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Ethnobotanical Study of Plant Resources in Serangan Island, Bali

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ABSTRACT

Serangan is a small island located in the south of Bali. The community is made up of a mixed community of Hindus and Muslims, and has identity as a 'coastal community'. The island reclamation project has affected natural ecosystem of the island, and has led to socio-economic and cultural changes within the community. In this changing environment, local knowledge on the use of biological resources, particularly plant resources, still largely remains undocumented. Therefore, this study was carried out to collect information on the utilization of plant resources by the Serangan local community. Data were collected by conducting interview, direct observation, inventory, and focus group discussion (FGD) with pebble distribution method (PDM). A total of 132 useful plant species belonging to 51 families were identified and reported to be beneficial to the locals. The highest numbers of plants were used for ritual/ceremonial activities (70 species), followed by tourism/recreational and medicines (59 species each), food (36 species), local technology and art (29 species), firewood (20 species), livestock fodder (15 species), revenue (5 species), and natural colorants (4 species). In terms of plant utilization, food-plants ranked highest (9.25%) among all use categories, followed by revenue (8.625%), medicinal plants (6.94%), recreation/tourism (6.75%), ritual/ tradition (6%), livestock fodder (5.31%), local technology and art (5.38%), firewood (4.31%), and natural colorants (3.5%). Considering the fact that plant resources play significant role for the local community, conservation activities based on indigenous knowledge need to be done to preserve the plants from local extinction.

Key words: Bali, ethnobotany, local community, useful plants, Serangan Island.

INTRODUCTION

Studying variation of local knowledge of various ethnic groups rests on the fact that the relationship between humans and nature mayalso vary. The variety depends on environmental factors such as species richness, abundance of useful plants, and cultural heritage of the communities that utilize the biological resources (Hilgert & Gil, 2006). Focusing on knowledge, use, and management of biological resources by local communities is important to improve the understanding and management options for conservation at local and regional levels (Dalle & Potvin, 2004). Therefore, to understand the dynamic relations between biodiversity and social and cultural systems, ethnoecological research is needed to be done. Ethnoecology is a multidisciplinary field that integrates techniques from biology, anthropology, ethnology, linguistics, economy, and other field (Gerique, 2006), encompassing all studies which describe local people interaction with the natural environment (Martin, 1995).

Ethnobotany is the part of ethnoecology which concerns plants (Martin, 1995).Since the beginning of civilization, people have used plants. Plants provide people with food, medicines, as well as materials for construction and the manufacture of crafts and tools and many other products like fuel, paints, and poisons (Gerique, 2006). Various ethnoecological studies on plant resources in Indonesia have been carried out. For example, Ngaju Dayak community in Central Kalimantan utilizes no less than 107 species of plants for various purposes such as food, drugs, and cosmetics (Setyowati *et al.,* 2005).

The local community of Serangan Island has a close relationship with their natural environment. Specifically, the Hindu-Balinese community in Serangan have known Tri Hita Karana, the Three Causes of Goodness, that places emphasis on three essential harmonies:people and God; people and people; and people and nature.Their knowledge is gained by experience, and is the result of their active adaptation to the environment. The local community is a heterogenous society. Broadly speaking, they come from Balinese (majority) and Bugis ethnic group (Vickers & Suwitha, 1992; Wisnawa, 2002), each of which have different culture, religion, and also community organization. Since both of the ethnic groups have long lived on the small island, they have identity as 'the coastal community'.

Over the years, the original landscape of Serangan Island has changed, mainly due to the reclamation process done by PT. Bali Turtle Island Development (BTID). The reclamation that enlarged the island up to three times of the original island has led to ecological impacts. Some of the impacts were disruption of mangrove and seagrass ecosystems (Sundra, 2006; Nakad, 2002), reduction of coral cover extents, changes in the structure of sandy beaches of the original island, changes ini seawater circulation patterns, disruption of nesting habitat, and coastal floras and faunas. The ecological impacts then led to social, economic, and cultural disruption such assanctity of the temples, livelihood changes (Suwarno, 2002; Wisnawa, 2002; Woinarski, 2002), and the emergence of conflicts within society (Woinarski, 2002).Those changes require Serangan people to be able to adapt to their surroundings.

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Unfortunately, in this changing environment, recognition of local people's rights and perspectives is still limited. Whereas, local knowledge is considered crucial information for the island management. Information on local knowledge is also a basis for researchers to understand adaptation strategies of local community (Walujo, 2009). Therefore, researches need to be conducted to unravel Serangan local community's knowledge of the utilization of biological resources, especially the plant resources.

MATERIALS AND METHODS

The study was carried out from November 2012 to January 2013 in Serangan Island, South of Denpasar District, Bali, Indonesia. The island lies at at 08º 43'16"–08º45'09" latitude and 115º13'04"–115°15'03" longitude. The village borders are the village of Sanur Kauh in the north, the Village of Tanjung Benoa in the south, Village Pedungan in the west, and the Badung Strait to the east. The average elevation of the mainland island of sea water is three meters, with the topography of the beach is a slope ranging from 0–2% (Wisnawa, 2002; Setyowati *et al*. 2002), temperatures ranging between 28--31°C and rainfall average 1,000 mm/year. The village has an area of 481 hectares, consisting of 394 ha area of land, 48 ha area of residential region, while the rest are the shoal coast (Serangan Village, 2012).

In-depth interviews were conducted to explore local knowledge on useful plant resources. Direct observations were conducted in the field along with the key informants for the inventory of useful plant resources. Data of plant species were sorted based on the benefits and weregrouped into various use categories. Focus group discussion (FGD)with pebble distribution method (PDM) was carried out to assess the most important plant species per use category. Determination of the respondents was conducted by purposive sampling technique based on ethnicity, gender, and age. Data were analyzedby using LUVI (Local User 's Value Index) (Sheil *et al*. 2004) . The identification of plant materials was confirmed at the Herbarium Bogoriense, LIPI, Bogor.

