BIODIVERSITAS
Volume 17, Number 2, October 2016
Pages: 814-822

ISSN: 1412-033X
E-ISSN: 2085-4722
DOI: 10.13057/biodiv/d170259

Wati (*Piper methysticum*) medicinal plant: The ethnobiological and ethnomedicinal values of the Marind tribe in Merauke, Papua, Indonesia

SUHARNO[1,♥], ROSYE HEFMY RECHNELTY TANJUNG[1,2,♥♥], SUPENI SUFAATI[1], VERENA AGUSTINI[1]

[1]Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Cenderawasih. Jl. Kamp Wolker, Perumnas III, Waena, Jayapura 99582, Papua, Indonesia. Tel./Fax. +62-967-572115, ♥email: harn774@yahoo.com.

[2]Environmental Studies Center, Universitas Cenderawasih. Jl. Kamp Wolker, Perumnas III, Waena, Jayapura 99582, Papua, Indonesia. ♥♥email: hefmitanjung@yahoo.co.id

Manuscript received: 10 August 2016. Revision accepted: 11 October 2016.

Abstract. *Suharno, Tanjung RHR, Sufaati S, Agustini V. 2016. Wati (*Piper methysticum *L.) medicinal plant: The ethnobiological and ethnomedicinal values of the Marind tribe in Merauke, Papua, Indonesia. Biodiversitas 17: 814-822.* Biological resources around neighborhood play important roles in the cultural development of the surrounding communities, including the use of plants. *Wati* (kava, *Piper methysticum*) is one of the species that has long been used as a traditional medicine and cultivated by Marind tribal community in the lowlands of Merauke, Papua. The aim of this study is to examine the use and domestication of *wati* plant by Marind tribe in Papua. Results of the study showed that *wati* plant has long been used by the Marind tribal community as a medicinal plant with high customary value. Each customary event includes *wati* plant as a complementary requirement for legitimate activities by the Marind tribe. It is the importance of customary values that led the domestication of *wati* plant done since 60 years ago on a small scale to eventually develop into plant called as "the Marind people's gold". Results of the observation showed that 93.8% of the Marind people have largely recognized *wati* plant, while 53.3% of the immigrant communities from outside the area recognized it, but only 33.3% knew about its utilization. Although not all indigenous elders cultivate it, they recognize, utilize, and understand the rules of using *wati* plant in traditional events and as traditional medicine. As traditional medicine, the parts used by Marind people use root (100.0%), stem (96.6%), and leaves (89.7%). For customary events, the most important parts are the whole plant (100.0%), stem (100.0%), leaves (98.3%) and roots (93.1%). Their children even recognize it and know its benefits, but most of them 31.25% only utilize it but are prohibited from participating in its preparation (0.0%). The domestication of this plant is quite unique because it is closed to the public and is still done by a conventional method.

Keywords: Ethnobiology**,** ethnomedicine, Marind tribe, Papua, *Piper methysticum*

INTRODUCTION

As an archipelagic country, Indonesia is abundant with natural resources, including the diversity of plants. More than 30,000 plant species are found there in where 9,600 species are medicinal plants (Suharno et al. 2011; Putri et al. 2016). Over than 1,800 plant species known exist and were planted in several forest formations, with 940 plant species used by local people for traditional herbal medicine and only 300 species by drug industries (Putri et al. 2016). In Papua, various medicinal plants species with cultural value are quite significant in number (Suharno et al. 2011).

Wati or *kava* plant (*Piper methysticum* L; Piperaceae) is one of the local plants in Papua. It grows well in lowlands in Merauke Regency (Nova 2009). The plants with woody shrubs stature growing in the wild, can reach a height of 5 m, and can be cultivated by slip and generative. In nature, most individuals are male species (Cassileth 2011; Tanjung et al. 2014). In internationally world, the plants are well-known as "kava" and largely mostly used by local people as traditional medicine (Lebot and Simeoni 2004; Nova 2009).

Wati plant is used to treat rheumatism, respiratory tract infections, tuberculosis, gonorrhea, and headache. Its leaves and stems contain several compounds that can be utilized as with anti-stress, analgesic, and psychoactive drugs (Backhauβ and Krieglstein 1992; Kavanagh 2009; Tanjung et al. 2014) as well as antibacterial (Amorim et al. 2007) and anticancer ones (Hashimoto et al. 2003; Tabudrayu and Jaspars 2005). The roots of *wati* plants have been utilized as a traditional beverage in many countries, including in the Pacific Islands (Balick and Lee 2002; Anke and Ramzan 2004). In the last few decades, *wati* plants have been known to have sedative and anxiolitic properties (Boon and Wang 2003; Garrett et al. 2003; Sarris et al. 2009; Shanti and Avinash 2013). The plants have potential as a source of compounds for pharmacy because they contain a variety of lactone compounds such as sedative, soporiphyic, analgesic, and actinoconvulsive ingredients as well as local anesthetics, muscle relaxants, and diuretics (Davis and Brown 1999; Briskin et al. 2001; Laporte et al. 2011). In adversely, other some studies indicated that *wati* plant might have implications on liver damage for users (Anon. 2002; Anke and Ramzan 2004; Ulbricht et al. 2005; Amorim et al. 2007; Martin et al. 2014; Hussein 2015).

As one of the regencies in Papua Province, Merauke has a population of 246,852 people (data per December 2013) and became one region in the eastern of Indonesia

directly that borders with Papua New Guinea (PNG). Before the splitting of region, Merauke regency had approximately 29% of the territory of Papua Province. However, after several regions were splitted, the remaining is 46,791.63 km^2, which covers 20 regencies, 8 urban villages, and 160 villages (www.merauke.go.id). Indigenous peoples that inhabit Merauke territory are from Marind tribe, consisting of several large groups at swamps, beaches, and inland.

