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The local knowledge and potential of *suweg* (*Amorphophallus paeoniifolius*) in the Citanduy and Cimanuk watersheds of West Java, Indonesia

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Abstract. *Mutaqin AZ, Kurnadie D, Iskandar J, Nurzaman M, Megantara EN, Husodo T, Kendarto DR, Wulandari I, Shanida SS. 2023. The local knowledge and potential of* suweg *(*Amorphophallus paeoniifolius*) in the Citanduy and Cimanuk watersheds of West Java, Indonesia. Biodiversitas 24: 324-332.* The Indonesian archipelago is rich in natural resources and ethnic diversity. Each ethnic group interacts with the surrounding environment in ways that often differ. Interaction with the environment creates local knowledge that is complex in terms of language, practical understanding, beliefs, and social interaction. One useful natural resource that grows in many areas of Indonesia, especially in watershed ecosystems, is *suweg* (the elephant foot yam) which has the scientific name *Amorphophallus paeoniifolius* (Dennst.) Nicolson. Local communities, such as in the Citanduy and Cimanuk watersheds of West Java, use *suweg* for various purposes in their lives. The study reported here aimed to document the local knowledge and development potential for *suweg* in the Citanduy and Cimanuk watersheds. The research used mixed observation methods, predominantly qualitative. The data collection technique was purposive, based on interviews (structured, semi-structured, and in-depth interviews) with several informants or community groups who were considered competent to know *suweg*. Data were analyzed through emic and ethical approaches. Data analysis was conducted by cross-checking, summarizing, and synthesizing. The results of the research showed that *suweg* grows in a range of environmental conditions on managed agroecosystem lands. The corms of *suweg* are peeled, cooked and eaten in a variety of side dishes. The leaves of *suweg* have been used as food for fish in pond-system aquaculture. The results of this study suggest that *suweg* has potential for expanded development, based on sociological and ecological evidence.

Keywords: *Amorphophallus paeoniifolius*, Cimanuk and Citanduy Watersheds, *suweg*

INTRODUCTION

A watershed is a landscape area that is an integral part of a river and its tributaries, and which functions to accommodate, store, and transfer the flow of water from rainfall down into lakes or the sea (Regulation of the Ministry of Environment and Forestry of the Republic of Indonesia No. P.59 of 2019). The USA EPA (2022) refers to a watershed as an area that drains water, sediment, and dissolved materials to a common receiving body or outlet. The term is not restricted to surface water runoff, and includes interactions with subsurface water. Watersheds vary from the largest river basins to just acres or less in size. Flotemersch et al. (2015) note that watersheds are spatially explicit landscapes containing interacting physical, ecological, and social attributes, while Pacheco and Fernandes (2020) state that watersheds are often areas where humans live and utilize existing resources for their welfare.

Plants are one of the natural resources in a watershed. Communities living within a watershed ecosystem area use its various plant species for a range of purposes. Gascon et al. (2015) consider that humans depend on biodiversity for their welfare. Chapagain and Tamang (2017) have listed some of the diverse uses of plant biodiversity, such as for fuel, food, medicine, animal feeds, and fish poisoning. Caruso and Grace (2015) suggest that the relationship between humans and plants should be considered from several perspectives, such as cultural, social, and spiritual. Moktan and Das (2013) observed that communities often have strong belief in and dependence on plant uses, especially medicinal ones.

The particular plants used by ethnic groups may vary in species, purposes, and processing methods. The interaction between the community and plants creates local, traditional knowledge. Bruchac (2014) defined traditional or indigenous knowledge as a network of knowledge, beliefs and traditions intended to preserve, communicate, and contextualize indigenous relationships within culture and