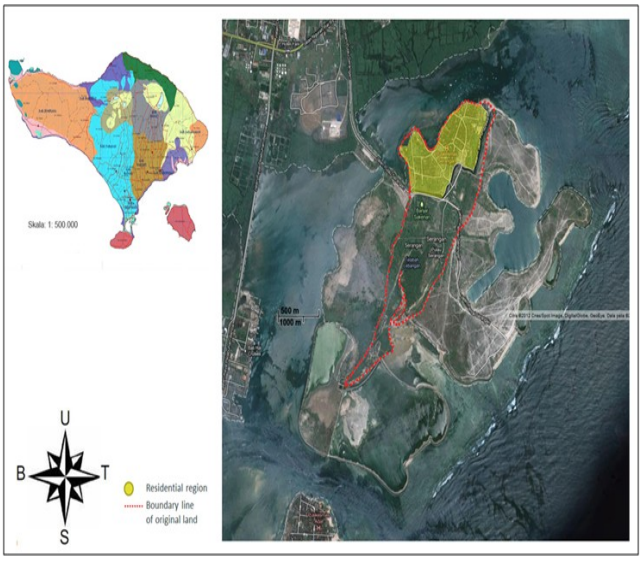

Figure 1. Study area (a) Bali, (b) Serangan Island

$$\text{LUVI} = \sum_{i=species,for\ all\ j,} Gij \quad (1)$$

$$\text{LUVI} = \sum_{category=j} Gij = Rwj\ x\ Rw\ ij \quad (2)$$

Note:
LUVI = Importance of a species, the sum of all species
Rwj = the weight given to the broad class of use to which the specific *j* belongs
Rwij = the relative weight within the category *j* for the uses of species *i* that qualify as members of *j*

RESULTS AND DISCUSSION

Local perception on the diversity and the use of plants

Plants have important roles in Balinese culture. Based on the interviewwith the key informant, a total of 146 species from 55 families plants known by the community were recorded, of which 132 species of 51 families were considered beneficial for the community. This means that 90.41% of the plant species known by the community were considered beneficial for them. Those species were categorized into nine use categories as summarized in Table 1.

Table 1. Main categories of use of plant resources

Use Category	Description
Food	Secondary foods
Medicine	Medicinal and health related
Firewood	Wood for fire
Local technology and art	Heavy and light construction material, fishing equipments, housing, music instruments, art material, handicraft
Natural colorant	Plants deriving pigments for coloring food
Revenue	Plants and processed products that are sold for cash as a source of income
Ritual/tradition	Plant parts used in ceremony or ritual
Livestock fodder	Fodder used for livestock such as goat and Bali cattle
Recreation/tourism	Ornamental plants, roadside plants, typical coastal plants

Of the 51 families documented, the most dominant family in terms of number of species was*Fabaceae* (15 species). This wasfollowed by *Apocynaceae* (10 species), *Euphorbiaceae* (9 species), *Malvaceae* and *Poaceae* (6 species each), *Moraceae* (5 species), and *Piperaceae*, *Poaceae*, *Rhizophoraceae*, *Rubiaceae* and *Rutaceae* (4 species each) (Figure 2). Meanwhile, the number of useful species recorded per use category can be found in Figure 3 and Table 3.

The highest number of the plant species in Serangan area was used for ritual/ceremonial activities (70 species), followed by tourism/recreational and medicines (59 species each), food (36 species), local technology and art (29 species), firewood (20 species), and livestock

fodder (15 species). Only five species were used in revenue category, and four species were used as natural colorants.

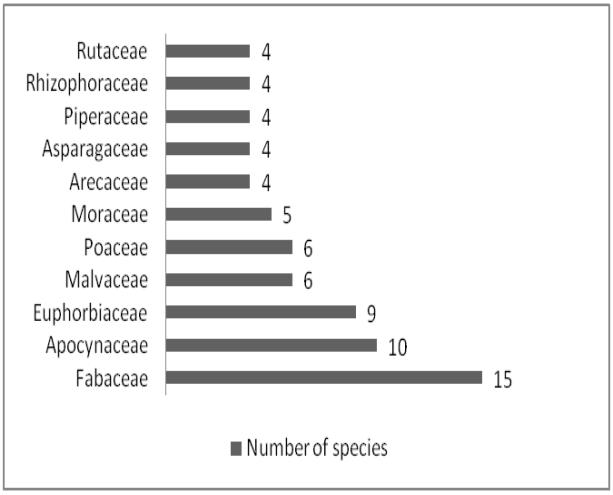

Figure 2. Representation of useful species richness from each family.

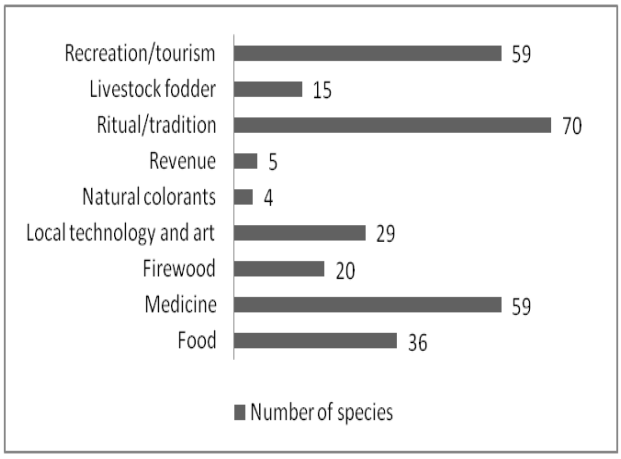

Figure 3. Diversity of plant species per use category.

The local community has assessed the importance of plant species according touse categories. Based on the top ten most important species, there were49 species of plants from all use categories. The results of the PDM and LUVI of each use categorywere outlined in Table 2.

A. Plants as Sources of Food

Twenty-seven percent of the useful plants were identified as sources of food (36 species). Ten most important food plants Werenyuh (*Cocos nucifera*), Poh (*Mangifera indica*), Nyambu air (*Eugenia aquea*), Sotong (*Psidium guajava*), Kayu sugih (*Pleomele angustifolia*), Juwet (*Syzygium cumini*), Kayu manis (*Sauropus androgynous*), Delima (*Punica granatum*), Silikaja (*Annona squamosa*), and Silik (*Annona muricata*).

Generally, Serangan local community uses plants as secondary food, such as vegetables, fruits, and seasoning. The absence of paddy field in Serangan causes the community to obtain their staple food, rice (*Oryza sativa*), from outside of the island. Nyuh (*C. nucifera*) is an important species to this category since it can be used for making many kinds of food such as Nyuh (*C. nucifera*) is also used as a raw material of tuak and arak Bali (wine). Poh fruit (*M. indica*) is very fancied by the people as refreshing food. Poh fruit (*M. indica*) can be eaten raw or as rujak kuah pindang, a kind of Balinese salad dressing. Rujak kuah pindang is made using Poh (*M. indica*), Bangkuang (*Pachyrhizus tuberosus*), and Cucumber (*Cucumis sativus*). Similarly, Nyambu air fruit (*E. aquea*) is also widely used as refreshing food.

