INTL J TROP DRYLANDS
Volume 9, Number 1, June 2025
Pages: 36-49

E-ISSN: 2775-6130
DOI: 10.13057/tropdrylands/t090104

Traditional foodways and conservation beliefs among Javanese communities in the Paranggupito Karst, Indonesia

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Manuscript received: 20 November 2024. Revision accepted: 27 April 2025.

Abstract. *Candraningtyas CF, Charsyah C, Setyasih DMD, Mardianto MB, Chairunisa S, Md Naim D, Setyawan AD. 2025. Traditional foodways and conservation beliefs among Javanese communities in the Paranggupito Karst, Indonesia. Intl J Trop Drylands 9: 36-49.* This study explores the interconnections between food traditions, ritual practices, and biodiversity conservation among Javanese communities living in the karst landscape of Paranggupito, Central Java, Indonesia. Drawing on ethnographic fieldwork in three villages—Songbledeg, Gudangharjo, and Gunturharjo—the research documents the use of plant and animal species in both daily diets and ceremonial contexts. It highlights how traditional foods such as *tumpeng*, *urap*, *tiwul*, and *nagasari* require specific species that are cultivated, preserved, and protected across generations. Ritual events—including *mitoni*, *nembung*, *rasulan*, and commemorations of the deceased—emerge as cultural drivers of biodiversity conservation, reinforcing the need to maintain agroecological diversity. Moreover, the study reveals how sacred beliefs and taboos, such as the protection of white Java porcupines (*Hystrix javanica*) and *Danyangan* trees (*Ficus* spp.), shape informal yet potent conservation ethics. These beliefs, deeply rooted in spirituality and upheld by social norms, significantly contribute to the sustainability of species and landscapes without the need for external regulation. The findings underscore the invaluable role of integrating indigenous knowledge and cultural practices into modern conservation frameworks, particularly in ecologically fragile regions such as karst areas. By viewing food and ritual as conduits of ecological stewardship, the study presents a compelling model of biocultural resilience where cultural identity and environmental sustainability are mutually reinforcing.

Keywords: Biodiversity, culinary heritage, Javanese rituals, karst ecosystem, traditional knowledge

INTRODUCTION

Indonesia, as one of the world's mega-biodiverse countries, harbors not only rich biological resources but also an abundance of cultural heritage across its archipelagic landscape. The intersection between biological and cultural diversity is especially evident in rural communities, where natural resource use is intimately tied to long-standing traditions, rituals, and culinary practices. These communities, through their deep-rooted knowledge and practices, play a crucial role in managing resources, a fact that we, as environmental scientists, cultural anthropologists, and policymakers, should deeply respect and appreciate. This cultural richness is supported by ecological specificity in various regions, including the karst landscapes of Java, Indonesia. In such environments, human adaptation to environmental limitations has produced locally grounded wisdom in managing biodiversity. The cultural practices of these communities—reflected in food, rituals, and taboos—constitute valuable systems of knowledge that contribute to the sustainable use of biodiversity (Batoro and Siswanto 2017; Iskandar 2017).

Among these cultural expressions, food emerges as one of the most enduring domains. It serves not only as sustenance but also as a medium of identity, spirituality, and ecological interaction. Traditional cuisine is often shaped by the availability of native plant and animal species, which are selected and maintained for their taste, symbolism, ritual function, and adaptive value. In many parts of Indonesia, particularly in Java, food plays a central role in life-cycle rituals such as birth ceremonies, weddings, and funerals. These rituals reflect a deeply rooted worldview that links human well-being to environmental balance (Bessière 1998; Nasir 2019). As a result, unique crop varieties are preserved, and agrodiversity is promoted, since ritual and everyday foods are rarely substituted or abandoned (Sutrisno et al. 2020).

The Javanese community, which comprises over 40% of Indonesia's population, upholds a diverse culinary repertoire embedded in both spiritual and ecological values (Suharnomo and Syahruramdan 2018). In the karst regions of Central Java, such as Paranggupito, agricultural practices are shaped by the challenges of shallow soils and limited water access. Here, culturally selected crops like cassava (*Manihot esculenta*), maize (*Zea mays*), and

coconut (*Cocos nucifera*) become vital. These food plants not only meet nutritional needs but also play symbolic roles in community rituals. Events such as *slametan* and *rasulan*, which are performed to honor ancestors or give thanks to nature, often feature these ingredients as offerings (Koentjaraningrat 2009; Henri et al. 2018). Food, in this context, becomes more than sustenance—it is a form of ecological stewardship.

Many of these rituals also incorporate sacred prohibitions and taboos that function as informal conservation tools. For example, the white porcupine (*Hystrix javanica*) is regarded as a spiritual guardian and is therefore protected from hunting. This belief indirectly supports government conservation efforts (Geng et al. 2017). Similarly, ritual protection is extended to spiritually charged trees such as the *banyan* (*Ficus benjamina*) or strangler fig (*Ficus annulata*), collectively known as *danyangan*. These beliefs are not written into law, yet they are practiced and internalized through cultural codes passed down across generations (Hongmao et al. 2002; Mensah et al. 2020).

Integrating such traditions into conservation frameworks has shown promise in enhancing community participation and achieving sustainable outcomes. While top-down conservation models often struggle to gain local compliance, cultural practices embedded in daily life provide a bottom-up alternative that aligns ecological health with community interests (Kealiikanakaoleohaililani et al. 2021; Ahmad et al. 2022). In Paranggupito's agricultural landscape—where forests, fields, and homes are interwoven—rituals grounded in food and spirituality serve as practical conservation mechanisms. These practices also preserve heirloom food species and foster agroecological diversity, which in turn buffers communities against climate risks and economic dependence (dos Santos et al. 2021).

Despite the pressures of modernization, Paranggupito's karst communities continue to uphold their cultural and ecological heritage through food. Traditional ingredients like tubers (*Dioscorea esculenta*), arrowroot (*Maranta arundinacea*), sticky rice, banana, and coconut remain central to both ritual and daily dishes. Their continued use reflects not nostalgia, but a conscious commitment to resilience. Culinary items such as *tiwul*, *gethuk*, *nagasari*, and *serundeng* encapsulate a system in which agriculture, spirituality, and ecological values are intertwined (Herminingrum 2019; Dewantara 2018). In this way, foodways become living expressions of memory, identity, and environmental care.

This study aims to document and analyze the role of cultural food traditions and ritual practices in biodiversity conservation among Javanese communities in the Paranggupito Karst of Central Java. It explores how local knowledge, foodways, and symbolic rituals contribute to the protection of plant and animal species, agricultural diversity, and overall ecosystem health. By examining these cultural-environmental interactions, the study offers insights into how indigenous knowledge systems can be integrated into modern conservation strategies. Ultimately, it advocates for culturally grounded, community-led approaches that strengthen both biodiversity and local livelihoods in the face of ecological change.

