



# Indigenous practices for cultivation of fruit plants in *Kampung Dukuh*, West Java, Indonesia

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## Research

### Abstract

**Background:** Fruit is underrepresented as a source of nutrition owing to high production challenges and a lack of successful domesticating techniques. However, this issue can be addressed if an effective indigenous practice can be identified, and then the techniques can be promoted and shared with other communities. This research aims to document: (1) the landscape and land classification in *Kampung Dukuh*, (2) the fruit plants found in *Kampung Dukuh*, and (3) the cultivation technique practiced by indigenous people.

**Methods:** The research was conducted through field observations at 162 sites within the village and in-depth interviews with 30 informants selected using the purposive sampling method. Data were analyzed using Miles and Huberman Models.

**Results:** (1) Indigenous people have traditional practices in understanding their living environment and have divided the living area into five zones, viz., cover land, deposit land, arable land, forbidden land, and reserve land (2) a high fruit plant diversity of 587 plants belonging to 90 species and 38 families were present in *Kampung Dukuh*. The most dominant family is Moraceae (13.33%), followed by Anacardiaceae (10%) and Rutaceae (8.89%) (3) The fruit plant cultivation technique involves a series of processes from site preparation, planting, tree caring, and fruit harvesting.

**Conclusions:** Indigenous people divide their land into five zones and cultivate 90 species of fruit plants. Their cultivation techniques, from site preparation to harvesting, underscore the value of indigenous knowledge and highlight the area's rich fruit plant diversity. These practices offer valuable insights for sustainable fruit cultivation in similar contexts.

**Keywords:** traditional methods, cultivation technique, indigenous people

## Background

Fruits are available throughout the year because different fruit species produce fruit at different times, and can be consumed directly or processed for later consumption (Omotayo & Aremu 2020). For instance, in Sundanese community, *rujak buni* is a traditional food prepared by pounding the fruit of *Antidesma bunius* with chilies and palm sugar (Silalahi *et al.* 2022). Fruit is a natural source of many nutrients including carbohydrates, lipids, proteins, minerals, and vitamins (Sabbadini *et al.* 2021). According to Ravindra *et al.* (2021), more than 70% of local fruits in Kalimantan such as *Averrhoa bilimbi*, *Artocarpus odoratissimus*, and *Mangifera pajang* are rich in at least one micronutrient, and 53% contain important nutrients to combat malnutrition. Therefore, it plays a crucial role in ensuring dietary diversity and nutrition for people's well-being (Suwardi *et al.* 2019; Torres-Vitolas *et al.* 2019; Cordero-Ahiman *et al.* 2021; Pandey *et al.* 2021). Additionally, fruit has a role in under-nutrition prevention such as stunting (Li *et al.* 2022). In developing countries like Indonesia, stunting in children is closely connected to long-term malnutrition which is associated with poverty (Sudigyo *et al.* 2022). Many tropical fruits are seasonal and the cost of obtaining them is rather high, thus fruit is often underrepresented in rural children's diets unless the discovery of effective low-cost domesticating techniques then being promoted and implemented by the rural farmers (Kretz *et al.* 2021; Mann *et al.* 2022).

From an ecological perspective, fruit plants play a significant role in sustaining biodiversity and providing ecosystem services (Xia *et al.* 2020). Fruit plants have been cultivated to mitigate climate change and prevent floods and landslides (Reppin *et al.* 2020). Fruit trees such as *Syzygium aqueum*, which is cultivated in Urug Village, West Java is consumed by local people and also as food for *Macaca fascicularis* (long-tailed macaques) (Mudiana & Ariyanti 2022; Anggraeni *et al.* 2023). Long-tailed macaques consume the flowers (Nila *et al.* 2014) and fruit of *S. aqueum* (Reinegger *et al.* 2023). Nevertheless, the existence of fruit plants, both wild and cultivated, depends on the environment and requires careful planning and management (Xia *et al.* 2020; Mann *et al.* 2022). To maximize the role of fruit plants as a source of nutrition and environmental services, it is necessary to identify the most appropriate techniques for cultivating these plants (Narendra *et al.* 2013; Dahanayake 2015).

The indigenous cultivation techniques are always the synergy of local people's understanding of their living environment, and socioeconomic, and cultural value, and have been implemented over many generations (Wendiro *et al.* 2019). Indigenous peoples survive on the availability of natural resources, therefore, they always pay extra attention to protecting the natural resources to meet their daily needs (Filho *et al.* 2022). Indigenous practices are considered productive, sustainable, and environmentally friendly, and reflect their social, economic, and cultural values (Irangani & Shiratake 2013).

*Kampung Dukuh* is inhabited by the Sundanese group, stands out as the only Traditional Village within Cikelet Sub-district which has the significant potential for traditional and cultural richness in the West Java Province (Cholidatul *et al.* 2021). Each household in *Kampung Dukuh* has its home garden that is planted with fruit plants, medicinal plants, ornamental plants, and herbs. According to Pratama *et al.* (2019), at least 35 fruit tree species can be found in the home garden and mixed garden of *Kampung Dukuh*, such as *Annona muricata*, *Averrhoa carambola*, and *Garcinia mangostana*. The fruit of *G. mangostana* is used as a skin medicine by burning, pounding, mixing with oil, and then smearing it on the injured skin (Santhyami & Sulistyawati 2021). This shows that indigenous peoples in *Kampung Dukuh* understand the natural resources well and deliberately cultivate these plants to meet their needs. Considering the importance of indigenous practices in natural resource management, especially the fruit plant species, this study is set to answer the following objectives: (1) describe the landscape and land classification in *Kampung Dukuh* (2) document the fruit plants found in *Kampung Dukuh* (3) report the traditional fruit tree cultivation techniques practiced by indigenous people in *Kampung Dukuh*.

## Materials and Methods

### Study area

The research was conducted in the Sundanese indigenous area. *Kampung Dukuh* is located within Ciroyom Village, Cikelet Sub-district, Garut Regency, West Java, Indonesia (Figure 1). Ciroyom Villages lies at coordinates 7°33'46.42" S and 107°41'55.89" E. It is about 102 km from Tarogong Kidul, the capital of Garut Regency, and about 301 km from Jakarta, the capital city of Indonesia. The total area of Ciroyom Village is 11 km<sup>2</sup> with an elevation of 390 meters above sea level. Ciroyom Village has a mean air temperature of 26°C and there is a dense forest to the north of the village (BPS 2023).



