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# Diversity of rice landraces and taxonomic strategies in Kanekes folk-biology as insights for biocultural conservation

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**Abstract.** *Mulyanto D, Iskandar BS, Aulia SAZ, Ruswanda AS, Sobarna C, Iskandar J. 2026. Diversity of rice landraces and taxonomic strategies in Kanekes folk-biology as insights for biocultural conservation. Asian J Ethnobiol 9 (1): y090114. https://doi.org/10.13057/asianjethnobiol/y090114.* The Kanekes of Western Java, Indonesia, one of the last indigenous communities practicing upland rice-based agroforestry, hold a rich folk-taxonomic system that reflects the connection between language and biological knowledge. Rapid infrastructure development has increased interactions with the outside world, putting pressure on cultural and linguistic resilience. Semi-structured interviews were conducted with 43 local expert informants, aged 40-70 years. Data were then analyzed through folk taxonomic classification and linguistic analysis of the naming structures. The Kanekes people named 89 upland rice landraces using a binomial structure, with the second lexeme serving as a descriptor. About 46.06% of identified landraces used other plants' names as descriptors, many of which also held cultural significance in the ethnobotany of the Kanekes. Other descriptors included terms related to the shape, quality, and color of the rice plant parts. This study shows that the widespread use of cross-species metaphors in upland rice nomenclature serves as an important cognitive process for intraspecific classification, connecting sensory perception, ecological familiarity, and cultural memory. These findings enhance ethnobiological models of folk taxonomy by illustrating how metaphorical descriptors integrate landraces within wider ecological and linguistic networks. This case further exemplifies that biocultural conservation relies on preserving crop diversity and maintaining the ecological and linguistic frameworks that facilitate knowledge transmission and varietal identification.

**Keywords:** Baduy, bio-cultural diversity, folk-taxonomy, intraspecific classification, nomenclature

## INTRODUCTION

A large number of farmers around the world grow landraces (Van Andel et al. 2019). Landraces are groups of crops selected by local communities over time. These crops are adapted to the local climate, environment, and ways of life (Casañas et al. 2017). Landraces are part of the local environment and traditions, helping to preserve cultural heritage through their genetic resources (Cabanting and Perez 2016). They also help maintain cultural services like food production and environmental stability (Pfeiffer et al. 2006; Eticha et al. 2010; Ficiciyan et al. 2018; Gepts 2023; Ortman et al. 2023). However, since most of the genetic variety in crops is found in landraces, the growing use of modern, uniform plant varieties is causing a loss of biodiversity (Dyer et al. 2014; Akhalkatsi et al. 2017; Lodhi et al. 2020; Britwum and Demont 2022; Khoury et al. 2022; Almeida et al. 2023).

Asian rice (*Oryza sativa*) is highly diverse in biological, cultural, and linguistic aspects, which is crucial for the nutrition, adaptability, and cultural resilience of Asian communities (Van Driem 2012; Zapico et al. 2015; Deb 2017; Wang et al. 2024). Rice is not only a staple food in most parts of Asia, but it also plays an essential role in marking the rhythm of the year through changes in seasons and rituals. The cultivation of rice has shaped festivals, customs, proverbs, and the structure of language, fostering an interdependent cultural mindset among Asians (Ko 2016). For example, the myth of the rice goddess is common in Southeast Asia and conveys shared ideas about fertility. Additionally, folk beliefs surrounding rice cultivation and storage, along with related rituals, are fundamental to Southeast Asian culture (Walker 1994; Crystal and Whittlesey 2004; Qing and Lesmana 2022).

Upland rice farming has developed over a long time through cultural choices, leading to farming and language practices that fit local areas (Zapico et al. 2015; Wangpan et al. 2019). However, its biological diversity as well as cultural and linguistic richness are threatened by homogenization and socio-economic modernization

(Ishikawa et al. 2006; Zapico et al. 2020; Pieroni 2022). In Southeast Asia, rice farming has become a major industry, and it is now mostly carried out on a large scale. Meanwhile, government and rule-making groups are marginalizing the role of upland rice (Heidhues and Rerkasem 2006).

Studies have established a strong correlation between biodiversity, linguistic, and cultural diversity (Maffi 2005; Franco and Narasimhan 2009; Franco et al. 2015; Hidayati et al. 2017; Franco 2021; Hidayati et al. 2022; Roy et al. 2024). The Kanekes people, the only indigenous people in Western Java, Indonesia, still practicing traditional upland rice-based agroforestry, have developed a rich body of knowledge about ecosystems and the biotic resources they use, based on dynamic relationships between population structure, agricultural practices, and their way of life. This knowledge helps them interact with their environment in ways that align with their cultural customs (Iskandar and Iskandar 2016; Iskandar et al. 2018; Arifiani et al. 2019; Iskandar and Iskandar 2021; Iskandar et al. 2024). However, increasing pressures from modernization and the homogenization of lifestyles, caused by greater contact with the modern world, pose a threat to their cultural and linguistic resilience. According to Ethnologue, their language is classified as an "endangered indigenous language of Indonesia" (ethnologue.com/language/bac/). Unfortunately, until recently, research on the folk-biological aspects of this language has been limited (Iskandar and Ellen 1999; Hidayati et al. 2022).

The process of classifying and naming surrounding plants and animals is a fundamental aspect of folk biological systems across the globe (Berlin 1992). Humans have an inherent desire to distinguish, categorize, and relate different elements, which allows them to navigate and understand their environment (Ellen 2008). This ability not only helps in memorizing information but also supports reasoning and interaction with the natural world (Ulicsni et al. 2016; Loko et al. 2018; Phaka et al. 2019; Tokuoka et al. 2019; Mandakh et al. 2020; Addi et al. 2022; Wang et al. 2024; Mziray and Lusekelo 2025). As such, understanding the connection between language and biological knowledge is crucial for preserving both cultural and ecological diversity (Loh and Harmon 2005; Maffi 2005). However, most ethnobotanical research has focused on folk-class (life form) and folk-generic levels. With limited attention given to folk-specific and folk varietal levels, this study examines how the Kanekes classify, name, and identify their upland rice landraces. By documenting and analyzing the naming patterns and metaphorical descriptors for these varieties, it explores how such nomenclature explains connections between local species and cultural knowledge, and assesses its role in preserving biocultural diversity in the middle of socio-ecological transformation.