landscape over time. According to UNESCO (2022), local and indigenous knowledge refers to the understandings, skills, and philosophies developed by societies with long histories of interaction with their natural surroundings. This knowledge is integral to a cultural complex encompassing language, classification systems, resource use practices, social interactions, rituals, and spirituality. Bendem-Ahlee et al. (2014) state that local knowledge is the knowledge possessed by a local community derived from a series of activities, such as observing, analyzing, interpreting and reaching conclusions. This knowledge is obtained through extensive experience and cultural inheritance between generations (Intem et al. 2021). The knowledge is generated and transmitted through interactions within specific social and agroecological contexts (Charatsari et al. 2022). Knowledge is embodied in practice, action, morality, and spirituality (Thaman et al. 2013); within a culture that is dynamic and subject to social change over time (Kohsaka and Rogel 2019). Berkes (2012) notes that local knowledge is often transmitted through stories, teachings, songs, dances and other cultural practices. Local knowledge is essential to the relationship between humans and their environment and to the sustainable management of ecosystems (Burgos-Ayala et al. 2020). Carvalho and Moreira (2011) report that local knowledge provides new insights and opportunities for sustainable and multipurpose use of resources.

The communities of the Citanduy and Cimanuk watersheds in West Java have diverse natural resources, including plants. *Suweg* (*Amorphophallus paeoniifolius* (Dennst.) Nicolson) is a plant that is distributed in several areas in both watersheds. The communities have long used it for several purposes. The knowledge about *suweg* needs to be documented, considering that there is not much research on this topic, especially in these two watersheds. Besides that, documentation of local people's knowledge about *suweg* will serve various scientific and pragmatic interests, including the potential for development of the resource in both economic and ecological aspects. Local knowledge about *suweg* should be systematically arranged, and preserved for future generations, so as to identify and acknowledge the unique contribution to knowledge about the plant possessed by specific communities, and to document it for educational purposes (World Intellectual Property Organization 2017).

MATERIALS AND METHODS

Study area

This research project was conducted in January-November 2021 in Kuta Village, Tambaksari Subdistrict, Ciamis District; in Ciangir Village, Tamansari Subdistrict, Tasikmalaya City; and in Pasiripis Village, Kertajati Subdistrict, Majalengka District, West Java, Indonesia. The Kuta and Ciangir villages are in the Citanduy watershed while Pasiripis is in the Cimanuk watershed (Figure 1).