MATERIALS AND METHODS

Study area

This research was conducted in the karst region of Paranggupito Sub-district, located in Wonogiri District, Central Java, Indonesia (Figure 1). The area is part of the Gunung Sewu UNESCO Global Geopark, which is known for its unique karst topography and rich cultural heritage. Three villages were selected as study sites: Songbledeg Village, Gudangharjo Village, and Gunturharjo Village. These villages represent different population densities and land use characteristics within the karst system. Gunturharjo is the largest, covering an area of 10.58 km², followed by Gudangharjo (7.78 km²) and Songbledeg (7.46 km²). Based on 2023 data from the Central Statistics Agency, the populations of Gunturharjo, Gudangharjo, and Songbledeg were 3,034, 1,568, and 2,543 people, respectively (Central Statistics Agency 2023).

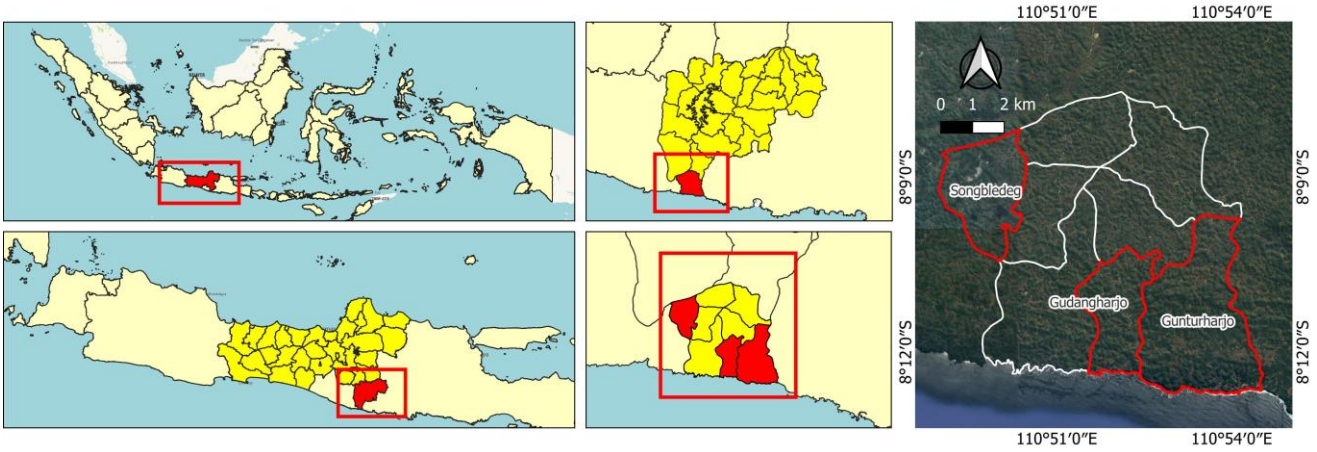

Figure 1. Map of the research location in Paranggupito, Wonogiri, Central Java, Indonesia

The karst ecosystem in this region consists of limestone hills, caves, underground rivers, and rock crevices that support distinctive biological assemblages. Vegetation is generally adapted to dry, shallow, and nutrient-poor soils, with species such as wild orchids, drought-tolerant shrubs, and small trees with deep root systems (Martosuwito et al. 2013). Fauna includes cave-dwelling bats, specialized insects, birds, and endemic aquatic organisms inhabiting subterranean streams (Sulistiyowati and Haryono 2021). The biodiversity of this karst landscape holds important ecological and economic value, supporting community livelihoods through small-scale agriculture, ecotourism, and environmental research (Tolentino et al. 2020).

Despite its ecological value, the karst landscape in Paranggupito faces ongoing threats from limestone mining, land conversion, and unsustainable natural resource extraction. These pressures highlight the urgent need for community-based conservation initiatives that integrate local cultural practices into biodiversity management. Cultural values held by local people—especially in relation to sacred trees and protected fauna—offer pathways for sustainable coexistence between humans and nature (Mensah et al. 2020).

Community and ecosystem characteristics

The communities residing in Songbledeg, Gudangharjo, and Gunturharjo Villages are predominantly farmers who rely heavily on the surrounding environment for their livelihoods. These rural populations maintain close relationships with their land, forests, and water sources, which are integral to agricultural practices, animal husbandry, and food processing. Shrubs and tree leaves are commonly collected from nearby forests to feed livestock. At the same time, local fields and gardens are cultivated with food crops such as cassava, maize, rice, and various vegetables. These practices demonstrate the community's dependence on natural cycles and reflect an agroecological system shaped by the karst environment.

The karst topography presents unique ecological challenges. Soil in these areas is often thin and rocky, limiting intensive farming and requiring adaptive strategies for food production. Terraced fields are used to maximize cultivation on sloped limestone terrain, and the cropping system is typically diversified to ensure food security throughout the dry and rainy seasons. In many cases, households maintain home gardens that serve not only as food sources but also as medicinal and ritual plant reserves, reflecting both practical and cultural functions of local biodiversity (Iskandar 2017; Sutrisno et al. 2020).

A deeply spiritual worldview underpins the environmental management practices in these villages. Sacred natural elements such as large old trees—locally known as *danyangan*—are preserved as dwelling places for spirits and ancestral guardians. These trees are ritually protected and never cut down, except for minimal trimming during ceremonial events. Similarly, certain animals, such as the white-colored Java porcupine (*H. javanica*), are protected due to taboos that associate them with mystical consequences if harmed. These cultural norms play a crucial role in local conservation ethics, indirectly protecting species and maintaining ecosystem stability (Hongmao et al. 2002; Geng et al. 2017).

The integration of ritual beliefs and environmental management is further demonstrated in annual community ceremonies such as *rasulan* and *slametan*. These ceremonies, where the entire village participates in environmental clean-up activities, offerings, and food sharing, serve as a testament to the community's commitment to preserving their cultural heritage. These events not only strengthen social cohesion but also reinforce environmentally responsible behaviors. In such ceremonies, specific trees and water sources are ritually purified, and the use of designated plant species for offerings serves as a cultural mechanism for preserving local biodiversity.

The interaction between the community and its karst ecosystem is a prime example of an ethnoecological system—one in which environmental constraints, spiritual beliefs, and cultural practices coevolve. These communities play a crucial role in managing the karst ecosystem, viewing nature not as separate from culture but as a continuum of mutual responsibility. Their way of life reflects a low-impact, high-resilience strategy for managing biodiversity in fragile ecosystems.

Data collection procedures

This study employed a qualitative ethnographic approach to document traditional practices, food systems, and conservation-related beliefs among Javanese communities in the Paranggupito Karst region. Fieldwork was conducted in three villages: Songbledeg, Gudangharjo, and Gunturharjo. The research team utilized structured and semi-structured interview guides, field notebooks, a digital camera for documentation, and a laptop for data processing and reporting.

A total of 102 respondents were interviewed, selected using a combination of purposive and random sampling techniques. Purposive sampling targeted key informants such as village elders, ritual leaders, and individuals with extensive knowledge of cultural practices and local biodiversity. These individuals were typically over 50 years old and had long-standing involvement in ritual and culinary traditions. To capture a broader range of perspectives, random sampling was also employed to include participants from diverse social, economic, and gender backgrounds within each village.