B. Plants for Medicine

Since long, Serangan Island has reputation as an island with magical power and traditional disease treatment center. Similar to the common Balinese people, Serangan local community recognizes two types of disease, the Sekala (naturalistic) such as headache, skin pain, and abdominal pain, et cetera, and also the Niskala (*personalistic*) as affected by witchcraft. The existence of health center and the mushrooming of stalls that sell drugs, as well as the easy access to Denpasar causethe community to use modern medicines. However, there are still many people who put their trusts in traditional medicines and healing. Knowledge on Balinese traditional medicine (*usada*) which was introduced by the ancestors is a valuable knowledge of healing that is imbued by the values of Hindu,originating in the *lontar* (Prastika, 2009). *Lontar Usada Taru Pramana* is a scriptthat includes a variety of healing ingredients derived from plants (Suryadarma, 2005).

The community identified 59 medicinal plant species. Ten most important species according to the community Werekayu manis/katuk (*Sauropus androgynus*), Mengkudu (*Morinda citrifolia*), Base (*Piper betle*), Jeruk nipis (*Citrus aurantifolia*), Sambung nyawa (*Gynura procumbens*), Samiroto (*Andrographis paniculata*), Cemcem (*Spondias malayana*), Lidah buaya (*Aloe vera*), Kalikosta (*Acacia nilotica*), and Menori (*Calotropis gigantea*). Kayumanis (*S. androgynus*) isserved as medicinal plant against various diseases, one of them is to reduce fever. Based on the research, the leaves of Kayu manis (*S. androgynus*) is rich in pro-vitamin A carotenoid, vitamin B and C, protein, and mineral (Selvi & Basker, 2012). Another medicinal plant species is *mengkudu* (*M. citrifolia*), which has many benefits, such asfor treating cough and gastritis. Base (*P. betle*) is also one of the medicinal herbs that is usedfor reducingheadache. The community also used the leaves and the fruits of Cemcem (*S. malayana*) to treat gastrointestinal problems, to lower high blood pressure, and to provide nutrition for breastfeeding mothers. It is reported that the Cemcem leaves (*S. malayana*) have benefits for improving digestive health (Alonzo, 2005) due to the high ascorbic acid in it (Sakong *et al*. 2011).

C. Plants For Firewood

According to the community, there were 20 species (15.15%) that can be used as firewood. Six of those species were a major component of mangrove species. The firewood obtained from mangrove species are very rarely used by the community. Ten most important species in this category were Akasia (*Acacia auriculiformis*), Tiying (*Bambusa vulgaris*), Cemare (*Casuarina equisetifolia*), Prapat (*Sonneratia alba*), Waru (*Hibiscus tiliaceus*),

Table 2. PDM and LUVI scores of the top ten important plant species based on use category.

No	Local Name	Scientific Name	PDM	LUVI	% LUVI
Food			**18,5**		
1	Nyuh	*Cocos nucifera*	17	0,015725	1,57
2	Poh	*Mangifera indica*	16,375	0,015147	1,51
3	Nyambu air	*Eugenia aquea*	9,75	0,009019	0,90
4	Sotong	*Psidium guajava*	9,375	0,008672	0,87
5	Kayu sugih (suji)	*Pleomele angustifolia*	9,125	0,008441	0,84
6	Juwet	*Syzygium cumini*	9,125	0,008441	0,84
7	Kayu manis (katuk)	*Sauropus androgynus*	8,875	0,008209	0,82
8	Delima	*Punica granatum*	8,125	0,007516	0,75
9	Silikaja	*Annona squamosa*	6,625	0,006128	0,61
10	Silik	*Annona muricata*	5,625	0,005203	0,52
Total			100	0,09	9,25
Medicinal Plants			**13,875**		
1	Kayu manis (katuk)	*Sauropus androgynus*	13,875	0,009626	0,96
2	Mengkudu	*Morinda citrifolia*	13,125	0,009105	0,91
3	Base	*Piper betle*	13	0,009019	0,90
4	Jeruk nipis	*Citrus aurantifolia*	13	0,007978	0,80
5	Sambung nyawa	*Gynura procumbens*	10,875	0,007545	0,75
6	Samiroto	*Andrographis paniculata*	9,375	0,006504	0,65
7	Cemcem	*Spondias malayana*	7,125	0,004943	0,49
8	Lidah buaya	*Aloe vera*	7,125	0,004943	0,49
9	Kalikosta	*Acacia nilotica*	7	0,004856	0,49
10	Menori	*Calotropis gigantea*	7	0,004856	0,49
Total			100	0,07	6,94
Firewood			**8,625**		
1	Akasia	*Acacia auriculiformis*	15,25	0,006577	0,66
2	Tiying	*Bambusa vulgaris*	13,625	0,005876	0,59
3	Cemara	*Casuarina equisetifolia*	11,875	0,005121	0,51
4	Prapat/pidada	*Sonneratia alba*	10,625	0,004582	0,46
5	Waru	*Hibiscus tiliaceus*	11,375	0,004905	0,49
6	Camplung	*Calophyllum inophyllum*	9,75	0,004205	0,42
7	Suar	*Samanea saman*	8,625	0,00372	0,37
8	Mentigi	*Ceriops tagal*	7,5	0,003234	0,32
9	Lindur	*Bruguiera gymnorrhiza*	6,625	0,002857	0,29
10	Asam kranji	*Pithecellobius dulke*	4,75	0,002048	0,20
Total			100	0,04	4,31
Local Technology and Art			**10,75**		
1	Nyuh	*Cocos nucifera*	19,5	0,010481	1,05
2	Prasok	*Dracaena draco*	11,75	0,006316	0,63
3	Pandan duri	*Pandanus tectorius*	10,25	0,005509	0,55
4	Suar	*Samanea saman*	9,75	0,005241	0,52
5	Ketapang	*Terminalia catappa*	9,75	0,005241	0,52
6	Waru	*Hibiscus tiliaceus*	9,5	0,005106	0,51
7	Bintaro	*Cerbera manghas*	9,375	0,005039	0,50
8	Nangka	*Artocarpus heterophyllus*	9	0,004838	0,48
9	Camplung	*Calophyllum inophyllum*	6,5	0,003494	0,35
10	Tiying	*Bambusa vulgaris*	4,625	0,002486	0,25
Total			100	0,05	5,38

