The potential of using wild edible animals as alternative food sources among food-insecure areas in Indonesia

Annis Catur Adi, Dini Ririn Andrias and Qonita Rachmah
Department of Nutrition, Faculty of Public Health, Universitas Airlangga, Surabaya, Indonesia

Received 17 July 2019
Revised 22 August 2019
Accepted 26 August 2019

Abstract

Purpose – This study aims to assess the household food security status and explore the potency of wild edible animals as a food source in the food insecurity–prone area of Bangkalan district, Madura, Indonesia.

Approach/methodology/design – This cross-sectional quantitative study used a mixed-method approach. A total of 66 participants were purposively recruited. Household food security was assessed using the short version of the U.S. Household Food Security Survey Module (US-HFSSM). A list of available wild edible animals was obtained from each interview using a structured questionnaire. For the qualitative study, an in-depth interview was conducted among key informants at subvillage level.

Findings – We found that 33.4 percent of households were food insecure. At least 18 kinds of wild edible animal protein consumed by the respondents were identified in the study area, which consisted of five kinds of insects, five kinds of fish, three types of birds, and two mammals. Most of the wild edible animals were rich in protein.

Originality/value – Wild edible animals can be promoted to support household food security. Villagers did not usually consider consuming wild edible animals as a normal practice as there were concerns about the taste and safety of eating wild animal foods. Methods of processing and cooking foods to improve the taste and safety aspects need to be explored. The information obtained from this study adds more evidence related to the potential of edible wild animals as a food alternative for households in food-insecure areas.

Keywords Wild edible animals, Alternative food sources, Food insecure areas, Indonesia

Paper type Research paper

Introduction

Household food insecurity is a critical issue as it can affect the nutritional status of each individual in the household. Moreover, optimum nutritional status is required for the foundation of healthy human development[1]. In accordance with national data, there has been an escalation of Indonesian people living in poverty rising from 11.07 percent to 14.47 percent[2]. Specifically, the Indonesian food insecurity atlas showed that all districts in Madura Island were included in a list of prioritized districts for provincial food security programs due to their insecurity status[3]. One of the underlying causes of food insecurity in Madura Island is poverty which limits the economic access to food sources. In the context of food insecurity, collecting wild foods can be a form of coping strategies to increase physical

The authors would like to thank the Faculty of Public Health, Universitas Airlangga for funding this research, the enumerators, and the participants in the study.

The authors declare that there is no conflict of interest in this study.

Journal of Health Research
Vol. 34 No. 3, 2020
pp. 247-257
Emerald Publishing Limited
e-ISSN: 2586-940X
p-ISSN: 0857-4421
DOI 10.1108/JHR-07-2019-0156

access to food. The Food and Agricultural Organization (FAO) defined wild foods as plants (including roots and tubers, leaves, vegetables, and fruits) and animals (including insects, amphibians, reptiles, birds, and mammals) which were not cultivated or reared, are underutilized, and are gathered for food[4].

Some wild and underutilized foods are a good source of vitamins, and some of them even have a higher vitamin and mineral content than cultivated plants[5-9]. Wild foods have been a significant contributor to household food security through two general pathways, by providing direct access to food and nutrients and by helping increase economic capability by selling the wild foods, which may then increase the household economic access to other foods. In southern Ethiopia, a study found that income earned from selling wild foods contributed significantly to fulfill the basic needs of poor households[10]. Similarly, in Amhara, Ethiopia, where seasonal food crises are common, the availability of wild fruits helps the community to fulfill their nutritional needs and also gives the potential for sale[11]. However, wild foods are usually considered as inferior food. In southern Sudan where giving prestigious foods to guests is common, sorghum (*Sorghum bicolor*) was given to male guests because it is considered more prestigious, whereas wild foods were given to women and children[12].