## MATERIALS AND METHODS

### Study area

This study was carried out in Kanekes Village, Lebak District, Banten, Indonesia (6°38'35" South and 106°14'34" East; Figure 1), approximately 156 km southwest of Jakarta, the capital of Indonesia. Kanekes Village covers 51 square kilometers and is home to around 11,600 people, who are commonly referred to by their neighbors as the Baduy. Situated at the base of the Kendeng mountains in Western Java, the Kanekes people are divided into two main groups: The *Tangtu* (Inner Baduy) and the *Panamping* (Outer Baduy). The *Tangtu* group resides in three isolated hamlets, strictly follow traditional customs, and have had very limited contact with outsiders. Some of their most sacred rituals are still not permitted for outsiders, including the *Panamping*, to participate in, except for their respective leaders. In contrast, the *Panamping* live outside the boundaries of the *Tangtu*'s sacred land and are permitted to engage in certain activities strictly forbidden to *Tangtu* members.

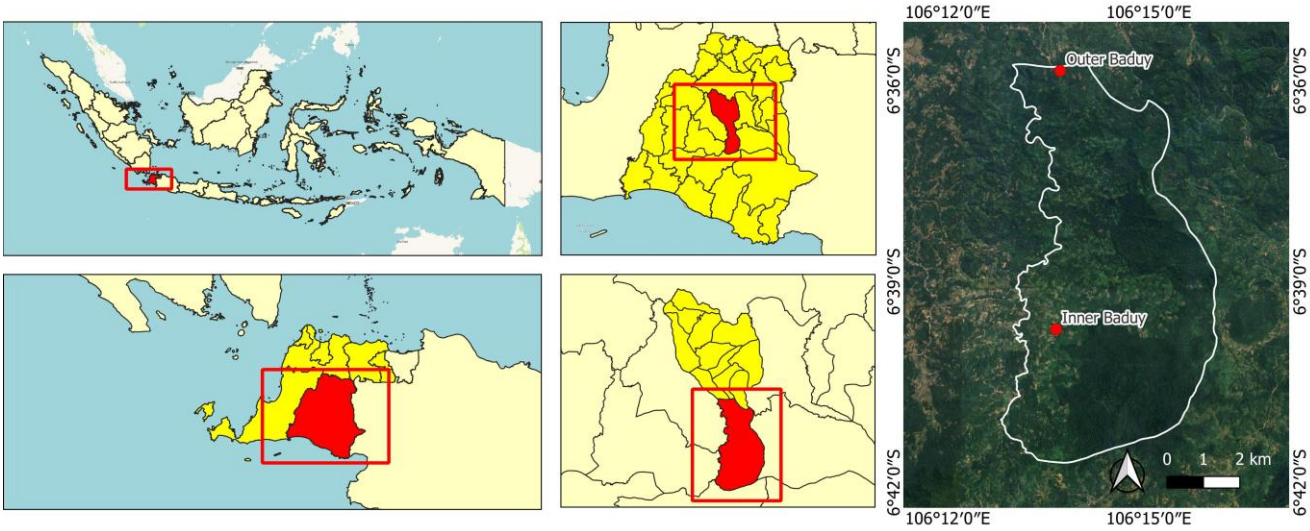


**Figure 1.** The map of the study area, Kanekes area in Lebak District, Banten, Indonesia

The Kanekes practice upland shifting farming (*huma),* with rice as the central crop. Their yearly rituals and schedule are based on the rice cycle (Iskandar and Iskandar 2016). Many rules are followed by all Kanekes families, such as the prohibition on planting new rice varieties, growing rice in wet or terraced areas, andusing man-made fertilizers or chemicals.

Their language belongs to the Sundanese-Badui language group, which is a member of the Malayo-Polynesian within the Austronesian language family (Hammarström et al. 2024). It used to be considered a dialect of Sundanese, but now it is considered a separate language because it has different words and cultural practices compared to other Sundanese speakers (Blust 2013). There are significant differences not only in words related to family, pronouns, greetings, and how people refer to things, but also in words for things like natural features, colors, and shapes. However, the Kanekes people, especially those in the *Panamping* area, have been getting more in touch with the outside world, mainly through ecotourism and becoming more connected with the rest of Indonesia, are making their language and culture change faster than ever. Now, more and more *Panamping* people use Sundanese, or even Bahasa Indonesia, when talking to government workers, tourists, and researchers. Some have even become Muslim, resulting in their exclusion from the Kanekes community (Suryani 2021).

**Data collection**

Data were gathered through semi-structured interviews to learn about the language used in local knowledge related to rice landraces. These landraces have special names that show how people connect with their local environment, including the names of plants and animals. Information about these plants and animals was collected, including the physical features that local people think have special meanings connected to certain rice landraces. Even though knowledge about upland rice landraces is not tied to a particular cultural area, people who were first interviewed often suggested others they thought were better suited to discuss this knowledge, as they were seen as knowledgeable about it (da Silva et al. 2014; Espinosa et al. 2014). Using this method of finding people through recommendations, 43 people (aged 40-70) were interviewed. The data saturation point is reached when no further names or details about new landraces are found, and no new people from the same village are mentioned by previous informants as experts, except those who have already been interviewed. Interviews were conducted across three different hamlets (one in *Tangtu* and two in *Panamping*). This distinction is methodologically important because of the differential access, language use, and agroecological knowledge between the two groups. From these people, we got details about the names of the rice landraces, what the words mean, what they refer to, and which landraces they actually grew.

Prior to interviews, verbal informed consent was obtained from all informants after explaining the study's objectives in the local language. Anonymity and confidentiality were assured. Interviews were carried out in different places chosen by informants, such as homes, fields, bushland, and roadside stalls. Each interview documented its context, including the location and the presence of other informants, which may have influenced the informant's answer. The last author of this article is an ethnobiologist who has been working with the Kanekes people since the late 1980s and is well-versed in their language. To help communicate with the informants and ensure the information was accurate, most interviews were conducted and written down in their language. When needed, a local interpreter helped, as they spoke both Sundanese and the local language. During each interview, the informants were asked these questions: (i) Which upland landraces do you know? (ii) What are the names of these landraces? (iii) Can you explain what the name means? If the name of the rice landrace was linked to a plant or animal, then these additional questions were asked: (i) What are the features of the plant or animal you mentioned? (ii) How are these features connected to the landraces? (iii) How is the plant or animal used in your community?

Reference plant samples were collected and labeled with the names used by the Kanekes people to describe them. This helped verify the correct scientific names of the plants by comparing them in the field. The samples were identified by a taxonomist and stored at the Herbarium Jatinangoriense, which is run by the Biology Department at Universitas Padjadjaran in West Java, Indonesia.

