# The diversity and function of useful plant species for Bali Aga Community in Bukit Kangin Forest, Tenganan Pegringsingan Village, Karangasem Regency, Bali

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**Abstract**. *One of the villages in Bali that is still running its daily life traditionally is Tenganan Pegringsingan Village. This village is located in Manggis District, Karangasem Regency, Bali Province. The local community is Bali Aga and construct original Balinese Village. There are various plant species in it, some are used traditionally, and there are some plant species that have not been used traditionally. In the meantime, no research has recorded the plant species in the forest, both those that can be used by the local community and those that have not been utilized. The aim of study was to appoint the diversity index and the function of each part of useful plant species in the Bukit Kangin forest of Tenganan Pegringsingan village for the local community. The research method used exploration and interview methods. It showed 77 plant species and percentage of plant functions for the community 46 species about 60% were useful for the local people. The plants used by Bali Aga community for medicinal purposes, traditionally utilized as religious ceremonial material purpose (Hindu), as board materials, as sources food, clothing and industrial materials. Part of the plants that used was root, stem, leaf, seeds, and fruits. According to study of literature useful plant in Bukit Kangin forest have many chemical compound that support the function.*

## INTRODUCTION

Tenganan Pegringsingan Village known as old village that are influenced by the Hindu culture of Pre Majapahit and belongs to the Bali Aga village (Wijana, 2016). The worship of ancestral spirits appears as a fundamental emphasis in the culture of Bali Aga. This Pre-History era cultural aspect was traces of the past. This characteristic can be found in burials common where various stone graves were in sarcophagi form. The Burial system was very regularly known by the Bali Aga people in ancient times (Wijana, 2016).

Tenganan Pegringsingan Village divided into five regions as balinese people called as Banjar, consist of Banjar (1) Tenganan Pegringsingan (2) Gumung (3) Tenganan Dauh Tukad (4) Kangin and (5) Kauh. Tenganan Pegringsingan traditional village formed by: Banjar Kauh, Banjar Tengah, and Banjar Kangin (Banjar Pande). The wide area village is 917 200 hectares, covering 255 840 hectares of paddy fields, uplands of 583 035 hectares, and settlements and social facilities of 78 325 hectares. The village is sorrounded by

Macang Village on North, Bungaya and Asak Villages on East, Pasedahan Village on South, and Ngis Village on West. Tenganan Pegringsingan Village have three hills, there are Bukit Kangin, Bukit Kauh and Bukit Kaja/Kelod (Marla and Rupa, 2007; Sumunar *et al.*, 2017; Kristomo, 2017).

The useful plants grouped into several groups, namely as material: (1) medicine, (2) social activities, (3) religion, (4) food, (5) housing, (6) household eqipment, (7) cosmetics, (8) rigging woven, and (9) clothing. Ornamental plants, aromatics, coloring Agants and as food for livestock were another benefits (Hasanah, 2011). Heyne (1987) stated that the categorization of plant utilization consists of (1) clothing, (2) housing, (3) food, (4) medicines, (5) household needs, and (6) ceremonies religion. Including roots, stems, leaves, flowers, seeds, and fruit. Several species thrive in forest vegetation. This species composition exists in the forest vegetation (Wijana, 2014). Some researchers that research this terrestrial vegetation topic such as Sriastuti (2005); Mirnanto (2009); Wijana and Sumardika (2009); Onrizal (2010); Junaedi *et al.* (2010); Wijana and Setyawan (2017); Wijana and Wesnawa (2018); Wijana *et al.* (2018); Wijana *et al.* (2019). Ethnobotany experiments were done by Wijana (1994); Cotton (1996); Albuquerque *et al.* (2005); Mahendra *et al.* (2011); Haryanti *et al.* (2015).

The diversity concept is a variety of differences between groups. Diversity in ecology refers to species diversity measured by the number of community species and their relative abundance. Species diversity is based on two components, 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 (Wijana, 2016; Wijana, 2014; You *et al.*, 2019; Ludwig and Reynold, 1988; Barbour *et al.*, 1987; Mueller-Dombois and Ellenberg, 1974; Cox, 1976). Based on Molles Jr and Manuel (2008) and Chapin III *et al.* (2002), species diversity is diversity variation of the species, both growing animals and organisms that live in an ecosystem or a certain place.