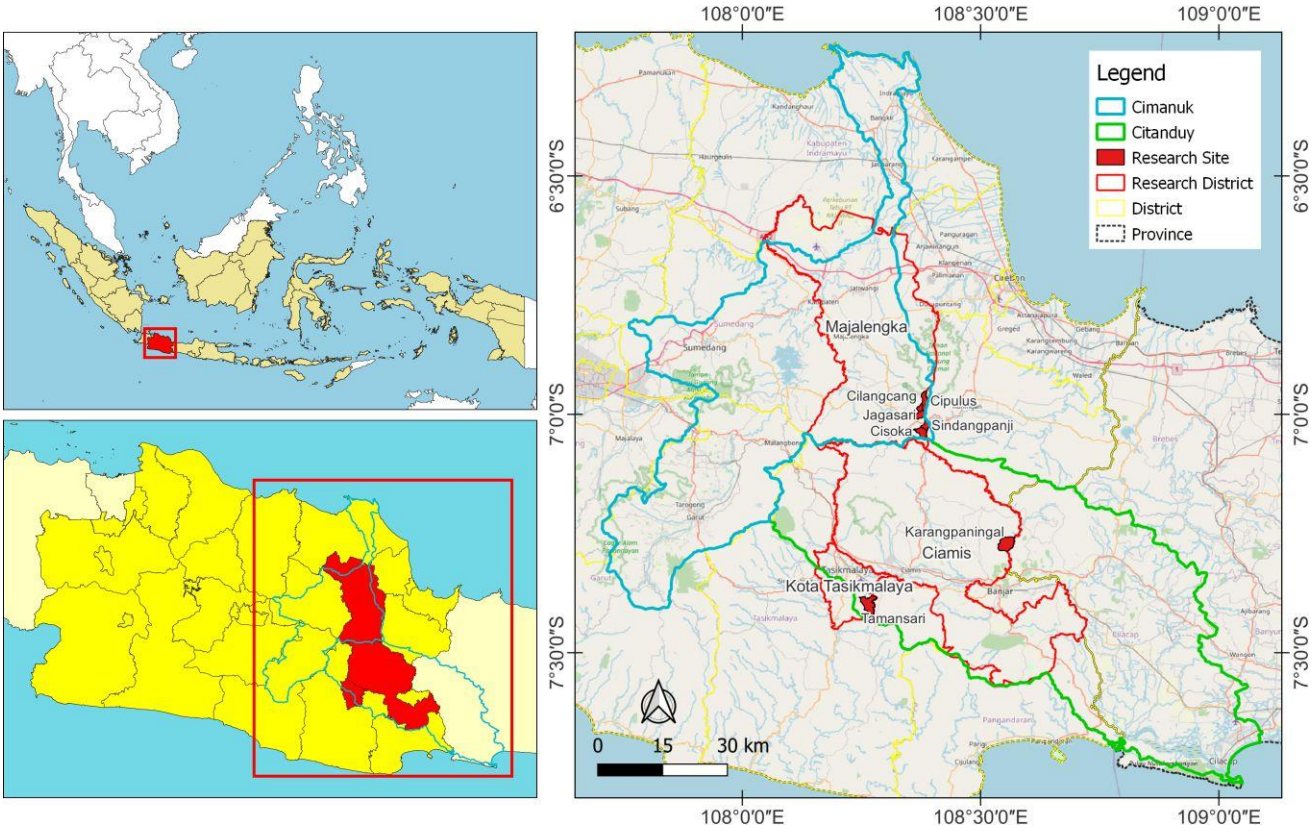

Figure 1. Study sites in the Ciamis, Tasikmalaya, and Majalengka districts, West Java, Indonesia

We chose the study sites for several reasons. The Citanduy watershed is a rural area with an agricultural landscape. Local, traditional culture is still a strong influence in the lives of the community near the Matenggeng Dam development area, which impacts social, economic, cultural, and environmental aspects, including the cultivation and use of *suweg*. Ciangir Village is near the landfill affecting the social, economic, cultural and biogeophysical environment, with impacts on *suweg*. Pasiripis Village in the Cimanuk watershed is near Kertajati International Airport and experiencing rapid changes in the socio-cultural and natural environment, including *suweg* that grows naturally in the environment.

The Cimanuk River has a catchment area of ±350,000 hectares, with a river length of about 180 km. The river flows from Gunung Papandayan at an altitude of about 2,500 masl to the Java Sea, in the northern Indramayu District (Widyastuti and Taufik 2019). The Cimanuk watershed as a whole has an area of ±3,600 km^2 with an average annual rainfall of 2,800 mm. The constituent rocks of this watershed are sedimentary, alluvial, and volcanic; soil types are regosol, latosol, andosol, gley, alluvial, mediterranean, and podzolic (Decree of the Ministry of Public Works and Housing of the Republic of Indonesia No. 267 of 2010). The temperature ranges from 24-31ºC.

The Citanduy watershed is divided into sub-watersheds: Citanduy upstream, Cijolang, Ciseel, Cikawung, Cimuntur, Citanduy upper, and Segara branches (Brotosusilo et al. 2016). This watershed has sedimentary and igneous rock types of tertiary and quaternary age. It has geohydrological characteristics, most of which are medium-high productivity aquifers in the upstream areas, and low-water productivity aquifers in the downstream areas (Decree of the Ministry of Public Works and Housing of the Republic of Indonesia No. 483 of 2013).

Kuta Village, Ciamis District, has an area of 97.40 hectares. Forty of the 97.40 hectares is *Leuweung Gede*/ *Gede* forest, a sacred forest. Kuta Village is about 45 km from Ciamis City (Karangpaningal Village 2011). Kuta village has an altitude of 463 masl and a 40-59% slope; its soil type is latosol, and the soil pH is slightly acidic. Generally, land use types are rice fields, home gardens, gardens, and forests. Main resources in Tambaksari Subdistrict derive from agricultural commodities such as rice, spinach, cucumbers, cayenne peppers, wild cabbages, long beans, chickpeas, mustard greens, bananas, papayas, mangosteens, breadfruit, peanuts, sweet potatoes, cassavas, taros, edible cannas, corns, coconuts, coffees, cardamoms, peppers, and cocoas. Besides these, other resources include livestock commodities such as cows, goats, chickens, and ducks (Statistics of Ciamis District 2019).