**Data analysis**

After conducting interviews with the informants, all collected data were compiled in Microsoft Excel 2016. A compiled list of landrace names was parsed to identify its base lexeme and descriptive modifier (descriptor). Modifiers were classified into semantic categories. To ensure analytical rigor, naming terms in upland rice documentation are considered valid if the terms are used repeatedly by at least three informants independently and consistently to balance inclusivity with reliability. The threshold was proportionally modified to the current sample size using a consensus-based validation adapted from Ellen (1993). Cross-checking between informants on the same taxa was conducted to assess consistency in the terms and meanings. Terms cited by only one individual were excluded to ensure that the dataset represents shared knowledge.

To assess the local salience of each landrace within the community, the Relative Frequency of Citation (RFC) was calculated using the following formula (Tardío and Pardo-de-Santayana 2008):

$$RFC = \frac{FC}{N}$$

Where, FC refers to the number of informants who independently cited a specific landrace, and N is the total number of informants (N = 43). The value of RFC ranges from 0 to 1, with higher values showing greater citing.

As the Kanekes people have no written language, the names of landraces, plants, and animals used as descriptors were recorded and transcribed using the International Phonetic Alphabet (www.internationalphoneticalphabet.org)

before they were transliterated. The data were then organized in a table format, including the literal meanings of the descriptors, their referents, and possible meanings of the landrace names. Traits related to the rice grain or husk, endosperm color, and ripening period were included.

## RESULTS AND DISCUSSION

### The rice in folk taxonomy

The term *tutuwuhan* is used by the Kanekes people to refer to plants, lichen, and mushrooms in a biological sense. This term is derived from the partial reduplication of the first syllable of the word *tuwuh*, meaning 'growth from the ground', and it is attached with the suffix '-an'. Thus, *tutuwuhan* can be defined as 'all growth from the ground', primarily referring to plants. Within the *tutuwuhan* category, there are four terms representing different types of life forms: *tatangkal*, *aareuyan*, *jujuukutan*, and *kakaian*. The term *tatangkalan* is derived from the partial reduplication of the first syllable of *tangkal* and is attached with the suffix '-an'. *Tatangkalan* refers to 'plants with stems that have an erect or vertical posture relative to the earth's surface'. The second term, *aareuyan*, comes from *areuy*, meaning 'plants that propagate on the ground, other plants, or objects'. *Jujukutan* refers to 'all uncultivated small plants without stems', while *kakaian* denotes 'all erect, woody plants'. In this context, *kakaian* is considered subordinate to *tatangkalan*, although it is regarded as a separate category from a utilization perspective.

In Kanekes ethnobotany, rice is considered a member of *tatangkalan* life form. The full and formal name of the plant in Kanekes is *tangkal paré***,** meaning ‘rice plant’. Under the category of folk-generic taxa *paré*, there are four named folk-specific taxa: *paré***,** *paré ketan***,** *paré ceré***,** and *paré hawara* (Table 1). Although the term *paré* does not include *biasa* in its name, the Kanekes people often add *biasa* when referring to this folk-specific taxon to distinguish it from the others. To clarify what *biasa* signifies, the Kanekes compare it with other folk-species. First, they contrast it with *paré ketan*, which refers to glutinous rice, and *paré ceré*, which refers to semi-glutinous rice. Second, they contrast it with *paré hawara*, which refers to short-harvested rice. Therefore, the formal definition of the folk-species *paré* is all long-harvested non-glutinous rice. The inclusion of the hidden category *biasa*, which only appears in natural context, confirms its role as a prototype. This prototype status also reflects the fact that this category of non-glutinous rice is the main staple in the daily diet of the Kanekes people. In terms of quantity, almost 80% of the known landraces are classified as *paré (biasa)*.

The fundamental way names are structured at the folk-specific level involves adding a second word to describe the first. In this case, the words *biasa*, *ketan*, *ceré*, and *hawara* serve as these descriptive terms. However, in the case of the prototype, the descriptive term is not included in the official name. Similarly, the naming pattern at the folk-varietal level follows the same structure, where the folk-specific name is the first lexeme and another term acts as the descriptive second lexeme.

For most Kanekes people, as a primary lexeme, *paré* is clearly a simple expression that is not linguistically analyzable. However, some older informants mentioned that the term *paré* was a shortened version of the original classical word *papaharé*, which means “a plant grows to the same height regularly, produces fruit evenly, grows side by side, and imitates each other”. This term was previously used to distinguish rice from more ancient staple crops that did not have such characteristics. The Kanekes people had a story that during an earlier time, their ancestors did not know how to grow rice and instead ate *jegéng*, which their Sundanese neighbors called *sekul*. This plant produces countless tiny grains, about the size of a pinhead, in clusters, and can be cooked like rice by steaming it for eating. The Malay and Javanese neighbors referred to it as *jawa* or *jawawut*, and it may be the same plant known as foxtail millet (*Setaria italica*).

The term *paré*, explicitly referring to *O. sativa*, is also used to name several other plant species (Table 2). The precise meaning of *paré* can be found in the other plant named *paparéan*. In their language, the partial reduplication of the first syllable of a basic word plus the suffix ‘-an’, can be defined as ‘relating to the X (basic word),’ hence, *paparéan* can be interpreted as ‘a plant that resembles *paré*’. There are five plants named *paparéan* in Kanekes ethnobotany, all belonging to the Poaceae family. Presumably, the morphological similarities between *O. sativa* and these plants are the cognitive basis for naming the Kanekes as *paparéan*. There are five other plants whose vernacular names use the term *paré* through compounding. In these plant names, the term *paré* is used metaphorically to denote size, and the names of the plants can be interpreted as “a smaller variety of X”.

### Nomenclature and identification strategy

Just as *paré* is used as a descriptor for other plants, other plants also served as descriptors to name upland rice landraces. There are 89 upland rice landraces known by the Kanekes people (Table 3). Of these, 41 (46.06%) landraces used other plant names or other plant parts as descriptors (Table 4). These names refer to 38 species from 21 plant families. These plants had cultural significance in the Kanekes ethnobotany, used as food, construction and craft materials, botanical components in rites, firewood, or medicine (Table 5).

Although most of the plants whose vernacular names were used as descriptors are non-native plants, most of them were introduced long ago, probably during the great Austronesian migration, such as *Areca catechu*, *Cocos nucifera*, *Saccharum officinarum*, and *Nephelium lappaceum*, or during the Maritime Silk Road period of Indonesian history, such as *Carthamus tinctorius*, *Cymbopogon citratus*, *Curcuma longa*, *Kaempferia galanga*, and *Luffa aegyptiaca*.

Other categories of descriptors with high percentages included vernacular terms for shapes and quality. There were only seven rice landraces whose descriptors used

animal names, serving as shape and/or color metaphors (Table 3: No. 13, 15, 20, 21, 77, 81, and 82).

