Journal of Engineering and Applied Sciences
MEDWELL PUBLICATIONS

Distribution Mapping of Useful Plant Species and their Utilization in the Aspect of Traditional Food Material by the Community of Tenganan Pegringsingan, Karangasem, Bali

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Key words: Distribution maps, useful plant species, traditional foodstuffs, Tenganan Pegringsingan

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Page No.: 3359-3366
Volume: 15, Issue 18, 2020
ISSN: 1816-949x
Journal of Engineering and Applied Sciences

Abstract: The purposes of this research were resulting the mapping of useful plant species and knowing the utilization of useful plant species oriented to social culture of Bali Aga Tenganan Pegringsingan, especially from the aspect of food. The population of this study in terms of mapping was the entire area of Bukit Kangin forest. The population in terms of useful plant species was all plant species that existed in Bukit Kangin forest. The social culture population was the entire community in Tenganan Pegringsingan village. The sample of this research from the aspect of mapping was the entire area of Bukit Kangin forest. The samples for useful plants were plant species covered by squares measuring 20×20, 5×5 and 1×1 m 65 squares each. The data were analyzed descriptively. The results of this research concluded. It had been produced a map of useful plant species in Bukit Kangin forest, Tenganan Pegringsingan, Karangasem, Bali. The plant species that dominate in the vegetation map for the distribution of useful plant species were the Enau species (*Arenga pinata* Merr.). There were 17 plant species out of 46 species which were utilized for food purposes by the community of Tenganan Pegringsingan village based on the social culture of Bali Aga.

INTRODUCTION

Tenganan Pegringsingan village has three hills namely Bukit Kangin, Bukit Kauh and Bukit Kaja. Bukit Kangin forest has an area of 65.13 ha. The mapping of Bukit Kangin forest area, Tenganan Pegringsingan village was done by the definitive measurement of simple measurement method, polygon measurement system with direct distance measurement system and compass polygon geometry. This mapping was done with a view to finding and describing the concrete position of various types of plants in Bukit Kangin. Many benefits are obtained from plants in the middle of the forest, but not much has been exploited for its use and the existence of the Bukit Kangin forest. By this distribution map of useful plant species, the local communities and/or the communities outside the village who need certain plants and are available in Bukit Kangin forest will quickly and easily obtain them[1].

The Bukit Kangin forest in plain view shows very different ecosystem conditions. The Bukit Kangin forest shows the condition of vegetation, especially, the life form of the tree habitus which is still very good, green and shady crown cover. Vegetation in other forests shows

the density and the interval of growth between one plant with another plant that has a considerable distance, so that, the forest looks rather "bare" and "empty". By using vegetation ordination analysis to determine the edafic conditions in Bukit Kangin, it shows a more fertile condition compared to other hills in the village[2, 3].

With green conditions and a good life form, in the Bukit Kangin forest grows a variety of plant species with high diversity. Based on the results of interviews with local communities, stated that many plant species can be used for the benefit of local communities. Although, plants in the Bukit Kangin forest can be used for the benefit of the local community, the community must not be arbitrarily picking. There is a regulation from the local village that regulates the utilization of the "contents" of the forest in it. The traditional rules or awig-awig are very strict governing the environment and social culture of the Tenganan Pegringsingan village community. In addition, there are beliefs and traditions that are very strongly held by the people of Tenganan Pegringsingan, so that, the forest remains sustainable until now.

Useful plants are plants that can be utilized by the community in accordance with the socio-cultural community, to improve the welfare, health and sustainability of the life of the community itself. Hasanah[4] stated that based on the usefulness of useful plants in Indonesia are grouped into several forms of uses namely clothing, food, shelter and household appliances, medicine, cosmetics, rigging and plaiting as well as for social and religious activities. In addition, useful plants in Indonesia are also often used as ornamental plants, aromatics, materials coloring and as food for livestock. Heyne[5] states that plants can generally be used for clothing, food, shelter, medicine, household and religious. The purposes of this study were to produce a distribution map of useful plant species and to know the utilization of useful plant species oriented to the social culture of Bali Aga Tenganan Pegringsingan especially from the aspect of food.

MATERIALS AND METHODS

According to Soenaryanto[6] in the simple map mapping notes and boundary mapping, the mapping method carried out with a simple measurement technique can be used in research related to vegetation mapping. In addition to mapping studies in Bukit Kangin Forest, also studied and explored the useful plant species. The exploration of the useful plant species in the original nature used the quadratic method. While the interview method, literature study, questionnaire and observation were used for the study of the usefulness of plant species that have been recorded. The following is a brief description of the data collection methods used in the field.