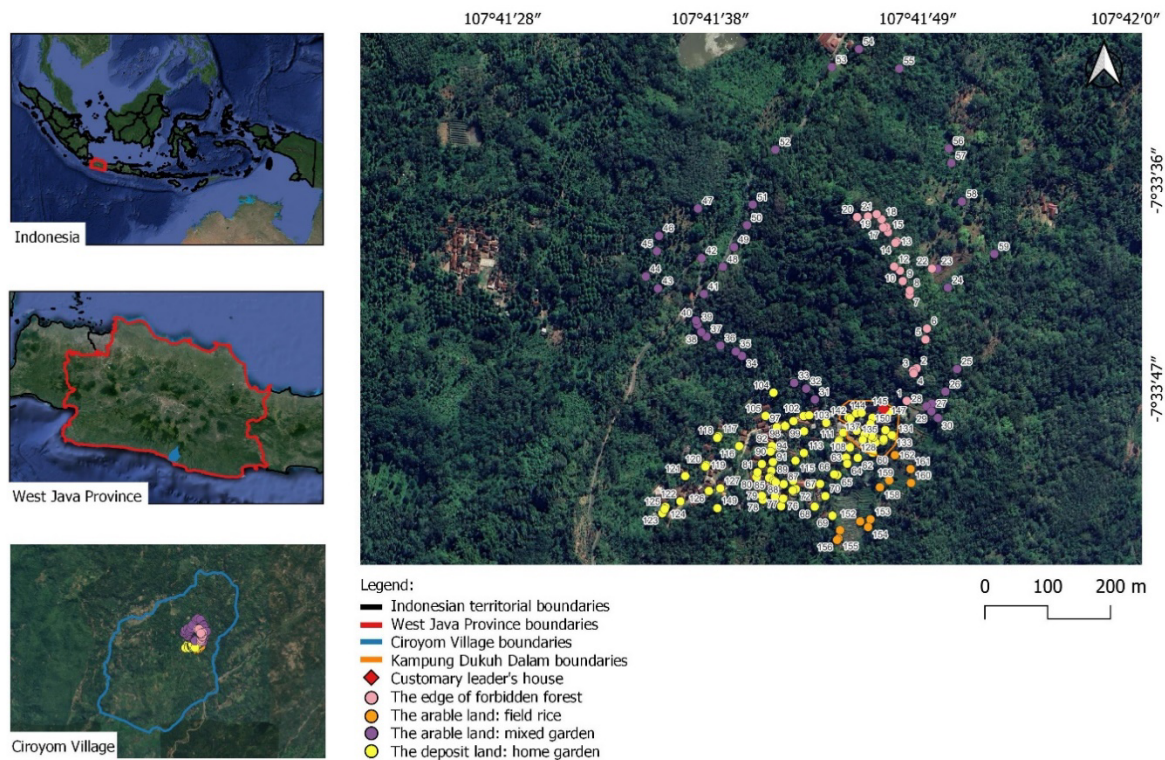


Figure 1. Research location: *Kampung Dukuh*, Ciroyom Village, Cikelet Sub-district, Garut Regency, West Java

*Kampung Dukuh* is inhabited by 432 people, consisting of 219 men and 213 women. They belong to the Sundanese ethnic group, the second-largest ethnic community in Indonesia, following the Javanese ethnic group. They communicate using the local language known as Sundanese. In their daily activities, particularly during worship, communal gatherings, and traditional ceremonies, they wear traditional Sundanese clothing, called *pangsi hitam* and *ikat kepala*. Regarding their occupations, they are engaged in agriculture, with a gender-based division. Men assume the responsibility of cultivating in the fields, whereas women oversee the planting and harvesting of crops. *Kampung Dukuh* is led by a committee of four government-appointed leaders and a customary leader (*kuncen*). The government-appointed leaders are representatives of the neighborhood associations (*rukun tetangga*) and community units (*rukun warga*). The government-appointed leaders are entrusted with the responsibility of executing government, development, and community affairs. Nevertheless, the government-appointed leaders must garner approval from the customary leader before implementing any of the decisions made. In carrying out his duties, the customary leader is assisted by two helpers namely *Wakil Kuncen I* who is in charge of receiving guests, and *Wakil Kuncen II* who is guarding the holy water in the forbidden forest.

*Kampung Dukuh* is divided into *Kampung Dukuh Dalam* (*tonggoh*) and *Kampung Dukuh Luar* (*landeuh*), which are separated by a bamboo fence. *Kampung Dukuh Dalam* is inhabited by less than 40 families, with no electricity, and the houses are of traditional design, and made of black nipa roofs and woven bamboo walls. Meanwhile, *Kampung Dukuh Luar* is inhabited by more than 70 families and with electricity supply. The majority of the houses in this area are modern, characterized by tile roofs and brick walls. Only a few houses feature walls made of woven bamboo. One thing in common to the houses in *Kampung Dukuh Dalam* and *Kampung Dukuh Luar* (both traditional and modern houses) is all the houses are raised on short stilts (Figure 2). The indigenous people of *Kampung Dukuh* live their daily lives by *pamali* (the customary rules) and prohibitions. Throughout the rice season, they engage in various traditional ceremonies that uphold their cultural roots. These include *Selamatan Mitembayam*, conducted during the rice planting phase; *Nyalemeutkeun Pare*, conducted 40 days after planting; and Meuseul or Nganyaran, conducted while awaiting the ripening of the rice. As the full moon graces the 14th day of Robiul Awal in the Islamic Calendar, the entire village partakes in the solemn Cebor Opat Puluh ceremony. The ceremonial practice involves bathing on a night of the full moon, using sacred water obtained from the hallowed grave of *Kampung Dukuh*. This ceremony holds the profound objective of purifying both the body and soul, serving as a means to ward off all manifestations of disease.

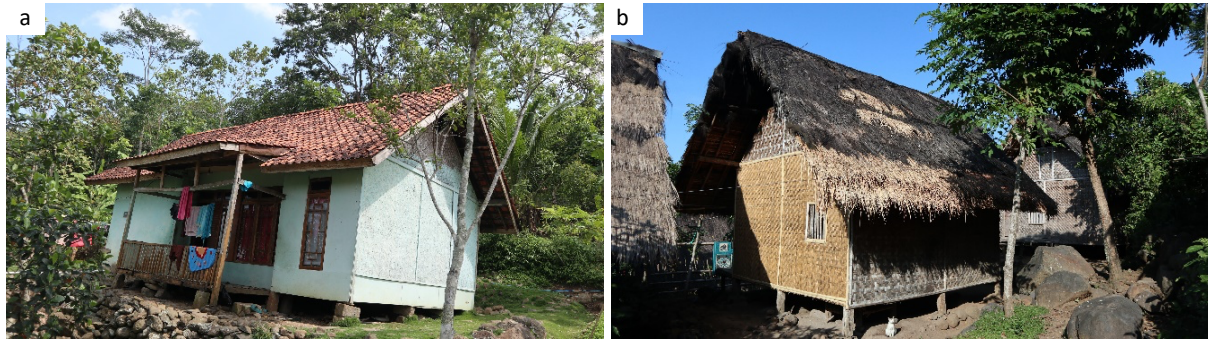


Figure 2. Traditional house in the: (a) *Kampung Dukuh Luar* (b) *Kampung Dukuh Dalam*

### Data Collection

The research was conducted through in-depth interviews with 30 informants selected through purposive sampling. The questions posed to informants were divided into four parts: the preparation before planting, the planting process, caring for fruit trees, and the harvesting. We also carried out field observation to document fruit tree cultivation techniques on site. The observations were carried out at 162 locations of different site quality. Altogether, 22 observation sites are located at the edge of the forbidden forest, 11 sites at the rice field (arable land), 37 sites at the mixed gardens (arable land), and 92 sites at the home gardens (deposit land). During the field observation, we were accompanied by local individuals designated by the elders. These appointed individuals possessed valuable knowledge about plant biodiversity, enhancing the research team's understanding of the local flora. Fruit plant species were documented in the Sundanese language. In cases where we were unfamiliar with the Indonesian names of certain species, inquiries were made with other Sundanese individuals outside of *Kampung Dukuh* who possessed knowledge about plant biodiversity. This approach allowed us to tap into the expertise of those familiar with the local flora and ensured a comprehensive understanding of the plant species under investigation.

