

The use by local communities of plants from Sesaot Protected Forest, West Nusa Tenggara, Indonesia

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Abstract. Hidayat S. 2017. *The use by local communities of plants from Sesaot Protected Forest, West Nusa Tenggara, Indonesia. Biodiversitas 18: 238-247.* Sesaot Protected Forest is a forest area located very close to human settlements in Sesaot Village, Narmada Sub-district, West Lombok District, West Nusa Tenggara, Indonesia. The level of dependence of rural communities on the forest resources is very high. This study aimed to determine the range of utilization of plants made by people living around the forests, and to evaluate conservation needs for these plants. Utilization of the various plants by Sesaot society was observed in an ethnobotanical study employing a combination of open interview techniques and field observation over a two week period. The results of the study showed that there were 61 species of forest plants utilized by the Sesaot people. Among the 61 species, there were species that had a single function or others that had multiple functions. There were 20 species utilized as food and beverage; 19 used as medicines and herbs; and 15 species as building materials. Other species were utilized in a variety of ways: as fuel wood, as material for craft and/or furniture, for animal traps, as food wrappings and as ornamental plants. The part of the plant most widely used was wood (30.8%), either as a building material, as craft material, for firewood, or in medical treatments. The utilization of wood products poses significant risks for the survival of certain tree species, because the timber is generally obtained by illegal logging. It was noted that certain prized timber producing species tend to be targeted by illegal loggers; such as garu (*Dysoxylum parasiticum*), bajur (*Pterospermum javanicum*), rajumas (*Duabanga moluccana*) and some species of Myrtaceae. This study showed that Sesaot Protected Forest has an important role in sustaining the daily life of the surrounding community. However, without strong conservation efforts in the management of Sesaot Protected Forest, it is feared that unsustainable utilization practices will lead to the loss of some important plant species from this region.

Keywords: Conservation, plants, protected forest, Sesaot, utilization

INTRODUCTION

Sesaot Protected Forest (SPF) has an area of approximately 5,950 hectares, located to the west of Mount Rinjani, in West Lombok, West Nusa Tenggara, Indonesia. Located in the sub-district of Namada, at an altitude of 300-600 meters above sea level the region comprises four villages. Of the four villages, there are 12 backwoods areas immediately adjacent to the Sesaot Protected Forest. Most inhabitant still dependent on forest products, both timber and non-timber products (FKS 2010). This kind of dependency on forest products is found in general amongst peoples residing adjacent to natural forests. More than 1.6 billion people around the world depend to varying degrees on forests for their livelihoods-not just for food but also for fuel, for livestock grazing areas, and for medicine (Banerjee and Madhurima 2013).

Some species of wild plants that can be found in SPF include bajur (*Pterospermum javanicum* Jungh.), klokos (*Eugenia koordersii* Herter), juwet (*Syzygium cumini* (L.) Skeels), rajumas (*Duabanga moluccana* Blume), ombar (*Chisocheton pentandrus* subsp. *paucijugus* (Miq.) Mabb.), and beringin (*Ficus benjamina* L.). Some other plant species found there are the result of reforestation in 1982; for example mahoni (*Swietenia macrophylla* King), albizia (*Paraserianthes falcataria* (L.) I.C.Nielsen), and sonokeling (*Dalbergia latifolia* Roxb.). Most of the

harvested timber is used as building materials but some is used for firewood, both for subsistence and for sale. Some species of fruit-bearing trees can also be found in SPF such as durian (*Durio zibethinus* L.), mango (*Mangifera indica* L.), rambutan (*Nephelium lappaceum* L.), kepundung (*Baccaurea racemosa* (Reinw. ex Blume) Müll. Arg.), and jackfruit (*Artocarpus heterophyllus* Lam.). Besides the potential of the plants, there are also potential uses for the wildlife that inhabit the area of SPF, including some species of birds, snakes, pigs, raccoons, and deer (FKS 2010).

With increasing numbers of people around the region of SPF, the need for food and building materials from forests will continue to grow. Rising human populations and their more intensive economic activity increasingly threatens the existence of forests in Indonesia (Soepiyanto et al. 2013). Globally, an estimated 350 million people, mostly in developing countries, depend on non-timber forest products (NTFP) as a primary source of income, nutrition and medicine. These products play a vital role in sustaining the lives of local gatherers, who must increasingly adapt to diminishing resources to stay alive (Joshi and Singh 2010). To guarantee the active participation of local communities in sustainable forest management practice, the government in Indonesia has empowered local communities that live within and around native forest area through various programs, including the establishment of community

forests (Kusmana 2012). Many forms of community forestry exist. They are viewed as effective mechanisms for forest management; mobilizing local people through democratic processes of program formulation and decision making, from which the people can expect to obtain economic benefits (Maryudi and Krott 2012). Community forestry is one of the key strategies to tackle rural poverty.

In 1995, the government developed a test model for a community forest (HKm) in a protected forest area covering 25 ha. This trial was considered quite successful in terms of conservation and economic aspects and led to it being extended by the Government of West Lombok regency to encompass an area of 3,857 ha (Galudra et al. 2010). But, through the partial conversion of protected forest areas into community forest, it was anticipated that there would be damage to forest caused by more extensive, uncontrolled use of forest resources. Indeed, the pressure on forest resources is rising. People are more likely to emphasize the need for economic benefits today than the need for conservation for the future. Now, within the forest, one can see all kinds of fruit trees grown by local people who are economically dependent on the forest resources. They collect firewood, manage their plantings, and log timber from the protected area (Magdalena et al. 2013).

