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Mangifera spp. in the Ethnoclimatology Study of *Tatangar Banjar* Tradition in Kalimantan

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Abstract. *The biodiversity of Mangifera spp. not only supports the local economy and preserves food security but also safeguards cultural heritage through their role in ethnoclimatology studies within the Tatangar tradition of the Banjar community in Kalimantan. The Banjar community demonstrates a unique connection with nature by utilizing specific Mangifera species as crucial indicators of seasonal transitions, deeply ingrained in their cultural identity. This study aims to reveal the prevalence of various Mangifera species, including endangered ones, in diverse landscapes, promoting a sustainable agroforestry system and conservation efforts. Qualitative and quantitative research methods were employed to explore and analyze Tatangar knowledge within the Banjar community in Mandiangin Barat Village, particularly its connections to climate and weather. The Banjar community further traditionally classifies Mangifera species, or known as "asam-asaman", based on morphological traits, aiding in their interpretation of Tatangar signs. These signs, rooted in the flowering time of Mangifera trees, serve as essential climate indicators, guiding agricultural practices and influencing decisions on planting and harvesting. This local knowledge enhances agricultural resilience, enriches their cultural heritage, and underscores the intrinsic relationship between culture, nature, and sustainability in Kalimantan, making it a valuable subject for ethnoclimatological exploration.*

Keywords: *banjar community, ethnoclimatology, mangifera* spp. *tatangar*

INTRODUCTION

Kalimantan holds distinctive biodiversity potential, with one prominent aspect being the diversity of its *Mangifera* species (Gunawan et al., 2022). At least 31 species of *Mangifera* can be found, and three of them are endemic (Polosakan, 2016). Numerous *Mangifera* species can also be easily found in the forests and gardens of local communities in South Kalimantan because of their wide distribution (Gunawan et al., 2022). In Banjar culture, *Mangifera* is commonly known as a group of *asam-asaman*. Beyond contributing positively to the economy (Dedi et al., 2021), *Mangifera* also plays a vital role in ensuring local food security by providing essential nutrients for the community (Ravindran et al., 2021). This diversity not only enriches the natural environment but also corresponds with the diverse culture of the Banjar community. Rich traditions and customs also incorporate the utilization of various local plants in the daily lives of the Banjar people. Hence, *Mangifera* holds not only significant economic and nutritional benefits but also deep cultural significance in Kalimantan.

Based on research into the oral tradition of the Banjar community called "*Tatangar*", a unique connection with nature has been discovered (Musdalipah, 2016). *Tatangar* is part of the Banjarese's belief system that uses certain signs from nature and living beingss. One particular *Mangifera* species, *M. foetida* (bachang) known as hambawang by the local people, plays a crucial role as a signifier of season changes in Kalimantan (Nengsih, 2016; Yayuk et al., 2009). This phenomenon is observed through changes in the phenology of the plant and is considered a sign of a season change. Meanwhile, other plants such as passionflower and bananas in *Tatangar* are considered as signs for soil fertility (Yayuk,

2018). This shows that the Banjar community holds traditional ecological and climate knowledge that reflects local wisdom passed down through their oral traditions. However, such knowledge is rarely documented due to the lack of research, especially in South Kalimantan. Therefore, an ethnoclimatological study was carried out in Mandiangin Barat Village to explore the diversity and traditional classification of *Mangifera* species in Tatangar and analyze its role as a natural indicator in the Banjar community's tradition.

MATERIALS AND METHODS

Study site

Field exploration research was conducted from June to July 2023 of Mandiangin Barat, Karang Intan Subdistrict, Banjar Regency, South Kalimantan. Geographically, the area is situated between the coordinates of 20°49'55" N - 30°43'38" N latitude and 114°30'20" E - 115°35'37" E longitude (Figure 1). The topography of the village is predominantly flat to undulating, with elevations ranging from 49 to 55 meters above sea level and slope gradients varying from 15 to 25%, particularly in hilly and mountainous areas (BPS, 2022). Rubber, fruit, and field plantations can be found in the undulating and hilly terrain, as well as in the mountainous regions.

