

## Diversity of Plants and Their Cultural Significance in The Kotagede Heritage Sites, Yogyakarta, Indonesia

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**Abstract:** This research aims to demonstrate the value of intangible assets at heritage sites for species conservation. The study is located in Kotagede, a remnant of the Kingdom of Mataram Islam. A floristic survey was performed at major sites, including the Grand Mosque, the Royal Cemeteries, and the Water Reservoir Area (Sendang). Data on intangible knowledge of plants was collected through interviews with caretakers (juru kunci) and visitors to Kotagede. A total of 61 species from 41 families of angiosperms were recorded, and many of them were cultivated and purposefully planted for cultural needs. Several species were cultivated due to their medicinal use and source of food. Overall, this study concluded that heritage sites serve as physical assets for preserving history and intangible assets that contain intangible value. Conservation of plant species occurs due to cultural and philosophical values that are closely related to the existence of the heritage.

**Keywords:** Culture, conservation, heritage, species, Kotagede.

### Introduction

The nexus between culture and nature has been studied by many authors, especially related to the topic of biodiversity and heritage (Agnoletti & Rotherham, 2015; Bridgewater & Rotherham, 2019). Several studies point out the importance of preserving the culture through protection of biodiversity, for example by establishing an eco-cultural landscape (Bridgewater & Rotherham, 2019; Merçon et al., 2019) and recognizing intangible cultural heritage (Rotherham, 2007).

Unfortunately, heritage conservation efforts are often focus on the protection of physical assets of historical structure. Moreover, it has been highly criticized that nature and culture are managed by two different authorities. This division shows a less attempt of integration of the protection of culture and nature (Head & Muir, 2006). In fact, humanity are now challenged by the losses of the intangible assets of traditional culture, knowledge and practice on

nature and universe (Mavhura & Mushure, 2019). The loss of traditional knowledge partly because it has been passed through traditional communication, such as trough folk song, fable, legends, and myths (Mavhura et al., 2013).

Several efforts have been conducted to integrating cultural and natural assets in a landscape, such as in Penang, Malaysia (Connolly, 2020), Ouro Preto, Brazil (Bhakti et al., 2021), Lampung, Indonesia (Syahiib et al., 2023). The main goal of such an initiative is to use scientific approach to embrace indigenous knowledge and to protect biodiversity in an eco-cultural landscape (Ogar et al., 2020).

Rapid urbanization has brought an urgent call to heritage protection along with nature conservation in many countries, including Indonesia (Lechner et al., 2021; Udejaja et al., 2020). Conservationists should put more attention to the establishment of an ecocultural landscape that demonstrates a harmonious nature and culture. In turn, protection of ecocultural landscape could support sustainable

development of a country (Abdullah & Leksono, 2022).

This research draws an empirical study of the royal tomb of Kotagede, in Yogyakarta Special City, Indonesia in order to understand the importance of cultural heritage in biodiversity conservation. The paper examines the plant species diversity in heritage sites of Kotagede. Next, it also studies the intangible heritage of biodiversity protection in Kotagede. The novelty of this paper lies in efforts to explore plant biodiversity and its roles as an intangible heritage.

## Materials and Methods

### Location and context of the study

Yogyakarta Special City is known as a Cultural City (Kota Budaya). The Municipality has inaugurated six areas in the city as heritage. So far, the term heritage has been associated with the monumental objects and historical assets as the legacy of the traditional court and the colonial government that ruled Yogyakarta in the past (Siregar, 2019). Cultural heritage protection is a form of application of Law No. 11 of 2020 concerning cultural heritage that protects cultural heritage in the form of sites and areas. Kotagede is one of the sub-district (*kemantren*) in the Municipality that is designated as an area that has historical events is as the area of the former first capital of the Islamic Mataram Kingdom.

### Data collection

Data collection was carried out in three stages. First, we collect data about important historical buildings as physical heritage of Kotagede. An in-depth interview with the caretaker was conducted to find out a brief history and function of the buildings. The second stage is the observation of the composition of the diversity of angiosperm plants found at the site. Floristic surveys were made at three main locations: the royal tomb area, the grand mosque area, and the water reservoir area (sendang) (figure 1).

The third stage is an exploration of intangible knowledge about plant diversity and the function of plant culture as part of the eco-cultural landscape. In-depth interviews were conducted by asking open-ended questions and obtaining extensive answers from informants.

