa (Jack) Neil	Mimosaceae	Jengkol	Tree	TG, SL, SK
Artocarpus altilis (Parkinson ex F.A.Zorn) Fosberg	Moraceae	Sukun	Tree	TG, SK
Artocarpus camansi Blanco	Moraceae	Keluih	Tree	TG
Artocarpus integer (Thunb.) Merr.	Moraceae	Cempedak	Tree	TG, SL, SK
Artocarpus heterophyllus Lam.	Moraceae	Nangka	Tree	TG, SL
Averrhoa bilimbi L.	Oxalidaceae	Belimbing Wuluh	Tree	TG, SL, SK
Averrhoa carambola L.	Oxalidaceae	Belimbing Besar	Tree	TG
Baccaurea motleyana (Mull.Arg) Mull.Arg	Phyllantaceae	Rambai	Tree	TG, SL, SK
Carica papaya L	Caricaceae	Pepaya	Herb	TG, SL, SK
*Citrus amblycarpa (*Hassk.) Ochse	Rutaceae	Jeruk Kesturi	Tree	SL
Citrus aurantifolia (Christm.) Swingle	Rutaceae	Jeruk Nipis	Tree	TG, SL, SK
Citrus hystrix DC	Rutaceae	Jeruk Purut	Tree	TG, SL, SK
Citrus maxima (Burm.) Merr	Rutaceae	Jeruk Bali	Tree	TG, SK
Citrus sinensis L	Rutaceae	Jeruk Manis	Tree	TG, SL
Dimocarpus longan L	Sapindaceae	Kelengkeng	Tree	SL
Durio zibethinus L.	Malvaceae	Durian	Tree	TG, SK
Eleiodoxa conferta (Griff) Burret	Arecaceae	Salak Hutan	Palm	TG
Garcinia mangostana L	Clusiaceae	Manggis	Tree	TG, SL, SK
Lansium parasiticum (Osbeck) K.C.Sahni & Bennet	Meliaceae	Lansat	Tree	SL
Mangifera foetida L.	Anacardiaceae	Mancang	Tree	SL, SK
Mangifera indica L.	Anacardiaceae	Mangga	Tree	TG, SL, SK
Mangifera laurina Blume	Anacardiaceae	Asam Pauh	Tree	TG,
Mangifera odorata Griff.	Anacardiaceae	Kuweni	Tree	TG, SK
Manilkara zapota (L.) P.Royen	Sapotaceae	Sawo	Tree	TG, SL, SK
Musa x paradisiaca L.	Musaceae	Pisang	Herb	TG, SL, SK
Musa textilis Nee	Musaceae	Pisang Raja	Herb	TG, SL
Neolamarckia cadamba (Roxb.) Bosser	Rubiaceae	Jabon	Tree	SL
Nephelium lappaceum L.	Sapindaceae	Rambutan	Tree	TG, SL, SK
Pometia pinnata J.R.Forst. & G.Forst.	Sapindaceae	Boh Keulayu	Tree	TG, SL
Psidium guajava L.	Myrtaceae	Jambu Biji	Tree	TG, SL, SK
Salacca zallaca (Gaertn.) Voss	Arecaceae	Salak	Palm	TG
Sandoricum koetjape (Burm.f.) Merr.	Meliaceae	Setui	Tree	TG, SK
Spondias pinnata (L. f.) Kurz	Anacardiaceae	Kedondong	Tree	TG, SL, SK
Syzygium aqueum (Burm.f.) Alston	Myrtaceae	Jambu Air	Tree	TG, SL, SK
Syzygium malaccense (L.) Merr. & L.M.Perry	Myrtaceae	Jambu Bol Merah	Tree	TG, SL
Syzygium samarangense (Blume) Merr. & L.M.Perry	Myrtaceae	Jambu Air Merah	Tree	TG, SK

Note: TG: Tenggulun; SL: Selamat; SK: Simpang Kiri

Frequency of fruit tree species

The frequency of each species across the study area is shown in Figure 2. Sixteen species, i.e., *A. muricata, A. jiringa, A. integer, A. bilimbi, B. motleyana, C. papaya, C. aurantifolia, C. hystrix, G. mangostana, M. indica, M. zapota, M. paradisiaca, N. lappaceum, P. guajava, S. pinnata,* and *S. aqueum* were the most frequently recorded fruit plant species in all of the villages. On the other hand, 4 fruit plant species, i.e., *C. amblycarpa, D. longan, L. parasiticum,* and *N. cadamba,* were found only in Selamat village, and 6 species, i.e., *A. squamosa, A. camansi, A. carambola, E. conferta, S. zallaca,* and *M. laurina,* were found only in Tenggulun Village.