### Data analysis

The identification of plant species in *Kampung Dukuh* involved observing morphological characteristics and referencing several identification books, including *Flora of Java* and *Fundamentals of Plants Systematic*. To validate species and family names, a comparative analysis was conducted by referencing current and related publications, along with utilizing online database portals such as the International Plant Name Index (IPNI), and Global Biodiversity Information Facility (GBIF). In this research, fruit plants collected during field observations were handed over to laboratory assistants at the Department of Biology, Universitas Indonesia, to be processed into a herbarium and the selected fruit were analyze for their secondary metabolite. The data were later analyzed using the Miles and Huberman Model, and summarized in the form of a table and diagrams.

## Results and Discussion

### The informant's profile

In-depth interviews were carried out with 30 informants exhibiting diverse characteristics, as detailed in Table 1. Among the informants, 20% were classified as young, while 40% fell into the middle-aged category, and an additional 40% were elderly. Regarding gender distribution, 47% were male and 53% were female. The primary occupations of the informants varied, with the majority (43%) engaged in farming, followed by traders (10%) and teachers (3%). A significant portion (40%) identified as full-time housewives. Education levels varied, with 83% having completed primary school, 7% attending junior secondary school, another 7% completing senior secondary school, and finally, 3% holding a bachelor's degree.

Table 1. The informant's profile

Characteristics	Group	No. of informants	Percentages (%)
Age group (years old)	Young (age 18-36)	6	20
	Middle-aged (age 37-55)	12	40
	Elderly ( $\geq 56$ )	12	40
Gender	Male	14	47
	Female	16	53
Occupation	Farmer	13	44
	Housewife	12	40
	Trader	3	10

Education	Teacher	1	3
	Unemployed	1	3
	Primary school	25	83
	Junior secondary school	2	7
	Senior secondary school	2	7
	Bachelor's degree	1	3

### The landscape and land classification in *Kampung Dukuh*

The indigenous people classified their living environment into five different types (Figure 3). First, *tanah tutupan* or the “cover land” is the forested area north of *Kampung Dukuh*, where they are only allowed to harvest products without land clearing. To them, the cover land is crucial in ensuring environmental stability and water security for consumption and irrigation. Second, *tanah titipan* or the “deposit land” is entrusted by the ancestors to future generations and is divided into deposit lands according to the descendants of Arab, *Dukuh*, *Jasaung*, *Sukapura*, and *Sumedang*. Arab is land assigned to descendants of Zainal Abidin or Arabian in origin, *Dukuh* is land for the original people living in *Kampung Dukuh Dalam*, *Jasaung* is for indigenous people from *Kampung Dukuh Luar*, *Sukapura* for descendants from *Sukapura* that have historical ties with people from *Kampung Dukuh*, meanwhile, *Sumedang* is for descendants from Sumedang that have historical ties with people from *Kampung Dukuh*. The indigenous people are using the deposit land for settlement and home gardens. Third, *tanah garapan*, or the “arable land” is land for rice and mixed crops planting. Rice fields are located to the south of the settlement, while mixed gardens are located at the edge of forested areas or cover land. Fourth, *tanah larangan* or the “forbidden land” is located within the cover land area and close to *Kuncen's* house. The forbidden forest is the location where the founder of *Kampung Dukuh*, Syekh Abdul Jalil, was buried. Every Saturday, his tomb will be visited by Moslem pilgrims from different regions. Visitors to the tombs have to comply with several rules including not wearing underwear. Civil servants are not allowed to visit his tomb. According to local belief, Syekh Abdul Jalil was betrayed by Prince Rangga Gempol II of Sumedang, thus, he gave up his position as the religious leader in the Kingdom of Sumedang. Therefore, civil servants are discouraged from visiting his tomb, as it is believed that their presence may potentially bring calamity to the *Kampung*. Lastly, *tanah cadangan* or the “reserve land” that is managed by Perhutani, a state-owned enterprise, and planted with rubber trees.

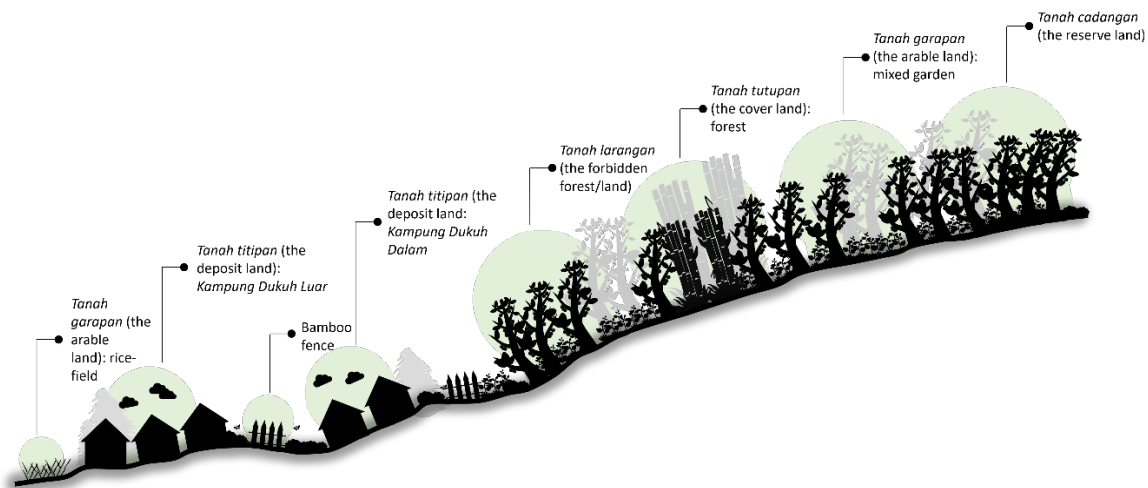






Figure 3. An illustration of the five land classifications in *Kampung Dukuh*

### The fruit plants found in *Kampung Dukuh*

A total of 587 plants belonging to 90 species and 38 families were recorded in *Kampung Dukuh* (Table 2). A higher ratio of total fruit plants to inhabitants (432 people), viz., 1.36, is noticed here. Moraceae is the most dominant family (13.33% or 12 species), followed by Anacardiaceae (10% or 9 species each), Rutaceae (8.89% or 8 species), Myrtaceae (6.67% or 6 species), Arecaceae (5.56% or 5 species), and Fabaceae (4.44% or 4 species). The other four families, Annonaceae, Meliaceae, Solanaceae, and Zingiberaceae are each represented by 3.33% or 3 species. Each of the other 28 families is represented by less than 3%, or 1 to 2 species (Figure 4). This indicates a rich fruit-bearing plant diversity in the *Kampung Dukuh*, demonstrating both food security potential and ecological significance for the indigenous people.



