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Food traditions and biodiversity conservation of the Javanese Community in Gunungkidul Karst, Yogyakarta Province, Indonesia

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Abstract. *Sulistiyowati E, Setiadi, Haryono E. 2022. Food traditions and biodiversity conservation of the Javanese Community in Gunungkidul Karst, Yogyakarta Province, Indonesia. Biodiversitas 23: 2080-2092.* Local traditions manifested through foods and rituals may have contributed to the conservation of plants. In this study, we explore how the Javanese community living in the dryland Karst Gunungkidul, Yogyakarta Province, Indonesia, uses food traditions and rituals to conserve plant diversity and, to some extent, conserve the ecosystem. The primary method was free listing interviews with 109 respondents, followed by in-depth interviews with 19 people of senior community members, local leaders (*sesepuh*), and customary leaders (*juru kunci*). The study found that local people use 43 species of 19 families to produce ten culinary varieties as the local food traditions. In addition, there are 29 rituals performed by local people to mark and celebrate various events. Some rituals such as *rasulan*, *gumregan*, and life cycle rituals reflect local ecological knowledge to support biodiversity and ecosystem conservation in the area.

Keywords: Biodiversity conservation, food tradition, Java, plant-based food, rituals, *slametan*

INTRODUCTION

As an essential element of the culture, foods have become a shared value that shapes social practice in an ethnic group (Dean 2019; Reddy and van Dam 2020). From the cultural perspective, food has two meanings; material meaning and the symbolical meaning of respecting the spiritual beings (Nasir 2019). Local people may use rituals to symbolize a repayment for nature (Geng et al. 2017). This concept reflects the local ecological knowledge of conservation. In addition, local people tend to maintain plants diversity in their culinary traditions and rituals because a particular species may refer to a cultural symbol that can not be replaced by another (Sutrisno et al. 2020). The beliefs and rituals build an intimate relationship between people and their environment, which leads to awareness of participating in conservation efforts (Kealiikanakaoleohaililani et al. 2021).

The connection between foods, culture, and biodiversity has been studied in ethnobiology. Among the studies, for example, the use of palms in ceremonies (Gruca et al. 2014; Campos et al. 2019), bananas in traditional ceremonies in Northern India (Sarma et al. 2020), and plant rituals in China (Geng et al. 2017). In Indonesia, there are similar examples of research, such as foods served during Ramadan in Aceh (Manan et al. 2022); foods of Riau People in Sumatra (Mardatillah et al. 2019); the genealogy of cassava-based culinary in Java (Herminingrum 2019); ethnic food of Sasak Tribe (Sukenti et al. 2016); and plant rituals in Aceh (Sutrisno et al. 2020). Indonesia is a multicultural country with 15 major ethnic groups and approximately 1,300 sub-ethnic groups (Ananta et al. 2015; Auwalin 2020). Therefore, the study of plants, food traditions, and rituals is fundamental. Such a study will help preserve culture and allow biodiversity conservation in the long term.

This research explores the food traditions, rituals, and plant conservation in one of the major ethnicities in Indonesia, the Javanese. The Javanese people constitute about 40.06% of the total population of Indonesia (Suharnomo and Syahruramdan 2018). As a case study, this research focused on Javanese people who live in Karst Gunungkidul in Yogyakarta Province, Indonesia. Gunungkidul was chosen for this study because most live in rural areas and maintain a traditional way of living (Rahmadi 2018). Moreover, Gunungkidul's economy has recently been opened to tourism that offers ecotourism and the protection of nature (Isdarmanto et al. 2018; Saputro et al. 2020; Kusumayudha et al. 2021) and culinary tourism (Marwanti et al. 2020).

This paper explores food traditions and rituals and discusses their importance in biodiversity (plants) conservation efforts. By doing this kind of study, we seek to contribute to biodiversity conservation based on local knowledge and culture. The novelty of this article is in its approach to linking food traditions, rituals, and biodiversity conservation. It is different from other research that discusses the aspect of ethnobiology of wild plants for maintaining food security (Abdullah et al. 2021; Kidane and Kejela 2021). This paper does not solely discuss plants

and rituals (Bamin and Gajurel 2015; Geng et al. 2017; Sarma et al. 2020). Although several authors have conducted ethnobotanical studies of medicinal plants in Gunungkidul (Nahdi and Kurniawan 2019), the use of plants for food and rituals in the area has not yet been documented.

MATERIALS AND METHODS

The community and the context

One of the widely recognized Javanese communities that still hold on to traditional systems and values is living in the Karst Gunungkidul (also called Karst Gunungsewu), Yogyakarta Province, Indonesia. The research on this landscape was first delivered by Junghunn in 1845 and was continued by Herbert Lehmann in 1936. The total length of the karst is 85 km, and the maximum width is 30 km (Tjia 2013). The karst consists of approximately 40,000 conical hills spread over Java Island, from Pacitan in East Java Province to Gunungkidul in Yogyakarta Special Province, Indonesia (Tjia 2013; Khotimah 2019).

Gunungkidul experienced severe environmental degradation in the past, with most of its land converted into agricultural land (Khotimah 2019; Puspanti et al. 2021). As a result, Gunungkidul is a distinct community characterized by agriculture and traditional living practices; approximately 45% of the total workforce depends on agricultural and natural resources sectors (Central Statistics Agency 2020). Although the land is dry and infertile, Gunungkidul is inhabited by 768,523 people, with a population density of about 245 people/km^2 (Central Statistics Agency 2020). Hindus and Buddhas influenced the early culture of the Gunungkidul people (Ahmadi et al. 2021). However, the percentage of Hindus and Buddhas is less than 1% of the total population, at about 0.053% and 0.001%, respectively. Overall, 95% of the population is Moslems (Central Statistics Agency 2020). People believed that their ancestors originated from the Great Hindu Kingdom Majapahit (1293-1527) in East Java-based on local folktales. However, the archaeological proofs of the folktales were not yet found. The remnants of Majapahit's influence could only be found in terms of folktales (Panji of Majapahit) in a wayang beber performance (Ahmadi et al. 2021) and mask art (Subiyantoro et al. 2021).

