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Ethnobotanical uses of plants by Brangkuah Community of Moyo Island, West Nusa Tenggara, Indonesia

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ABSTRACT

An ethnobotanical study at Moyo Island, West Nusa Tenggara was carried out to record the traditional knowledge and utilization of plant species there. It is expected that traditional knowledge can play a role in natural resource management systems which can be used in conservation programs. This research was conducted with field observational methods in the Moyo forest and interviews with local people that have knowledge about utilization of plants. There are about 48 species of plants which are utilized by the Brangkuah Community in Moyo Island. Most of them are collected from the forest and 21% (10 species) are cultivated. Local people also use plants for medicine 41% (21 species), food 39% (20 species) and building materials 16% (8 species). The Brangkuah have started to cultivate several plants which are used as building material and food plants which previously collected from the forest. The Brangkuah community has conserved useful plants for their daily life. It is expected that the forest is sustainable.

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Introduction

Ethnobotany is the study of the relationship between people and plants (Harsberger, 1986). It studies how plants are used, managed and perceived in human societies and used for food, medicine, building, spices, social life, etc. Each ethnic group has extensive experiences in the utilization and conservation of biological and ecological diversity (Walujo, 1998). Ethnobotany is the most important approach in studying the natural resource management by the indigenous people (Abbasi *et al.*, 2012). Obtaining information from this study of ethnobotany has several applications, (1) Documentation of the traditional knowledge of plant species used and the methods of preparing and administering the medication, especially for serious ailments, still reside with traditional healers, (2) Knowing the diversity of plant species that have a direct value in supporting vital social life of local communities. This information can later be used as a priority list of plants for rehabilitation and/or community development programs,

and (3) Obtaining basic information of the potential species in traditional medicines.

This study is an inventory of the plants that are used by the Brangkuah community in Moyo Island, West Nusa Tenggara. The island lies between 809'36"- 8023'19" LS and 117027'45"- 117035'42" BT. Based on Agricultural Decree on October 23, 1972, Number 501/Kpts/Um/197, Moyo Island was designated as a conservation area since 1973 and regional boundaries with an area of 18.765 hectare of forest were carried out (Simbolon, 1973). Moyo Island region is administratively located in Sumbawa Besar, Labuan Badas district, West Nusa Tenggara.

This region lies in the Wallacea region between the line of Wallace and Weber that separates the two biogeographic regions of Asia and Australia. It is the midpoint where Asian and Australian fauna and flora are approximately equally represented, and follows the deepest straits traversing the Indonesian Archipelago

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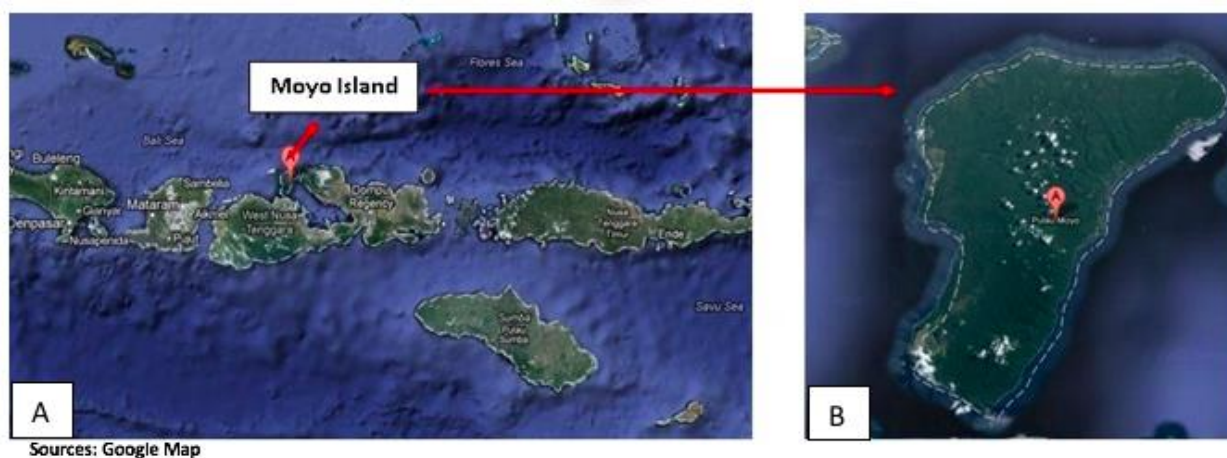


Fig. 1 Map of Moyo Island. (a) Map of Wallacea region, (b) Moyo Island

(Monk *et al.*, 1997). The geography of Moyo Island is lowland with a maximum altitude of 600 m above sea level. Soil texture is sandy, nutrient-poor with high soil permeability which causes leaching of soil nutrients when it rains. Average rainfall is 1260 mm/year. In Moyo island, education and health facilities are very limited, so they utilize natural resources on the island. Sometimes, they come to Sumbawa by boat to get their needs. In Moyo Island, there are groups of people who live in a village, they are called Brangkuah.