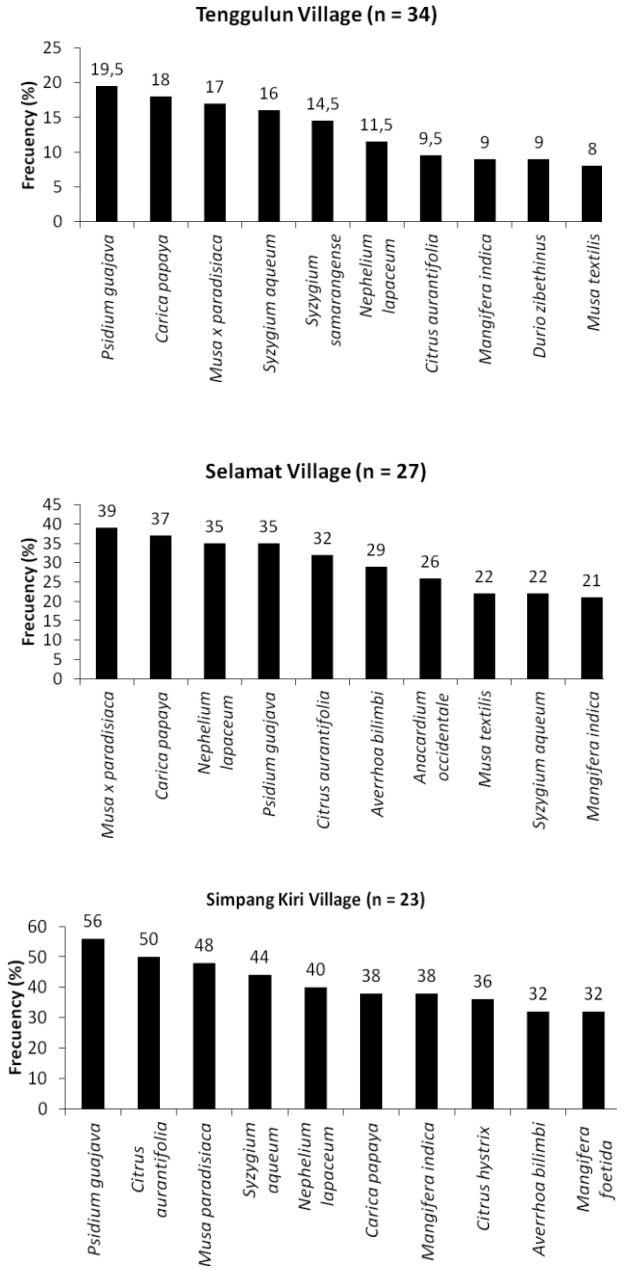

Figure 2. The frequency of each species in the study area

Of the total fruit plant species recorded in the Tenggulun Village, *P. guajava* was the most frequently recorded species with a frequency of 19.5%, followed by *C. papaya* 18% and *M. paradisiaca* 17%, while in Selamat Village *M. paradisiaca and C. papaya* with frequency of 39% and 37%, respectively, and in Simpang Kiri Village *P. guajava* (56%), *C. aurantifolia* (50%), and *M. paradisiaca* (48%). Generally, *P. guajava* and *C aurantifolia* were the most frequently recorded fruit plant species in the household home garden. The results of this study were similar to those of Navia et al. (2017) and Yuliawati et al. (2016) that *M. paradisiaca* was commonly planted by rural communities in home gardens. Fruit plants and vegetables are the most common in the home gardens to provide a source of food (Tefera et al. 2015).