The community forest program is understood by local people as an opportunity to acquire the right to manage land in state forests for farming activities. As a result, people tend to behave exploitatively to maximize their own economic benefit from the land. On the other hand, the local community also has the power to preserve the forest if they decide to be involved in this way. They often demonstrate the application of local wisdom in independent forest management strategies aimed at maintaining the harmony of ecological, economic, and cultural functions of

the community forest (Jayadi et al. 2014). Nevertheless, according to Maryudi (2012), experience in some countries indicates that the implementation of community forest programs is rarely followed by genuine power devolution to local forest users. Yet according to Lestari et al. (2015), the main objective of sustainable forest management should be to meet the needs and aspirations of the current generation without damaging future generations.

In the case of Sesaot Protected Forest, it has become important to prepare an inventory of forest plants currently utilized by the local people in order to determine the species of plants that can potentially be developed as a mainstay of economic use within the context of preserving the forest for the future. Our study, reported here, aimed to determine the utilization of forest plant diversity by communities around the region of SPF and to discuss approaches to its conservation. We hope this research can be used as supporting data for a community forest management program that is being implemented in Sesaot Protected Forest. As Sukara (2014) has said, good forest management now provides ecosystem services that safeguard the human welfare of this and future generations.

MATERIALS AND METHODS

Area of study

This research was conducted in 2012, between April 26 and May 3, in the Protected Forest of Sesaot Village, located in the eastern end of the Sub-district of Narmada, West Lombok District, West Nusa Tenggara Province, Indonesia. Sesaot village is geographically located within the coordinates 8°30'-8°33' S and 116°13'-116°18' E.

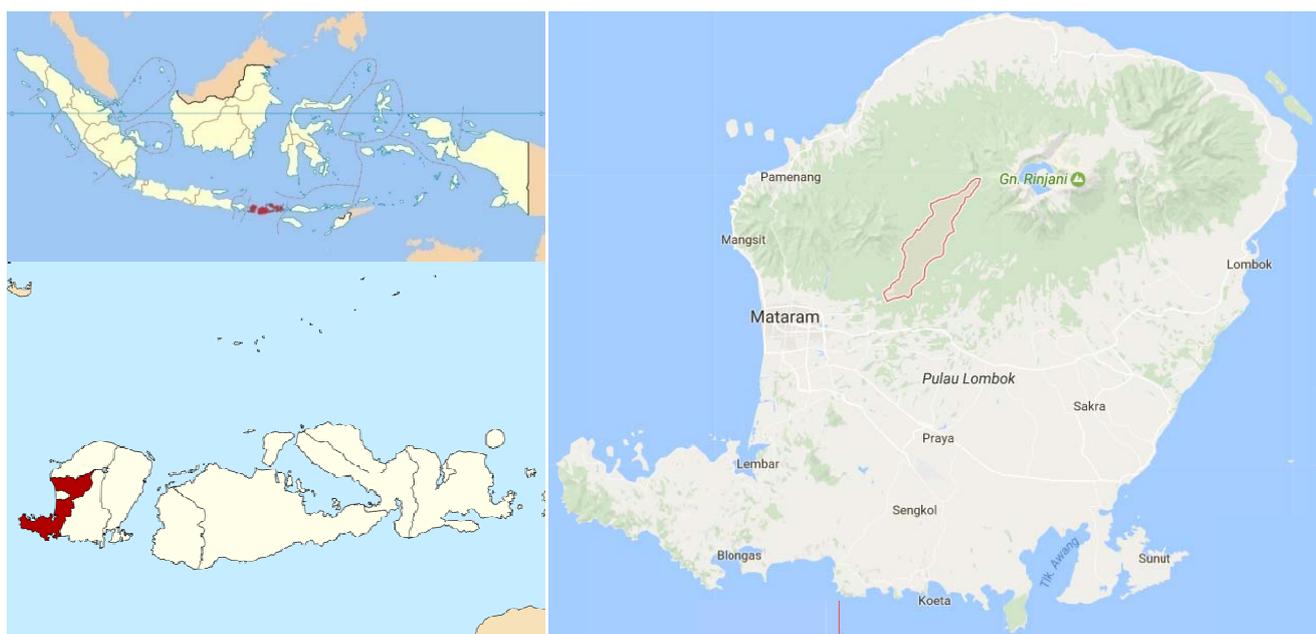


Figure 1. The research location on the island of Lombok, in the Protected Forest of Sesaot Village, located in the eastern end of the Sub-district of Narmada, West Lombok District, West Nusa Tenggara Province, Indonesia

Method

Interviews were openly conducted with several respondents from Sesaot villages and the surrounding area to obtain information on the use of plants of Sesaot Protected Forest. Respondents included community leaders in the village of Sesaot (resident caretaker, a forestry officer, chief manager of community forest) and other people who were thought to know the use of plants in the area (e.g. healer, health drink maker, herbalist). The information obtained included the names of local plants, their specific uses, and the various ways of using them. Interviews were conducted in the respondents' homes and then a search was made for the plants referred to in Sesaot Protected Forest, to verify the existence of the plants in the forest and determine the scientific name for each species described by the respondents. Some plant species were identified directly on the spot, while for some others identification could not be made on the spot and depended on making herbarium specimens. The herbarium specimens were then identified by reference to voucher specimens held by Herbarium Bogoriense as well as the herbarium and living plant collections in Bogor Botanic Gardens. The scientific names of plants adopted were those already in use within The Plant List.

