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Local knowledge of utilization and management of sugar palm (*Arenga pinnata*) among Cipanggulaan People of Karyamukti, Cianjur (West Java, Indonesia)

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Abstract. *Gunawan R, Ramadhan UG, Iskandar J, Partasasmita R. 2017. Local knowledge of utilization and management of sugar palm (Arenga pinnata) among Cipanggulaan People of Karyamukti, Cianjur (West Java, Indonesia). Biodiversitas 19: 93-105.* Sugar palm, locally known as *kawung* or *aren*, (*Arenga pinnata* (Wurmb.) Merr.) has long been known for its various ecological, economic, and socio-cultural uses among rural people of West Java. Rural people have utilized and managed *kawung* based on their local knowledge. Nowadays, however, the abundance of *kawung* trees has been decreasing in many areas, for example, through reduction in planting and destruction. The decreasing experience in managing *kawung* trees among local people has eroded their local knowledge, and therefore documenting this knowledge is important before it disappears entirely. This paper (i) reports local knowledge of the Cipanggulaan people of Cianjur, West Java on landraces of sugar palm; (ii) identifies various uses of sugar palm by those people, and (iii) describes traditional management systems for the sugar palm conducted by those people. This study adopted qualitative methods developed in ethnobotany based on participant observation and in-depth interviews. Research findings identified two local landraces and at least 10 different plant parts used in various ways. Particular attention was paid to the making of palm sugar in various ways. Conservation of the sugar palm has traditionally been conducted by selective harvesting of the sugar palm fruit and allowing some palms to regenerate naturally.

Keywords: Local knowledge, species variation, utilization, management, sugar palm

INTRODUCTION

Sundanese people who live in rural areas of West Java have known sugar palm plant, locally known as *kawung* or *aren* (*Arenga pinnata* (Wurmb) Merr), for a long time. This plant plays important roles in ecological, economic, and socio-cultural functions for rural people. On the basis of ecological functions, for example, the sugar palm plant has been known as protection for soil against erosion due to its root strength in holding soil. In terms of socio-economic and cultural functions, the sugar palm plant has traditionally been utilized for various purposes, for instance, its flowers are tapped to obtain sap for making special Sundanese drink (*tuak*) or making sugar (*gula kawung*). Tapping sugar palm plant has traditionally been done by the rural Sundanese people. The old Sundanese lontar-leaf manuscript of 1518, called *Sanghyang Siskanda ng Karesian* (registered as 'kropak 630' in the National Museum) documented this traditions as follows: "…. *imah kaosi, loit kaosi, paranje kaosi, huma kaomean, sadapan* (*kawung*) *karaksa, palana ta gurip, sowe waras nyewana* (*kropak* 630, translated by Atja and Danasasmita 1981)". This can be translated as: " ….[our need] in the household (*imah*) is fulfilled, barn (*leuit*) is filled with rice, cage (*paranje*) is packed with chicken, swidden fields (*huma*) are managed, sugar palm (*kawung*) is tapped, chicken is taken care of, and our life is always healthy".

Based on this manuscript, it can be inferred that based on the advice from Sundanese ancestors, each household of rural people who would like to achieve a good livelihood and to be always healthy (*hurip*), some endeavors must be carried out, such as swidden fields (*huma*) to be managed, sugar palm to be tapped, and the chicken to be looked after. In addition, the special mythology on the sugar palm plant has been popularly known by Sundanese people, particularly for old generation. Based on Sundanese mythology, for example, the sugar palm plant is similar to the paddy crop in that it has been traditionally believed as originated from the tomb of the Goddess *Dewi Asri* or *Nyi Pohaci* (Prawirasuganda 1964; Iskandar 1998).

Therefore, based on ecological history, initially, both paddy and sugar palm had traditionally been respected by the rural people. However, unlike paddy crops, sugar palm plant had not been cultivated intensively. Sugar palms are scatteringly found in various biotopes: secondary forest, garden or mixed garden, even in the home-garden. Most sugar palms have grown naturally. Normally when seedlings of sugar palm are naturally found, which are predominantly dispersed by common palm civet or *luwak* (*Paradoxurus hermaphroditus* Pallas 1777) in some agro-

ecosystem types, such as swidden farming, garden or mixed-garden, they are not given special treatment, but the surrounding area is usually left weeded (cf Iskandar 1998).

Historically, because villages have been closely interrelated with sugar palm plant, the villagers have mythology and plentiful local knowledge of this plant. As a result, the villagers have utilized sugar palm based on their local knowledge as well as their cosmos or beliefs (cf. Toledo 2002; Berkes 2008). Local knowledge, in this case, has been called with various terms, including folk knowledge, traditional knowledge, indigenous knowledge, traditional environmental (or ecological) knowledge, people science or rural people knowledge. It may be defined as knowledge owned by local people, orally transmitted and inherited intergeneration based on practical engagement in everyday life and constantly reinforced by experience, trial and error, and deliberate experiment which is characteristically the product of many generations of intelligent reasoning (Ellen and Harris 2000).