In their life, the Marind tribe has very high traditional values and depends on environment and forest products. The community uses forest products in a variety of both official and unofficial events and activities. The position of various plant species as symbol and identity of the ethnic group is still high. *Wati* plant is one of the customarily invaluable plant species, so it is called as "the Marind people's gold". For the Marind people, *wati* plant has a significant value for the benefit of local customary people, thereby increasing economic value to the family. Davis and Brown (1999) and Shanti and Avinash (2013) revealed that change in peoples' attitudes also affects the change in utilization of natural resources for the survival and socialization process among them. The purpose of this study is to investigate the traditional utilization of *wati* plants as medicine by the Marind people in Merauke, Papua, Indonesia.

MATERIALS AND METHODS

Study area

The study was performed through survey from May to June 2016 in Merauke District, Papua Province, Indonesia. The survey was held for three weeks in several locations where *wati* (*P. methysticum*) plants were naturally found or cultivated by local people. It was made randomly in villages representing several sub-districts, i.e. Okaba, Merauke, and Sota (Figure 1).

Wati plants are evenly grown in the lowland areas in the southern part of Papua. On a large scale, the cultivation of *wati* plants is concentrated in Merauke Sub-district and Sota Sub-district . Mean while, the plant are considered as "sacred" for the Marind people, so that not all locations can be accessed for detailed information. However, some major

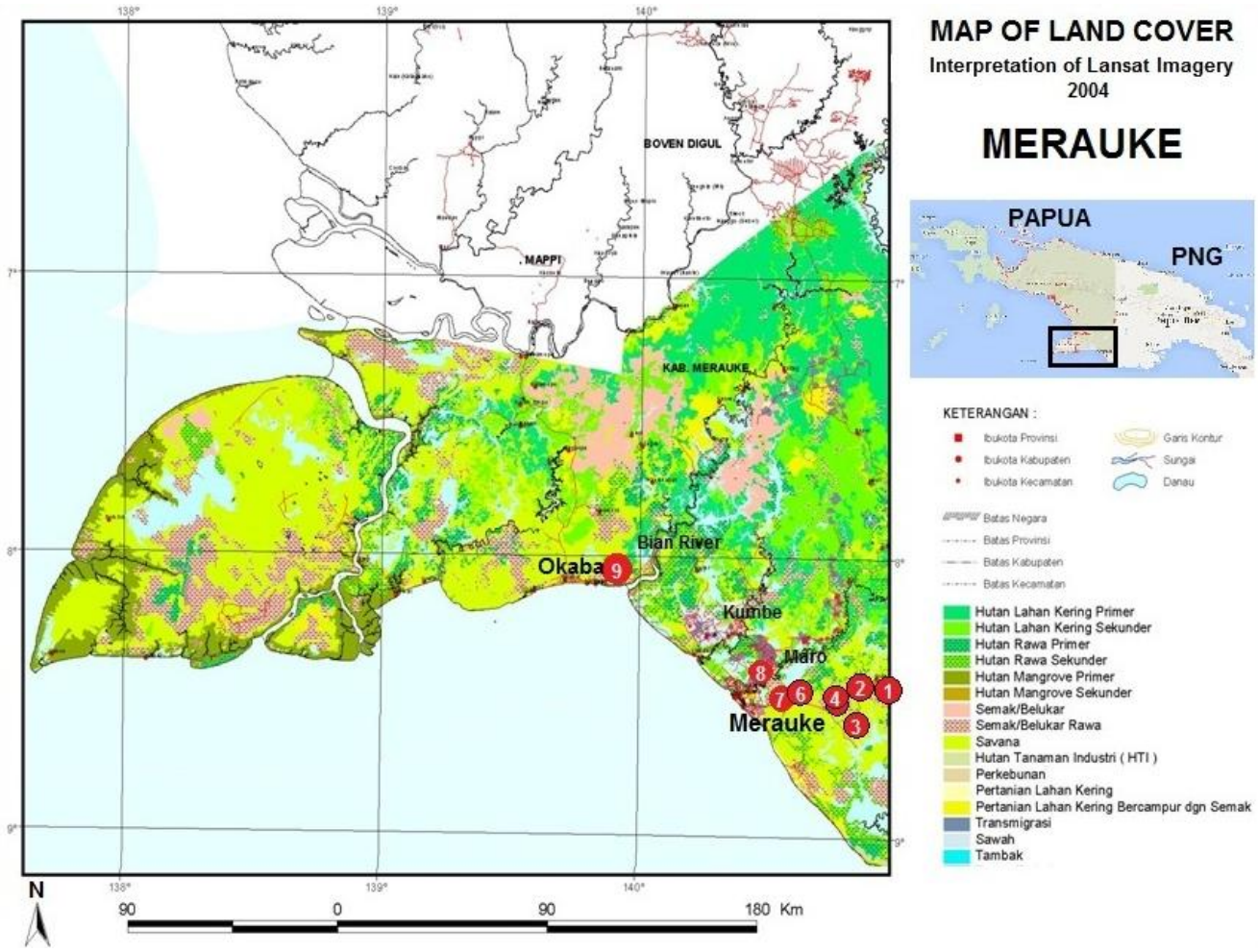

Figure 1. Location of the study in several Sub-districts in Merauke District, Papua, Indonesia: 1. Sota village, 2. Pinje, 3. Yanggandur, 4. Wasur I, 5. Wasur II, 6. Mangga Dua-Johar, 7. Mangga Dua, 8. Kuprik, 9. Sanggase

Table 1. Location of sampling in some major villages in Merauke, Papua

No.	Location		Coordinate position	Alt (m asl.)	Temperature (^{o}C)
	Village	Sub-District (Kecamatan)			
1.	Sota, Sota	Sota	S: 08^{o}25'42.5"; E: 141^{o}01'01.8"	22	31.0-33.0
2.	Pinje Km 67, Sota	Sota	S: 08^{o}26'54.6"; E: 140^{o}53'31.1"	20	31.5-34.0
3.	Yanggandur	Sota	S: 08^{o}28'31.6"; E: 140^{o}50'24.4"	26	31.0-32.5
4.	Wasur I, Rimba Jaya	Merauke	S: 08^{o}31'26.3"; E: 140^{o}31'10.2"	21	29.5-31.5
5.	Wasur II, Rimba Jaya	Merauke	S: 08^{o}31'24.2"; E: 140^{o}31'13.1"	21	30.0-31.5
6.	Mangga Dua-Johar, Kelapa Lima	Merauke	S: 08^{o}28'35.1"; E: 140^{o}24'21.5"	15	30.0-32.0
7.	Mangga Dua, Kelapa lima	Merauke	S: 08^{o}28'45.4"; E: 140^{o}24'20.1"	20	29.0-30.0
8.	Kuprik	Semangga	S: 08^{o}28'01.7"; E: 140^{o}26'12.2"	25	25.0-33.5
9.	Sanggase, Okaba	Okaba	S: 08^{o}03'52.5"; E: 140^{0}01'03.2"	19	26.0-29.0

locations such as Merauke Sub-district and Sota Sub-district are considered to represent as samples of other various locations where *wati* plants are cultivated (Table 1).