Fruit plant species diversity

Fruit plant species diversity was higher in Selamat village than in Simpang Kiri and Tenggulun (Table 3). The highest Shannon diversity index was recorded in Selamat village (3.03), while the highest species evenness was recorded in Simpang Kiri Village (0.95). The Shannon Diversity Index showed that the home gardens in all villages had H' values between 2.95 and 3.03. This indicated that the fruit plant species diversity index in the study area was categorized as medium (Barbour et al. 1987). However, a different finding was reported by Prasetyo (2007) that the fruit diversity in the home garden of Jabon Mekar Village, Bogor, Indonesia was high.

Contribution of fruit plant species to household's livelihoods

The home gardens of the study area were planted with annual and perennial fruit plants, which are the main source of food for the households to meet dietary needs. The communities in the study area grew different plant species in their home gardens mainly for household consumption and, to a limited extent, for the income generation. The results of this study were consistent with the study reported by Abebe et al. (2019) in Burie District, Ethiopia, where fruit plant species in the home gardens were primarily used for consumption by themselves. The fruit plants are rich in nutrition to ensure food quality and dietary diversity to the maintenance of human health (Mabaya et al. 2014; Khruomo and Deb 2018; Suwardi et al. 2019; Navia et al. 2019). Most rural communities have received income from selling various fruits in the traditional market (Navia et al. 2020; Suwardi et al. 2020b; Suwardi et al. 2020c).

In addition to being used as food, fruit plants from the home gardens were also used as feed for animals (9 species), fuelwood (5 species), medicine (5 species), and household items (5 species) (Table 4).

Table 3. The Shannon diversity and evenness indexes of three villages in the study area

Village	Richness	Shannon (H')	Evenness
Tenggulun	34	2.95	0.84
Selamat	27	3.03	0.92
Simpang Kiri	23	2.98	0.95

Tabel 4. Other uses of the fruit plant species in the study area

Uses	Species
Medicine	*Annona muricata, Averrhoa bilimbi, Carica papaya, Citrus aurantifolia, Psidium guajava*
Fodder	*Archidendron jiringa, Artocarpus altilis, Artocarpus camansi, Artocarpus integer, Artocarpus heterophyllus, Musa x paradisiaca, Neolamarckia cadamba, Spondias pinnata, Syzygium aqueum*
Fuelwood	*Archidendron jiringa, Durio zibethinus, Lansium parasiticum, Neolamarckia cadamba, Pometia pinnata*
Household items	*Archidendron jiringa, Durio zibethinus, Neolamarckia cadamba, Spondias pinnata, Syzygium aqueum*

Approximately 23.43% of respondents used leaves of several species, such as *A. heterophyllus*, *M. paradisiaca*, and *S. pinnata*, as fodder for goats in particular because of the high content of starch and metabolizable energy which gives livestock better digestibility (Amalina et al. 2020). A total of 52% of respondents traditionally used several species, such as *A. bilimbi* fruit, for cough treatment. Fruit extracts of *A. bilimbi* contain bioactive compounds such as saponin (Wahab et al. 2009; Kumar et al. 2011) known to have antitussive and expectorant effects for effective treatment of coughs (Roy et al. 2011; Hasim et al. 2019).

Fuelwood is the main source of energy for 68.85% of the respondents in the study area. They harvest firewood from the home gardens to prepare any food. *A. jiringa* and *N. cadamba* were the most preferred firewood by the respondents in the study area. Other popular materials used by respondents in the home garden are wood for handles of various tools and household utensils. *D. zibethinus* was the most common species whose wood was used by respondents for furniture and household utensils such as tables, chairs, beds, doors, or windows.

The results of this study highlight the significant function of fruit plants in supporting household livelihoods in a variety of ways, including food supplies, medicines, animal feed, fuelwood, and household items. Home gardens contribute significantly to the food supply, especially for rural communities, due to the high production and diversity of cultivated edible species (Tynsong and Tiwari 2010). Proper management of home gardens has a significant potential to improve food security and offers a contribution to household income in the study area. In addition, the integration of scientific management into indigenous knowledge may promote rural agriculture in the Aceh Tamiang District.

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