Since the sugar palms have been managed by the rural people based on the local knowledge and beliefs, these plants have been utilized sustainably for a long time. Nowadays, however, due to human population increase, intensive market economic penetration, and the erosion of local knowledge, the utilization of sugar palms in many rural areas has decreased. For example, in many cases sugar palms have been vastly cut, even various biotopes which were previously full of sugar palms, have been converted into commercial monoculture gardens, such as vegetable gardens. As a result, population of sugar palms has rapidly decreased in many rural areas of West Java. Today the populations of sugar palm are found only some areas, particularly in the upland of remote rural areas. It is interesting that although sugar palm trees have rarely been found in many rural areas, the trees are still abundantly found in Cipanggulaan, Karyamukti Village, Cianjur, West Java. These trees have traditionally been managed and utilized for a long-standing. Indeed, the hamlet name of Cipanggulaan is referring to a ‘location of sugar processing' because sugar palm trees have been predominantly found in this area, and have been traditionally tapped to make sugar.

Some studies on the sugar palms in many rural areas of Indonesia have been conducted by some scholars. For example, study on variations and utilization of sugar palms was carried out by Irawan et al. (2009). The study on insects as pollinator, pest, and diseases of the sugar palm plant was done by Siregar (2016). Some studies in relation with utilization of sugar palm trees, various benefits of sugar palm, and as raw material of bioethanol, and local institutional of palm sugar and the role of sugar for livelihood income, business and potential of agribusiness of the sugar palm were also carried out (Rachman 2009; Effendi 2010; Lempang 2012; Nuryanti et al. 2015; Wirastini 2015; Yuldiati et al. 2016). Other studies on the processing of sap and the quality of sap of sugar palm, and characterization and quality sugar of sugar palm, and microbial and organoleptic quality of *tuak* were also conducted (Kalengkongan 2013; Mussa 2014; Victor 2015; Choong et al. 2016; Jaya et al. 2016). In addition, the production and content of starch in stalk of sugar palm were investigated (Fitriani et al. 2012; Manatar et al. 2012).

This paper elucidates local knowledge of local people of Cipanggulaan, Cianjur, West Java on varieties or landraces, utilization, and conservation of sugar palm (*Arenga pinnata* (Wurmb) Merr). Three main aspects are elucidated in this paper, namely (i) local knowledge of the villagers on *landraces* of the sugar palm; (ii) traditional utilization of the sugar palm by villagers; and (iii) traditional conservation system of the sugar palm carried out by villagers.

We use the word *landrace* (following Shigeta 1996; Brush 1991, see also Iskandar and Ellen 1999), to distinguish local people of Cipanggulaan categories for sub-division of ancestral crop species from ‘varieties' in the conventional Western taxonomic sense. Thus, in this context, a landrace is a local category for grouping the sugar palm plant according to characteristics reflected in specific vernacular names.

MATERIALS AND METHODS

Study area

This research was carried out in Cipanggulaan Hamlet, Karyamukti Village, Campaka Sub-district, Cianjur District, West Java Province, Indonesia (Figure 1).

Cipanggulaan hamlet was chosen due to some considerations. For example, the people in this hamlet still predominantly manage and utilize sugar palm trees. In addition, most old people and tappers still use and own local knowledge of the sugar palm plant.

To reach Cipanggulaan we can use motorcycle from Bandung to Cianjur with an approximate distance of 62 km. From Cianjur, we continue to travel by motorcycle heading to Warung Kondang and to Cikancana, Lampegan Pal Dua and finally arrive at Cipanggulaan Hamlet. The distance from Cianjur to Cipanggulaan is approximately about 25 km and it takes about 2 hours to reach there by motorcycle.

The Cipanggulaan Hamlet has total area of approximately 35 hectares and is located in the Southwest of Cianjur. To the northwest and northeast the hamlet is bordered by Karesian Mountain and Gunung Padang, respectively. To the East, it is bordered by megalith site of Gunung Padang and to the south is bordered by Pasir Alam. The altitude of Cipanggulaan is 800 m above sea level and has annual rainfall of about 3000 mm. The agricultural land use types consist of homegarden, garden or mixed garden, and wet paddy fields. The gardens are predominantly cropped with monoculture systems, such as cassava (*Manihot esculenta* Crantz), chili (*Capsicum frutescens* L.), banana (*Musa paradisiaca* L.), and coffee (*Coffea arabica* L.). Like in other areas of West Java, each monoculture garden system is popularly named according to the predominant crop, such as garden of cassava (*kebun singkong*), garden of chili (*kebon cabe rawit*), banana garden (*kebon pisang*), and garden of coffee. In addition, the garden is predominantly planted with mixed annual and perennial crops locally named *talun* for ancient term or

now is called *kebun campuran* (mixed-garden) (cf. Iskandar and Iskandar 2011; Iskandar et al. 2016.). In addition, the sugar palm trees (*Arenga pinnata* (Wurmb) Merr) are usually found in the mixed garden (Figure 2). The sugar palm trees in the mixed-garden or garden are not purposely planted by people, but they are predominantly dispersed by *careuh* or *luwak* (civet-*Paradoxurus hermaphroditus* Pallas 1777).