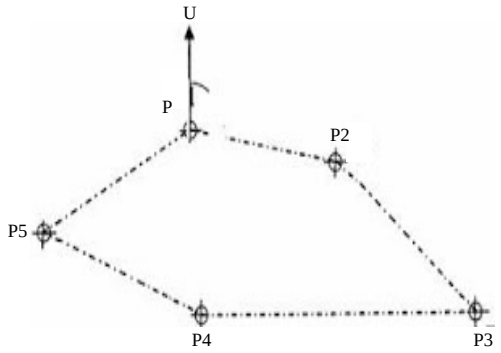

Fig. 1: Benchmark point[6]

Mapping aspect: The steps taken to collect useful plant species mapping data were as follows. Mapping the distribution of useful plants was done after the process of measuring the study location. The measurement method was used for the calculation, processing and correction of the data to determine the position (coordinates) of each measured point in the mapping area. The mapping method applied was carried out with a simple measurement technique based on Soenaryanto[6] on a simple map mapping note and boundary layout. The simple mapping work steps are described as follows. Performing temporary sticking by determining the measuring point (peg). How to set the point can be seen as Fig. 1.

The points made in the field must be easily found, these points were marked with wood (stakes) with a size of 15×15 cm^2 which were planted in the ground, then the wood must be given a number of points and a nail on top of it The distance of the stakes was adjusted to the location on the field.

Measuring the distance directly between wooden pegs using a length measuring device that was equipped with lines along with meter numbers. When working on distance measurements, the device was placed horizontally, so that, the distance was measured precisely. Perform simple definitive measurements by using the sliding system compass polygon method according to Teten.

Angular or azimuth measurements were taken on each wooden peg that had been placed at location points to form a closed polygon. Calculate the coordinates of a compass polygon point by knowing the coordinates of the starting and ending points, then determining its geographical azimuth. Also, using the compass and GPS (Global Positioning System).

The mapping of useful plant species distribution was carried out by an explorative method with the data collection of species using GPS to determine the location of plants presented in the map of the distribution of useful plants.

Table 1: List of tools and materials

Name	Category	Function
GPS (Global Positioning System)	Tool	Navigation system that can display plant position and time information
Compass	Tool	Measuring angle or azimuth position (coordinates) of each point measured in the mapping region
Environmental thermometer	Tool	Temperature gauge for the study area
Soil tester	Tool	Measuring pH and soil organic matter
Anemometer	Tool	Measuring wind speed
Hygrometer	Tool	Humidity gauge
Lux meter	Tool	Measuring light intensity
Meter tape	Tool	Measuring length and distance between squares
Wooden peg	Tool	As a pioneer in measuring ground points and installing transect lines
Raffia rope	Tool	As a transect line
Altimeter	Tool	Measuring height of place
Electric scales	Tool	Weighing soil samples
Blast Furnace	Tool	High temperature baking sample
Digital camera	Tool	Documentation in the field
Plastic bags	Material	A place to store soil samples
Label	Material	Labeling on plant samples and soil samples
Marker	Material	Stationary
Data recording sheet	Material	Record the results of field observation data

Vegetation aspect: The data collection of useful plant species in Bukit Kangin refers to Barbour *et al*.[7], Mueller-Dombois and Ellenberg[8], Cox[9], Ludwig *et al*.[10] and Wijana[3]. The data collection of useful plant species were done in two stages, namely the preparation stage and the implementation stage.

Preparation stage:

- Observation of research sites is observing the location, layout and plant species in the Bukit Kangin forest, Tenganan Pegringsingan village
- Licensing of research implementation at Tenganan Pegringsingan village office
- Preparing approval for determining the implementation time with the resource persons
- Provision of tools and materials as presented in Table 1

Implementation stage: The implementation stage in collecting useful plant species data in Bukit Kangin forest, Tenganan village, Pegringsingan carried out with the following work steps (Fig. 2):

- Divide the forest area into three zones namely 1-3
- Spread the raffia as a compass line
- Laying the squares on the compass line alternately
- The interval between squared 1 and the other squares was 10 m each

Data collection of plant species was carried out on tree habitus plant species with a square size of 20×20 m, sapling with a size of 10×10 m and seedling with a size of 1×1 m. The total number of the squares was 65.