The Brangkuah community have been living in Moyo island for last 58 years, they are a farming society. The people utilize plants from the forest during daily life in traditional ways. The majority of people are descendants of the Bugis tribe. The other tribes are Bima, Selayar, Makasar, and Timor with different languages. The majority religion is Muslim. Distribution of the population is on the coastal area and the river. The main livelihood of people is farming that is sedentary and carried out in groups. Other livelihoods include collecting honey and wood in the forest to be sold in Sumbawa. For consumption purposes, the Brangkuah community cultivate some crop plants such as rice, tubers, corn, etc. in their fields (Trimanto *et al.*, 2013). Besides farming, they also grazed wild cattle (*Bos sundaicus*). Based on information, cattle were grazed in the forests by order of the Sumbawa king (1870), as many grasslands are in Moyo island. This cattle came from India.

The utilization of plants by the Brangkuah community in Moyo Island has not been investigated. The aim of this research is to record the utilization of plants by the Brangkuah community. Knowledge diversity of plant species has a direct value in supporting life in local communities, so the information about this diversity can be used to create a plant list of priorities for rehabilitation programs.

Materials and Methods

This Research was conducted in April 2013 at the Brangkuah community, Moyo Island, West Nusa Tenggara (Figure 1). Interviews, questionnaires, free listing, participant observation and direct observation, can be used to study the potential of plants in ethnobotany (Hoffman and Gallaher, 2007). According to Jain (1995), information regarding the usage of medicinal plants available in the local area for treating various ailments and diseases, is collected by directly contacting the elders, herbal doctors and the people who have knowledge about these medicinal plants.

The data was collected by observation with walk systematic exploration in the forest. Observation of Brangkuah people in the forest was used to study the plants that they have utilized (Figure 2). Interviews were also conducted of elder people in the Brangkuah community who have indigenous knowledge and influence in this community. If Brangkuah people are sick, they will consult with elder people to treat their illness by using wild plants in the forest around the Brangkuah community. We have documented plant species that are cultivated in their gardens. Approximately 50 home gardens were used to sample. Observation and interview methods were used to document and record the plants used. The respondent aged from 30–65 years old. All respondent has private house and a garden surrounding their house. The interviewees were asked questions related to their ethnobotanical knowledge of plants cultivated in home gardens in their villages. We also have recorded whether the plants are introduced species (imported from other regions) or native to the forest.

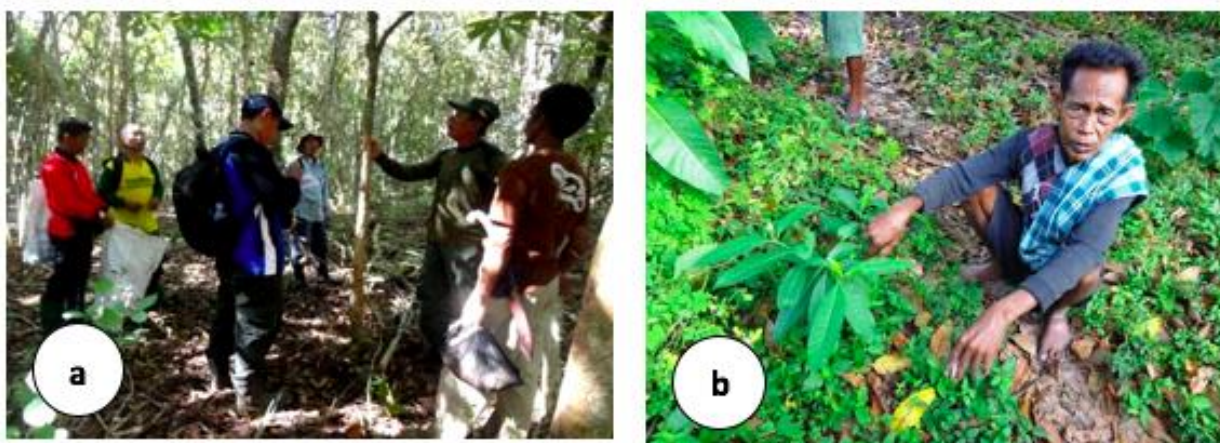


Fig. 2 a) Observation of ethnobotany in the forest, b) Interview with elder people of Brangkuah community who cultivated plants from the forest in their gardens

The following information was reordered 1) Scientific Name (binomial), 2) local name, 3) plant part used, 4) utilization category, 5) the used plant status, and 6) how the plants were used. The data obtained were analyzed descriptively. A literature study was used to know the chemical constituents of plant species based on the latest research. Most of the materials were preserved by making a herbarium specimen to identify the plant species. The herbarium specimen was identified in Herbarium Bogoriense and Purwodadi Botanic Garden LIPI (Indonesian Institute of Sciences). The Plant List (<http://www.theplantlist.org/>) was used to standardize scientific names.

Results

Medicinal plants

The results of the study of the 48 plant species utilized by people in Moyo Island Nusa Tenggara were recorded (Figure 3). The largest group is traditional medicine with a percentage of 41% or 21 species (Figure 4a). Besides medicine, plants are used as food, building material and organic pesticides. The use of wild plants in forests is larger than the cultivated species (Figure 3b). Thirty eight species were collected from the forest and 10 species were cultivated while *Annona squamosa* is used for medicine and food. Some plants are cultivated around the garden to make them more easily available when needed. Ten plant species are cultivated. The majority of plants are introduced. Most plants are taken from the forest, which shows that the people are dependent on the forest for their survival. They need timber, food, and medicine in daily life.