Continued

Natural colorants			**3,5**		
1	Kunyit	*Curcuma longa*	28,875	0,010106	1,01
2	Kayu sugih (suji)	*Dracaena draco*	28,875	0,010106	1,01
3	Kayu manis (katuk)	*Sauropus androgynus*	25,25	0,008838	0,88
4	Pandan arum	*Pandanus amaryllifolius*	17	0,00595	0,60
Total			100	0,04	3,50
Revenue			**8,625**		
1	Poh	*Mangifera indica*	27,5	0,023719	2,37
2	Nyuh	*Cocos nucifera*	25,0625	0,021616	2,16
3	Nyambu air	*Eugenia aquea*	15,875	0,013692	1,37
4	Jepun bali	*Plumeria* sp.	16,875	0,014555	1,46
5	Biu	*Musa paradisiaca*	14,6875	0,012668	1,27
Total			100	0,09	8,63
Ritual/traditional			**12**		
1	Nyuh	*Cocos nucifera*	16,75	0,01005	1,01
2	Jepun bali	*Plumeria* sp.	11,25	0,00675	0,68
3	Pandan arum	*Pandanus amaryllifolius*	10,75	0,00645	0,65
4	Base	*Piper betle*	10,5	0,0063	0,63
5	Sandat	*Cananga odorata*	9,5	0,0057	0,57
6	Pacah	*Impatiens balsamina*	9,5	0,0057	0,57
7	Biu	*Musa paradisiaca*	8,5	0,0051	0,51
8	Bunut	*Ficus pilosa*	8,25	0,00495	0,50
9	Pucuk	*Hibiscus rosa-sinensis*	7,75	0,00465	0,47
10	Kembang kertas	*Bougainvillea spectabilis*	7,25	0,00435	0,44
Total			100	0,06	6,00
Livestock fodder			**10,625**		
1	Padang bintak	*Cynodon dactylon*	18,625	0,009895	0,99
2	Waru	*Hibiscus tiliaceus*	16,875	0,008965	0,90
3	Nyuh	*Cocos nucifera*	12,875	0,005246	0,52
4	Prapat/pidada	*Sonneratia alba*	12,75	0,006773	0,68
5	Gamal	*Gliricidia sepium*	9,875	0,005246	0,52
6	Tiying	*Bambusa vulgaris*	7,625	0,004051	0,41
7	Ketapang	*Terminalia catappa*	7,125	0,003785	0,38
8	Bekul	*Ziziphus mauritiana*	5,25	0,002789	0,28
9	Suar	*Samanea saman*	4,625	0,002457	0,25
10	Kerasi	*Lantana camara*	4,375	0,002324	0,23
Total			100	0,05	5,31
Tourism/Recreational			**13,5**		
1	Prapat/pidada	*Sonneratia alba*	15,375	0,010378	1,04
2	Jepun	*Plumeria* sp.	14,125	0,009534	0,95
3	Kembang kertas	*Bougainvillea spectabilis*	10,875	0,007341	0,73
4	Nyuh	*Cocos nucifera*	10,25	0,006919	0,69
5	Lindur	*Bruguiera gymnorrhiza*	9,75	0,006581	0,66
6	Flamboyan	*Delonix regia*	9,625	0,006497	0,65
7	Jangkah	*Rhizophora apiculata*	8,75	0,005906	0,59
8	Pandan duri	*Pandanus tectorius*	8,375	0,005653	0,57
9	Mentigi	*Ceriops tagal*	7	0,004725	0,47
10	Cemara	*Casuarina equisetifolia*	5,875	0,003966	0,40
Total			100	0,07	6,75

Table 3. List of 132 useful plant species belonging to different families.

Number	Scientific Name	Family	Local Name	Food	Medi-cines	Fire-wood	Local tech-nology and art	Natu-ral color-ant	Rev enue	Rit-ual/ tra-ditio n	Live stoc k fod-der	Rec-reati on/ tour-ism
1	*Acacia auriculiformis*	Fabaceae	Akasia			v	v					
2	*Acacia nilotica*	Fabaceae	Kalikosta		v	v					v	
3	*Adenium coetenium*	Apocynaceae	Jepun jepang									v
4	*Allamanda cathartica*	Apocynaceae	Coblong-coblongan							v		v
5	*Aloe vera*	Xanthorrhoeaceae	Lidah buaya		v							
6	*Alpinia galonga*	Zingiberaceae	Isen	v	v					v		
7	*Alstonia scholaris*	Apocynaceae	Pulai		v		v			v		
8	*Andrographis paniculata*	Acanthaceae	Samiroto	v	v							
9	*Annona muricata*	Annonaceae	Silik	v	v							
10	*Annona squamosa*	Annonaceae	Silikaja	v	v							
11	*Araucaria heterophylla*	Araucariaceae	Cemara							v		v
12	*Artocarpus heterophyllus*	Moraceae	Nangka (Bl), Perasa (Bg)	v	v		v			v		
13	*Averrhoa bilimbi*	Oxalidaceae	Belimbing wuluh	v	v					v		
14	*Averrhoa carambola*	Oxalidaceae	Belimbing	v	v					v		
15	*Azadirachta indica*	Meliaceae	Intaran		v	v	v			v		v
16	*Bambusa vulgaris*	Poaceae	Tiying, tiying ampel			v	v			v	v	
17	*Barleria prionitis*	Acanthaceae	Landep-landep							v		
18	*Bauhinia* sp.	Fabaceae	Kupu-kupu									v
19	*Borassus flabellifer*	Arecaceae	Lontar/ental			v	v			v		v
20	*Bougainvillea spectabilis*	Nyctaginaceae	Kembang kertas							v		v
21	*Bruguiera gymnorrhiza*	Rhizophoraceae	Lindur, tanjang merah	v	v	v						
22	*Caesalpinia bonduc*	Fabaceae	Keket							v		
23	*Caesalpinia pulcherrima*	Fabaceae	Kembang merak							v		v
24	*Caladium* sp.	Arecaceae	Keladi hias									v
25	*Calophyllum inophyllum*	Clusiaceae	Camplung		v	v	v			v		
26	*Calotropis gigantea*	Apocynaceae	Menori		v					v		