Selection of key informant sources using purposive sampling techniques based on local population information (Tamalene, 2016). The main informant selection technique is to use saturated sampling, namely all caretakers who are considered to know about the history, symbolization and philosophy of plants in the Gedhe Mataram Kotagede Mosque area (Sari, 2017). The number of caretakers interviewed was 3 people, while other informants are visitors (5 informants). The key informants include Mas Bekel HD and Mas HS as the royal maid. We also interviewed Mas SB as the care taker of the Royal Tomb and Mr. W as the care taker of the Grand Mosque.

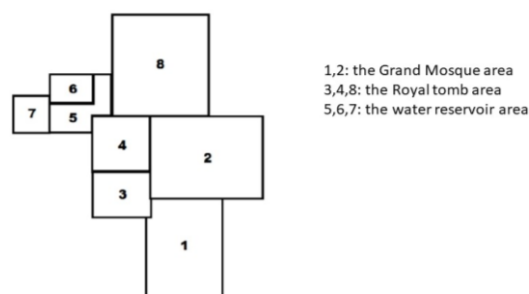


Figure 1. Location of data collection

### Data analysis

We performed descriptive analysis to information about historical sites and buildings. A summary of the sites and the purposes of the buildings were generated and presented as a table. Next, floristic data were analyzed to calculate the importance value index (IV) and the diversity index ( $H'$ ). The data were calculated using the following formula 1.

$$\text{Density} = \frac{\text{Total number of species A}}{\text{Total area (m}^2\text{)}} \quad (1)$$

$$\text{Relative Density} = \frac{\text{Density of species A}}{\text{Total density of all recorded species}} \times 100\% \quad (2)$$

$$\text{Frequency} = \frac{\text{Total number of plots inhabited by species A}}{\text{Total plots}} \quad (3)$$

$$\text{Relative Frequency} = \frac{\text{Frequency of all species}}{\text{Total frequency of all species}} \times 100\% \quad (4)$$

$$\text{Importance value (IV)} = \text{Relative Density} + \text{Relative Frequency} \quad (5)$$

In addition to the above formula, the diversity index is calculated using the Shannon-Wiener Diversity Index ( $H'$ ).

$$H' = -\sum P_i \ln(P_i), \text{ where } P_i = (n_i/N)$$

$H'$  = Shannon-Wiener diversity index

$n_i$  = number of individuals of species  $i$

$N$  = The number of individuals of all species

The criteria for the diversity index's score are as follows:

$H' < 1$ : low diversity

$1 < H' \leq 3$ : moderate diversity

$H' > 3$ : high diversity

Qualitative data analysis were performed after the interview data were transcribed. Then, the data were coded and categorized in Microsoft Excell format. After the process of coding and categorizing, description and narrative were developed (Creswell, 2003; Tickle, 2017).

## Result and Discussion

### Inventory of historical buildings

Kotagede as an ecocultural landscape host many historical sites as a legacy of the Mataram Kingdom. Kotagede Kingdom was founded in 1586 by Ki Ageng Pemanahan and his son Sutawijaya. The history of the establishment of the Mataram Kingdom began with a piece of land called Alas Mentaok which is the remains of the Medang Kamulan Kingdom. The land was gifted by Sultan Hadiwijaya of Pajang to Ki Gede Pemanahan and his son, Danang Sutawijaya. Since his arrival in Alas Mentaok in  $\pm 1570$ , Ki Gede Pemanahan developed the area into a kingdom and named it as Mataram. There are several historical sites in Kotagede, as follow (table 1).

**Table 1.** Historical buildings in Kotagede

Name of historical sites	Purposes
The Grand Mosque of Kotagede	Place of worship for moslems
The Royal Tomb located near the Grand Mosque of Kotagede	Historical tomb for the rulers of Mataram Kingdom. This tomb is no longer active and the burial place of the kings are transferred to Imogiri (East of Yogyakarta)
The Legi Market	Traditional market that sell produce, vegetables, cattles, and food from local farmers-and vendors.
Sendang Seliran (Water reservoir)	Built by Panembangan Senopati (a prominent historical

Walls of Kotagede

figure) as a place for the royal bathing. High wall structure that functions as the protection of buildings in Kotagede

The varieties of old buildings in Kotagede highlights the importance of this area as a cultural site. Some of the buildings was damaged but some have been renovated to restore its original form and function. Some of these buildings, such as the great mosque and the tombs of kings have a diversity of plant species that are important for conservation.