They use medicine plants to treat fevers, skin diseases, headaches, wounds, toothaches, and supplement drinks (Table 1). Some species are used to treat the sick through ritual ceremonies. The processing of plants in medicine with traditional methods include crushing, boiling,

chewing, or are eaten instantly. Frequently encountered diseases are skin disease and malaria. They use *Carica papaya* leaves and all parts of *Physalis angulata* if they are attacked by malaria diseases and for prevention they use mosquito nets at night. They use leaves of *Barleria lupulina* (datula), *Lantana camara* (taride) and *Strophanthus* sp. (Luto) for skin wounds. Some diseases are believed to be caused by evil, so they use *Jathropa curcas* (jarak) for these diseases. The climate of this island is very hot and dry, so people often use plants to refresh their body, e.g. *Clerodendrum chinense* (Paminta), *Elephantopus scaber* (kopasahe) and *Ficus septica* (empusu). Some plants are used as anti-poison, e.g. *Curcuma longa* (Huni). *Piper retrofractum* is used by women after childbirth. The fruit can be used to stop bleeding in wounds. *Zingiber inflexum* (empuja) is used as antibacterial, for diseases such as tuberculosis and diarrhea.

Food plants

The diversity of plants plays an important role to meet food demands. There are globally about 3000 food species that are utilized by people and only 200 species are domesticated (Hawkes, 1983). There are 20 species of plants that are used for food (Table 2). They are fruit, vegetables, seasoning and staple food. There are 5 cultivated plants species. This island has no access to the market so they cultivate all the food plants that they need in their field or garden. Some food plants are collected from the forest.

People use rice as a staple food (Figure 5) and grow tuber plants as alternatives. The tuber plants are mostly cultivated like *Manihot esculenta* and *Xanthosoma sagittifolium*. They eat the tuber if the rice is limited. *Dioscorea hispida* is collected from the forest where it is commonly found.



Fig. 3 Useful plants in Brangkuah village: (a) *Piper betle*, (b) *Alstonia spectabilis*, (c) *Bauhinia purpurea*, (d) *Piper retrofractum*, (e) *Lantana camara*, (f) *Cycas rumphii*, (g) *Cucurbita moschata*, (h) *Phyllanthus emblica*, (i) *Alstonia spectabilis*, (j) *Xanthosoma sagittifolium*, (k) *Zingiber inflexum*, (l) *Dioscorea hispida*

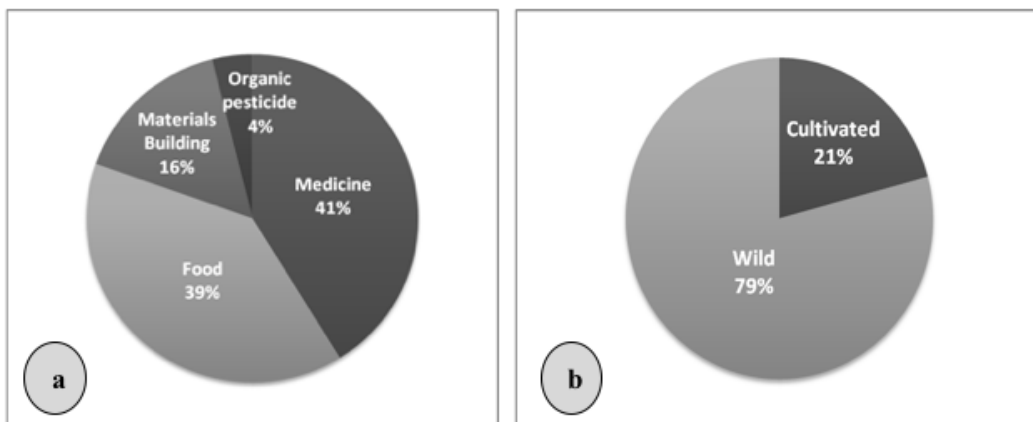


Fig. 4 Percentage of utilization of plants by Brangkuah community: (a) comparison of utilization of plants, and (b) comparison of wild and cultivated plant species

The island also contains a variety tubers like *Tacca* sp. and *Amorphophalus* sp. but they are not utilized because they don't know how to use them. Some fresh fruits are collected from the forest e.g. *Cucurbita moschata* (banda ladu), *Phyllanthus emblica* (riu), *Streblus asper* (velli), *Polyalthia* sp. (loka). The most cultivated fruit plants in the Brangkuah community are *Musa paradisiaca* x *balbisiana* (banana) and *Mangifera indica* (mango). Vegetables are mostly grown in their own gardens and fields, e.g. leaf vegetable *Moringa oleifera* (parongge) and fruit like *Solanum melongena* (kadai egg plant). Some plants are used for seasoning, e.g. fruit *Tamarindus indica* (mangege).