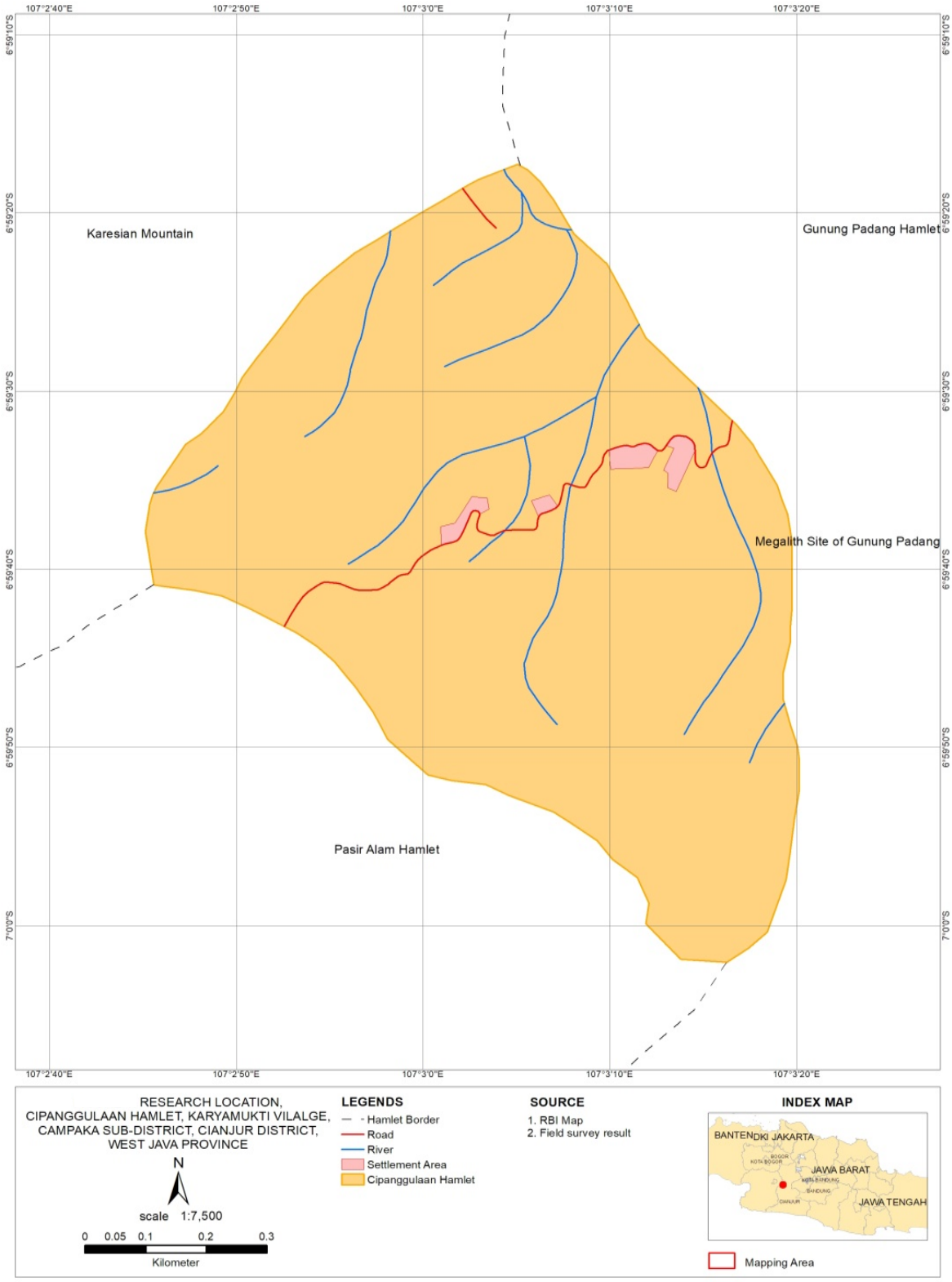

Figure 1. Study site in Cipanggulaan Hamlet, Karyamukti Village, Campaka Sub-district, Cianjur District, West Java Province, Indonesia

Figure 2. The sugar palm trees are predominantly found in the mixed-garden

According to the village statistic, Cipanggulaan's population in 2015 was 171, consisting of 9 males and 73 males, belonging to 51 households. The main occupations of the people are farmers, labor farmers and other off-farm labor, and traders. Ten out of 51 households were farmers who were intensively involved in managing and utilizing the sugar palm trees. They consisted of 6 households as sugar palm juice tappers (*tukang sadap kawung*) and 4 households as processors of the sugar palm fruits into *kolang-kaling*.

Procedure

The method used in this study was qualitative with an ethnobotanical approach (cf. Martin 1995; Alexiades and Sheldon 1996; Cunningham 2001; Albuquerque et al. 2014). Some techniques, namely observation, participant observation, and deep interview were applied to collect the primary data in the field. The observation was conducted to observe the general environmental conditions of the hamlet, land use, and garden (mixed-garden) that are planted with the sugar palm trees. Participant observation was carried out by involving the researchers doing some activities, such as going to the garden, tapping the sap, and processing the sap to make sugar, and also asking some questions to informants in relation to activities being done. Semi-structure and/or depth interview were purposively carried out to some informants, such as formal village leader staff, informal leaders, sugar palm farmers, sugar palm juice tappers, the processors of the sugar palm juice namely palm sugar and brown sugar makers.

The primary data, statistical data, and reports were analyzed by cross-checking, summarizing and synthesizing, and making a narrative account with descriptive analysis and evaluative (cf. Newing et al. 2011).