Based on data in Table 3, among 89 landraces, 77 (86.51%) of the descriptors referred to morphological characteristics as metaphors and 11 (12.36%) to plant ecology. The morphological parts most commonly referred to were grain (35.95%), endosperm (24.72%), and culm (7.86%) (Figure 2). The most referred characteristics are color (31.46%) and shape (16.85%).

**Table 1.** Taxonomic level of *paré* in Kanekes folk-classification

| Taxonomic level | Named set contrast | Definition |
|---|---|---|
| Unique beginner | *Tutuwuhan* | All that growth (including plant, mushroom, lichen) |
| Folk-class/life form | *Tatangkalan* | All plants with erect stature |
| Folk-generic taxa | *Paré* | Rice (*Oryza sativa*) |
| Folk-specific taxa | *Paré* | Ordinary, common, non-glutinous, long-harvested rice |
| | *Paré ketan* | Gluninous rice |
| | *Paré ceré* | Semi-glutinous rice |
| | *Paré hawara* | Short-harvested rice |

**Table 2.** List of other plants whose names use the term *paré*

| Vernacular name | Scientific name | Meaning of vernacular name |
|---|---|---|
| *buwah paré* | *Mangifera laurina* Blume | Small, wild variety of mango |
| *konéng paré* | *Curcuma euchroma* Valeton | Small, wild variety of turmeric |
| *ki paré* | *Breynia cernua* (Poir.) Müll. Arg. | Small variety of fart-bush |
| *ki paré* | *Glochidion obscurum* (Roxb. ex Wlld.) Blume | Small variety of buttonwood |
| *ki paré* | *Glochidion rubrum* Blume | Small variety of pin-flower tree |
| *paparéan* | *Bothriochloa glabra* (Roxb.) A.Camus | Rice-like plant |
| *paparéan* | *Leersia hexandra* Sw. | Rice-like plant |
| *paparéan* | *Oryza officinalis* Wall. ex Watt | Rice-like plant |
| *paparéan* | *Oryza rufipogon* Griff. | Rice-like plant |
| *paparéan* | *Phalaris arundinacea* L. | Rice-like plant |


**Figure 2.** Examples of rice landraces classified according to grain (A-D), culm (E-F), and endosperm characteristics (G-H): A. *Paré bentik*, B. *Paré kembang kalapa*, C. *Paré nangsi*, D. *Paré rumbay*, E. *Paré seungkeu*, F. *Paré tunggul*, G. *Paré ketan limar*, H. *Paré ketan bodas*

**Table 3.** List of upland rice landrace names, meanings, and generic agro-botanical characteristics

| No. | Folk-species \| Folk-varietal descriptor | Literal meaning of descriptor | Referent | Probable meaning of the landrace name | Hull feature | Endosperm color |
|---|---|---|---|---|---|---|
| | *Paré* | | | | | |
| 1 | *aléan* | Selected | seeds origin | rice plant with selected seeds | Hairy | White |
| 2 | *ambuganti* | (mythical) Mother's gift | seeds origin | rice plant of archaic seeds | Hairy | White |
| 3 | *anjeni* | Tapering-ends | grain shape | rice with slender, tapering-ends grain | Hairy | White |
| 4 | *areuy* | Vine, climber plant | culm characteristic | rice with slender yet sturdy culm | Hairless | White |
| 5 | *baduyut* | Snake-gourd | hull characteristic | rice with small, soft hairy hull | Hairy | White |
| 6 | *balogor* | Lax | panicle characteristic | rice with loose, big grains panicle | Hairless | White |
| 7 | *bangban* | Bamban plant | grain shape | rice with slightly round grain | Hairless | Red |
| 8 | *banter* | Obstinate | plant ecology | rice plant with obstinate culm | Hairy | White |
| 9 | *baur* | Mingled | seeds origin | rice plant from mingled seeds | Hairy | White |
| 10 | *batu* | Stone | endosperm quality | rice grain with hard endosperm | Hairless | White |
| 11 | *bayur* | Bayur plant | grain color | rice with light-brown grain | Hairless | White |
| 12 | *bentik* | Curl eyelashes | grain shape | rice with slender, tapering-ends grain | Hairless | White |
| 13 | *beunteur* | Spotted barb | grain shape | rice with long, slender grain | Hairless | White |
| 14 | *beureum tiwu* | Sugarcane-red | endosperm color | rice with dark-red grain and endosperm | Hairy | Red |
| 15 | *biluk* | Giant red flying squirrel | endosperm color | rice with brownish endosperm | Hairy | Red |
| 16 | *bologor* | Native | seeds origin | rice plant of archaic seeds | Hairless | White |
| 17 | *bongkok* | Palm-leaved bat-flower | endosperm color | rice with orangish-red endosperm | Hairless | Red |
| 18 | *bubuay* | Giant rattan | leaf sheath | rice with thick leaf sheath | Hairy | White |
| 19 | *bunar* | Slim bamboo | endosperm color | rice with pale-brown endosperm | Hairy | Red |
| 20 | *buntut manjangan* | Rusa's tail | awn characteristic | rice with long, brownish awn | Hairy | White |
| 21 | *buntut nyiruan* | Honey-bee sting | awn characteristic | rice with long, blackish awn | Hairy | Red |
| 22 | *cao* | River, waterway | plant ecology | rice that can grow in wetter soil | Hairless | White |
| 23 | *cikur* | Sand ginger | endosperm aroma | rice with sand ginger aroma | Hairless | White |
| 24 | *cingir* | Pinkie | grain size and shape | rice with small, slender grain | Hairless | White |
| 25 | *cokrom* | Eggplant | grain shape | rice with lengthy oval grain | Hairless | White |
| 26 | *gintung* | Bishop-wood fruit | grain shape | rice with round, yellowish grain | Hairless | Red |
| 27 | *guling* | Trundle | panicle characteristic | rice with heavy panicle | Hairless | White |
| 28 | *janah* | Name of person | seeds origin | rice plant introduced by Janah | Hairless | White |
| 29 | *jawara* | Prime/superior | seeds quality | high quality rice plant | Hairy | White |
| 30 | *jeruk* | Citrus fruit | grain shape and color | rice with round, yellowish grain | Hairless | White |
| 31 | *karudin* | Name of person | seeds introducer | rice plant introduced by Karudin | Hairless | White |
| 32 | *kapundung* | Kapul fruit | endosperm color | rice with bright-brown endosperm | Hairless | Red |
| 33 | *kembang adding* | Areca palm's inflorescence | grain color | rice with dark-white color of grain | Hairless | White |
| 34 | *kembang kalapa* | Coconut palm's inflorescence | grain shape and color | rice with oval, brown grain | Hairless | White |
| 35 | *kiara* | Weeping fig | grain shape and color | rice with round, yellowish grain | Hairy | White |
| 36 | *kohak* | Imperfect shape | grain shape | rice with imperfect grain shape | Hairless | White |