Interviews were conducted through home visits, with each session lasting approximately 30 minutes. Researchers engaged directly with participants to build rapport and ensure context-rich responses. The semi-structured interview format allowed for both guided and open-ended discussions, facilitating the collection of factual knowledge—such as species used in food or ritual—as well as insights into belief systems and taboos (Döringer 2021).

The questionnaire consisted of two sections. The first covered demographic information, including age, gender, education level, and occupation. The second explored respondents' familiarity with local flora and fauna, traditional food preparation, and participation in cultural events such as *slametan*, *rasulan*, and other ceremonies.

Specific focus was given to species used in offerings and food, the parts harvested, and the symbolic meanings attached. Information on local taboos—such as prohibitions on hunting certain animals during pregnancy—was also gathered to understand culturally embedded conservation behavior. Table 1 presents a summary of respondent demographics across the three study sites.

Interview focus and themes

The interview sessions were designed to explore various dimensions of local knowledge, with a focus on the community's relationship with biodiversity, ritual practices, and food traditions. The main themes covered during the interviews included: (i) traditional food preparation and plant use; (ii) cultural ceremonies and associated food species; (iii) spiritual beliefs and environmental taboos; and (iv) perceptions of conservation and ecological change.

Respondents were asked to describe traditional dishes and their main ingredients, with particular emphasis on local plant and animal species used in ceremonial and daily cooking. Each interview also aimed to capture the specific parts of the plants (e.g., leaves, tubers, seeds, fruits) that were harvested and their symbolic or ritual significance. These discussions provided insight into how biodiversity is maintained through the continuous use of culturally valued species, a concept aligned with previous ethnobotanical findings in other Indonesian contexts (Putri et al. 2014; Sutrisno et al. 2020).

In addition to documenting food-related knowledge, interviews investigated the structure and meaning of traditional ceremonies such as *mitoni*, *nembung*, *rasulan*, *slametan*, and death rituals. Informants were asked to explain the foods presented during these ceremonies and the cultural logic behind their selection. For example, the preparation of *tumpeng* (cone-shaped rice) during *slametan* was described as a symbol of spiritual ascent and environmental harmony. Respondents also discussed ritual taboos such as the prohibition against hunting *H. javanica* and the cultural significance of sacred trees like the *danyangan*, which reinforced local ecological ethics.

Further, respondents elaborated on their personal experiences and family traditions related to plant conservation, including the cultivation of ritual species in home gardens and the transmission of knowledge about traditional recipes. These themes helped frame biodiversity conservation not only as an ecological process but also as a cultural and spiritual one. Insights from these interviews formed the empirical basis for identifying species of cultural importance and the conservation behaviors embedded in local traditions.

Data analysis

The data obtained from interviews and field observations were analyzed using a qualitative thematic approach. This method involved identifying recurring patterns, meanings, and cultural expressions within the narratives related to biodiversity, ritual practices, and traditional food systems. Responses were first grouped into categories based on the main research themes, such as traditional food knowledge, species used in rituals, spiritual taboos, and perceived links between nature and culture. These categories were then interpreted to reveal the underlying cultural logic that informs community-based environmental stewardship (Döringer 2021).

Each plant and animal species mentioned during the interviews was documented along with its local name, scientific name, family, part used, and its role in either daily food preparation or ceremonial events. These data were used to construct a detailed inventory of culturally important species and their ethnobotanical uses. Descriptive summaries were created to explain the types of rituals, associated foods, and conservation-related beliefs, which are later presented in the next section, along with tables and figures.

Whenever possible, the analysis also linked specific practices to broader theoretical concepts in ethnobiology and conservation science. For instance, the concept of sacred species—such as the *danyangan* trees or white porcupines—was interpreted as a cultural mechanism for in situ conservation. Ritual requirements that involve precise plant species for offerings were analyzed as drivers of agrobiodiversity preservation in household gardens and terraced farms (Hongmao et al. 2002; Mensah et al. 2020). These cultural drivers are particularly significant in dryland karst regions, where ecological fragility demands sustainable land-use strategies rooted in tradition.

Moreover, the data analysis also considered external pressures—such as modernization, urbanization, and climate variability—that challenge the continuity of these cultural practices. In this context, the role of traditional foods and rituals in maintaining biodiversity was examined not only as a legacy system but also as a dynamic response to contemporary ecological and socio-economic realities. The goal of the analysis was to uncover how these culturally embedded practices function as living forms of conservation and how they may be leveraged in designing inclusive, community-based biodiversity strategies.

RESULTS AND DISCUSSION

Sociodemographic characteristics of respondents

The respondents involved in this study were residents of three karst villages in Paranggupito Sub-district: Songbledeg, Gudangharjo, and Gunturharjo. The selection of respondents focused on individuals with rich experiential knowledge related to traditional food practices, rituals, and environmental beliefs. Most participants were elderly and had strong cultural ties to ancestral traditions. The average age of respondents across the three villages ranged from 51 to 56 years, indicating that the older generation largely preserves the knowledge documented in this study.

In terms of gender distribution, female respondents constituted a slightly larger proportion of the sample in Songbledeg and Gunturharjo, while male respondents were more prevalent in Gudangharjo. This variation reflects the different roles men and women play in preserving and transmitting cultural knowledge—women often manage

food-related practices. In comparison, men may be more involved in ritual leadership and land management.

Educational attainment among the respondents was generally low, with most having completed only primary or junior secondary school. A few had no formal education, particularly among the older population. Despite limited formal schooling, these individuals possessed deep local knowledge related to biodiversity, agriculture, and cultural ceremonies. Occupationally, the majority of respondents were farmers or engaged in agroforestry, reflecting their dependence on land-based livelihoods and natural resource management. The details of respondent characteristics are summarized in Table 1.

Traditional food practices in the Paranggupito Karst

In the Paranggupito Karst region, traditional food systems are shaped by the community's dependence on locally cultivated and foraged resources. The majority of residents are subsistence farmers who process their agricultural yields into everyday meals and ceremonial dishes. This practice reinforces local food sovereignty while preserving cultural knowledge surrounding the preparation, symbolism, and seasonality of ingredients. Key staple crops include cassava (*M. esculenta*), maize (*Z. mays*), rice (*Oryza sativa*), and coconut (*C. nucifera*), which are grown on terraced lands adapted to the karst topography and limited irrigation.

Cassava holds a prominent place in local food culture. Though not native to Java, its resilience and yield have made it a staple, especially in dryland areas. A variety of dishes have evolved around cassava, such as *nasi tiwul*, *gethuk*, *romeon*, and *utri*, each with distinct preparation techniques and cultural meanings. For instance, *tiwul*—a rice substitute made by steaming dried cassava flour—is often consumed daily, while *gethuk* and *romeon* serve as snacks during social or ritual gatherings. These food items not only highlight nutritional adaptation but also cultural resilience in the face of ecological limitations (Herminingrum 2019).