Ciangir village is in a rural area (Statistics of Tasikmalaya Municipalityity 2020). The village is about 5 km from the subdistrict government and 15 km from the city government. It has an altitude of about 40 masl, and the temperature is between 27-30ºC. The landscape is comprised of agricultural land, plantations, livestock forage or yearland, and fisheries (Tamansari Village 2019). The resources in Ciangir Village are agricultural commodities such as rice, corn, cassavas, sweet potatoes, peanuts, green beans, large chilies, cayenne pepper, long beans, cucumbers, eggplants, gingers, cardamoms, turmerics, galangals, avocados, starfruits, jackfruits, guavas, water guavas, mangosteens, papayas, bananas, sapodillas, and soursops (Statistics of Tasikmalaya Municipality 2020).

Pasiripis Village in the Cimanuk watershed has an area of 897 ha consisting of 467 ha of rice fields, 216.2 ha of plantations, 20.5 ha of livestock land, 13 ha of ponds/ reservoirs, and 0.5 ha of other lands (Pasiripis Village 2020). The village is 7 km from the subdistrict government and 32 km from the district government (Statistics of Majalengka District 2020). This village has an average of 109 rainy days and 1974 mm of rain per year. Resources in this village are agricultural commodities such as rice, large chilies, cayenne peppers, long beans, cucumbers, chayotes, tomatoes, bananas, water guavas, guavas, mangos, papayas, soursops, jackfruits, and sapodillas. Other resources include livestock commodities such as cows, sheep, ducks, and chickens (Statistics of Majalengka District 2019).

Procedures

The study used a mixed method, based on predominantly qualitative observations. The data collected was the local knowledge about the habitat, use, and management of *suweg*. The semi-structured interview was carried out in the three villages. This interview was carried out through depth interviews with local experts that were purposively selected (Iskandar et al. 2016; Iskandar 2018), who were considered competent to know *suweg*. This interview used the guidelines for interviews made previously and developed during the interview (Husodo et al. 2019). The informants included the landowners where *suweg* exists, farmers, and public authorities (Asif et al. 2021). We also applied participant observations to crosscheck and validate the information obtained from the informants through daily activities of the community.

The structured interview was conducted using a questionnaire for respondents who were randomly selected in three villages. Respondents selected were the household, assuming that he/she represented his/her family knowledge (Wulandari et al. 2021). The number of respondents was calculated based on the Slovin formula (Putra and Welly 2015). Based on this formula, the number of respondents interviewed was 75 in Kuta Village (from a total of 110 households), 75 in Ciangir Village (from a total of 214 households), and 100 in Pasiripis Village (from a total of 1,739 households).

$$n = \frac{N}{1 + Ne^2}$$

Where:

n : Sample size (number of informants to be interviewed)

N : Total population of potential informants (Number of households)

e : % desired confidence level based on sampling error (10%)

Data analysis

Data analysis was conducted by cross-checking, summarizing, and synthesizing (Newing et al. 2011). For

the data relating to the utilization of *suweg*, a variable called the 'use value' of the species was calculated using the formula (Silva et al. 2014; Zenderland et al. 2019; Jadid et al. 2020):

$$UVs = \frac{UVis}{ni}$$

Where:
UVs : Use value of the species
UVis: Number of stated uses of one species
ni : Total number of informants interviewed

RESULTS AND DISCUSSION

Generally, *suweg* is growing naturally. It is not an agricultural commodity, so it is not managed or cultivated by the community. The three communities reported that *suweg* is a species that has been growing for a long time in the neighborhoods where they live. The communities have long interacted with this plant resource, thus developing deep knowledge of its properties. The results show that the communities know a great deal about *suweg*: its habitat; management of its growth; ways of utilizing it for their own purposes; and the potential for development of *suweg* to provide greater economic and ecological benefits.

Habitat

According to local people's knowledge, *suweg* can grow in various environmental conditions. Details of the *suweg* habitat are recorded in Table 1 and Figure 2.