| | | | | | | |
|---|---|---|---|---|---|---|
| 37 | *kolélét* | Name of place | seeds origin | rice from Kolelet | Hairy | White |
| 38 | *koněng** | Turmeric | grain color | rice with light-yellow grain | Hairless | White |
| 39 | *konyal* | *Ficus recurva* fruit | endosperm color | rice with round, dark-yellow endosperm | Hairless | Red |
| 40 | *leungsir* | Island lychee | endosperm color | rice with pale brown endosperm | Hairless | Red |
| 41 | *limar* | Reddish color pattern of batik | endosperm color | rice with reddish endosperm | Hairless | Red |
| 42 | *lopang* | Sponge gourd | endosperm color | rice with brownish endosperm | Hairless | Red |
| 43 | *malati* | Jasmine | endosperm color | rice with pure white endosperm | Hairy | White |
| 44 | *marukan* | Pearl-like | grain shape | rice with hairless, round, pearl-like grain | Hairless | Red |
| 45 | *ménténg* | Rambai fruit | grain color | rice with bright-brown grain | Hairless | White |
| 46 | *menyan* | Incense | endosperm aroma | rice with aromatic endosperm | Hairy | White |
| 47 | *nayagati* | Name of place | seeds origin | rice with archaic seeds from Nayagati | Hairy | White |
| 48 | *nangsi* | Red oreocnide | grain color | rice with dark brown grain | Hairless | White |
| 49 | *ninggul* | Stubble | awn characteristic | rice with short, thick awn | Hairy | White |
| 50 | *pendok* | Kris sheath pattern | grain shape | rice with slender, tapering-ends grain | Hairless | White |
| 51 | *peuteuy* | Bitter bean | grain shape | rice with round, thin grain | Hairless | White |
| 52 | *racik* | Braided rope | hull characteristic | rice with rough and hairy hull | Hairy | White |
| 53 | *reumay* | Long oval | grain shape | rice with long, oval grain | Hairless | White |
| 54 | *rumbay* | Long oval | grain shape | rice with long, oval grain | Hairless | White |
| 55 | *sabeulah* | Half | grain size | rice with small, thin grain | Hairless | White |
| 56 | *salak* | Snake fruit | hull characteristic | rice with brownish thick hull | Hairy | White |
| 57 | *sampay* | Climbing rattan | culm characteristic | rice with hairy culm and panicle | Hairy | Red |
| 58 | *sempur* | Elephant apple | grain color | rice with ivory-color grain | Hairy | White |
| 59 | *seréh* | Lemongrass | endosperm aroma | rice with aromatic endosperm | Hairy | White |
| 60 | *seungkeu* | Dark-purplish | culm color | rice with dark-purplish internode | Hairy | White |
| 61 | *seuti* | Climbing rattan | grain shape and color | rice with round, brown orangish grain | Hairy | White |
| 62 | *sikep* | Bitter yam | grain shape and color | rice with round, white brownish grain | Hairy | White |
| 63 | *singgul* | Certain musical instrument | grain shape | rice with slightly round grain | Hairy | White |
| 64 | *sintung* | Inflorescence of coconut tree | panicle characteristic | rice with sparse inflorescence | Hairless | White |
| 65 | *tanggay* | Nail | endosperm color | rice with white nail endosperm | Hairless | White |
| 66 | *tanjung* | Tanjong plant | grain shape | rice with oval, tapering-ends grain | Hairless | White |
| 67 | *tapos* | Perah fruit | grain shape and color | rice with oval, brownish grain | Hairless | White |
| 68 | *tundun* | Rambutan fruit | hull characteristic | rice with hairy grain | Hairy | White |
| 69 | *tunggul* | Stubble | culm characteristic | rice with large, short tiller | Hairy | White |
| 70 | *wanti* | Name of a hamlet | seeds origin | rice from ancient hamlet of Wanti | Hairy | White |
| *Paré ceré* | | | | | | |
| 71 | *telong* | Shakes easily from the straw | grain characteristic | rice with grain that shakes easily | Hairless | Red |
| *Paré hawara* | | | | | | |
| 72 | *bunar* | Slim bamboo | grain color | short duration rice with brown grain | Hairless | White |
| 73 | *koas* | Sword bean | grain shape | short duration rice with long grain | Hairless | White |
| *Paré ketan* | | | | | | |
| 74 | *areuy* | Vine, climber | culm characteristic | rice with slender yet sturdy feature | Hairless | Red |

| | | | | | | |
|---|---|---|---|---|---|---|
| 75 | *beledug* | Dry land | plant ecology | rice that can grow in dry land | Hairy | White |
| 76 | *bodas* | White | endosperm color | rice with pure white endosperm | Hairy | White |
| 77 | *bulu kuda* | Horse's hair | awn characteristic | rice with long, thick awn | Hairy | White |
| 78 | *gadog* | Bishopwood | grain shape and color | rice with round, yellowish grain | Hairless | White |
| 79 | *hideung* | Black/dark-purple | endosperm color | rice with blackish endosperm | Hairless | Black |
| 80 | *kasumba* | Safflower | endosperm color | rice with orangish-red endosperm | Hairless | Red |
| 81 | *keuyeup* | Gecarcinucid crab | endosperm color | rice with reddish-brown endosperm | Hairless | Red |
| 82 | *kidang* | Barking deer | grain color | rice with brownish grain | Hairy | White |
| 83 | *jalupang* | Jalupang plant | culm characteristic | rice with hard, elastic culm | Hairy | White |
| 84 | *langgasari** | Story of origin of rice | seeds origin | rice with archaic origin | Hairless | White |
| 85 | *meloy* | Tall, slender, and limber thing | culm characteristic | rice with tall, slender, limber culm | Hairy | White |
| 86 | *nangka* | Jackfruit | grain color | rice with yellowish grain | Hairy | White |
| 87 | *putri* | Girl/princess with pinkish cheeks | endosperm color | rice with pinkish endosperm | Hairless | Red |
| 88 | *ruyung* | Stick made from sugar palm | endosperm color | rice with dark-brown endosperm | Hairless | Red |
| 89 | *siang** | Bright-red | endosperm color | rice with bright-red endosperm | Hairless | Red |

Note: *: Sacred landrace, religiously obligatory to be planted by all Kanekes households

**Sacred landraces**

Three landraces are considered sacred by the Kanekes (Table 3: No. 38, 84, 89 and Figure 3). All Kanekes families are obliged to plant these landraces. Failure to plant them is considered a serious violation of customs and can result in a family being excommunicated from the village and considered no longer Kanekes people. Even though it is not landraces that are considered sacred, because their physical characteristics are considered quite different, some landraces (Table 3: No. 12, 41, 45, 50, 59, 60) are usually planted in-between sacred landraces as border plants so that the purity of sacred landraces is maintained. All other landraces can be planted as desired, depending on each family's needs. For example, if a family plans to hold a wedding ceremony for one of their children at the end of the season, they will usually plant glutinous rice landraces, as many traditional foods for the ceremony are made with glutinous rice.

