

Kawung: Landraces, management, uses, and conservation based on moral versus economic interest among Outer Baduy community, South Banten, Indonesia

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Abstract. Iskandar BS, Iskandar J. 2021. Kawung: Landraces, management, uses, and conservation based on moral versus economic interest among Outer Baduy community, South Banten, Indonesia. *Biodiversitas* 22: 5572-5584. The sugar palm or *kawung* (*Arenga pinnata* (Wurm) Merr.) has naturally or semi naturally grown in many rural areas of Banten and West Java. The sugar palm has social, economic, cultural, and ecological benefits for rural communities, but its population has dramatically decreased. This study aimed to access the knowledge, traditional management, uses and traditional conservation of sugar palm. This research used a qualitative method with an ethnoecological approach. The results showed that the Outer Baduy community has a rich knowledge of sugar palm. Two landraces of sugar palm are recognized by Outer Baduy mainly *kawung gedé* and *kawung salompét*. They have not intensively cultivated the sugar palm, but managed the *kawung* seedlings which grow naturally or assisted by civet or *careuh* in traditional agroforestry systems, including *huma*, *reuma*, *leuweung lembur*, and *leuweung kolot*. The weeds growing surrounding the seedlings are cleared, and then the seedlings will grow naturally and finally develop to mature trees. The sugar palm has been traditionally used for ecological, socio-economic, and cultural functions. The Outer Baduy community has traditionally conserved the sugar palm which grows in traditional agroforestry systems. The sugar palm trees, fruits, and the stems have never been cut, used as the sweetmeats, and made into sago flour, respectively, while the civets which have assisted distribution and regeneration of the sugar palm have never been hunted, and their habitat has never been destroyed.

Keywords: Ethnoecology, *kawung*, Outer Baduy community, traditional ecological knowledge

INTRODUCTION

The sugar palm plant (*Arenga pinnata* (Wurm) Merr.) is recognized as a native plant species to the Indo-Malayan archipelago, with its distribution center in Indonesia (Mogea et al. 1991). Since Indonesia has been the center of the sugar palm distribution, this plant can be found widely in many rural areas in Indonesia, including Java, Madura, Bali, Nusa Tenggara, Sumatra, Kalimantan, Sulawesi and Papua. This sugar plant has various local names in various ethnic groups in Indonesia, such as *kawung* (Sunda), *aren* (Jawa, Madura), *hano* (Bali), *pola* (Sumbawa), *kalotu* (Sumba), *nao* (Bima), *maoke* (Flores), *nau* (Timor), *hanau* (Kerinci), *poula* (Mentawai), *peto* (Nias), *bargot* (Mandailing), *ujuk* (Gayo), *pola* or *paula* (Karo), *bagot* or *agaton* (Toba), *bak jug* (Aceh), *seho* (Manado), and *sageru* (Maluku) (Kurniawan et al. 2018).

Among the plant species of the Arecaceae family, sugar palm (*A. pinnata*) is known as one of the multipurpose trees (MPTs) for the rural communities in Indonesia. Sugar palm provides social, economic and cultural benefits to rural communities in various parts of Indonesia, for example, the production of palm sugar, palm wine (*tuak*), sweetmeat (*kolang kaling*), palm flour (*sagu*), roof

material, palm fiber brooms, stick brooms, cigarette paper, traditional medicine, botanical pesticide, and traditional ceremonial materials (Fatriani et al. 2012; Iskandar and Iskandar 2017; Amrul et al. 2018; Anwar 2018; Erawan et al. 2018; Azhar et al. 2019; Sujarwo et al. 2020; Iskandar 2021; Ratnani et al. 2021; Withaningsih et al. 2021).

Although sugar palm has many benefits for rural people in Indonesia, in general this plant has not been cultivated by the rural people. It grows naturally, and its regeneration in various rural ecosystems is mainly assisted by the common palm civet, *careuh* or *luwak* (*Paradoxurus hermaphroditus* Pallas, 1777) (Surya et al. 2018; Withaningsih et al. 2019; Zuhud et al. 2020) because the common palm civet, in addition to eating other animals, also loves eating various fruits, including Arabica coffee (*Coffea arabica* L.), *kondang* (*Ficus variegata* Blume), and sugar palm. Since the common palm civet has predominantly eaten the palm sugar palm fruits, the feces of this animal usually contains a lot of the sugar palm seeds that can potentially germinate and grow into seedlings of the sugar palm in nature (Subrata and Syahbudin 2016).

Like in other rural areas in Indonesia, sugar palm in many rural areas in Banten and West Java grows naturally or semi-naturally in various land uses, including

homegardens, mixed-gardens, swidden farmings, and forests (Iskandar 2012; Febriyanti et al. 2017; Gunawan et al. 2018; Withaningsih et al. 2019). The population of sugar palm in rural areas of Banten and West Java is determined by inputs and outputs to stock of the sugar palm population. Inputs for population level of the palm sugar is determined predominantly by natural regeneration rate, while outputs is determined by natural death, exploitation rate, and conversion rate of land uses that are grown with sugar palm to other land use types. Because the exploitation of the sugar palm both for home industrial activities, including making palm sugar, sweetmeat and palm flour and intensive conversion of land uses having the sugar palm has rapidly increased and population of the common palm civet has decreased, the population of sugar palm is getting lower in rural ecosystems. In other words, the input rate is lower than the output rate. Moreover, the decreasing or even disappearance of the sugar palm in rural areas of Banten and West Java may cause the decreasing or disappearance of various functions of the sugar palm for rural people.

Unlike the Sundanese people in general, the traditional Baduy people who reside in Kanekes Village, Leuwidamar District, Lebak District, South Banten, have traditionally conserved the *kawung* in their village based on the Traditional Ecological Knowledge (TEK) strongly embedded with their culture. So, it can be seen that there is a strong relationship between cultural factors, such as local language, the TEK and the biodiversity conservation of the Baduy (Franco et al. 2015; Hidayati et al. 2017). Given the ecological and cultural importance of *kawung*, it may be considered as cultural keystone species of Baduy rural ecosystems (Garibaldi and Turner 2004; Ellen 2006; Platten and Henfrey 2009; Coe and Gaoue 2020).

The purpose of this study was to assess the knowledge of the Outer Baduy on *kawung* landraces, *kawung* management, various uses of *kawung*, and traditional *kawung* conservation.

MATERIALS AND METHODS

Study area

The study was undertaken in 3 hamlets of Outer Baduy, namely Kaduketug, Babakan Marengo, and Gajeboh, Kanekes Village, Leuwidamar Sub-district, Lebak District, Banten, West Java (Figure 1).

Baduy has a total area of about 5,136.58 hectares. About 3,000 hectares (58 %) of the land area is designated as protected forest, and approximately 2,136.58 hectares (48%) as swidden field and secondary fallowed land, and settlement. The Baduy area has been established as customary land (*tanah ulayat*) by the local government of Lebak District, Banten since 2000 (Iskandar 2012).

Baduy area is located in village of Kanekes, sub-district of Leuwidamar, district of Lebak, province of Banten, Indonesia and resided by the Sundanese traditional people called Baduy people. Traditionally, Baduy can be divided

into two areas: Inner Baduy (*Baduy Jero* or *Baduy Dalam*) and Outer Baduy (*Baduy Luar* or *Baduy Panamping*), which is based on village administrative.