Data analysis

The results of interviews and surveys were tabulated. In the table, the list of plants were sorted based on their usefulness, the parts of the plant used, and the potential risks to conservation. With the help of Microsoft Excel software, the percentage of the total represented by each utilization category, by each plant part used, and by each plant Family utilized, were calculated from the raw data.

RESULTS AND DISCUSSION

From interviews and field surveys, an inventory was compiled of 61 species of forest plant commonly used by people who live in Sesaot and surrounding villages (Table 1). The utilization is determined by the need for personal consumption or to earn cash income from sale. Sheil and Salim (2012) have reported that it is the poorer communities with the lowest educational attainment who are the highest users of wild plant products. According to Lestari et al. (2015) high-income people are more concerned about forest sustainability than about its immediate usefulness.

Forest products utilized by the Sesaot not only consist of the types of timber-producing plants, but also commodities that can be directly consumed, such as fruits, ferns, edible nuts, betel leaves, and grasses, as well as honey. Wildlife such as birds, deer, and wild boar that are hunted are also included in the category of utilized forest products. Harvesting depends on seasonal availability and also market demand. The retrieval and gathering of wood as fuel is the most easy to use and is relatively plentiful. As a source of energy, firewood is used every day both for household and industrial purposes.

Of the 61 species of forest plants utilized by Sesaot village, wood is the plant part most widely used, either as building materials, firewood, or therapeutic agents. Wood is still a major forest product for most people because it is needed for building material either used directly or offered for sale. Likewise with firewood, in the era of expensive fuels, the community looks for firewood as a cheap energy source to support their simple country lifestyle. Apart from wood, the other plant parts most widely utilized by people are the fruit and leaves (Table 2).

Forests are one of the most important ecosystems on Earth. They are the origin of many sources of food, medicines, raw materials for construction, energy, and wild plants domesticated to become critically important crops (Tidwel 2016). In this study, the highest category of use is foodstuffs (20 species), ingredients in medications (18 species), and building materials (15 species). The diversity of foodstuffs and medicines proves that food and health is a major priority for the independent livelihoods of the villagers living near the forest. Furthermore, use of timber plants for building materials usually depends on the mode of building construction preferred within the community. If the residential communities around the forest commonly use timber as their main building material, then this will require significant harvesting of forest plants for use as building materials. The utilization of forest plants for purposes other than these three categories (i.e. food, medicine and wood) are low (Table 3).

Foodstuffs

Exploitation of forests as a source of food by the community has been going on since ancient times. According to Ickowitz et al. (2016), forests and trees can contribute to food security and nutrition in at least three ways. First, forests contribute indirectly to food security through the ecosystems services that they provide to agriculture. Second, smallholder farming practices that are dependent on trees, such as swidden cultivation and agroforestry, likely result in more diverse diets since they produce a variety of foods. Third, people living in or near forests can have direct access unmediated by markets to wild foods from forest. Changing times do not transfer total food consumption out of the forest, especially for the people around Sesaot forest. Continuing population and consumption growth will mean that the global demand for food will increase for at least another 40 year (Sukara 2014). Within the context of traditional plant use, the field of food and nutraceutical plants now seems highly relevant for ongoing efforts to improve biodiversity in food culture and food security (Sujarwo and Caneva 2016) Some people from the Sesaot community are of Sasak ethnicity. Sasak people divide their cuisine into three main categories: daharan (meal, main dishes, and their complements); jaje (snack); and ineman (beverage). Most daharan dishes are served as daily food; some are served in rituals and ceremonies (Sukenti et al. 2016). Fruit is generally a primary food source derived from the forest. This contrasts with the results of research of Sakai et al. (2016) in the Kalimantan Forests. According to Sakai et al. (2016), among the four NTFP categories, wild vegetables were

Table 1. List of plants in the regional SPF utilized by Sesaot and surrounding villages, West Nusa Tenggara Province, Indonesia