RESULTS AND DISCUSSION

Local knowledge of the sugar palm

The sugar palm (*Arenga pinnata* (Wurmb) Merr), family of *Arecaceae* is locally known in Cipanggulaan as *kawung* or aren in Indonesian. According to informants, *kawung* can traditionally be divided into two varieties (landraces) namely *kawung cibuy* and *kawung alit* or *kawung saeran*. The *kawung cibuy* is characterized as having a tall and large trunk, bearing a lot of fruit, and can be tapped. With approximately 30 m of height, the lush *kawung cibuy* produces a lot of fiber, having shiny and greasy leaves, with curvy leaf midrib. On the contrary, the *kawung alit* or *kawung sareran* is a short tree, having a small-size trunk, producing little fruit, and either can or cannot be tapped. The *kawung saeran* or *kawung alit* is not that tall, less than 30 meters in height, producing little fiber which is dry and bristle (*jogrog*). In term of sap production, *kawung cibuy* produces more sap than *kawung alit* or *kawung saeran*. This sugar palm classification of the Cipanggulaan is similar to that of Rancakalong, Sumedang of West Java. According to informants of Rancakalong, the landraces of the sugar palm can be classified based on tree

height, trunk diameter, amount of fruit, possibility of being tapped, and vegetation canopy closure in their habitat (Irawan et al. 2009). Similarly, based on the Baduy people of South Banten, the landraces of the sugar palm can be traditionally classified as the big trunk called *kawung gede* and the small one called *kawung salompet* (Iskandar 2012).

Moreover, in Cipanggulangaan, sugar palm plant is further classified based on its age or stage of growth. There are six categories of the sugar palm trees based on their stage of growth, namely *cumohok, cumawene, mepek, mapak, jeunah,* and *bungkul* (Table 1 and Figures 3, 4).

Table 1 indicates that the sugar palm tree has a lifespan of about 30 years from its early seedling (*cumohok*) until its unproductive stage (*bungkul*) and it can grow to a height of more than 20 meters and reaches its productivity—to be tapped and harvested-, at the age of 17 years. However, in some cases, the trees can be firstly tapped before they reach 17 years since the trees start to produce flowers at the age of 7-10 years. In addition, at this time the stem is full of starch (Burkill 1935).

Table 1. The folk-classification of the sugar palm based on its age or stage of growth

Local vernacular	Height of tree (meters)	Age of tree (years)	General characteristics
Cumohok	1-1.5	< 1	The sugar palm seedling has several leaf midribs similar to that of *congkok* plant (*Curculigo latifolia* Dryland).
Cumawene	1.5-3	1-15	The sugar palm tree has continuously growing young shoots and still has an edible white terminal bud (*humut*).
Mepek	3-10	15-17	The leaf midribs have not appeared and the tree do not have terminal bud (*humut*).
Mapak	10-20	17-20	The sugar palm begins to produce stalks (*leungeun*) of flowers (*jari* or *langari*) and fruit (*caruluk*) but the stalks are not ready to be tapped and the fruit is not yet ripe.
Jeunah	>20	20-30	The stalks are ready to be tapped and the fruit can be harvested.
Bungkul	Stump shape less than 10 m	>30	The sugar palm tree is not productive anymore—the stalks are no longer tapped and the fruit is no longer harvested. Often, the trunk is cut, leaving only the stump called *bungkul*.

Figure 3. The sugar palm plant called *cumohok*, and *cumawene*

Figure 4. The sugar palm plant called *jeunah*

Utilization of *kawung*

Cipanggulaan people in general, and particularly our informants, see sugar palm tree (*kawung*) as one, among many, important plant. The plant is considered the most versatile tree among the palm trees since almost every part of the tree such as root, trunk, hair of trunk, inner part of tree, rachis, leaf, leaflet midrib, and stalk of flowers (Table 2, Figure 5), is useful. The utilization of *kawung* is predominantly based on the knowledge inherited from their ancestors as well as their individual experiences of trial and error processes (cf. Ellen and Harris 2000; Ellen 2006). The traditional utilizations of *kawung* among the Cipanggulaan including making sugar from its juice, and harvesting the fiber and leaves for various purposes, are generally similar to those of the Rancakalong people, Sumedang West Java and Baduy people of South Banten (Iskandar 1998; Irawan et al. 2009). However, some special uses of *kawung* among the Cipanggulaan, are recorded; for example, the trunk hair (*jawul*) is traditionally used as tinder for igniting fire, whereas, this use is not recorded among the Baduy and Rancakalong. In addition, the rachis of the plant is used for book marking, for instance, when people recite the Holy Koran, while that part is rarely used in Baduy or Rancakalong. Moreover, the utilization of the starch and the making of *kolang kaling* are predominantly done among both Cipanggulaan and Rancakalong, but these uses have never been documented in Baduy.

Making palm sugar

Making palm sugar is done through several stages, namely, climbing the sugar palm tree using a long bamboo ladder (*naek tangkal kawung pake sigay*), opening the bark (*ngabalukang*), beating the peduncle/stalk of flower (*ninggur*), swinging the peduncle (*ngayun*), cutting the peduncle (*magas*), and tapping the sap (*nyadap*).

Climbing the sugar palm tree *(naek kana sigay)*. The tapper climbs the palm tree using a long bamboo ladder (*sigay*). The *sigay* is made of *bambu gombong* (*Gigantochloa verticillata* (Willd) Murr) whose internodes are holed to use as foot holder for the tapper (Figure 6).

Opening the bark *(ngabalukang* or *mukaan)*. The bark covering the peduncle and flowers are removed. The bark is cleaned and the fiber and dirty materials are removed.

Swinging and beating the peduncle *(ngayun dan ninggur)*. The peduncle which is approximately located 20 cm under the base of the peduncle is swung and beaten. Beating dan swinging are done several times periodically. The informants informed us that these activities can be carrried out for about a month and are aimed to open pores of the peduncle. As a result, the sap drips smoothly.