The village is close to the Sultan Adam Grand Forest Park and Lambung Mangkurat University's Research and Development Center for Tropical Rainforest Ecosystems (KHDTK). The climate in Mandiangin Barat Village falls within the B climate type according to the Schmidt and Ferguson classification, characterized by an average annual rainfall ranging from 2000 to 3000 mm per year, with the highest rainfall occurring in January and the lowest from April to October.
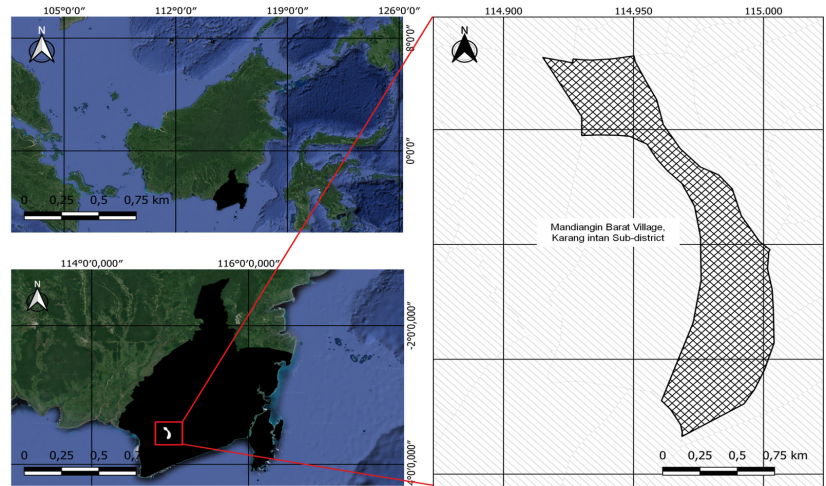
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Figure 1. Map of Mandiangin Barat Village, Karang Intan Sub-district, Banjar Regency, South Kalimantan

Data collection and analysis

Before conducting the fieldwork, preliminary research was done involving mapping the plant species mentioned in Tatangar using comprehensive literature sources that have documented Tatangar in South Kalimantan. The research employed a qualitative methodology within an ethnobotanical framework, following the guidelines established by Martin (1995), to collect data. Various of methodologies were utilized, including in-depth interviews and plant species identification. Given that most of Mandiangin Barat Village residents engage in small-scale farming, particularly in paddy, rubber, and seasonal fruit cultivation, in-depth interviews were conducted with 3 key informants who were purposefully selected based on their extensive knowledge of the local environment and Tatangar. The selection criteria for respondents included having at least some knowledge of Tatangar with a total of 32 respondents. Discussions with village leaders gathered information about the village's history, demographics, and physical characteristics.

In this study, qualitative and quantitative research methods were employed to explore and analyze knowledge related to Tatangar, particularly its connections to climate and weather, and its explanations and roles within the Banjar community in Mandiangin Barat Village. This approach was most suitable given the research's objective of delving into their ethnoclimatological knowledge. A voice recorder was used, and pictures were taken to document Tatangar's sayings along with the plants recognized as indicators by the key informants and respondents. Prior consent was obtained before each interview. Qualitative data collected during the interviews were compiled, transcribed, categorized into themes, concepts, and patterns, and subsequently analyzed thematically. The quantitative data regarding the climate condition in Mandiangin Barat Village were obtained from the Karang Intan Sub-district annual reports for the period of 2013-2022. These data from the climatology station data in Banjarbaru were utilized as a variable for the flowering period of the *Mangifera* species.

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RESULTS AND DISCUSSION

Mangifera diversity in *Tatangar* Banjar

Tatangar is an oral tradition comprised of expressions concerning signs that can be sensed, seen, observed, or experienced by individuals. Each Tatangar expression carries meanings or advice that has been passed down through generations by the Banjar community, thus forming an oral tradition (Yayuk et al., 2009). These signs can originate from the characteristics of living beings such as humans, animals, and plants. The significance of a Tatangar sign can be related to danger, blessings, and even natural phenomena that will occur. Many of them can even depict the ecological conditions in South Kalimantan and the traditions of the Banjar people in managing natural resources (Yayuk, 2018).

The exploration of the Tatangar knowledge in Mandiangin Barat Village revealed the mentioning of at least 34 different plant species (Figure 2). Some of these species play a significant role in agriculture, such as in determining both the suitable locations and timings for planting or harvesting. This is also often achieved through climate prediction based on the characteristics observed in certain plants (Table 1).