Data collection

We collected data through interviews and field visits. Key persons were chosen by a purposive sampling method. Open questions were administered to explore the knowledge, practice, and belief on the food traditions, plants, rituals, and conservation. Observation and field diaries were generated during 21 field visits to the respondents' hamlets. Key persons in this research originated from seven hamlets in three districts (Semanu, Panggang, and Girisubo). The seven hamlets include: Bulu, Plebengan, Turunan, Pejaten, Kandri, Tileng, and Teken (Figure 1).

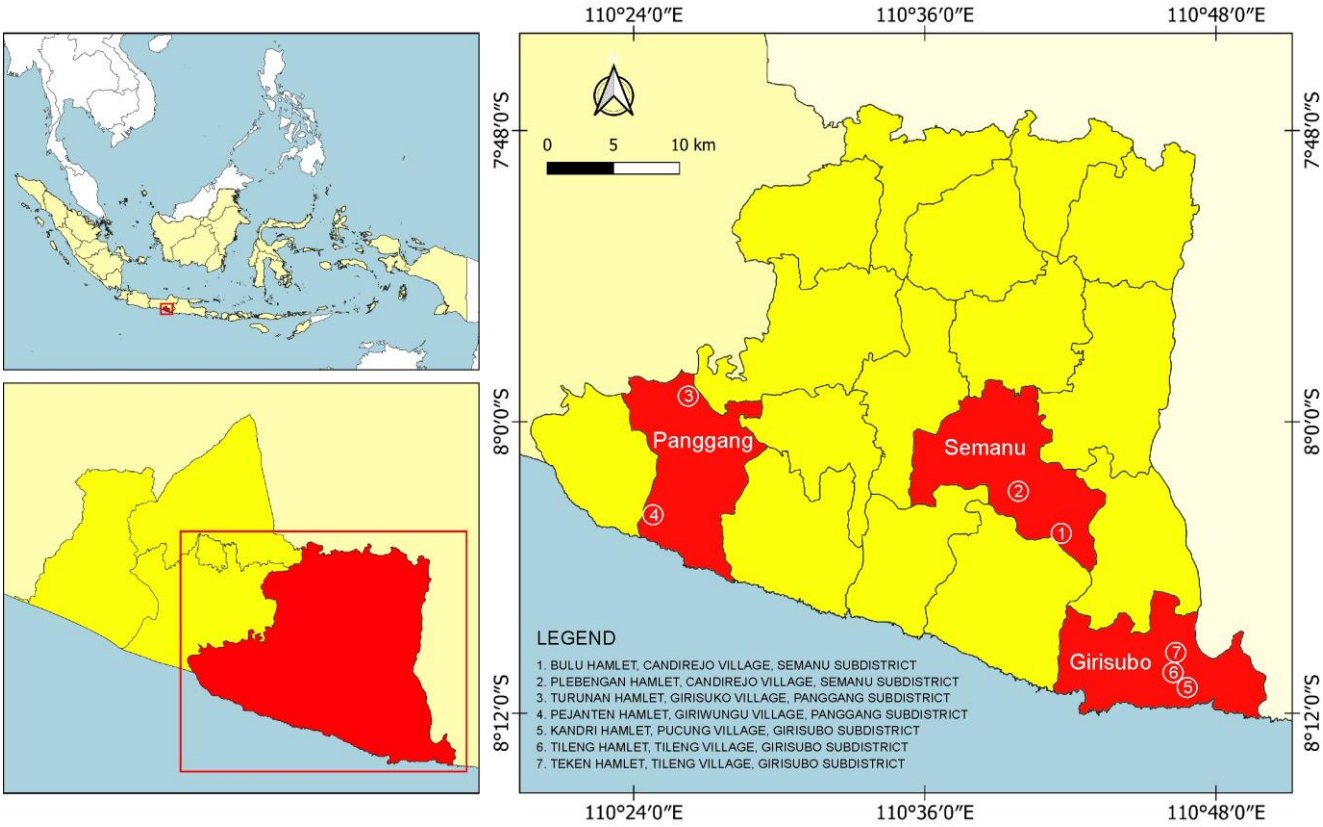

Figure 1. Map of the research location in the Karst Gunungkidul, Yogyakarta, Indonesia. Hamlets are indicated in number, from 1 to 7

The first part of this research will seek to understand people's knowledge of plants around them and the species' use in culinary traditions according to their experiences. In eight months (October 2020-June 2021), we conducted a free-listing study to collect information about food traditions and local culinary recipes in the studied area (see Quinland 2018; May and Lewis 2020). There are 109 respondents involved in the free-listing study. The respondents were chosen purposefully based on their age and experiences in practicing rituals and food traditions. All the background information regarding the respondents was obtained from the head of the hamlet (*dukuh*) (Table 1).

After conducting a free listing, we asked 19 key respondents to explore in-depth knowledge about plants, food traditions, and rituals. Finally, we conducted a semi-structured interview following the method by May and Lewis (2020). The respondents were categorized as the elderly (*sesepuh*) or the village's customary leader (*juru kunci* or *kaum*). There could be several *sesepuhs*, depending on the hamlets. *Sesepuh* could also mean a senior community member or the village's formal leader.

Each interview with key respondents lasted for about one to two hours at the respondent's home. We conducted home visits and face-to-face meetings because online communication and by-phone interviews were challenging due to the village's remoteness.

We asked questions about the following: 1) list of the plants used in the traditional culinary, 2) name of the foods, 3) the significance of the plant to the cuisine, 4) the practice and beliefs of local people concerning the customs and rituals involved in the cuisine.

Data analysis

From the free listing data, we calculated the Use Value (UV) using as follows by Hoffman and Gallaher (2007):

$$\text{Use Value (UV)} = \frac{\text{Number of citations per species (U)}}{\text{Number of informants (N)}}$$

The qualitative data analysis started with transcribing the interview recording and generating insights from field notes. To help with the transcription, we use InqScribe software. Then, data coding and data categorization were conducted using Microsoft Excel. After generating codes and categories, we developed the descriptions and narratives of the findings using the theme and subthemes. Overall, we follow the qualitative research steps by Creswell (2012) and Albuquerque et al. (2014).

RESULTS AND DISCUSSION

Food traditions in Gunungkidul

Based on the free listing study, the respondents listed 43 wild and cultivated species used in their food traditions and daily menu. The plants are used as staples, side dishes, and vegetables. The UV value varies from 0.01 to 0.80. Rice (*Oryza sativa*) and cassava (*Manihot esculenta*) have the highest UV values. They are 1 and 0.56, respectively. Other species that have a high UV are *kecipir* (*Psophocarpus tetragonolobus*), *bayam* (*Amaranthus* sp.), and banana (*Musa paradisiaca*).