Record the number of individuals of each plant species at each sample point and systematically measure stem diameter measurements. To make it easier to work in the field, the data obtained were recorded in a book that had been prepared in a work table that contained the name of the area, scientific name, number of individual species and the circumference of the stem.

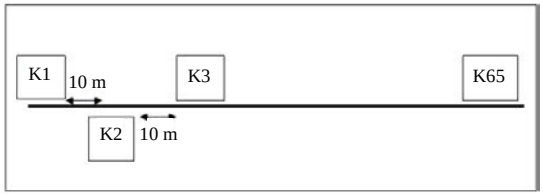

Fig. 2: Laying of Squares in the field in useful plant species data collection K1-K65 = Squares 1-65

Measuring research supporting parameters such as temperature, humidity, altitude, light intensity, soil organic matter, soil moisture and soil pH. Documenting every plant species found. Sampling species in the field and collecting plant species in plastic bags that had been labeled as ingredients for the herbarium. Conduct laboratory observations by identifying plant species through literature studies.

RESULTS AND DISCUSSION

Useful plant mapping: It should be said that the concept of useful plant species is a plant species that is utilized by the community around Bali Aga Tenganan Pegringsingan village, Karangasem based on the socio-culture of the local community. The data distribution of useful plant species is presented on the map as presented in Fig. 3. Based on Fig. 3 seen the map illustrates the distribution of 46 useful plant species that exist in the Bukit Kangin Forest region. From the map of the distribution of useful plant species, it appears that useful plant species that dominate both from tree habitus (mature plant), saplings and seeds (seedling) is a plant species of Enau (*Arenga pinnata*). Thus, it can be stated that the plant

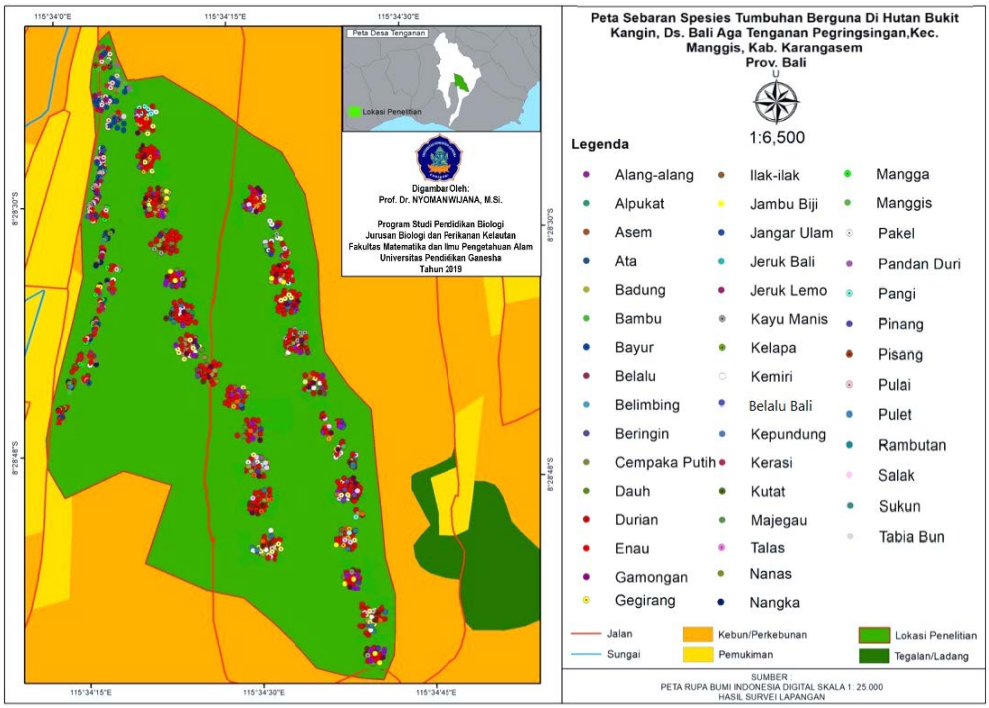

Fig. 3: Distribution map of useful plant species composition in Bukit Kangin forest

Enau (*Arenga pinnata*) as a species that controls in terms of space and natural resources in the Bukit Kangin forest. Based on the condition of such vegetation it can further be stated that plants Enau (*Arenga pinnata*) can be indexed sikan as a plant species of character both in zones 1-3. It should be noted for zone 3, that in the tree habitus is dominated by Enau (*Arenga pinnata*) but in the sapling habitus (sapling) is a Bamboo plant (*Gigantochloa apus*) and in the seedling habitus (seedling) is a Pulai plant (*Alstonia scholaris*). However, in general the physiognomy of vegetation that appears in the Bukit Kangin forest is the Enau plant (*Arenga pinnata*). Here, are some examples of useful plants on the coordinates of the vegetation map to show that the Enau plant (*Arenga pinnata*) as the dominant plant in the Bukit Kangin forest (Table 2).