Inner Baduy consists of 3 hamlets, namely Cibeo, Cikartawarna, and Cikeusik. Meanwhile, Outer Baduy consists of more than 60 hamlets, located predominantly in the northern part of Kanekes village which surrounds the Inner Baduy. Traditionally the Inner Baduy people hold custom or *adat* stronger than the Outer Baduy people. The Baduy informal leader, called *Puun*, consists of *Puun* Cibeo, *Puun* Cikartawarna, and *Puun* Cikeusik who resides in hamlet of Cibeo, Cikartawarna, and Cikeusik, respectively. The total population of Baduy in 2018 was 11,710 people, representing 3,414 households, consisting of about 83 % of the Outer Baduy people, and only 17 % of the Inner Baduy (Statistical Data of Kanekes Village 2018).

The Baduy people live mainly as swidden farmers (*peladang* or *pahuma*), but they have additional livelihoods. The women are mainly involved in weaving cloth, while the men make traditional knitted bags, *jarog* and *koja*, made from bark fibers of *teureup* (*Artocarpus elasticus* Reinw. ex Blume) (Figure 2), and, for outer Baduy people only, make palm sugar (*gula kawung*) by tapping peduncles of *kawung* because the Inner Baduy people are traditionally prohibited from making palm sugar.

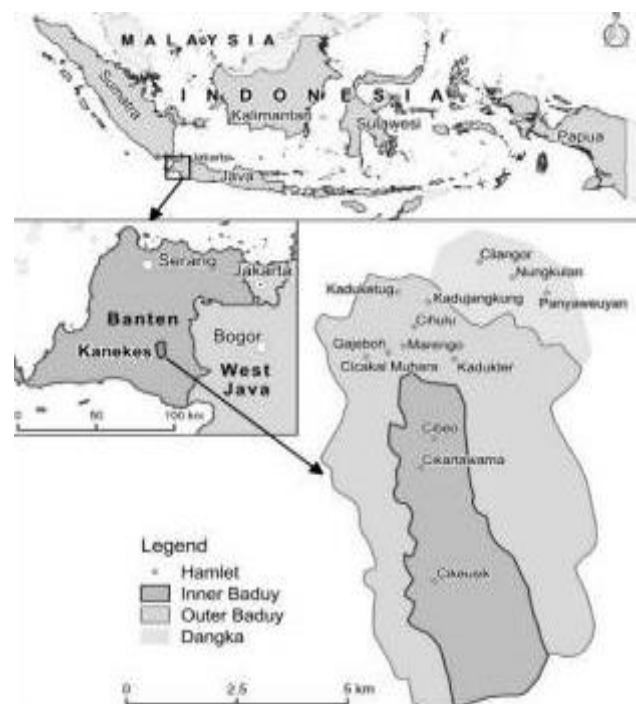


Figure 1. Study sites in hamlets of Kaduketug, Marengo, and Gajeboh, Outer Baduy, Kanekes Village, Leuwidamar Sub-district, Lebak District, Banten Province, Indonesia (Adapted from Iskandar and Ellen 1999)



Figure 2. A. A woman is weaving cloth, B. A man is knitting traditional bag, and C. The traditional bags and the traditional woven cloths are being displayed in Outer Baduy house for trading to visitors who come to Baduy area

Procedures

The method used in this study was qualitative with the ethnoecological approach (Albuquerque et al. 2014). Some techniques, including observation, participant observation, and deep interview were employed to collect primary data (Newing et al. 2011; Albuquerque et al. 2014).

As the first step to any ethnobotanical or ethnobiological research, concerns seeking, rapport building, and ethical considerations are important. In accordance with requirement of ethics, we were careful to ensure the rights of individuals were not infringed upon. The research permit letter was obtained from the University of Padjadjaran and district of Lebak. At the beginning of the field study, we reported and asked permission for the research plan to the village leader and his staff at the house of formal village leader (*Jaro Pamaentah*) and at the same time looked for houses of the Outer Baduy that could be used as base camps during the field research. Three hamlets, namely Kaduketug, Babakan Marengo, and Gajeboh were chosen for study area because they are located quite close together and many Outer Baduy households in these hamlets own sugar palm trees and make palm sugar industries in their home. During our fieldwork, between 2015 and 2017, we undertook several field visits, and in each visit we stayed for about a week in the Outer Baduy home.

The field observation was carried out to observe the local environment, including the human settlement or hamlet, village forest (*leuweung lembur*), swidden field (*huma*), fallowed secondary forest (*reuma*), and protected mature forest (*leuweung kolot*). In addition, observation was done to observe informant activities, including tapping the peduncles of *kawung*, boiling the juice, molding sugar using wooden molds, and wrapping the palm sugar.

Participant observation was undertaken during which the researchers accompanied an informant both to observe what he did and said, and also participated in some activities, including going to swidden field to tap the peduncles of *kawung*, and going to the informant house to observe and participate in boiling the juice of *kawung* sugar, and so on. While the deep interviews were employed with informants that were purposely selected based on their competence with considering the diversity of informants. Total informants were 16 people, consisting of the village leader (*Jaro Pemerintah*), secretary of village leaders (*Carik Desa*), hamlet informal leaders (*Kokolot Lembur*),

kawung owners, tapper and maker of *kawung* palm sugar, and village middlemen. They reside in Outer Baduy hamlets, including hamlets of Kaduketug, Babakan Marengo, and Gajeboh. In the deep interview with informants, the informants gave extensive responses to a series of general questions, some of which had been prepared in advance and some of which arose naturally during the conversation. Some aspects were intensively discussed with informants, namely *kawung* landraces, utilizations, and conservation of *kawung*.

Data analysis

Data were analyzed in some stages, including cross-checking, summarizing, synthesizing, and made narrative (Newing et al. 2011). The cross-checking was done to validate the data collected with observation, participant observation, and deep interview. The valid data were summarized and synthesized. Moreover, it was made narrative with descriptive and evaluative analysis.

Some literatures, including Backer et al. (1968) and Heyne (1987) were used to identify plant species that were used to make utensils, preservatives, and firewood to make the palm sugar. In addition, some plant species were identified in the plant taxonomic laboratory of the Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Padjadjaran, Sumedang, Indonesia.

RESULTS AND DISCUSSION

Knowledge of *Kawung* landraces

Based on botanical classification formulated by ethnobotanists, including Rapini (2014) and Iskandar (2018), the Outer Baduy community knows *kawung* very well in 4 level (Table 1).

At a level of unique beginner (level 0), the Outer Baduy people usually distinguish the terms for cultivated plant species which are commonly called *pepelakan* (crops) and species of wild plants called *tutuwuhan* (plants). However, since the *kawung* is not specially planted in various land use types of Outer Baduy, this plant is considered plants (*tutuwuhan*) instead of crop (*pepelakan*).