Table 2. Fruit plant found in *Kampung Dukuh*

Family Name	Scientific Name	Local Name	Picture
Anacardiaceae	<i>Anacardium occidentale</i> L.	Jambu mede	
	<i>Bouea macrophylla</i> Griff.	Jatake	
	<i>Buchanania arborescens</i> (Blume) Blume	Popoan	
	<i>Mangifera foetida</i> Lour.	Bacang	

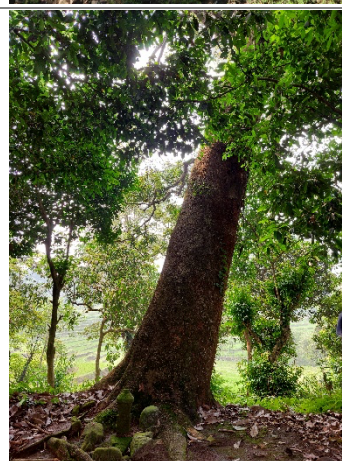
*Mangifera indica* L.

Mangga



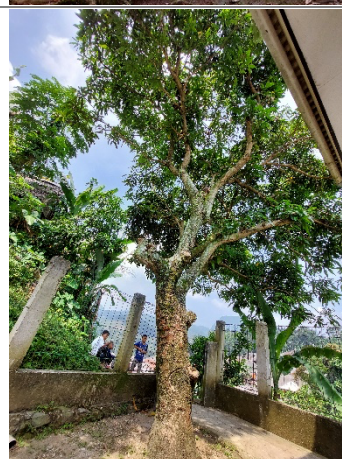
*Mangifera kemanga* Blume




Kemang







*Mangifera laurina* Blume

Mangga piit



	<i>Mangifera odorata</i> Griff.	Kuweni	
	<i>Spondias dulcis</i> Parkinson	Kedondong	
Annonaceae	<i>Annona muricata</i> L.	Sirsak	



	<i>Annona reticulata</i> L.	Nona	
	<i>Stelechocarpus burahol</i> (Blume) Hook.f. & Thomson	Burahol	
Araceae	<i>Monstera deliciosa</i> Liebm.	Monstera	
Areaceae	<i>Areca catechu</i> L.	Pinang	

*Arenga pinnata* (Wurmb)  
Merr.

Aren



*Cocos nucifera* L.

Kelapa



*Elaeis guineensis* Jacq.

Sawit



*Salacca zalacca* (Gaertn.) Voss

Salak





Bromeliaceae	<i>Ananas comosus</i> (L.) Merr.	Nanas	
Cactaceae	<i>Selenicereus undatus</i> (Haw.) D.R.Hunt	Naga	
Caricaceae	<i>Carica papaya</i> L.	Pepaya	
Clusiaceae	<i>Garcinia mangostana</i> L.	Manggis	
Combretaceae	<i>Terminalia catappa</i> L.	Ketapang	

Cucurbitaceae	<i>Cucurbita moschata</i> Duchesne	Waluh	
Euphorbiaceae	<i>Aleurites moluccanus</i> (L.) Willd.	Muncang	
	<i>Macaranga tanarius</i> (L.) Müll.Arg.	Mara	
Fabaceae	<i>Archidendron jiringa</i> (Jack) I.C.Nielsen	Jengkol	

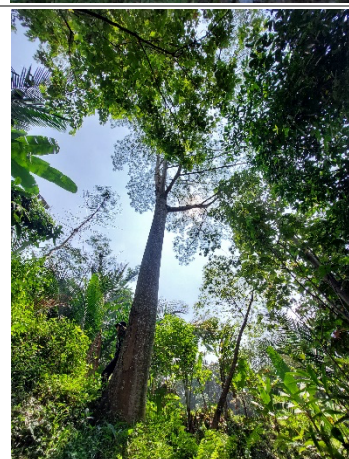
*Leucaena leucocephala* (Lam.)    Petai cina, selong  
de Wit





*Parkia speciosa* Hassk.    Peuteuy



*Samanea saman* (Jacq.) Merr.    Kihujan



Gnetaceae	<i>Gnetum gnemon</i> L.	Tangkil	
Lauraceae	<i>Cinnamomum parthenoxylon</i> (Jack) Meisn.	Kisereuh	
	<i>Persea americana</i> Mill.	Alpukat	



Lecythidaceae	<i>Planchonia valida</i> (Blume) Blume	Putat	
Lythraceae	<i>Lagerstroemia speciosa</i> (L.) Pers.	Bungur	
Malvaceae	<i>Durio zibethinus</i> L.	Duren	
	<i>Theobroma cacao</i> L.	Coklat	
Melastomataceae	<i>Melastoma malabaticum</i> (L.) Smith	Senduduk	

Meliaceae	<i>Lansium domesticum</i> Corrêa	Duku	
	<i>Swietenia macrophylla</i> King	Mahoni	
	<i>Sandoricum koetjape</i> (Burm.f.) Merr.	Sentul	
Moraceae	<i>Artocarpus altilis</i> (Parkinson) Fosberg	Sukun	

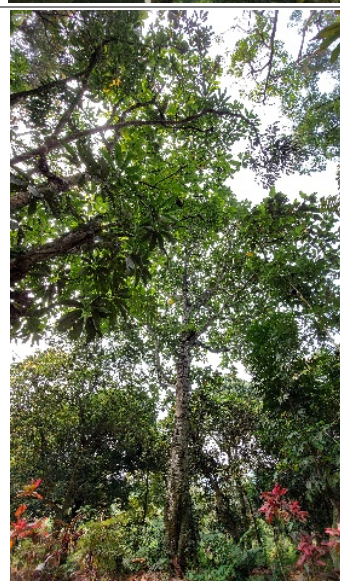
*Artocarpus camansi* Blanco

Kluwih



*Artocarpus elasticus* Reinw. ex  
Blume

Teureup



*Artocarpus heterophyllus* Lam.

Nangka





*Artocarpus integer* (Thunb.)  
Merr.

Nangka beurit



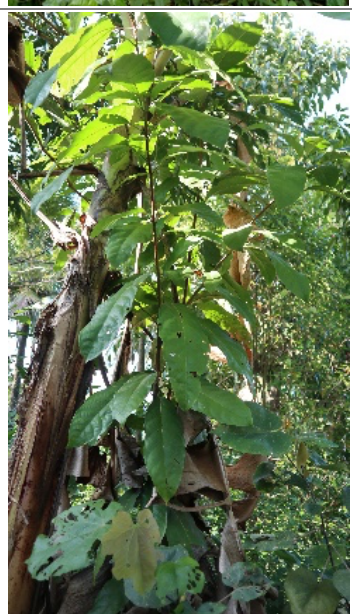
*Ficus ampelas* Burm. f.