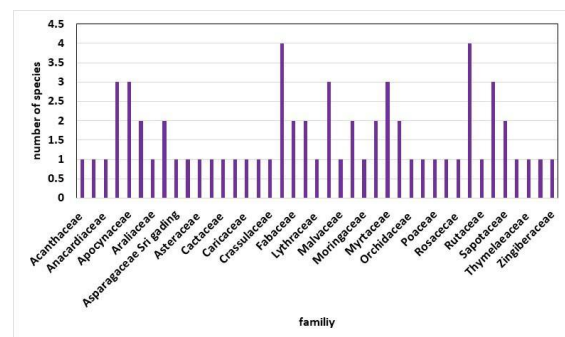
### Plant species diversity and species protection

This study recorded that in the Kotagede heritage complex, there were 61 species from 41 families of angiosperms. In addition, there are also species from the classes Bryophyte and Pteridophyte. The dominant family in the heritage sites was Myrtaceae (4 species), followed by Annonaceae, Rubiaceae, and Apocynaceae with 3 species each. The composition of the family found in the area is as follows (Figure 2).

A



B



**Figure 2.** Family composition: (a) word cloud visualization -the dominant family shown in a bigger font, (b) family composition in number of species

The diversity index (H') of three areas observed in this research varies: 3,49 in the Royal Cemeteries complex, 1.92 in the Grand Mosque Area, and 2.93 in the Water Reservoir Area. The highest H' is in the Royal Tomb complex because it is the most sacred place among the three. To visit the place, visitors must adhere to strict traditional rules, which are mostly based on Mataram Islam's rules.

The floristic surveys found that almost all species found in the Royal Cemeteries of Kotagede are domesticated and conserved to meet cultural and aesthetic values. The highest IVI in the Royal Cemeteries is mostly dominated by ornamental plants such as *Adenium obesum* (kamboja) and *Acalypha siamensis* (teh-tehan), edible plants and fruits such as *Cymbopogon citratus* (serai), *Manilkara kauki* (sawo kecil), and *Mangifera indica* (mangga). There are also aromatic and fragrance plants, for example, *Cestrum nocturnum* (Arum dalu) and *Jasminum sambac* (Melati) (Table 2).

**Table 2.** Species with the highest IVI value in the Royal Cemetery Complex

Species	Family	Local name	IVI
<i>Adenium obesum</i>	Apocynaceae	Kamboja pink	13.26
<i>Acalypha siamensis</i>	Euphorbiaceae	teh-tehan	12.36
<i>Cymbopogon citratus</i>	Poaceae	Sereh/serai	8.22
<i>Manilkara kauki</i>	Sapotaceae	Sawo kecil	7.83
<i>Mangifera indica</i>	Anacardiaceae	Mangga	7.00
<i>Cestrum nocturnum</i>	Solanaceae	Arum dalu	6.93
<i>Jasminum sambac</i>	Oleaceae	Melati	6.48
<i>Dimocarpus longan</i>	Sapindaceae	Kelengke	6.48
<i>Artocarpus heterophyllus</i>	Moraceae	Nangka	6.02
<i>Syzygium malaccense</i>	Myrtaceae	Jambu dersono	6.02

The Royal Cemeteries Complex, the major historical site in Kotagede, hosts about 51 plant species. It shows the role of historical sites in preserving the habitat of plant species. As a man-made habitat, the plants in this complex exist due

to humans intervention. Interestingly, several names of the plants found in the complex represent the names of the villages (kampong) in Kotagede. This shows the toponym of village names in Kotagede, which is associated with the presence of plants in the area. Several examples may justify the phenomenon. Examples of toponyms are Kampong Soka, which may come from the word "soka" (*Ixora* spp.), and the Kanthil area, which comes from the word "kanthil" (*Magnolia champaca*) (Jayanti, 2021).

The Royal Graves, as a sacred cemetery, serves as a conservation area to support biodiversity potential because it suffers less disturbance as compared to other urban matrixes (Säumel et al., 2023). In Kotagede, the sacredness of the Royal Tomb is still preserved. Visitors of the Royal Tomb must abide by traditional rules, such as wearing traditional costume and fabrics, removing footwear (interview, caretaker, August 2022), and praying in silence (*semedi*/meditation) (Barqah & Fauzi, 2023). There have been many studies to support the idea that cemeteries play a significant role in protecting potential, for example Löki et al., (2019), Skobel et al., (2023), and Säumel et al., (2023).