Among the various plant species mentioned, the *Mangifera* genus stands out as the most prevalent, particularly in its role as a *Tatangar* indicator. This underscores the significance of the community's knowledge regarding *Mangifera* and its predictive role in deciphering forthcoming phenomena. Furthermore, the extensive diversity of *asam-asaman* or the *Mangifera* referenced species reflects the depth of the community's understanding of this genus. It also demonstrates how they harness this diversity as a reliable signpost for specific phenomena, thus nurturing a rich oral tradition within the Banjar community. In South Kalimantan, its prominence is because of the rich diversity of the wild species (Singh et al., 2016) and its vital role in local garden forests vegetation (Hafizianor et al., 2023; Hafizianor, 2015), where the fruits are widely consumed and valued by the community.
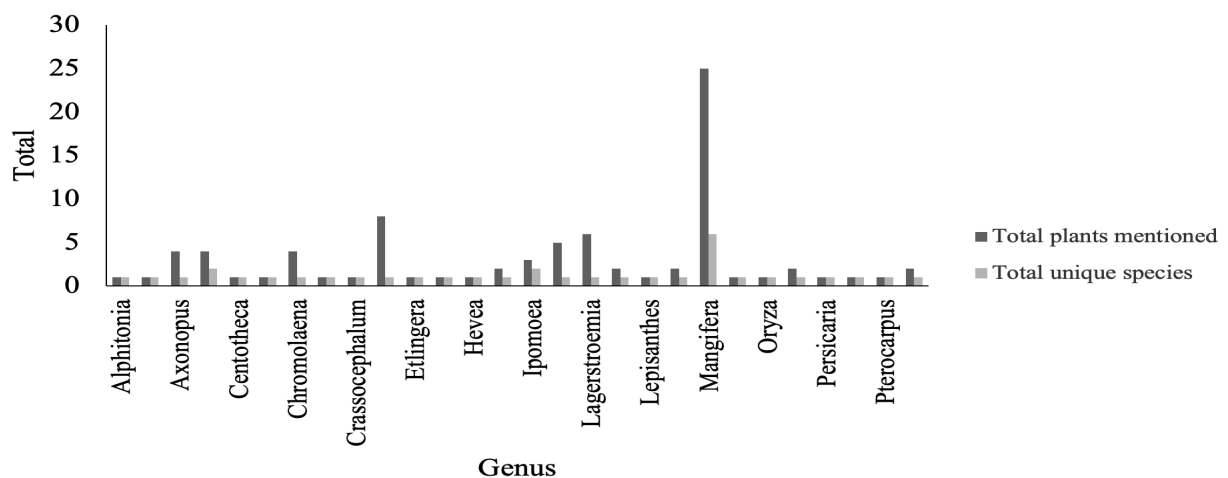

Figure 2. Plant genera mentioned in *Tatangar*

Table 1.*Mangifera* species diversity in *Tatangar* and its uses

Scientific name	Local name	Nativity	Conservation status	Tatangar's indicator	Other uses
M. indica	Mangga	Introduced	Data Deficient	Short dry season	Food, economy, board
M. laurina	Hampalam	Native	Not Listed	Short dry season	Food, economy, board
M. similis	Hambawang putaran	Native	Vulnerable	Short dry season	Food, economy, board
M. odorata	Kuini	Introduced	Data Deficient	Long dry season, fruit (dukuh) season	Food, economy, board
M. foetida	Hambawang damar	Native	Least Concern	Long dry season, fruit (dukuh) season	Food, economy, board
M. casturi	Kasturi	Native	Extinct in the Wild	Long dry season, fruit (dukuh) season	Food, economy, board

Other than the aforementioned Mangifera species, various species of local asam-asaman, such as asam pauh (*M. quadrifida*), tambusui (*M. macrocarpa*), asam tungku (*M. pajang*), asam binjai (*M. caesia*), and asam tandui (*M. rufocostata*) are also well-known to the Banjar community (Mursyidin, 2023). This variety of asam-asaman reflects a rich diversity, as Kostermans and Bompard have identified up to 31 different *Mangifera* species in Kalimantan (Kostermans et al., 1993). In Banjar Regency itself, there are other Mangifera species such as binjai (*M. caesia*) and various other species (Noor et al., 2015); however, they are not specifically mentioned in *Tatangar*.

Mangifera is widely distributed within the study area. It can be found in various of landscapes, including mixed forest gardens, rice fields, rubber plantations, and home gardens. Despite its presence in diverse landscape conditions, some species of the *Mangifera* genus, such as *M. similis* (hambawang putaran) and *M. casturi* (kasturi), have been deemed scarce by the locals. Both of these species have also been categorized as Vulnerable (VU) and Extinct in the Wild (EW), respectively, according to the IUCN Red List (IUCN, 2023a, 2023b). Another study also highlights the rarity of certain local *Mangifera* species in South Kalimantan (Febriyanti et al., 2023; Fitriani et al., 2022; Noor et al., 2015; Sari, 2014).

In addition to its role in Tatangar, asam-asaman fruits are primarily utilized by the Banjar community in Mandiangin Barat Village as a direct source of consumption. The method of consuming these fruits varies depending on the type of Mangifera. Typically, the fruits are peeled, sliced, and eaten. However, there is an exception when it comes to hambawang putaran (*M. similis*). In this case, the fruit's flesh is sliced horizontally and then opened by twisting it, as the name suggests. This unique preparation method is employed to bring out the sweetness of the fruit. A similar approach to serving M. similis can also be found among the Dayak Benuaq ethnic group in East Kalimantan, who also consume it by twisting the fruit first (Atmoko et al., 2016). Furthermore, other species of Mangifera, such as *M. casturi* and *M. laurina*, are often used as sesajen or offerings in Banjar traditional rituals known as nyiru. The term "nyiru" refers to a large tray filled with 41 types of local fruits and is typically used

during wedding ceremonies and festivities in Kalimantan (Febriyanti et al., 2023).