27	*Cananga odorata*	Annonaceae	Sandat							v		v
28	*Capsicum annuum*	Piperaceae	Tabia lombok	v								
29	*Capsicum frutescens*	Piperaceae	Tabia kerinyi	v								
30	*Carica papaya*	Caricaceae	Pepaya	v	v					v		
31	*Cassia siamea*	Fabaceae	Kasia							v		v
32	*Casuarina equisetifolia*	Cassuarinaceae	Cemara			v				v		v
33	*Catharanthus roseus*	Apocynaceae	Tapak lima							v		
34	*Ceiba pentandra*	Malvaceae	Kapuk randu			v	v			v		
35	*Cerbera manghas*	Apocynaceae	Bintaro	v	v	v	v					
36	*Cereus* sp.	Cactaceae	Belatung									v
37	*Ceriops tagal*	Rhizophoraceae	Mentigi			v				v		v
38	*Chlorophytum comosum*	Asparagaceae	Lili paris									v
39	*Citrus aurantifolia*	Rutaceae	Nipis	v	v							
40	*Citrus grandis*	Rutaceae	Semaga	v	v					v		
41	*Citrus imblicarpa*	Rutaceae	Lemo	v	v							
42	*Cocos nucifera*	Arecaceae	Nyuh (Bl), Keluku (Bg)	v	v		v		v	v	v	v
43	*Codiaeum variegatum*	Euphorbiaceae	Puring							v		v
44	*Cordia myxa*	Boraginaceae	Kendal				v					
45	*Crinum asiaticum*	Amaryllidaceae	Bakung									v
46	*Curcuma longa*	Zingiberaceae	Kunyit	v	v			v				
47	*Cynodon dactylon*	Poaceae	Padang bintak								v	
48	*Cyperus pedunculatus*	Cyperaceae	Padang kateki		v					v	v	
49	*Datura metel*	Solanaceae	Kecubung		v					v		
50	*Delonix regia*	Fabaceae	Flamboyan									v
51	*Dendrocalamus asper*	Poaceae	Tiying petung				v			v		
52	*Dioscorea* sp.	Dioscoreaceae	-									v
53	*Diospyros maritima*	Ebenaceae	Kayu api			v						
54	*Dodonaea viscosa*	Sapindaceae	Dodonea			v						
55	*Dracaena draco*	Asparagaceae	Prasok				v			v		v
56	*Erythrina variegata*	Fabaceae	Dadap	v	v					v		
57	*Euchresta horsfildii*	Fabaceae	Purnajiwa		v					v		
58	*Eugenia aquea*	Myrtaceae	Nyambu air	v	v				v	v		
59	*Euphorbia milii*	Euphorbiaceae	Ekordea									v
60	*Exoecaria agallocha*	Euphorbiaceae	Menengen				v					
61	*Ficus benjamina*	Moraceae	Bingin							v		v
62	*Ficus callosa*	Moraceae	Kelombo							v		
63	*Ficus pilosa*	Moraceae	Bunut							v	v	v
64	*Ficus septica*	Moraceae	Awar-awar				v			v		
65	*Gardenia jasminoides*	Rubiaceae	Jempiring		v					v		v
66	*Gliricidia sepium*	Fabaceae	Gamal								v	
67	*Glochidion zeylanicum*	Phyllanthaceae	Bingin pantai									v
68	*Gloriosa superba*	Liliaceae	Kembang sungsang							v		v
69	*Gynura procumbens*	Asteraceae	Sambung nyawa		v							
70	*Haemanthus multiflorus*	Amaryllidaceae	Bunga desember									v
71	*Heliconia collinsiana*	Heliconiaceae	Biu hias									v
72	*Hibiscus rosa-sinensis*	Malvaceae	Pucuk		v					v		v
73	*Hibiscus tiliaceus*	Malvaceae	Waru		v	v	v			v	v	v
74	*Hibiscus schizopetalus*	Malvaceae	Pucuk geringsing									v

75	*Impatiens balsamina*	Balsaminaceae	Pacah		v				v		
76	*Imperata cylindrica*	Poaceae	Ambengan		v		v		v		
77	*Ixora javanica*	Rubiaceae	Soka						v		v
78	*Jasminum pubescens*	Oleaceae	Menuh						v		v
79	*Jatropha curcas*	Euphorbiaceae	Jarak pagar								v
80	*Jatropha gossypifolia*	Euphorbiaceae	Jarak pantai, jarak merah		v						
81	*Jatropha podagrica*	Euphorbiaceae	Jarak bali		v				v		
82	*Lannea grandis*	Anacardiaceae	Kayu santen		v		v		v		v
83	*Lantana camara*	Verbenaceae	Kerasi						v	v	
84	*Leucaena leucocephala*	Fabaceae	Lamtoro	v	v					v	
85	*Mangifera indica*	Anacardiaceae	Poh (Bl), pao (Bg)	v	v			v	v		v
86	*Melia azedarach*	Meliaceae	Gempines			v	v				
87	*Michelia alba*	Magnoliaceae	Cempaka putih		v		v		v		v
88	*Michelia campaka*	Magnoliaceae	Cempaka		v		v		v		v
89	*Morinda citrifolia*	Rubiaceae	Mengkudu	v	v				v		
90	*Moringa oleifera*	Moringaceae	Kelor	v	v				v	v	
91	*Muntingia calabura*	Muntingiaceae	Singapur	v	v				v		
92	*Musa paradisiaca*	Musaceae	Biu	v			v	v	v		
93	*Nerium indicum*	Apocynaceae	Kenyeri		v				v		
94	*Ocimum citriodorum*	Lamiaceae	Kemangi	v	v						
95	*Opuntia sp.*	Cactaceae	Belatung								v
96	*Ortosiphon aristatus*	Lamiaceae	Kumis kucing		v						
97	*Pandanus amaryllifolius*	Pandanaceae	Pandan arum					v	v		
98	*Pandanus tectorius*	Pandanaceae	Pandan duri				v		v		v
99	*Piper betle*	Piperaceae	Base		v				v		
100	*Piper retrofractum*	Piperaceae	Tabia bun		v				v		
101	*Pithecellobius dulce*	Fabaceae	Asam kranji			v					
102	*Platycerium bifurcatum*	Polypodiaceae	Simbar menjangan								v
103	*Pleomele angustifolia*	Asparagaceae	Kayu sugih	v	v			v	v		
104	*Plumeria acuminata*	Apocynaceae	Jepun		v			v	v		v
105	*Plumeria obtusa*	Apocynaceae	Jepun jawa						v		v
106	*Plumeria* sp.	Apocynaceae	Jepun cenana						v		v
107	*Polyscias balfouriana*	Araliaceae	Mangkokan								v
108	*Pongamia pinata*	Fabaceae	Kwanji								v
109	*Psidium guajava*	Myrtaceae	Sotong	v	v				v		
110	*Punica granatum*	Lythraceae	Delima	v	v						
111	*Rhapis excelsa*	Arecaceae	Palem wregu								v
112	*Rhiziphora apiculata*	Rhizophoraceae	Jangkah, bakau putih								v