Useful plants from food aspects: From the results of exploitation in the field, it is obtained the data on the useful plants that are utilized by the Tenganan Pegringsingan village people that are oriented to the socio-cultural of Bali Aga as presented in Table 3. From Table 3 it appears that there are 46 species of useful plants that can be recorded from the map of the useful plant species distribution. The 17 species of the 46 useful plant species are used as food plant species. The food plant species include: Avocado (*Persea americanda* Mill.), Starfruit Reed (*Averrhoa bilimbi*), Durian (*Duriozibetinus* Murr.), Enau (*Arenga pinata* Merr.), Guava (*Syzygium aqueum*), Guava (*Syzygium Murr*.) aqueum), Bali Orange (*Citrus maxima* Merr.), Jangar Ulam (*Syzygium polyanthum*), Bali Orange (*Citrus maxima* Merr.), Lemo Orange (*Citrus amblycarpa*), Juwet (*Syzygium cumini*), Coconut (*Cocos nucifera* L.), Mango (*Mangifera indica*), Mangosteen (*Garcinia mangostana* L.), Pineapple (*Ananas comosus* (L.) Merr.), Jackfruit (*Artocarpus heterophyllus* Lamk), Banana (*Musa paradisiaca*), Rambutan (*Nephelium lappaceum*) and Salak (*Salaccaendulis* Reinw). The useful plant species that exist in the Bukit Kangin forest seem to be the same as the cultivated plants in the community garden in general. Bukit Kangin forest, is not merely a pure forest, but is used by the community as a plantation and also its existence next to the community garden.

Each plant has various benefits for the community of the Tenganan Pegeringsingan village. Each plant has a variety of benefits for the community of the Tenganan Pegeringsingan customary village. There are two species of plants that have the most number of utilization types used by the community of Tenganan Pegringsingan village based on the Bali Aga culture, they are Enau (*Arenga pinata* Merr.) and Coconut (*Cocos nucifera* L.) as many as 4 types of utilization. Enau and Coconut are used for food, shelter, medicine and ceremonies. Utilization of plants based on the types of benefits described in detail in Table 4.

Table 2: Coordinate point data for plant species in zone 1 (291-307 masl) zone 1 square 1

Local name	Scientific name	Species code	GPS Coordinate	
			X (Horizontal)	Y (Vertical)
Kepundung	*Baccaurea racemosa*	I	9062923.643	342821.7455
Enau	*Arenga pinnata*	A	9062912.313	342808.0243
			9062915.192	342809.0047
			9062912.998	342813.8572
			9062916.88	342817.036
			9062923.522	342818.8833
			9062925.176	342817.4459
			9062932.233	342811.9148
			9062942.378	342803.8401
			9062953.407	342795.7621
			9062955.144	342786.9475
			9062963.645	342783.0627
			9062969.058	342781.6115
			9062865.289	342891.9849
			9062866.958	342894.6212
			9062867.852	342897.2604
			9062870.078	342901.2159
			9062876.698	342896.8976
			9062885.872	342895.5427
			9062886.293	342889.8158
			9062880.104	342890.8294
			9062878.064	342877.2944
			9062862.391	342885.7197
			9062866.250	342882.6226
			9062883.364	342875.0729
			9062891.082	342868.8788
			9062886.991	342869.114
Nangka	*Artocarpus heterophyllus*	G	9062797.160	342920.3111
Durian	*Durio zibethinus*	B	9062794.813	342913.4933
			9062799.795	342915.0165
Pakel	*Mangifera odorata*	C	9062808.822	342903.9731
			9062809.365	342901.1085
			9062814.429	342894.8141
			9062811.048	342907.8185

Table 3: Utilization of useful plant species by the community of Tenganan Pegeringsingan village based on Bali Aga's social culture

