

## ***Bubulcus ibis* (cattle egret) conservation with *awig-awig* (customary law) in Bali, Indonesia**

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**Abstract.** Sudaryanto FX, Hardini J, Kalih LATTWS, Suana IWS. 2022. *Bubulcus ibis* (cattle egret) conservation with *awig-awig* (customary law) in Bali, Indonesia. *Biodiversitas* 23: 1904-1910. The study on the conservation of *Bubulcus ibis* (Linnaeus, 1758) in Petulu Village, Ubud, Bali, Indonesia, was conducted to determine the population dynamics and behavior of *B. ibis* the vegetation used, the conservation efforts by the community, and the benefits to ecotourism. The population of *B. ibis* in August 2019 was  $625 \pm 12$  birds,  $7053 \pm 15$  birds in February 2020, and  $465 \pm 17$  birds in July 2020. In Petulu Village, *B. ibis* breeds from December 2019 to February 2020. The most commonly used tree for nesting was *Ficus subcordata* Bl. Based on in-depth interviews, 100% of the inhabitants of Petulu Village were willing and carried out the conservation of *B. ibis* with *awig-awig*. The tourists who come to Petulu are 100% amazed by the use of *awig-awig* (traditional law) as the *B. ibis* conservation method.

**Keywords:** Bali, breeding, cattle egret ecotourism, Ubud

### **INTRODUCTION**

Petulu Village is one of the tourist villages in Bali, Indonesia with *kokokan* as its specialty, a Balinese name for *Bubulcus ibis* (Linnaeus, 1758) (cattle egret). Since 1965, the village of Petulu has become the habitat of thousands of *B. ibis*. The *B. ibis* who live in trees, found in yards and on the roadside of the village. The people of Petulu Village live side by side and protect the birds. For the persistence of the community for preserving the *B. ibis*, the government of the Republic of Indonesia awarded the Kalpataru Award to Petulu Village in 1990 and 2005 (Noor 1993). Kalpataru is an award given by the government of Indonesia to individuals or groups for their services to the environment.

The success story of Petulu villagers in maintaining *B. ibis* in their village cannot be separated from the existence of *awig-awig* (customary law), which strongly protects the bird. The substance of *awig-awig* includes prohibitions, sanctions, and wisdom values to preserve nature and harmonize the social environment, which is based on the concept of *Tri Hita Karana* (THK). In Hindu religious philosophy, THK contains the understanding that the three causes of prosperity are rooted in the harmonious relationship between humans and their God, their environment, and fellow human beings. The THK is binding to both native and migrant villagers (Yusa and Dharmawan 2018; Sudaryanto et al. 2019b). According to Arjawa and Jayantiari (2017), *Desa Pakraman* (traditional village) is an organization that underlies the life of the

Balinese people. Traditional Villages have the *awig-awig*, the instrument of customary law in a society that must be obeyed by the community, or the norms of customary law institutions, and *awig-awig* does not conflict with human rights under the law of the Unitary State of the Republic of Indonesia, and also international law (Yusa and Dharmawan 2018). *Awig-awig* also guarantees anyone who wanted to carry out small business activities in traditional villages (Resen and Dyatmikawati 2016). The success stories of *awig-awig* to protecting ecosystems and biodiversity are also found in the island of Nusa Penida (Sudaryanto et al. 2019b), Tenganan Village (Sumarmi et al. 2020), and Pandan Selat Banten Village Buleleng (Windari 2019). Similar to *awig-awig* is customary law and taboo in Nigeria (Jimoh et al. 2017).

In addition to the role of *awig-awig*, basic data on population dynamics, population behavior, and habitat profiles are also important to study in the sustainable conservation of *B. ibis*. Population dynamics occur as a result of immigration, emigration, births, and deaths within a population over time. Several studies have been conducted on the population of *B. ibis* in Petulu Village, among others are Noor (1993), and Yuni et al. (2017). Population studies conducted by those scholars are generally very brief and have no long-term impacts on the population dynamics of *B. ibis*. Bird activities, such as flying, finding partners, looking for nesting material, making a nest, incubating, tidying up the nest, and parenting is very important to find out the important stages in bird development. The habitat profile of *B. ibis* can

provide clues about the ideal and most widely used tree species for making nests so that it can be considered as a reference in rehabilitating bird habitats.