Rice-based dishes such as *tumpeng* and *nasi jagung* are typically reserved for ceremonial occasions, particularly those involving communal prayers or rites of passage. *Tumpeng*, in particular, is a symbolic dish shaped like a mountain, representing the harmony between humans and nature. It is usually served with side dishes made from vegetables (*urap*), chicken (*ingkung*), eggs, and tempeh, reflecting the agricultural abundance and spiritual unity of the community (Atikaalistiana 2006; Dewantara 2018).

Other traditional foods include *urap*, *pecel*, *nagasari*, *serundeng*, *jadah*, and *ketan*, each combining locally available ingredients with culinary techniques passed down through generations. The use of fresh vegetables such as *Ipomoea aquatica* (water spinach), *Vigna unguiculata* (long bean), and *Cucumis sativus* (cucumber) reflects the integration of biodiversity into daily dietary habits. Furthermore, these dishes are commonly linked with ritual use, creating an inseparable bond between food and spirituality.

Table 2 summarizes the diversity of food traditions recorded during fieldwork. It lists 16 local food types, the species used, and the parts utilized. These traditional foods are also illustrated in Figure 2, while key food crops cultivated in the karst landscape are depicted in Figure 3.

Table 1. Sociodemographic characteristics of respondents (N=102)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	47	46.1%
	Female	55	53.9%
Age Group	40-49 years	17	16.7%
	50-59 years	54	52.9%
	≥60 years	31	30.4%
Average Age	—	—	53.68 years
Education Level	No formal education	5	4.9%
	Elementary school	49	48.0%
	Junior high school	30	29.4%
	Senior high school	14	13.7%
	Higher education	4	3.9%
Occupation	Farmer	84	82.4%
	Small trader/craftsman	10	9.8%
	Housewife	5	4.9%
	Other	3	2.9%

Figure 2. Several traditional foods in Paranggupito, Wonogiri, Central Java, Indonesia: A. *Urap* (Triasandy 2024), B. *Tumpeng* (Atikaalistiana 2006), C. *Tiwul* (Dwiwahyudi 2019)

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

Food traditions	Description	Local name	Common name	Species as the main ingredient	Family	Part used
Tumpeng	Rice is shaped like a mountain, accompanied by side dishes that are typically sourced from the people's harvest.	*Beras*	Rice	*Oryza sativa* L.	Poaceae	Seed
		Ayam	Chicken	*Gallus gallus* f *domesticus*	Phasianidae	Meat and skin
		Telur	Chicken	*Gallus gallus* f. *domesticus*	Phasianidae	Egg
		Tempe	Tempeh	*Glycine max* L.	Fabaceae	Seeds
Pecel	Vegetables that are boiled and then served with peanut sauce.	*Kangkung*	Spinach	*Ipomoea aquatica* Forssk.	Convolculaceae	Young shoots and leaves
		Kacang Panjang	Long beans	*Vigna unguiculata* (L.) Walp.	Papilionaceae	Entire part
		Mentimun	Cucumber	*Cucumis sativus* L.	Cucurbitaceae	Fruit
		Kacang tanah	Peanuts	*Arachis hypogaea* L.	Fabaceae	Seeds
		Tauge	Bean sprouts	*Vigna radiata* (L.) R.Wilczek	Fabaceae	Seeds
Nasi Tiwul	Rice with a chewy texture made from cassava flour.	*Singkong*	Cassava	*Manihot esculenta* Crantz	Euphorbiaceae	Tuber
Nasi Jagung	Rice with a sweet flavor and coarse texture made from ground corn.	*Jagung*	Corn	*Zea mays* L.	Gramineae	Seeds
Urap	Traditional salad served with seasoned grated coconut.	*Singkong*	Cassava	*Manihot esculenta* Crantz	Euphorbiaceae	Tuber
		Kacang Panjang	Long beans	*Vigna unguiculata* (L.) Walp.	Fabaceae	Entire part
		Kelapa	Coconut	*Cocos nucifera* L.	Arecaceae	Coconut fruit meat
Garut	Food made from boiled or fried arrow-tuber, which has a chewy texture and a slightly sweet flavor.	*Umbi Garut*	Arrow tuber	*Maranta arundinacea* L.	Marantaceae	Tuber
Ganyong	Food made from ganyong tubers with a chewy texture and sweetness tasted similar to potatoes.	*Umbi ganyong*	Cassava tubers	*Canna edulis* Kerr.	Cannaceae	Tuber
Gembili	Food made from boiled or steamed gembili tubers is typically served as a snack.	*Umbi Gembili*	Gembili tubers/ yam bean	*Diosorea esculenta* L.	Diosoreaceae	Tuber
Serundeng	Food made from toasted grated coconut seasoned with spices.	*Kelapa*	Coconut	*Cocos nucifera* L.	Arecaceae	Fruit
Nagasari	Steamed cake made from rice flour, coconut milk, and bananas was wrapped in banana leaves.	*Beras*	Rice	*Oryza sativa* L.	Poaceae	Seeds
		Pisang	Banana	*Musa paradisiaca* L.	Musaceae	Fruit and leaves
		Kelapa	Coconut	*Cocos nucifera* L.	Arecaceae	Coconut fruit water
Utri	Snack made from grated cassava, mixed with palm sugar, wrapped in banana leaves, and steamed.	*Singkong*	Cassava	*Manihot esculenta* Crantz	Euphorbiaceae	Tuber
		Gula Jawa	red sugar	*Cocos nucifera* L.	Arecaceae	Coconut tree sap
Ketan	Sticky rice is a type of rice that has a high starch content, which makes it sticky when cooked.	*Beras Ketan*	Sticky rice	*Oryza sativa* var. *glutinosa*	Poaceae	Seed

Jadah	Traditional food made from steamed sticky rice	*Beras Ketan*	Sticky rice	*Oryza sativa* var. *glutinosa*	Poaceae	Seed
		Kelapa	coconut	*Cocos nucifera* L.	Arecaceae	Coconut meat
Gethuk	Preparations were made from crushed cassava and usually mixed with sugar and coloring.	*Singkong*	Cassava	*Manihot esculenta* Crantz	Euphorbiaceae	Tuber
		Kelapa	coconut	*Cocos nucifera* L.	Arecaceae	Coconut meat
Manggleng	Meals were made from steamed or boiled cassava (manioc) that is then mashed and mixed with grated coconut and sugar. This dish has a chewy texture and a sweet flavor.	*Singkong*	Cassava	*Manihot esculenta* Crantz	Euphorbiaceae	Tuber
		Kelapa	Coconut	*Cocos nucifera* L.	Arecaceae	Coconut fruit meat
		Gula Pasir	Sugarcane	*Saccharum officinarum* L.	Poaceae	Sugarcane stalks
Romeon	Cassava chips are food made from thinly sliced cassava and then fried using cooking oil.	*Singkong*	Cassava	*Manihot esculenta* Crantz	Euphorbiaceae	Tuber