Species diversity is the known existence found in groups or communities in various species that live in a habitat. According to the description above, this study aims to (1) assign the diversity index of useful plant species that exist in the forest of Tenganan Pegringsingan Village, Karangasem, Bali, (2) Determine each useful plant by functions and each part of the plant (leaf, stem, flower, seed, fruits) that useful for Bali Aga community, (3) observation about how local community used the useful plants in Bukit Kangin for daily activities.

## MATERIALS AND METHODS

### Study Area

Observation conducted in Bali Aga community for interview and exploration held in Bukit Kangin Forest, Tenganan Pegringsingan Village, Manggis District, Karangasem Regency, Bali Province. Tenganan Pegringsingan Village geographically coordinates 8028'38"S and 115033'58"E. The location artificially divided into 3 zone, Zone 1 at the top/in coordinates 8028'29"S-115034'20"E and 8028'48"S-115034'27"E. Zone 2 in the middle coordinates 8028'27"S-115034'9"E and 8028'45"S-115034'34"E, and Zone 3 at the bottom coordinates 8028'32"S-115034'7"E and 8028'21"S-115034'4"E (Figure 1).

### Field Methods and Data Collection

The research methods are divided into two methods. Observation in Bali Aga community and exploration in Bukit Kangin forest. Data was collected in observation by using a questionnaire and observation sheet. The population in the exploration method were all useful plant species in the Bukit Kangin Forest area. Sample collecting by a square of 20x20 m size (tree), 5x5 m (sapling), and 1x1 m (seedling), amount of them is 65 squares, and spread of quadrants at predetermined points. The squares were unfolded in 3 zones on the peak, middle, and bottom of the Bukit Kangin area.

Observations were made to conclude the location, layout, uniformity, and heterogeneity of the Bukit Kangin forest. The tools and materials used in this research were compass, GPS (Global Positioning System), hagameter, soil tester, thermometer for the environment, hygrometer, luxmeter, wooden peg, anemometer, camera, raffia, ovens, altimeter, electric scales, and furnaces. The result from data collecting by using squares showed in Figure 2. Vegetation parameters calculated were density and dominance. Then the data was analyzed about the species diversity index (Wijana, 2016; Wijana, 2014; Ludwig and Reynold, 1988). Each species of the plant also identified part of plants used by the local community and how the processing is so that it can be used. The method collects data by using a questionnaire and observation sheet to the traditional leader and Bali Aga Community. Conducted a literature review to analyze the chemical composition of each plant.
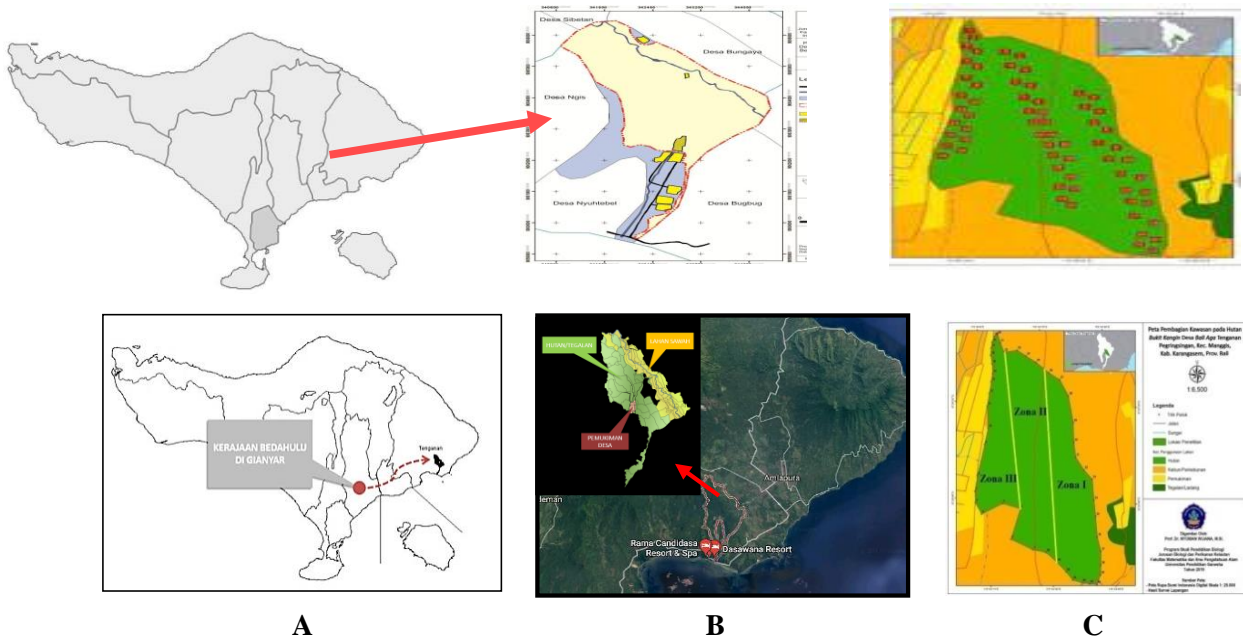