## MATERIALS AND METHODS

### Study area

The study was conducted from August 2019 to July 2020 in Petulu Village, Ubud, Bali, Indonesia. Petulu Village is located at 8°28'24" S, 115°16'30" E; 8°30'35" S, 115°16'10" E; 8°35'14" S, 115°16'9" E; 8°29'38" S, 115°16'47" E with an altitude of 200-300 m asl. (meter above sea level). The total area of Petulu Village is about 2.33 km<sup>2</sup> with a population of 6,411 inhabitants. The *B. ibis* nest can be obtained in tree, grown in the yard of villagers' houses, and along the side road of the village, with a length of 1200 m (Figure 1).

### Procedures

#### Population number

The number of *B. ibis* population was carried out by Total Count, using a modified Drive Count and In and Out Count method (Borkowski et al. 2011; Hostetler and Main 2016; Abdullah et al. 2017). Three observers were assigned to four observation sites located in the north, west, south, and east of Petulu Village (Figure 1). Counting was done in the morning between 05:00 and 07:00 when the birds fly out of their nests to look for food. Birds flying towards the observer were counted using a hand counter. Before the birds return to their nests in the afternoon, a count of the birds remaining in the nest was carried out by three observers. The average count of birds remaining in the nest was added with the average count of birds leaving the nest

so that the bird population can be obtained. The number of bird population was calculated every month for a year.

### Behavior

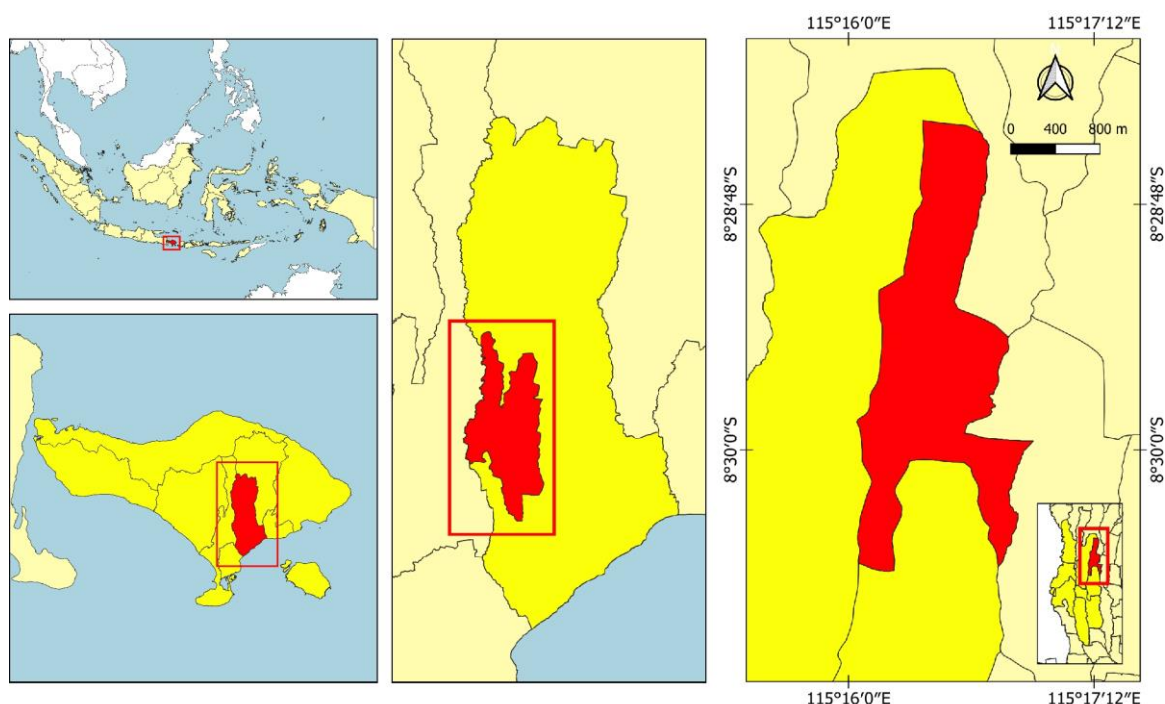
The observed behavior of *B. ibis* was flying, finding partners, looking for nesting material, making a nest, incubating, tidying up the nest, and parenting. Two observers were tasked with recording the behavior of the bird. The behavioral activity of birds were observed with binoculars, using the Scan Sampling method (Aboushiba et al. 2013; Sudaryanto et al. 2020). The observation interval was 10 minutes, starting from 06:00-08:00, 12:00-14:00, and 17:00-18:00. Observations were made once a month for a year.