Cutting peduncle *(magas).* Cutting the beaten peduncle is done using a tapping knife (*peso sadap*) (Figure 7). After the peduncle is beaten for about one month, the color of flowers attached to the peduncle will change from the brownish green to dark brown. After one month the color of flowers will change to black and oily (*lalunyu*) locally called *humanyir*. The next stage is tapping the peduncle (*nyadap*) which is carried out twice a day, namely early morning between 0.5.00 and 0.6.30 am and late afternoon between 4.00 and 5.00 pm. So, for each penduncle, we have to prepare two bamboo containers (*lodong*) for daylight and overnight tappings.

The collected juice (*lahang)* is then processed to make sugar. These stages of processing the *lahang* takes approximately 6 hours, traditionally done by wives in the kitchen or special place called *cipanggulaan*.

The stages of sugar making can be seen in Table 4.

Management and conservation of the sugar palm

Based on information from the informants, the sugar palm plant (*kawung*) has been known by people of Cipanggulaan for a long time. This plant species has important ecological and socio-economic functions, and may be considered one of 'biocultural keystone species' (cf. Ellen 2006). In terms of ecological functions, for example, result, this plant predominantly grows in dry land and does not need intensive maintenance (cf. Iskandar 2014). The *kawung* has also been perceived or believed, particularly by the old generation, to be created from the tomb of *Nyi Pohaci* goddess, similar to the creation of rice (*Dewi Sri* in Javanese) and the mythology on the sap of the peduncle of flowers for making sugar (cf. Prawirasuganda 1964; Iskandar 1998; Iskandar 2014). In addition, the kawung tree has been considered as a multi-function species, such as being used for making sugar (*gula kawung*), *kolangkaling*, vinegar, and so on for the rural people. As a result, there is a popular expression among the Cipanggulaan people that '*hirup mah kudu sampurna saperti kawung'* meaning that human life must be perfect, fruitful, and providing benefits for other people similar to the sugar palm plant. There is another saying, '*kun kal kawung walatum kal kawung'* which means 'the human life must be similar to that of *kawung.* A dead tiger leaves its stripes, A dead elephant leaves its ivory, while a dead human leaves his/her services beneficial for others.

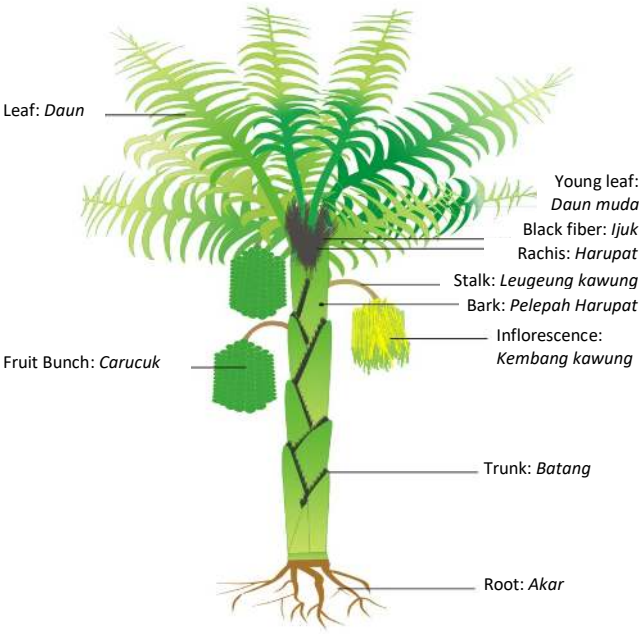

Figure 5. Various parts of the sugar palm plant (*kawung*) which have been traditionally utilized by people of Cipanggulaan, Cianjur, West Java, Indonesia

Table 2. Traditional uses of different parts of sugar palm plant (*kawung*)