**Table 3.** Species with the highest IVI value in the Grand Mosque of Kotagede

Species	Family	Local name	IVI
<i>Portulaca grandiflora</i>	Portulacaceae	Krokot	44.48
<i>Magnolia alba</i>	Magnoliaceae	Cempaka	30.34
<i>Cananga odorata</i>	Annonaceae	Kenanga	27.24
<i>Ficus benjamina</i>	Moraceae	Beringin	20.34
<i>Jasminum sambac</i>	Oleaceae	Melati	16.90
<i>Rosa sp</i>	Rosaceae	Mawar	16.90
<i>Alpinia purpurata</i>	Zingiberaceae	Lengkua	16.90
<i>Hibiscus rosa-sinensis</i>	Malvaceae	Bunga sepatu	13.45
<i>Gardenia jasminoides</i>	Rubiaceae	Ceplok piring	13.45

Next, a different finding could be observed on the floristic survey of the Grand Mosque complex. There are fewer species found in the



area, mainly because the Grand Mosque Complex is an open space destined for praying for mosquitoes. There are only 9 species recorded in the area, with the highest IVI value coming from ornamental species, *Portulaca grandiflora* (krokot), and fragrance species such as *Magnolia alba* (cempaka) and *Cananga odorata* (kenanga).

Although the plant species in the Grand Mosque Complex are less diverse than those in the Royal Cemeteries, the site is an equally important place for conservation. The message of biodiversity and the protection of nature is represented by the mosque's ornamental architecture. The motive of the *mihrab* (an empty space in the wall of the mosque to indicate the qibla or the direction of the Kaaba) is in the form of lianas (lung-lungan), or a woody climbing plant. (Savitri & Sumardiyanto, 2021). The *lung-lungan* plant symbolizes the path to heaven and the harmonious relationship between heaven and earth (Sadah et al., 2018; Savitri & Sumardiyanto, 2021). Interestingly, the *lung-lungan* motive could also be found in other grand mosques in Java, for example, the grand mosque of Sunan Giri (Pradana, 2020) and The Mosque of Taman sari in Yogyakarta (Suharyani, 2017). Next, the study recorded 26 species found in the Water Reservoir Area (Sendang) of Kotagede. *Jasminum sambac* (Melati) has the highest IVI and is followed by *Cananga odorata* (Kenanga) and *Acalypha siamensis* (Teh-Tehan). All of them are ornamental species that have shown high aesthetic value (Table 4).

There are four water reservoirs in the complex, namely Sendang Kakung, Sendang Puteri, Sumber Kemuning, and Sumber bendha. Sendang Kakung and Sendang Putri which often called Sendang Seliran Complex. The Sendang Seliran complex is highly appreciated for its sacred cultural value and local knowledge in the form of myth and folklore. The myth of Sendang Seliran is related to the sacred fish and tree, which are believed to be the sacred beings that protect Kotagede. People believe that the fish and the banyan tree in the sendang should be protected at any cost, because any disturbance to the sacred beings may brought a bad luck (Ilham, 2021). Due to the myth, the surrounding area of Sendang Seliran is well protected and preserved. The phenomenon implies that myth plays a significant role in conservation, as Kayode & Otoide (2021) highlighted that myth may serve

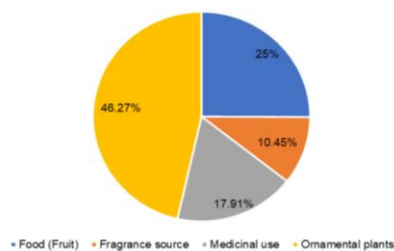
as “disincentive to deforestation”. A similar finding by Sulistiyowati et al (2022) underlined that underlined that myth in the Javanese community is a type of knowledge that "could be advantageous to help ecosystem rehabilitation and conservation".

**Table 4.** Species with the highest IVI value in the the Water Reservoir Area of Kotagede

Species	Family	Local name	IVI
<i>Jasminum sambac</i>	Oleaceae	Melati	19.90
<i>Cananga odorata</i>	Annonaceae	Kenanga	14.65
<i>Acalypha siamensis</i>	Euphorbiaceae	teh-tehan	13.52
<i>Cestrum nocturnum</i>	Solanaceae	Arumda lu	12.99
<i>Adenium obesum</i>	Apocynaceae	Kamboja pink	12.70
<i>Manilkara kauki</i>	Sapotaceae	Sawo kecil	12.17
<i>Plumeria obtuse</i>	Apocynaceae	Kamboja putih	9.69
<i>Carica papaya</i>	Caricaceae	Pepaya Woh	9.69
<i>Eugenia uniflora</i>	Myrtaceae	dewand aru	8.03
<i>Ixora finlaysoniana</i>	Rubiaceae	Soka putih	8.03

### The use and cultural value of plant species

This section will delve deeper into the use and cultural significance of the species found in the heritage sites of Kotagede. The data presented here is mostly based on a summary and conclusion from an in-depth interview with informants and key people. Overall, plant species encountered in Kotagede serve many purposes, including as ornamental plants (46.26%), food sources (25%), fragrance sources (10.45%), and medicinal uses (17.91%) (Figure 3).