### Habitat profile

The vegetation profile of *B. ibis* was determined by identifying the tree species, the number of trees, tree height, first branch height, canopy width, canopy thickness, diameter at breast height, and tree position (distance to x and y axes). Tree identification followed Setyawati et al. (2015), Nursa and Andriyani (2021), Wijaya and Defiani (2021). Vegetation profiles were made from the vertical and horizontal structures of the canopy cover (Singh et al. 2015; Sudaryanto et al. 2019a; Sudaryanto et al. 2020).

### The role of awig-awig and ecotourism

The role of awig-awig in the conservation of *B. ibis* in Petulu Village was identified by conducting in-depth interviews with 50 inhabitants of the village. In-depth interviews were also conducted with 15 foreign tourists who visited Petulu Village Ubud (Showkat and Parveen 2017; Young et al. 2018; Sudaryanto et al. 2019b).



**Figure 1.** Petulu Village, Ubud, Bali, Indonesia

### Data analysis

Population dynamics and bird activity was presented in the form of a histogram and analyzed descriptively. Habitat profiles of the vertical and horizontal structures of canopy cover were carried out descriptively by looking at the function of the canopy strata. The role of *awig-awig* for the conservation of *B. ibis* was analyzed using the Likert method (Joshi et al. 2015).

## RESULTS AND DISCUSSION

### Population dynamics

In August 2019, the population of *B. ibis* was recorded at  $625 \pm 12$  birds. The population continued to increase until it reached its peak in February 2020, which was  $7053 \pm 15$  birds. The increased population was caused by the immigration of *B. ibis* to Petulu Village for breeding purposes, as well as the hatching of the juvenile during the bird's reproductive season. After the breeding, the birds began to emigrate from Petulu Village, so the population continued to decline in the following months (Figure 2).

### The behavior of *Bubulcus ibis*

Figure 3 showed the behavior of *B. ibis* in Petulu Village for a year. Every reproductive season, apart from *B. ibis* who live in Petulu Village, other groups of *B. ibis* also come from other areas to Petulu Village to breed. From August to November, the sky in Petulu Village is filled with flying *B. ibis* who immigrated to the village. The *B. ibis* begins to look for partners in the reproductive season. The change in feather color from white to orange is a sign that the bird is entering a reproductive period. Birds that have found a partner, start to collect materials to build their nests. Nesting materials were tree branches where they built the nest in trees, such as *Ficus subcordata* Bl., *Artocarpus heterophyllus* Lamk., *Mangifera indica* L., and *Ficus ampelas* Burm.f. Also, leaves and grasses from rice fields in Petulu Village, such as *Oryza sativa* L., *Panicum respen* L., and *Eleusine indica* (L) Gaertn., were used to build the nest. Some birds took nesting material from other birds' nests on the same tree. The branches are stacked with

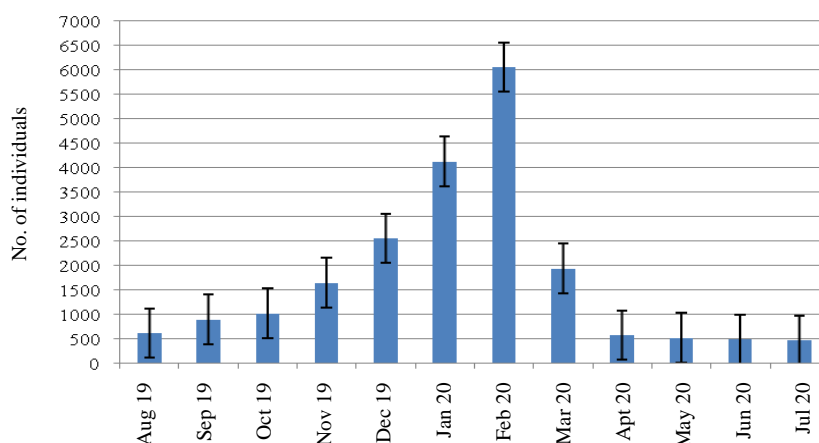
a thickness of between 9-14 cm; and a diameter of 20-35 cm. Nesting took place between 5-10 days which was done alternately by the pair of birds. The nesting activity began in November and reached its peak in December, even in that month it was recorded that several birds have started incubating their eggs. Bird eggs generally amount to three eggs which are incubated alternately. Birds that are not in charge of incubating eggs make repairs or tidy up their nests from the outside. February was the peak of the incubation period. The incubated eggs will hatch within 24 days. The breeding period was 56 days, starting as soon as the eggs hatch until the birds can fly and are expelled by the mother from the nest.