People in Gunungkidul have developed local food traditions using local plants as ingredients. The respondents mentioned three main staples and ten side dishes (Table 2; Figure 2). The species used for making the cuisine come from several families, namely Poaceae, Euphorbiaceae, Caricaceae, Fabaceae, Rubiaceae, Moraceae, Pedalilaceae, Gnetaceae, Amaranthaceae, Musaceae, Cucurbitaceae, Solanaceae, Convolvulaceae, Asteraceae, Sapindaceae, Moringaceae, Lamiaceae, and Arecaceae.

Many plants that compose the traditional food of Gunungkidul are mostly planted species as a part of the agrobiodiversity that forms the agroecosystem. In many ways, the protection of agrobiodiversity contributes to conservation in general (Bennett et al. 2017), as many conservation efforts occur in the agricultural setting (Santos et al. 2021). In addition, the knowledge of species as ingredients to make local cuisine is a part of local ecological knowledge that contributes to conservation.

In terms of staple food, unlike any other Indonesian region that relies on rice (Davidson 2018), the people of Gunungkidul develop local staple traditions in the form of cassava rice and maize rice. The use of cassava as the main staple of Gunungkidul people could not be separated from the famine incident called the *gaber* catastrophe in 1962-1963. *Gaber* was a name given to a severe food crisis occurring in Gunungkidul Regency. Our respondents, who were all above 60 years old and had been a toddler or a teenager in that year, recalled that *gaber* was the most challenging time among people of Gunungkidul. Pujo from Semanu District (male, 74 years) described that *gaber* as a solid cake made of rotten cassava flour. Although it was very unappealing, Pujo could not afford other foods because rats had eaten most food and even plants in the field. Our respondents recalled that after *gaber*, people saved and made use of everything that could be eaten in their village, including papaya's stems and leaves (*Carica papaya*), bananas' stems (*M. paradisiaca*), and wild vegetables. Unfortunately, there was not much literature discussing the gaber catastrophe in Gunungkidul. A classic work by Nibbering (1993) associated the threat to food security with the prevalence of rats that destroyed agriculture. Nevertheless, a more recent article described that food security in Gunungkidul has been achieved by implementing rice subsidies and the culture to uphold the consumption of local staples (Utami et al. 2018).

Table 1. The profile of respondents

Criteria	Semanu	Panggang	Girisubo
Number of respondents	37	30	42
Gender			
Male	21	16	28
Female	16	14	14
Education			
No formal education	12	3	7
Elementary School	16	21	30
Junior High School	7	5	1
Senior High School	2	1	4
Age (average)	67.2	63.2	63.1

Table 2. Types of local food, local ingredients/species used, and the UV

Food traditions	Description	Local name	Common name	Species as the main ingredient	Family	Part used	Uv
Main staple (Grains)	Main staples as the source of carbohydrate	*Beras*	Rice	*Oryza sativa*	Poaceae	Seed	1.00
		Tiwul	Cassava rice	*Manihot esculenta*	Euphorbiaceae	Tuber	0.56
		Jagung	Maize rice	*Zea mays*	Poaceae	Seed	0.27
Pecel and Urap	*Pecel:* A type of salad with mixed vegetables and peanut sauce. *Urap:* the salad is mixed with shredded coconut in a paste made of chili, palm sugar, and galangal	*Pepaya*	Papaya	*Carica papaya*	Caricaceae	Flower, leaf, young stem	0.09
		Turi	Vegetable hummingbird	*Sesbania grandiflora*	Fabaceae	Flower, leaf, young seed	0.09
		Pace	Noni	*Morinda citrifolia*	Rubiaceae	Young leaf	0.05
		Daglek/daun kupu-kupu	Bauhinia	*Bauhinia purpurea*	Fabaceae	Young leaf	0.14
		Ipek	Ficus	*Ficus* sp	Moraceae	Leaf	0.03
		Dadap	December tree	*Erythrina subumbrans*	Fabaceae	Leaf	0.03
Sambal	A thick paste made of chili, onion, and the intended ingredients	*Wijen*	Sesame	*Sesamum indicum*	Pedaliaceae	Seed	0.04
		Kacang tanah	Peanut	*Arachis hypogaea*	Fabaceae	Seed	0.34
Tempeh	Fermented bean cakes made of a type of beans	*Benguk*	Velvet bean	*Mucuna pruriens*	Fabaceae	Seed	0.15
		Lamtoro	White popinac	*Leucaena leucocephala*	Fabaceae	Seed	0.17
		Kedelai	Soy bean	*Glycine max*	Fabaceae	Seed	0.26
		Koro	Jack bean	*Canavalia* sp	Fabaceae	Seed	0.30
Jangan asem-asem	A type of sour soup with mixed vegetables, spiced with onion, shallot, bay leaves, galangal, and shrimp paste	*So*	Gnemon/ Melinjo	Gnetum gnemon	Gnetaceae	Young leaf, flower, and fruit peel	0.28
		Asem	Sour Tamarind	Tamarindus indica	Fabaceae	Young leaf, fruit	0.11
		Bayam	Spinach	*Amaranthus* sp/ *Amaranthus spinosus*	Amaranthaceae	Young leaf	0.44
Jangan gabrus	A type of soup made of shredded coconut, spiced with crushed onion, shallot, bay leaves, and galangal	*Kecipir*	Winged beans	*Psophocarpus tetragonolobus*	Fabaceae	Young fruit	0.49
		Kacang potro	Cowpea	*Vigna unguiculata* subsp. *Unguiculata*	Fabaceae	Seed, young fruit, young leaf	0.18
		Kacang gude	Pigeon pea	*Cajanus cajan*	Fabaceae	Young seed	0.21
Jangan gurih	a type of soup made of shredded coconut, spiced with crushed onion, shallot, bay leaves, and galangal	*Gedang*	Banana	*Musa paradisiaca*	Musaceae	Flower, stem	0.32
		Waluh	winter squash	*Cucurbita pepo*	Cucurbitaceae	Fruit	0.16
		Bligo	Wax gourd	*Benincasa hispida*	Cucurbitaceae	Fruit	0.05
		Keluwih	Breadfruit	*Artocarpus camansi*	Moraceae	Fruit	0.04
Jangan lombok	a type of soup made of shredded coconut, spiced with crushed onion, shallot, bay leaves, and galangal	*Lombok*	Chilli	*Capsicum frutescens*/ *Capsicum annuum*	Solanaceae	Fruit	0.72
		Petai	stink bean	*Parkia speciosa*	Fabaceae	Seed	0.09