The utilization of *wati* plant by the Marind People

Direct observation was done to examine the utilization and cultivation of *wati* plants. Questionnaires and interviews were used to gain additional information. The study involved 74 respondents from 9 observation sites included Merauke Sub-district, Sota Sub-district, Semangga Sub-district, and Okaba Sub-district. Informants were selected with purposive sampling technique. The respondents can be categorized as key informants, main informants, and additional informants, who were from social/customary figures, farmers or users of *wati* plants. Of the 74 respondents, 58 were from the Marind tribe and 15 were migrant communities outside of the tribe. As for the migrants, they were specially selected based on the period (>5 years) of living in Merauke and were considered as adult. The detail of respondents were as follow; from social or customary figures; 10.3%, male or female adults 62.1%, and children 27.6%. Data were collected from key informants, then substituted by other informants such as customary figures and laypersons who use *wati* plants in customary events and as traditional medicine. Interviews were conducted using semi-structural and open-ended technique with all informants in the survey locations and other informants deemed relevant (Walujo 2004; Zebua and Walujo 2016).

The cultivation of wati plant by the Marind People

The techniques of cultivating *wati* plants were known through interviews with *wati* plant farmers. The latter was interviewed for more accurate and reliable information. The interviews were carried out in five active farmer groups when the direct observation was done in the field. The data obtained were presented in the form of descriptive information. Samples of soil taken for soil fertility levels were analyzed at the Laboratory of Soil, SEAMEO-Biotrop, Bogor.

Data analysis

Results of the observation were analyzed by a descriptive technique. The data process involved organizing, sorting, categorizing, evaluating, comparing, and synthesizing data, and drawing conclusions.

RESULTS AND DISCUSSION

The utilization of *wati* plant by the Marind People

Results of the study showed that *wati* plants have long been utilized by the Marind people with customarily high value. It unknown the use and domestication of wati plants within Marind tribe, but they have long been used since their ancestors for generations. In the other hand, intensive cultivation is is known to have started at small scale from 60 years ago.

Wati plant has a high value because it is used in various customary events of the Marind tribe. In fact, in the resolution of specific cases related to conflict between social groups, *wati* plant should be provided as a means to unite them in solving the problem. By brewing water with or directly chewing *wati* leaves, the entertainment is served during the community meetings or into the conflicting tribes. They used water as sedative to facilitate the consultation for consensus to resolve the conflict among communities. According to Davis and Brown (1999), *wati* plants are associated with mystical and ceremonial events as indicated in the Marind tribe people in Merauke. Most residents keep this issue because according to traditional elders some people take advantage of *wati* plants for the negative activities that harm others.

The observation showed that 93.8% of the Marind tribe were able to recognized *wati* plants, while 53.3% of the immigrant from outside the area have recognized the plants, with only 33.3% knew about its utilization. Although not all traditional elders or leaders cultivate the plants, they have recognized, utilized, and understood the rules of the use of *wati* plants in the traditional events and as a traditional medicine. Their children were also recognized *wati* plants and knew the benefits, but only 31.2% of them have utilized them and they were prohibited from participating in the preparation process (0.0%) (Table 2).

The knowledge of *wati* utilization among the Marind tribe is almost the same between men and women, with survey indicated that more men serve as *wati* farmers (90.5), while women were only 53.3%. Most children as respondents revealed that some of them (12.5%) actively helped their parents for cultivating *wati* plants, but they did not understand cultivation techniques done by their parents. The knowledge of customary rules for children is also not informed by their parents as indicated that no respondent (0%) among children knew such rules. For migrant

communities, information about *wati* plant is less. At least only 53.3% of respondents knew *wati*, and only 33.3% knew the benefits of *wati* (Table 2). Moreover, they also do not understand about the function of *wati* plant as traditional medicine and its utilization in traditional events of the Marind people.

The utilization of *wati* plant in customary events

The use of *wati* plants in customary event is to the role of pig in a variety of formal and informal events. Some important traditional events where *wati* plant plays complementary requirement in legitimated activities such as girl-proposing, wedding ceremony, celebration of special occasion, ceremonial meal for died people, special guest banquet, even the meeting of traditional leaders in solving inter-ethnic and other problems. Either large or less materials of *wati* plant and pig provided in these events show the social level of the relevant organizing community. For a customary event, the most important parts of *wati* plant utilised were all parts (100.0%) and stem (100.0%) of *wati*, followed by leaves (98.3%) and roots (93.1%) (Figure 2).

In a girl-proposing event and a wedding ceremony, *wati* plant is used as *ube rampe*. In such event, the utilization of *wati* is integrated as a customary function and a medicinal function. Usually *wati* plant is used as medicine, it is served at the end of the event. Some customary figures revealed that other roles of *wati* plants were highly confidential as to maintain security within an ethnic group and among the groups outside their tribe.

The utilization of *wati* plant as traditional medicine

Table 2 shows that all customary elders and both male and female adults understand about *wati* plant as medicine. Not all women know, however, how to process *wati* plant used as traditional medicine. Some information suggested that this plant is often used as drug of cough, influenza, aches, muscular pain, tonic for the body (fatigue), sedative, maag, injury, malaria, even AIDS. The preparation procedure is very simple and traditional, just by making *wati* plant in drinks. In use as a medicine, the parts mostly used by were roots (100.0%), stem (96.6%), and leaves (89.7%). For both customary elders and adults, they understand how to use the plant, and only 75.0% of children knew that *wati* plant can be used as a medicine and a small portion of them (12.5%) know how to use.