### Habitat profile

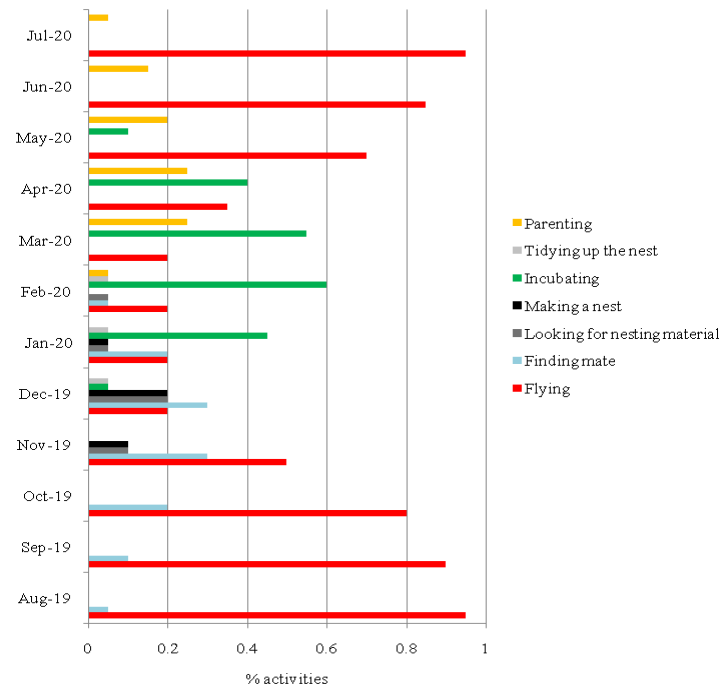
The dominant tree (49%) used by *B. ibis* for nesting was *F. subcordata*. The *B. ibis* was also found nesting in several other tree species as presented in Table 1. The trees used for nesting were generally having tight canopy and in contact with the canopy of other trees (Figure 4). In one tree only, there were 39-54 nests. The nest was between 0.5 and 20 m from the ground. The lowest nests were found in the bamboo clump of *Schizostachyum brachycladum* Kurz., and the highest nests were found in the tree of *F. subcordata*.

**Table 1.** Trees of *Bubulcus ibis* nesting in Petulu Village, Ubud, Bali, Indonesia

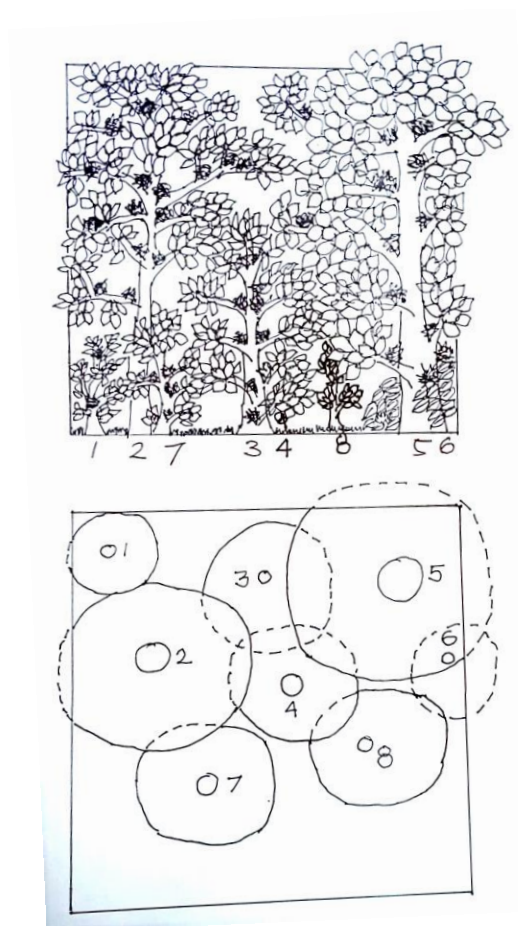
Scientific name	English name	Percentage (%)
<i>Ficus subcordata</i> Bl.	Banyan fig species	49
<i>Mangifera indica</i> L.	Mango	9
<i>Artocarpus heterophyllus</i> Lamk.	Jackfruit	19
<i>Ficus ampelas</i> Burm.f.	Dioecious fig	9
<i>Plumeria alba</i> L.	White Frangipani	2
<i>Magnolia alba</i> F.	White Champaca	2
<i>Cocos nucifera</i> L.	Coconut Tree	3
<i>Tectona grandis</i> L.f.	Teak	5
<i>Punica granatum</i> L.	Pomegranate	1
<i>Schizostachyum brachycladum</i> Kurz.	Sacred Bali bamboo	1