Table 1. Folk botanical classification of *kawung* based on Outer Baduy community

Level	Class			Rank
	Baduy term	Indonesian term	English term	
0	<i>Tutuwuhan</i>	<i>Tumbuh-tumbuhan</i>	Plant	Unique beginner
1	<i>Tangkal/Kakayon</i> *)	<i>Pohon</i>	Tree	Life form
2	<i>Kawung</i>	<i>Aren</i>	Sugar palm	Generic/species
3	<i>Kawung gedé</i>	<i>Kawung besar</i>	Big sugar palm	Varietal
4	<i>Kawung salompét</i>	<i>Kawung kecil/Salompét</i>	Little palm sugar	

Note: *)In Sundanese of non-Baduy, *tangkal* can also called *palem* tree

Table 2. Outer Baduy vocabulary of *kawung* (*Arenga pinnata*) partonyms

Baduy term	Indonesian term	English term
Leaves:		
<i>Daun</i>	<i>Daun</i>	Leaf
<i>Pucuk daun kawung</i>	<i>Pucuk daun aren</i>	Young leaf of <i>kawung</i> palm
<i>Daun kawung</i>	<i>Daun aren</i>	Leaf of <i>kawung</i> palm
<i>Palapah daun</i>	<i>Pelepah daun</i>	Leaf midrib
<i>Injuk</i>	<i>Ijuk</i>	Fiber from leaf
Reproductive parts:		
<i>Kembang kawung</i>	<i>Bunga aren</i>	Flower of Sugar palm
<i>Leungeun kembang</i> (see Figure 3)	<i>Tangkai bunga aren</i>	Stalk on which fruit grow
-Gelap	-Tangkai bunga aren ke 1 dari atas	-First stalk from upper
-Adi gelap	-Tangkai bunga aren ke 2 dari atas	-Second stalk from upper
-Caruluk	-Tangkai bunga aren ke 3 dari atas	-Third stalk from upper
-Jenah	-Tangkai bunga aren ke 4 dari atas	-Forth stalk from upper
-Bulu kélék	-Tangkai bunga aren ke 5 dari atas	-Fifth stalk from upper
-Béngkél	-Tangkai bunga aren ke 6 dari atas	-Sixth stalk from upper
<i>Caruluk</i>	<i>Buah aren</i>	Fruit of sugar palm
<i>Harupat/injuk aren</i>	<i>Ijuk aren</i>	Black fiber
Stem:		
<i>Tangkal</i>	<i>Pohon</i>	Trunk
<i>Sagu</i>	<i>Sagu, Tepung aren</i>	Flour of trunk core
Roots:		
<i>Akar</i>	<i>Akar</i>	Roots

At the life form level (level 1), based on the Outer Baduy community, plants can be divided into some types, including *kakayon* or *tangkal* (tree), *jukut* (grass), *rungkun* (bush), and *areuy* (vine). One example of *tangkal* or *kakayon* (tree) is 1 *kawung*, included at generic level (level 2). The Sundanese of non-Baduy recognize species of *tangkal palem* (Palmae trees), including *kawung* (*A. pinnata*), *kawung monyét*, *saray* or *langkap* (*Caryota mitis* Lour.), *jambé* or *pinang* (*Areca catechu* L.), and so on.

We use the word *landrace* which is applied by scholars, including Soemarwoto and Iskandar (2021) to distinguish local categories of *kawung* variations, based on knowledge of Outer Baduy people, with Western botanical sense. The *landrace* is different from the botanical scientific in that it is based on category for subdivision of ancestral plant varieties in the conventional Western taxonomic sense.

Based on Outer Baduy, *kawung* is categorized into two *landraces* at varietal level (level 3): *kawung gedé* (big *kawung*) and *kawung salompét* (small *kawung*). *Kawung gedé* has the following characteristics, namely having tall trunk, big trunk diameter, lot of fruit, and may be tapped

producing lot of juice. Meanwhile, *kawung salompét* has the following characteristics: having short trunk, small trunk diameter, little fruit, and can be tapped producing little juice, but adapted to shaded place.

The Sundanese people of Cipanggulaan community of Karyamukti Village, Cianjur, West Java is similar to Outer Baduy community in that they divide *kawung* into two *landraces*, namely *kawung cibuy* and *kawung alit* or *kawung saéran* (Gunawan et al. 2018). However, Rancakalong Sundanese community of Rancakalong Village, Sumedang, West Java, is different from the Cipanggulaan and Outer Baduy. They divide *kawung* into 4 *landraces*: *kawung ageung* or *kawung gedé*, *kawung kembang*, and *kawung monyét*. *Kawung ageung* or *kawung gedé* has these characteristics: it has tall trunk, big trunk diameter, lot of fruits, can be tapped, and usually grows in open vegetation canopy. *Kawung kembang* has the following characteristics: it has tall trunk, big trunk diameter, little fruits, can be tapped or cannot be tapped, and is adapted to living under shading vegetation canopy. *Kawung saéran* has characteristics: having short trunk,

small trunk diameter, moderate amount of fruit, can be tapped, and adapted to living under shading canopy. While *kawung monyét* has characteristics: short trunk, small trunk diameter, little amount of fruit, cannot be tapped, and adapted to living under shading canopy. Botanically, the three landraces, namely *kawung angeung*, *kawung kembang*, and *kawung saéran* are identified as *A. pinnata* (Wutmb) Merr.); however, *kawung monyét* is identified as *C. mitis*, family *Arecaeae* (Iskandar 2018).

Based on patronym that refers to the phenomenon of referring to part of a whole through specialized term (<https://www.wordsense.eu/partonym/2> May 2021), the various parts of *kawung* are distinctively given names, including *daun* (leaf), *injuk* (fiber from leaf), *tangkal* (trunk), *sagu* (trunk core), *kembang* (flower), *caruluk* (fruit), and *leungeun* (stalk) (Table 1). Moreover, stalk itself can be divided into six different types, from upper to lowers in succession, namely *gelap*, *adi gelap*, *caruluk*, *jenah*, *bulu kélék*, and *béngkél*, respectively (Figure 3).

It can be seen from Table 2, Outer Baduy and Cipanggulaan community, Karyamukti village of Cianjur all have rather similar local terms of *A. pinnata* parthonyms, such as *daun* (leaf), *kembang* (flower), *buah caruluk* (fruit), *leungeun* (stalk), *tangkal* (trunk), and *akar* (root) (Gunawan et al. 2018).

In terms of stalk, however, Outer Baduy and Cipanunggalan community are dissimilar in that Baduy community has more terms than Cipanggulaan, Cianjur on stalk. The stalk of *kawung* can be divided by Baduy Community into different types, i.e., *gelap*, *adi gelap*, *caruluk*, *jenah*, *bulu kélék*, and *caruluk* (Figure 3).

Traditional management of *kawung*

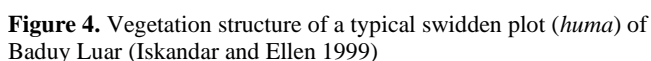
Kawung grows naturally or semi-naturally in various agroforestry traditional of Outer Baduy, including *huma*, *reuma*, *leuweung lembur*, and *leuweung kolot*. Particularly, *kawung* trees are predominantly found in the *huma* agroforestry traditional systems. The initial *kawung* trees have predominantly been grown in *huma* as follows: at the time of the land preparation for swidden farming (*huma*), all undergrowth vegetation of mature secondary forest was cut down totally. Meanwhile, some economically-valuable perennial plants, including *kadu/durian* (*Durio zibethinus* L.), *peuteuy/petai* (*Parkia speciosa* Hassk.), *jengkol* (*Archidendron pauciflorum* (Benth.) I.C.Nielsen), *mangga* (*Mangifera indica* L.), *kaweni* (*Mangifera odorata* Griff.), *kalapa* (*Cocos nucifera* L.) and *kawung* (*A. pinnata*) are only pruned by cutting the branches and twigs, and left to grow mixed with paddy crop and other annual crops later in the *huma* system. For example, the *kawung* trees at the time of clearing of the mature secondary forest are not cut down, but only the midrib leaves are cut, leaving young leaves and stalk of *kawung* on which fruit grow.