Scientific name	Local name	Uses	Processing
<i>Aglaia argentea</i>	Durenan	Hot beverage	Wood boiled up, then drunk as a tea beverage
<i>Aleurites moluccanus</i>	Kemiri	Spices, firewood	Fruit shell is broken and the fleshy part taken
<i>Alocasia macrorrhizos</i>	Bira	Anti-itch medication	Stem sap is smeared on the body to ease the irritation from the sting of nettle leaves
		Wrapper	The leaves are used as wrappers for tobacco
<i>Alpinia galanga</i>	Ilat-ilat	Deodorant	The leaves are rubbed on the body while bathing
<i>Alstonia scholaris</i>	Lita	Treatment for malaria	Bark is boiled in water; the boiled liquid is drunk
<i>Alyxia reinwardtii</i>	Bakti	Bird trap	Stem sap is attached to a bamboo splinter or a place where the bird is looking for food
<i>Amomum compactum</i>	Kapulaga	Food	Young shoots are consumed as a stir-fry vegetable
<i>Anamirta cocculus</i>	Peron	Fish poison	Fruit is crushed and put into the river to stun fish
<i>Antidesma bunius</i>	Wuni	Food	Edible fruit
<i>Ardisia humilis</i>	Lebeng	Craft/household appliance	Wood is used to make the butt of a hoe or other implements
<i>Arenga pinnata</i>	Aren	Beverage	Inflorescence stalks are tapped for sugary sap (nira) used as a sweet energy drink
<i>Artocarpus elasticus</i>	Terap	Building material	Wood
		Food	Edible fruits, roasted seed
<i>Artocarpus heterophyllus</i>	Nangka	Food, firewood	Edible fruit
<i>Baccaurea racemosa</i>	Kepundung	Food	Edible fruit
<i>Begonia grandis</i>	Beluncang	Ornamental plant, food	The stalk/flower is used as a flavoring for vegetable tarts
<i>Begonia multangula</i>	Beluncang	Ornamental plant, fever medication	Whole plant is crushed and used in massaging the body
<i>Caesalpinia sappan</i>	Sepang	Heartburn medicine	The bark is made as a tea beverage
<i>Calamus ciliaris</i>	Rotan	Craft materials	Bag, rope
<i>Calophyllum inophyllum</i>	Bintangur	Food	Young leaves are consumed as a vegetable
<i>Calophyllum soulattri</i>	Badung	Anti-itch medication	A drop of sap wood plus a drop of oil is smeared on the body to relieve the itch caused by insect bites
<i>Cassia siamea</i>	Johar	Furniture	Wood
<i>Clerodendrum speciosum</i>	Api-api	Hair wash medication for killing head lice	Leaves kneaded and then rubbed on the head
<i>Cordyline fruticosa</i>	Andong	Hepatitis medication	Yellow leaves boiled, then the boiled liquid is drunk
<i>Costus spiralis</i>	Memunti	Medication for curing ulcers	Bulbs are finely ground; a little salt is added, and then the paste is placed on festering body ulcers
<i>Dalbergia latifolia</i>	Sonokeling	Building material	Wood
<i>Debregeasia longifolia</i>	Dara manuk	Building material, firewood	Wood
<i>Diospyros malabarica</i>	Kelincung	Building material	Wood
<i>Diplazium esculentum</i>	Paku nyantoh	Food	The leaves are consumed as a stir-fry vegetable
<i>Dracontomelon dao</i>	Dao	Building material	Wood
<i>Durio zibethinus</i>	Durian	Food	Edible fruit
<i>Dysoxylum parasiticum</i>	Garu	Building material	Wood
<i>Elaeocarpus sphaericus</i>	Genitri	For health	Seeds made into a necklace
<i>Eugenia koordersii</i>	Klokos udang	Building material	Wood
<i>Ficus ampelas</i>	Pot alas	Craft material	Finely abrasive leaves used for smoothing wood
<i>Ficus variegata</i>	Goa	Food	Young leaves are consumed as a vegetable
		Toothache medicine	The sap is applied to dental cavities
<i>Flacourtia rukam</i>	Rukem	Food	Edible fruit
<i>Freycinetia funicularis</i>	Bengku	Craft material	The roots are used as a weaving material for household appliances
<i>Glochidion dasyanthum</i>	Tales	Medication for treating lacerating wounds	The young leaves are finely ground, then placed on body lacerations caused by sharp objects such as knives
<i>Hoya macrophylla</i>	Daun tebal	Medication for treating ear complaints such as deafness	The young fruit is heated, squeezed into water, and then applied as drops in the ear
<i>Macaranga triloba</i>	Klutuk	Building material, firewood	Wood
<i>Medinilla crassinervia</i>	-	Ornamental plant	Flower
<i>Musa x paradisiaca</i>	Pisang rabat	Food	Banana stem is consumed as a vegetable
<i>Neolitsea javanica</i>	Udu madah	Building material	Wood
<i>Nephelium lappaceum</i>	Rambutan	Food, firewood	Edible fruit; Wood
<i>Nephrolepis hirsutula</i>	Paku jangkang	Food	The leaves are consumed as a stir-fry vegetable.
<i>Pangium edule</i>	Pakem	Food	Fruit used as a flavoring
<i>Paraserianthes falcataria</i>	Sengon	Firewood	Wood
<i>Pinanga coronata</i>	Nubodo	Ornamental plant	Outdoor ornamental
<i>Piper sarmentosum</i>	Sesaer	Food	The leaves are consumed as a stir-fry vegetable
<i>Planchonia valida</i>	Je	Building material	Wood

<i>Platynerium coronarium</i>	Kadaka	Ornamental plant	Outdoor ornamental
<i>Polyalthia longifolia</i>	Baleman	Building material	Wood
<i>Pterospermum javanicum</i>	Bayur	Diabetes drug	Roots are sliced into small pieces, then mixed in wine and drunk
		Building material firewood	Wood
<i>Sandoricum koetjape</i>	Kecapi	Food	Edible fruit
<i>Swietenia macrophylla</i>	Mahoni	Malaria medicine	Seeds are pounded to make a beverage similar to coffee
<i>Syzygium cumini</i>	Juwet	Food	Edible fruit
		Building material	Wood
<i>Syzygium lineatum</i>	Greget tunggak	Food	Edible fruit
		Building material	Wood
<i>Syzygium polyanthum</i>	Jukut	Gout medicine	The leaves are boiled, the boiled liquid is drunk
<i>Syzygium racemosum</i>	Sedia daya	Building material	Wood
<i>Tabernaemontana sphaerocarpa</i>	Kumbi	Arthritis drug	The half-ripe fruit is heated and then crushed and applied to arthritic joint
		Wound treatment	Fruit sap is applied to wounds
<i>Trevesia sundaica</i>	Pangang	Wrapper	Young leaves are used to wrap steamed fish

