

The Composition and Diversity of useful Plant Species in Bukit Kangin Forest, Tenganan Pegringsingan Village, Bali

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Key words: Species composition, species diversity, useful plants, Tenganan Pegringsingan

Abstract: This study were to determine the composition of useful plant species in the forest of Tenganan Pegringsingan village, Bali and to determine the diversity index of useful plant species in the forest of Tenganan Pegringsingan village. This study was an explorative study. The population of this study was the entire useful plant species in the area of Bukit Kangin forest. The sample of this study was the entire useful plant species covered by the squares sized of 20×20 m (for data collection of mature habitus species), 10×10 m (for sapling) and 1×1 m (for seedling), 65 squares for each data collection. The plant species composition analyzed descriptively and diversity index refers to Shannon-Wiener. Then, it followed by the analysis of Equity (E) and species Richness (R). The results of the study showed that there were 77 plant species in Bukit Kangin forest. Based on the Tenganan Pegringsingan Bali Aga social culture, 46 of them (60%) were useful plant species for the local people whereas the remaining 31 plant species (40%) were the unutilized plant species, there were 31 plant families which consisted of 46 useful plant species with as many as 2,249 total species individual.

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INTRODUCTION

Broadly speaking, Balinese society based on the implementation of Hindu religious ceremonies, consists of two groups or Soroh or Kawitan namely the Bali Aga and Bali Majapahit groups. The community order based on soroh is so, strong enveloping the activities of Balinese life. Bali Majapahit consists of several soroh such as Pande, Sangging, Bhujangga Wesnawa, Pasek, Dalem

Tarukan, Tegeh Pulasari, Arya, Brahmana Wangsa and others. Whereas the Bali Aga soroh is considered as the Original Bali or Ancient Bali. The Bali Aga community existed before Bali Majapahit came to Bali. Bali Majapahit came from Java in the days of the Majapahit Kingdom (East Java). The Bali Aga community has very little influence from Javanese-Hindu culture from Majapahit. The Bali Aga people generally inhabit villages in mountainous areas such as Sembiran village, Cempaga

village, Sidatapa village, Pedawa village, Tigawasa village in Buleleng regency and Tenganan Pegringsingan village in Karangasem regency. Majapahit Balinese people in general are the largest part of the population of Bali^[1].

Tenganan Pegringsingan village is an old village in Bali with spatial characteristics that are influenced by the Hindu culture of Pre Majapahit, so that, it belongs to the Bali Aga village^[1]. A fundamental emphasis on the culture of Bali Aga appears in relation to the worship of ancestral spirits. This cultural aspect leaves many traces of the past that is the Pre-History era. Cultural results that show this characteristic can be found in the matter of burials which are known to have various stone graves in the form of sarcophagi. It gives an analysis that a very regular burial system was known by the Bali Aga people in ancient times. Sarcophagus or other chests are found in several villages in Bali such as Gilimanuk, Jembrana regency, Marga Tengah, Tabanan regency, Taman Bali, Bangli regency and so on^[1].

Another feature in relation to the Balinese culture of Aga in the burial system is the existence of open graves such as in Trunyan village, Bangli regency. The ancestral spirits that have been celebrated subsequently their spirits are symbolized as gods in the form of ancestor spirit worship. The ancestral spirit which was seen as the forerunner of its existence was given a certain title such as the Trunyan village known as Datonta which is the highest idol of the Trunyan community^[1].

Recent developments, leading to the refinement of the conception of belief in a higher power (super natural) there are several streams owned by the Balinese Aga. The concept of worship of certain deities for the people of Bali Aga there are those who adhere to the Bayu religion, Syambhu religion, Kala religion, Brahma religion, Vishnu religion and Indra religion^[1]. So, far it is said that Balinese Aga people who adhere to certain religions are characterized by forms of religious activities carried out such as: followers of the Bayu religion directing their people to worship the God of Bayu (God of the Winds) and at the time of death their bodies are placed on the cliffs they consider sacred. This belief is still found in Trunyan village (Kintamani)^[1]. Another feature of the Bali Aga community such as that in Tigawasa village is that it does not carry out a cremation or Ngaben ceremony but a similar ceremony is carried out called the Nangun ceremony. The concept of luan (upstream) and teben (downstream) is another feature of the Bali Aga culture as seen in the position of Tenganan Pegringsingan village by having the following characteristics: Tenganan Pegringsingan village was built on a step-by-step basis, the roads are covered with large stones, sanctuaries are built with steps, buffalo maintenance for ceremonies^[2]. As befits the indigenous people who live in mountainous/hilly areas, it is clear that the area consists of forests as areas that are the source of their survival. The forest areas

which are the source of their survival are strictly guarded and used wisely, so that, the forest's preservation is maintained. Besides that they recognize and believe that the forest is a duwe forest which is the forest owned and/or given by God Almighty (Ida Sang Hyang Widhi Wasa), so, it must be preserved. Thus the forest has remained sustainable until now^[1].

Parwata revealed that the main physical feature of the Bali Aga village was the wide open space that extends (linear) from North to South (Kaja-Kelod) which divides the village into two parts. In a diametral position at the northern end (Kaja) lies Puseh Temple (a place of worship for Vishnu, the God of creation) in the middle as the place of Bale Agung Temple (place of worship for Lord Brahma) and to the South (Kelod) lies the Temple Dalem (place of worship for Lord Shiva).