| **A** | **B** | **C** |

Figure 1 Research sites and artificial zones (A= Bali Island, B= Tenganan Pegringsingan Village, C= The Map Research in Bukit kangin devided as 3 zone)

## RESULTS AND DISCUSSION

### The Diversity of Useful Plant Species

This research were collected 77 species of plants from Bukit Kangin. Seventy-seven plant species consist of total 2 574 individual species and are classified into 40 families. Based on field observations, exploration, interviews, and literature study 46 species of them were used in the traditional method and process by Bali Aga. Classified diverse families of plants as a result of collecting various species in Bukit Kangin, Tenganan Village, Pegringsingan, Karangasem are presented in Figure 2.

Thirty one families consisting of about 46 species with a total amount of individu were 2 249 individuals. Arecaceae families have the highest total individual among other families. Aecaceae, Lauraceae, and Cucurbitaceae Families have the lowest amount individual. The most useful plant species found were Ata (*Lygodium circinatum* (Burm.) Sw.) (3.51%), pule (*Alstonia scholaris* (L.) R.Br.) (6.44%), bayur (*Pterospermum celebicum* Miq.) (8.35%), and sugar palm (*Arenga pinnata* Merr) (48.51%). There are 2,574 plants in Bukit Kangin. Based on questionnaire results in Bali Aga as local community, there are 77 species, 46 species (60%) are useful for the local community, while 31 species (40%) are included in plants that are not useful and not used by local communities for social culture.

Figure 2 A) Families with species members and families with individual species members zone 1; B) families with species members and families with individual member species zone 2; C) families with Species Members and families with individual member species zone 3; D) families with species members and families members of species Bukit Kangin vegetation, Tenganan Pegringsingan.

Based on observations results for general vegetation in the Bukit Kangin, it can be seen that the total plant species found were 77 species, 40 families, and the total number of individuals was 2 574 individuals. The forest area is 32 565 m². The Ministry of Environment in 2004 has stated that if the area per hectare of forest is <1 000 trees (<1 000 trees/ha), it can be called having a low density. It can be concluded that the plant density in the Kangin Hill research area is low (only 790 trees/ha). They were zone 1, zone 2, and zone 3. Each zone's data were analyzed, then the general vegetation in Bukit Kangin. The recapitulation results of the calculation of the Diversity Index, Equity, and Richness of useful plant species can be seen in Table 1.

Table 1 The parameters diversity and support data of useful plant in Bukit Kangin

| No | Parameters | Habitus Zone | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Zone 1 | | | Zone 2 | | | Zone 3 | | |
| | | P | Q | R | P | Q | R | P | Q | R |
| 1 | Diversity (H') (%) | 1.19 | 1.29 | 0.90 | 1.19 | 1.33 | 1.15 | 1.79 | 1.62 | 1.53 |
| 2 | Diversity (General Variation) (H") (%) | 2.28 | 2.45 | 1.06 | 2.28 | 2.51 | 2.22 | 3.46 | 3.07 | 2.89 |
| 3 | Eveness (E) (%) | 1.17 | 0.82 | 0.36 | 0.95 | 0.80 | 0.77 | 1.35 | 1.16 | 1.07 |
| 4 | Richness (R) (%) | 1.10 | 3.48 | 2.89 | 1.83 | 4.22 | 3.04 | 2.37 | 2.51 | 2.53 |
| 5 | Density (m²) | 10.41 | 0.11 | 0.06 | 9.83 | 0.08 | 0.03 | 17.56 | 0.09 | 0.03 |
| 6 | Dominance (cm) | 283.75 | 895.4 | 6,881.7 | 623.9 | 314.87 | 1374.67 | 1576.6 | 338.47 | 957.82 |