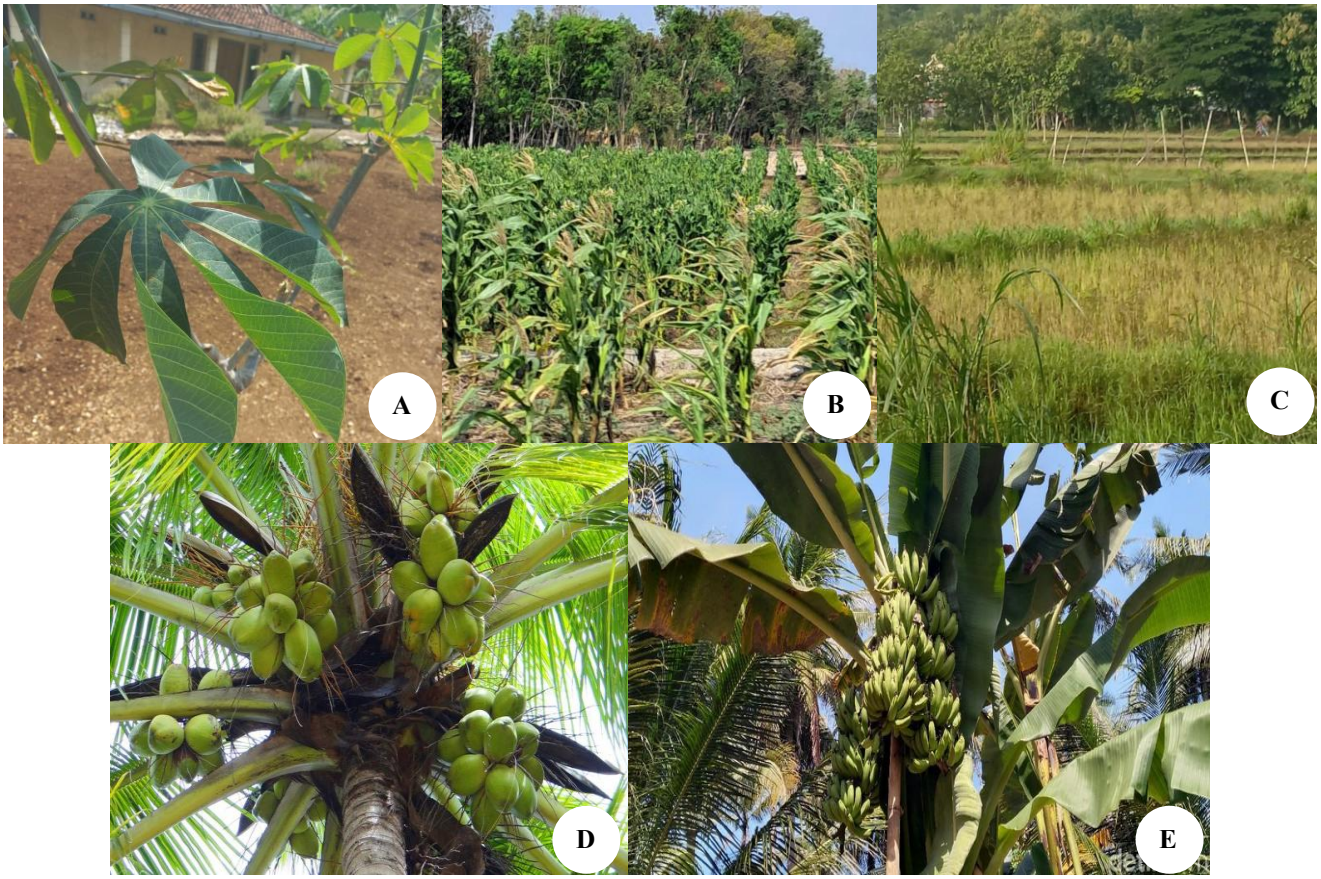

Figure 3. Several plants are used for making traditional foods in dryland Paranggupito Karst, Wonogiri, Indonesia. A. Cassava (*Manihot esculenta*), B. Corn (*Zea mays*), C. Rice (*Oryza sativa*), D. Coconut (*Cocos nucifera*), E. Banana (*Musa paradisiaca*)

Traditional food is not only a matter of sustenance but also functions as a regional identity marker and potential driver of community-based ecotourism. The diversity of flavors, ingredients, and preparation styles offers economic opportunities through culinary tourism while contributing to biodiversity conservation by maintaining the cultivation of heirloom crops. As reported in other contexts (Samtono et al. 2022), such community-centered culinary practices can enhance food security, cultural pride, and ecological resilience.

Ritual ceremonies and symbolic food

Rituals and ceremonies occupy a central role in the cultural life of Javanese communities in the Paranggupito Karst region. These events—spanning life-cycle transitions from pregnancy to death—are expressions of gratitude, spiritual protection, and communal identity. Food offerings are integral components of these ceremonies, functioning as both symbolic gestures and instruments for ecological continuity. The preparation, selection, and serving of particular foods reflect deeply held cosmological beliefs and ecological awareness.

One of the most prominent ritual traditions is the *slametan*, a communal prayer event performed at various points in life such as childbirth (*mitoni*), postnatal blessings (*sepasaran*), marriage arrangements (*nembung*), weddings, and death commemorations (*nyewu*). In each of these events, food plays a vital symbolic function. For instance, *tumpeng*—a cone-shaped rice dish—serves as a centerpiece of offerings, symbolizing mountains and the balance of the universe. The accompanying side dishes (e.g., *ingkung*, *urap*, *tempeh*, eggs) are carefully chosen not only for their availability but also for their symbolic resonance (Dewantara 2018).

In childbirth ceremonies such as *bancakan* and *mitoni*, *tumpeng* is served alongside other dishes to invoke blessings for the mother and unborn child. During *kething-kething*, a buffalo-head-shaped dish called *kebo gerang* is presented as a prayer for strength and endurance in toddlers. In marriage rituals like *nembung* and *sisetan*, *ketan* (sticky rice) and *jadah* (glutinous rice cake) represent commitment, unity, and harmony, as the sticky texture metaphorically bonds the couple.

Ritual foods are also presented in sequences during funerary ceremonies—from *geblag* (first day) to *nyewu* (1,000th day)—with *tumpeng* and goat meat being commonly served to symbolize sustenance for the soul's journey and appreciation for those conducting the burial. The layers of symbolic meaning attributed to food in these events are crucial to understanding how biodiversity is embedded within ritual frameworks.

Table 3 provides a comprehensive summary of these ritual events, the associated dishes, and their cultural meanings. Figure 4 shows visual documentation of selected ceremonies.

These ceremonial practices promote the continuity of plant and animal use within culturally regulated cycles. Because specific species are required for offerings—such as coconut (*C. nucifera*), glutinous rice (*O. sativa* var. *glutinosa*), banana (*Musa paradisiaca*), and cassava (*M. esculenta*)—their cultivation is preserved, and knowledge of their preparation is passed on through generations. In this way, ritual foods act not only as cultural expressions but also as tools for species conservation.