Unlike wild edible plants that have been documented largely in many studies, studies on wild edible animals are quite limited. Among edible animals explored in the previous studies, insects were most commonly studied[13-15]. Nowadays, insects are promoted as a real animal protein alternative and have been perceived as environmentally beneficial compared to poultry and livestock[16]. Other research studies in Bangladesh found wild animal foods obtained from freshwater an important part of the poor community's diet. Small fishes, of less than 10 cms, and consumed with their bones, significantly contribute to calcium intake[17]. To our knowledge, there is very little evidence showing the utility of wild edible animals in Indonesia. Some villagers recognized the use of wild animals by their elders; however, the practice was not much used in recent times. The poor in low-income households in the food-insecure areas in Indonesia constantly needed any available sources of protein for their daily consumption. Therefore, wild edible animals are an obvious and sensible choice and sometimes a preferable one, as well. This study aims to observe the level of household food insecurity and the possibility of adding wild edible animals to the diet alongside assessing the nutrient and bioactive components of them.

Methodology

Setting

This *cross-sectional* study was completed in Bangkalan district, located in the western part of Madura Island, East Java Province, Indonesia (Figure 1). Bangkalan district was purposively selected by considering the highest number of poor households and the possibility of gathering wild edible animals. Two villages, namely, Blega village and Geger village, were randomly selected.

Figure 1.
Bangkalan district, located in the western part of Madura Island, East Java Province, Indonesia

Sampling and data collection

This study used a mixed-method approach to collect the data. Quantitative research was conducted to assess household characteristics, food security levels, and lists of available wild edible animals. Household food security status was assessed by using a short version of the U.S. Household Food Security Survey Module (US-HFSSM) which was translated into the Indonesian language. A total of 66 households from two selected villages, *Blega* village and *Geger* village in Bangkalan district, were randomly chosen for quantitative research. Interviews were carried out by trained enumerators with a nutrition background. In addition, a qualitative study was conducted using an in-depth interview with key informants including two village chiefs, two farmer group leaders, and two food security agency staff helpers at the subdistrict level.

Data management and analysis

Quantitative data were checked for their completeness, and then univariate analysis was performed for each variable. Quantitative data collected in this study included household characteristics (household members, number of children, age of household head, educational background, occupation, and household income), household food security status, and coping strategies for food insecurity. Qualitative data were assessed through in-depth interviews in the form of recordings and images. In-depth interviews were carried out by a researcher using both the Madura and Indonesian languages and then transcribed into English. Before presenting the data, researchers double-checked for a non-English recording and an English version of the transcript. Transcription was then analyzed for the experience, practice, and potency of eating wild edible animals.

Ethical consideration

This study was ethically approved by the Health Research Ethics Committee, Faculty of Public Health, Universitas Airlangga (IRB number: 303-KEPK). Informed consent was obtained from all participants before the study was conducted.

Results

Household characteristics

The majority of the households were a typical nuclear family consisting of a parent with their dependent children with an average of two from the median number of 4 (2–8). The mean age of the household head was 47.9 ± 15.3 years, and that of the spouse was 43.7 ± 13.1 years. Most household heads had a low educational background, 29.7 percent graduated from elementary school, 18.8 percent did not attend any formal education, and 15.6 percent did not finish elementary school. Most household heads worked as farmers/fish farmers (37.5 percent) and casual laborers (25.0 percent) with a median income of Indonesian Rupiah (IDR) 395.000 (IDR 39.000 – 2.225.000) per capita per month, equal to USD 27.24 (USD 2.7–153.5). Table I shows the results of household characteristics.

There was no significant difference in household characteristics between households in Blega and Geger villages. However, the median household income was slightly higher in Blega than in Geger, which was probably influenced by the education levels of the household head which was slightly higher in Blega than in Geger, suggesting that better education enables the household head to obtain a better occupation and salary.

Food security and coping strategy

Food security assessments using the US-HFSSM instrument found that 33.4 percent of households were food insecure (Table II). The prevalence of household food insecurity found