Ampelas



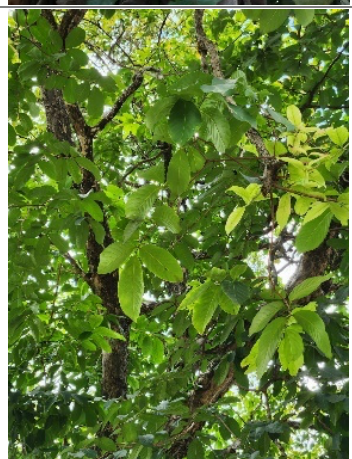
*Ficus callosa* Willd.

Pangsor



*Ficus drupacea* Thunb.

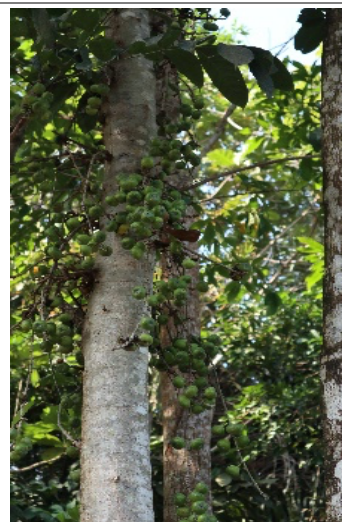
Koang





*Ficus hispida* L.f.

Bisoro



*Ficus racemosa* L.

Loa



*Ficus variegata* Blume

Nyawai



*Filicium decipiens* (Wight & Arn.) Thwaites

Kerai payung



Muntingiaceae	<i>Muntingia calabura</i> L.	Kersen	
Musaceae	<i>Musa acuminata</i> Colla	Pisang	
Myristicaceae	<i>Myristica fragrans</i> Houtt.	Pala	

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Myrtaceae*Psidium guajava* L.

Jambu biji



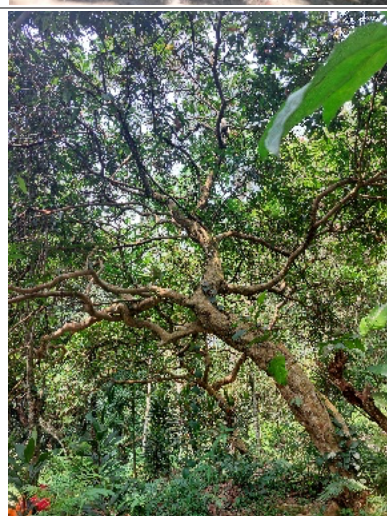
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*Syzygium aqueum* (Burm.f.)  
Alston

Jambu air



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*Syzygium densiflorum* Wall. ex  
Wight & Arn. Kopo



*Syzygium malaccense* (L.)  
Merr. & L.M.Perry

Jambu bol



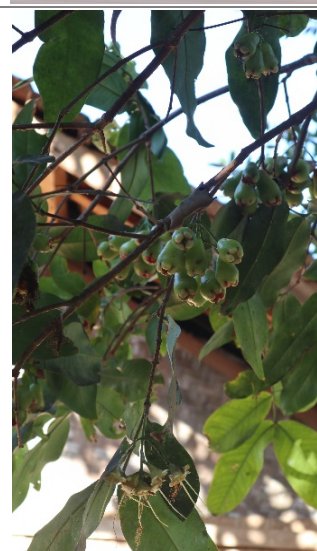
*Syzygium polyanthum* (Wight)  
Walp.

Salam



*Syzygium samarangense*  
(Blume) Merr. & L.M.Perry

Jambu lili



Oleaceae	<i>Olea europaea</i> L.	Zaitun	
Orchidaceae	<i>Vanilla planifolia</i> Andrews	Paneli	
Oxalidaceae	<i>Averrhoa carambola</i> L.	Belimbing	
Passifloraceae	<i>Passiflora edulis</i> Sims	Markisa	

Phyllanthaceae

*Phyllanthus emblica* L.

Malaka



Piperaceae

*Piper nigrum* L.

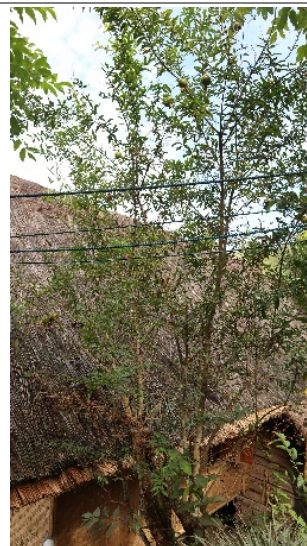
Lada



Punicaceae

*Punica granatum* L.

Delima



Rubiaceae	<i>Morinda citrifolia</i> L.	Mengkudu	
	<i>Mussaenda frondosa</i> L.	Kingkilaban	
Rutaceae	<i>Citrus × amblycarpa</i> (Hassk.) Ochse	Jeruk limo/ jeruk sambal	
	<i>Citrus × aurantiifolia</i> (Christm.) Swingle	Jeruk nipis	
	<i>Citrus × aurantium</i> L.	Jeruk peres	



*Citrus × limon* (L.) Osbeck

Jeruk sitrun, limon



*Citrus hystrix* DC.

Jeruk purut



*Citrus maxima* (Burm.) Merr.

Jeruk bali



*Citrus nobilis* Lour.

Jeruk garut



*Murraya paniculata* (L.) Jack

Sukik





Sapindaceae	<i>Dimocarpus longan</i> Lour.	Lengkeng	
	<i>Nephelium lappaceum</i> L.	Rambutan	
Sapotaceae	<i>Manilkara zapota</i> (L.) P.Royen	Sawo	
Solanaceae	<i>Capsicum frutescens</i> L.	Cabe	

	<i>Solanum melongena</i> L.	Terong		
	<i>Solanum nigrum</i> L.	Leunca		
Verbenaceae	<i>Gmelina arborea</i> Roxb. ex Sm.	Jati gamelina	india,	
	<i>Tectona grandis</i> L.f.	Jati, jeunti		

Zingiberaceae	<i>Amomum compactum</i> Sol. ex Maton	Kapol	
	<i>Elettaria cardamomum</i> (L.) Maton	Kapulaga	
	<i>Etlingera elatior</i> (Jack) R.M.Sm.	Honje	

Moraceae is known for its wide adaptability to various environmental conditions (Yusuf 2011) and contributes to the resilience of the local ecosystem (Hidayat *et al.* 2010). The most common Moraceae species is *Artocarpus heterophyllus* and it is found in *tanah titipan* or the deposit land (78.26% or 18 trees) and *tanah garapan* or the arable land (21.74% or 5 trees). The species is commonly planted in *Kampung Dukuh* because of its multiple functions. It produces food that can be eaten directly or processed into vegetables; stems and branches as building and utensils such as mortar containers, pestles, musical instruments, drums, and ashtrays; and leaves as body ache medicines. Besides, *A. heterophyllus* comes with strong roots and thus has an ecological function in preventing soil erosion, considering *Kampung Dukuh* is situated in a hilly area with many steep slopes.