Tenganan Pegringsingan village consists of five official residents association (Banjar), namely: Banjar Tenganan Pegringsingan; Banjar Gumung; Banjar Tenganan Dauh Tukad; Banjar Kangin and Banjar Kauh. Tenganan Pegringsingan traditional village consists of traditional residents association, namely: Banjar Kauh, Banjar Tengah and Banjar Kangin (Banjar Pande). The land area in Tenganan Pegringsingan village is 917,200 ha with details covering 255,840 ha of paddy fields, uplands of 583,035 ha and settlements and social facilities of 78,325 ha. Geographically the village is flanked by two hills. The boundaries of Tenganan Pegringsingan village are to the North bounded by Macang village to the East it is bounded by Bungaya and Asak villages to the South by Pasedahan village and to the west by Ngis village. In general, Tenganan village people are farmers and several tourism entrepreneurs. The population is only 688 people with a total of 232 family heads, consisting of 333 men and 355 women. There are three hills in Tenganan Pegringsingan village, Bukit Kangin, Bukit Kauh and Bukit Kaja/Kelod^[3].

The concept of useful plants based on their usefulness is grouped into several groups, namely as material clothing, food, housing, household equipment, medicine, cosmetics, rigging woven, social activities and religion. In addition, useful plants are often used as ornamental plants, aromatics, coloring agents and as food for livestock. To simplify stated that the categorization of plant utilization consists of clothing, housing, food, medicines, household needs and ceremonies religion. Plant parts that are used include roots, stems, leaves, flowers, seeds and fruit.

There might have been several species in a forest vegetation. Species that make up a vegetation can be seen as the composition of the species that exist in the forest vegetation^[4]. Research related to species composition in terrestrial vegetation has been widely carried out by researchers such as^[5-10]. Ethnobotany research on useful plant were done by Haryanti and Dibadan^[11], Mahendra *et al.*^[12] and Wajana^[13].

The concept of diversity is a variety or difference between groups. In ecology, diversity generally refers to species diversity which is measured by the number of species in the community and their relative abundance. Species diversity consists of two components, namely the number of species that exist, generally leading to species richness and the relative abundance of species that leads to the similarity or evenness of species. Thus, species diversity is a combination of the concepts of Richness and Equitability of certain species^[1, 4, 14-17]. According to Canter^[24] who stated species diversity is a variation of the diversity of species both growing, animals and organisms that live in an ecosystem or a certain place. Species diversity is the existence of differences that can be found in groups or communities in various species that live in a habitat.

Based on the description above in this study aims to determine the composition of useful plant species found in the forest of Tenganan Pegringsingan, Karangasem, Bali. Determine the diversity index of useful plant species that exist in the forest of Tenganan Pegringsingan village, Karangasem, Bali.

MATERIALS AND METHODS

The research was carried out in Bukit Kangin forest, Tenganan Pegringsingan village, Manggis district,

Karangasem regency, Bali province. Geographically Tenganan Pegringsingan village is located at coordinates 8028'38"S and 115033'58"E. The research location was centered in Bukit Kangin forest, Tenganan Pegringsingan village, artificially divided into three zones, namely zone I was located at the top/peak of Bukit Kangin with altitudes between 8028'29"S-115034'20"E and 8028'48 "S-115034'27"E. Zone II was located in the middle of Bukit Kangin with an altitude between 8028'27"S-115034'9"E and 8028'45"S-115034'34"E and Zone III was located at the bottom of Bukit Kangin with an altitude between 8028'32 "S-115034'7"E and 8028'21 "S-115034'4"E (Fig. 1).

This type of research conducted in this research was exploratory research. The population in this research was all useful plant species in the Bukit Kangin forest area. The research sample was all useful plant species covered by a square of 20×20 m size (for tree/mature tree habitus), 5×5 m (for sapling) and 1×1 m (for seedling), 65 squares each. The squares were put in three zones in the Bukit Kangin forest area alternately.

The implementation of this research is as follows. Observations were made to determine the location, layout, uniformity and heterogeneity of the Bukit Kangin forest. Prepare research permit at the Village Office/Desa Adat Tenganan Pegringsingan. Prepare the tools and materials to be used in research. The tools and materials used in this