Timber plants

The Brangkuah communities utilize timber for construction and transportation equipment such as boats. *Alstonia spectabilis* (Kayu batu), *Protium javanicum* (Loa), *Pterocymbium javanicum* (Haju sala) and *Schleichera oleosa* (Kesambi) are kinds of timber that used for building houses. The house construction contains 95% plant materials (Figure 6). Stilt construction is needed to protect houses from wild animals such as wild pigs, dogs, and cattle, because are near the forest. For roofs, they use leaves of *Cocos nucifera* (Kalopo) or *Imperata cylindrica* (Alang-alang). For house building, they use timber cutdown from the forest.

Big trees with diameters of 30 cm are found along rivers (Figure 7). *Ficus* species and *Bamboo* are often found along rivers too. However, people do not use bamboos for their houses. They prefer trees because they are stronger and more durable. People do not cut timber close to river since they assume that the trees maintain availability of water. The Brangkuah community has cultivated a selected plant e.g., *Tectona grandis* (teak) that they use in their field or garden house, it is done to reduce the utilization of timber trees from the forest.

Organic pesticides

Brangkuah communities will utilize bark of *Kleinhofia hospita* (entana) and *Crescentia cujete* (billa) fruit for organic pesticide if their crops are attacked by plant pathogens or pests. Utilization of plants for organic pesticides are shown in Table 4.

Discussion

Medicine

Moyo is an isolated island. Life facilities are very limited, so they depend mainly on plants from the forests to get their needs. The limited availability of modern (Allopathy) medicines causes people to choose plants in treating some diseases. The poor economy of the Brangkuah community means they are not easily able to go to Sumbawa. They also utilize plants from the forest. Medicinal plants or herbal medicines are plants that are

derived from material or preparation with therapeutic or other human health benefits, which contain either raw processed ingredients from one or more plants. Every ethnic group has a unique method to utilize plants as medicine. The Brangkuah communities are dependent on nature to treat their diseases. It is important to conserve the plants that they use. Villagers implement some conservations of useful plants in their area. This information can be used as basic knowledge of the plants that have a medical potential.

The plants from the forest are very important to local people in treating several diseases. They will always conserve these plants to provide medicine if they are in need. The medical facilities of the island are limited. If they want to go to hospital they must go to the city and get difficult transportation, using a boat to Sumbawa. Chemical medicines are limited, so they use plants from the forest if they are sick. Several plants are cultivated in their gardens. Brangkuah communities believe that every disease has a medicine and that medicine is provided by nature, so they use plants to treat their diseases. Cultural values, beliefs, and rituals as well as the role of the family and other community members are all necessary components of healing (Andre et al., 2006). The most severe diseases of the population are skin diseases and malaria. Itching of the skin and fever are a symptoms that often arise when the diseases strike. They use plants to refresh their bodies because diseases often attack their skin.

Barleria lupulina, *Elephantopus scaber*, *Clerodendrum chinense*, *Ficus septica*, *Lantana camara*, *Stropanthus* sp. are plants species that they use for skin diseases. They use it to refresh their body and treat wounds. The species contain anti-inflammatory, anti-bacterial, and antiseptic qualities (Butt et al., 1997; Damu et al., 2005; Kanchanapoom et al., 2001, 2005; Nayak et al., 2008; Prusti et al., 2008). Little documentation of the knowledge of local people existed, before these studies were conducted. Local knowledge of herbal medicines should be documented, so the potential species information of traditional herbs can be used in the future. Malaria is an endemic disease in the Brangkuah community. Fever is a symptom that often accompanies the disease. *Plasmodium falciparum* and *Plasmodium vivax* are microbial agents that cause Malaria in eastern Indonesia (Tjitra et al., 1999). The Brangkuah community also has knowledge on how to treat disease. *Amaranthus spinosu*, *Annona squamosa*, *Ziziphus jujuba*, is used to reduce fever. Based on the research, this plant contains antimicrobials, antioxidants to fever antimalaria, and neuro-protection (Sadiq et al., 2009; Hilou et al., 2006; Shirwaikar et al., 2004). *Carica papaya* and *Physalis angulata* are used in treating malaria. They use a simple method like crushing and boiling leaves with water then drink it.



Fig. 5 Activity of brangkuah people to cultivate rice. This location is near the forest, (a) small house and field its far from they live, and (b) bringing the harvest home



Fig. 6 Traditional house of the Brangkuah community



Fig. 7 Trees that are found in river sites (a) *Ficus variegata*, (b) *Gigantochloa atter*, (c) activity of the local people who can not escape from springs, and (d) wild cattle also used the spring