113	*Rhizophora mucronata*	Rhizophoraceae	Bakau									v
114	*Ricinus communis*	Euphorbiaceae	Keliki		v							
115	*Tamarindus indica*	Fabaceae	Kelagi	v	v							v
116	*Terminalia catappa*	Combretaceae	Ketapang	v	v		v				v	v
117	*Thespesia populnea*	Malvaceae	Waru rot			v						
118	*Triphasia trifolia*	Rutaceae	Jeruk kingkit									v
119	*Samanea saman*	Fabaceae	Suar			v	v				v	v
120	*Sansevieria trifasciata*	Asparagaceae	Lidah mertua									v
121	*Sauropus androgynus*	Euphorbiaceae	Kayu manis	v	v			v		v		
122	*Schleichera oleosa*	Sapindaceae	Kosambi	v	v		v					
123	*Scizostachyum brachycladum*	Poaceae	Tiying gading				v			v		
124	*Spondias malayana*	Anacardiaceae	Cemcem	v	v							v
125	*Sonneratia alba*	Lythraceae	Prapat/pedada			v					v	v
126	*Sterculia foetida*	Malvaceae	Kepah/kepuh				v			v		
127	*Suregada glomerulata*	Euphorbiaceae	Kayu telur				v					
128	*Syzygium cumini*	Myrtaceae	Juwet	v	v					v		
129	*Xylocarpus granatum*	Meliaceae	Banang-banang			v						v
130	*Vitex trifolia*	Lamiaceae	Liligundi		v					v		
131	*Ziziphus mauritiana*	Rhamnaceae	Bekul	v	v						v	
132	*Zoysia japonica*	Poaceae	Rumput jepang									v
Total	**Total**	**Total**	**Total**	**36**	**59**	**20**	**29**	**4**	**5**	**70**	**15**	**59**

Note: Bl = local name in Balinese; Bg = local name in Bugis language

Camplung (*Calophyllum inophyllum)*, Suar (*Samanea saman*), Mentigi (*Ceriops tagal*), Lindur (*Bruguiera gymnorrhiza*), and Asam kranji (*Pithecellobius dulke*). In terms of the total number of plant species producing firewood, this result corresponds to the results obtained from the study of the community of Lampeapi Village, Wawonii Island, Southeast Sulawesi. In such a small island, the community utilize no less than 24 species of plants for firewood, with 7 species of which are major components of mangrove (Sunarti & Rugayah, 2009).

Akasia (*A. auriculiformis*) was considered the most important plant species served as firewood because of its abundant presence throughout Serangan. This is consistent with a research conducted by Worabai (2013), that reported that the Acacia (*A. auriculiformis*) is the predominant species at the tree level in *bet tua* (a 20-year-old coastal forest in Serangan) with Important Value Index by 55%. The wood has high specific gravity value (0.6 to 0.75 g/cm) with caloric value of 4.8 to 5 kcal/kg, so that it is an excellent source of firewood (Parotta, 1997). Tiying (*B. vulgaris*) is used as firewood as well, sincethis kind of bamboo can produce charcoal that can burn hotter and cleanerrather than charcoal derived from other wood (Benton *et al*. 2011). Cemare (*Casuarina equisetifolia*) is used as a source of firewood because the wood is excellent material for charcoal (Whistler & Elevitch, 2006; Boer & Lemmens, 2005) and their existence in the island was abundant. Meanwhile, the stems and the branches of Suar (*Samanea saman*) are known as a source of firewood and charcoal (Staples & Elevitch, 2006) . The wood of Prapat (*Sonneratia alba*) is very goodas firewood (Boer & Lemmens, 2005). Meanwhile, the wood of Waru (*Hibiscus tiliaceus*) can be considered good firewood (Wiselius, 2005), with a caloric value of 4,196 kcal/kg (Cahyono *et al*. 2008).

D. Plants for Local Technology and Art

There are 29 plant species (21.97%) that are used for local technology and art. Ten most important species for this category are Nyuh (*Cocos nucifera*), Prasok (*Dracaena draco*), Pandan duri (*Pandanus tectorius*), Suar (*Samanea saman*), Ketapang (*Terminalia catappa*), Waru (*Hibiscus tiliaceus*), Bintaro (*Cerbera manghas*), Nangka (*Artocarpus heterophyllus*), Camplung (*Calophyllum inophyllum*), Dan tiying (*Bambusa vulgaris*).

Bali is well-known for its art. Therefore, art has been part of life for Balinese community in Serangan. The Hindu-Balinese community used the leaves of Prasok (*D. draco*) for making *barong*'s tail. Bintaro wood (*C. manghas*) is used as primary material of Sidakarya mask. The use of bintaro wood as material of traditional mask is also reported in Sri Lanka (Pinto, 1986). Pandan duri (*P. tectorius*) is widely used as material for handicrafts (Keim *et al*. 2006; Thomson *et al*. 2006). Meanwhile, the Muslim-Bugis community used Nangka wood (*A. heterophyllus*) to make *gambus*, a traditional music instrument.

The community had utilized woods from Suar (*S. saman*) and *camplung* (*C. inophyllum*) as construction of *jukung*, Balinese traditional boat. Timber was deemed suitable because it has a mass of light. When the research is carried out, besides wooden boat, a lot of people also used modern boats made of fiberglass. Suar (*S. saman*) (Staples & Elevitch, 2006) and Camplung (*C. inophyllum*) (Friday & Okano, 2006) is widely used as materials for wooden boats in many other areas. Then, according to Wiselius (2005), despitethe fact that the wood is light and quite fragile, Waru (*H. tiliaceus*) is widely used for carving materials and musical instruments. For fishing tools made from plants, the community use *tumpung* which is made of woven *tiying* stem and *lambah* which is made ofthe leaves of Ental (*Borassus flabellifer*) to make fish trapped into the net.