Table 2. Classification of plant parts used by the Sesaot community, West Nusa Tenggara Province, Indonesia

Plant part used	Species number	Percentage (%)	Uses
Wood	20	30.8	Building materials, furniture, firewood, medicine, craft materials
Fruit	15	23.1	Foodstuffs, medicine
Leaves	13	20.0	Foodstuffs, medicine, wrappers
Sap	5	7.7	Medicine, bird trap
Flower	2	3.1	Foodstuffs, medicine, ornamental plant
Stem	2	3.1	Foodstuffs
Bark	2	3.1	Medicine
Seed	2	3.1	Spices, craft materials, medicine
Root	2	3.1	Medicine
Shoots	1	1.5	Foodstuffs
Tuber	1	1.5	Medicine
Total	65		

Note: a species can have more than one plant part used

Table 3. Number and percentage of species within each category of plant use in Sesaot community, West Nusa Tenggara Province, Indonesia

Categories for the use of plants	Species number	Percentage (%)
Foodstuffs/beverages	20	27.0
Medicinal plant	18	24.3
Building materials	15	20.3
Firewood	6	8.1
Ornamental plant	5	6.8
Craft material/household appliances	4	5.4
Catcher animals	2	2.7
Wrapper	2	2.7
Spices	1	1.4
Furniture materials	1	1.4
Total	74	

Note: a species can be in more than one category of utilization

among the most frequently collected resources. Fifty-nine percent of households collected wild vegetables, one to three or more times a month. This was followed by firewood and mushroom collection, whereas fruit collection was the least frequent activity among the four categories.

Other than as a producer of fruits, some species of wild plants in SPF also serve as a non-fruit food ingredient. Many species of plants produce certain parts that can be used as a vegetable, both for subsistence and for the market. Paku nyantoh (*Diplazium esculentum* (Retz.) Sw.) and paku jangkang (*Nephrolepis hirsutula* (G. Forst.) C. Presl.) are examples of wild plants used as vegetables. Besides being cooked and consumed directly, these fern leaves are mostly harvested for sale in the market. Paku nyantoh in Indonesia is generally known as a vegetable. Leaves of paku nyantoh, based on the research of Seal (2012) and Tongco et al. (2014), have a high protein content. On the other hand, the young leaves of 'goa' (*Ficus variegata* Blume) and the stalks of the banana, 'rabat' (*Musa x paradisiaca* L.), are more widely consumed directly. In Kalimantan, *F. variegata* leaves are also used as a vegetable and are believed to increase the milk of mothers (Lushaini et al. 2015). Vegetables obtained from wild plants are rarely widely promoted in the market, and it is very likely that they could be more useful than is already commonly recognised. In research by Srianta et al. (2012) on leafy vegetables of wild *Paederia foetida* and *Erechtites hieracifolia* in two villages of Pandaan, East Java both wild species were found to have the potential to supply nutrients and phytochemicals for local people's daily life, of a value quite comparable with that of commercial and commonly consumed leaf vegetables in Indonesia.

Medicinal plants

Indigenous people develop traditional knowledge in a practical context arising out of daily necessity. Thus, documentation of medicinal plants, even very simple records, can provide a valuable contribution to wider society (Himmi et al. 2014). Traditional medicinal

knowledge can depend on forest resources as well as on resources cultivated in herbal gardens (Antons 2010). For example, it is said that 25% of the raw materials for the traditional Indonesian medicine ‘jamu’ is collected from the forests by people knowledgeable in regard to the medicinal benefits of such forest resources, but that the number of such skilled collectors is in decline and that there is a danger of unsustainable harvesting of wild plants.

Traditional knowledge of plants for medicinal uses in rural areas is a significant potential connection between plants and local peoples. Plants can often provide low cost, efficient, treatments for certain problems, with few side effects (Patel 2014). There are many plants of SPF with potential medicinal uses, but this study only obtained 14 species that were found to be commonly used by the public. The reliance on folk medicines for health care is associated with a lack of modern medicines and medication, with poverty, and with traditional beliefs in their effectiveness (Joshi and Singh 2010)

Bajur roots is one of the ingredients that is popular and much sought after today in the Sesaot region. Bajur root are the size of adult finger nails (± 2 cm) and once sliced and dried, they can be mixed in a bottle (600 ml) of palm sugar water (‘tuak’). Once blended, it becomes a red wine ready for drinking. This drink is usually served in rituals of the Sasak. Sasaknese have a traditional banquet adopted from Bali called ‘begibung’, which is a way of eating together, communally, from one large plate called a ‘janggel’. Begibung was first introduced by Karangasem kingdom soldiers when they occupied Lombok in 1692. For hygienic reasons, sometimes the janggel is replaced by individual plates. Begibung is still carried out in some villages in Lombok (Sukenti et al. 2016).