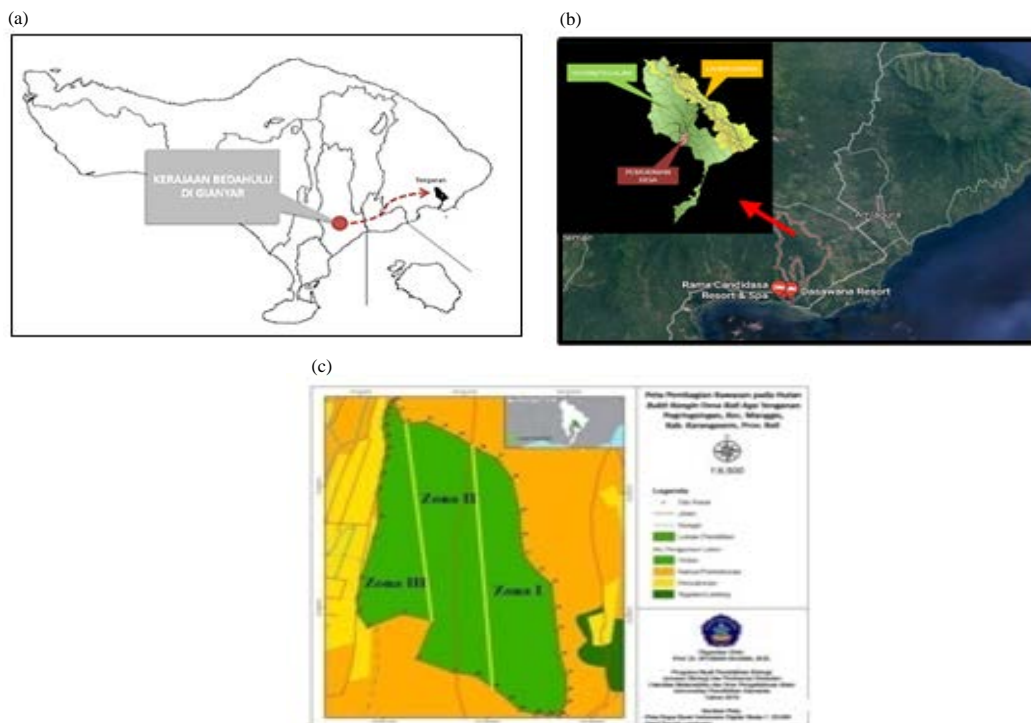


Fig. 1(a-c): Research sites and artificial zones. (A = Bali Island, B = Tenganan Pegringsingan village, C = The Map of Bukit kangin forest)

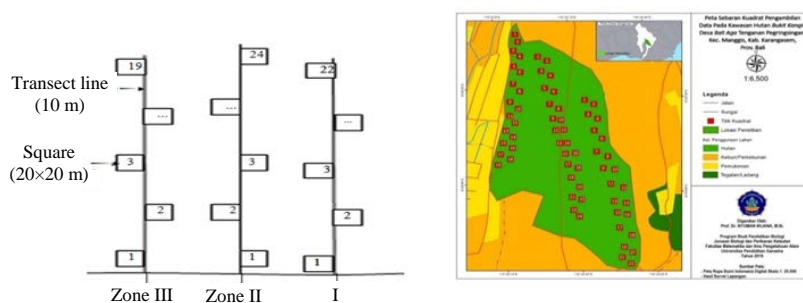


Fig. 2(a, b): Scheme (a) and Map (b) Squares laying in the field^[4, 14-17]

Table 1: Shannon-Wiener diversity index value range^[4, 14-17]

Score	Category
< 2	Low diversity
2-3	Medium diversity
>3	High diversity

study are (1) GPS (Global Positioning System), Compass, Hagameter, Environmental Thermometer, Soil tester, Anemometer, Hygrometer, lux meter, tape meter, Wooden peg, Raffia rope, camera, Altimeter, Ovens, Furnaces and Electric Scales. Laying the square for data retrieval is presented in Fig. 2. Vegetation parameters measured are density and dominance. From the collected data then analyzed according to the data sought, i.e., the composition of plant species analyzed descriptively while to find the index of species diversity refers to Shannon-Wiener^[4, 14-17]. The magnitude index of species diversity obtained next is compared with the following criteria. (Table 1).

After analyzing the diversity index of plant species, it is continued to look for the individual's Equity (E) and Species Richness (R).

RESULTS

The composition of useful plant species: The results of exploration of plant species in Bukit Kangin, obtained as many as 77 species of plants. Of the 77 plant species including 40 families with a total of 2,574 individual species. Furthermore, from the 77 plant species found based on interviews, literature studies and field observations, 46 plant species were obtained which were used by the local community traditionally. The results of the study related to the composition of useful plant species in Bukit Kangin, Tenganan village, Pegringsingan, Karangasem are presented in Table 2.

Based on Table 2 and Fig. 3, there are 31 families consisting of 46 species of useful plants with a total number of individual species of 2,249 individuals. The family that has the highest number of individuals is the

Arecaceae family. The families with the lowest number of individuals are the Aecaceae, Cucurbitaceae and Lauraceae families. The most useful plant species found were sugar palm (*Arenga pinnata* Merr) (48.51%), bayur (*Pterospermum celebicum* Miq.) (8.35%), pule (*Alstonia scholaris* (L.) R.Br.) (6.44%) and Ata (*Lygodium circinatum* (Burm.) Sw.) (3.51%). Based on Table 1 too, the number of individuals as a whole, there are as many as 2,574 plants in Bukit Kangin. Based on the total number of plants in Bukit Kangin, 2,249 individuals (87%) are included in useful plants while non-useful plants are 325 individuals or 13%. Based on data on the total plant species found in Bukit Kangin, there are 77 species, 46 species (60%) of which are plants that are useful for the local community while 31 species (40%) are included in plants that are not useful or are not used by local communities based on social culture of Bali Aga, Tenganan Pegringsingan village. Based on the above data it can be interpreted that the majority (60%) of these plants is used by the local community and 40% are not traditionally used by the local community. Useful plants traditionally utilized by local communities are for the purposes of religious ceremonial material (Hindu) as many as 29 plant species (35.80%), for medicinal purposes as many as 18 plant species (27.70%) as many as 17 plant species food (20.99%), the need for board materials is 13 plant species (16.05%), the need for clothing and industrial materials is 2 plant species (2.47%) (Fig. 4).