Oseng-oseng	sauteed vegetables, usually mixed with tempeh and chili pepper and seasoned with onion and soy sauce.	*Koro pedang*	Pig bean	*Canavalia ensiformis*	Fabaceae	Young seed	0.03
		Koro uceng	Jack Bean	*Canavalia* sp	Fabaceae	Young seed	0.13
		Pare	Bitter melon	*Momordica charantia*	Cucurbitaceae	Young fruit	0.19
Lalab (fresh)	Fresh vegetables, usually eaten as condiments, accompanied with *sambal bawang* (crushed garlic and chili), or *sambal terasi* (crushed onion, chili, and shrimp paste)	*Terong ngor*	-	*Solanum indicum*	Solanaceae	Fruit	0.08
		Terong lalab	Black nightshade	*Solanum torvum*	Solanaceae	Fruit	0.17
		Kemangi	Basil	*Ocimum africanum*	Lamiaceae	Fruit	0.11
Lalab (boiled/stewed)	Boiled/stewed leaves, usually eaten as condiments	*Luntas*	Indian camphorweed	*Plucea indica*	Asteraceae	Leaf	0.09
		Lung	Sweet potato	*Ipomoea batatas*	Convolvulaceae	Leaf	0.15
		Kenikir	Cosmos	*Cosmos caudatus*	Asteraceae	Leaf	0.12
		Sambi	Lac tree	*Schleichera oleosa*	Sapindaceae	Leaf	0.01
		Kelor	Moringa	*Moringa oleifera*	Moringaceae	Leaf	0.03
		Legetan	Panicle spot flower	*Acmella paniculata*	Asteraceae	Leaf	0.02
Gudeg	A type of dish made with coconut milk spiced with turmeric, galangal, bay leaves, and kemiri	*Kelapa*	Coconut	*Cocos nucifera*	Arecaceae	Young flower, milk	0.80
		Keluwih	Breadfruit	*Artocarpus camansi*	Moraceae	Young fruit	0.05
		Gori	Jack fruit	*Artocarpus heterophyllus*	Moraceae	Young fruit	0.17

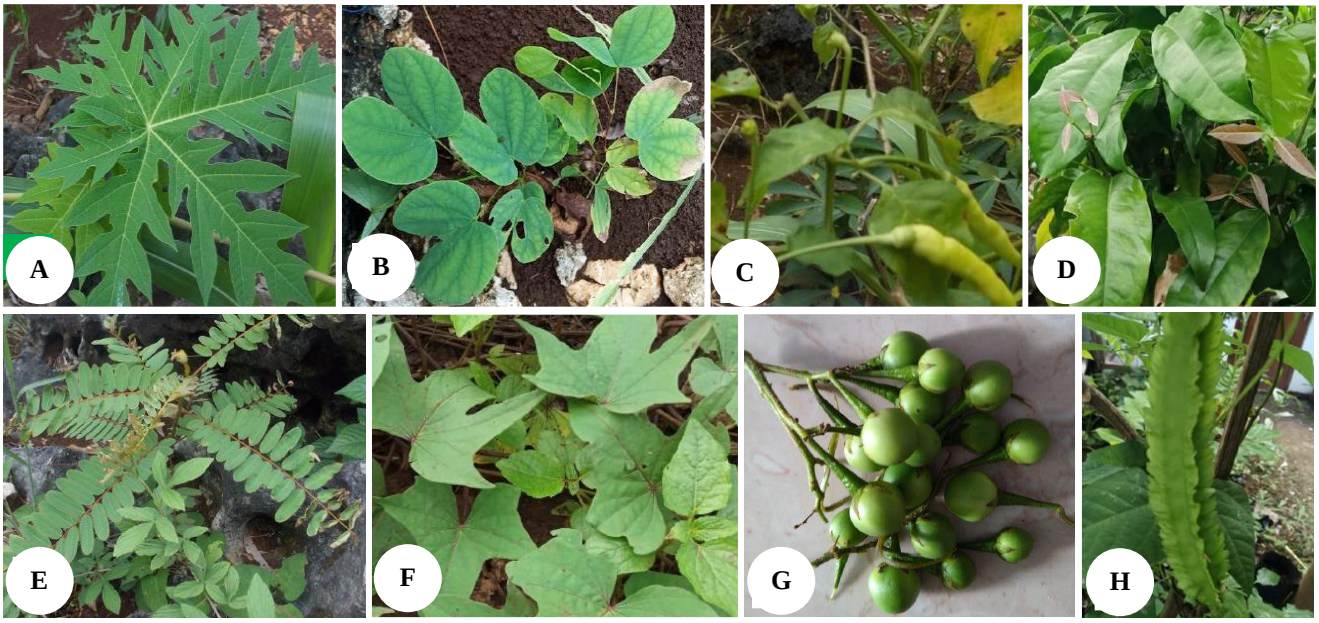

Figure 2. Several plants are used for making traditional foods in dryland Karst Gunungkidul (pictured in their natural habitat) A. Papaya (*Carica papaya*), B. Tayuman (*Bauhinia purpurea*), C. *Lombok imet*, local chili with the variety called *imet* (*Capsicum annuum*), D. So/melinjo (*Gnetum gnemon*), E. Turi (*Sesbania grandiflora*), F. Lung (*Ipomoea batatas*), G. Terong lalab (*Solanum torvum*), H. Kecipir (*Psophocarpus tetragonolobus*)

The irrigation network does not support Gunungkidul's agricultural land. Hence, agricultural produce is governed by the season. The primary carbohydrate source -rice and cassava- are planted in the terraced lands. Although cassava is now considered the primary commodity of Gunungkidul and hence influences the staple and culinary

traditions of Gunungkidul, cassava itself is not a native plant of Java. The tuber was native to South America and brought to Asia in the 1800s (Malik et al. 2020).