Table 1. List of plants used in folk medicine by Brangkuah community

No	Species	Local name	Use	How to use	Plants Category	Chemical Compound
1	<i>Ageratum conyzoides</i> L.	Golka	Headache, scorpion stings	Crushed leaves applied to the head, while for the sting of a scorpion crushed leaves applied to the sting	Wild	Extracts and metabolites have been found to possess pharmacological and insecticidal qualities (Okunade, 2002), leaves have anti-inflammatory effects (Kamboj and Saloja, 2012)
2	<i>Amaranthus spinosus</i> L.	Nadu	Fever	Roots, added pecans and rice, boiled and then drunk	Wild	Methanolic extract of stem has anti-diabetic, antihyperlipidemic and spermatogenic effects (Sangameswaran and Jayakar, 2008) Antimalarial (Hilou et al., 2006)
3	<i>Annona squamosa</i> L.	Garosso	Fever	Crushed leaves were given water and then drunk	Cultivated	Antioxidant to fever (Shirwaikar et al., 2004) and mosquitocidal effect (Jaswanth et al., 2002)
4	<i>Areca catechu</i> L.	Uwa	Strengthen teeth (Nginang)	Matured fruit was chewed	Wild	Betel compound of natural substances chewed for its psychostimulating effects (Norton, 1999)
5	<i>Barleria lupulina</i> Lindl.	Datulla	Wound	Flowers are crushed and then applied to the wound	Wild	Anti – inflammatory (Wanikiat et al., 2008)
6	<i>Bauhinia purpurea</i> L.	Rufe	Pain, suplement drink	Boiled bark, take water, then drink	Wild	Triterpenes, steroids, glyceride, flavonoids, phenylpropanoids (Kuo et al., 1998)
7	<i>Calophyllum soulatri</i> Burm.f	Mantau	Eye disease	Crushed leaf, brought near to the eyes of the sick	Wild	Bioactive compounds of antimicrobial activity (Pretto et al., 2004)
8	<i>Clerodendrum chinense</i> (Osbeck) Mabb	Paminta	Refreshing body	Crushed leaves mixed with rice and pecans applied to body	Wild	Iridoid glucosides and six known cyclohexylethanoids (Kanchanapoom et al., 2005)
9	<i>Curcuma longa</i> L.	Huni	Antidote of poison	Seeds and rhizomes are pounded and then consumed	Cultivated	Diferuoyl methane that a phenolic compound of antioxidative components and anti-inflammatory activity (Ak and Gulcin, 2008)
10	<i>Elephantopus scaber</i> L.	Kopasahe	Refreshing body	plants, rice, ground nutmeg was crushed then massaged to the whole body	Wild	Anti-bacterial activity, its has deoxyelephantopin and isodeoxyelephantopin, and a new germacranolide sesquiterpene lactone named scabertopin (Prusti et al., 2008; Butt et al., 1997)
11	<i>Ficus septica</i> Burm.f.	Emposu	Refreshing body	The leaves are picked and then massaged to the skin	Wild	It has phenanthroindolizidine alkaloids (Damu et al., 2005)
12	<i>Jatropha curcas</i> L.	Jarak	Ritual ceremony to cure diseases	Stem halved and then taken inside and then added rice	Wild	Saponins, phytate, lectin activity, and Trypsin inhibitor activity (Makkar et al., 1997)
13	<i>Lantana camara</i> L.	Taride	Wound	Crushed leaves rubbed on scars	Wild	used as an antiseptic for wounds and externally for leprosy and scabies and has antimicrobial activity (Nayak et al., 2008)
14	<i>Morinda citrifolia</i> L.	Mito	Appetite and diabetes	Ripe fruit extract drink	Wild	high antioxidative activity with a wide range of degenerative diseases, including ageing, cancer, diabetes and cardiovascular. Its contain both α -tocopherol and BHT (Zin et al., 2002)

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15	<i>Piper betle</i> L	Sirih	Strengthen teeth	Leaf chewed along with lime	Cultivated	It has an antimicrobial influence. Chemical analysis of the extract showed hydroxychavicol, fatty acids (stearic and palmitic) and hydroxy fatty acid esters (stearic, palmitic and myristic (Nalina and Rahim, 2007))
16	<i>Piper retrofractum</i> Vahl	-	Childbirth	Fruit was crushed and applied to wound	Wild	Contains piperidine alkaloids piperine and piperonaline. This fruit has neurotrophic activity.
17	<i>Stropanthus</i> sp.	Luto	Wound	Plant sap applied to the wound	Wild	Un-identified
18	<i>Zingiber inflexum</i> Blume	Empuja	Tuberculosis and diarrhea	Rhizome grated with nutmeg were then given water and drunk	Wild	Very little research on this plant species
19	<i>Ziziphus jujuba</i> Mill.	Rangga	Fever	Young leaves crushed and then scrubbed	Wild	Contains compounds that may be useful in the development of therapeutic agents for neuro-protection (Sadiq et al., 2009)
20	<i>Carica papaya</i> L	Pepaya	Malaria	Leaves were crushed and boiled with water. The water was filtered then drunk	Cultivated	Contains flavonoids, terpenoids, saponins, tannins that have antimalarial activity (Ayoola et al., 2008)
21	<i>Physalis angulata</i> L.	-	Malaria	All of parts this plant were boiled with water then water was filtered then drunk	Wild	It has antimalarial activities of physalins B, D, F, and G (Sa et al., 2011)