The diversity of useful plant species: As stated in the data collection method in the field that the study area was divided into three zones, they were Zone I-III. Further, the data from each zone were analyzed then the general vegetation in Bukit Kangin was analyzed as well. The analysis was also based on the habitus, namely the seedling, sapling and mature phases. Recording the diversity of useful plant species in the Bukit Kangin forest used the Shannon-Wiener Diversity Index. The range

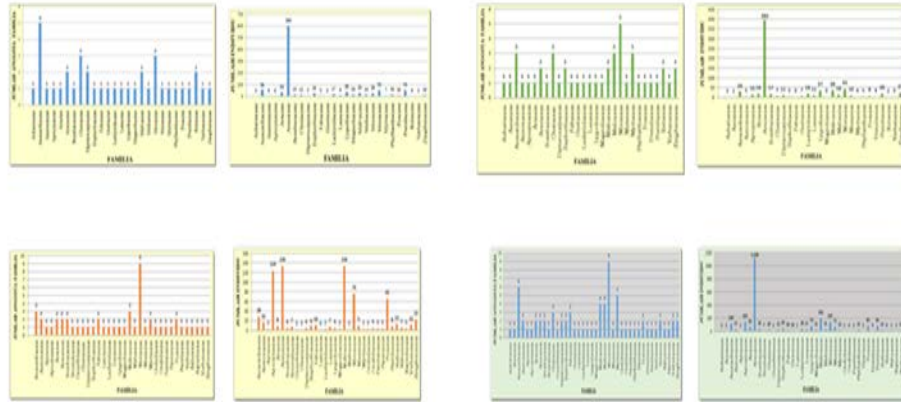


Fig. 3: Graph to clarify Table 2 a) Familia with species members (Left), Familias with Individual Species Members (Right) Zone I; B) Familias with species members (Left). Familia with Individual member species (Right) Zone II; C) Familias with species members (Left). Familia with Individual member species (Right) Zone III; D) Familias with species members (Left). Familial members of species (Right) Bukit Kangin vegetation, Tenganan Pegringsingan

Table 2: The composition of useful plant species in Bukit Kangin, Tenganan village, Pegringsingan

Local name	Scientific name	Family	Individual number
Cogongrass	<i>Imperata cylindrica</i> (L.) P. Beauv.	Poaceae	7
Avocado	<i>Persea americana</i> Mill.	Lauraceae	1
Tamarind	<i>Tamarindus indica</i> L.	Fabaceae	2
Ata	<i>Lygodium circinatum</i> (Burm.) Sw.	Lygodiaceae	79
Badung	<i>Garcinia dulcis</i> (Roxb.) Kurz	Clusiaceae	5
Rope Bamboo	<i>Gigantochloa apus</i> Kurz	Poaceae	76
Bayur	<i>Pterospermum celebicum</i> Miq.	Malvaceae	188
Belalu	<i>Hopea celebica</i> Burck	Dipterocarpaceae	20
Belalu Bali	<i>Hopea</i> sp.	Dipterocarpaceae	1
Bilimbi	<i>Averrhoa bilimbi</i> L.	Oxalidaceae	4
Banyan	<i>Ficus benjamina</i> L.	Moraceae	4
White Magnolia	<i>Michelia alba</i> DC.	Magnoliaceae	21
Dracontomelon	<i>Dracontomelon mangiferum</i> Bl.	Anacardiaceae	1
Durian	<i>Durio zibethinus</i> Murr.	Bombacaceae	34
Sugar Palm	<i>Arenga pinnata</i> Merr.	Arecaceae	1.091
Bitter Ginger	<i>Zingiber aromaticum</i> Valetton	Zingiberaceae	32
Gegirang	<i>Leea</i> sp.	Leeaceae	27
Ilak	<i>Amomum</i> sp.	Zingiberaceae	25
Guava	<i>Psidium guajava</i> L.	Myrtaceae	1
Bay Leaf	<i>Syzygium polyanthum</i> Miq.	Myrtaceae	1
Grapefruit	<i>Citrus maxima</i> (Burm.) Merr.	Rutaceae	3
JerukLemo	<i>Citrus amblycarpa</i> Ochse	Rutaceae	3
Java Plum	<i>Syzygiumcumini</i> (L.) Skeels	Myrtaceae	1
Cinnamon	<i>Sauropusand rognous</i> (L.) Merr.	Euphorbiaceae	10
Coconut	<i>Cocos nucifera</i> L.	Arecaceae	37
Candlenut	<i>Aleurites moluccanus</i> Willd.	Euphorbiaceae	30
Kepundung	<i>Baccaurea racemosa</i> Mull. Arg.	Phyllanthaceae	21
West Indian Lantana	<i>Lantana camara</i> L.	Verbenaceae	14
Kutat	<i>Planchonia valida</i> Blume	Lechytidaceae	38
Majegau	<i>Dysoxylum densiflorum</i> Miq.	Meliaceae	3
Mango	<i>Mangifera indica</i> L.	Anacardiaceae	38
Mangosteen	<i>Garcinia mangostana</i> L.	Clusiaceae	4
Pineapple	<i>Ananas comosus</i> (L.) Merr.	Bromeliaceae	7
Jakcfruit	<i>Artocarpus heterophyllus</i> Lam.	Moraceae	46
Pakel	<i>Mangifera odorata</i> Griff.	Anacardiaceae	59
Thatch Screwpine	<i>Pandanu stectorius</i> B.C. Stone	Pandanaceae	3
Pangi	<i>Pangiumedule</i> Reinw.	Achariaceae	5
Areca Palm	<i>Areca catechu</i> L.	Clusiaceae	11
Banana	<i>Musa paradisiaca</i> L.	Musaceae	72
Pule	<i>Alstonia scholaris</i> (L.) R. Br.	Apocynaceae	145
Pulet	<i>Urenalobata</i> L.	Malvaceae	11
Rambutan	<i>Nephelium lappaceum</i> L.	Sapindaceae	3