Tiwul and *gatot* are two kinds of traditional foods popular in Gunungkidul. Varieties of recipes were made to increase the flavor of cassava. The recipes range from staple food to crisps fried in palm oil. We generated an illustration of several types of commonly cassava-based food on the daily menu of local people (Figure 3). The varieties of local cassava-based culinary in Gunungkidul are relatively similar to the study reported by Herminingrum (2019).

Rituals in Gunungkidul

The most commonly used term for a traditional ceremony in the Javanese culture is *slametan*. *Slametan* is conducted to protect human beings from evil spirits, in which Javanese people pray for the state of *slamet*, which means "nothing is going to happen (to anyone)" (Geertz 1976). The word *slametan* derives from *salam's* Arabic word based on its terminology. At *slametan*, people serve food offerings for the spirit and invisible beings and meals for the guests who attend the ceremony. The food is for eating and serving a spiritual duty to repay nature. However, it could also be translated as an indirect strategy for conservations. Before creating the offerings, local people are fully aware of protecting, planting, and maintaining the plants.

Throughout the year, local people conduct many rituals or *slametan*. The respondents cited that there are 29 rituals performed for various purposes. The rituals could be categorized chronologically based on a person's agricultural cycle and life cycle. For example, based on the agricultural cycle, there are rituals to mark the beginning of the planting season (5 practices), the maintaining of agricultural plants (4 practices), and the harvesting season (8 practices) (Table 3). Meanwhile, life cycle rituals from the wedding to the death of a person (10 practices) will be discussed in a separate section.

The respondents cited that not all village members perform all rituals. However, there are several rituals considered compulsory. They are *rasulan*, *gumregan*, and life cycles rituals. In this paper, we delved into the three main ceremonies aforementioned. The rituals require foods made from local plants as the main ingredients. The composition of food and plant ingredients is ruled by unwritten traditional customary principles passed from one generation to another.

Rasulan, *the post harvesting cermony*

Rasulan ceremony is described as a ritual to offer God gratitude that the agricultural harvest has been abundant (Rahayu 2019). Another author described that peasants often perform it once a year, especially after a harvest season (Adriyanto and Kusdarini 2020). In general, the ceremony begins with the head of the indigenous custom (*Juru Kunci*) bringing an offering arranged in a basket made of young coconut leaves (*janur*). This basket is called *panjang ilang*. These *panjang ilang*s contain specific food offerings and adornments (*uborampe*). The most complicated *panjang ilang* is in Bulu Hamlet, consisting of 14 types, whereas the most modest is in the Turunan Hamlet, with only one *panjang ilang*.

The origin of food traditions during *rasulan i*n the dry karst of Gunungkidul is not yet known. However, it is often linked to the history of the Gunungkidul people. Locals believe that their ancestor was King Brawijaya of the ancient Majapahit Kingdom (1201-1550) in East Java, although archaeological artifacts hardly prove it. Nonetheless, the similarity of food traditions in Gunungkidul with Hindu origin is observed. For example, *panjang ilang*, *sajen*, and *tumpeng* could be observed in the Hindu religion (Geertz 1976). This culture is also linked to Javanese's animistic beliefs long before the Hindu religion. Moreover, the resemblance of *tumpeng* -the cone-shaped rice- to Mount Meru strengthens the claim (Woodward 2011). For the local people, *tumpeng* symbolizes ecology and the ideal concept of conservation (Figure 4).

As the biggest harvest festival, all village members usually celebrate the *rasulan*. The ceremony begins with purifying the village from spiritual impurities. People go to the nearest shrine, called *resan*. In our respondents' villages, the *resan* usually is a big tree near water sources. In Bulu Hamlet, the *resan* is the *bulu* tree (*Ficus annulata)* and in Pejaten is the banyan tree (*Ficus benjamina*). A customary local leader (*juru kunci*) cited prayers in the *resan*, sometimes accompanied by an arrangement of offerings called *sajen*. The *sajen* contains white and red rose petals (*Rosa* sp.), *kenanga* (*Cananga odorata*), *kantil* (*Michelia campaca*), *suruh* leaves (*Piper betle*), tobacco (*Nicotiana tabacum*), *menyan* (incense), *melati* (*Jasminum* sp.), and *gambir (Uncaria* sp.).

Several important foods, mostly from agricultural produce, must be present during *rasulan*. A basket of tubers, called the *rak-rak*, symbolizes the welfare of the village. The *rak-rak* consists of boiled cassava (*M. esculenta), uwi (Dioscorea alata), gembili (Dioscorea esculenta), kimpul (Xanthosoma* sp.*),* and *kentang kleci* (*Plectranthus rotundifolius*). A bamboo basket (*tampah*) is filled with rice, dish, and snack. The dishes' compositions are *ingkung* (chicken in coconut milk), *jangan lombok* (chili cooked with onion and shallot and sometimes stinky beans/*Parkia speciosa*), boiled eggs, and fried noodles. In some hamlets such as Plebengan Hamlet in Semanu District, as described by Pak Kas (male, 59 years), the *rasulan* always requires a particular snack made of traditional cereals of *jawut* (*Setaria italica*), *cantel* (*Sorghum bicolor*), and *ketan* (*Oryza sativa var glutinosa*). The grains are made into rice cakes called *jadah*. *Jadah* is made by stewing the cereals, mixing the ingredients with coconut shreds, and grounding the cake until soft and chewy.

The sticky rice cake *jadah* symbolizes togetherness among villagers, hoping that they, their families, and friends could "stick" together (Jiyo, male, 62 years). At the *rasulan*, each household cooks abundant foods. Then, they invite people to eat with the family. The family food usually consists of rice, fried noodle, chicken in coconut milk, sweetened fried *tempeh* and tofu, and *jangan lombok* (chili in coconut milk).

Slametan*: Ceremonies marking the birth, wedding, and death*

A particular *slametan* marks a special event in a person's life cycle. Each *slametan* involves an elaborate ceremony and requires multiple food arrangements and offerings (*uborampe*). Here, we compiled the use of food arrangements in *slametan*, described by the *juru kunci* (the customary leader) (Table 4).