Figure 2. Tuak *bajur*, health drink from Sesaot village, West Nusa Tenggara Province, Indonesia

For diabetics, ‘tuak Bajur’ is believed to serve as a potent drug. In addition, people believe that if the root of Bajur are mixed with ordinary water it can be used as a hemorrhoid medicine. Sesaot people usually sell root of Bajur in markets around Narmada, or individually, by root collectors to health drink makers, at a price of Rp. 75,000-80,000 per three kg.

According to Salempa et al. (2014), the root/bark of *Pterospermum javanicum* can treat dysentery, toothache, ulcers and sprains. Extracts of *Pterospermum* also have anti bacterial potential. In addition, there are some other important medicinal plants species, like lita (*Alstonia scholaris*) and mahogany (*Swietenia macrophylla*) used to treat malaria. About 300 distinct native ethnicities live in Indonesia and each ethnic group has used their traditional knowledge to develop medicines based on the availability of materials in their own locality. The geographic variability across Indonesia dictates that different plant species are utilized to cure various diseases by different ethnic communities in different regions of the country (Batubara and Mitsunaga 2013). *Alstonia scholaris* is generally used as a cure for malaria by various ethnic groups in Indonesia. Beside this, *A. scholaris* is also used by Indonesian people for some other diseases. For example this species is believed by the Cikondang community to provide a cure for intestine disease, dysentery and diabetics (Ramdhan et al. 2015). Lita (*A. scholaris*) stem sap is also used as medicine for diarrhea by the Sasak people.

Building material

The technical requirements for wood as a building material are principally, strength, adequate size, and high natural durability. In SPF, there are some plants that give strong, durable timber suitable as building materials. These include the species recognized in the timber trade as ‘garu’ (*Dysoxylum parasiticum* (Osbeck) Kosterm.), ‘Bajur’ (*Pterospermum javanicum* Jungh.), and ‘udu’ (*Neolitsea javanica* (Blume) Backer). The main problem with these in general is that the continuous use of these particular timbers results in reduction in the population of mature stands and even damage to the ecosystem in broad terms. As stated by Abimaje and Baba (2014), some building materials such as steel, glass and concrete are manufactured from mineral raw materials extracted from geological resources. Timber on the other hand requires the felling of mature trees which take many years even many decades to replace, so without due consideration to afforestation, there is high risk of over-exploitation outstripping the natural rate of forest replacement and increase, leading ultimately to imbalance in the ecosystem, environmental degradation, desert encroachment and even complete desertification.

Most people who live in Sesaot are ethnic Balinese and Sasak. As was the traditional custom of the Balinese, garu, a fragrant wood, is often used as a construction material for temples, and for pillars of houses. On the other hand, Bajur wood is more suitable for interior construction purposes, particularly for boards or beams. In addition, Bajur wood is used for detailed carpentry, flooring, and furniture.

There are at least ten species of wood commonly illegally harvested by the community, either for their own use or for sale to collectors. According to Rahayu et al. (2012) demand for wood is directly linked to traditional house construction in local communities around the forest. Wood is also important for house furniture items, for farming equipment and for fuel, among other uses. Garu and Bujur are the two favored timber species, often illegally harvested in Sesaot forest. Bujur wood prices in Sesaot are around 3 million rupiah per cubic meter. The wood is usually sold to collectors, then by collectors sold on to furniture craftsmen in Narmada, especially in the Narmada market. Bujur wood can also be used as an ingredient for the manufacture of plywood, furniture, ship building, bridges, pulp and paper.

Material for firewood

Lee et al. (2015) have done research in forest margin communities around the Rinjani Forest, located in western and northern Lombok. The communities there use woody biomass, including tree branches, palm fronds, dead wood and bamboo for everyday cooking, all of which they collect, and/or buy from local markets. The most commonly reported source of these materials was agroforestry areas, often referred to as mixed gardens. Species with dense biomass that require frequent pruning, such as coffee and cacao, provide an especially good source of fuel-wood. Firewood is also collected from forest cultivation areas and primary forests. Forest cultivation and firewood collection from primary forests are illegal, but incidents of these are infrequently reported and offenders are rarely charged.

Sesaot community dependence on firewood is very high, both for households and for commercial use. The study of Sakai (2016) found that the usage of NTFPs were negatively associated with wealth only for firewood collection; poor people, who could not afford to use as much gas as wealthy people, collected and used more firewood. For the case in Sesaot, not only poverty, but cultural or customary practices are determinants of significant use of firewood. At the time of traditional events and religious rituals, the Sesaot have the most need of firewood for cooking purposes. For example, in weddings, the provision of firewood is one of the requests made by the family of the bride to her husband-to-be. The species of plants used as firewood are, among others: mahogany (*S. macrophylla*), albizia (*P. falcata*), bujur (*P. javanicum*), jackfruit (*A. heterophyllus*), rambutan (*N. lappaceum*), walnut (*Aleurites moluccanus* (L.) Willd.), and dara manuk (*Debregeasia longifolia* (Burme.f.) Wedd.). The best wood used for firewood is from hardwood species. Hard wood is usually heavier, and heavier wood is directly proportional to its density (BJ). An estimated 70% of the energy consumed by people in Indonesia comes from firewood. The use of plants as firewood is not without ecological risk because people often overlook the need for maintain the long-term preservation in the forest of stands of those species that provide them with the firewood. The Sesaot forest is currently dominated by stands of species that are of less

importance with regard to conservation. This is presumably because of the replacement of native forest stands with stands that are cultivated to provide more economic benefit to local communities in the short term, especially stands that produce firewood. Stupak et al. (2011) has said that no timber suitable as fencing poles may be processed or marketed as firewood.