Table 2. List of plants used in food by Brangkuah community

No	Species	Local name	Use	How to use	Plants category	Nutrition content
1	<i>Annona squamosa</i> L.	Garosso	Fresh fruit	mature fruit was eaten	Cultivated	Per 100 g fruit contains high carbohydrate (23.64 mg), vitamin C (36.3 mg), and high mineral content: Calcium (24 mg) and Magnesium (21 mg) (USDA, database)
2	<i>Artocarpus altilis</i> (Parkinson ex F.A. Zorn) Fosberg	Polo	Vegetable	the leaf can be cooked	Wild	Per 100 g fruit contains: water 70.6 g, carbohydrate (27.12 g), vitamin C (29 mg), and mineral content: Potassium (490 mg), Calcium (17 mg), and Magnesium (25 mg) (USDA, database)
3	<i>Cucurbita moschata</i> Duchesne	Banda ladu	Fresh fruit	mature fruit was eaten	Wild	Per 100 g fruit contains 11.7 g Carbohydrate, Sugar total 2.2 g, Fiber 2.0 g, Calcium 48 mg, Phosphorus 33 mg, Magnesium 34 mg, Vitamin C 21 mg, Vitamin B6 0.15 mg (USDA, database)
4	<i>Cycas rumphii</i> Miq	Kamate	Staple food	fruit halved put in the water within 2 days and then consumed	Wild	Cycad has starch in the central pith. It contains toxins (Nishida et al., 1955)
5	<i>Dioscorea hispida</i> Dennst	Gadung	Staple food	tubers sliced and made into chips	Wild	Per 100 g tuber containing 27.88 mg Carbohydrate, 17 mg Calcium, 17.1 mg Vitamin C, 0.5 mg Ferum, Vitamin K 2.3 µg (USDA, database)
6	<i>Inocarpus fagifer</i> (Parkinson) Fosberg	Lella	Staple food	ripe fruit was cooked	Wild	Containing high Carbohydrate 75.79%-77.7%, Fat 7%, Protein 10.54-11.64%, and raw fiber

7	<i>Manihot esculenta</i> Crants	Wojo	Staple food	boiled tubers for consumption	Cultivated	0.83% -1.13% (Epriliani et al., 2002; Wawo et al., 2011). Per 100 g tuber contains Carbohydrate 38.06 g, Protein 1.36 g, Calcium 16 mg, Magnesium 21 mg, Sodium 14 mg, Zinc 0.34 mg, Vitamin C 20.6 mg, Vitamin K 1.9 mg,
8	<i>Mangifera indica</i> L.	Mangga	Fresh fruit	mature fruit was eaten	Cultivated	Per 100 g fruit contains Carbohydrate 36.4 mg, Calcium 11 mg, Vitamin C 36.4 mg, Vitamin K 4.2 µg (USDA, database)
9	<i>Moringa oleifera</i> Lam.	Parongge	Vegetable	leaves in the vegetable	Wild	Leaves contain 9.4 g Protein, Carbohydrate 8.28 g, total lipid 1.4 g, Magnesium 42 mg, Iron 4 mg, Calcium 185 mg, Phosphorus 112 mg, Vitamin C 51.7 mg, Vitamin B6 1.2 mg. (USDA, database)
10	<i>Musa paradisiaca</i> L.	Pisang	Fresh fruit	mature fruit was eaten	Cultivated	Per 100g fruit contains 22.84 Carbohydrate, Sugar 12.23 g, Fiber 2.6 g, Calcium 5 mg, Magnesium 27 mg, Sodium Na 1 mg, Vitamin C 8.7 mg, Vitamin B6 0.36 mg (USDA, database)
11	<i>Phyllanthus acidus</i> (L.) Skells.	Kalimbi	Fresh fruit	fresh fruit was eaten with salt	Wild	Per 100 g Fruit contains Vitamin C 4.6 mg, Calcium 5.4 mg, Phosphorus 17.9 mg (Devi et al., 2011)
12	<i>Phyllanthus emblica</i> L	Riu	Fresh fruit	mature fruit was eaten	Wild	High content Ascorbic Acid 5.88 mg per 100g fruit (Barthakur and Arnold, 1991)
13	<i>Protium javanicum</i> Burm f.	Loa	Fresh fruit	fresh fruit was eaten	Wild	Limited information, several compounds that were investigated were scopoletin, isoscopoletin, coumarin, herniarin, scoparon, umbeliferone (Adfa et al., 2010)
14	<i>Schleichera oleosa</i> (Lour.) Merr.	Sambi	Fresh fruit	mature fruit was eaten	Wild	Per 100 g contains Carbohydrate 14 g, protein 22 g, fat 49 g, fibre 5 g (Iwasaa, 1997)
15	<i>Sesamum indicum</i> L.	Riiga	Seasoning food	seeds for seasoning	Cultivated	Per 100 g Seed contains 23.4 g Carbohydrate, Total lipid 49.7 g, Fiber 11.8 g, Magnesium 351 mg, Calcium 975 mg, Phosphorus 629 mg, Sodium, Na 11 mg (USDA, database)
16	<i>Solanum melongena</i> L.	Kadai	Vegetable	the fruit can be vegetable	Cultivated	Per 100g fruit contains Carbohydrate 5.88 g, Fiber 3g, Protein 0.98 g, Total lipid 0.18 g, Vitamin C 2.2 mg, Vitamin B6 0.084 mg, Calcium 9 mg, Magnesium 14 mg, Phosphorus 24 mg, Sodium, Na 2 mg.
17	<i>Streblus asper</i> Lour.	Velli	Fresh fruit	fresh fruit was eaten	Wild	Per 100 g fruit content Carbohydrate 5.59 mg, Total sugar 12.65 mg, Protein 1.48 mg, Calcium 3 mg, Iron 10 mg (USDA, database)
18	<i>Tamarindus indica</i> L	Mangge	Seasoning food	mature fruit was eaten	Wild	Per 100 g contain Vitamin C 3.5 mg, Calcium 74 mg, Magnesium 92 mg, Phosphorus 113 mg, Potassium, K 628 mg, Carbohydrate 62.5 g, Protein 2.8 g, Fiber 5.1 g, Sugar 38.8 g (Nayak and Basak, 2015)
19	<i>Polyalthia</i> sp.	Loka	Fresh fruit	mature fruit was eaten	Wild	Unidentified