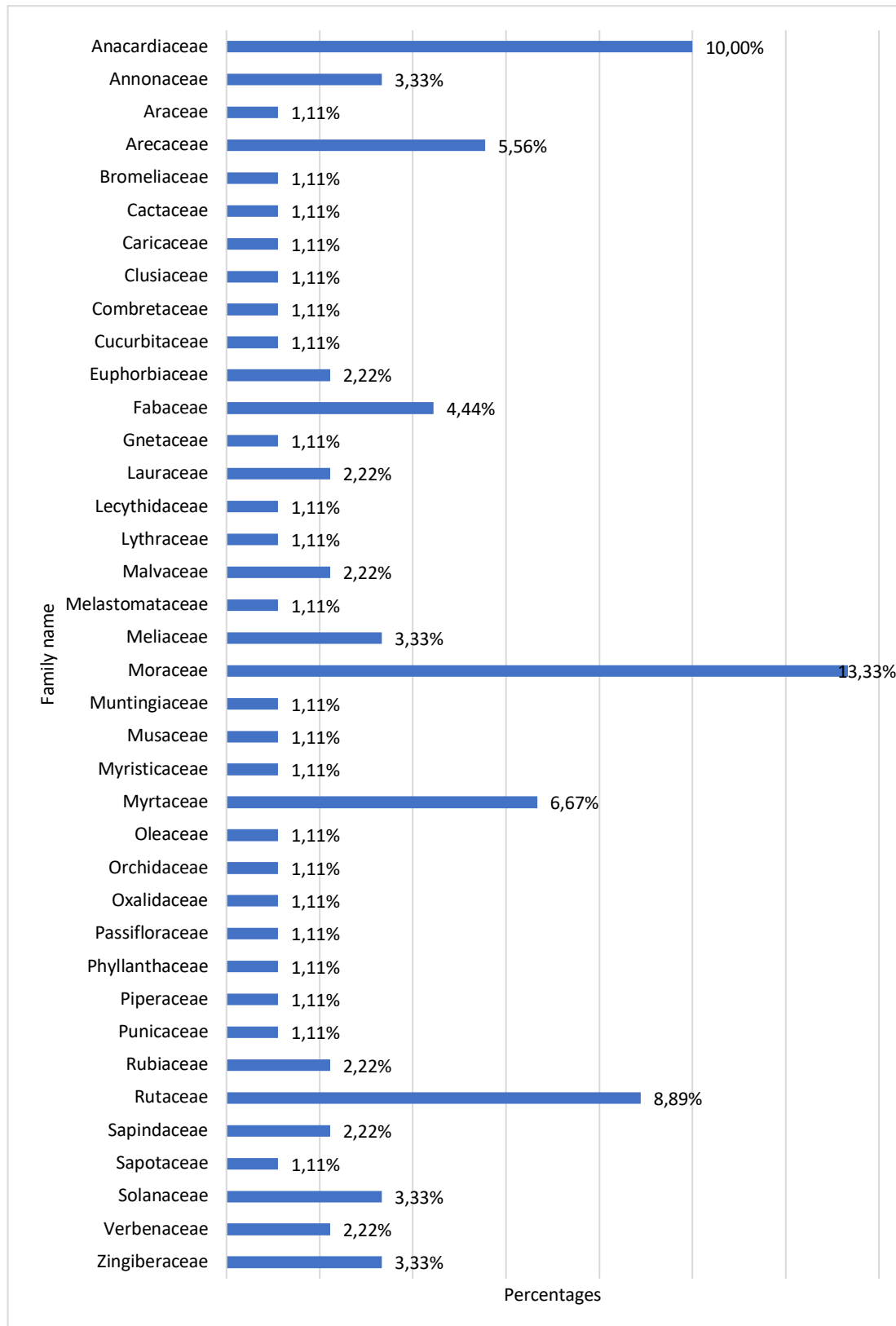


Figure 4. Fruit plant families recorded in *Kampung Dukuh*

In *Kampung Dukuh*, the deposit land is the cornerstone of fruit cultivation practices, with 83.82% of fruit plants thriving on this land type, followed by the arable land (11.93%) then the cover land (4.26%) (Figure 5). This high percentage indicates a strong culture of household-level horticulture, suggesting that many indigenous people are actively engaged in cultivating fruit-bearing plants on their properties. These fruit plants are an important source of dietary needs and contribute to their



income. This is because indigenous people sell their fruits after being processed to the pilgrims who come every Saturday. For example, they sell *sale cau*, a traditional food made from banana fruit which is processed by exposing it to smoke from burning the wood for three days. Therefore, it has a sweet and smoky taste (Figure 6).

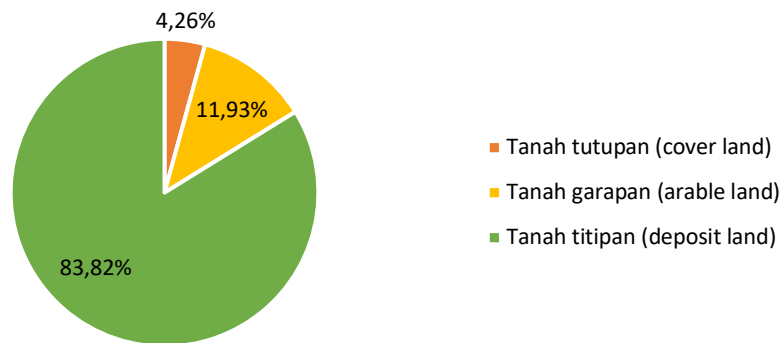


Figure 5. The area for fruit tree cultivation in *Kampung Dukuh*



Figure 6. (a) Exposing the banana fruit to smoke (b) *Sale cau*

In the arable land, fruit plants and other crops are usually planted together. Nevertheless, if it is concerning to rice fields, it will only cultivated with limited and selected fruit plants such as *Parkia speciosa* and *Mangifera indica*. The indigenous peoples understand that the rice plants require a lot of sunlight. If many fruit trees are cultivated near the rice field they will affect the rice harvest and quality of the grains. Therefore, fruit trees are only sparingly present in the arable land. Meanwhile, a good number of fruit trees are present in the cover land, including *Garcinia mangostana* and *Stelechocarpus burahol*. Many wildlife, particularly the bird species, was encountered at the cover land during the survey trip, suggesting that the area is rich with fruit tree species and therefore attracted a good number of bird species.