**Table 4.** Distribution of term category used as descriptor (N=89)

| Term category | Number of landraces | % of total |
|---|---|---|
| Phytonymic (or other plant's part term) | 41 | 46.06 |
| Shape | 9 | 10.11 |
| Quality | 9 | 10.11 |
| Zoonymic (or animal organ name) | 7 | 7.86 |
| Eponymic | 5 | 5.62 |
| Color | 4 | 4.49 |
| Inanimate object | 3 | 3.37 |
| Plant ecology | 2 | 2.25 |
| Human organ | 2 | 2.25 |
| Toponymic | 2 | 2.25 |
| Pattern | 2 | 2.25 |
| Plant life form | 2 | 2.25 |
| Lore | 1 | 1.12 |

**Table 5.** List of plants whose name or the name of its part/product is used as descriptor

| Family | Scientific name | Cultural use(s) | Landraces listed in Table 3 |
|---|---|---|---|
| Arecaceae | *Areca catechu* L. | Betel chewing | 33 |
| | *Arenga pinnata* (Wurmb) Merr. | Food, construction, rite | 88 |
| | *Calamus ornatus* Blume | Craft | 61 |
| | *Cocos nucifera* L. | Food, construction | 34, 64 |
| | *Korthalsia ferox* Becc. | Craft, construction | 57 |
| | *Plectocomia elongata* Mart. ex Blume | Craft, construction | 18 |
| | *Salacca zalacca* (Gaertn.) Voss | Food | 56 |
| Asteraceae | *Carthamus tinctorius* L. | Dye | 80 |
| Cucurbitaceae | *Luffa aegyptiaca* Mill. | Medicinal | 42 |
| | *Trichosanthes villosa* Blume | Medicinal | 5 |
| Dilleniaceae | *Dillenia indica* L. | Medicinal, construction | 58 |
| Dioscoreaceae | *Dioscorea hispida* Dennst. | Food, medicinal | 62 |
| | *Tacca palmata* Blume | Medicinal | 17 |
| Euphorbiaceae | *Elateriospermum tapos* Blume | Firewood, construction | 67 |
| Fabaceae | *Canavalia ensiformis* (L.) DC. | Food | 73 |
| | *Parkia speciosa* Hassk. | Food | 51 |
| Marantaceae | *Donax canniformis* (G.Forst.) K.Schum. | Construction, rite | 7 |
| Malvaceae | *Colona javanica* (Blume) Burret | Craft | 83 |
| Malvaceae | *Pterospermum javanicum* Jungh. | Construction | 11 |
| Moraceae | *Artocarpus heterophyllus* Lam. | Food | 86 |
| | *Ficus benjamina* L. | Shade, rite | 35 |
| | *Ficus recurva* Blume | Medicine | 39 |
| Oleaceae | *Jasminum sambac* (L.) Aiton | Ornamental, rite | 43 |
| Phyllanthaceae | *Baccaurea dulcis* (Jack) Müll.Arg. | Food | 32 |
| | *Baccaurea racemosa* (Reinw.) Müll. Arg. | Food | 45 |
| | *Bischofia javanica* Blume | Construction | 26, 78 |
| Poaceae | *Cymbopogon citratus* (DC.) Stapf | Spice | 59 |
| | *Saccharum officinarum* L. | Food | 14 |
| | *Schizostachyum blumei* Nees | Craft | 19, 72 |
| Rutaceae | *Citrus* L. | Food | 30 |
| Sapindaceae | *Nephelium lappaceum* L. | Food | 68 |
| | *Pometia pinnata* J.R.Forst. & G.Forst. | Food, medicinal | 40 |
| Sapotaceae | *Mimusops elengi* L. | Ornamental, rite | 66 |
| Solanaceae | *Solanum melongena* L. | Food | 25 |
| Styracaceae | *Styrax benzoin* Dryand. | Rite | 46 |
| Urticaceae | *Oreocnide rubescens* (Blume) Miq. | Construction | 48 |
| Zingiberaceae | *Curcuma longa* L. | Spice | 38 |
| | *Kaempferia galanga* L. | Spice | 23 |


**Figure 3.** Three sacred landraces: A. *Paré koněng* (light-yellow grain), B. *Paré ketan langgasari* (white; hairless grain; associated with archaic origin), C. *Paré ketan siang* (bright-red grain)

**The future of landrace diversity**

Except for the three sacred landraces, other landraces have different cultural values. The number of landraces planted varied from a minimum of four landraces to a maximum of 18 landraces. Of the 43 households surveyed from three different hamlets, the majority (65.12%) planted 5 to 9 landraces in their fields. Of the 89 landraces known by the Kanekes, only 67 were planted at the time this research took place. Except for the sacred landraces, the ordinary landraces with the highest relative frequency of citation value are landraces No. 12 (RFC=0.349), No. 60 (RFC=0.349), No. 41 (RFC=0.279), No. 45 (RFC = 0.279), and No. 50 (RFC = 0.232).

According to informants, the number of landraces planted in each field was much greater in the past. Although since the 1990s they have incorporated the cultivation of *Paraserianthes falcataria* into their upland agroforestry system, not only to restore soil fertility but also to generate income, and this income allows them to expand the field beyond their traditional territory by leasing land from non-Kanekes neighbors, it seems that population pressure is difficult to overcome. As a result, the average field area is shrinking over time, thereby narrowing the maneuvering space for planting various types of landraces. Older informants (70 years old) stated that in the past, the number of landraces known and planted was more than 100. Today, although they still know 89 landraces, only 50-60 are regularly planted.