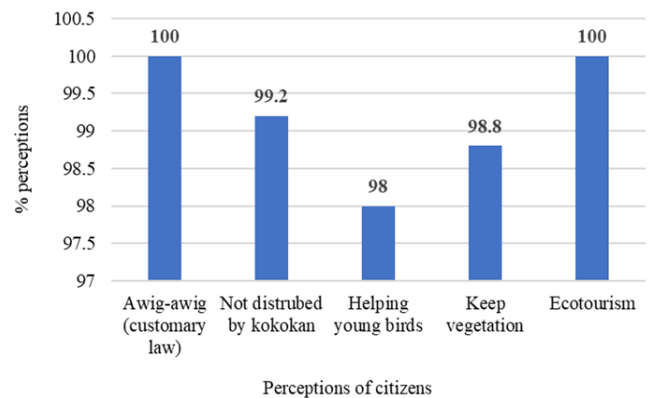
**Figure 2.** Population dynamics of *Bubulcus ibis* in Petulu Village, Ubud, Indonesia



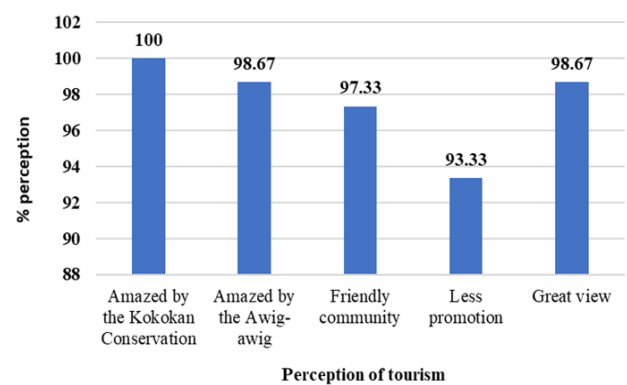
**Figure 3.** Activities of *Bubulcus ibis* in Petulu Village, Ubud, Bali, Indonesia



**Figure 4.** Tree profile of *Bubulcus ibis* nesting site in Petulu Village, Ubud, Bali, Indonesia: 1,4. *Ficus subcordata*; 2,5,8. *Artocarpus heterophyllus*; 3. *Mangifera indica*; 6. *Punica granatum*; 7. *Plumeria alba*



**Figure 5.** Community perception of Petulu villagers, Ubud, Bali, Indonesia towards *Bubulcus ibis* conservation (n=50)



**Figure 6.** Tourists' perceptions to Petulu Village, Ubud, Bali, Indonesia on *Bubulcus ibis* conservation (n=15)

### The role of awig-awig

Based on the interviews with 50 inhabitants of Petulu Village, all respondents (100%) knew and agreed that *B. ibis* was protected by awig-awig (Figure 5). Both native and immigrant inhabitants, should not disturb *B. ibis* in the village. Those who violate were sanctioned by the village apparatus. Only 2% of the villagers were unable to return a *B. ibis* cub that has fallen from the nest. This is because there are about 39-54 nests in one tree, so we do not know which nest the juvenile comes from.