All vegetation biomass cut is left to dry by sunlight. After drying, it is collected into several piles and burned to produce organic fertilizer. During the burning of the vegetation biomass, the *kawung* fruit that falls to the ground around the palm trees is also burned. Some of the *kawung* seeds, however, are burned without being damaged, even breaking the dormancy. At the start of the

rainy season, the land that has been cleared is planted with the upland paddy crop (*Oryza siva* L.) and other annual crops, including *hiris* (*Cajanus cajan* (L.) Huth), *kacang penyut* (*Vigna sinensis* (L.) Savi ex Hassk.), *dégéng* (*Setaria viridis* (L.) P.Beauv.), *hanjeli* (*Coix lacryma-jobi* L.), *jagong* (*Zea mays* L.), *bonténg* (*Cucumis sativus* L.), *kumili* (*Coleus rotundifolius* (Poir.) A.Chev. & Perrot), *tiwu* (*Saccharum officinarum* L.), and *cau* (*Musa x paradisiaca* L.). When the paddy crop begins to grow, the remnants of the undamaged burned *kawung* seeds exposed and lost their dormancy also grow mixed with the paddy and other annual crops. In order to maintain the *kawung* seedlings, usually various terrestrial weeds, such as the grasses that grow around the palm seedlings, are removed. When the paddy crops are cleared of weeds, so are the sugar palm seedlings. As the paddy crops grow taller, *kawung* seedlings also grow taller, and the mature *kawung*, whose midrib was cut during the land clearing, can regrow. As a result, *kawung* trees grow dominantly on the *huma* land forming the Baduy *huma* agroforestry system (Figure 4). Furthermore, after the harvesting of paddy in *huma*, *kawung* are allowed to naturally grow in the fallowed secondary forest, which is reopened for swidden farming system after having been left fallow for more than 3 years. The procedure for cutting down vegetation of the mature secondary forest in preparing land for swidden farming is the same as previously narrated, namely that shrubs are cut down and perennial crops trees that have economic importance, including *kawung*, are pruned by cutting the leaf midrib only.



Figure 3. Stalk on which fruit grow can be divided into 6 types from up to bottom: *gelap*, *adi gelap*, *caruluk*, *jenah*, *bulu kélék*, and *béngkél*, respectively



Based on study on *kawung* in Baduy and other rural areas of Indonesia, it is generally accepted that in general *kawung* has not been intensively cultivated by the rural people. However, *kawung* grows naturally with the help of *luwak* (Febriyanti et al. 2017; Gunawan et al. 2018; Azhar et al. 2019; Harsoyo et al. 2020; Withaningsih et al. 2021).

There were 4 species of palm (Family *Arecaceae*) that have economic value in Outer Baduy, namely *kawung* (*A. pinnata*), *kiray* (*Metroxylon sagu* Rottb.), *kalapa* (*C. nucifera*), and *jambé* (*A. catechu*). Among these four species, *kawung* has ecological, socio-economic, and cultural functions for the Baduy community (Table 3).

Kawung trees found in various biotopes in Outer Baduy play an important role in ecological functions, including soil protection against soil erosion and landslides control. This is because the *kawung* trees' roots have fibers that are very strong, deep, and scattered to protect soil erosion. In addition, *kawung* has the ability to secure water, so it can be planted in relatively dry-land areas and is important for water conservation (Iskandar 2014; Terrvana et al. 2020).

In addition to soil protection function, *kawung* has an important role in plant pollination in Outer Baduy ecosystem because many bees, including *odéng* (*Apis dorsata* Fabricius, 1793) or *nyiruan* (*Apis cerana indica* Fabricius, 1798) have usually visited the inflorescences of *kawung*, and the high diversity of bee insects are found in the field-grown with *kawung*.

Kawung has various socio-cultural functions for Outer Baduy community, including using *kawung* as raw materials of the traditional medicines, botanical pesticide, cigarette paper, roofing house and rice-barn (*leuit*), ropes, building material, firewood, traditional rituals, and folklore.

Based on the tradition of the Outer Baduy community, various health disorders considered non-serious illnesses are usually treated by using various medicinal plants. For example, one species of plant commonly used as ingredients for treating the body that feels tired and has less energy is juice of *kawung* sugar (*tuak kawung*). To prepare this traditional medicine, the procedure is a very simple, namely *tuak kawung* is mixed with areca nut (*A. catechu*) and *limus* leaves (*Mangifera foetida* Lour.) then boiled in a pan on fire stove in the kitchen. Then, the boiled water can be drunk to recover the tired body (Iskandar and Iskandar 2005; Iskandar 2021).

Unlike the Sundanese people in general, based on Baduy traditional law (*pikukuh*), Outer Baduy community is prohibited (*tabu* or *teu wasa*) to plant paddy in the irrigated paddy field (*sawah*). Conversely, practicing the swidden farming (*ngahuma*) is considered an obligation in the Baduy religion and can be considered their cultural identity. Since the land is considered sacred, some taboos, including hoeing the soil, applying modern rice seeds, employing inorganic fertilizers, and using synthetic pesticides are applied in the swidden system. Therefore, Outer Baduy community has been applying the organic farming and LEISA (Low External Inputs and Sustainable Agriculture) in their practice of swidden farming, recently promoted as new paradigm of Western knowledge after failure of the Green Revolution which emphasized the high inputs from outside of the village ecosystem and must be expensively purchased by farmers (Reijntjes et al. 1992).

Table 3. Various ecological, and socio-economic and cultural functions of *Arenga pinnata* among Outer Baduy community

Main function	Part of plant	Specific function
Ecological function	Root	Soil erosion and landslide control
	Bark	Pieces of midrib can be used as terraces in the <i>huma</i> for soil protection
	Flower	Source of honey bee insects
Socio-cultural function	Flower	Juice (<i>tuak</i>) is used as traditional medicine
	Flower	Juice (<i>tuak</i>) is used as botanical pesticides
	Young leaf	Young leaf is used as wrapping tobacco as cigarette paper
	Fiber from the leaf	Raw material of house and rice barn (<i>leuit</i>) roof
	Fiber from the leaf	Raw material of ropes
	Trunk	Building material of house and rice barn (<i>leuit</i>)
	Trunk	Raw material of stick
	Leaflet midrib and young leafs	Traditional ritual material of planting rice in swidden field (<i>ngaseuk huma</i>)
	Leaflet midrib	Material for ritual of offerings to the ancestors after the rice harvest (<i>ngalaksa</i>)
	<i>Kawung</i> Plant	Folklore
Socio-economic function	Inflorescences	Juice tapped for drinking (<i>tuak</i>) and material of botanical pesticide
	Inflorescences	Juice tapped for making <i>kawung</i> palm sugar (<i>gula kawung</i>)