20	<i>Xanthosoma sagittifolium</i> (L) Schott	-	Staple food	tuber was steamed and mixed with coconut	Wild	Contains antioxidant, Phenol, Flavanoids, Zn, Ca, Fe. (Sarma et al., 2015) Per 100 g tuber contain Carbohydrate 28.66%, Fiber 0.56%, starch 20.8%, Protein 2.81 % (Arysandhi and Estiasih, 2016)
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Table 3. List of plants used as building materials by Brangkuah community

No	Species	Local name	Use	How to use	Plants category	Wood density
1	<i>Alstonia spectabilis</i> R.Br.	Kayu batu	Building materials	Mature timber logged and used for house building	Wild	0,62 g/cm ³ , suitable in lowland, easily propagated with seeds
2	<i>Dysoxylum cauliflorum</i> Hiern.	Buampu'u	Roofs	Wood aged 20 years use used to make roofs	Wild	0,715 g/cm ³ , high quality timber
3	<i>Schleichera oleosa</i> (Lour.) Merr.	Kesambi	Building materials	Mature timber logged and used for house building	Wild	0,760 g/cm ³ , easily propagated with seeds
4	<i>Protium javanicum</i> Burm.f	Loa	Building materials,	Mature timber logged and used for boards	Wild	0,750 g/cm ³ , high quality timber
5	<i>Pterocymbium javanicum</i> R.Br	Haju sala	Building materials	Mature timber logged and used for house building	Wild	0,400 g/cm ³
6	<i>Tectona grandis</i> L.f.	Jati	Building materials	Mature timber logged and used for house building	Cultivated	0,526 g/cm ³
7	<i>Cocos nucifera</i> L	Kalopo	Roofs	Older leaves are used for roofing houses	Wild	available in abundance
8	<i>Imperata cylindrica</i> (L.) Raeusch.	Alang-alang	Roofs	The leaves are dried and then strung together to make a house roof	Wild	available in abundance

Table 4. List of plants used as Organic Pesticide by Brangkuah community

No	Species	Local name	Use	How to use	Plants category	Chemical compound with literature survey
1.	<i>Kleinhovia hospita</i> L	Entana	Organic pesticide	Bark soaked in water and water used for organic pesticide	Wild	These compounds showed promising hepatoprotective effects on nitrofurantoin-induced cytotoxicity in human liver-derived (Gan et al., 2009)
2.	<i>Crescentia cujete</i> L	Billa	Organic pesticide	Fruit soaked in water and water used for organic pesticide	Wild	HCN toxicity, Alkaloids, saponins, flavanoids, tannins (Ogbuagu, 2008)

Carica papaya extract has antimalarial properties, it also contains flavonoids, erpenoids, saponins, and tannins (Ayoola et al., 2008). *Physalis angulata* also has antimalarial properties (Sa et al., 2011). Fewer than 5% of tropical forest plant species have been examined for their chemical compounds and medicinal value (Idu, 2009). Basic information of herbal medicine can be used to develop chemical compounds of the plant.

Food

The difficulty in accessibility and limited transportation in Moyo Island make the communities isolated. Transportation to Sumbawa Besar for communities to do shopping for food material and the other needs is limited to only once a week. The communities cultivate certain plants to meet their needs for food when foods from grocery shopping is limited. Variety of cultivated plants is limited because their knowledge of plant cultivation is

somewhat limited. Plants that are consumed by Brangkuah communities are both from wild and cultivated. There are 13 wild plants species, while 7 species are cultivated. Rice is a staple food in Brangkuah communities so they cultivate it in their farms. Limited knowledge for rice cultivation causes suboptimal rice production in Brangkuah village. Farmers in Brangkuah Villages use seed for cultivation from previous rice harvests and irregular of row spacing, which had suboptimal effects on growth and yield of rice. Processing of plants which are used by Brangkuah communities are categorized as traditional processing types such as boiled, steamed, and halved. For poisonous plant such as *Cycas rumphii*, Brangkuah communities have good knowledge to reduce poison effect from these plants. They are halved and the seeds soaked in water. *Cycas* seeds contain a cyanin of poisonous components (Nishida et al., 1995). Janick and Paull (2008) reported that indigenous people eliminate toxin from the *Cycas* seed with several

techniques such as roasting, boiling, shredding, and soaking in water or seawater before drying and grinding into flour.