Characteristics	Village		
	Blega (n = 31)	Geger (n = 35)	Total (N = 66)
Household member, *median (min–max)*	4 (2–7)	4 (2–8)	4 (2–8)
Number of children, *median (min–max)*	2 (0–5)	2 (0–5)	2 (0–5)
Age of the household head, *mean ± SD* (years)	47.8 ± 10.7	47.9 ± 18.5	47.9 ± 15.3
Education of the household head, n (%)			
Not attended formal education	2 (6.5)	10 (30.3)	12 (18,8)
Elementary school (not graduated)	4 (12.9)	6 (18.2)	10 (15.6)
Elementary school (graduated)	9 (29.0)	10 (30.3)	19 (29.7)
Junior high school	2 (6.5)	2 (6.1)	4 (6.2)
Senior high school	8 (25.8)	4 (12.1)	12 (18.8)
University	5 (16.1)	1 (3.0)	6 (9.4)
Occupation of the household head, n (%)			
Unemployed	0 (0.0)	2 (6.0)	2 (3.2)
Farmer/ fish farmer	7 (22.6)	17 (51.5)	24 (37.5)
Small-scale entrepreneur	3 (9.7)	2 (6.1)	5 (7.8)
Government employee	4 (12.9)	1 (3.0)	5 (7.8)
Private employee	8 (25.8)	1 (3.0)	9 (14.1)
Casual labourer	8 (25.8)	8 (24.2)	16 (25.0)
Others	1 (3.2)	2 (6.1)	3 (4.7)
Household income, *IDR/capita/month, median (min-max)*	625.000 (260.500–2.225.000)	300.000 (39.000–1.010.000)	395.000 (39.000–2.225.000)

Table I. Household characteristics

Variables	Village		
	Blega (n = 31)	Geger (n = 35)	Total (N = 66)
Household food security status, n (%)			
Food secure	24 (77.4)	420 (57.1)	44 (66.7)
Food insecure without hunger	4 (12.9)	13 (37.1)	17 (25.8)
Food insecure with hunger	3 (9.7)	2 (5.7)	5 (7.6)

Table II. Household food security status

in other studies and in other areas in Indonesia was varied. During the economic crisis of 1999, only 20 percent of households in Java Province were food secure while 80 percent were food insecure[12]. The latest reports showed that 58 of 398 rural districts in Indonesia were food insecure[13]. Furthermore, compared to other districts in East Java Province, Bangkalan was the second highest district, where the percentage of the population have lived below the poverty line since 2012–2013 (24.70 percent and 23.23 percent, respectively)[14]. It might explain the higher percentage of households that are vulnerable to food security. While an analysis by Usfar *et al.*[15] in two rural areas and four urban areas in Indonesia found that only 23 percent of urban households and 16 percent of rural households were food secure, a report from the Food Security Agency of East Java Province in 2016 showed that 27.16 percent of households were vulnerable to food insecurity and 12.69 percent of households were food insecure[16]. The variation of food insecurity prevalence among various studies is probably influenced by the different instruments used to assess the household food security status and the time frame of the study.

Figure 2 showed that in each village, the coping strategy used was different. In Blega, most of the food-insecure households prefer to buy cheaper but less preferred foods (36.3 percent), whereas in Geger, they prefer to borrow food (42.8 percent). During periods of

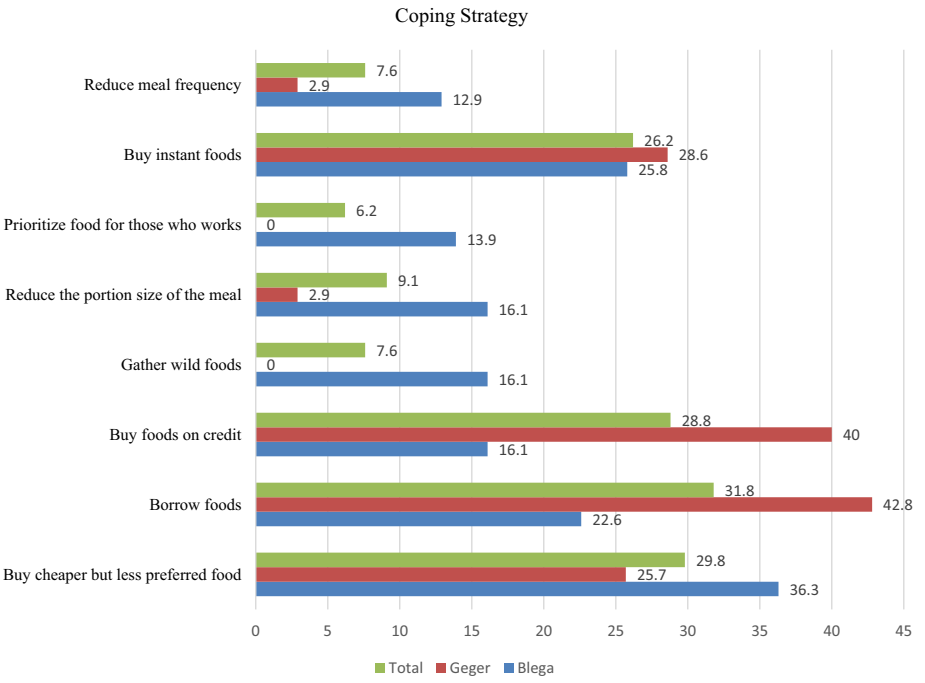

Figure 2.
Coping strategies used by households in Bangkalan district, Madura island, Indonesia ($N = 66$)