Table 2: Continue

Local name	Scientific name	Family	Individual number
Snake fruit	<i>Salacca zalacca (Gaertn.) Voss</i>	Aecaceae	1
Breadfruit	<i>Artocarpus altilis (Parkinson) Fosberg</i>	Moraceae	7
Tabia Bun	<i>Piper retrofractum Vahl</i>	Piperaceae	3
Taro	<i>Colocasia esculenta (L.) Schott</i>	Araceae	54
Total		46 31	2.249

Table 3: Tables should be placed in the main text near to the first time they are cited

Parameters	Habitus-zone								
	Zone I			Zone II			Zone III		
	A	B	C	A	B	C	A	B	C
Diversity (H') (%)	1,19	1,29	0,90	1,19	1,33	1,15	1,79	1,62	1,53
Diversity (general variation) (H'') (%)	2,28	2,45	1,06	2,28	2,51	2,22	3,46	3,07	2,89
Evenness (E) (%)	1,1717	0,8178	0,3600	0,9508	0,8005	0,7681	1,3489	1,1633	1,0672
Richness (R) (%)	1,1042	3,4774	2,8936	1,8302	4,2231	3,0447	2,3703	2,5061	2,5265
Density (m ²)	10,41	0,11	0,06	9,83	0,08	0,03	17,56	0,09	0,03
Dominance (cm)	283,75	895,40	6.881,72	623,85	314,87	1.374,67	1.576,63	338,47	957,82

A = Seedling; B = Sapling; C = Trees

Table 4: Summary data on vegetation parameter index of useful plant species in Bukit Kangin Forest, Tenganan Pegringsingan

Parameters (%)	Index
Diversity (H')	1,4802
Diversity (General Variation) (H'')	2,7899
Evenness (E)	0,7287
Richness (R)	3,8722
Density (m ²)	0,0691
Dominance (cm)	8.183,58

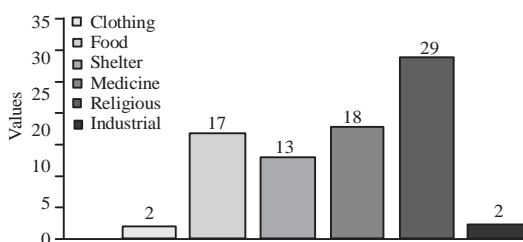


Fig. 4: Recapitulation of number of useful plants based on utilization

of values used to categorize the Diversity Index of useful plant species based on the Shannon-Wiener Diversity Index has been presented in Table 1. From the calculation of the Species Diversity Index, it is then continued with an analysis of Equity (E) and species Richness (R). The size of the square used for data collection of useful plant species was based on its habitus, i.e. tree/mature (20×20 m), sapling (10×10 m) and seedling (1×1 m). The recapitulation results of the calculation of the diversity index, equity and richness of useful plant species can be seen in Table 3. As an illustration from the table above, the graph can be made as in Fig. 5 and 6.

DISCUSSION

Based on the data in Table 3 and 4 and Fig. 5 and 6, it can be seen that the diversity index value in the Bukit

Kangin forest vegetation in each habitus (seedling, sapling and trees) is the largest index value in zone III (H' = 1.79 and H'' = 3.46). Evenness parameters for both seedling, sapling and trees habitus with the highest index are in Zone III. For species richness, the highest index level of seedling is in Zone III (2.3703), the level of sapling is in zone II (4.2231) and the level of trees is in Zone II (3.0447). For the density parameter, the zone with the highest index at the seedling level is Zone III (17.56), the highest sapling level is in Zone I (0.11) and for the tree level there is in Zone I (0.06). For its dominance index, the highest zone at the level of seedling is in Zone III (1.576.63), the level of sapling is in Zone I (895.40) and the level of trees is in Zone I (6.881.72). From the results of the analysis, viewed from various parameters, there appears to be a variation of the index between the three zones, except that the most constant is Zone III which is related to the diversity and evenness parameters of the species/evenness. This means that species diversity is strongly supported by a component of evenness rather than a component of species richness. To give a more general view of the vegetation in Bukit Kangin forest, a general analysis was carried out with the results shown in Table 4. From the results of the analysis it appears that H' and H'' obtained by 1.48 and 2.79. This index is included in the low category. The species evenness parameter is 0.73; species richness 3,87; density of 0.06 and dominance of 8.18. Seen from the Shannon-Wiener diversity index category, Bukit Kangin's forest vegetation is included in the low diversity category. It can be concluded that the useful plant species community in Bukit Kangin belongs to the low diversity and evenness component of individual species is a factor that is more influential on the emergence of differences in the value of the index of diversity in the forest vegetation in Bukit Kangin.