**Discussion**

Rice has a significant and ancient history among Austronesian-speaking societies (Bellwood 2011; Fuller 2011; Sagart 2011; Li 2017; Alam et al. 2021; Deng et al. 2022; Li et al. 2023), including the Kanekes people, who have cultivated it from immemorial time. In their language, the term *paré* for rice has a monolexemic, non-binomial structure. The lexical root of *paré*, also used in different Indonesian ethnic groups to refer to the rice plant and cognate with the Javanese term *pari*, traces back to Proto-Western Indonesian *paray*, further relating to Proto-Austronesian *pajay* (Li 2017). A Kanekes lore mentioning the ancestors' reliance on foxtail millet and rice seems connected to the prehistoric memory of the proto-Austronesian people regarding the significance and interrelation of these two crops. A study on crop remains from Early Neolithic archaeological layers in Taiwan showed that early Austronesians cultivated rice and foxtail millet together at least 4,500 years ago (Deng et al. 2022).

*Structure of Kanekes rice taxonomy*

This study showed that the Kanekes people named rice landraces using a binomial structure, in which the second lexeme functioned as a descriptor. This naming strategy correlated with other findings and identified practical considerations that assisted locals in learning crucial information about various folk-species, making recognition and memorization easier (Hiepko 2006; Wang et al. 2019; Kielak 2020; Mandakh et al. 2020; Addi et al. 2022). Studies have shown that many cultures give plant species names based on their resemblance to other objects (Ghimire and Aumeeruddy-Thomas 2010; Mokhiruh 2017; Mandakh et al. 2020). This method reflects a direct approach to recognizing plants through human senses. Similarly, the Kanekes names for upland rice landraces can be classified as metaphoric names that are coined based on resemblance with other entities, human expressions, as well as cultural artifacts, and in most cases, these metaphors deal with the color, shape, size, and structure, as well as qualities that the association is based on. In nomenclature practices, this method was common in other regions (Milică 2020; Kravchenko et al. 2022).

The term *paré* is polysemous with the folk-genus for all rice and as the prototypical folk-species referring to non-glutinous, long-harvested rice. When contrasted with other folk-species, it is referred to as *paré (biasa*), with *biasa* (ordinary) marking its prototypical status. This aligns with Berlin's assertion that prototypes are occasionally designated by the attributive "real", "genuine", or "ideal type" (Berlin 1992). The dominance of this category, 79.78% recorded landraces, further reinforces its role as the cognitive anchor for the entire folk-specific rank, reflecting its importance as a daily staple. This pattern supports Berlin's generalization that folk-varietal taxa are rare and, when present, typically correspond to species of major cultural and economic importance (Berlin et al. 1973; Berlin 1976; Dougherty 1978).

The category *paré hawara* differs from the other folk-species, characterized as a short-maturing type of rice, which serves as a replacement variety when other varieties fail to grow, thereby optimizing land use and productivity. It is sown about one month after the main planting but can be harvested concurrently with other landraces (Iskandar and Ellen 1999). Within Kanekes folk-biology, *paré hawara* represents functional taxa based on agronomic time and adaptive strategy rather than morphological traits. While this study confirms Berlin's general principles, such as the presence of prototypical categories and the concentration of varietal differentiation in culturally salient species, it also expands his framework. In the Kanekes case, upland rice forms a hyper-diverse subsistence system organized through practical agronomic reasoning and heavily reliant on interconnected ecological knowledge.

The functional basis of the Kanekes classification differs from various ethnobotanical systems, where secondary lexemes predominantly differentiate between wild, semi-cultivated, and cultivated, as documented for enset, potato, yam, and sorghum (De Haan et al. 2007; Mekbib 2007; Worojie et al. 2021; Haile et al. 2022). In those systems, classificatory distinctions primarily organize plants within degrees of domestication and management status. However, in a completely domesticated rice system of Kanekes, differentiation is structured on gastronomic and agronomic purposes.This functional contrast forms the contextual basis for the different metaphorical structuring discussed below, thereby expanding the flexibility of folk taxonomy in accordance with local subsistence needs and crop ecology.

*Intraspecific cognition: Metaphor and nomenclature strategies*

Some specific groupings in the Kanekes rice taxonomy are further subdivided into smaller taxa that align with the folk-varietal level. In numerous folk classification systems, such extensive intraspecific differentiation is rare and generally limited to species that have intensive human management (Berlin 1992). The Kanekes show the opposite pattern: varietal-level distinctions are the most numerous, with 89 upland rice landraces documented. Folk-varietal level applied a rigid binomial structure (*paré* + descriptor), creating a highly efficient mechanism for identifying within a culturally significant domain. This naming strategy reflects the principles of cognitive economy, in which classificatory systems minimize cognitive effort while maximizing informational content (Zamudio and Hilgert 2015). Descriptors serve as mnemonic anchors that facilitate the recall of new or infrequently encountered landraces by referencing familiar entities.

The prevalence of certain descriptor categories, especially phytonyms, can be understood as both a linguistic preference and an adaptive cognitive strategy shaped by sensory salience and cultural familiarity. Instead of representing nuanced morphological differences with abstract terms, Kanekes nomenclature translates perceptual information into tangible, culturally relevant references. Metaphor is crucial to this process. Metaphorical naming enables complex perceptual or functional characteristics to be condensed into concise lexical forms (Wonkyi 2021). In folk botanical nomenclature, metaphors mediate between direct sensory experience in nature and the semantic relations among them, integrating ecological knowledge into daily language (Rosaldo 1972).

Quantitatively, 46.06% of the descriptors are phytonymic. These metaphors are based on a limited set of perceptual parameters, such as color, shape, size, and analogy with other objects. Probably, due to the limited number of basic color terms in the Kanekes lexicon, most distinctions are conveyed metaphorically. Examples include *paré malati* (pure white endosperm, like jasmine) and *paré tapos* (oval, brownish grain like perah fruit), all derived through comparisons with other plants or things associated with distinct color and grain forms. However, these metaphors are not limited to visual comparison. Farmers compared the rough and relatively thick hull of *paré salak* to the textured skin of the snake fruit when discussing it. Some even used their hands to imply the surface they were referring to. In the case of *paré cikur,* the explanation relied on the olfactory sense, as elders described the distinctive aroma of the cooked rice as similar to sand ginger, a scent recognized from occasional food preparation. Descriptor use is therefore grounded in shared multisensory experience.

High reliance on phytonymic descriptors extends beyond Berlin's fundamental analytical framework. Numerous cross-species metaphors have been documented, but metaphors using phytonomy are less prevalent than in this study. In the Andean potato system, 79.5% of primary names are metaphorical and predominantly zoonymic, illustrating the physical variety of underground tubers that evoke analogies to animal body parts (De Haan et al. 2007). In Sidama enset system, phytonymic references coexist with gendered, ritual, and functional descriptors (Haile et al. 2022). Sorghum shows zoonymic metaphors, though these are not structurally dominant (Mekbib 2007), whereas in the yam system, metaphors are not common, with names mostly literal or toponymic (Worojie et al. 2021).