E. Plants as Natural Colorant

Three percent of the useful plants were identified as sources of natural colorants (4 species). The plants were Kayu sugih (*Pleomele angustifolia*), Kayu manis (*Sauropus androgynus*), and Pandan arum (*Pandanus amaryllifolius*) as green colorants, and Kunyit (*Curcuma longa*) as yellow colorant. These species contain natural pigments. For example, Kayu sugih leaves (*P. angustifolia*) is rich in chlorophyll pigment (Prangdimurti *et al*., 2006). Therefore, the community used the leaves asgreen natural dye used in porridge and traditional cakes. The community did not use those colorants to color other things beside food. This is different fromthe villagers of Bali Aga in Tenganan Pegringsingan that also utilize plants as textile dye (*kain geringsing*) besides food (Danur, 2005).

F. Plants for Revenue

During the research work, not many of the plants can be considered to gather additional income. Before the island reclamation and land acquisition occurred, Serangan had been known with its Nyuh (*Cocos nucifera*) and Bangkuang (*Pachyrhizus tuberosus*) plantations.At that time, the brown, small-sized, sweet bangkuang crops had been harvested twice a year and had been marketed during Galungan. The area then has turned intoa 20-year-old coastal forest and has been owned by PT. BTID. When this study was conducted, the typical bangkuang was already very difficult to find. Even according to several informants, the bangkuang is no longer found in the island.

The plants in this category are generally those delivering edible fruits and those supporting Hindu-Balinese ceremonies. There are 5 species of plants used as a source of income, namely Poh (*Mangifera indica*), Nyuh (*Cocos nucifera*), Nyambu air (*Eugenia aquea*), *jepun bali* (*Plumeria* sp.), and Biu (*Musa paradisiaca*). The community sold Poh (*M. indica*) and Nyambu air (*E. aquea*) in a processed form (salad) at Rp 5,000. Meanwhile, plants supporting ceremony that are used to generate income are Jepun bali (*P. acuminata*), Nyuh (*C. nucifera*), and Biu (*M. paradisiaca*). Dried Jepun flowers (*Plumeria* sp*.)* are collected and sold as an incense ingredient, while the leaves of Nyuh (*C. nucifera*) and Biu (*M. paradisiaca*) can be sold as Canang materials. Canang sari is sold at a price ranging from Rp 15,000 to Rp 20,000 per 50 pieces. During Galungan and Kuningan holidays, the price can reach up to Rp 70,000 per 50 pieces .

G. Plants for Traditional/Ritual/Ceremony

There were 70 species of plants (53%) that can be utilized in this category. Ten most important ceremonial species were Nyuh (*Cocos nucifera*), Jepun bali (*Plumeria* sp.), Pandan arum (*Pandanus amaryllifolius*), Base (*Piper betle*), Sandat (*Cananga odorata*), *pacah* (*Impatiens*

balsamina), Biu (*Musa paradisiaca*), Bunut (*Ficus pilosa*), Pucuk (*Hibiscus rosa-sinensis*), ***Dan kembang kertas*** **(***Bougainvillea spectabilis*).

Similar to other Hindu-Balinese communities, Serangan Hindu-Balinese community is also known as religious society. There are several kinds of ceremonies, the Dewa Yadnya, the Pitra Yadnya, the Rsi Yadnya, the Manusa Yadnya, and the Butha Yadnya. Tumpek Ubuh is a part of the ritual in reverence of plants, especially large trees, fruit-bearers, or those considered useful to humans. At the time when Nyuh (*Cocos nucifera*) and Bangkuang (*Pachyrhizus tuberosus*) plantations still existed in Serangan, the Tumpek Ubuh was still frequently performed.

Most of the Nyuh (*C. nucifera*) parts are used in all ceremonies (Sardiana, 2010). In Lontar Prakerti, *nyuh* utilization in ceremonies symbolizes the'head' (Sardiana & Dinata, 2010). Five of the ten most importantceremonial plants are thosederiving flowers. In the Hindu religion, flowers with various color functioning as a symbol of life (*sthiti*). For example, red-colored flower is a symbol of the omnipotence of Lord Brahma (the symbol of the power to destroy the universe) and black-colored floweris a symbol of the omnipotence of Lord Vishnu (the symbol of power to maintain the Universe) (Nala, 2004). Jepun bali (*Plumeria sp*.) is widely used for *canang* (Sardiana, 2010). Likewise, Pandan arum (*P. amaryllifolius*) is widely used to complement the central part of Canang.

Yadnya ceremony is not only meaningful as a means of prayers to God, but is also meaningful to embed meaningful values, so that utilization of plants for offerings aims to instill conservation values in human being (Sardiana, 2010). Considering that plants are always used as principal material of offerings in every Hindu ceremony in Serangan, conservation efforts are needed to prevent the plants from extinction. People's awareness of the importance of plants as the principal material in ceremony indicated by the preservation efforts of the plant species: the plants are grown in their *natah* (homeyard). Similar cases are also reported in almost all regions of Bali, as in Buleleng Regency. In Buleleng, the community plant various kinds of ceremonial plants such as Base (*P. betle*) and Pinang (*Areca catechu*) (Sudi *et al*., 2006).

The Muslim-Bugis community in Serangan also has several religious traditions, one of them is Megalicik Qoran that is held on the 9th of Muharram based on Islamic calendar. During that time, the community surrounds the village three times by bringing a three-centuries-year old Koran as a request to avoid disasters. The next day, on the 10th of Muharram, the women of the community make Ash-Shura porridge that is made of rice (*Oryza sativa*), shredded beef, and peppers (*Capsicum annuum*).

H. Plants for Livestock Fodder

Approximately 300 residents in Serangan own livestock, such as chicken (*Gallus gallus*), goat (*Capra aegagrus*), and Bali cattle (*Bos sondaicus*). The community identified 15 species of plants (11.36%) that can be used as livestock fodder (goats and cows fodder, especially). Ten most important plant species in this category were Padang bintak (*Cynodon dactylon*), Waru (*Hibiscus tiliaceus*), Prapat (*Sonneratia alba*), Nyuh (*Cocos nucifera*), gamal (*Gliricidia sepium*), Tiying (*Bambusa vulgaris*), *ketapang* (*Terminalia catappa*), Bekul (*Ziziphus mauritiana*), ***Suar*** (*Samanea saman*), and Kerasi (*Lantana camara*). Padang bintak (*Cynodon dactylon*) has a reputation as a good fodder (Heyne, 1987a). Meanwhile, the leaves of Waru (*Hibiscus tiliaceus*) contains saponin that can increase proportion of propionate, the major energy source for cattles (Istiqomah *et al*. 2011). Another plant species, Prapat (*S. alba*) has leaves that can make excellent fodder for livestock (Kustanti, 2011).