Traditionally, to eradicate various natural rice pests of the swidden faming systems, such as *gaang* (*Gryllotalpa africana* Palisot de Beauvois, 1805), *kungkang* (*Leptocorisa acuta* Thunberg, 1783), *ganjur* (*Orseolia oryzae* Wood-Mason, 1889), and *kuuk* (insect larvae of *Holotrichia helleri* Brsk.), botanical pesticides are commonly used by Outer Baduy people. The botanical pesticide ingredients consist of a mixture of *kawung* palm wine (*tuak*), *cangkudu* fruit (*Momordica charantia* L.), *laja/galanga* rhizome (*Alpinia galanga* (L.) Willd.), *jeruk Bali* peel (*Citrus maxima* (Burm.) Merr.), green coconut water (*C. nucifera*) and stove ashes (*lebu hawu*) which are usually applied to pest control in the swidden field (*huma*) that is being planted with rice (Iskandar 2012). Thus, the effect of the smell of these botanical pesticides can repel insect pests of rice. In other words, the botanical pesticides have been functioning as a repellent to drive insect pests away from the paddy crops (Reijntjes et al. 1992). Indeed, if insect pests directly contact the botanical pesticides, the pesticides can paralyze or kill these pests.

Cigarette paper

In the past, before *kréték* cigarettes intensively penetrated to many remote villages, Baduy community, particularly Outer Baduy people predominantly used the young leaves of *kawung* to make cigarette paper. Nowadays, however, the use of *kawung* leaves for smoking by the Outer Baduy has been decreasing because *kréték* cigarettes are easily bought in the small village shops.

Traditionally, to make cigarette paper, first, the young sugar palm leaves are harvested from the *kawung*. Second, each leaf is scraped by a knife until it is thin. Third, the young *kawung* palm leaves that have been thinned are placed on the house roof for drying with the sunshine. Fourth, the dried *kawung* palm leaves are cut into pieces about 10 cm long, almost the same size as a *kréték*

cigarette. Fifth, when a person smokes, tobacco is rolled with the young *kawung* leaves, and the tip is burned, then inhaled by the smoker.

Roofing material of house and rice barn (*leuit*)

Traditionally, the Outer Baduy people still maintain traditional houses such as those of the Sundanese people in the past. The houses of the Outer Baduy community are very simple in the form of huts. Houses are built using various materials available in the local environment, such as wood, bamboo, *kiray* leaves (*M. sagu*), and *kawung* palm fibers/*injuk kawung* (*A. pinnata*). Wood is used for the pillars of the house. Bamboo is used for the walls and the floor of the house. Meanwhile, the *kawung* fibers and *kiray* leaves are mainly used for both the roof of house (*hateup imah*) and the roof of rice barn (*hateup leuit*) (Figure 5).

The *kawung* fibers are usually used as a coating for the leaves for the roof of the house and roof rice barn so that the leaves are stronger. This is possible because the rainfall does not pound directly on the *kiray* leaves on the roof of the house or the roof of the rice barn but first on the *kawung* fibers. Usually at a certain time, the *kiray* leaves along with the *kawung* palm fibers as the roof of the house and rice barn are replaced because the *kiray* leaves are damaged by exposure to rainwater and hot sun (Iskandar 2012).

Rope materials of fastening

Since the Outer Baduy predominantly uses various bio-resources to fulfill the subsistence household daily needs, the *kawung* fibers are traditionally used as raw materials to make many products, including rope. In addition to *kawung* fiber, bamboo and hoe or rattans are commonly used as rope material in Outer Baduy.



Figure 5. A. The traditional house, and B. rice barn (*leuit*) whose roofs are made of *kiray* leaves (*Metroxylon sago* Rttb.) and fiber of *kawung*



Figure 6. The traditional bamboo bridge of outer Baduy which uses *kawung* fibers for binding the bamboo

The Outer Baduy has a main river, the Ciujung River whose upstream is located in the traditional protected forest area of Cikeusik hamlet of Inner Baduy. Then, the river flows downstream through some Outer Baduy areas and non-Baduy areas. A bridge made of bamboo is built at the places where the Ciujung River of Outer Baduy must be crossed. To build the bamboo bridge they mainly use bamboo sticks, namely as a bridge or footing made of *awi gedé* (*Gigantochloa verticillata* (Wild.) Munro), and for the bridge support poles, and the handrails along the bridge they use *awi hideung* (*Gigantochloa atroviolacea* Widjaja). Meanwhile, to tie the bamboos to the bamboo bridge they use a rope of *kawung* fiber (Figure 6). Indeed, *kawung* fiber is often used as rope in Inner Based, because nail is prohibited to use in Inner Baduy.

Building material

Unlike in non-Baduy community, the *kawung* trees have never been cut down to make flour from their stem core in Outer Baduy. However, the non-productive and/or dead *kawung* trees, the logs are commonly used as various building materials, including houses and rice barns (*leuit*). Traditionally, the logs of *kawung* are usually used as a support under the floor of both the house (*palupuh*) and the rice barn.

Traditional ritual material

The Outer Baduy community in managing the swidden farming system (*huma*) uses the TEK and cosmos or belief. According to the cosmos of the Baduy people, they believe that the rice has a rice Goddess, called *Nyi Pohaci* (*Dewi Sri* in Javanese). Consequently, the *huma* farming systems are carefully managed and the local environment is maintained. To ensure the success of the rice planting, the Goddess of rice is highly respected, and almost every stage in the management of the *huma* farming systems, including planting and harvesting rice is usually accompanied by the traditional ceremonies (Iskandar and Iskandar 2017). For example, at the time of planting rice in *Huma Serang* (sacred swidden of Inner Baduy) and *Huma Jaro Dangka* (swidden of Informal leader-Jaro Dangka of Outer Baduy), a ceremony is usually conducted. The ceremony is carried out in a special place in the middle of the *huma* and for the ceremony, *sawén* is made from stem and midrib of immature leaves of *kawung* stuck in the ground with the supporting frame made of bamboo. The *sawén* place is considered sacred and used for ceremonies at the time of planting rice and harvesting *huma* rice.

At the *ngalaksa* ceremony it is also customary to use young leaves of *kawung*. *Ngalaksa* is a ceremony to make *laksa* from *huma* rice flour that has just been harvested from *huma sérang* in Inner Baduy and *huma tauladan* of *Jaro Dangka* in Outer Baduy.

At the *ngalaksa* ceremony of Outer Baduy, the Baduy men who take part in the ceremony make *téké*, *anak-anakan*, and *tutumbukan* made of sticks and *kawung* leaves. *Téké* is a tool for wrapping *laksa* in the shape of a boat, made from *kawung* palm leaves whose ends are pinned by using a safety pin of the tiny bamboo stick. Next, some of the *téké* are joined together with bamboo skewers.