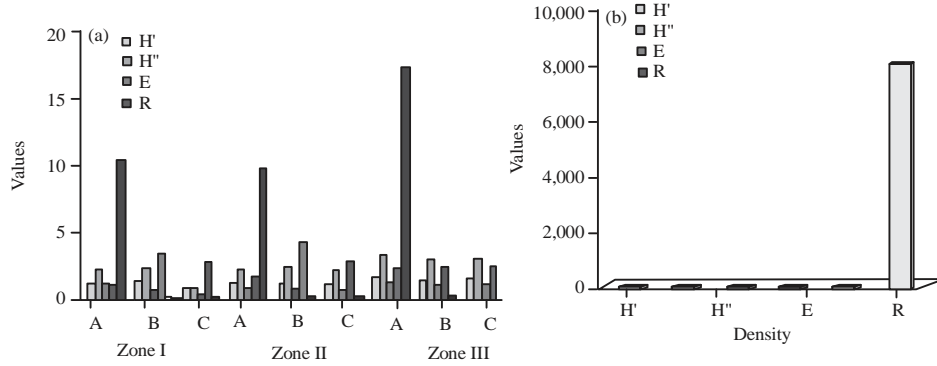


Fig. 5(a, b): Parameters of each zone and Habitus useful plants in Bukit Kangin forest, Tenganan Pegringsingan (A = Seedling, B = Sapling, C = Trees)

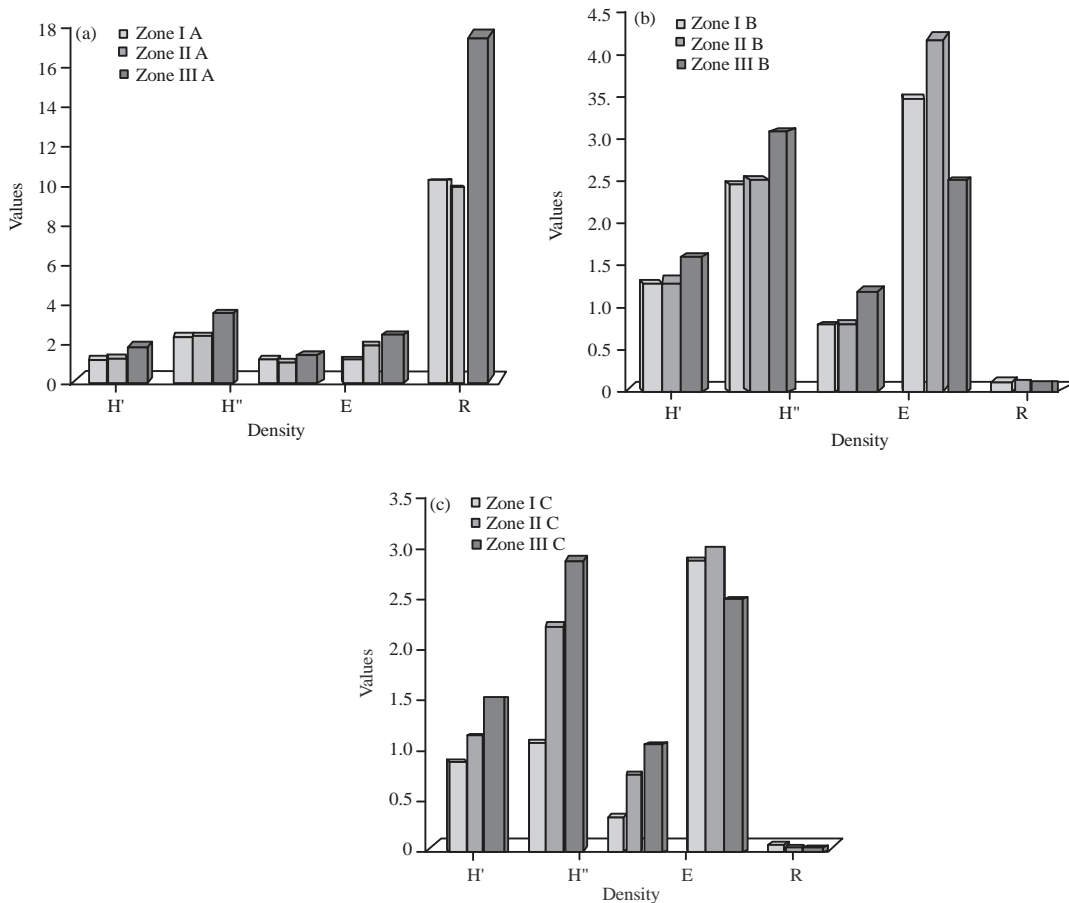


Fig. 6(a-c): Parameters of useful plant based on habitus in each zone

The number of species that comprise the Bukit Kangin forest vegetation in Tenganan Pegringsingan village was 77 species of plants. Of the 77 plant species there were certain species that had a high total number of individuals than the other plant species^[17]. Polunin stated that this condition showed that each species had a certain range of habitats. In each

particular range of environments has certain environmental parameters, both edafic and climatic factors. Every change in the range of environments suits their needs^[18]. Hasanuddin and Safmaneli^[18], stated that different species have different competitive abilities because they have different morphological and physiological characteristics.

The total number of individuals found in the Bukit Kangin forest was 2,574 individuals with the forest area of 32,565 m². Based on the standard criteria from the Minister of Environment in 2004 which stated the criteria for forest density, if in units of area per hectare there are <1,000 trees (<1,000 trees/ha), then the forest can be classified as having a low density. Based on this statement, it can be concluded that the density of plants in the Bukit Kangin research area was relatively low (only 790 trees/ha). Plant density will be closely related to the competition between plants in getting sunlight and nutrients. In terms of nutrient and water competition, high plant density causes higher competition between plants, so, plants often experience nutrient and water shortages. If it is associated with the condition of Bukit Kangin which was classified as low plant density means competition between plants was not too high or low, so, plants would not lack nutrients and water. Thus forest vegetation is always in fertile conditions.