Ornamental plants

Aside from being a source of food, clothing, and building materials, forests can have various species of plants with potential as ornamentals. Ornamental plants are important to increase the scenic beauty of the human environment. Ornamental plants have valuable functions in beautifying the appearance of homes and buildings through landscaping (Sihombing et al. 2015).

Forest plants that could potentially be developed as ornamental plants in general include groups like the palms, ferns, and orchids. Nubodo (*Pinanga coronata* (Blume ex. Mart.) Blume) and kadaka (*Platyserium coronarium* Mull. Desv.) are two species that the Sesaot use as ornamental plants in some yards. However, in some situations, *P. coronata* could cause a problem because it has an invasive, weedy potential. Keppel and Watling (2011), and Parker and Parsons (2011) reported that *Pinanga coronata* poses the largest threat to the native biodiversity of rainforests in Fiji and Hawaii. On the other hand, the species *Platyserium coronarium* is popular as an ornamental plant due to its uniquely shaped fronds (Taha 2011).

The ornamental plants listed in Table 3 are specifically for non-orchid plant groups. Ornamental species from among the orchids are also commonly found in SPF and planted in house yards and porches. According to Bawaihaty (2014), several species of orchids will not survive if there are no mosses in a forest. The presence of orchids in SPF implies that the forest is sufficiently damp to enable mosses and various species of natural orchids to grow. Some species of forest orchids like *Corymborkis veratrifolia* (Reinw.) Blume, *Tropidia angulosa* (Lindl.) Blume, and *Dendrobium salaccense* (Blume) Lindl. can be found in the yards of most homes of Sesaot Village.

Craft materials/household appliances

There are four species of plants that are used as craft materials and household appliances in SPF, namely johar (*Cassia siamea* Lam.), pot alas (*Ficus ampelas* Burm.f.), bengku (*Freycinetia funicularis* (Savigny) Merr.), and lebeng (*Ardisia humilis* Vahl.). The lives of most villagers still rely on simple tools for a range of creative uses. Kitchen equipment, mortars, and gardening tools such as hoes are still made from wood obtained from forests, wood of species such as lebeng. Nedelcheva et al. (2011) reported that most traditional handicrafts are connected with major household or community activities, such as food preparation, or are components of apparel, furniture, or house features. Handicrafts are part of their activities, but not the main occupations inherited from their forefathers (Reddy et al. 2008). Handicraft is only considered to be an auxiliary job, because farmers are only able engage in handicrafts once they have finished their field work (Hien et al. 2016).

Other uses

In addition to the uses described above, there are some plant species that have unique uses. Two species of plants that are often used as a leaf wrappers are bira (*Alocasia macrorrhizos* (L.) G. Don), used to wrap tobacco, and pangang (*Trevesia sundaica* Miq.) to wrap pindang fish. This contrasts with the Seberuang Dayak people in West Kalimantan who use the *Nepenthes* pitchers as vessels or containers to cook rice or sticky rice. For provision along the journey, Dayak people traditionally only took rice and salt, and used *Nepenthes* pitchers, especially the big ones like the lower pitchers of *N. bicalcarata*, *N. ampullaria*, and *N. rafflesiana*, as containers (Setiawan et al. 2015).

Two other plant species are used for catching birds and fish, either for personal consumption or for sale. These are the fruit of peron (*Anamirta cocculus* (L.) Wight & Arn.), used to poison fish in the river for easy capture. According to Mungenge et al. (2014), fish caught using such poisons are apparently safe for human consumption, because the common experience is that there are no obvious ill effects produced by consuming the fish. In the case of the other species, bakti (*Alyxia reinwardtii* Blume), its sap is used to capture small birds. Stem sap is attached to a bamboo splinter or a place where the bird is looking for food. When the bird takes the decoy food, it will be attached to this sap and cannot escape anymore.

Grouping plants by botanical family

Myrtaceae, which is represented by the genus *Syzygium*, is a plant family that is most commonly used by the community in Sesaot (Figure 3). Based on the research, by Bawaihaty (2014), *Syzygium* have the highest important values index in the primary forest of Sesaot. Besides uses for its wood, the *Syzygium* plant group also produces fruit, like juwet, that can be eaten. Swami et al. (2012) reported that the ripe fruits of *S. cumini* are used for health drinks, and for making preserves, squashes, jellies and wine. Wood, leaves or fruits are plant parts of the genus *Syzygium* that in some of its species contain useful biologically active substances that are antifungal, antibacterial, and/or antioxidant (Jemi et al. 2010). Therefore, this the plant genus is widely used.