food insecurity, collecting and consuming wild foods can be used as one of the alternative strategies particularly if economic access to foods is an issue. However, this study found that only 7.6 percent of households collected wild foods as a coping strategy during periods of food insecurity. Even in Geger village, which was found to be more food insecure, there were no households that gathered wild foods during food insecurity periods.

During times of food insecurity and with limited resources, consumption of animal source foods which are usually more expensive than plant source foods is often reduced. Wild edible animals may provide an alternative source of animal protein. During the study, we identified 18 kinds of wild edible animals that had been consumed by the respondents in the study area, which consisted of five kinds of insects, eight kinds of fish and other freshwater species, one amphibian, one reptile, and three kinds of bird (Table III).

Among those wild edible animals, the most acceptable wild edible animals were from the fish and other freshwater animal groups due to the taste and ease of cooking. Fish was usually fried and was consumed as a side dish with rice and Indonesian chilly sauces (*sambal*). One nutritionist from the Public Health Center said

> "Koncil fish (Channa striata) was available in several places, however, some people said it can electrocute and could be dangerous. Thus, it becomes inedible." (NI, 35 years old)

> "Most fishes eaten in Geger area are sea fish that are sold by food vendors every day, so we rarely consume freshwater fishes." (MW, 46 years old)

Other than fish, some kinds of edible insects were also consumed but not as much as fish. Some respondents said that they did not consume insects because they were afraid of allergic reactions.

Wild edible animal	Group	Method of cooking	Seasonal availability	Protein content (per 100 g)
Young bee/bee larvae, consumed with the nest (*Apis aculate*)	Insect	Mix with grated young coconut, seasoned, wrapped in banana leaf and steamed (*botok*)	Seasonal	15.0 g
Grasshopper (*Melanoplus cinereus*)	Insect	-Fried -Roasted	Seasonal	23.6 g
White ants (*Isoptera*)	Insect	-Fried -Mix with grated young coconut, seasoned, wrapped in banana leaf and steamed (*botok*)	Seasonal	18.2 g
Young cricket (*Gryllus sp*)	Insect	Fried	Seasonal	23.6 g
Weaver ants (the queen and egg) (*Oecophylla*)	Insect	Mix with grated young coconut, seasoned, wrapped in banana leaf and steamed (*botok*)	Seasonal	53.3 g (dry)
Marsh gourami/*sepat* fish (*Trichogaster trichopterus*)	Fish	Fried	Seasonal	15.2 g
Catfish/*Keting* fish (*Mystus nigriceps*)	Fish	Fried	Seasonal	14.8 g
Common snakehead/ *Koncil/Kutuk/Gabus* fish (*Channa striata*)	Fish	Fried	Seasonal	16.2 g
Common barb/*Wader* fish (*Barbus binotatus*)	Fish	Fried	All-season	19.0 g
Eel/*belut* (*Monopterus albus*)	Fish	Fried	All-season	14.6 g
Water snails/*Kreco/Tutut* (*Bellamya javanica*)	Freshwater species	-Boiled -Roasted (satay)	Seasonal	11.8 g
Small freshwater crabs/ *yuyu* (*Paratelphusa maculata*)	Freshwater species	-Boiled -Mashed, mixed with grated young coconut, seasoned, wrapped in banana leaf and steamed (*botok*)	All-season	16.9 g
Freshwater shells/*Remis* (*Corbicula javanica*)	Freshwater species	-Boiled -Sauteed	Seasonal	14.3 g
Green frog (*Rana esculenta*)	Amphibian	Fried	Seasonal	16.4 g
Monitor lizard/*biawak* (*Varanus nebulosus*)	Reptile	Boiled and mixed with coconut milk (as a soup)	All-season	26.8 g
Bu'/Tupai (*Scandentia*)	Mammals	Stir-fried, cooked with coconut milk, satay	Undefined	21.4 g
Weasel/*Musang* (*Paradoxurus hermaphroditus*)	Mammals	Stir-fried, satay	Undefined	–
Spotted dove/ *tekukur* (*Streptopelia chinensis*)	Birds	Fried	All-season (but rare)	28.1 g
Forest chicken (*Gallus varius*)	Birds	-Fried -Roasted -Boiled and mixed with coconut milk (as a soup)	All-season (but rare)	26.9 g
Wild bustard/*Gemak* (*Turnix suscitator atrogularis)*	Birds	Fried	All-season (but rare)	28.1 g