The interviewees reported details of some local terminology used to describe several environmental conditions for growing *suweg*, such as *tiis* or cold, *negrak*/ *negla* or opened, and *hieum*/ *linduk*/ *liuh* or canopied. *Tiis* means a cool, cold, or low-temperature place. *Negrak*/ *negla* means an open area or exposed to a lot of sunlight without any canopy. *Hieum*/ *linduk*/ *liuh* is where objects are mostly blocked from exposure to sunlight, such as by canopies.

Suweg can grow with various plants categorized as herbs, shrubs, or trees on the same land, such as *Eleusine indica* (L.) Gaertn., *Cyperus rotundus* L., *Cynodon dactylon* (L.) Pers., *Musa paradisiaca* L., *Ageratum conyzoides* L., *Mimosa pudica* L., *Colocasia esculenta* (L.) Schott, *Carica papaya* L., *Manihot esculenta* Cranzt, *Lansium domesticum* Corr. Var. duku Hasskl., *Swietenia mahagoni* (L.) Jacq., and *Cocos nucifera* L.

Utilization

Suweg is used for several purposes. The results of the use value analysis of *suweg* can be seen in Table 2.

Table 1. Knowledge about the habitat of *suweg* held by the community in three village areas of the Citanduy and Cimanuk watersheds

Villages	Descriptions			
	Seasonal condition	Land condition	Soil condition	Plants around *Suweg*
Kuta	Rainy season	Opened, canopied	Various types	Various species
Ciangir	Rainy season	Opened, canopied	Various types	Various species
Pasiripis	Rainy season	Opened, canopied	Various types	Various species

Figure 2. The *suweg* habitat. A. Opened (*negrak*/ *negla)*, B. Canopied (*hieum*/ *liuh*/ *linduk*)

In the past, *suweg* was widely used, like other corm plants. However, along with the increase of alternative main dishes such as rice, the use of *suweg* has also decreased. Especially in the Pasiripis Village, people are not using *suweg* for feeding fish because local people rarely find it. Besides, the people of Pasiripis Village rarely have fish ponds. In Kuta Village, people said that *suweg* has no cultural value attached to its use, such as *pamali* (taboos), even though Kuta Village is an area that still adheres to its ancestral beliefs.

Generally, the use of *suweg* for food is carried out by simple processing: (i) peeling; (ii) washing under running water or storage water; (iii) cutting; (iv) steaming or *di-seupan* for about 30 minutes; (v) serving and then eaten individually or together with family or neighbors. Heating, soaking, and boiling is physical processes for removing soluble antinutritional factors, such as oxalate level (Adeleke et al. 2017; Awulachew 2022). Oxalate is responsible for most kidney stones (Olaleye et al. 2013). For fish feed, it is the fresh leaves of *suweg* that are chosen, not leaves that are withered. The fresh leaves are used to feed various edible fish species, such as *Osphronemus goramy*, *Oreochromis niloticus*, and *Colossoma macropomum*.

Management and development potential

Generally, *suweg* is not managed or cultivated (Table 3 and Figure 3) because there is no market for *suweg*. Local people said that *suweg* might have economic value if such a market did exist. *Suweg* is found growing in their environment, is easy to plant and maintain, and has been used for specific purposes even though it does not have an economic impact on family prosperity. The community assume that *suweg* could be used as an ingredient for various processed food like other tuber plants.

The community reported that *suweg* needs to be conserved, especially considering its potential use. The locals have indirectly carried out conservation efforts by allowing *suweg* to grow on their lands. The planting propagules come from the peeled corm skins containing buds, which are discarded arbitrarily (usually without purposive burial). Sometimes, the villagers intentionally plant *suweg* corm material or plant sprouted *suweg* saplings on their land. Generally, these lands are agroecosystem lands such as home gardens, which are often managed by the community.

Suweg has the potential to be developed for the purposes of economic improvement and environmental management, especially in watershed ecosystems. The community of West Javanese watersheds widely use *Suweg* for several necessities of life. Utilization of *suweg* does not require high expenditure, nor is the processing too complicated. *Suweg* is not an introduced plant because it has long been grown or found in the community environment. *Suweg* is a plant from the genus *Amorphophallus* that can grow in various environmental conditions. *Suweg* can grow in open or canopied areas, hot or cold air conditions, different soil types, and with multiple plant species around it. Ecologically, *suweg* is found on lands that are managed by the community. *Suweg* is found at various altitudes and environmental conditions. *Suweg* shoots appear at the end of the dry season or the beginning of the rainy season when the weather has cooled. *Suweg* grows until the end of the rainy season or the beginning of the dry season, which is marked by the yellowing of the leaf blades and petioles. This condition is an indicator that *suweg* can be harvested.