The strict ritual codes surrounding food use reinforce the value of biodiversity beyond mere subsistence. They represent a culturally embedded conservation strategy, where species are protected and nurtured due to their spiritual importance and irreplaceable roles in communal life.

Cultural beliefs and taboos supporting species conservation

In the Paranggupito Karst communities, deeply rooted cultural beliefs and taboos serve as informal mechanisms for wildlife and habitat conservation (Figure 5). These unwritten rules, transmitted orally and embedded in local cosmologies, play a crucial role in shaping community behavior toward the environment. Rather than relying on formal enforcement, conservation is achieved through fear of spiritual consequences, respect for ancestral teachings, and adherence to ritual norms. Such culturally grounded practices demonstrate how indigenous belief systems can align closely with ecological sustainability goals (Hongmao et al. 2002; Geng et al. 2017).

One notable belief held by local residents is the prohibition against hunting white-colored Java porcupines (*H. javanica*). These animals are considered spiritual beings or "queens" of their species. The presence of a white porcupine is thought to signify supernatural warning, and those who attempt to harm or kill them are believed to suffer misfortune, illness, or crop failure. Although the white morph is rarely, if ever, observed, the myth surrounding it ensures protection for the entire porcupine population, including the more commonly seen brown individuals. This culturally maintained taboo thus functions as a highly effective conservation tool, reducing hunting pressure on a protected species that is listed under Indonesia's Ministry of Environment and Forestry Regulation No. P.106/MENLHK/SETJEN/KUM.1/6/2018.

Another form of ecological stewardship is observed in the reverence for sacred trees, particularly large, old *banyan* trees (*F. benjamina*) and strangler figs (*F. annulata*), collectively known as *danyangan*. These trees are seen as the spiritual homes of ancestral spirits and are considered untouchable outside of ritual contexts. They are ritually cleaned during the annual *rasulan* ceremony, but cutting or damaging them outside this event is strongly discouraged. As a result, these trees are preserved for generations, serving as keystone habitats for birds, mammals, insects, and epiphytes. Their large biomass also contributes significantly to local carbon sequestration, soil stability, and microclimate regulation (Mensah et al. 2020).

In addition to animal and plant taboos, the community also practices behavioral restrictions during sensitive periods. For example, men with pregnant wives are forbidden from hunting or killing animals, based on the belief that doing so may cause physical or spiritual harm to the unborn child. This belief not only serves as a protective measure for the child but also helps reduce hunting during certain seasons, allowing animal populations to recover. These belief systems reflect a profound understanding of ecological interdependence. While they are not derived from scientific frameworks, their effects align closely with conservation principles. By imposing spiritual boundaries on resource exploitation, these practices contribute to the sustainability of species and ecosystems without requiring external intervention. Furthermore, they foster a collective sense of responsibility and continuity, ensuring that ecological ethics are embedded in everyday life and transmitted across generations.

Table 3. Rituals performed by villagers

Event	Name of ceremony	Major food arrangements involved in the ceremony	Description of the foods/species	The meaning of the ceremony
Birth	*Bancakan* (3 months pregnant) and *Mitoni* (7 months pregnant)	*Tumpeng*	*Tumpeng* is a cone-shaped rice. At the bottom of the cone are various dishes, such as *ingkung*, which is chicken cooked with coconut milk and bay leaves; *urap* or vegetables mixed with grated coconut; eggs, tofu, tempeh, and meat.	Form of gratitude and a means to ask for safety and a smooth delivery process.
	Sepasaran bayi	*Sego tumpeng janganan*	Yellow cone-shaped rice with various side dishes was served, such as fried chicken, omelet, salted fish, braised tofu, and tempeh.	The tradition of welcoming the birth of a baby is carried out on the fifth day after the baby is born as a form of prayer and hope that the baby will receive safety and protection in his life.
	Kething-kething	*Kebo gerang*	*Jadah* is food made from ketan or glutinous rice (made of *Oryza sativa* var. *glutinosa*), which is shaped like a buffalo's head and given horns from a coconut.	As a form of celebration and prayer for children aged 2-3 years. In this tradition, children will be asked to choose various foods or objects provided in front of them, each of which symbolizes a certain aspect of life, talent, or future. Kebo gerang itself can symbolize strength and physical endurance.
	Upacara Adat Anak	*Jajan pasar*	Snacks such as *nagasari* are made from a mixture of rice flour and bananas wrapped in banana leaves (*Musa* spp). *Kolong* snacks, on the other hand, can be made from sticky rice flour or cassava (*Manihot esculenta*), etc.	Symbolic meaning as a representation of prosperity, blessings, and abundance. The shape and variety of market snacks show hope for a colorful, diverse, and rich life.
Adult	*Nembung (menjelang pernikahan)*	*Ketan*	Ketan is a traditional sticky rice dish made from *Oryza sativa var. glutinosa* (glutinous rice), known for its natural stickiness when cooked.	Pre-marriage tradition to clarify the commitment between a man and a woman. It establishes whether both parties are seriously considering marriage. A symbolic gesture involves offering ketan (glutinous rice), which represents a bond or commitment, as it adheres tightly, signifying that the woman is "bound" if she accepts it.
	Sisetan	*Jadah*	Sticky rice cake was made of ketan or glutinous rice (*Oryza sativa* var. *glutinosa*) mixed with coconut (*Cocos nucifera*).	Sisetan symbolizes the binding between two people in a romantic relationship. The sticky texture of this jadah (traditional sticky rice cake) represents the wish for the engaged couple to remain inseparable and united until their marriage ceremony.
	Wedding	*Tumpeng*	A cone-shaped rice. At the bottom of the cone are various dishes, such as *ingkung* made from chicken cooked with coconut milk and bay leaves; *urap* or vegetables mixed with grated coconut; eggs, tofu, tempeh, and meat.	The tumpeng, a cone-shaped rice structure, represents the ecosystem and resembles a mountain, representing harmony within the environment. The array of accompanying dishes signifies abundance and prosperity.

Death	*Geblag* (the first day of a person's death), *Nelung dino* (the third day of a person's death), *Pitung dino* (the seventh day of a person's death), *Patangpuluh* (40 days of a person's death), *Pendak 1* (1 year), *Pendak 2* (2 years), and *Nyewu* (1000 days)	*Tumpeng*	The same as above, except on *geblag* (the first day of a person's death), the family typically slaughters a goat.	The succession of funeral ceremonies serves as stages of spiritual support and honor to the departed. The cone-shaped rice tumpeng symbolizes the balance of nature and interconnected life. Various dishes at the base of the tumpeng represent life's elements, representing the soul's journey and the family's prayers for peace and spiritual tranquility. The slaughtering of a goat is seen as a means of exchange that aids the spiritual journey of the deceased. The goat meat is subsequently given primarily to key individuals involved in the burial, like the gravediggers, as an expression of appreciation for their service. This distribution reinforces community ties and honors those assisting in the funeral rites.