Tutumbukan as a symbol of man is made of *kawung* leaflet midrib that is split and the ends are shaped like a spear. The symbol of women is *anak-anakan*, made from palm leaves cut with a knife to form a person's body. Each family participates in the *Ngalaksa* ceremony to make a number of *téké* according to the number of individuals in the family. Meanwhile, the number of *anak-anakan* is based on the number of women and the number of

tutumbakan according to the number of boys in each family. Then, *téké*, *anak-anakan* and *tutumbakan* from each family are gathered in a winnowing tray (*nyiru*) and offered to the Baduy ancestors by *Jaro Dangka* (informal leader), at a ceremony and worship of god by pronouncing *Jaro Dangka* in the forest area of the northern village where *Jaro Dangka* is settled (Iskandar 2012).

Folklore

In the Outer Baduy community, there are some stories related to *kawung*, such as the story of *anak buncit* (a child with a pot belly) and origin of *kawung* that can be tapped into sugar. In the story of *anak buncit*, it is told that a child with a pot belly who lost his mother was accompanied by his father looked for his mother to swidden field (*huma*). When *anak buncit* and his father arrived at the *huma*, they found a large animal that was suspected of being the killer of the *anak buncit*'s mother. When they took shelter under a *kawung* tree, they heard a magical voice, which stated that *anak buncit* was welcome to kill the large animal with a spear made of *awi tamiang pugur* (*Schizostachyum silicatum* Widjaja). So, they stood on the *kawung* tree and speared the big animal to death with the *tamiang pugur* spears. Based on this story, *kawung* tree has never been cut down in Outer Baduy people (Iskandar et al. 2019).

The story of the origin of *kawung* which can be tapped in the Outer Baduy community is narrated by Iskandar (2012) as follows:

Once upon time, there were two children whose parents asked to guard the swiddens, when the paddy came to maturity. Many birds, called *piit* (*Lonchura leucogastroides* Horsfield & Moore, 1856) ate paddy rice from the swidden. These birds were chased and perched on the inflorescence stalk of a sugar palm (*leungeun kawung*). Whenever these birds were chased, they always they came back. As a result, the children got angry (*mamarahan*) and the *leungeun kawung* was cut (*dipagas*) with chopping knife (*golok*). Juice came out and was tasted by the children. It was sweet. Therefore, the juice was collected in a bamboo internode (*ruas awi*). However, the fresh juice would not last for long and its taste became bitter and sour (*haseum*). The children then heard the voice of a *kurah* bird (*Megalaema* sp), which seemed to say *kurah, kurah, kurah, kurah, kurah*, repeated many times. They interpreted this to mean that that a bamboo internode should be cleaned with water first, called *kunkurahan* derived from *kurah*. Later, it was decided that before collecting the juice, the bamboo should be cleaned with water and smoked. Therefore, the juice can be kept by making it into palm sugar (*gula kawung*).

On the basis the folklore above, it can be perceived that *kawung* is not an introduced plant in Outer Baduy, but is considered a native plant and has become folklore material in the Baduy community.

Socio-economic function: Making kawung palm sugar

Although *kawung* is used for various uses, the main socio-economic function of *kawung*, especially the Outer Baduy, is to be tapped and made into sugar (*gula kawung*). Various materials, including *sigay*, *paninggur*, *panyodék*,

nyiru, *raru*, *cetakan gula*-sugar-molded wood, *malam odéng*, *kararas* and *daun salak* are used to make the *kawung* sugar (Table 4).

Almost all materials used to make *gula kawung* are mainly harvested and obtained from the local ecosystems. For example, *sigay*, *ruas*, and *nyiru* are made from *awi mayan* (*Gigantochloa robusta* Kurz) and *awi tali* (*Gigantochloa apus* (Schult.f.) Kurz, respectively are harvested from various traditional agroforestry systems, including *leuweung lembur*, *reuma* and *leuweung kolot*. In addition, *paninggur*, *panyodék*, *cetakan gula*, and *suluh* are made from woody plant species, such as *ki sabrang/sungkai* (*Peronema canescens* Jacq), *ki bangbara* (*Antidesma montanum* Blume), *onyam* wood (*Antidesma ghaesembilla* Gaertn.), *laban* (*Vitex pubescens* Vahl), *kopi* (*Coffea canephora* Piere ex. A.Froehner), and *tundun* (*Nephelium lappaceum* L.) harvested from *leuweung lembur*, *reuma* and *leuweung kolot*. Meanwhile, sugar wrappers are made from dry banana leaves/*kararas* (*M. x paradisiaca* L) and dry *salak* leaves (*Salacca zalacca* (Gaertn.) Voss) usually harvested from *huma*, *reuma* and *leuweung kolot*. Thus, it can be inferred that plant biodiversity of Baduy ecosystems can play an important role in supporting the *kawung* sugar industry of Outer Baduy households. In other words, the various plant species that make up some Outer Baduy landscapes of Outer Baduy are not only important in providing ecosystem services, including producing oxygen (O₂), absorbing CO₂, protecting the soil against erosion, and habitat of wild animals but also important for the socio-economic and cultural aspects of the Outer Baduy community, such as food, fruits, vegetables, medicinal, and ritual plants (Iskandar 2012).

Making kawung sugar

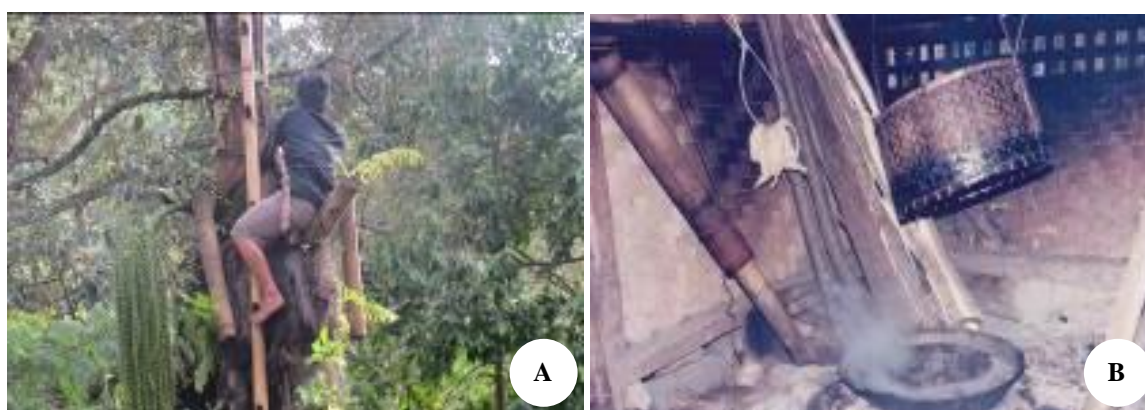
The Outer Baduy community commonly undertakes five stages to make *kawung* sugar, i.e., tapping the juice, boiling and evaporating the juice, coagulating the liquid, pouring the coagulated sugar into a wooden mold, and wrapping the *kawung* sugar (Iskandar 2012).

The first step is to select the productive palm trees grown in various land use types of Outer Baduy, including *huma*, *reuma*, *leuweung lembur* and *leuweung kolot*. The inflorescence stalks of selected productive *kawung* tree, which is about 5-10 years, are beaten with a big wood stick (*paninggur*) for 15-25 minutes, to obtain plenty of juice. This is traditionally accompanied by a special incantation. After about six weeks a very thin slice of inflorescence stalks are cut to test the production of juice. If plenty of juice comes out, the inflorescence stalk, about 25 centimeters length from the trunk, is cut with a machete (*golok*). The next day it is ready to be tapped, after which it is examined every few days.