Suweg can grow on various highlands or lowlands, especially on damaged or unused land. *Suweg* can grow with multiple other annual or perennial plants, such as in agroforestry cropping systems. *Suweg* can contribute to ecosystem quality to reduce erosion, sedimentation, and carbon absorption, increase oxygen supply, and enrich the habitat of various other organisms.

Table 2. Knowledge about the use of *suweg* held by the community in three villages areas of the Citanduy and Cimanuk watersheds

Villages	Descriptions			
	Use Value	Utilization type	Parts of the plant used	Utilization technique
Kuta	1.95	Suplementary food (*jaburan*), fish feed	Corm, leaf	Steamed (*di-seupan*), fried, Unprocessed
Ciangir	2.41	Suplementary food (*lalawuh*), fish feed	Corm, leaf	Steamed (*di-seupan*), fried, Unprocessed
Pasiripis	1.01	Supplementary food	Corm, petiole	Boiled

Table 3. Knowledge of community about *suweg* management in the Citanduy and Cimanuk watersheds

Sites	Descriptions			
	Cultivation status	Cultivation land	Development potential	Conservation
Kuta	Not cultivated	Home garden, monoculture garden	√	Important
Ciangir	Not cultivated	Home garden, monoculture garden	√	Important
Pasiripis	Not cultivated	Home garden, monoculture garden	√	Important

Figure 3. Type of land where *suweg* grows. A. Home garden, B. Garden

Discussion

The community said that *suweg* grows on land cultivated with various environmental conditions related to climatic, edaphic, and biotic factors. *Suweg* is found in several ecological conditions, such as multiple altitudes, open and canopied land, and growing with different plants. Various altitudes will affect air temperature, humidity, rainfall, number of rainy days, oxygen level, light intensity, and soil characteristics (Ohmura 2012; Al-Ahmadi and Al-Ahmadi 2013; Ceballos et al. 2021). *Suweg* has a growing environment with a diverse range (Yuzammi et al. 2017). Mukherjee et al. (2014) report that the genus *Amorphophallus* is divided into two groups relating to climatic conditions: the tropical and the sub-tropical.

Regarding altitude, *Amorphophallus* species have been found growing in areas with a height of 64-134 masl (Hidayat 2019), 8-572 masl (Trimanto and Hapsari 2016), and 598-955 masl (Mutaqin et al. 2021). Regarding light exposure, *suweg* grows in areas with a range of light exposure, open or canopied (Heng and Hetterscheid 2010; Permatasari et al. 2014). *Suweg* is found on lands with 40-100% canopy cover (Hidayat 2019) with a light intensity of 7500-37700 lux (Permatasari et al. 2014).

Regarding edaphic factors, Bunyani et al. (2020) state that *suweg* can grow well in different soil types, including limestone soil, clay soil, sandy soil, red soil, or black soil. Hafsah et al. (2018) report that soil pH affects the distribution of *Amorphophallus*. *Suweg* grows at a soil pH of 5.8-6.5 according to Hidayat (2019) and 7-7.4 according to Permatasari et al. (2014). Generally, a soil pH of 6.0-7.0 is considered optimal for the growth of a wide range of plant species (Agegnehu 2020). Sahoo et al. (2016) have reported on the effect of soil fertility levels on the corm yield of *A. paeoniifolius*. Likewise, Venkatesan et al. (2013) reported that planting media containing organic matter in various conditions affects plant height and canopy width.

Regarding biotic factors, Permatasari et al. (2014) have reported on *suweg* growing on land in company with a range of species of trees and shrubs, including litchi, mango, sweet potato, taro (Narayan et al. 2018), *Eleusine indica* (L.) Gaertn., *Chromolaena odorata* (L.) R.M.King & H.Rob., *Colocasia esculenta* (L.) Schott, *Parkia speciosa* Hassk., and *Sweitenia mahagoni* (L.) Jacq (Mutaqin et el. 2021).