Species	Type of utilization					
	Cl	Fd	Sh	Md	Rg	In
Alpukat (*Persea americanda* Mill.)		+		+		
Ambengan/Alang-alang (*Imperata cylindrica* Beauv)				+	+	
Asem/Celagi (*Taramindus indica* Linn.)				+	+	
Ata (*Lygordium circirnatum*)					+	+
Badung (*Garciniadulcis* Kurs.)					+	
Bambu Tali (*Gigantochloa accer*)			+		+	
Bayur (*Pterespermumcelebicum*)			+	+		
Belalu (*Hopea celebia*)			+			
Belalu Bali (*Hepea* sp.)			+			
Belimbing Buluh (*Averrhoa bilimbi*)		+		+	+	
Beringin (*Ficus benyamina*)					+	
CempakaPutih (*Michelia alba*)			+		+	
Dauh (*Dracontomelon mangiferum*)					+	
Durian (*Duriozibetinus* Murr.)		+	+		+	
Enau (*Arenga pinata* Merr.)		+	+	+	+	
Gamongan (*Zingiber aromatica*)				+	+	
Gegirang (*Leea angulata*)					+	
Ilak-ilak (*Amomum* sp.)					+	
Jambu Biji (*Syzygium aqueum*)		+		+		
Jangar Ulam (Syzygium polyanthum)				+		
Jeruk Bali (*Citrus maxima* Merr.)		+			+	
Jeruk Lemo (*Citrus amblycarpa*)		+			+	
Juwet (*Syzygium cumini*)		+		+		
Kayu Manis (*Sauropus androgynus*)				+		
Kelapa (*Cocos nucifera* L.)		+	+	+	+	

Table 3: Continue

Species	Type of utilization					
	Cl	Fd	Sh	Md	Rg	In
Kemiri (*Aleurites moluccanus* (L.) Willd)	+				+	+
Kepundung (*Baccaurea racemosa*)	+	+	+			
Kerasi (*Lantana camara*)				+		
Kutat (*Planconia valida*)			+			
Majegau (*Dysoxylum densiflorum*)			+	+		
Mangga (*Mangifera indica*)		+	+			
Manggis (*Carcinia mangostana* L.)		+	+			
Nanas (*Ananas comosus* (L.) Merr.)		+			+	
Nangka (*Artocarpus heterophyllus* Lamk)		+	+		+	
Pakel (*Mangifera foetida* Lour.)					+	
Pandan medui (*Pandanus tectorius*)					+	
Pangi (*Pangiumeldute*)					+	
Pinang (*Areca catechu* L.)				+	+	
Pisang (*Musa paradisiaca*)		+			+	
Pule (*Alstonia scholaris*)				+		
Pulet (*Urenalobata*)				+		
Rambutan (*Nephelium lappaceum*)		+			+	
Salak (*Salaccaendulis* Reinw)		+			+	
Sukun (*Artocarpus altilis*)				+		
Tabia Bun (*Piper retrofractum* Vahl.)					+	
Talas/Keladi (*Colocasia esculenta*)					+	

Keterangan: Cl = Clothing; Fd = Food; Sh = Shelter; Md = Medicine; Rg = Religious; In = Industry

Table 4: Percentage of types of use of useful plants by the community of Tenganan village Pegeringsingan oriented to Bali Aga's socio-cultural

No. of types of utilization/Allotment of plant utilization	No. of species	Percentage (%)	Total (%)
1 Type of utilization			
Shelter	3	6.5	41.4
Drug	6	13.1	
Ceremony	10	21.8	
2 Types of utilization			
Food and medicine	3	6.5	43.3
Food and Shelter	2	4.3	
Food and ceremony	6	13.1	
Shelter and Medicine	2	4.3	
Shelter and ceremony	2	4.3	
Medicine and ceremony	4	8.7	
Ceremonies and Industry	1	2.2	
3 Types of utilization			
Clothing, food and shelter	1	2.2	10.9
Clothing, ceremonies and industry	1	2.2	
Food, Shelter and ceremonies	2	4.3	
Shelter, Medicine and ceremonies	1	2.2	
Food, Shelter, medicine, ceremonies	2	4.3	4.3
Total	46	100	100

In mapping vegetation, the most dominant plants were Enau plants (*Arenga pinnata*). Heyne[4] described that the Enau plant has height of 20 m and trunk diameter of 100-200 cm. This plant has a sturdy stem and the top is covered by black fibers known as ijuk. Enau plant has a size of leaves with a length of 50-70 cm and a width of 5-8 cm. The leaves are thick dark green with a sleek texture, thin but quite stiff. The shape of Enau leaves is compound with parallel shape of leaf bone and the evergreen leaves. The Enau plant actually does not require special soil conditions. Hatta[11] thus, these plants can live and grow on clay, moss and sandy soils. However, Enau cannot stand soil conditions that have acidic pH values. Enau is able to grow at an altitude of 9-1400 m above sea level. Good growth at an altitude of 500-800 m above sea level with rainfall of 1,200 mm per year. Temperature greatly affects all plant activities to absorb water, photosynthesis, transpiration, respiration, germination, growth and reproduction. The nature of plants with a wide range of temperatures has a high adaptability to the environment. Bukit Kangin forest is included in hot climates. The Bukit Kangin forest area as a whole has a temperature or temperature with an average range of 28-32°C.