Some plant species are used as food in the villages of Brangkuah Moyo Island. They can be directly consumed while several other types need processing. Almost all of directly consumed plants in Brangkuah village are local fruits that have spread and adapted to Moyo Island. Almost all of the plants have the main nutrient contents such as carbohydrates, proteins, minerals, and vitamins. *Manihot esculenta* (Wojjo) has a carbohydrate content higher than other plants which were observed with contents of 38.06 g per 100 g, so it can be used as an alternative food instead of rice. From this observation, we have studied some plants which contain Vitamin C such as *Phyllanthus acida*, *Annona squamosa*, *Tamarindus indica* and *Phyllanthus emblica* that are categorized as local fruit. *Annona squamosa* (Garosso) has a higher vitamin C content than other plants with a content value of 36.3 mg per 100 g fruit. Some plants observed in Brangkuah contain minerals such as Magnesium, Calcium, Sodium, and Zinc. *Sesamum indicum* (Riga) has a Calcium and Magnesium content while other plants which were observed had a nutrition value of Magnesium of 351 mg per 100 g seed and 975 mg per 100 g per seed for Calcium.

The general economic condition of the Brangkuah community is poor. Many people suffer from nutrient deficiencies. The livelihood of Moyo people is farming, although their fields are poor in nutrients. Although rice is the main crop, it can't grow in optimal yields because rainfall is low (1100 mm/year) and because of the poor soil condition. Fields are often far from the village so people make small houses in the field for overnight stays and a base during field work. Vegetables and tubers are cultivated. Alternative and supplementary foods are collected in the forest. The Brangkuah community also barter food within the community. Tuber plants like *Dioscorea*, *Amorphophallus*, and *Colocasia* can be cultivated. Tuber plants also grow well in forest. The island's soil and climate is suitable for tuber plant. Tuber plants can also be used as an alternative food source because rice production is still lacking on this island.

Timber

Timber is also used to make boats as public transportation in Bima and Sumbawa. Timber trees are necessary for house construction. Stilt houses are the typical home construction in this island, only a few people have built modern (brick) houses. All parts of stilt houses are made from wood. Timber trees determine the presence of epiphytic plants. Many epiphytic plants grow on trees, e.g. orchids and ferns. The epiphytic biodiversity will be safe if the timber trees are conserved. Several epiphytic species need specific host trees to live, if the timber plant is continuously cut, many epiphytic plant will disappear.

Alstonia spectabilis is a favorite timber species. The preferred type of wood is hard, old and strong. Several of physical property of wood influence the quality of wood such as moisture content, wood density, shrinkage and permeability of the timber, while the mechanical properties include static bending strength, tensile strength, compressive strength, shearing strength, stiffness, toughness, hardness and cleavage resistance. The higher of wood density has positive correlation with strengthens of wood (Bowyer et al., 2003).

The Brangkuah community collects timber from the forest. Conservation becomes an important aspect to be considered because timber utilization can reduce the amount of trees in the forest. Although trees are not rare or endangered, some species are used as a host species for epiphytic orchid and ferns in general. Forests are also important for water conservation. The forest water makes springs which flow into a river. There are many big trees, so it necessary to conserve timber trees in the forest. Besides a reduction in utilization of timber trees from the forest, they could also cultivate timber plants. Besides *Tectona grandis* (teak), other species which can be considered to be cultivated include *Alstonia spectabilis*, *Schleichera oleosa*, *Dysoxylum cauliflorum*. The Brangkuah community also conserves timber plants around the river and spring. Several species of trees grow along rivers. Thirty two trees are recorded along rivers which are around the Brangkuah community (Trimanto, 2013). They call rivers "Brang". Multiple streams of spring water flow throughout the year including Brang Rea, Brang Sibaru, Brang Koa and Brang Stema. The rivers are formed by the torrential flow of the springs. People use large springs for their daily necessities. Water availability is a basic requirement of society because they rarely have wells. The river is also important to wild cattle to soak in every afternoon. In this island, people retain the presence of large trees along the flow of the spring because they are convinced that big trees are able to secure the availability of clean water every day. These communities have good knowledge to conserve the plants around of river. The values, ethics and morals of local wisdom contain prohibitions and encouragement, which has played a role in maintaining and preserving springs in this island.

Organic pesticide

The majority of people are farmers. Pests often attack paddy fields and corn. Limited fertilizers and pesticides are used because they use plants to increase agricultural production. The Brangkuah community has good knowledge about poisonous plants. They utilize *Kleinhovia hospita* and *Crescentia cujete* in pesticides. The fruit *Crescentia cujete* is soaked in water and water is used for organic pesticide. Bark of *Kleinhovia hospita* is soaked in water and water is used for organic pesticide. Based on the reserach *Kleinhovia hospita* has cytotoxicity

(Gan *et al.*, 2009) and *Crescentia cujete* has HCN toxicity (Ogbuagu, 2008).

Conclusion

This study observed that 48 plant species are used by the Brangkuah community at Moyo Island, and most of them are collected from the forest. The community uses plants for food, medicine and building material. The Brangkuah community has started to cultivate several plants for building material and food that used to be collected from the forest. The Brangkuah community has conserved several useful plants and also protected harvest methods from the wild.

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