Figure 4. Ceremonies performed by villagers A. Wedding (Oktavia et al. 2022), B. *Mitoni* (Intani and Damayanti 2018), C. Death ceremony (Dewantara 2018)

Figure 5. Culturally protected species and sacred trees in the Paranggupito Karst landscape. A. Javan porcupine (*Hystrix javanica*), considered a sacred animal and protected by taboo, B. *Banyan* tree (*Ficus benjamina*), locally known as *danyangan*, ritually preserved as a spiritual dwelling and biodiversity refuge

Contribution of food and ritual traditions to biodiversity conservation

Traditional food and ritual practices in the Paranggupito Karst landscape are more than cultural expressions—they serve as active mechanisms for biodiversity conservation. The sustained use of specific plant and animal species in both daily life and ceremonial contexts reinforces agrobiodiversity and ecological stewardship. Species such as *O. sativa* (rice), *C. nucifera* (coconut), *M. paradisiaca* (banana), and *M. esculenta* (cassava) are consistently cultivated because of their ritual significance in dishes like *tumpeng*, *urap*, *tiwul*, and *nagasari*. These dishes, essential

in life-cycle ceremonies from birth to death, generate a cyclical demand that ensures the continuous propagation of these culturally important crops in home gardens and farms.

Food-related rituals not only preserve species but also promote environmental ethics. Taboos—such as prohibitions against hunting *H. javanica* or cutting sacred *Ficus* trees (*danyangan*)—act as informal governance systems. These beliefs, rooted in spiritual worldviews, discourage overexploitation and foster respect for local fauna and flora. Since such taboos are enforced through cultural norms rather than external regulations, they tend to be resilient to ecological and socio-economic pressures.

Agricultural practices in the region mirror this ethos. Local gardens are planted with a diverse array of species—including *M. arundinacea*, *Canna edulis*, *D. esculenta*, *Leucaena leucocephala*, and *Moringa oleifera*—which serve culinary, medicinal, and ritual purposes. These multifunctional gardens act as micro-reserves for plant genetic resources while supporting household nutrition and ritual needs. Collective ceremonies such as *rasulan* also demonstrate how ritual fosters conservation behavior. During these events, community members purify sacred trees and springs, prepare traditional foods, and reaffirm their ecological responsibilities. Such activities embed biodiversity care within communal routines and intergenerational knowledge.

Ultimately, the foodways and ritual practices of the Paranggupito Karst communities represent a locally grounded model of conservation. By linking ecological function with cultural meaning, these traditions support species continuity, cultural resilience, and sustainable land use. In ecologically fragile karst systems where top-down conservation often falters, these bottom-up, community-led practices offer enduring strategies for preserving biocultural diversity.

Several culturally important species—such as *L. leucocephala*, *M. arundinacea*, *C. edulis*, and *F. annulata*—were documented through narrative accounts and interviews. Although not included in Tables 2 or 3 due to insufficient frequency data, their roles in ritual practices, food systems, and homegarden diversity are explained in the main text.

Discussion

Ritual food practices as cultural drivers of biodiversity conservation

Ritual food practices in the Paranggupito Karst landscape embody a form of biocultural conservation, where culinary traditions actively contribute to maintaining species diversity and ecological balance. Far from being merely symbolic, these practices rely on the consistent use of specific plants, which must be cultivated, foraged, or protected to sustain ritual functions. Dishes such as *tumpeng*, *urap*, *tiwul*, *nagasari*, and *gethuk* depend on a variety of plant species, embedding them within seasonal agricultural cycles and household agroecosystems.

The ritual prominence of *tumpeng*, a cone-shaped rice dish symbolizing the cosmic mountain, illustrates how food reinforces ecological thinking within cultural contexts. This ceremonial dish is accompanied by *urap*, *ingkung*, and tempeh (from *Glycine max*), promoting a diverse, multi-species food system. Ingredients include *O. sativa*, *V. unguiculata*, *Arachis hypogaea*, *I. aquatica*, and *C. nucifera*, among others, as reflected in Table 2 and Figures 2-3. Such culinary diversity sustains both nutritional and ecological resilience through integrated farming practices.

Ritual events throughout the life cycle—such as *mitoni* (prenatal blessing), *sepasaran bayi* (infant ritual), and *rasulan* (village purification)—create strong incentives to grow and maintain culturally significant crops. These patterns mirror findings from other ethnobotanical contexts, where sacred plant use fosters long-term species conservation (Geng et al. 2017; Sutrisno et al. 2020). Thus, food sustains ritual, and ritual in turn sustains biodiversity.

Crops like *M. esculenta* (cassava), *M. arundinacea* (arrowroot), and *D. esculenta* (yam) are central to daily and ceremonial diets. Their consistent use supports their conservation within karst-based agriculture. These tubers are not selected merely for productivity but for cultural relevance and ecological adaptability—a contrast to market-driven monocultures (Bérard and Marchenay 2006).

Ritual needs influence agricultural planning, encouraging species diversification, seed saving, and knowledge transmission across generations. Home gardens and terraced plots are often managed with upcoming ceremonies in mind, ensuring continuity through both cultural and ecological stewardship. This reflects what Hongmao et al. (2002) term "traditional conservation through use," where survival of species is ensured through embedded cultural practice.

In the fragile karst environment, where soils are shallow and water scarce, this ritual-based food system builds resilience. It not only safeguards agrobiodiversity and food sovereignty but also functions as a living cultural archive, preserving ecological knowledge, crop diversity, and community autonomy in the face of modern agricultural change.

Sacred beliefs and informal conservation ethics

In Paranggupito, local belief systems function as a powerful ethical framework for biodiversity conservation. These systems are expressed through taboos, myths, and spiritual practices that govern human interactions with nature. Though unwritten and passed down orally, they are widely respected and often more strictly followed than formal legal regulations. This aligns with the concept of "sacred ecological knowledge," in which spiritual and moral values are intimately linked to environmental stewardship (Geng et al. 2017; Kealiikanakaoleohaililani et al. 2021).

One well-known example involves the taboo against hunting white-colored *H. javanica* (Java porcupine), which is believed to be a sacred creature or queen of its species. Even though sightings of white porcupines are rare or possibly mythical, the belief discourages hunting of all porcupines to avoid spiritual consequences. This taboo functions as a form of species-level protection and mirrors legal efforts, since *H. javanica* is listed as a protected species in Indonesia (under Indonesia's Ministry of

Environment and Forestry Regulation No. P.106/MENLHK/SETJEN/KUM.1/6/2018. The convergence of cultural beliefs and state policy illustrates how informal and formal conservation mechanisms can reinforce each other.

Sacred trees, particularly *F. benjamina* and *F. annulata*, known locally as *pohon Danyangan*, also play a vital role in this spiritual ecology. These trees are believed to be inhabited by ancestral spirits and are ritually cared for but never felled. As shown in Figure 5, they function ecologically as keystone structures, providing habitat, stabilizing slopes, and storing carbon. Their spiritual status grants them protection from land-use change, ensuring continuity in both ecological and cultural landscapes.