Parts of *kawung*	**Uses**	**Processing**
Root	- Traditional *jamu* for curing back pain, and fatigue, and virility drug. - For curing and clearing mucus in the eye and eye cataract	**Traditional *jamu***: the roots are cleaned and boiled with 3 glasses of water, combined with *alang-alang* roots *(Imperata cylindrical* L*)*, red ginger (*Zingiber officinale* Rosc), *kumis kucing (Orthosiphon stamineus* Benth), *brotowali (Tinospora crispa* L.), root of avocado tree *(Persea americana* Mill*)*, for about 30 minutes until the remaining water left is about one glass, and let it stand until the concoction gets warm or cool before it is drunk; for **curing eyes and cataract**: the fresh root is cut and the water coming out from the root is dripped into the eyes.
Trunk	- Wood stick *(iteuk or tongkat)* - Handle of a machete or an ax *(gagang* or *perah golok or kampak)*	**Handle of a machete or an ax**: trunk of the tree called *ruyung* is said to be the best material for this purpose, particularly its thickness and endurance. The *ruyung* is molded as handle of a machete that has been designed before, smoothened using a special knife, and perfected by sandpaper, until finally installed to the handle of a machete. All of these stages are done by males.
Hair of trunk (*kawul*)	- Tinder for igniting fire	Two *gandawesi* (firestones) are hit to each other, causing ignition. Then, the ignition is put on tinder (*kawul*) until it is lit or becomes ember. The ember is used to light traditional cigarettes made of tobacco wrapped in young palm leaf.
Inner part of trunk	- Inner part of trunk where starch is taken (*onggol- onggol, sayur aci kawung*)	In the past, the Cipanggulaan people used to obtain starch from the trunk and make various traditional cakes, such as *onggol-onggol* and *sayur aci kawung* from the *kawung* starch. Nowadays, however, the trunk is sold to middlemen who usually come to their hamlet and collect the trunk to be processed and made into starch.
Fiber	- Raw material of rope (*bahan tambang*) - Raw material of roof *(bahan hateup)* - Filter of palm juice *(panyaring lahang)*	People of Cipanggulaan used to collect and process palm fiber for various purposes such as rope, roof, or filtering palm juice. Today, however, they usually harvest the palm fiber and sell it to middlemen.
Rachis *(harupat)*	- Amulet and talisman (*tolak bala* or *sawen*) - Material for traditional wedding ceremony - Material for igniting fire in the kitchen *(Neurakeun seuneu di dapur*) - Hair ornaments and bun - Bookmarker and pointing tool when reciting Holy Koran - Material for making an arrow or blowpipe - Material for making a puncture tool to determine fruit maturity of sugar palm	Rachis of palm (*harupat*) is usually used for various purposes, such as stick for determining the maturity of palm fruits. The *harupat* is taken from the fiber mound and used for special purpose.
Leaf	- Traditional tobacco or traditional cigarettes wrapper	Making traditional cigarettes wrappers: the young yellowish palm leaves are harvested and separated from the midribs (*disebet*), then the leaves are half-dried under the sun, before thinned and smoothened with a knife (*dipaud*) to remove outer skin (*kulumud*) of the leaves. Finally the smoother leaves are cut in accordance with the cigarette size and ready to be used. They are used as smoking paper.
Leaflet midrib (*nyere* or *lidi*)	- Material for making brooms of leaflet midrib *(sapu nyere* or *lidi*) - Material for making traditional basket (*membuat keranjang*) - Material for making woven plate	Making brooms from leaflet midribs: the leaflet midribs are separated from the leaves using a knife (*disebet*), and then dried under the sun before tied with bamboo straps (*dismpay*). People and informants say that kawung midribs are more elastic than that of the coconut (*Cocos nucifera*) (*nyere kalapa*). Owing to their elasticity, the *kawung* midribs can be molded and woven to make baskets and plates
Fruit (*caruluk*)	- Material for making *kolang kaling*	Processing *kolang-kaling*: ripe palm fruit is boiled for about 5 hours to remove its itchy sap, and then peeled and separated from its rind, and beaten (*digeprek*) to flatten it before finally soaked and stored in a container filled with water.
Stalk of flowers *(tangan kawung)*	- Material for making vinegar - Material to make sugar	Producing palm vinegar: the clear and whitish sap (*lahang*) is stored in bottles and dried under the sun for about a week. Detailed stages of palm sugar (*gula kawung*) making are provided in the following section below.

Figure 6. A man is climbing the sugar palm tree

Figure 8. The liquid is poured into bamboo internodes to be molded

Figure 7. A man is cutting the peduncle

Figure 9. The sugar that is molded with the bamboo internode is put in the kettle, and the residual is cracked with a spoon

Although the sugar palm plant provides a lot of benefits for the rural people, this plant is not intensively cultivated by the people of Cipanggulaan. Based on our observation and on our informants accounts, we found that the sugar palm trees grow in various land uses, including mixed-gardens assisted by *luwak* or common palm civet (*Paradoxurus hermaphroditus* Pallas 1777). Based on animal ecology, the *luwak* has special behavior of loving to eat various fruits, including the ripe sugar palm fruits (cf. Iskandar 2015; Partasasmita et al. 2016). As the animal defecates, its feces contain the sugar palm fruit, and if it is left to the natural process, the seed will grow into a sugar palm tree. Or, later on, the seeds from the feces of the civet are collected and transferred to a proper nursery. These seedlings are maintained by individual households. For instance, to avoid nutrient competition, grass and other plants surrounding the palm seedlings are removed; for more protection measure, fences are built encircling the young trees.

To sum up, based on the ecological history, the Cipanggulaan people of Karyamukti, Cianjur, West Java have utilized and managed the sugar palm plant (*kawung*) for a long time. Various parts of the *kawung* plant have traditionally been used among the Cipanggulaan. The utilization and management of the *kawung* plant have been based on traditional knowledge or traditional ecological knowledge and beliefs (cf. Toledo 2002; Berkes 2008). Obtaining, distributing, and circulating traditional knowledge have been done among individuals of the Cipanggulaan in three stages, namely parental learning, peer group learning, and individual learning (cf. Puri 1997). The parental learning exists among male children aged less than 17 years that are involved in various activities utilizing various parts of the sugar palm plant in

each household. The peer group learning process takes place among groups of young people before marriage where they share and learn knowledge and experiences on the utilization of the sugar palm plant. And finally, the individual learning process occurs when each adult acquires various knowledges of the sugar palm based on his or her personal experiences by trial and error.