Note: P= Seedling, Q= Sapling, R= Trees

Table 2 Summary on vegetation parameter index of plant species in Bukit Kangin Forest

| No | Parameters | Index |
|---|---|---|
| 1 | Diversity (H') (%) | 1.4802 |
| 2 | Diversity (General Variation) (H") (%) | 2.7899 |
| 3 | Eveness (E) (%) | 0.7287 |
| 4 | Richness (R) (%) | 3.8722 |
| 5 | Density (m²) | 0.0691 |
| 6 | Dominance (cm) | 8 183.58 |

According to the data in Table 1, Bukit Kangin's largest diversity index value in zone 3 includes seedling, sapling, and trees habitus 3. The highest index level of seedling for richness was in zone 3, the richness of sapling was in zone 2, and richness of trees was in zone 2. The zone with the highest index for the density parameter at the seedling was zone 3, the highest density for the sapling level was in zone 1, and the tree was in zone 1. The highest zone for dominance index at seedling was in zone 3, the highest dominance for sapling was in zone 1, and for trees was in zone 1. The differences in vegetation parameters of the three zones, especially the most constant were zone 3, are very related to the diversity and evenness parameters of species. This means is species diversity is supported by component of evenness than the component of species richness.

For a more general view of the parameters of vegetation in Bukit Kangin forest, a general analysis was added as supplement data shown in Table 2. From the analysis results carried out, 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.

The number of species that comprise the Bukit Kangin 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. Polunin (1990) stated that this condition showed that each species had a specific range of habitats. Each particular range of environments has specific environmental parameters, both edaphic and climatic factors. Every change in the range of environments suits their needs. Hasanuddin and Safmaneli (2012), stated that different species have different competitive abilities because they have different morphological and physiological characteristics.

The total number of individuals found was 2 574 individuals, with a forest area of 32 565 m$^2$. Based on the standard criteria from the Ministry of Environment in 2004, which stated the criteria for forest density, if there are <1 000 trees (<1 000 trees/ha) in units of area per hectare, 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 (Fachrul, 2007). 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 under infertile conditions.

**Useful Plants**

The results of interviews with village heads, balian, banten artisans, craftsmen, and the general public, obtained useful plant data used by the people of the Tenganan Pegeringsingan Traditional Village who are oriented to the socio-culture of Bali Aga, the local village, obtained information for clothing, board, food, medicine religious ceremonies (Hinduism), and crafts. Utilization of useful plants by the people of the Tenganan Pegeringsingan Traditional Village, it can be stated that there are 29 species of plants used as a means of ceremony (35.5%), 18 species of medicine (21.6%), 17 species of food (19.2%), board 14 species (18.9%), clothing 2 species (2.4%), and industrial 2 species (2.4%). Some examples of useful plants, how to process and use them can be seen in Table 3.

Table 3 Some examples of useful plants that are used as materials for clothing, food, boards, religious ceremonies, medicines, and industry

| No | Local Name and Scientific Name | Utilization and Processing Method | Product |
|----|-------------------------------|-----------------------------------|---------|
| 1 | Kepundung (*Baccaurea racemosa*)  | Red dye on Geringsing Fabric, by: 1) the bark of *Baccaurea racemosa* tree is cut into several parts; 2) The pieces of bark are dried in the sun to dry; 3) bark of *Baccaurea racemosa,* which has been dry then milled until smooth; 4) bark of *Baccaurea racemosa* which has become flour is added with water and noni root bark to soak the thread for 3 days, then let stand for 2 months; 5) The process is |  Red geringsing fabric thread |