The cultivation of wati plant

The Marind tribes of Merauke lowland still has a farming habit with a nomadic agricultural field system. It is evident that the small-scale gardens cultivated are still nomadic, although they are in areas that are not too far from the settlement occupied. The gardening technique applied is still very simple. Most activities in *wati* plant cultivation are dominantly carried out by men as heads of the family, although mothers and other women also played an important role.

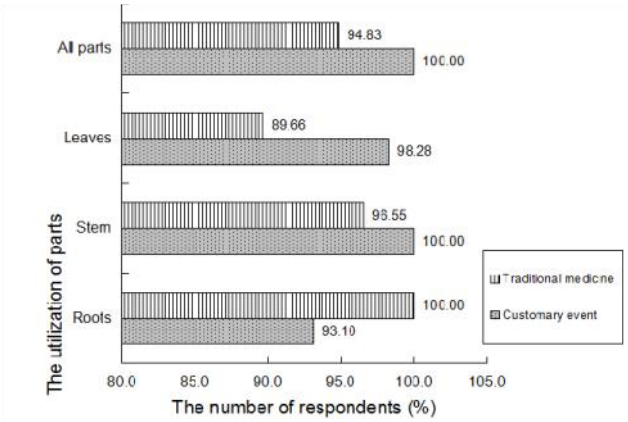

Figure 2. The utilization of parts of *wati* (*P. methysticum*) plant by the Marind tribe in traditional medicine and customary events in Merauke, Papua

Table 2. The Marind tribe people's knowledge about the utilization of *wati* plants in Merauke, Papua

Knowledge of communities on wati plant	The respondents of Marind tribe (percentage)					Migrant communities	
	Customary figures	Men	Women	Children	Total	Total	%
Know the plants wati	6 (100)	21 (100)	15 (100)	15 (93.75)	57 (98.28)	8	53.33
Know the benefits of wati plant	6 (100)	21 (100)	15 (100)	13 (81.25)	55 (94.83)	5	33.33
Never used	6 (100)	21 (100)	15 (100)	5 (31.25)	47 (81.03)	0	0.00
Never mix potions	6 (100)	21 (100)	4 (26.67)	0 (0.00)	31 (53.45)	0	0.00
Performers cultivation	5 (83.33)	19 (90.48)	8 (53.33)	2 (12.50)	34 (58.62)	0	0.00
Understand cultivation techniques	6 (100)	19 (90.48)	8 (53.33)	0 (0.00)	33 (56.90)	0	0.00
Know the rules of customary	6 (100)	21 (100)	8 (53.33)	0 (0.00)	35 (60.34)	0	0.00
Knowledge of wati as medicine	6 (100)	21 (100)	15 (100)	12 (75.00)	54 (93.10)	0	0.00
Know how to use as a traditional medicine	6 (100)	21 (100)	12 (80.00)	2 (12.50)	41 (70.69)	0	0.00
Knowledge of wati as customary	6 (100)	21 (100)	15 (100)	9 (56.25)	51 (87.93)	0	0.00
Know how to use a customary	6 (100)	20 (95.24)	14 (93.33)	0 (0.00)	40	0	0.00
Knowing the risks of misuse of customary	6 (100)	20 (95.24)	14 (93.33)	0 (0.00)	40	0	0.00

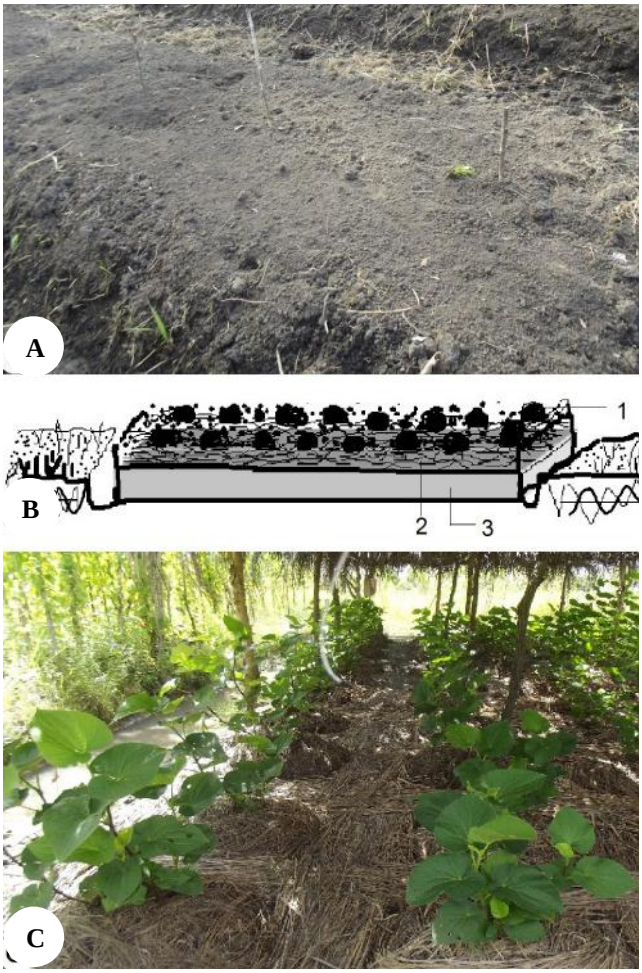

Figure 3. *Wati* plant preparation and cultivation. A. Making seedbed, B. Making the graphic line of land used in *wati* plant cultivation (1. mound (*kuming*), 2. litter, 3. soil seedbed). C. *Wati* cultivation land.