Tapping is undertaken twice a day: in the morning, between 5.00 and 6.00 o'clock and in the afternoon about 4.00-5.00 o'clock. In the morning, the tapper usually takes 2-3 bamboo internodes (*ruas*) with him. He climbs a *kawung* tree using a long bamboo ladder (*sigay*), in each internode a hole is made which can be used as a foot hold (Figure 7A).

Table 4. Various materials that are commonly used in making *kawung* sugar among Outer Baduy community

Vernacular name & material	English common name	Function
<i>Nira/peuent kawung</i>	Juice of <i>kawung</i>	Raw material to make <i>kawung</i> sugar (<i>gula kawung</i>)
<i>Ruas</i>	The bamboo internode (<i>ruas</i>) of <i>awi mayan</i> (<i>Gigantochloa robusta</i> Kurz)	For collecting <i>kawung</i> juice which is hung over peduncle
<i>Sigay</i>	The long bamboo ladder made of <i>awi mayan</i> (<i>Gigantochloa robusta</i> Kurz) or <i>awi tali</i> (<i>Gigantochloa apus</i> (Schult.f.) Kurz) and in each node a hole is made to be used as foot hold	For climbing a <i>kawung</i> tree to tap the peduncle
<i>Paninggur</i>	The big wooden stick made of <i>meuhmal</i> (<i>Litsea tomentosa</i> Blume), hearth wood of <i>nangka</i> (<i>Artocarpus heterophyllus</i> Lam.), hearth wood of <i>bungur</i> (<i>Lagerstroemia indica</i> L.)	For beating the <i>kawung</i> peduncle
<i>Golok</i>	Machete	For cutting the peduncle
<i>Kaén lamak</i>	Cloth	For preventing various dirt, bee insects, rain water to falling into <i>ruas</i> that is hung over the peduncle
<i>Kékéncéng</i>	Big kettle	For boiling the <i>kawung</i> juice to process of sugar
<i>Panyodék</i>	Wooden spoon	For stirring the liquid that is being boiled in the <i>kékéncéng</i> , and taking residues of bees in the liquid
<i>Nyiru</i>	Flat woven bamboo made of <i>awi tali</i> (<i>Gigantochloa apus</i> (Schult.f.) Kurz)	For covering the juice to prevent bees insects being trapped in the liquid that is placed in the <i>kékéncéng</i>
<i>Kuluwung</i>	Round woven bamboo made of <i>awi tali</i> (<i>Gigantochloa apus</i> (Schult.f.) Kurz)	To prevent the liquid spilling over when it is being boiled in the <i>kékéncéng</i>
<i>Raru</i>	Selected additives made of <i>mardélan</i> leaves (<i>Macaranga tanarius</i> (L.) Müll.Arg.), <i>mara gedé</i> fruits (<i>Macaranga</i> sp.), <i>hiris</i> leaves (<i>Cajanus cajan</i> (L.) Huth), <i>manggu</i> leaves (<i>Garcinia mangostana</i> L.), and <i>areuy kawao</i> (<i>Millettia sericea</i> (Vent.) Benth.)	For maintaining the freshness of the juice and good quality of sugar
<i>Cetakan gula</i>	Wooden mold which has 6 or 7 shapes made of half coconut shells (<i>batok</i>) made of <i>ki sabrang/sungkai</i> (<i>Peronema canescens</i> Jacq), <i>ki bangbara</i> (<i>Antidesma montanum</i> Blume), kayu <i>onyam</i> (<i>Antidesma ghaesembilla</i> Gaertn.)	To mold sugar when the boiling liquid has coagulated in the <i>kékéncéng</i>
<i>Malam odéng</i>	Wax bees of <i>odéng</i> (<i>Apis dorsata</i> Fabricius, 1793) or <i>nyiruan</i> (<i>Apis cerana indica</i> Fabricius, 1798)	For preventing boiling over of the liquid when it is being boiled in the <i>kékéncéng</i>
<i>Kararas or daun salak</i>	Dry banana leaves/ <i>kararas</i> (<i>Musa x paradisiaca</i> L.) and dry <i>salak</i> leaves (<i>Salacca zalacca</i> (Gaertn.) Voss)	For wrapping the <i>kawung</i> sugar (<i>gula kawung</i>)
<i>Suluh</i>	Fire wood made of various trees, such as <i>laban</i> (<i>Vitex pubescens</i> Vahl), <i>kopi</i> (<i>Coffea canephora</i> Piere ex. A.Froehner), <i>tundun</i> (<i>Nephelium lappaceum</i> L.).	As fire wood burned in the stove (<i>gonggo</i>) for boiling juice or liquid in the <i>kékéncéng</i> to processing <i>kawung</i> palm sugar
<i>Gonggo</i>	A stove made by digging a pit about 1 meter deep and 0.5 meters wide. The walls of the stove are cemented with a semi clay soil and mixed with palm fiber. Three holes are made on the upper parts.	For firing the wood in the process of making <i>kawung</i> palm sugar

**Figure 7.** A. The tapper of Outer Baduy man is climbing using *sigay* to tape the peduncle of *kawung*, and B. The juice is being boiled for shot time on a stove. The *ruas bambu* are washed with clear water and smoked by placing them upside down on a small bamboo stick above a stove

Peduncle is beaten with the *paninggur* a few times and very thin slice is cut from the peduncle. Juice is collected in a bamboo internode (*ruas*), hung over the peduncle, and to prevent dirt falling into the *ruas*, the peduncle and upper *ruas* are covered with a cloth. Common sources of contamination are *kawung* flowers (*kembang kawung*), bees, and water, particularly during the rainy season.

In the afternoon the *ruas* are removed. The peduncle is beaten and a very thin slice is cut, the resulting juice is collected in a new *ruas*. The full *ruas* are carried to a farm shelter located near the hamlet, where the juice is poured into a big kettle (*kékéncéng*). To prevent fermentation, the juice is boiled for a short time on a stove called *tungku gonggo*. The *ruas* are washed with clear water and smoked (*dipuput*), by placing them upside down on a small bamboo stick above a stove (Figure 7B). Before the shelter is left, the rest of the fire wood in the stove is removed and the kettle is covered with a winnowing tray (*nyiru*) to prevent insects being trapped in the liquid. The smoked *ruas* are taken from the stove and hung on the wall.

Second, after collection of juice for a few days, the *kékéncéng* is full of liquid. The liquid is now ready to be processed through boiling and evaporation. The juice is boiled for several hours (*nyaahkeun wédang*). The liquid is sometimes stirred during boiling, and residues such as bees are removed with a wooden spoon. To prevent the liquid from spilling over, a *kékéncéng* is covered with a *kuluwung* made of woven bamboo and some wax of *odéng* (*A. dorsata*) or *nyiruan* (*A. indica*) is put in the liquid, now called *mépés*, to prevent from boiling over. To maintain the freshness of the juice and to produce good quality sugar, selected additives (*raru*), such as *mardelan* leaves (*Macaranga tanarius* (L.) Müll.Arg.), *mara gedé* fruit (*Macaranga* sp.), *hiris* leaves *C. cajan*, *manggu* leaves (*Garcinia mangostana* L.), and *areuy kawao*, a kind of vine (*Millettia sericea* (Vent.) Benth.) are put in the liquid.