Livestock are an important feature in Indonesia, but they can sometimes cause significant damage to agricultural and other environmental interests. According to the community, there were about three thousands of Bali cattles throughout Serangan Island. They become established in Serangan as a result of deliberate releases. This makes a serious risk of cattle causing deterioration to natural environment as well as disruption of restoration program in Serangan, whichalso leads to public unrest. Accordingly, the cattles were considered pests by the non-stock breeder community. Indeed,regulation to control the cattles has already listed in *awig-awig*, butthe cattles still roam freely.Fencing may be one of the options to overcome this problem. Besides, cultivation of the plants that are not fancied by the cattles need to be increased. *Pulai* (*Alstonia scholaris*) is one of the plants. All of its parts, such as bark, stems, and leaves contain white sap that has extremely bitter andunpleasant taste (Heyne, 1987b).

I. Food for Supporting Tourism and Recreational Interests

Serangan community recognized 59 species of plants (44.7%) that weresubstantial to support tourism and/or or recreational interests. Generally, the plants in this categoryinclude ornamental plants, roadside plants, and several species of mangroves. Ten most important species were Prapat (*Sonneratia alba*), Jepun (*Plumeria* sp.), Kembang kertas (*Bougainvillea spectabilis*), nyuh (*Cocos nucifera*), Lindur (*Bruguiera gymnorrhiza*), Famboyan (*Delonix regia*), Jangkah (*Rhizophora apiculata*), Pandan duri (*Pandanus tectorius*), and Mentigi (*Ceriops tagal*). Among those, four of which were mangrove species, while the three of them, Jepun (*Plumeria* sp.), Kembang kertas (*B. spectabilis*), and *flamboyan* (*D. regia*) werethe plants that have flowers with attractive colors. The diverse vegetation and coastal fauna in the mangrove ecosystembecome the main attraction that makes them important in tourism.

Analysis of Importance Value of Plant Species per Use Category

Nyuh (*C. nucifera*) was highly respected by Serangan community. It is indicated by the fact that this species was listed in top ten most important species for six categories: food, traditional/ritual, revenue, local recology and art, tourism, livestock fodder. The result is similar to the research conducted by Pratiwi & Sutara (2013), that in Denpasar and Badung, Bali, Nyuh (*C. nucifera*) is used as an *upakara*, drugs, construction, consumer, crafts, fuel, roofs, broom, and household items. Almost all parts of the tree can be used for people's daily need. This suggested

that this species has high potential value, so that the plantation of this species should be revived again. This is potential for income diversification for the people of the Serangan lowlands.

The results of LUVI calculation that shows the importance value of plant species according to the use categories is summarized in Figure 4.

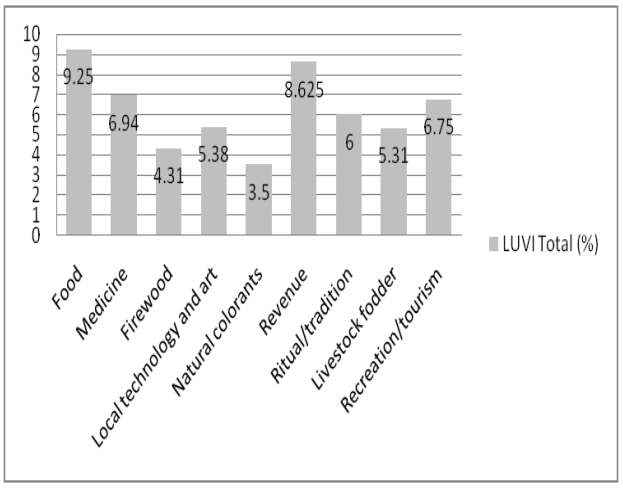

Figure 4. LUVI (%) of important plant species by different use categories.

Among the plant-use categories, food plants ranked highest (9.25%), followed by revenue (8.625%), medicinal plants (6.94%), recreation/tourism (6.75%), ritual/ tradition (6%), livestock fodder (5.31%), local technology and art (5.38%), firewood (4.31%), and natural colorant (3.5%).

The food use category as the highest utilization suggested that the community appreciate plant species as sources of food, particularly the fruit-bearer plants. As a small island, Serangan has a tropical climate and stays hot throughout the years. This makes the people fancy refreshing food and drinks to cool them down, while fruits provides that. *Rujak kuah pindang*, a kind of local fruit salad, can also make a source of income for Serangan women.

Regarding plants for ceremonial activities, it is interesting that this use category did not gain the highest use value, despite the number of the ceremonial plants was the highest of all (70 species). This is due to the fact that Muslim-Bugis community, as a part of the Serangan community, also have a role in the assessment. The Muslim-Bugis community tend to not utilize plants for their ritual activities.

Two categories with the lowest value were firewood (4.31%) and natural colorant (3.5%). This suggested that firewood is no longer a major source of energy in households, and has been replaced withliquefied petroleum gas. In line with that, natural food colorants have also been rarely used by the community.

CONCLUSION

Serangan coastal community naturally has valuable knowledge on plant diversity around them. There were 146 plant species known, of which 132 species belonging to 51 families were considered useful plants. Among all use categories, food-plants ranked highest(9.25%), followed by revenue (8.625%), medicinal plants (6.94%), recreation/tourism (6.75%), ritual/tradition (6%), livestock fodder (5.31%), local technology and art (5.38%), firewood (4.31%), and natural colorants (3.5%). Considering the fact that in any Hindu religious ceremony in Serangan requires utilization of plants, conservation activities need to be done to preserve the plants from local extinction.

Furthermore, since the use of traditional medicine is still prevalent, there is a need to conduct further studies, such as pharmacological study on medicinal plants. This could help in creating public awareness regarding the need for conservation of such plants and also in the promotion of ethnobotanical knowledge within the region. It is also important to conduct more detailed and in-depth study of the coastal and marine biodiversity around Serangan, since small island ecosystem is not only consisting of the landscapes, but also the waters around the island. Thus, the information obtained will be more comprehensive.

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