Based on data from all plants in Bukit Kangin, sugar palm trees (*Arenga pinnata Merr.*) were the most dominant plants found with a total of 1.091 individuals. The dominance of a plant species can be seen from the highest number of species; the large diameter of the stem; dominant growth^[19]. Furthermore, Darmawati *et al.*^[20] stated that species that dominates means having a wider environmental range compared to other species, so with a broad range of tolerance to environmental factors cause plant species will have a wide distribution. This is consistent with the conditions on the study field; it appears that sugar palm trees have a wide range or distribution. So, that Bukit Kangin forest of Tenganan Pegringsingan village is called Alas Jaka (arenga forest) by the local community.

Based on data on the composition of the whole plant species in Bukit Kangin, it was recorded 46 species (60%) of the total number of plants which were useful plants for the people of Tenganan Pegringsingan village. This relates to the Tenganan Pegringsingan community who has traditional rules (awig-awig) regarding the use of fairly complex forest products. Awig-awig is a norm that regulates the order of a community's life in Tenganan Pegringsingan village including its relationship with Tri Hita Karana, the concept of harmony philosophy which regulates the relationship between humans and God, humans and humans and humans and their environment, so that, the preservation of the forest can stay sustainable. Local wisdom is not transferred to future generations through formal or non-formal education but through local traditions. The wisdom is loaded with values that become a guide to life, to act and to interact with their environment^[21].

In Indonesia, sugar palm trees (*Arenga pinnata Merr.*) are plants that are found and spread throughout the archipelago, especially in humid hilly areas and grow individually or in groups^[22, 23]. Almost all parts of the palm tree (*Arenga pinnata Merr.*) are useful and can be

used for various needs such as the leaves, stems, fibers, roots, fruit, etc.^[22]. Mr. Kodri (private interview, 2019) as the community leader said that the sugar palm trees (*Arenga pinnata Merr.*) have many uses in Tenganan Pegringsingan such as as a complement to ceremonial means (coblong) used for earrings (sumpeng) for boys and as a roof on buildings. The building that must use palm trees (*Arenga pinnata Merr.*) as its roof is the Sacred Building (Bale Buga) which is in every house and located at the front. The palm tree part (*Arenga pinnata Merr.*) used for the roof is its fibers and is combined with palm leaves at the bottom. This means, palm trees (*Arenga pinnata Merr.*) are useful for the Tenganan Pegringsingan community which is related to the culture that exists in the Tenganan Pegringsingan.

Apart from that sugar palm tree (*Arenga pinnata Merr.*) is also very important for the conservation of land and water. The sugar palm tree is quite ideal for land conservation. Sugar palm trees have fairly dense leaves and full trunks wrapped in palm fiber, so, they can hold rain water that directly falls to the ground, so that, it will reduce soil erosion by rainwater. Then sugar palm (*Arenga pinnata Merr.*) has strong and deep roots and thus will refute the occurrence of abrasion if it is on the edge of a river^[24].

Candlenut (*Aleurites moluccanus Willd*) is used by the Tenganan Pegringsingan community as a natural dye for gringsing cloth (traditional woven cloth). In this case the candlenut plant (*Aleurites moluccanus Willd*) plays a role in giving a yellow color to the gringsing cloth. Utilization of this plant is very important, so, it is very conserved by the local community. Candlenut trees (*Aleurites moluccanus Willd*) are often found in tropical rain climates with rather dry conditions during the dry season. This species thrives in humid tropical regions to an altitude of 1,200 m above sea level^[25].

Muhadiono^[26] stated that diversity of a species community is very dependent on the number of species and the number of individuals found in the community. This is consistent with the statement^[1] Wijana^[1] which stated that species diversity is a combination of the concepts of equity (evenness) and richness of certain species. Sriastuti said that the number of species in a community is called species richness while the evenness of species refers to the number of individuals among species^[27]. Nahlunnisa^[27] added that low evenness value due to species that have a high number of individuals or dominant species and the number of individuals is not the same or uneven. From the statement above, this is consistent with the results of observations that there were dominating species. And for the overall forest vegetation in Bukit Kangin was dominated by species of palm trees (*Arenga pinnata Merr.*) with a total of 1,091 individuals.

Factors that affect species diversity are soil organic matter, soil moisture, soil pH, temperature, humidity and light intensity. The edaphic and climatic factors are one of

the determinants of the survival of organisms that live in and above the ground. Edaphic factors and climatic is a factor related to the physiology of a vegetation. The average value of edaphic factors in Bukit Kangin forest, namely soil organic matter is 2.88%. According to Sarna etc. good soil organic matter for the growth of a plant is 5%. Based on that the content of soil organic matter in Bukit Kangin did not support the growth of vegetation.