| No | Local Name and Scientific Name | Utilization and Processing Method | Product |
|---|---|---|---|
| | | repeated 4-5 times until the red color is even and as desired. | |
| 2 | Juwet (Syzygium cumini)  | The ripe fruit can be consumed directly. |  Ripe fruit of Syzygium cumini |
| 3 | White Cempaka (*Michelia alba*)  | This plant is used as a building material for Pura/Temples, *Bale Agung, Bale Banjar, and Bale Buga* (Traditional Buildings). Ways of making: 1) The tree is cut down; 2) *Glodogan* wood is made by removing the branches and bark of the tree; 3) *Glodogan* wood is cut into several pieces so that it becomes wooden blocks; 4) Furthermore, crushed by shaved. |  The temple building uses *Michelia alba* wood |
| 4 | Reeds (*Imperata cylindrica* Beauv)  | This plant is used as a drug to facilitate urine due to gallstones. Processing way: 1) pounding the roots of reeds; 2) Boil pounded grassroots with 2 cups of water which previously added yellow juice and coconut milk (previously coconut made from coconut milk had to be burned first); 3) Let it boil; 4) The boiled water is filtered first and then consumed. |  Loloh / herbal medicine from the roots of Reeds |
| 5 | Pandan medui (*Pandanus tectorius*) (Prickly Pandanus)  | This plant is used for *Mekered* (traditional pandanus war ceremonies) by using several spiky pandan leaves which are then combined and tied using a rope made of Bamboo Tali. *Mekered* is used during mekare-kare (war of sight) ceremonies. |  *Pandanus tectorius* used for *Mekered* |
| 6 | Kemiri (*Aleurites moluccanus* (L.) Willd) (Candlenut)  | This plant is used to blacken Prasi (Painting using palm leaves). Method of processing: 1) The candlenut fruit is burned for 5-10 minutes until all parts are blackened; 2) Rub onto palm leaves using immersion. |  *Prasi* |

The useful plant have many active compound according research from Wulandari *et al.* (2020) Kepundung (*Baccaurea racemosa*) have flavonoids, saponins, tannins, and polyphenols. Extract from the leave can be used as an antioxidant, and antidiabetic Bark of kepundung can be used as natural color for cloth and painting (Dwijendra and Acwin, 2003). Juwet (*Syzgium cumini*) has an active compound in seeds, leaves, stem, roots,

fruit, and flowers. Juwet seeds contain alkaloids, jambosine, jambolin glycosides. Other studies have also reported the presence of flavonoids, phenolics, vitamins, and anthocyanins. The leaves are rich in flavonol glycosides, quercetin, myrcetin, triterpenoids; esterases, galloyl carboxylases, and tannins. The stems have active compounds of betulinic acid, friedelin, epifriedenalol, beta sitosterol, eugenin, and fatty acid esters of epi friedelanol; quercetin, kaempferol, myricetin, gallic acid, ellagic acid; genin, flavonoids, and tannins. Flowers contain of kaempferol, quercetin, myricetin, isoquercetin, myrcetin 3-L-arabinoside, quercetin 3-D-galactoside, dihydromyricetin; oleanolic acid, acetyl oleanolic acid, eugenol triterpenoid A and eugenol triterpenoid B. The roots also have flavonoid glycosides and isorhamnetin 3 o-rutinoside. Fruit of juwet consist of raffinose compounds, glucose, fructose, citric acid, malic acid, gallic acid, anthocyanins (Dewi and Wahyuni, 2018; Wijayanti and Setiawan, 2018).

The flower of Cempaka Putih (*Michelia alba*) contain 0.2% essential oil. Essential oils contain phenol, cineol, eugenol, benzylaldehyde, and phenylethylalcohol. In addition to flowers, all part of cempaka plants contain alkaloids, flavonoids, and saponins. Extract from *Michelia alba* can uses as inhibitor for microbial growth (Swantara *et al*., 2020). Alang-alang (*Imperata cylindrica* Beauv) have active compound such as annitol, glucose, saccharose, malic acid, citric acid, coixol, arundoin, cylindrine, cylindol A, graminone B, imperanene, stigmasterol, campesterol, -siteosterol, fernenol, arborinone, arborinol, isoarborinol, simiarenol, anemonin. That edible as medicinal herb exhibits a wide range of therapeutic potential including immunomodulatory, antibacterial, antitumor, anti-inflammatory, and liver protection activities both in vivo and in vitro (Jung and Shin, 2021).

Pandan medui (*Pandanus tectorius*) consist of flavonoids, saponins, lignin, holocellulose and alpha cellulose, for cellulose content is 83-88% and lignin content is 18-22%. Chemical compound in *P. tectorius* mostly in leaf as essential oil, and the fruit (Zakaria *et al*., 2020). The content of the flesh of the seeds, leaves, and roots of Kemiri (*Aleurites moluccanus* L.) or candlenut contains saponins, flavonoids, and polyphenols, in addition to the flesh of the seeds containing fatty oil, the cortex contains tannins (Sulhatun *et al*., 2020).