The diversity of plant life forms and ecological contexts seems to influence the structural significance of metaphor in naming systems. Upland rice, as an annual grass grown in a biodiverse tropical agroforest, depends heavily on other plant taxa as reference points. In open highland ecosystems, animals and abiotic entities, such as sun and moon, may serve as consistent visual models. In humid tropical ecosystems characterized by high floristic diversity, other plants offer an easily accessible comparative basis. This pattern suggests that folk-taxonomic systems utilize metaphorical references from the most environmentally and cognitively salient elements of local landscapes.

With 86.51% landraces descriptor based on morphological characteristics, Kanekes case reflects a level of perceptual and experiential refinement maintained by individuals with advanced agricultural expertise. Although generic taxa can be intuitively identified as comprehensive categories, identifying the subgeneric level or varietal taxa

level requires meticulous observation and expertise (Berlin 1992). Among the Kanekes, such detailed recognition exemplifies how folkbiological knowledge operates as a conceptual module shaped by perceptual learning through continuous interaction with the environment (Atran and Medin 2008), and strongly connected to the traditional Kanekes way of life that includes both diverse cultivated and wild plants.

*Biocultural interdependence*

The prevalence of metaphors suggests that folk-varietal taxa identification depends on knowledge of the organisms used as descriptors. The Kanekes' nomenclature aids identification and situates each landrace within a complex network of ecological and cultural associations. Each metaphor encodes a distinct correlation. Knowing the specific aspects, such as morphology, application, and cultural significance of *kasumba* (*C. tinctorius*)*, konyal* (*Ficus recurva*)*, nyiruan* (*Apis mellifera*), *biluk* (*Petaurista petaurista*)*,* or other referents being compared is crucial for precise identification. The persistent presence and daily familiarity of these species enhance the transmission of landrace knowledge, as more than 40 folk-varietal names refer to other species. Comparative ethnobotanical research indicates that traditional plant nomenclature frequently reflects observed ecological relationships, such as habitat preferences, organism interactions, dispersal agents, and cross-species analogies (Nabhan 2000; Aparicio et al. 2021).

The loss of referenced plants or animals, whether through ecological disappearance or declining cultural familiarity, may weaken the cognitive foundation and intergenerational learning of upland rice diversity. The vulnerability does not exclusively depend on ecological disappearance. A descriptor species may persist biologically, but its mnemonic significance may diminish if it is no longer encountered, used, or referenced in everyday life. In such cases, the decline of varietal knowledge emerges from environmental changes and also changes in linguistic practice and daily experience. This phenomenon highlights the biocultural interdependence among language, biodiversity, and cultural knowledge (Maffi 2005), where ecological continuity and cultural familiarity are mutually reinforcing. This advances conservation strategy beyond a singular focus on genetic resources. Insights from various centers of crop diversity indicate that effective in situ conservation necessitates the preservation of ecological contexts and farmer-led practices that promote varietal differentiation, rather than merely safeguarding genetic material in isolation (Deb 2017; Haile et al. 2022). For the Kanekes, it is essential to preserve forest margins, swidden fallows, and agroforest mosaics where descriptor species thrive, as this is as vital as conserving the rice landraces. Furthermore, incorporating folk taxonomic knowledge into community-based biodiversity management can facilitate the dynamic preservation of both landraces and their ecological reference points.

*Historical erosion and contemporary threats*

Historical records suggest that the diversity of upland rice in the area was greater in the past. Jonathan Rigg registered a total of 150 upland rice landraces (Rigg 1862) from Jasinga Subdistrict, around 50 km northeast of Kanekes village, during his lexicographic research in the 1850s, before shifting cultivation was banned throughout Java except for the Kanekes community. Most of the names and characteristics of upland rice landraces registered by Rigg correspond to the names by which the Kanekes people are known today. Although Rigg's documentation was obtained from Jasinga instead of Kanekes district, the spatial proximity of the two areas and the partial overlap in recorded landrace names may serve as a regional proxy for understanding wider patterns of upland rice diversity in Western Java. As such, the comparison should not be viewed as a direct longitudinal measure of diversity change within the Kanekes itself, but rather as indicative of potential regional changes.

If the figures Rigg mentioned were reliable and more or less corresponded to the number of previously known landraces of Kanekes in the past, this indicates the disappearance of nearly half of the previously known upland rice landraces in only 170 years. Previous studies (Franco et al. 2015; Hidayati et al. 2017; Hidayati et al. 2022) concluded that Kanekes' folk plant names bear testimony to the linguistic and traditional knowledge prowess. However, this conclusion needs to be reconsidered historically.

Within this context of historical erosion, the obligatory cultivation of the three sacred landraces is a powerful cultural institution. This obligation is reinforced through social-ritual enforcement mechanisms. Households that fail to cultivate them are unable to independently practice essential swidden-cycle rites and are compelled to participate in relatives', a mechanism of social sanction that guarantees adherence (Iskandar and Ellen 1999). These sacred landraces serve as pillars of in situ conservation resilience, sustained through spatial segregation within swiddens, often protected by non-sacred varieties, and kin-based seed exchange networks which transfer germplasm and preserve variety. The sacred landraces of the Kanekes were actively perpetuated by a socio-religious governance system. This case shows that effective in situ agrobiodiversity conservation needs an internal cultural institution that integrates stewardship into social identity and spiritual practice.

In conclusion, this study concludes that the diversity of Kanekes rice is preserved through a highly intricate folk-taxonomic system that associates each landrace with sensory perception and ecological characteristics indicating that varietal classification relies not only on the examination of rice morphology but also on the persistent existence of descriptor species in the adjacent environment. Therefore, the preservation of Kanekes landraces necessitates the protection of both the farmed types and the biological habitats where these "descriptor" species thrive. In-situ conservation should incorporate folk taxonomic knowledge into community-based biodiversity management, encourage farmer-led seed exchange, and

guarantee the accessibility of descriptor species for intergenerational learning. Nevertheless, persistent factors such as land scarcity, diminished agricultural diversity, and the extinction of once-recognized landraces underscore the increasing pressures that may expedite the degradation of knowledge. Future research should investigate how farmers' experiential knowledge, such auditory, visual, and cultivation experiences, affects varietal memory and influences local decisions regarding the maintenance, marginalization, or abandonment of landraces, thereby facilitating a more accurate identification of varieties appropriate for in-situ conservation. Moreover, a comparison study of historical ethnobotany of upland rice of Kanekes or Sundanese is needed to show the continuity and change. Integrating ethnographic, linguistic, and genomic methodologies will facilitate the preservation of Kanekes' upland rice diversity and the accompanying biocultural knowledge amidst sociocultural and ecological transformations.

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