Belief-based prohibitions also guide behavior during sensitive life stages. For example, men with pregnant wives are traditionally forbidden from killing animals, out of fear that it may harm the unborn child. This taboo not only expresses intergenerational care but also reduces hunting pressure during critical periods. Such reproductive taboos have been documented in other indigenous communities and serve as culturally embedded mechanisms for wildlife conservation (Hongmao et al. 2002; Sharma and Pegu 2011).

Unlike externally imposed conservation rules, these sacred beliefs are upheld through collective memory, fear of supernatural repercussions, and respect for tradition. They create "invisible fences" that limit access and exploitation without physical barriers. In fragile karst ecosystems, where enforcement is often limited, these culturally grounded norms offer resilient and effective conservation models. By merging spirituality, morality, and ecological knowledge, Paranggupito's belief systems generate a conservation ethic that is holistic and deeply rooted in daily life. Together with ritual food practices and ecological customs, they illustrate how culture and nature are tightly interwoven and mutually reinforcing.

Culinary traditions, food sovereignty, and ecological resilience

The culinary traditions of the Paranggupito Karst communities are deeply rooted in their dryland environment, where limited water and poor soils necessitate adaptive strategies for food security and sustainable resource use. These traditions serve not only cultural functions but also support local food sovereignty and ecological resilience.

Staple crops such as *M. esculenta* (cassava), *Z. mays* (maize), and *O. sativa* (rice) form the backbone of local agriculture. Cultivated on terraced slopes that help conserve water and prevent erosion (Figure 3), these crops are rotated with legumes, vegetables, and tubers to improve soil fertility and break pest cycles. Beyond agronomic considerations, crop selection is closely tied to cultural practices—for example, cassava is essential for making *tiwul*, a traditional food consumed in both everyday and ritual contexts. Home gardens play a complementary role by hosting a wide variety of useful plants, including *M. oleifera*, *C. nucifera*, *Capsicum* spp., *V. unguiculata*, and *M. paradisiaca*. Managed primarily by women, these gardens serve as vital sources of food, medicine, and ritual materials. As noted by Bérard and Marchenay (2006), such gardens act as "cultural reservoirs," conserving plant diversity and traditional ecological knowledge across generations.

The preparation of traditional foods such as *urap*, *nagasari*, *jadah*, and *romeon* (Figure 2) emphasizes seasonal, plant-based ingredients and energy-efficient methods. Manual processing and communal preparation foster social cohesion and intergenerational knowledge transfer. These practices contrast with industrial food systems that often fragment communities and impose environmental costs (dos Santos et al. 2021).

Importantly, the community's control over seeds, cropping patterns, and food preparation methods reflects a strong commitment to food sovereignty. This form of autonomy is not only political but ecological, enabling decisions that sustain both cultural identity and agroecosystem resilience. The foodways of Paranggupito represent more than cultural heritage—they are adaptive, ecologically grounded systems of knowledge and practice. By linking biodiversity conservation with daily sustenance, they offer a compelling model of biocultural resilience in a changing environment.

Integration of indigenous knowledge into contemporary conservation discourse

The study underscores the crucial role of indigenous knowledge systems in biodiversity conservation, particularly in ecologically sensitive areas like the Paranggupito Karst in Java. Despite being marginalized in formal policy and scientific discourse, local traditions—rooted in ritual, taboo, and food culture—offer rich ecological insights and enduring sustainability practices. Integrating these systems into modern conservation frameworks is not only a matter of cultural respect but a strategic necessity for long-term ecological resilience. In Paranggupito, community-based conservation arises organically through culturally embedded practices. Activities such as planting ritual crops, protecting sacred trees, and observing wildlife taboos foster ecological stewardship without the need for external enforcement. These systems are sustained by spiritual beliefs, social norms, and everyday needs—dimensions often lacking in conventional, top-down conservation programs (Kealiikanakaoleohaililani et al. 2021).

Recognizing these cultural mechanisms within broader conservation strategies can enhance both equity and effectiveness. Local communities are often the most consistent guardians of their environment, but remain underrepresented in conservation planning. Bridging scientific and indigenous knowledge requires a paradigm shift that views culture not as an obstacle, but as a foundational element of conservation. Ethnobiological documentation, such as this study, plays a vital role in illuminating the ways cultural practices sustain biodiversity (Hongmao et al. 2002; Iskandar 2017). Moreover, indigenous knowledge fills critical gaps left by ecological science, which excels in modeling ecosystems but often overlooks the socio-cultural factors that drive land use and

species resilience. Indigenous perspectives capture long-term environmental observations and relational values central to place-based conservation. This synergy has been demonstrated in sacred groves in India and agroforestry systems in Latin America, and is evident in the Paranggupito Karst.

Although global frameworks like the Convention on Biological Diversity (CBD) and Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) increasingly recognize local knowledge, on-the-ground implementation is still lacking. Future conservation must adopt inclusive, co-developed approaches that empower communities and legitimize food and ritual traditions as integral parts of environmental governance. The cultural systems of Paranggupito are not static relics, but dynamic and adaptive frameworks that offer relevant models for contemporary, just, and sustainable conservation.

In conclusion, this study demonstrates that the culinary and ritual traditions of the Javanese communities in the Paranggupito Karst region are closely linked to biodiversity conservation. Traditional food practices, including the preparation of *tumpeng*, *tiwul*, *urap*, and other culturally embedded dishes, require the continued cultivation and use of specific plant species, thereby promoting agrobiodiversity and the conservation of heirloom crops. Ritual events such as *mitoni*, *rasulan*, and *slametan* serve as culturally sanctioned spaces for environmental management, where symbolic foods and sacred practices reinforce ecological ethics. Informal conservation is further strengthened through local taboos, such as the prohibition against hunting white porcupines (*H. javanica*) and the protection of sacred *danyangan* trees (*Ficus* spp.), which function as spiritual, ecological, and social foundations in the community. These beliefs and customs, passed down through generations, form a sophisticated system of indigenous environmental management that continues to shape land use, species protection, and food systems in the karst landscape. By maintaining ritual obligations and culinary identity, these communities ensure the sustainability of their ecosystems in ways that are self-regulated, spiritually meaningful, and ecologically healthy. The findings of this study confirm that integrating indigenous knowledge into formal conservation discourse is not only feasible but essential for culturally relevant and community-based biodiversity strategies. In an era of accelerating environmental degradation and cultural homogenization, the Paranggupito case offers a compelling model of biocultural resilience, where food, belief, and ecology coexist in mutually reinforcing harmony.

ACKNOWLEDGEMENTS

The authors would like to express their sincere gratitude to the community members of Songbledeg, Gudangharjo, and Gunturharjo Villages in Paranggupito, Wonogiri, Central Java, Indonesia, for their valuable participation, trust, and openness throughout the research process. Special thanks are extended to the village elders and traditional leaders who generously shared their cultural knowledge, rituals, and experiences, contributing significantly to the depth of this study. The authors also acknowledge the assistance of local authorities and field facilitators for their logistical support and coordination during data collection. This research would not have been possible without the warm hospitality and collaborative spirit of the local communities. The authors declare no conflict of interest related to this study.

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