Table III.
Wild edible animals in Blega, Bangkalan District, Madura

> "Some insects could cause itchy skin, including sarang tawon (Apis aculate), laron / White ants (Isoptera), and jangkrik / grasshopper (Melanoplus cinereus)." (MA, 55 years old)

Green frogs and monitor lizards were consumed only by certain people. Frogs were not culturally acceptable in the study area because the majority of the villagers were Muslims, and frogs were considered as *Haram* food (foods that should not be consumed due to religious reasons). Monitor lizards (*biawak*) were commonly considered as extreme foods, with some believing that consuming the meat of a monitor lizard would help a man's virility. Some mammals were believed to work as a medicine for itchy skin, so they are still consumed by some people.

> "I don't know if it's true or not, but some men believe that consuming lizards can be beneficial for man's virility." (SP, 50 years old)

> "Tupai/Bu' (Scandentia) and Musang (Paradoxurus hermaphroditus) usually used as a traditional medicine to heal itchy skin, and it is safe for children. However, the taste was not too delicious, that is why we don't really consume it." (SG, 48 years old)

Most of the wild edible animals were rich in protein. Identified using the Indonesian food composition data, the minimum protein content of edible wild animals was 11.8 grams found in small catfish (*Keting*) and the highest protein content was found in *weaver ants*. Fish and other freshwater animals contain approximately 12–24 grams of protein per 100 grams. Fish, mainly small fish, are usually also rich in calcium and other micronutrients. However, most of those edible wild animals have seasonal availability. Freshwater fish, for example, can be found during the rainy season or around harvesting season, whereas birds are rare all year. This seasonality issue was raised by the respondents (9.1 percent) as one of the reasons behind the low utilization of those wild edible animals for daily consumption. The other reasons for not consuming edible wild animals included being less tasty than regular food (21.2 percent), not sure of its safety (15.2 percent), and the availability of substitutes, e.g., conventional foodstuffs (19.7 percent). Even though the utilization was quite low, most of the respondents (85.9 percent) did not consider consuming wild edible animals to be a strange practice.

Discussion

Food security can be defined as "W*hen all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life*". Household food security emphasizes three basic elements, food availability, food access, and food utilization. Availability refers to adequate food for every person living in a specific area. Access means ensuring that everyone has sufficient resources to obtain foodstuffs (through production, purchase, or donation), and utilization means the use of food for human metabolism[17]. The FAO in 2008 added one more dimension of food security besides availability, access, and utilization, namely, that of stability. Stability means that adequate food availability and access should be maintained in difficult times such as times of natural disasters, political upheaval, or economic instability that causes food instability[18].

Household food security is also related to coping strategies which can be defined as strategies adopted by households in response to food shortages[19]. Coping strategies differ between households in food-insecure areas. A study of rural households of the Magway district of Myanmar, an agrarian rice-producing region, found the number of food-insecure persons was at 60.8 percent (87.5 percent in landless persons and 47.5 percent in farm household). One coping strategy adopted by food-insecure households was to borrow rice (or take advance rice or wages) from the shop or farmers, and another strategy was to eat low-quality rice; children were taken out from school to earn money for food; several

households migrated to overcome food insecurity; and finally, families would sell their productive assets[20]. A study in Sumenep, a northern part of Madura Island, Indonesia, describes several coping strategies used by households to survive. These included borrowing food or relying on the help of neighbors/friends, eating unpopular foods, limiting adults' food, and reducing the frequency of daily meals[21].