**Figure 3.** Percentage of plant species use in Kotagede heritage site

The use of plant species in Kotagede reflects the shared value of Javanese culture. Based on traditional Javanese custom, plants are used as sources of fragrance, such as *Jasminum sambac* (Melati), *Cananga odorata* (Kenanga), and *Magnolia odorata* (Cempaka) as mystical plants. Jasmine flowers (*Jasminum sambac*) have long been known to symbolize harmonious life between physical and metaphysical entities (Lestari, 2019). It also represents environmental awareness and health (Lestari, 2019). The origin of the traditional philosophical value is perhaps dated back to the Hindu civilization that inhabited Java before Islamic Kingdom of Mataram existed. The origin of the traditional philosophical value is perhaps dated back to the Hindu civilization that inhabited Java before the Islamic Kingdom of Mataram existed. The acculturation between Islam and Hinduism has been recorded in several works, including Geertz. (1976) and Woodward (2011). Woodward highlighted the importance of flowers in Javanese graves.

During the ritual of *Nyadran*, offerings such as incense, flowers, and food are given to the spiritual beings and people living in the vicinity of the cemetery. The practice is not normally accepted by puritan Islam, but for many Javanese Muslims, offerings serve as a medium for purification and asking for blessings and guidance from God Almighty. Related to this, numerous studies have highlighted the importance of the philosophical and spiritual meaning of flower offerings. Many authors agree that the philosophical value behind flower offerings may be the root of species protection and conservation (Darma et al., 2021; Sulistiyowati & Muttaqin, 2014; Sutrisno et al., 2020). On top of that, Darma et al. (2021) highlighted that, as flowers are important aspects of prayer, the culture of flower offering may affect the conservation behavior of society. In other words, people protect flower species and thus contribute to conservation because flowers have important philosophical and spiritual value.

In addition, the study found that the name of local species in the Javanese language contains semiotical meaning. The semiotical meaning of plants reflects the Javanese value of life, including the idea of a harmonious life between culture and nature. For example, the local name of *Stelechocarpus burahol* in Javanese is *kepel*.

The word *kepel* has a similar tone to *kempal*, which means "to gather". Thus, the plant symbolizes the need for unity and togetherness of physical and spiritual entities during prayer to God Almighty. Another example is the word *kanthil* (*Magnolia champaca*), which means "to stick". It represents that a human being is to stick to" or adhere to God's instructions through the Holy Book (Al Quran) and Hadith. Magnolia is a culturally important flower in many cultures in Asia (Silalahi et al., 2023). It is also widely used for rituals in Bali (Ratnani et al., 2021), Xishuangbanna, China (Hongmao et al., 2002), and India (Sikarwar, 2016).

Interestingly, other than cultural values, several plants encountered in the Kotagede heritage site are used for medicinal purposes. For example, *Graptophyllum pictum* (wungu) has long been known for its use as a remedy for hemorrhoids. In fact, researchers conducted empirical studies to prove the effectiveness of the plants in traditional remedies. (Goswami, Ojha, & Mehra, 2021; Kusumawati et al., 2022). The fact that plant species could also contribute to the development of medicine improves people's motivation to conserve. Finally, based on the above discussion, it might be inferred that plants possess philosophical value, which promotes conservation behavior across cultures. Such a value is an important reason for public participation in conservation efforts (Geng et al., 2017). Therefore, the protection of heritage sites is not only important for their physical historical value but also for their intangible value as a source of local knowledge and spiritual and philosophical value.

## Conclusion

A total of 61 species from 41 families of angiosperms are encountered in Kotagede heritage sites. This study concludes that heritage sites play more than a physical role as historical relics. Heritage sites also serve as intangible assets to protect local knowledge in the form of spiritual values and philosophies that help plant conservation. These values may encourage community participation in plant conservation and protection. Thus, the protection of heritage sites is important in an effort to save people, culture, and nature.

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