The result data from field research showed that Enau, seen from the extent of its distribution was included in the broad distribution. The plant species included in the wide distribution were 16 species, moderate distribution there were 14 species while those included in the narrow distribution were 16 species. Thus, Enau plant species

Table 5: Methods for utilizing useful plants as food by the village community of Pegeringsingan village (Some Sample Only)

Scientific and local names	Utilization and method	Product	Scientific and local names	Utilization and method	Product
Durian (*Duriozibetinus* Murr.) 	Ripe fruit can be consumed by: splitting the rind of the fruit first 1) Flesh can be consumed	 Durian	uwet (*Syzygium cumini*) 	The ripe fruit can be consumed directly	 Juwet
Enau (*Arenga pinata* Merr.) 	Cosnumed by making palm wine by way of: Palm flowers are beaten using tools every day for one week Flowers are cut and the sap that comes out is put into a container that has been prepared The sap that has been accommodated is moved into a larger container and added with Babakan (bark) Leave it for 3 days	 Tuak	Kepundung (*Baccaurea racemosa*) 	Ripe fruit can be consumed by: Peel the rind first Flesh can be consumed	 Kepundung

become dominant in the Bukit Kangin forest vegetation. Likewise, viewed from the number of individuals (density) of Enau plant species there were 1.091 (48.51%) individuals of 2.249 total individuals.

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Each particular area and certain ecosystems have their own species characteristics in vegetation. The results of the mapping of plant species mapping that had been done beforehand showed that Monkey Forest was dominated by Mahogany (*Swietenia mahagoni*). This plant was a result of revegetation. The dominant natural plant species in the Monkey Forest were Kepundung (*Baccaurea racemosa*). Meanwhile inPenglipuran forest, it was dominated by Majegau/Gau-gau (*Dysoxylumsp*) and in Alas Kedaton forest were Kayu Taluh (*Vitex glabrata*).

In Tenganan Pegringsingan village, the community uses forest products for clothing, food, shelter, medicines, industrial materials and complements in religious ceremonies. Based on an interview with Ms. Komang Handayani that there werevarious useful plants widely used as a complement in religious ceremonies by the people of Tenganan Pegeringsingan village, namely Bambu Tali (*Gigantochloa accer*), Enau (*Arenga pinata Merr*.), Gegirang (*Leea angulata*), Coconut (*Cocos nucifera L*.), Areca Palm (*Areca catechu L*.) and Banana (*Musa paradisiaca*) (Table 5).

According to Adjie Ein general Enau (*Arengapinata* Merr.) is used its old leaves or ron by Balinese Hindu for religious offerings (jejahitan) such as lamak, gantung gantungan and sampian. Meanwhile, its ripe fruit or bluluk (can also be eaten) is also used for offerings which is placed behind a dead body along with the other offerings or other banten. Tenganan Pegringsingan village community uses a lot of fruit in utilizing useful plants as food. Fruits contain nutrients, minerals, vitamins and fiber that are needed by the body. Each fruit has a different color and taste with their respective benefits. According to Ermawati[12] each fruit has different nutritious contents such as vitamin, mineral andfiber which are needed by the body to help digestion.

CONCLUSION

From the results of this research, it can be concluded as follows: it has been produced a map of the distribution of useful plant species in Bukit Kangin, Tenganan Pegringsingan, Karangasem, Bali. The plant species that predominate in the vegetation map on the distribution of useful plant species are the Enau species (*Arengapinata* Merr.). Based on the socio cultural of Bali Aga Tenganan Pegringsingan Village, there are 17 species of plants from

46 species that are used by the community as food ingredients. From the conclusions above, the recommendations that can be submitted are: vegetation map on the distribution of useful plant species can be used as a material to develop a creative tourism objects, especially to introduce useful plant species in their natural origins. Conservation of useful plant species, especially those used as food is very important to be carried out by the community and also by the government itself.

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