Another study among indigenous communities of *Sierra Tarahumara* in Mexico found that skipping meals was the most frequent coping strategy (56.10 percent), followed by restricted consumption by adults so that small children can eat (52.85 percent) and limited portion size at mealtimes (49.59 percent). This study also found that 5.69 percent of the households would gather wild food, hunt, or harvest immature crops while they faced food insecurity[22]. Supporting our results, a study in rural households in upland areas, Sekong province in Laos, found that gathering wild foods was the most common coping strategy used by households. At least 97 percent of the households collected wild food, which was not usually sold. Several wild foods gathered by the households included edible insects, wildlife (wild pigs and small fishes), wild tubers, wild mushrooms, leafy vegetables, and bamboo shoots[23]. We also found in our study that 7.6 percent of households collected wild foods as a coping strategy for their food insecurity situation. The most used coping strategy was buying cheaper but not first-choice food.

As noted earlier, a number of potential animal group food sources are used (Table III). Edible insects represent a rich source of protein for the improvement of human diets, especially for individuals suffering from poor nutrition because of protein deficiency[24]. Based on the interview results, among all of the edible insects, young bees' nests, young crickets, and weaver ant's eggs were the preferred insects, followed by grasshoppers and white ants even though they could cause an allergic reaction to those having hyper allergens. One of the reasons for the popularity is that young bees' nests, young crickets, and weaver ants' egg looks 'invisible' although eaten compared to grasshoppers and white ants. In addition, in the study area, white ants were more commonly used as animal feed. The practice of eating insects, also known as entomophagy, is common in Asia, Africa, and South America. A study proved that insects are rich in not only protein but also fats, essential amino acids, unsaturated fatty acids, as well as micronutrients such as zinc, magnesium, copper, iron, selenium, phosphorus, manganese, vitamin A, vitamin C, vitamin E, and thiamin[25]. Since 1997, thousands of insects have been widely observed as being edible; Young-Aree and Viwatpanich in 2005[26] reported 164 species in Laos, Myanmar, Thailand, and Vietnam, while a higher number of edible insects (549) were observed in Mexico. There was no report identified in Indonesia related to edible insects. Therefore, this study can be used as a contributor for further research. Although there are nutritional benefits from eating insects, there can be some dangers. According to Belluco, *et al.*[27], due to the high nutrient content in insects, they can be a good medium for pathogens such as *Salmonella, Camphylobacter, and Enterobacteriae* that can endanger human health. However, good storage and cooking methods can eliminate these issues.

Other than insects, fish and water-based animal foods are also used as wild edible animals in the Bangkalan district. Almost all fishes and freshwater life were preferred by the respondents but differed in seasonal availability. Marsh gourami/*sepat fish*, catfish/*Keting fish*, common snakehead/*Koncil/Kutuk/Gabus fish*, water snails/*Kreco/Tutut,* and freshwater shells/*Remis* (Corbicula javanica) were only available in the rainy season, whereas common barb/*Wader fish*, Eel/*belut*, and small freshwater crabs/*yuyu* are available in any season. Seasonal avilability affected the consumption among respondents. According to Focus Group Discussion (FGD), some of the respondents believed that the Common snakehead/*Koncil/Kutuk/Gabus fish* could electrocute them. In fact, it is a food taboo that is not true. The common snakehead does not cause electrocution; however, its shape does look like the electric catfish (*Malapteruridae*) that can cause electrocution.

Education of the differences might be beneficial to help increase edible wild fish consumption. Fish is a major source of protein, and some fish species contain omega-3 fatty acids that are essential for growth and development and play an important role in the prevention and treatment of noncommunicable diseases. Fish is also high in protein as a portion of fish (50 grams) contains 10 grams of protein.

Compared to insects and water animals, the other groups of edible animals (mammals, reptiles, and birds) are consumed less frequently because they are harder to find. Some respondents said that they have to hunt in the forest to find those wild animals. Some of them also said they hunted animals if required for medical reasons. For example, *Tupai/Bu'* (*Scandentia*) and *Musang* (*Paradoxurus hermaphroditus*) are consumed as a traditional medicine to treat allergies (itchy skin). However, there is no previous scientific study to explain any benefits.