Parts of useful plants that are used by the people of the Tenganan Pegeringsingan Traditional Village are based on the socio-culture of Bali Aga, the local village uses various roots, stems, leaves, flowers, fruit or seeds. The parts of plants used by the community of the Tenganan Pegeringsingan Traditional Village based on the socio-culture of the Bali Aga local village are presented in Table 4.

Table 4 Parts of plants utilized by the tenganan pegeringsingan traditional village community

| No | Species | Part of Plants | | | | | |
|---|---|---|---|---|---|---|---|
| | | Rt | St | Lf | Fw | Ft | Sd |
| 1 | Alpukat (*Persea americanda* Mill.) | | | + | | + | |
| 2 | Alang-alang (*Imperata cylindrica* Beauv) | | | + | | | |
| 3 | Asem/Celagi (*Taramindus indica* Linn) | | | | | + | + |
| 4 | Ata (*Lygordium circirnatum*) | | + | | | | |
| 5 | Badung (*Garcinia dulcis* Kurs.) | | | | | + | |
| 6 | Bambu Tali (*Gigantochloa accer*) | | + | + | | | |
| 7 | Bayur (*Pterespermum celebicum*) | + | + | | | | |
| 8 | Belalu (*Hopea celebia*) | | + | | | | |
| 9 | Belalu Bali (*Hepea* sp.) | | + | | | | |
| 10 | Belimbing Buluh (*Averrhoa bilimbi*) | | | + | + | + | |
| 11 | Beringin (*Ficus benyamina*) | | | + | | | |
| 12 | Cempaka Putih (*Michelia alba*) | | + | + | | | |
| 13 | Dauh (*Dracontomelon mangiferum*) | | | + | | | |
| 14 | Durian (*Durio zibetinus* Murr.) | | + | + | | + | |
| 15 | Enau (*Arenga pinata* Merr.) | | | + | + | + | |
| 16 | Gamongan (*Zingiber aromatica*) | + | | | | | |

| No | Species | Rt | St | Lf | Fw | Ft | Sd |
|---|---|---|---|---|---|---|---|
| 17 | Gegirang (*Leea angulata*) | | + | | | | |
| 18 | Ilak-ilak (*Amomum* sp.) | | + | | | | |
| 19 | Jambu Biji (*Syzygium aqueum*) | | | + | | + | |
| 20 | Jangar Ulam (Syzygium polyanthum) | | | + | | | |
| 21 | Jeruk Bali (*Citrus maxima* Merr.) | | | | | + | |
| 22 | Jeruk Lemo (*Citrus amblycarpa*) | | | | | + | |
| 23 | Juwet (*Syzygium cumini*) | | | + | | + | + |
| 24 | Kayu Manis (*Sauropus androgynus*) | | | + | | | |
| 25 | Kelapa (*Cocos nucifera* L.) | | + | + | | + | |
| 26 | Kemiri (*Aleurites moluccanus* (L.) Willd) | | | + | | + | |
| 27 | Kepundung (*Baccaurea racemosa*) | | + | | | + | |
| 28 | Kerasi (*Lantana camara*) | | | + | | | |
| 29 | Kutat (*Planconia valida*) | | + | | | | |
| 30 | Majegau (*Dysoxylum densiflorum*) | | + | | | | |
| 31 | Mangga (*Mangifera indica*) | | + | | | + | |
| 32 | Manggis (*Carcinia mangostana* L.) | | + | + | | + | |
| 33 | Nanas (*Ananas comosus* (L.) Merr.) | | | | | + | |
| 34 | Nangka (*Artocarpus heterophyllus* Lamk) | | + | | | + | |
| 35 | Pakel (*Mangifera foetida* Lour.) | | | + | | | |
| 36 | Pandan medui (*Pandanus tectorius*) | | | + | | | |
| 37 | Pangi (*Pangium eldute*) | | | | | + | |
| 38 | Pinang (*Areca catechu* L.) | | | | | + | |
| 39 | Pisang (*Musa paradisiaca*) | | + | + | + | + | |
| 40 | Pule (*Alstonia scholaris*) | | | + | | | |
| 41 | Pulet (*Urena lobata*) | | | | + | | |
| 42 | Rambutan (*Nephelium lappaceum*) | | | | | + | |
| 43 | Salak (*Salacca endulis* Reinw) | | | + | | + | |
| 44 | Sukun (*Artocarpus altilis*) | | | + | | | |
| 45 | Tabia Bun (*Piper retrofractum* Vahl.) | | | + | | | |
| 46 | Talas/Keladi (*Colocasia esculenta*) | | | + | | | |