Of the family Euphorbiaceae and Meliaceae, plants utilized range from those used for firewood, building materials and food, to medicine and spices. Wild fruits from the Euphorbiaceae like kepundung and wuni can be used as refreshers by people when in the forest, while wood like that of klutuk and kemiri is used as firewood. Wuni fruit has been considered to be good source of bioactive phenolics; the fruits when ripe are traditionally used as a medicinal treatments for gastric and other intestinal problems, e.g. diabetes, dysentery, indigestion and constipation (Kassem et al. 2013). Kepundung has a high vitamin C content. In addition, both species have a high water content compared to other wild fruit. So also with the family Meliaceae, besides producing wild fruit such as kecapi, the plant group also includes species like mahogany that are producers of medicinal materials. Another important forest family, the Moraceae, as well as being a source of timber for building materials, also provides

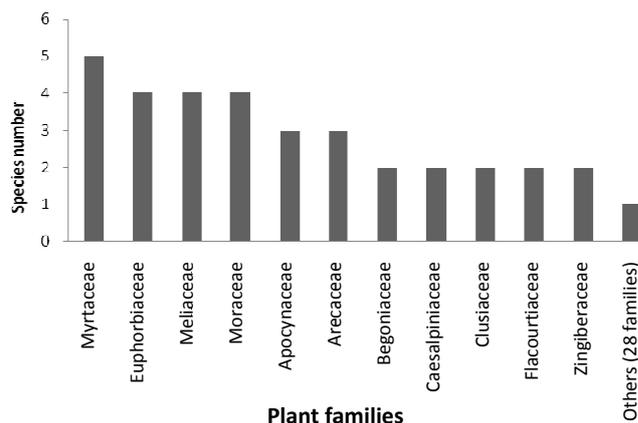


Figure 3. The number of forest plant species utilized by the Sesaot community, classified according to their botanical family

edible fruit, especially the genus *Artocarpus* that includes for example jackfruit and terep. *Artocarpus*, an important genus of the Moraceae family, produces many compounds-terpenoids, flavonoids, and stilbenoid-that provide people with various medicinal remedies (Hakim 2010; Nguyen et al. 2016).

Plant conservation issues

The utilization of forest plants by the Sesaot people also needs to be evaluated in terms of the long term conservation prospects for the species. These conservation prospects can generally be categorized as follows.

Low risk (high potential for sustainable use)

The use of plants as food and medicine obtained from fruit and foliage generally has low impact on the potential sustainability of the species utilized, especially for plants that produce useful fruits. The Sesaot communities are more likely to maintain the kinds of plants that produce food, with specific strategies to avoid destroying the viability of the plants by their harvesting activities. Numbers of some species are even multiplied by these efforts, as is the case for durians, jackfruits and bananas. Similarly, the use of leaves of some species of forest plants as vegetables does not currently pose a serious problem. The leaves are the parts most commonly produced by plants and are easily regenerated. Utilization of the leaves as a food ingredient is usually limited to young leaves, especially from among the group of ferns.

Medium risk

The use of plants as medicines and herbs can be classified in the category of moderate risk, depending on the volume of usage and on propagation efforts that may be employed. Kemiri is one plant that produces both herbs and firewood. In general, the use of its nuts is significant, but the effort to maintain the existence of the plants in the forest is high enough to provide for the sustainable use of the fruit as a flavoring and its twigs as a source of firewood. The use of some other species to provide natural remedies is often limited to only certain parts of the plants

such as sap and bark and does not destroy the long term viability of the plants at current levels of use.

High risk (low potential for sustainability)

The use of plants as building materials and firewood creates high risk for sustainability. This is because this kind of utilization depends of cutting down the trees or large portions of them. Various protective efforts based on legal enforcement instruments are unable to achieve significant outcomes, because illegal cutting and logging within the forest actually continues despite these measures.

Iswandono et al. (2015) in his research among the Manggarai people gained knowledge of community efforts aimed at minimizing the impact of using trees as building materials. The Manggarai perform traditional ceremonies when felling large trees from the forests to build a house. This applies a level of social sanction against overly exploitative tree-felling. These rules are sufficiently effective to be replicated in other areas that have similar cultures, such as in Sesaot. The Sesaot apply traditions called 'awig-awig', written customary rules, which among other things aim to regulate the extraction of firewood. Supposedly, awig-awig can also play a role in the management of logging in the forest if all elements of society do appreciate these customary rules. Some species that are endemic and legally protected, such as rajumas, Bajur, and klokos, but that are being targeted by illegal loggers, ought immediately be brought under the protection of the awig-awig rules applicable in Sesaot. Institutional protection of forests by awig-awig provides a greater space for civil society to participate in the efforts to achieve sustainability of function and utilization of forest resources. These kinds of customary laws are flexible, participatory, and accommodative of peoples' needs and patterns of belief (Jayadi et al. 2014). Bajur in particular is at high risk of extinction locally due to use of parts such as roots and stems that is damaging to whole plant survival. Stronger traditional sanctions need to be applied to the over-exploitation of this species.

In summary, there are many potential plants from Sesaot Protected Forest areas that can be utilized by the local community either for their own use or for sale. Many of the forest plants currently used are for wood, for building materials and fuel, while others are used as medicine, food, craft materials, household utensils, ornamental plants, and for a variety of other uses. Utilization of forest plants places varying levels of risk on long term conservation of forest plant species, depending on the volume of use and the particular plant parts used. However, through traditional cultural practices, such as awig-awig, the potential extinction of plant species in Sesaot can be avoided.

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