### The role of ecotourism

Based on the interviews with 15 foreign tourists who visited Petulu Village, all respondents (100%) were amazed by the awig-awig that protects the bird. Some of the foreign tourists said that they did not know about the existence of *B. ibis* in the village, this is due to a lack of information and promotion (Figure 6). Before the Covid 19 pandemic, the average of foreign tourists was only 20 visitors per month (Mart 2019), after the pandemic only five visitors per month. Meanwhile, domestic tourists who visit Petulu Village were mostly University students who have the assignment of observing *B. ibis*.

### Discussion

Starting from August to November 2019, *B. ibis* began to immigrate to Petulu Village. The population in August 2019 was  $625 \pm 12$  birds and  $1650 \pm 37$  birds in November 2019. In Petulu village, *B. ibis* began to reproduce from January to February 2020, with the highest population in February 2020, which was  $7053 \pm 15$  birds. Starting from March to July 2020, the birds began to emigrate from Petulu Village, so the population was only  $465 \pm 23$  birds in July 2020. The village of Petulu is a breeding ground for *B. ibis*, because the villagers protect them from human disturbance and predators. This also happened to *B. ibis* in Guerbes-Sanhadja (Algeria) and Faisalabad (Pakistan), which are also breeding grounds that are safe from predators (Abdullah et al. 2017; Metallaoui et al. 2020). In Petulu Village, *B. ibis* had the highest population of  $7053 \pm 15$  birds in the breeding season of December 2019 to March 2020, whereas in 2017, the highest population was only 2774 birds (Yuni et al. 2017). More *B. ibis* likely immigrates to Petulu Village, because there is no disturbance from humans and predators. This is because the villagers own and implement awig-awig that protects *B. ibis*.

### The behavior of Bubulcus ibis

In general, *B. ibis* immigrates to Petulu Village from August to November 2019. For some migratory birds, arriving late at the breeding ground area can find partners, but habitats are of poor quality. This may affect reproductive quality (Gilsenan et al 2020; Max-Planck-Gesellschaft. 2020). During this period, birds begin to look for partners. In Pakistan and India, *B. ibis* in the reproductive season also changes its coat color, and it is used to attract future partners (Abdullah et al. 2017; Manisha et al. 2020).

*Bubulcus ibis* in Petulu Village began to reproduce from January to February 2020. In Pakistan, the reproductive season for *B. ibis* occurs from April (when the rainy season begins) to August (Abdullah et al. 2017), while in India it is from March to August (Uttar Pradesh), April to July (Gujarat), and March to July (Jammu) (Manisha et al. 2020). The reproductive season of birds is influenced by rainfall, in other words, birds will reproduce when the rainy season starts and when rainfall is high, reproductive activity is plenty (Cavalcanti et al. 2016).

In Petulu Village, *B. ibis*, which has found a partner, engaged in mating activities from 07.00 to 17.00, this occurred between October (when the rainy season starts) and November 2019. After that, the couple begins to collect materials to build a nest. For the comparison with the cases in Pakistan and India, the juveniles of *B. ibis* do not hatch together (asynchronously), according to the time they lay eggs about 1-2 days apart (Kour and Sahi 2013; Abdullah et al. 2017). According to Manisha et al. (2020), in the case of India, especially in rural areas, *B. ibis* hatches in June, while in urban areas in August.

### Habitat profile

In Petulu Village, *B. ibis* is mostly nested in *F. subcordata*, *A. heterophyllus*, *F. ampelas*, *M. indica*, and five other tree species (Table 1). A previous study conducted by Yuni et al. (2017) that *B. ibis* only nests in the trees of *A. heterophyllus*, *Magnolia champaca* L., and *F. subcordata*. This happened in 2017 because *F. subcordata* in Petulu Village is still young and smaller than the dominant *A. heterophyllus*. At that time in 2020, *F. subcordata* is getting taller and more dominant (49%) than *A. heterophyllus*. (19%), so *B. ibis* nests are more abundant in *F. subcordata*. According to Kosasih and Subrata (2011), in Yogyakarta, *B. ibis* nests on the trees of *Gnetum gnemon* L., *Cassia siamea* Lamk., *A. heterophyllus*, *Calophyllum inophyllum* L., *Melia azedarach* L., *Antidesma bunius* L., and *Dysoxylum gaudichaudianum* (Juss) Miq. The highest number of nests of *B. ibis* is in *G. gnemon*, because the occurrence of the tree is quite abundant, and the branches are monopodial so that the nests can not be disturbed by the predators, for example monitor lizards (*Varanus salvator* Laurenti, 1768). In Algeria, *B. ibis* mostly nests on the trees of *Salix alba* L. and *Acacia cyanophylla* Lindl. (Metallaoui et al. 2020), *Acacia nilotica* (L.) in the case of India (Dalio 2018), and the trees of *A. nilotica* and *Syzygium cumini* (L.) for the case of Pakistan (Abdullah et al. 2017).