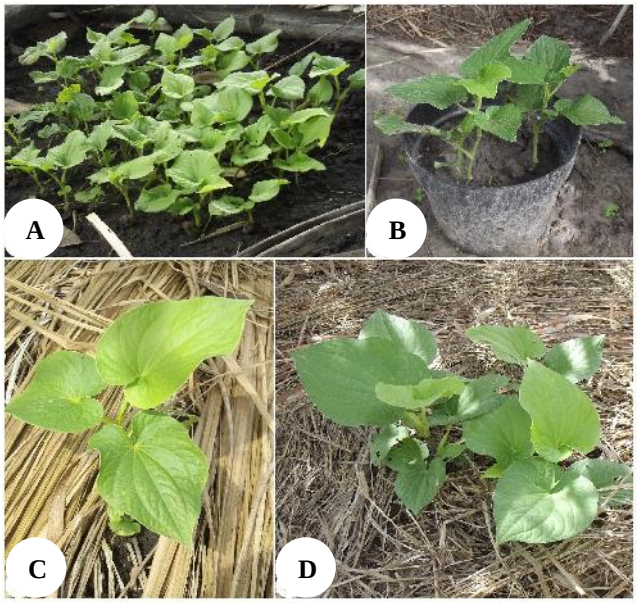

Figure 4. Overview of *wati* seeding and planting. A. Planting seeds that will be used by using a stem cutting technique on land, B. Preparation of seeds using stem cutting technique in pots, C. At one mound, there is one plant grown on land, and D. At one mound there are more than one plant

Table 3. Results of the analysis of soil physical and chemical properties of soil in cultivation land in the lowlands of Merauke, Papua

Parameters of physical and chemical properties		Location of village			
		Sota	Pinje, Km67	Wasur	Mangga Dua
pH (H_2O) (1:1)		5.3	5.6	5.7	5.1
pH ($CaCl_2$) (1:1)		4.6	4.5	4.5	4.4
C organic	(%)	1.75	4.54	0.58	5.35
N total	(%)	0.12	0.24	0.08	0.54
Ratio C/N		14.6	18.9	7.3	44.6
P (P_2O_5) available	(ppm)	14.0	7.3	8.2	3.4
K	cmol.kg^{-1}	0.51	0.61	0.23	0.78
Ca	cmol.kg^{-1}	3.66	1.96	1.98	2.06
Na	cmol.kg^{-1}	1.33	2.04	2.45	2.55
Mg	cmol.kg^{-1}	1.05	1.33	1.28	1.48
CEC	cmol.kg^{-1}	9.94	18.32	6.95	26.69
Base saturation	(%)	65.90	41.92	85.47	25.74
Al-H_{dd} KCl 1 N:					
Al^{3+}	(me/100g)	0.00	0.00	0.00	0.30
H^+	(me/100g)	0.10	0.10	0.10	1.63
Soil texture:					
sand	(%)	39.3	21.5	14.8	2.3
dust	(%)	18.6	42.0	45.6	67.0
clay	(%)	42.1	36.5	39.6	30.7

The land required for *wati* plant cultivation is generally very suitable for plant growth. The results of analysis of the soil in the Merauke lowlands showed that pH of soil ranged from 5.1 to 5.7 (H_2O) with an average of 4.5, content of soil organic C from 0.58 to 5.35%, total Nitrogen (N) from 0.08 to 0.54%, C/N ratio from 7.3 to 44.6, and phosphorus (P) content available from 3.4 to 14.0 ppm. Several cations can be exchanged such as calcium (Ca), ranging from 1.98 to 4.44 cmol.kg^{-1}, magnesium (Mg) from 1.05 to 1.56 cmol.kg^{-1}, potassium (K) from from 0, 23 to 0.78 cmol.kg^{-1}, natrium (Na) from 1.18 to 2.55 cmol.kg^{-1}, and CEC (cation exchange capacity) from 6.95 to 26.69 cmol.kg^{-1} (Table 2). Most areas have a clay loam soil texture to the dusty clay.

Discussion

The importance of *wati* plant is seen from a variety of customary activities that have utilized this plant as a part of the ritual. The customary elders/figures and the leaders of various clans in the Marind tribe consider that an event will not be "legitimate" without the presence of *wati* plant, meaning that *wati* plant must be absolutely available. The Marind community regards that *wati* plant is the first property, so that in any customary events *wati* plant is the main material that must be presented. *Wati* plant is also essential for certain traditional parties, for example, at grievance *wati* is used at the end of event, i.e. as a drink. The utilization of *wati* as a medicinal plant has also been done from generation to generation since the past. Someone who is exhausted usually consumes *wati* drink. However, for such case the consumption is only for adult, while children and unmarried people are still prohibited.

Scientifically, *wati* plant contains compound similar to anesthetic (Anon. 2004; Sarris et al. 2009; Laporte et al. 2011). People who drink it will feel "fly" and in a short

time (approximately 15-20 minutes) will make the person asleep. It is the time to sleep that will affect the rest of the body to work, because he/she will not remember anything else until waking up the next morning in a fresh condition. The duration of sleeping time varies, depending on the high or low content of *wati* drunk. This makes the Marind people knows that there are some *wati* plants with diverse types.

Wati plant with high-quality (easily intoxicating) is characterized by black or red color and short nodus. *Wati* black is often referred to as *palima*, while the short nodus *wati* is often referred to as *fangge yambad*. People are familiar with several types of *wati* plant leaves, some stated that there are three, five, and even seven types. This difference is due to different factors in certain regions. In view of the existing number of clan, each of the seven clans has generally its own characteristic. It is not clear whether or not the types of *wati* plant actually have specific difference to species level. However, if viewed morphologically, all "types" of diverse plants are still part of the plant species of *P. methysticum*. According to Davis and Brown (1999), there are many cultivars of *wati* plant species as indicated by the property of upright stems, stem color, internodes relative length (segments) its and hardness, lenticel distribution on stem, leaf color, and the aging process of leaves and hairs on the leaf surface. Lebot et al. (1999) revealed that there is the morphological variation of *wati* plant as a morphotype from various sources of different locations.