The results of our study are in line with several scientific reports regarding the development potential for *suweg*. Mutaqin et al. (2020) reported that *suweg* is a plant from the genus *Amorphophallus* which is generally found in several agroecosystems, such as home gardens and monoculture gardens. Ratna Kumar et al. (2015) informed that the community widely cultivates this plant in India. Meanwhile, if it is regarded as analogous to a plant of the same genus, namely *porang* (*Amorphophallus muelleri* Blume), then *suweg* should have prospects for development. Simatupang et al. 2022) stated that *porang* plants are canopy cover-tolerant, easy to cultivate, highly productive, and have relatively few pests/diseases. Wahidah et al. (2021) reported that *A. muelleri* is a local Indonesian plant that can be used as food and is easy to cultivate.

From a sociological view, local wisdom could develop *suweg*, which is an invaluable tradition influencing people's attitudes and behavior towards nature and is practiced by the community to maintain balance and preserve the environment (Fahrianoor 2013; Hasbiah 2015; Jundiani 2018; Latifah et al. 2018). *Amorphophallus* is one of the essential crop developed as flour and medicine and play a pivotal role in the human diet (Singh et al. 2010; Chandrasekara and Kumar 2016; Suriya et al. 2017; Mubarok and Santosa 2018).

Potential development is supported by some information related to the potential of the substances contained in *suweg*. Harijati et al. (2011) reported that *suweg* contains glucomannan. This compound is a carbohydrate with the main constituents mannose and glucose, with a molecular weight of 200-2000 kDa (Cheang et al. 2017). Mekkerdchoo (2016) reported that the amount of glucomannan is about 1-19% of dry weight. In addition, this *Amorphophallus* species contains several essential compounds such as steroids, alkaloids, tannins, glycosides, carbohydrates, fats, fixed oils, phenols, flavonoids, saponins, proteins, starch, *β*-carotene, lycopene, alpha-tocopherol, ascorbic acid, crude fiber, quinine, coumarin, sodium, cobalt, calcium, boron, nitrogen, phosphorus, potassium, magnesium, zinc, chromium,

copper, iron, and manganese (Singh et al. 2013; Basu et al. 2014; Kagale and Sabale 2014; Srivastava et al. 2014; Singh et al. 2016; Kumar et al. 2019).

Suweg's development potential can also be linked to market opportunities. The market opportunity for *suweg* may be analogous to the market for *porang* (*A. muelleri* Blume). Riptanti et al. (2022) mention that *porang* is an export commodity. The Agricultural Quarantine Agency of the Ministry of Agriculture of the Republic of Indonesia (2021) reported that the quantity of *porang* exports in the first semester of 2019 was 5.7 thousand tons. In the first semester of 2021 it was recorded as 14.8 thousand tons. Sari and Suhartati (2015) suggested that processed *porang* tubers could become an export commodity.

Economically, *porang* is more profitable and has a high price by adding value through processing the raw materials by diversification of products or developing various processed products from raw materials, so that *porang* cultivation is cost-effectively and demand for *porang* flour exports still exists (Sjah et al 2012; Firmansyah et al. 2017; Dermoredjo et al. 2021; Soemantri et al. 2021). The profit margin of *porang* cultivation is IDR 164,602,000/ha/3 years. Asih et al. (2018) reported that *porang* farming gives a profit of IDR 48,271,125/ha/year. Meanwhile, Susanawati et al. (2021) said that the profit from *porang* cultivation is IDR 43,108,720/year planting period from selling *porang* chips at IDR 54,736/ kg, seed bulbil IDR 162,500/ kg, and wet tubers IDR 6,967/kg. In particular, *suweg* can increase income by intercropping with other plants (Singh and Singh 2015; Narayan et al. 2018).

We conclude that *suweg* is a plant that has the potential to be developed, especially for food security, increasing people's economic income and environmental management in watershed ecosystems. Ecologically, *suweg* grows in the Citanduy and Cimanuk watersheds with varied ecological conditions. Sociologically, the community has specific knowledge about *suweg* related to habitat, utilization, and management.

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