Figure 3. Cassava-based food in dryland karst Gunungkidul. A Cassava tuber (*Manihot esculenta*); B. Dried cassava, called *gaplek*; C. Cassava flour; D. *Manggleng*, dried cassava and fried in palm oil; E. *Lempeng*, the cassava crisps; F. *Gatot*, the greyish and brownish dried cassava soaked in water for three days and then is steamed with shredded coconut; G. *Tiwul* or the cassava rice; H. *Lemet*, sweet cassava cake wrapped in banana leaves

Figure 4. Food and its adornment (*uborampe*) in the traditional *slametan* A. A tumpeng consists of cone-shaped rice, vegetable salad in shredded coconut, and boiled eggs; B. *Kembang boreh*, consisting 1. Red and white rose petals, 2. *Dlingo (Acorus calamus)* and *bengle (Zingiber cassumunar)*, 3. *Kenanga* (*Canangium odoratum*); C. *Sajen rasulan* (the offerings for *rasulan*) consists of 1. *Mbako* (tobacco), 2. Sirih (*Piper betle*), 3. Red and white rose petals (*Rosa* sp.), 4. *Cempaka* (*Michelia champaca*), 5. *Menyan* (incense), 6. *Gambir* (*Uncaria* sp.), 7. *Injet* (limestone paste), 8. *Melati* (*Jasminum* sp.)

Table 3. Rituals performed by villagers

Name of rituals	Purpose	Food traditions/ species
Beginning of the planting season		
Wiwit	Marking the beginning of the planting season	Rice and side dishes (*bancakan*) Main staple*: Oryza sativa* Side dishes*: Urap* made of *Amaranthus* sp., *Vigna sinensis, Vigna radiata, Daucus carota, Cocos nucifera, Allium cepa, Allium sativum, Musa paradisiaca*
Mendemi	Seeds are planted	Rice *Oryza sativa* (seeds)
Labuh	Rice and main staples are brought to the field	Rice Main staple: *Oryza sativa* Side dishes: *Urap* made of *Amaranthus sp, Vigna sinensis, Vigna radiata, Daucus carota, Cocos nucifera, Allium cepa, Allium sativum*
Tanam	Main staples are planted	No offer only prayers cited on the site.
Nyebar	Rice is not planted but dispersed in the ground	Rice (seed), no offers, only prayers cited on the site.
Nadah udan	Asking for rain	Rice, food adornments, drinks made from rice jelly Main staple: *Oryza sativa* Side dishes: *tumpeng* made of *Amaranthus* sp., *Vigna sinensis, Vigna radiata, Daucus carota, Cocos nucifera* (milk), *Allium cepa, Allium sativum, Alpinia galanga, Syzygium polyanthum, Coriandrum sativum, Aleurites moluccanus.* Protein source: eggs, tempeh, tofu, and chicken cooked in coconut milk (*ingkung*) Flower offerings: *Rosa* sp., *Cananga odorata, Michelia champaca, Nicotiana tabacum*
During the maintenance of plants		
Pari dandan	Performed when rice is bloom by giving flowers	A white powder was sprinkled into the rice paddy. The powder is made of *Kaemferia galanga and Oryza sativa* (flour) Flower offering: *Rosa* sp., *Cananga odorata*
Sedekah	Praying that the plants grow well by giving food to neighbors	rice and side dishes Side dishes: urap made of *Amaranthus sp, Vigna sinensis, Vigna radiata, Daucus carota, Cocos nucifera* (milk), *Allium cepa, Allium sativum. Jangan lombok* comprises *Capsicum frutescens, Capsicum annum, Allium cepa, Allium sativum,* and *Alpinia galanga.* Flower offering: *Rosa* sp., *Cananga odorata*, *Michelia champaca, Nicotiana tabacum, Musa paradisiaca* (fruit).
Bancakan	Praying that the plants grow well by giving food to neighbors	rice and simple side dishes consist of rice, *urap*, boiled eggs, and fried noodle.
Kirim wedak/ Kirim parem/ pareman	Giving powder made of rice flour to rice planted in the field	powder made of galangal (*Kaemferia galanga*) and rice (*Oryza sativa*)
Wiwit panen	Marking the beginning of harvest by giving food to children and neighbors	Rice and side dishes, flowers as offerings *Musa paradisiaca, Capsicum annum, Allium sativum, Allium cepa, Sesbania grandiflora, Erythrina subumbran*s Flower offerings: *Rosa* sp., *Cananga odorata, Pandanus* sp.
Bancakan	Praying that the harvest is abundance by giving food to neighbors	Rice and side dishes (same as above)
Rasulan	The most significant harvest ceremony performed in the village	Rice, side dishes, food adornment, and flowers (discussed in detail in the following subtitle)
Kirim dowa	Sending prayers to the ancestor	Rice, side dishes (same as *sedekah*)
Bersih dusun	Cleaning the village	Rice, side dishes (same as *rasulan*)
Bancakan beji	Cleaning the water source	Flowers (same as *rasulan*)
Sadranan	The substantial harvest ceremony performed in the village	Flowers, food adornment (same as *rasulan*)
Gumregan/gumreg	Paying respect to cattle and agricultural tools	Rice, dishes, *ketupat* Offering: rice cooked in young coconut leaves, shaped in rhomboid, called *ketupat* Flower offering: *Rosa* sp., *Cananga odorata*, *injet* (limestone paste)