Table 4. Processing of making sugar (*gula kawung*)

Stages	Tools	Processing activities
Putting the juice (*lahang*) into the kettle	Bamboo internode (*lodong*), fiber (*injuk*), kettle (*kancah*) and stove (*hawu*)	The kettle is put on a burning traditional stove (*hawu*) and the juice (*lahang)* is poured into a kettle. To get a clear and clean juice, the juice is filtered by fiber and other filtering tools. This is to avoid dirty materials such as firewood charcoal that has been used to smoke the bamboo internodes (*lodong*) to avoid sour juice.
Boiling the juice	Kettle (*kancah*), stove (*hawu*) wooden spoon (*cocolek)*, and filter (*serok*)	The juice starts to boil after about one or two hours and this is the time to stir the liquid continuously using a wooden spoon. By doing this, the liquid starts to produce white foam (*budah bodas*) that needs to be removed to get a clean and clear sugar. Stirring the liquid is continuing
The juice starts to boil and gets thicker	Kettle (*kancah*), stove (*hawu*) and wooden spoon (*cocolek*)	After boiling for approximately two hours, the juice starts to get thicker and the color changes from white to dark brownish called *wedang ngora* (dilute liquid)
Changing color and texture (*wedang nggora)*	Kettle *(kancah)*, stove (*hawu)* and wooden spoon (*cocolek*)	The boiling process is continuing for more than 30 minutes until the *wedang ngora* (dilute liquid) turns into *wedang kolot* (concentrated liquid), and the juice is getting thick, and the color turns into dark yellow. Stirring is still continuing to avoid overdone.
Thicker juice and dark yellowish (*wedang kolot*)	Kettle (*kancah*), stove (*hawu*), wooden spoon (*cocolek)*, and filter (*serok*)	After the color has changed to dark yellowish (*wedang kolot*), some dirty substances, including cinder can be clearly spotted and removed (*diserok*) with a *serok* (spoon filter). The juice boiling is carried out for more than 4 hours; the concentrated liquid color will change from the dark yellowish to yellow called *nyengka*. The boiling process is continuing, and *nyengka* stage will change to *peueut ngora* or *humanjuang*.
The *peueut ngora* or *humanjuang* stage	Kettle (*kancah*), stove (*hawu*) and wooden spoon (*cocolek*)	The boiling process uses smoldering fire that renders the *peueut ngora* or *humanjuang* continues boiling, and it will change the liquid to a *darker brown* called *peueut kolot*. The *peueut kolot* is continued to be boiled and stirred and until it turns bright brownish red.
Putting *kaliki* (*Ricinus communis* L) or muncang (*Aleurites moluccana* (L) Wild) fruits *(dipepes)*	Kettle (*kancah*), stove (*hawu*) and wooden spoon (*cocolek*), *kaliki*, candlenut (*muncang),* and coconut oil	To make the *peueut kolot* thickened and firm, special ingredients, such as fruit or oil must be added. This act is called *dipepes or mepes.* The ingredients used for making thick and firm consist of three pieces of pounded fruit of *kaliki* (*Ricinus communis* L) mixed with approximately a spoonful of vegetable or coconut oil.
The liquid has changed to become *peueut kolot*	Kettle (*kancah*), stove (*hawu*) and wooden spoon (*cocolek*)	After the *mepes* process has been finished and the liquid has become the *peueut kolot*, the liquid starts to produce fragrant aroma of sugar. Up to this point, the *peueut kolot* is considered ready to be lifted as indicated by the wooden spoon (*cocolek*) lifted from the kettle, the *peueut kolot* can be seen as a thin tissue form called *peueut rumamat*. While the *peueut kolot* is still dilute liquid, it is called *gumayot.*
The kettle (*kancah*) is lifted from the burning furnace (*hawu membara*)	Kettle (*kancah*), wooden spoon (*cocolek*)	The *peueut* that has been considered ‘‘well cooked’ (*rumawat*) in the kettle is taken from the burning stove. The stirring process (*pengguisan)* using a wooden spoon is continuously carried out for about between 10 minutes and 15 minutes to get the good liquid viscosity. As a result, the sugar production will be solid (*pepel*), and the color changes to sort of dark brown or chocolate color.