The product of *wati* plant is used as traditional drink. The way of making this drink is very simple, but it is only done by certain people such as customary elders, those who believed or elders who are usually agreed upon by community groups in the village they live (Table 2). The aim is to limit the making of *wati* drink in order that not all people can do it, so that the use and exploitation can be controlled. A product such as the filtered beverage liquid can be consumed. Some people still keep some information about how to make the traditional drink of *wati* as medicine. Ernst (2007) revealed that such anxiolytic herbal medicine has also been sold well in UK and other countries. In UK, *wati* plant is packaged in herbal medicine or dietary supplements. Many cases showed that *wati* is believed to be the cause of hepatotoxicity, even 100 cases reported in the world are associated with liver disease. According to Davis and Brown (1999), kava has been widely explored in South Pacific region, for example in Fiji, Tonga, Vanuatu, Samoa, and areas of Micronesia. This plant is important for traditional and ceremonial events in community and has been cultivated. According to Cassileth (2011), *wati* is also a native plant in the Hawaii islands where rhizome and its roots have widely been used as a non-fermented beverage with relaxant effect in order that people can be more relax. It can be used in social events and usually made as a ceremonial drink since hundred years ago in the Pacific islands.

In toxicological studies, some recent studies show that kavalactone and its extract have the effect of low toxicity level. *Wati* plant has also potential to cause drug interaction that inhibits cytochrome P450 enzymes. The constituents of kava, flavokavin, and pipermetistin showed cytotoxic in vitro, but in other studies there is no toxicity or hepatoprotective effect in treatment (Ernst 2007). Since 1999, the professional observers of health in some countries such as Germany, Switzerland, and the United States reported several cases possibly associated with the use of *wati*-related products (Anon. 2002), while in Canada the information is still minimal (Boon and Wong 2003).

All parts of *wati* plant can be utilized by community in a variety of events. However, people know and understand which parts can be utilized as needed. For wedding ceremony, particularly in proposing to a girl, the man's party is required to bring a few clumps (each clump is composed of some trees) as a requirement for "legitimate" proposing to the girl. Typically, these plants are taken as a whole from the roots to the stems and leaves, then strung together with other agricultural products such as bananas, batatas, lesser yam (*Dioscorea esculenta*), and fruits. All of these *ube rampe* are given to the family of the girl. Many interesting stories from results of this survey, but not all of the respondents are willing to share the story in depth as it relates to community tradition. Therefore, the research team also keeps some of the stories that are considered to be confidential in order that no misunderstanding occurred in the community, especially in Merauke.

Wati cultivation system among the Marind Tribal Community in Merauke

Cultivation system applied by indigenous people in Merauke (the Marind tribe) is a nomadic agricultural field system. According to Suharno (2001), most areas in Papua still use the nomadic agricultural field system, particularly local communities. This condition prominently appears in areas with locations far from town. Most lands in the lowlands of Merauke are under wet and marshy condition. Seasonal patterns affect the agricultural system. In the rainy season, most of the marshy areas will be inundated by water, while in the dry season most lands in the areas are dry. The type of muddy clay soil dominates the lowlands (Table 3).

Some fields are treated with a levee system or beds to avoid puddles when water is excessive due to high rainfall or other factors. Meanwhile, in suburbs and rural areas, people are free to choose land deemed suitable for gardening and free to determine their respective lands. In transmigration areas, people more use their land for planting vegetables and utilize the beds for growing rice paddy. Rice production in these areas is quite high, so Merauke is well-known as the granary of rice in the southern of Papua.

The prevailing customary system in Papua region affects the agricultural system in *wati* plant cultivation. Recently, *wati* plant is considered as a heritage with the highest cultural value as it is utilized as a part of the customary activities. In the cultivation system, the plant is still considered to be closed to the public, although there are some people who started to open up the information on how to develop and cultivate this sacred plant. The limitation of customary rule system is also important for safety and preventing from its misuse for the things that harm others.

***Wati* plant cultivation**

Information about *wati* plant cultivation for the common Marind people is very confidential, so that not all tribes/social groups can provide this information completely. The heads of family play a great role in cultivation of *wati*. Most farmers give credence to fathers/husbands/men to maintain *wati* garden. The reason is that the workload in taking care of the field is large. Mothers or women are not usually associated with this work due to such consideration. The role played by men to make *wati* garden can be seen from their involvement in farming from the process of clearing the garden, making beds, planting, and maintenance to harvesting. Some of them also involve their children. However, the research team found a farmer who involved a mother to maintain *wati* plant because he is less successful in farming, including in *wati* cultivation (Tanjung et al. 2014).

Selection of land. Location is selected based on the ease of access (such as yard and customary land), security (to minimize the misuse of *wati* plants), and the previous experience of quality crop, so that each tribe/community group has different methods.

Land clearing. Land clearing begins with clearing grass, shrubs, and trees at the location. This process is performed by a family together, especially the men, including their boys. The making of bed (*wambad*) is compulsory for *wati* garden. The beds are built with different sizes, averagely 3-4 m in wide and 10-25 m in long. Bed height greatly varies from one site to another, averagely ranges from 30 to 60 cm.

The process of making the cultivation land is done in steps (Tanjung et al. 2014), i.e.: 1) The making of beds (*wambad*); the height of *wambad* is adapted to the rising waters and to avoid the sinking of beds during the rainy season; 2) The addition of grass litter. The goal is to make the grass as organic fertilizer for the provision of nutrients for plant growth. Each village has different habits due to the experience of different communities. 3) A thin layer of black soil that is regarded as being able to strengthen plants to be more fertile. 4) The making of mound "*kuming,* local term". Mound is round-shaped of 8-15 cm in height with a diameter of 20 cm that serves to lay *wati* seeds. Mound is made with a planting distance of 60-100 cm between plants. 5) The grass cover. Mound is then covered with grass around it about 15-20 cm in tall, thinly covering mound.

Para-para of 160-180 cm in height must be made as shading protector for *wati* plant in the beds from direct sunlight. The condition will optimize the growth of *wati* plant. According to Davis and Brown (1999), several studies that used the treatment of shading and open land show that plant growth significantly increases in several parameters such as the number of stems per plant, stem length, leaf and dry weight of stem (kg), and sale value, while the parameter of leaf width did not affect it significantly.

Seeding and planting. The easiest and fastest way to provide seeds is to make stem cuttings as suggested also by Davis and Brown (1999). The observation also indicate that all social groups who have cultivated *wati* plants in Merauke have applied the same method. Nevertheless, some technologies such as tissue culture can also be developed in the effort to provide seeds, such as tissue cultures in root, crown, and trunk axial bud on *wati* plant stem (Li and Zheng 2012). The seeds are planted by putting on mound that was made before. In one mound, one or more seeds can be planted. This will affect the treatment when the plant grown (Figure 3).