Table 4. The foods and ceremonies accompany a person's life cycle

Event	Name of ceremony	Major food arrangements involved in the ceremony	Description of the foods/species	The meaning of the ceremony
Birth	*Lairan*	*Bancakan*	Main staple: rice (*Oryza sativa*) Main dish: Urap comprises of Rice and side dishes (*bancakan*) Main staple*: Oryza sativa* Side dishes*: Urap* made of *Amaranthus* sp., *Vigna sinensis, Vigna radiata, Daucus carota, Cocos nucifera, Allium cepa, Allium sativum* Fruits: *Musa paradisiaca* Protein source: eggs, chicken	To celebrate and give blessing to the newborn and the mother so that both are healthy
	Puputan	*Bancakan*	same as the event above	To celebrate the fell off of a baby's umbilical stump
		Jenang abang-putih	Main offering: Red and white rice porridge (*Oryza sativa*). The red porridge is made of rice, coconut milk, and palm sugar that gives brownish color, and this is to represent red. Besides, white porridge is a simple rice porridge in coconut milk, without sugar	The red and white porridge represents two supernatural siblings who accompany the baby. The first sibling is the umbilical cord (red), and the second is the amniotic liquid (white). Javanese believe that the two siblings accompany a person from birth to death, and is commonly called in the phrase *"kakang kawah, adi ari-ari,"* which means the bigger brother is the amniotic fluids and the younger brother is the umbilical cord
		Jajan pasar	Fruits: *Salak* (*Zallaca edulis*), *rambutan* (*Nephelium lappaceum*), banana (*Musa paradisiaca*), Snacks: cassava-based snacks (*Manihot esculenta*) such as *gethuk* or *lemet and jadah* (sticky rice cake) made of *Oryza sativa var glutinosa*	To give a blessing to a baby so that the baby can be prosperous in the future
	Selapan	*Bancakan*	same as the event above The baby is given a tassel made of *dlingo (Acorus calamus)* and *bengle (Zingiber montanum)*	Same as above, but *bancakan* in this event is more sophisticated in the main foods and dishes
Teen Ager	*Sunatan* (circumcision) for boys only	*Kenduri*	Main staple: Rice (*Oryza sativa*) Main dishes: *Urap* made of *Amaranthus sp, Vigna sinensis, Vigna radiata, Daucus carota, Cocos nucifera, Allium cepa, Allium sativum* Protein source: *ingkung* (chicken in coconut milk), sweetened tempeh or mear in palm sugar (*Cocos nucifera*), *salam* (*Syzygium aromaticum*), *laos* (*Alpinia galanga*), coriander (*Coriandrum sativum),* shallot *(Allium cepa),* garlic (*Allium sativum*)	To pray for the boy's health and mark the boy's journey to adulthood. Foods are served to men who gathered in the boy's house the night after circumcision. The gathering of the men is supposed to pray for the boy to enter his adulthood with a blessing and nothing harmful endangers him

Adult	Wedding	*Kenduri*	Main staple: Rice (*Oryza sativa*) Main dishes: *Urap* made of *Amaranthus sp, Vigna sinensis, Vigna radiata, Daucus carota, Cocos nucifera, Allium cepa, Allium sativum* Protein source: *ingkung* (chicken in coconut milk), sweetened tempeh or mear in palm sugar (Cocos nucifera), *salam* (*Syzygium aromaticum*), *laos* (*Alpinia galanga*), coriander (*Coriandrum sativum),* shallot *(Allium cepa),* garlic (*Allium sativum*)	To pray for the bride and groom's welfare. The varieties of food served during the *kenduri* represent the hope for a prosperous wedding
		Tumpeng	A *tumpeng* is cone-shaped rice. Several dishes are laid on the bottom of the cone, such as *ingkung*, which is chicken in coconut milk and bay leaves; urap or vegetables in shredded coconut; boiled eggs, tempeh, and meat	Cone-shaped rice called *tumpeng* represents the ecosystem where people live, resembling a mountain. The variety of dishes represents prosperity
Death	*Geblag* (the first day of a person's death) and *pitung dinan* (the seventh day of a person's death)	*Kenduri*	same as the event above	Foods are served to men during the *kenduri*. *Kenduries* will be conducted seven days after a person's death. In *kenduri*, people recite prayers to ask forgiveness for the deceased and bless the remaining family
		Tumpeng	A simple *tumpeng* is made of white rice. The dish is usually *ingkung* (a whole chicken in coconut milk) and accompanied by snacks called *ketan-kolak-apem*. *Ketan* is glutinous rice (*Oryza sativa var glutinosa*) cooked in shredded coconut. *Kolak* is sweet potato (*Ipomoea batatas*) cooked in coconut milk and palm sugar, and *apem* is a cake made of rice flour (*Oryza sativa*) and coconut milk (*Cocos nucifera*)	*Tumpeng* represents the ecosystem, whereas *ingkung* means a prayer. *Ketan-kolak-apem* is a food trilogy present at a person's death or commemorating a person's passed away. Ketan is made of sticky rice as a symbol of togetherness (stick together), *kolak* arrives from the Arabic world *Khaliq* or God the Creator, and *apem* is an interpretation of the Arabic word, *afwan*, which means forgiveness
	Patangpuluh (40 days of a person's death), *nyatus* (100 days), and *nyewu* (1000 days)	*Kenduri*	Usually the same as above, except that in *nyewu* (1000 days after a person's passed away), the family typically slaughtered a goat (if the deceased is a female) and two goats (if the deceased is a male) Protein source: Goat meat is usually made into *kicik* or meat seasoned with pala (*Mystica fragrans*) and pepper (*Piper nigrum*). Alternatively, the goat meat is cooked in soy sauce, turmeric (*Curcuma domestica*), pepper, cabbage *(Brassica oleracea*), tomato (*Solanum lycopersicum*), coconut milk (*Cocos nucifera*), *salam* (*Syzygium aromaticum*), *laos* (Alpinia galanga), coriander (*Coriandrum sativum),* shallot *(Allium cepa),* and garlic (*Allium sativum*)	same as the event above
		Tumpeng	same as the event above	same as the event above

Gumregan, *giving blessings to the cattle*

Gumregan is a ceremony held to give blessings to cattle, especially cows and goats. It is held in the month of *Gumreg* (based on the Javanese calendar). The exact timing of *gumreg* is decided by the elderly of the village. *Gumregan* begins with every villager cooking *ketupat*, rice cooked in an envelope made of young coconut leaves. The shape of the wrapping is usually a three-dimensional rhomboid. The varieties of *ketupat* are *ketupat pengluar*, *ketupat pendowo limo*, and *ketupat lepet*. Then, *Ketupats* are given to the cattle, and the horns are given a white sign made of *injet* (limestone soaked in water). Giving *ketupat* means giving a blessing to the cattle; hence the animals grow big and produce healthy offspring. In Bulu Hamlet, Semanu District, Sung (male, 68 years) cited that during *rasulan*, besides *ketupat*, an offering of flowers is also given to the cattle. The flowers as the offering are called *kembang boreh*, a mixture between red and white rose petals and *kenanga* (*C. odorata*), and a balm made of ground *dlingo* (*Acorus calamus*) and *bengle* (*Zingiber montanum*). The word *dlingo* is an acronym for *dho elingo* (remember), which means that human beings must remember God, the creator of life. It also means that human beings must protect animals and nature.