Third, if the liquid has coagulated, it is called immature sugar (*gula ngora*). In this case it must be stirred vigorously and removed from the heat. A wooden spoon (*panyodék*) and iron spoon (*susuk*) are used to stir the liquid.

Forth, as soon as the liquid coagulates further, it turns dark red and begins to settle, and it is called *gula kolot*

(mature sugar), and at this point the sugar is poured into a wooden mold which has 6 or 7 shapes made from half coconut shells (Figure 6). The resulting hard block sugar is therefore called *sabatok* (a half of coconut shell), and a pair of *sabatok* called *sahulu* (a head), while every ten *batok* is called a *sakojor*.

Fifth, after drying, the sugar is taken out of the wooden mold, and collected in *nyiru* and brought home. At night, the sugar is wrapped in dry banana (*M. x paradisiaca*) or *salak* (*S. zalacca* leaves (Figure 8). This sugar is now ready to be sold and some are used for household purposes. In some cases, sugar blocks are stored on a dry shelf above the stove (*parako*). When a sufficient number have accumulated they are taken, wrapped, and sold to middlemen in the same or other hamlets.

Kawung sugar production

Production of the *kawung* sugar (*gula kawung*) is determined by many factors, including the production of the juice of each peduncle, the number of peduncles for each tree, and number of the productive trees that can be tapped.

According to informants, each family of Outer Baduy have 3-6 *kawung* trees and each tree normally owns 6-10 stalks. If three peduncles can be tapped every day, so over three days they yield about 10-20 *batok* or 5-10 *hulu*, or 1-2 *kojor* of sugar. Normally one tree has 4-8 peduncles (*leungeun kawung*) and one in every 3 peduncles can be tapped to 10 *hulu* in each tree days, giving an average of 100 *hulu* each month. In other words, sugar production each month averages 10 times the production of one session (*nyaahkeun*), or 10 x 10 *hulu* = 100 *hulu*, which is equivalent to 25,000-30,000 rupiah or at least 100-125 liter of rice in 1985. In one year, representing about 6-8 months of active tapping, or from 4-8 peduncles only, with one peduncle is assumed to produce juice, 6-8 x 100 *hulu* or the equivalent of 600-800 *hulu* x (250-300 rupiah)=150,000-240,000 rupiah (600-800 liter) are produced in 1985. While in 2021, production of 600-800 *hulu* is equivalent to 5,700,000-8,000,000 rupiah, and price of *gula kawung* increased over time (Table 5).



Figure 8. A. The coagulate is being poured into a wooden mold, and B. *Kawung* sugars are wrapped by the dry banana leaves

Table 5. Price of *kawung* sugar in Outer Baduy in 1985-2021

Year*)	<i>Kawung</i> sugar price	Price of rice	Ratio of <i>kawung</i> sugar price to rice price
1985	250-300/hulu	200-250/liter	0.80-0.83
1995	400-500/hulu	300-350/liter	0.75-0.70
2004	2,000-2,500/hulu	2,000-2,500/liter	1.00-1.00
2015	6,500-7,000/hulu	8,000-8,500	1,23-1,21
2017	6,500-7,500/hulu	8,000-8,500/liter	1,23-1.13
2021	9,500-10,000/hulu	7,500-8,000/liter	0,78-0,8

Note: *)The field note; 1\$ USD in 2021= 14.500 Indonesian rupiah (Rp)

It can be seen from Table 5 that the price of *kawung* sugar has increased over time. In 1985 the price of *kawung* sugar was Rp 250-Rp 300/hulu, while in 2021 the price of *kawung* sugar increased to Rp 9,500-10,000/hulu. According to the tradition, the swidden rice is strongly prohibited to sell; as a result, the non-rice productions, including trading the *kawung* sugar the Outer Baduy have been able to maintain the integrity of their swidden system which is the central part of their cultural identity (Iskandar 2012). The sugar palm has been used based on moral versus economic interest. In terms of morals, the sugar palm has been used for socio-cultural aspects, including rituals, traditional medicine, and botanical pesticides in the swidden farming. The palm sugar has been predominantly traded for economic interest to obtain cash income from the Outer Baduy households.

Traditional conservation

Kawung grows in mixture with various woody plants of different height and light requirement in various traditional agroforestry systems of Outer Baduy, including *huma*, *reuma*, and *leuweung lembur*, resulting in vegetation with a complex vertical structure. Therefore, the traditional agroforestry of Outer Baduy resembles a forest with its natural ecological and socioeconomic and cultural functions. The natural ecological functions of forest consist of hydrologic and soil erosion control, microclimatic effects, carbon storage, animal habitat, and biodiversity conservation. Its economic functions include producing fruits, vegetables, building materials, and rituals for subsistence and some surpluses for trading to make money.

The traditional agroforestry systems are prohibited from converting to monoculture commercial garden systems. Therefore, both ecological, socio-economic, and cultural functions of Outer Baduy have been maintained over time. Among various plant species, *kawung* can be used sustainably by the Baduy community because the use is based on traditional ecological knowledge and belief or cosmos (Van Der Broek et al. 2011; Iskandar 2018). According to the belief, the *kawung* is prohibited to cut. In addition, the common-palm civet- *luwak* (*P. hermaphroditus*), as an animal for assisting distribution and natural regenerations of the *kawung* in various traditional agroforestry has been rarely hunted. Accordingly, the population of *luwak* has not decreased, and has played an important role in maintaining natural regeneration of

kawung in Outer Baduy ecosystem. Moreover, the *kawung* can be conserved in Outer Baduy.

Other factors leading to sustainable use of *kawung* are the prohibition of cutting the *kawung* trees for making flour, and using *kawung* seeds to make sweetmeat (*kolang kaling*). Conversely, in non-Baduy, the Sundanese villagers of West Java and Banten have commonly cut down *kawung* trees to make flour, and used *kawung* fruit as sweetmeat or *kolang kaling* (Febriyanti et al. 2017; Iskandar 2018; Withaningsih et al. 2019).

It can be seen that the combination of biophysical and socio-cultural factors, which together determine an individual's decision-making environment, lead to the sustainable management and use of *kawung* by Outer Baduy and this plant continues providing ecological and socio-economic and cultural functions (Bélair et al. 2010). In other words, the actions of the Outer Baduy people (praxis) in treating *kawung* and their agroforestry systems are strongly influenced by their perceptions and knowledge (corpus) of *kawung* and the traditional agroforestry by forming a complex system of corpus-cosmos-praxis (Berkas 2012; Iskandar 2018), and the diversity and culture of Baduy have formed special the biocultural system (Barthel et al. 2013; Maffi and Dilts 2014; Seele et al. 2019). In addition, since *kawung* has ecological, socio-economic and cultural functions, this species can also be considered the Outer Baduy community (Platten and Henfrey 2009; Coe and Gaoue 2020). It can be concluded that the Outer Baduy people have used their rich traditional ecological knowledge to manage *kawung* on a sustainable basis which provides ecological, socio-economic and cultural functions.

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