The observation showed that the provision of seeds can be done by using pots, buckets, or directly in a specific land by adding "black" soil. The cut seeds are allowed to grow shoots and laid under shade. When shoots were grown about 10-20 cm, or 20-30 days old, these seeds can be transferred to the cultivated lands. There are two planting systems: "single" and "double" planting systems, i.e. in one mound a seed is planted and in other mound more than one (usually 3 or 4) seeds are planted.

In addition to *wati* plant, in bed other crops are also planted. Traditionally, there is a group of other crops used to support the cultivation of *wati* plant. First, ornamental plants are planted as "decoration" or well-known as "*anggin-anggin*". *Anggin-anggin* is placed in the corners or among *wati* plants where 2-3 trees are planted in one bed. The ornamental plants are various such as croton (*Codiaeum variegatum*) and each clan has a different kind of croton. *Anggin-anggin* serves as a clan identity. Every garden with a certain type of croton will become the identity of clan that cultivates *wati* plants. It also applies at buying or selling transactions. When buyer requires *wati* plants in large quantity, *anggin-anggin* will be included in a form of croton identity. Croton signifies the clan from which they bought *wati* plants. Second, red ginger (*halia*, local name; *Zingiber officinale*) plant. Third, galingale (*Kaempferia galanga*). Galingale "must" be planted in bed to ward off pests and plant diseases. The technique for use is still very simple, by chewing its rhizome and sprayed on the leaves or stems that are exposed to disease or pests. If the disease occurs extensively, galingales are mashed before and sprayed into the parts exposed to pest and disease.

Maintenance. Routine maintenance includes the land clearing of weeds, the addition of litter among plants (fertilization), watering if necessary, branch multiplication, and propagation of clumps. The process of fertilization is done by adding the litter of certain plant species. All *wati* farmers in Merauke never used chemical fertilizers as the materials for fertilizing plants. They said that using the chemical fertilizers make *wati* plant "unable to intoxicate"; in other words, it has low quality.

Maintenance is done to keep quality plants by preparation of seed plan and disease-free plants. The diseases that are often found in *wati* plants in Merauke have not been recognized yet. Some types of worm can be a pest on *wati* leaves. According to Davis and Brown (1999), one of the diseases often found in some countries are "dieback" caused by cucumber mosaic cucumovirus (CMV) with the characteristics of slow plant growth and then death. Diseases due to fungi include anthracnose, leaf spot of *Sphaerulina*, *Sclerotium rolfsii* and *Fusarium* spp., while bacteria of the genus *Erwinia* is such as *E. carotovora*. Several nematode groups include spiral,

reniform, and "root-knot" nematodes. To overcome this problem, Nelson (2005) revealed the importance of an integrated pest control management.

Harvesting. It is carried out in accordance with buyer's demand, provided *wati* plants met the qualification of growth. This is done when the plant has grown about one year or reached about 50 cm in tall. A good crop to be harvested usually has a height of 50-120 cm.

Post-harvest. *Wati* farmers are very careful with buyer because of fear that *wati* they bought will be misused. Buyers with demand in large quantities will be asked to confirm what they will do with *wati* they want to buy. It is customarily governed by the Marind tribal community in general.

In *wati* plant cultivation system, there are some customary restrictions, for example, prohibition in gardening, i.e. women that have menstruation or just gave birth are prohibited from entering into seedbed. Meanwhile, menopausal women are allowed to manage and maintain *wati* plant, as she is considered pure.

For large purchase of wati plant, should be known by local customary leaders or the Customary Community Institution (*Lembaga Masyarakat Adat*, LMA) in Merauke. LMA has imposed special rules on the cultivation and utilization of *wati* in the life of indigenous population. According to Tanjung et al. (2014), they also agreed to set prices of *wati* plant to keep them under control.

According to Tanjung et al. (2014); as well as Angelique et al. (2015), the prospect of *wati* plant cultivation is very promising. The relatively high price become potential source of family income. David and Brown (1999) mentioned some benefits of *wati* plant cultivation. In the Fiji Islands, the economic value of the plant is higher than that of other crops such as sugar cane, copra, mango, papaya, pineapple, and various other types of plants. Similarly in Tonga and Vanuatu, *wati* plant has high sale price. Loew and Franz (2003) studied the traditional and industrial quality of *wati* plant. This plant has long been cultivated traditionally and has no serious effect. However, recently it is known that various products have a significant effect on the health of users.

ACKNOWLEDGEMENTS

We thank to DRPM of Directorate General of Strengthening Research and Development [Indonesia] that support this study through the Competitive Research Grant Program for the fiscal year of 2016. We also thank to Yosefa O and Viktor K.H. for their help during the fieldwork.

REFERENCES

Amorim MFD, Diniz MFFM, Araujo MST, Pita JCLR, Dantas JG, Ramalho JA, Xavier AL, Palomaro TV, Junior NLB. 2007. The controvertible role of kava (*Piper methysticum* G. Foster) an anxiolytic herb, on toxic hepatitis. Revista Brasileira de Farmacognosy 17 (3): 448-454.

Angelique F, Showman AF, Baker JD, Linares C, Naeole CK, Borris R, Johnston E, Konanui J, Turner H. 2015. Contemporary Pacific and Western perspectives on `awa (*Piper methysticum*) toxicology. Fitoterapia 100: 56-67.

Anke J, Ramzan I. 2004. Pharmacokinetic and pharmacodynamic drug interactions with Kava (*Piper methysticum* Forst.f.). J Ethnopharmacol 93: 153-160.

Anon. 2002. Hepatic toxicity possibly associated with kava-containing product - United States, Germany, and Switzerland, 1999-2002. Morbidity and Mortality Weekly Report 51 (47): 1065-1066.

Anon. 2004. Kava: A human health risk assessment. Food Standards Australia New Zealand. Technical Report Series No 30. Canberra, Australia.