Description: Rt= root, St= stem, Lf= leaf, Fw= flowers, Ft= fruit, Sd= seeds

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 1) the highest number of species; 2) the large diameter of the stem; 3) dominant growth Fachrul (2007). Furthermore, Darmawati *et al*. (2016) stated that species that dominate means having a wider environmental range compared to other species. Hence, 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 of distribution. So that Bukit Kangin forest of Tenganan Pegringsingan Village is called Alas Jaka (Arenga Forest) by the local community.

In Indonesia, sugar palm trees are plants that are found and spread throughout the archipelago, especially in humid, hilly areas, and grow individually or in groups Lempang (2012), Alam and Suhartati (2000). Almost all parts of the palm tree are useful and can be used for various needs, such as the leaves, stems, fibers, roots, fruit, etc. (Lempang, 2012). Mr. Kodri (private interview on 2019), as the community leader, said that the sugar palm trees 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 as its roof is the Sacred Building (*Bale Buga*) which is in every house and located at the front. The palm tree part used for the roof is its fibers and is combined with palm leaves at the bottom (Nahlunnisa *et al.*, 2016). This means palm trees are useful for the Tenganan Pegringsingan Community, which is related to the culture in the Tenganan Pegringsingan.

Apart from that, sugar palm tree is also very important for conserving 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 rainwater that directly falls to the ground and reduce soil erosion by rainwater. The sugar palm has strong and deep roots and thus will refute the occurrence of abrasion if it is on the edge of a river (Idris *et al.*, 2020).

Candlenut (*Aleurites moluccanus* (L.) Willd) is used by the Tenganan Pegringsingan Community as a natural dye for gringsing cloth (traditional woven cloth). In this case, the candlenut plant gives a yellow color to the gringsing cloth. The utilization of this plant is very important, so it is very conserved by the local community. Candlenut trees are often found in tropical rain climates, with rather dry conditions during the dry season (Krisnawati *et al.*, 2011). 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 factors related to the physiology of vegetation. The average value of edaphic factors in Bukit Kangin forest, namely soil organic matter, is 2.88%. According to Onemli (2004), that 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 soil composition, good or bad condition of the soil to support plant growth and development. In general, plants need an optimal pH range 5-8 to carry out their life activities (Polunin, 1990). Polunin (1990) 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 allows all kinds of plants to grow well in the area. The value of soil moisture is 29.72%. According to Hardjowigeno (2003), 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 Deshmukh (1992). According to Wijana and Setyawan (2017) the optimum temperature for photosynthesis ranges from 10-30°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, 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 air temperature 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 with 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 can only grow in areas with certain humidity (Sholeh and Djumadi, 2007; Mirmanto, 2009; Hasanuddin and Safmaneli, 2012). The average value of light intensity is 49 lux. According to (Wijana, 2014). 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 a certain intensity, the rate of photosynthesis takes place in accordance with the magnitude of the received light intensity.

The many types of plants used by the community indicate that there is a relationship between culture and community cultivation with plants. The descriptive analytic method is also has done in Talang Mamak Community (Ade and Affandi, 2016). The power of mind is based on the beliefs held by the local community, namely the Hindu Community. One example of using plants for medicinal purposes is identical to the use of plants for religious purposes (Wijana, 2016). This is because treatment efforts are identical to the implementation of religious ceremonies that aim to ask for healing from Ida Sang Hyang Widhi Wasa. In this case, the parts of plants that are generally used for medicinal purposes and religious ceremonies are leaves (32.40%), fruit (30.99%), and flowers (5.64%).

**CONCLUSION**

The results of this study it can be concluded: (1) 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''). Part of plants that were used as religious ceremonial material (Hindu), traditional medicine, food sources, building construction, clothing, and industrial material was stem, leaf, seeds, and fruits. How to used and method to proccess is according to kind of species; (4) The application of *awig-awig* (traditional rules) and the traditional culture of Bali Aga connected with forest conservation are needed to be preserved and bequeth to the next generation and to maintain plant species in their ecosystems.

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