The average soil pH value is 6 which include acidic pH. Soil acidity is very influential on the condition of soil composition, good or bad condition of the soil to support plant growth and development. In general, plants need an optimal pH in the range 5-8 to carry out their life activities^[17]. Polunin states that soil pH which is not too acidic and not too alkaline allows all types of plants to grow in that place properly. Soil pH in Bukit Kangin has an average pH of 6 which means that it allows all types of plants to grow well in the area. The value of soil moisture is 29.72%. According to Hardjowigeno^[28], good soil moisture for plant growth is a minimum of 25%. So, the moisture content of the soil can still be said to be very supportive of the growth of useful plants in Bukit Kangin. The average temperature in Bukit Kangin was 29°C. The temperature of an environment affects the growth and development of plants because temperature determines the speed of chemical reactions that include plant life, especially, in the process of respiration and photosynthesis^[29]. According to Wijana and Setiawan^[8] the optimum temperature for photosynthesis ranges from 10°C-30°C. This means that the temperature in the Bukit Kangin forest was included in the good category for growth. Conversely, if the temperature is lower or even higher than the optimum temperature range, then there is a decrease in the rate of photosynthesis in plants.

The average value of the height of the place is 217 masl. Altitude affects changes in air temperature. The higher the existence of a place, the lower the air temperature. It can be said that the temperature of the air becomes colder and vice versa if the lower the location of a place the air temperature will be higher or the air temperature can be said to be hotter. The difference in air temperature caused by differences in this place determines the presence of plant vegetation in an area. Air humidity can affect plant life because it affects the plant's transpiration process. Plants that have a 66-70% humidity mean that these plant species have a wide distribution throughout the forest area. This is consistent with the average humidity in Bukit Kangin which was 70.6%. There are plant species, though that are only able to grow in areas that have certain humidity^[17]. The average value of light intensity is 49 lux. According to Wijana^[4] the intensity of light in an ecosystem varies. The light intensity factor is very influential on plant physiology, especially in physiological photosynthesis. In its effect the light intensity is needed by plants for photosynthesis

activity, following the normal curve, meaning that at a certain time with certain intensity, the rate of photosynthesis takes place in accordance with the magnitude of the received light intensity.

Simple summary: This study was conducted to determine the composition and density of useful plants in the Tenganan village which is one of the Bali Aga (ancient village in Bali). Based on the composition of plant species in the parameters of density that are <1,000 trees/ha, it is deemed important to conduct in-situ revegetation while the conservation of existing plant species is absolutely essential to maintain and use by considering the concept sustainable. The implementation of awig-awig (traditional rules) and the traditional culture of Bali Aga associated with forest conservation are very necessary to be maintained and passed down to the next generation, so that, they do not experience cultural extinction and the extinction of plant species in their ecosystems.

CONCLUSION

From the results of this study it can be concluded: In total there were 77 species of plant species in Bukit Kangin based on the socio-cultural culture of Bali Aga Tenganan Pegringsingan Traditional village, 46 species (60%) of which were useful plants for the local community while 31 species (40%) belonged to unutilized plants (2) There were 31 families consisting of 46 useful plant species with a total number of individual species of 2,249 individuals. The family that had the highest number of individuals was the Arecaceae family. The families with the lowest number of individuals were the Aecaceae, Cucurbitaceae and Lauraceae families. The most useful plant species found were sugar palm trees (*Arenga pinnata* Merr.) (48.51%), bayur (*Pterospermum celebicum* Miq) (8.35%), Pule (*Alstonia scholaris* (L.) R.Br) (6, 44%) and Ata (*Lygodium circinatum* (Burm.) Sw) (3.51%). (3) The diversity index value in the Bukit Kangin forest vegetation was 1.48 (H') or 2.79 (H'') and it was included in the low diversity category. The component of species evenness was greater than the richness species component. This was a factor that is more influential on the emergence of differences in the value of the existing index of diversity in forest vegetation in Bukit Kangin forest. From the conclusions above, it can further be recommended as follows. Based on the composition of plant species in the parameters of density that are <1,000 trees/ha, it is deemed important to conduct in-situ revegetation while the conservation of existing plant species is absolutely essential to maintain and use by considering the concept sustainable. The implementation of awig-awig (traditional rules) and the traditional culture of Bali Aga associated with forest conservation are very

necessary to be maintained and passed down to the next generation, so that, they do not experience cultural extinction and the extinction of plant species in their ecosystems.

Conflicts of interest: This study examines the composition and diversity of useful plant species in the Bukit Kangin forest, Tenganan Pegringsingan in perspective to develop tourism forests in the village area in the future. As it is known that the traditional village of Tenganan Pegringsingan has become a world tourist destination with its cultural attractions which are very well known. In addition, to traditional rural spatial planning following North-South linearity, there is also a well-known culture that exists in the traditional village of Tenganan Pegringsingan which is a ritual culture of war pandanus or Mekare-Kare or megeretpandan. Pandanus war rituals are held as offerings and homage to Indra who is believed to be the God of War. This pandanus war ritual is also held as a tribute to the ancestors. In addition to the existing cultural attractions, the potential of existing vegetation in the Bukit Kangin forest can be designed as a new creative tourism object based on the forest. Forest is also closely related to the local wisdom of the local community in carrying out conservation, traditional use of plant species, the methods used to process and produce a forest product. Useful plant species in the Bukit Kangin forest can be used as clothing, food, shelter, medicines and religious rituals (Hindu) in accordance with the traditions in the village. In this study, the potential of the forest in Tenganan Pegringsingan village was examined through the study of the composition of useful plant species, the diversity of plants that exist to be developed as forest-based creative tourism objects. In the long run, there are additional tourist objects in the traditional village of Tenganan Pegringsingan. In addition, to cultural tourism, there are alternative forest tourism objects that can provide economic added value to the people in the village.

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