Backhauβ C, Krieglstein J. 1992. Extract of kava (*Piper methysticum*) and its methysticin constituents protect brain tissue against ischemic damage in rodents. Eur J Pharmacol 215 (2): 265-269.

Balick MJ, Lee R. 2002. Tradisional use of sakau (kava) in Pohnpei: Lessons for integrative medicine. Alternat Ther 8 (4): 96-98.

Boon HS, Wong AHC. 2003. Kava: a test case for Canada's new approach to natural health products. Canadian Med Assoc J 169 (11): 1163-1164.

Briskin D, Kobayashi H, Mehta A, Gawienowski M, Ainsworth L, Smith M. 2001. Production of kavapyrones by Kava (*Piper methysticum*) tissue cultures. Plant Cell Rep 20 (6): 556-561.

Cassileth B. 2011. Kava (*Piper methysticum*). Oncology 15: 384-385.

Davis RI, Brown JF. 1999. Kava (*Piper methysticum*) in the South Pasific: its importance, methods of cultivation, cultivars, diseses and pests. Australian Centre for International Agriculture Research, Canberra, Australia.

Ernst E. 2007. A re-evaluation of kava (*Piper methysticum*). British J Clin Pharmacol 64 (4): 415-417.

Garrett KM, Basmadjian G, Khan IA, Schaneberg BT, Seale TW. 2003. Extracts of kava (*Piper methysticum*) induce acute anxiolytic-like behavioral changes in mice. Psychopharmacology 170: 33-41.

Hashimoto T, Suganuma M, Fujiki H, Yamada M, Kohno T, Asakawa Y. 2003. Isolation and synthesis of TNF-α release inhibitors from Fijian kawa (*Piper methysticum*). Phytomedicine 10: 309-317.

Hussein AA. 2015. A closer look at the risks vs. benefits of kava (*Piper methysticum*). J Stud Res 4 (2): 69-72.

Kavanagh DJ. 2009. Kava anxiety depression spectrum study (KADSS): a mixed methods RCT using an aqueous extract of *Piper methysticum*. Compl Ther Med 17 (3): 176-178.

Laporte E, Sarris J, Stough C, Scholey A. 2011. Neurocognitive effects of kava (*Piper methysticum*): A systematic review. Human Psychopharmacol Clin Exp 26 (2): 102-111.

Lebot V, Johnston E, Zheng QY, Mc.Kern D, Mc.Kenna DJ. 1999. Morphological, phytochemical, and genetic variation in Hawaiian cultivar of 'Awa (Kava, *Piper methysticum*, Piperaceae). Econ Bot 53 (4): 407-418.

Lebot V, Simeoni P. 2004. Is the quality of kava (*Piper methysticum* Forst.f) responsibility for different geographical patterns?. Ethnobot Res Appl 2: 19-28.

Li M, Zheng X. 2012. Establisment of regeneration system in vitro for *Piper methysticum*. Agric Biotechnol 1 (5): 18-19.

Loew D, Franz G. 2003. Quality aspects of traditional and industrial kava-extracts. Phytomedicine 10: 610-612.

Martin AC, Johnston E, Xing C, Hegeman AD. 2014. Measuring the chemical and cytotoxic variability of commercially available kava (*Piper methysticum* G. Forster). PLoS One 9 (11): e111572. Doi:10.1371/journal.pone.0111572.

Nelson S. 2005. Integrated pest management for 'Awa (Kava, *Piper methysticum*). Plant Desease. PD-28. College of Tropical Agriculture and Human Resources (CTAHR), Hawai.

Nova KN. 2009. The efforts to conserve of *wati* (*Piper methysticum*) medicinal plants, *wowirian* (*Pandorea pandorana*) and *jilat* (*Villebrunea trinervia*) from Papua. Warta Penelitian Pengembangan 15 (3): 27-30. [Indonesian]

Putri LSE, Dasumiati, Kristiyanto, Mardiansyah, Malik C, Leuvinadrie LP, Mulyono EA. 2016. Ethnobotanical study of herbal medicine in Ranggawulung Urban Forest, Subang District, West Java, Indonesia. Biodiversitas 17 (1): 172-176.

Sarris J, Kavanagh DJ, Byrne G, Bone KM, Adams J, Deed G. 2009. The kava anxiety depression spectrum study (KADSS): a randomized, placebo-controlled crossover trial using an aqueous extract of *Piper methysticum*. Psychopharmacology 205: 399-407.

Shanti P, Avinash DS. 2013. Herbal medicines for depression and anxiety: a comprehensive state of the art review. Global J Res Med Pl Indigen Med 2 (5): 317-336.

Suharno, Tanjung RHR, Warpur M. 2011. Medicinal plants of Papua: Potencial and utilization [Indonesian]. Aura Pustaka. Yogyakarta.

Suharno. 2001. Farming systems (agricultural) societies of Bira Lake, sub-district Central Mamberamo, Jayapura District. Sains 1 (1): 19-25. [Indonesian]

Tabudravu JN, Jaspars M. 2005. Anaticancer activities of constituents of kava (*Piper methysticum*). South Pacific J Nat Sci 23: 26-29.

Tanjung RHR, Suharno, Futwembun A. 2014. The utilization and domestication of wati (kava, *Piper domesticum* L.) medicinal plants is traditionally by Marind tribes in Papua [Indonesia]. *Proceedings of the National Seminar on Biological Indonesia.* pp: 104-124. Jayapura 7-8 October 2014.

Ulbricht C, Basch E, Boon H, Ernst E, Hammerness P, Sollars D, Tsourounis C, Woods J, Bent S. 2005. Safety review of kava (*Piper methysticum*) by the Natural Standard Research Collaboration. Expert Opin Drug Saf 4 (4): 779-794.

Walujo EB. 2004. Data collection for ethnobotany. In*:* Rugayah, Widjaya AE, Pratiwi (eds). Guidelines for Data Collection of Flora. Research Center For Biology,Indonesian Institute of Sciences, Bogor.

Zebua LI, Walujo EB. 2016. The traditional knowledge of Papua society in identifying, classifying and utilizing of red fruit (*Pandanus conoideus* Lam). J Biol Papua 8 (1): 23-37. [Indonesian]