Food culture is an important factor that influences the acceptance of food in a community. Food will be more easily accepted if it follows the concepts believed by the community regarding what is considered "edible"[19]. Taste and safety are two factors that can be improved to promote the utilization of edible wild animals, mainly in food-insecure households. Ahmed and Lorica[28] stated that increasing the utilization of animal foods is a potential way to improve household food security status, and according to Bouis[29], this potency can be achieved through three pathways: (1) adoption–income linkages, which is the potential to increase income from selling the wild edible animals, which can impact the improvement of nonstaple food consumption because these kinds of food are still elastic to income; (2) adoption–employment linkages, which are collecting wild edible animals as an alternative productive activity (employment), which may result in the capability of obtaining an income; (3) adoption–consumption linkages, which is direct access for household consumption.

There were several issues that could arise with the practice of consuming wild edible animals. For example, if the wild animals became an endangered species, then hunting and poaching become illegal. Also, there will be issues of zoonotic disease increase due to an increase in wild animal consumption. Based on our observations, none of these issues were raised in this study area. The Indonesian Ministry of Environment and Forestry under rule No P.20/MENLHK/SETJEN/KUM.1/6/2018 mentioned the type of plants and animals that are protected by the state, and none of the wild animals found in this study were included[30]. Similarly, the risk of zoonotic transmission was not found in our selection of wild edible animals. Cantlay, *et al.*[31] stated that potential zoonotic viral pathogens from wildlife mostly came from wild animals under the family of *Suidae, Cervidae, Sciuridae, Viverridae, Caprinae, Pteropodidae, Hystricidae, Ursidae, Cercopithecidae, Felidae, Manidae, Elephantidae, Squamata, Testudines, Crocodylia,* and *Galliformes*. Besides, based on our analysis, there were no reports of infection caused by the practice of consuming wild animals.

Conclusions

In food insecurity–prone areas, consuming wild edible animals can be useful as a coping strategy. However, this study shows that the practice of consuming wild edible animals was still low due to several reasons such as seasonal availability, taste, safety, poor information regarding proper cooking methods, nutrient content, health benefits, as well as religious beliefs and aversion to "weird" practices. Based on our analysis, we conclude that several animals were available throughout the year that are rich in protein and easy to cook, i.e., common barb, eel, small freshwater crabs and snails. Promoting the practice of consuming wild edible animals is now required to increase the awareness of this useful practice.