The acculturation between Hindu culture and Islamic culture appears in the *gumregan*. The event of *gumregan* is often cited as commemorating Prophet Sulaiman (or Solomon in the bible) as one of the prophets in Islam. The ceremony of *gumregan* shows local appreciation for animals and the plants used to feed them. The *gumregan* shows that people in Gunungkidul respect their livelihood. Such a ritual may serve as local wisdom for conserving animals, including local plants as the main ingredients of offerings. Some plants, such as *dlingo* (*A. calamus*) and *bengle* (*Z. montanum*), do not only serve for offering but also for making spices and traditional medicine (Rajput et al. 2014; Maneenoon et al. 2015; Khwairakpam et al. 2018).

How food traditions and rituals contribute to conservation

The United Nations Convention on Biological Diversity promotes the potential of traditional and local ecological knowledge for biodiversity conservation (O'Neill et al. 2017; Tengö et al. 2017). The convention document clearly states that conservation and sustainable use of biodiversity should acknowledge indigenous knowledge and practices. Still, there is a need to study the direct link between food traditions, rituals, and conservation. Some research highlights the importance of food traditions to food security (Gras et al. 2016). On the other hand, some others pinpoint the significance of rituals in conservation (Bamin and Gajurel 2015; Sutrisno et al. 2020). Therefore, our finding adds to another dimension of conservation studies: the link between food traditions, rituals, and conservation. We highlighted five principal findings in our research.

First, we found the link between traditions and the conservation of plants and the ecosystem. Rituals in Gunungkidul could not be separated from the use of plants as ingredients of the food offerings. For example, the culture of bringing food offerings to the shrine near a water source during the *bancakan beji* indicates that water is essential for people living in the dry land. People protect the water materially by cleaning it during *rasulan* and spiritually by holding a ceremony. The primary offerings of the processions must consist of certain plants. People only use definite leaves and plants as offerings. The strict food arrangements and offerings that require certain plants show that local people have strong motivation to conserve plants through their culture. It means that species used for food traditions and rituals will be conserved because they are irreplaceable (Sutrisno et al. 2020). The concept encourages people to plant and conserve biodiversity in their home gardens.

Secondly, the needs for plants in rituals lead to sustainable agriculture. The locals' need to perform rites and beliefs set an agricultural system that grows ritual plants. The composition of plants in the local agricultural practice is generally shaped by the needs of foods and to supply offerings during prime events such as *rasulan*. Modern agriculture that requires planting commodity plants such as rice and maize does not necessarily change the overall species composition grown by farmers. In addition, to preserve food traditions, people produce vegetables and spices used in their daily staples. In the terraced farmland, people conservatively plant cassava (*M. esculenta*), yams (*Ipomoea batatas*), corn (*Zea mays*), coconut (*Cocos nucifera*), groundnut (*Arachis hypogaea*), soybean (*Glycine max*), and *so/melinjo* (*Gnetum gnemon*). Meanwhile, in yards and home-gardens people plant coconut (*C. nucifera*), clove (*Syzygium aromaticum*), coffee (family Rubiaceae), cacao (*Theobroma cacao*), and woods such as *sonokeling* (*Dalbergia latifolia*), mahogany (*Swietenia macrophylla*), *lamtoro* (*Leucaena leucocephala*), tobacco (*N. tabacum*), fruits and vegetables. The varieties remain the same as they were reported by previous studies traced back decades ago (see Uhlig 1980; Simanjuntak 2001). Agriculture shapes foods in the daily menu of villagers and constitutes many important events such as *rasulan* and *slametan*.

Third, people demonstrate local ecological knowledge of their landscape ecology. Understanding the local environment as depicted by food symbols, such as *tumpeng*, shows local ecological knowledge belonging to the group. This type of knowledge could be advantageous to help ecosystem rehabilitation and conservation. The culture of bringing foods to a shrine called *resan* -which means tree in Sanskrit-near a water source indicates that water is essential for people living in the dry land. Hence people protect the shrine materially by cleaning it during *rasulan* and spiritually by holding a ceremony in the *resan*. *Resan* does not only represent a spiritual place, but it also portrays traditional practices of tending trees as a form of traditional agroforestry. The importance of agroforestry itself has been discussed by much literature, including Suryanto and Putra (2012), Roshetko et al. (2013), and Khasanah et al. (2015). In general, the finding confirms other several studies, reporting that local ecological knowledge aids the protection of wildlife (Turvey et al. 2014; Pereira et al. 2016; Ulicsni et al. 2016), restores ecological balance (Reyes-García et al. 2019), and assists the

community in adapting to climate change (Leonard et al. 2013).

Next, food traditions and rituals show active public participation in conservation. Community participation is crucial for a successful conservation endeavor (Geng et al. 2017). However, in many conservation programs led by the government, public participation appeared to be one of the biggest challenges (Sorice et al. 2013). Despite that, our research confirmed that food traditions and rituals reflect the indirect participation of the local community in conservation efforts. The traditional rituals, such as *rasulan*, *gumregan*, and life-cycle rituals, are embedded in the daily rhythm of the local community. The rituals build a personal relationship between people and nature; hence the approaches are considered sustainable (Kealiikanakaoleohaililani et al. 2021).

Lastly, we note that food traditions and rituals construct social identity and cohesion. The sticky rice cake *(jadah)* symbolizes togetherness at many ceremonies and rituals. Serving traditional meals and inviting neighbors, relatives, and passersby to have meals together during the *slametan* do not solely reflect the people's hospitality. We believe that it serves as a measure to alleviate hunger and ensure that all community members can eat invaluable food during the festive. Togetherness and living harmoniously are two principal virtues of the Gunungkidul people, reflected in food and rituals. Besides, although Islam is the major religion in Gunungkidul, traditional beliefs influence people's identity. The combination creates harmonious life, as depicted in the cone-shaped rice and vegetables that represent the land of Gunungkidul (*tumpeng*).

To conclude, adapting to available staples, creating culinary recipes, and preserving the culture and plant diversity using rituals are strategies for biodiversity conservation in Gunungkidul. In addition, the conservation effort reflects local people's adaptive capabilities toward disaster and drought-prone environments. Finally, the practice and beliefs manifested in local people's rituals are a powerful tool for conservation and more effective than the government's regulation (Bamin and Gajurel 2015; Geng et al. 2017).

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