#### The indigenous practices for the cultivation of fruit plant

In *Kampung Dukuh*, every activity is intimately tied to their strong adherence to ancestral customs, perpetuated through generations, particularly those intertwined with nature-related activities. Mama Uluk said, "*Jalan perkawis adat, ari setiap adat pasti ngagaduhan fungsi atanapi ciri anu nyangkut kana alam. Atos sakedahna urang adat tiasa ngutarakeun fungsi-fungsi adat*". This statement emphasizes that in every indigenous society, there is a set of customary rules regarding nature. We must communicate the role and purpose of these customary regulations to the generations. Those who violate customary rules in *Kampung Dukuh* face the penance of fasting for 40 days and seeking forgiveness from God. If despite repentance, the transgression persists, the individual may incur calamity. In the context of cultivating fruit trees, there is a customary rule to conduct several rituals that aim to seek blessings and divine favor from God Almighty, as outlined below:

##### *Sateuacan melak tatangkalan* (Preparation before planting)

Indigenous people in *Kampung Dukuh* obtain fruit plant sources through various methods, including collecting seeds from partially eaten fruits left over or abandoned by fruit-eating animals. Some frugivores that can be found in *Kampung Dukuh* are squirrels, monkeys, and gibbons. Grafting is also carried out to obtain the seedlings of cultivars or hybrid fruit plants that bear infertile seeds. Besides, the indigenous people also often acquire seedlings through barter with neighbors within the

same village, purchased from farm shops, or contributed by government programs. Fruit tree seedlings obtained from the government or farm shop are usually in polybags. The seedlings acquired from farm shops or provided by the government will be sun-dried for one week before planting. This practice aims to help the plants acclimate to the conditions in *Kampung Dukuh*. The seedlings will be stored temporarily in the house if the farmers have no time to dry them under the sun (Figure 7). Before planting, the indigenous people will determine an auspicious day by consulting the elderly in the village. Or else, a farmer can plant it on the day he or she was born. For instance, if the farmer is born on a Monday, then he or she is advised to plant the fruit plants on Monday as well, but avoiding his or her parent's death anniversary. This day counting system is also known as *naktu weton* in Sundanese and Javanese cultures (Umbara *et al.* 2021), and if planting is carried out on an inauspicious day it will hinder the fruit plant from growing well.



Figure 7. Sun-dried plant seedling

Subsequently, a suitable location for planting will be selected, usually is either at the arable land or the deposit land. Larger plants like *Durio zibethinus* or *Mangifera indica* will be planted on arable land, namely the mixed garden. Nevertheless, it is worth noting that some indigenous people opt to plant them in their deposit land, if there is ample space available to them. Indigenous people carefully select arable land (mixed garden) for planting fruit trees, favoring fertile black soil that is loose and free of stones. They then clear away weeds by cutting them with a sickle or manually uprooting them. After that, they prepare holes for the fruit tree seedlings. Slightly larger planting holes will be prepared and then filled in with fermented manure or dried leaves gathered from the surroundings. These holes with organic materials will be left for a week before the seedling is planted. This practice allows some time for the organic materials to permeate and integrate well with the soil (Sundari & Abdulloh, 2019; Russo *et al.* 2020), then forming beneficial humus (Salawati *et al.* 2022) for the seedlings. Besides, the indigenous people believe that doing this will improve aeration and encourage root growth (Salawati *et al.* 2022). However, some indigenous people prefer to plant the fruit tree directly without waiting for a week. They will add fertilizer around the roots before covering them with soil.

#### *Melak tatangkalan* (The tree planting process)

The farmer recites prayers or mantras when planting the fruit tree, meanwhile, there is a mantra specific for the bananas. The mantra is not shared with outsiders or people not originating from *Kampung Dukuh* and it is considered as a confidential tradition. Seedlings obtained from seeds, cuttings, or through exchanges with neighbors can be directly planted in the planting holes. Seedlings that come from neighbors are usually freshly revoked from the arable land (rice fields and mixed gardens) or home gardens. When revoking the seedlings, they ensure the soil ball around the roots is not damaged. Likewise, when they obtain the seeds from the government or a plant shop, which are usually already planted in polybags, they will carefully remove the polybags without disturbing the soil and root ball. They believe that the roots have a strong relationship with the soil where they were first grown, thus disturbing or discarding the soil in a polybag will harm the seedlings and cause mortality. This is also to ensure that the plant's roots can better adapt to a new environment after transplanted, helps in establishing a connection between the roots with the new planting site, and minimizes stress on the plant during the transplant process.

*Ngurus tatangkalan* (Caring for fruit plants)

Caring for fruit plants includes applying fertilizer, eradicating pests or weeds, and rituals if the plants do not bear fruit. The indigenous people in *Kampung Dukuh* often source for organic fertilizer, for instance, the *angrum* (*Gliricidia sepium*) leaves, banana pseudostem, firewood ashes, and animal manure. The indigenous people in *Kampung Dukuh* use the tiny leaflets of *G. sepium* as compost by spreading them around the plant base (Figure 8). The application of a banana pseudostem is conducted by cutting it into small pieces and sprinkling it around the plant base. There are no specific rules regarding the correct time to use these fertilizers, but they are usually applied during the dry season as ground cover to help maintain the ground humidity. The firewood ashes originated from the kitchen; the ashes will be collected after they have cooled down and sprinkled around the plant base and exposed roots (Figure 9). Usually, the common firewoods are stems and branches of *rambutan* (*Nephelium lappaceum*), *kadu* (*Durio zibethinus*), or other types of wood that are not used as building materials and are forbidden to burn openly. One of the plants that should not be used as firewood is *peuteuy* (*Parkia speciosa*). Indigenous peoples believe they will be struck by misfortune if they have accidentally used it. For instance, the eldest boy in the family will have difficulty finding a mate when he grows up and other *P. speciosa* trees owned by the family would never bear fruit.

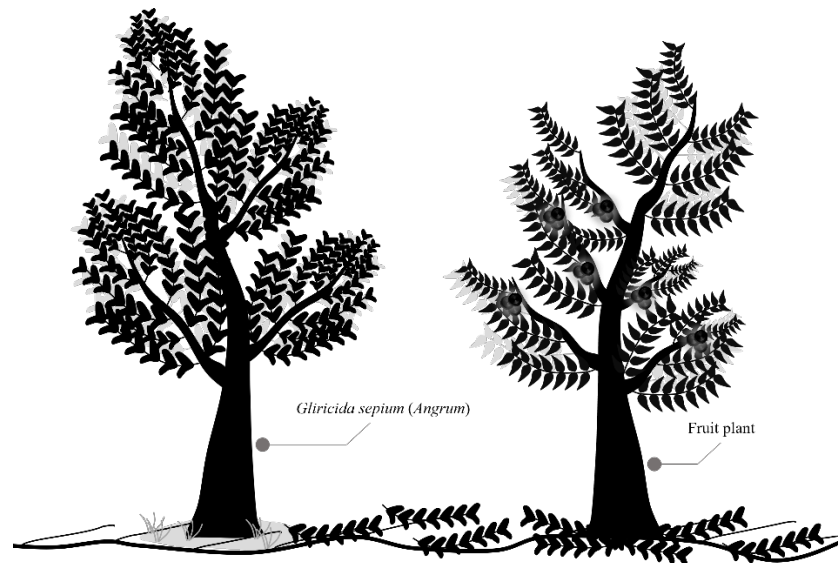


Figure 8. An illustration of the use of *G. sepium* as a fruit tree fertilizer in *Kampung Dukuh*



Figure 9. (a) Cooking using firewood (b) Firewood ashes as fertilizer

Animal manure is commonly used as a fertilizer by indigenous peoples in West Java (Komariah 2016; Kusmarni & Holilah 2018; Anggraeni *et al.* 2023). The indigenous people in *Kampung Dukuh* use poultry such as chicken, duck, and goat manure. The manure needs to be fermented for several weeks before being applied to the plants. After that, they will spread around the tree base and exposed roots. However, fruit plants in the yard are usually planted close to the poultry coop so their droppings fall directly to the ground (Figure 10). According to Adekiya and Agbede (2017), manure application must be adjusted to the fruiting period of these plants. If the plant has a short growing season, fertilization should be conducted a few weeks before planting. Thus, the release of nutrients contained in manure does not pass the plant's growth period. For example, to produce tomato (*Lycopersicon esculentum*) with high-quality fruit, the best time to apply poultry manure is three weeks before planting. If fertilization is conducted in six weeks (42 days) after planting, it will not be effective because *L. esculentum* is only growing for 90 days.