References

1. Chhikara N, Devi HR, Jaglan S, Sharma P, Gupta P, Panghal, A. Bioactive compounds, food applications and health benefits of Parkia speciosa (stinky beans): a review. Agriculture and food security 2018; 7(1): 46.
2. Indonesia Ministry of National Development Planning. National Action Plan for Food and Nutrition Action Plan Year 2011-2015. Jakarta: Ministry; 2011.
3. Government of East Java. Provincial Action Plan for Food and Nutrition: East Java Year 2011-2015. East Java: Government of East Java; 2011.
4. Food and Agriculture Organization [FAO]. Use and Potential of Wild Plants in Farm Households. Rome: FAO; 1999.
5. Grosskinsky B, Gullick C. Potential of indigenous food plants to support and strengthen livelihoods in Southern Sudan. The Potential of Indigenous Wild Foods Workshop Proceedings, 22-26 January 2001.USAID/OFDA; 2001.
6. Cruz-Garcia, Price L. Ethnobotanical investigation of 'wild' food plants used by rice farmers in Kalasin, Northeast Thailand. J Ethnobiol Ethnomed. 2011; 7: 33.
7. Imran M, Talpur FN, Jan MI, Khan A, Khan I. Analysis of nutritional components of some wild edible plants. J Chem Soc Pak. 2007; 27(5): 500-8.
8. Ogle BM, Johansson M, Tuyet HT, Johansson L. 2001. Evaluation of the significance of dietary folate from wild vegetables in Vietnam. Asia Pac J Clin Nutr. 2001; 10(3): 216-21.
9. Chhikara N, Kaur R, Jaglan S, Sharma P, Gat Y, Panghal A. Bioactive compounds and pharmacological and food applications of Syzygium cumini–a review. Food Funct. 2018 Dec 13; 9(12): 6096-115.
10. Irawan D, Wijaya H, Limin SH, Hashidoko Y, Osaki M, Kulu IP. Ethnobotanical study and nutrient potency of local traditional vegetables in Central Kalimantan. Tropics. 2006; 15(4): 441-8.
11. Fentahun MT, Hager H. Exploiting locally available resources for food and nutritional security enhancement: wild fruits diversity, potential and state of exploitation in the Amhara region of Ethiopia. Food Sec. 2009; 1: 207-19.
12. Studdert LJ, Frongillo Jr EA, Valois, P. Household food insecurity was prevalent in Java during Indonesia's economic crisis. J Nutr. 2001 Oct; 131(10): 2685-91.
13. World Food Programme [WFP]. WFP Indonesia Country Brief. 2018 [cited 2019 Feb 5]. Available from: https://docs.wfp.org/.
14. East Java Food Security Agency [BKP] and World Food Programme [WFP]. Food Security and Vulnerability Map of East Java 2015. East Java: East Java Food Security Agency and WFP; 2015.
15. Usfar AA, U Fahmida, J Februhartanty. Household food security status measured by the US Household Food Security/Hunger Survey Module (USFSSM) is in line with coping strategy indicators found in urban and rural Indonesia. Asia Pac J Clin Nutr. 2007; 16(2): 368-74.
16. Food Security Agency. Yearly Report of Food Security Agency. [N.p] : Food Security Agency; 2016.
17. Gross R, Hans S, Hans P, HJA Preuss. The Four Dimensions of Food and Nutrition Security: Definitions and Concepts. Rome: FAO; 2000.
18. Food and Agriculture Organization [FAO]. An Introduction to the Basic Concepts of Food Security: Food Security Information for Action Practical Guides. Rome: FAO; 2008.
19. Hartog AP. Food habit and Consumption in Developing Countries. Wageningen, Netherland: Wageningen University Press; 2006.
20. Kyaw D. Households' Food Security Status and Coping Strategies to Food Insecurity in Myanmar. Japan: Institute of Developing Economies, Japan External Trade Organization; 2009.
21. Faradita Meilinda Wulan S, Adi AC. Household food security and coping strategy in isolated island of Gili Labak, Sumenep Regency, Madura. Media Gizi Indonesia. 2016; 11(2): 153-9 [Indonesian].

22. Cordero-Ahiman O, Santellano-Estrada E, Garrido A. Food access and coping strategies adopted by households to fight hunger among indigenous communities of Sierra Tarahumara in Mexico. Sustainability. 2018; 10(2): 473.

23. Siliphouthone I, Yasunobu K. Rural Household's Coping Strategies and Food Insecurity in the Upland Areas, Sekong province, Lao PDR. Japanese J Farm Management. 2014; 52(1-2): 119-24.

24. Johnson DV. The contribution of edible forest insect to human nutrition and to forest management: current status and future potential. Proceeding of Workshop on Asia Pacific Resources and the Potential for Development. 18-21 February 2008, Chiang Mai, Thailand: FAO; 2008.

25. Rumpold BA, Schlüter O. Insect-based protein sources and their potential for human consumption: Nutritional composition and processing. Animal Frontiers. 2015; 5(2): 20-4.

26. Van H, Arnold. Edible insects: future prospects for food and feed security. Rome: FAO; 2013.

27. Belluco S, Mantovani A, Ricci A. Edible Insects in a Food Safety Perspective. In; Halloran A, Flore R, Vantomme P, Roos N, editors. Edible Insects in Sustainable Food Systems. Switzerland: Springer Cham; 2018. pp. 109-26.

28. Ahmed M, Lorica HM. Improving developing country food security through aquaculture development – lessons from Asia. Food Policy. 2002; 27: 125-41.

29. Bouis, H. Commercial vegetable and polyculture fish production in Bangladesh: their Impacts on household income and dietary quality. Food Nutrition Bulletin. 2000; 21(4): 482-7.

30. Indonesia, Ministry of Environment and Forestry. Rules of Indonesia Ministry of Environment and Forestry No P.20/MENLHK/SETJEN/KUM.1/6/2018. Jakarta: Ministry of Environment and Forestry; 2018.

31. Cantlay JC, Ingram DJ, Meredith AL. A review of zoonotic infection risks associated with the wild meat trade in Malaysia. Ecohealth. 2017 Jun; 14(2): 361-88.

Corresponding author
Qonita Rachmah can be contacted at: qonita.rachmah@fkm.unair.ac.id