		The stirring (*pengguisan)* must be done in appropriate time in order to get a good quality of sugar and to avoid a hole in the middle of the sugar (*kohok, kopong, poporong*) and bad taste, considered rough (*resag* or *kasar*).
The sugar is poured into bamboo internodes to be molded (*nitis or nyetak gula)*	Wooden spoon *(cocolek),* bamboo internode mold *(caman, ganduan)*, and cutting board (*talenan* or *ebeg)*.	The thick sugar (*peueut*) is molded into bamboo internodes with a diameter of 5 cm and a height of 10-12 cm called *ganduan* (Figure 8). The *peueut* is taken from the kettle using a wooden spoon and put in the bamboo molder called *caman* and then put on a woven bamboo measuring approximately 20 cm x 40 cm (*ebeg*). The *peueut kolot* from the kettle is put in *ganduan* or *caman* little by little, that is, filled a half part, and after 5 minutes, is fully filled to get hard and solid sugar (*pepel* or *padat*). If the *peueut* is filled at once, the sugar may be broken.
The leftover sugar in the kettle is scraped *(kukurud)*	*Kattle (kancah)* and wooden spoon *(cocolek)*	Not all the *peueut* in the kettle can be taken for molding (*nitis*), but there is residual stuck on the kettle. This residual is cracked using a wooden spoon called *kukurud (*Figure 9*).*
The sugars are wrapped *(ngabungkus*, *ngabonjor* or *pengemasan*).	Dry banana stem *(bebog cau garing)* and bamboo winnowing tray *(nyiru or niru*)	After the *peueut* is molded in the bamboo molder, it is let stand for 5 minutes to get the sugar hardened. The sugar is released from the bamboo molder and put on the dry bamboo winnowing tray (*nyiru*). The sugar is wrapped with dry banana stem. One pack consisting of 4 pieces of sugar (*gandu*) is called *sabonjor*. While one piece consisting of 2 pieces of *gandu* is called one pack (*sabungkus*).
Sugar seepage *(kamalancin)*	*Ebeg*, and mold (*ganduan*)	After the *peueut* is released from the bamboo internode molder and put on *ebeg*, there is reddish brown water seepage under the ebeg originating from the sugar called *kamalancin.*
The sugar is stored	Plastic bag (*kantong keresek*), or paper bag (*kantong kertas*)	After wrapping (*bonjor* and *bungkus*), the sugar must be put in warn dry wrapper of hard paper bag or plastic bag (*kantong keresek*). Then, it is better to put it on the upper stove place (*para seuneu*) to make it warm and smoked. This will make the sugar tastes better and dry.
Washing the tools	Kettle (*kancah*), wooden spoon (*cocolek)*, filter (*serok*), bamboo internode (*caman*), molder (*ganduan*), and *ebeg*	All activities of the sugar making are done. Therefore, all tools including the juice container (*lodong*) must be cleaned. The *lodong* need to be smoked (*dipuput*) after it is washed; this is to avoid fermentation process inside the *lodong* indicated by sour smell.
The bamboo internode is smoked *(muput lodong)*	Bamboo internode (*lodong*) and piece of bamboo burned (*awi tali dibakar*)	The bamboo internode (*lodong*) that has been used must be resmoked (*dipuput*) by burning a bamboo firewood put it in the *lodong* until it produces smokes, and this process is repeated three times. Then, the bamboo internode is put in dry place upside down (*ditonggengkeun*). It is aimed at avoiding the *lodong* to get sour smell and in the end, to keep the liquid later on. The smoking of the bamboo internode (*muput*) is done during boiling liquid in the kettle.

Nowadays, however, population increase and intensive penetration of market economy to villages have resulted in significant changes in village lives and have impacted sugar palm trees as well. Many mixed-garden areas, where sugar palm trees grow have been converted to other land uses. This situation leads to a process of local knowledge erosion. And consequently, the utilization and processing of various products of the sugar palm plant done by the Cipanggulaan people have dramatically changed (Table 5).

As indicated in Table 5, at present, the utilization and the process of the sugar palm plant has dramatically changed. As a result, the population density of the sugar palm trees has continuously decreased over time. Traditionally, to avoid the local extinction of the sugar palm in their area, the Cipanggulaan people made several efforts. For example, if the palm fruits have to be harvested, some fruits must be left as sources of seeds, hunting the common palm civet (*careuh*) was prohibited, and some fruit-producing trees were planted in mixed garden to attract the civets to come and help distribute feces containing seed the sugar palm seeds.

Table 5. Changes of utilization and processing of various products of the sugar palm tree

In the past	At present
Intoning and chanting spells (*jampi* and *jangjawokan*) in local vernacular before tapping activities were always part of the activities and was believed to be an important step	Tapper does not recite spell anymore before tapping flower peduncle and replace it with intoning the Muslim prayer in Arabic (*syahadat*).
Most tools used to make sugar were obtained and made locally of various sources, such as *caman, lodong, guisan* that are made of bamboo, wood harvested from the forest or mixed-garden. Dried banana stem for wrapping the sugar was obtained from garden, and so on.	Many tools and materials used for making and packaging sugar are obtained not from the local, but are bought from shops, for instance, plastic bag for wrapping the sugar.
Almost all parts of the sugar palm trees, including root, leaflet midrib, fiber, were utilized by local people.	Some parts of the sugar palm plant are no longer used, for instance, *ijuk* is no longer used for roof and replaced with tiles. Kolang kaling and gula aren are produced to make cash money to fulfill the household economic function for rural people.
Population of the sugar palm trees was predominantly found in various rural land use systems, such as mixed-garden. In addition, the population of civet as disperser of sugar palm seeds was commonly found.	Population of the sugar palm trees tends to be decreasing due to land conversion, and consequently, the habitat of palm civet has been disturbed, and the animal as seed dispersal is rarely seen. In addition, a newly emerging habit that makes civet as pet, leads to increasing civet hunt and sale as pet.

Nowadays, however, population size of the sugar palm trees in Cipagulaan has continuously dwindled over time, because the input rate to population stock by civet-assisted natural regeneration is less than the output rate of stocks, by many cuttings of palm trees or natural death due to old age. It can be concluded that the rural people of Cipanggulaan have an extensive local knowledge on variations (landraces) of species of the sugar palm plant and the folk classification of the sugar palm based on its age or stages of growth. Traditionally, various different parts of the plant, including roots, wood, trunk, stem, leaf, fruit, leaflet midrib, and hair of trunk of the sugar palm plant have been used for various economic purposes and socio-culture functions. Nowadays, the population size of the sugar palm trees has been dwindling. Therefore, conservation of the sugar palm trees that have been traditionally endeavored, including leaving some the fruit natural regeneration and prohibition of hunting the common palm civet as the palm seed dispersal must be conducted. To maintain the sustainability of the utilization of the sugar palm plant in the rural area, the cultivation of this species must be carried out based on local knowledge combined with the Western scientific knowledge, instead of relying on civet-assisted regeneration.

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