Most of the indigenous people in *Kampung Duku* use diluted table salt in pest control. A certain amount of diluted table salt is carefully sprayed on plant parts that are attacked by pests, where overapplying may accidentally kill the plant. According to Rathore *et al.* (2021), salt can be used to kill grubs and prevent beetles from entering the stem part and laying eggs. Nevertheless, there is not enough evidence to suggest table salt as a natural insecticide (Ojianwuna & Enwemiwe 2021). Meanwhile, some indigenous people in *Kampung Duku* do not eradicate pests because they believe pests are also God's creatures who have the right to live. They believe that if they give sustenance to God's creatures, then God will provide other sustenance to them.



Figure 10. (a) Duck coop around the banana plant (b) Chicken coop (c) Pomelo tree planted behind the chicken coop (d) Pomelo fruits

If all the above efforts have been carried out but the trees are still unsuccessful in bearing fruit, the indigenous people in *Kampung Duku* will carry out several rituals. The timing of this ritual is according to the needs and beliefs of the plant owner. First, they prune away the terminal stem and a few branches then cover the pruning parts using black plastic to prevent the plant from being attacked by pests. They believe pruning will help to balance the vegetative and reproductive growth and ensure light is distributed evenly to the branches near the tree's canopy. Second, scoring the plant stem using a machete. Scoring is a technique commonly used to remove small portions of plant bark. It aims to manipulate the distribution of photosynthesis products and other compounds so that they accumulate at the top of the scoring zone (Christopoulos *et al.* 2021). Third, tie or ring the plant stem using a stolen bra strap. This is equivalent to girdling, a common practice to regulate plant growth, promote flowering, and fruit development by ringing the tree trunk (Chai *et al.* 2021). It is the indigenous belief that a stolen bra strap works more effectively than any girdling method and causes no harm to the tree (Figure 11).



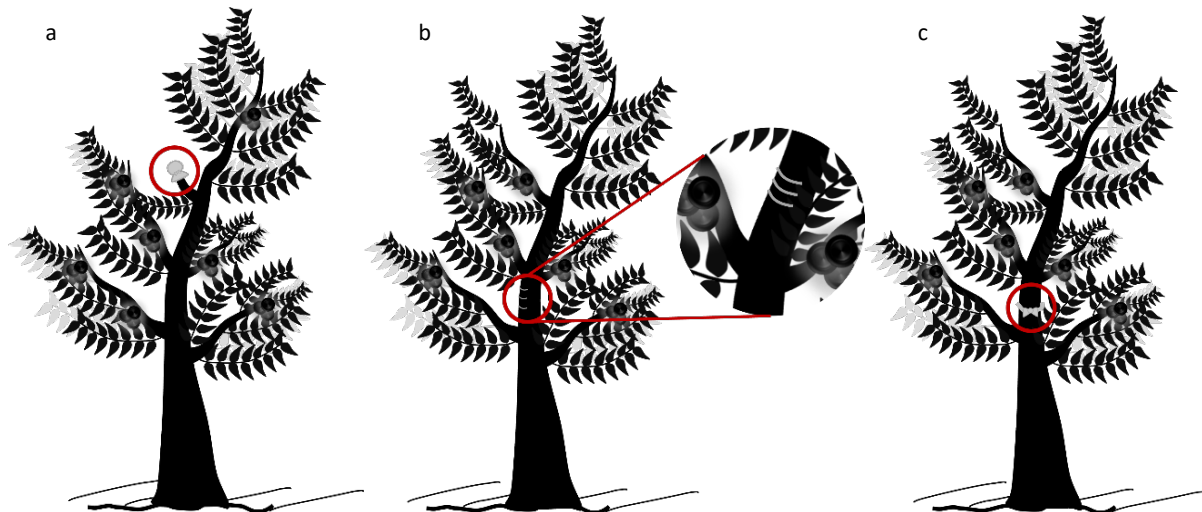


Figure 11. (a) Pruning and covering it using a plastic bag (b) Scoring (c) Girdling

#### *Panéén buah (Fruit harvesting)*

In *Kampung Dukuh*, the fruit plant was harvested, handled, and processed using traditional methods at the household level. The timing for harvesting depends on the species and maturity of the fruit. Before harvesting, indigenous people will consult the elderly for a good day to harvest and recite a special prayer so that the harvest will be blessed. Traditional harvesting methods include collecting fruits with a net, plucking fruits from branches, and picking up fallen ripe fruits on the ground. After harvesting, the fruits must first be shared with the elderly and neighbors before self-consumption. It aims to make the harvest blessed and therefore, there will be a better harvest next time.

## Conclusions

In conclusion, the indigenous people of *Kampung Dukuh* have developed a sophisticated system for understanding and managing their environment, which is divided into five distinct zones: cover land, deposit land, arable land, forbidden land, and reserve land. This traditional knowledge has fostered a remarkable diversity of fruit plants, with 587 individual plants identified, representing 90 species across 38 families. The Moraceae family is the most prevalent, followed by Anacardiaceae and Rutaceae. The cultivation of these fruit plants is a comprehensive process that includes site preparation, planting, tree care, and harvesting, reflecting the community's deep-rooted agricultural practices and sustainable interaction with their environment. This intricate system not only sustains the biodiversity of the area but also preserves the cultural heritage and ecological balance crucial for the well-being of *Kampung Dukuh's* inhabitants.

## Declarations

**List of abbreviations:** BPS = *Badan Pusat Statistik* (Central Bureau of Statistics), Perhutani = *Perusahaan Hutan Negara Indonesia* (Indonesian State Forestry Company)

**Ethics approval and consent to participate:** This research received approval from each local government, ensuring that all research procedures adhered to ethical standards. All participants provided informed consent before participating in the study.

**Consent for publication:** All informants involved have agreed to publish their data for non-commercial use, and their consent for publication was obtained as a part of the overall informed consent process.

**Available data and materials:** The manuscript contains all the data.

**Competing interests:** The authors declare that they have no competing interests relevant to this research.

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**Authors' contributions:** AA, RY, and YKT designed the research. AA and EHH conducted the fieldwork. AA conducted the quantitative analysis. AA and EHH wrote the draft of the manuscript. AA, YKT, and WS revised the data analysis and the manuscript. All authors thoroughly read, revised, and approved the final draft of the manuscript.

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