In the village of Petulu, the vegetation is quite dense. Many trees are close together, even overlapping each other. Examples are *M. indica*, *F. subcordata*, *A. heterophyllus*, *Punica granatum* L., *Plumeria alba* L. (Figure 4). This situation makes *B. ibis* comfortable making nests in these trees. The *F. subcordata* is a dominant tree for nesting (49%) (Table 1). For example, the plant species contains 54 nests of *B. ibis*. In general, the trees where the canopies meet have various birds. Apart from being safer for nesting, they also provide a source of food. An example is the Gunung Tilu Nature Reserve, West Java, Indonesia. There are 29 bird species in the canopy area, while in the

sub-canopy, there are only 16 bird species (Partasasmita et al. 2017; Narango et al. 2019). The diversity of tree species supports the diversity of bird species, for example in Surakarta, there are 96 tree species with 50 bird species (Ridwan et al. 2015). van der Hoek et al. (2017) mentioned that there are 1878 bird species (18.1% of birds in the world) that nest in tree cavities. According to Menaa et al. (2016) and Basile et al. (2021), by understanding the relationship between bird communities and forest floristics, we better understand how bird communities tend to change if the composition of tree species changes as a result of climate change or deforestation.

#### *The role of awig-awig*

The *Awig-awig* of Petulu Village is believed can protect *B. ibis* for sustainable conservation, this is also supported by the villagers that can interact well with the bird species. According to Sudaryanto et al. (2019b), this also occurred in the Nusa Penida Islands. On the Island of Nusa Penida, no one disturbs or steals the *Leucopsar rothschildi* Stresemann, 1912 Stresemann, because the *awig-awig* includes, among other things, protection for the *L. rothschildi*. Those who violate *awig-awig* are subject to customary sanctions in the form of monetary fines or even being excommunicated from the community. Tenganan Village of East Bali, and Selat Village of Buleleng District, also have *awig-awig* which contains forest conservation. The *awig-awig* was still being used and considered effective in maintaining the existence and conservation of forests (Windari 2019; Sumarmi et al. 2020). In Nigeria, there is also a culture similar to *awig-awig*. Jimoh et al. (2017) said the culture and value systems of the Oban Sector of Cross River National Park Nigeria, have helped the conservation of flora and fauna, it can be encouraged, strengthened, and replicated for sustainable natural resource management in other places.

#### *The role of ecotourism*

Ecotourism has a positive impact on various business activities in Bali, and alternative tourism has answered market needs which are currently changing their orientation from quantity to quality (Butarbutar and Sumarno 2013; Dianasari and Saputra 2017). An example is ecotourism at Monkey Forest Ubud which is managed by the local community, before the Covid 19 pandemic, there were 3000 visitors per day, but during the pandemic, it is only 100 visitors per day. This is much different from the number of tourists in Petulu Village, which is only 20 visitors per month. According to Choi et al. (2020), it is necessary to develop a marketing strategy, that ecotourism implemented has a low impact on environmental damage, and increases the income of the local community. This strategy has not been implemented yet in Petulu Village (Figure 6). Ernawati et al. (2018) revealed the results of their analysis that the impact of tourism in Ubud for the community is positive.

This study can be concluded that Petulu Village is a breeding ground for *B. ibis*, the reproductive season occurs from December 2019 to February 2020. The number of trees used for nesting are 127 individuals consisting of nine

species, the dominant tree for nesting is *F. subcordata*. One tree can be occupied by 88-138 birds, including 39-54 nests, with a nest height of 0.5-20 meters above ground level. All inhabitants of Petulu Village (100%) agree to protect *B. ibis* by implementing *awig-awig*. All foreign tourists who visited the village admire the customary law of *awig-awig* that protects *B. ibis*.

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