The majority of *Mangifera* trees are encountered in mature and tall forms within mixed forest garden formations referred to as dukuh. Dukuh represents a mixed forest garden area that mostly accommodates seasonal fruit-bearing plants, such as durian (*Durio zibethinus*), langsat (*Lansium domesticum*), and cempedak (*Artocarpus integer*) (Hafizianor, 2015; Khairunisa et al., 2021; Kissinger & Pitri, 2021). The ownership system of these gardens is traditionally inherited through generations, resulting in the coexistence of trees within a dukuh for decades, coinciding with the age of the
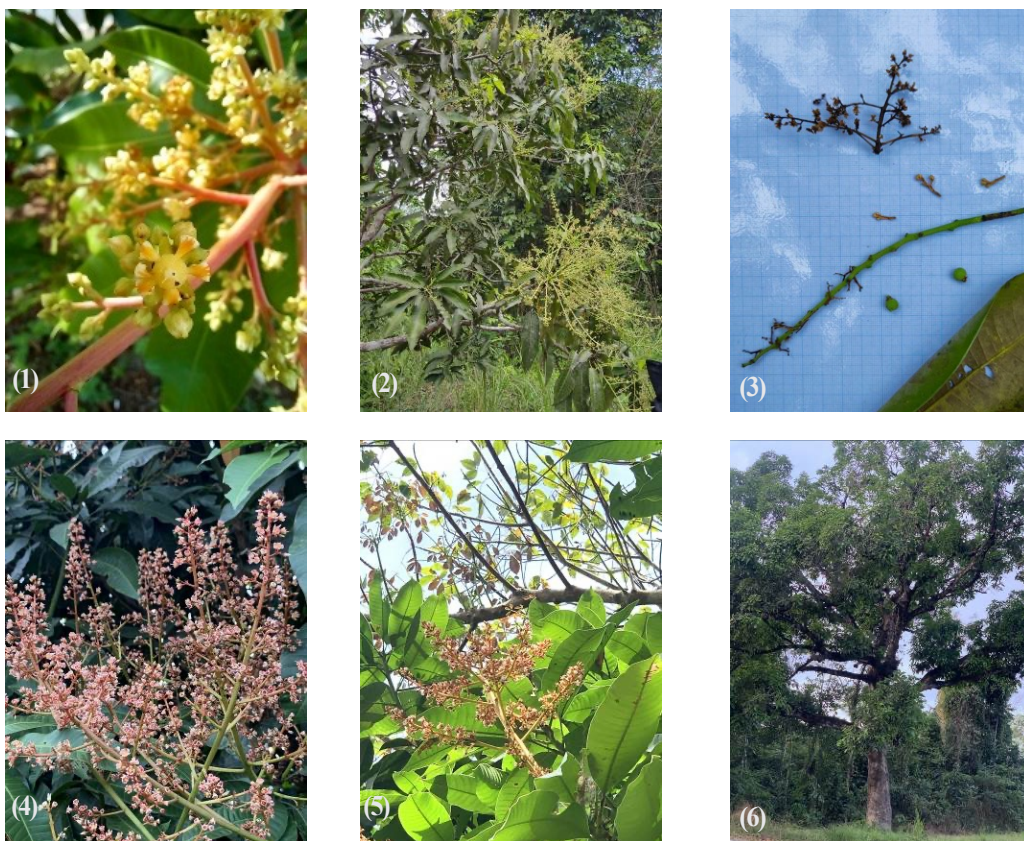

Figure 3. Traditional classification of Mangifera by Banjar communities: (A) *Asam-asaman bakambang putih kuning* (Mangoes with pale yellowish flowers): (1) *Mangifera indica*, (2) *M. laurina*, (3) *M. similis*. (B) *Asam-asaman bakambang habang* (Mangoes with reddish flowers): (4) *M. odorata*, (5) *M. foetida*, (6) *M. casturi.*

dukuh itself. This intricate interplay fosters a sustainable agroforestry system, serving as a significant conservation effort practiced by the Banjar people in Mandiangin Barat Village. It also plays a pivotal role in safeguarding the rare *Mangifera* species, thereby contributing to the broader conservation effort.

Traditional *Mangifera* classification in its role as *Tatangar*

The Banjar community broadly classifies the *Mangifera* species mentioned in Tatangar into two main groups based on their morphological characteristics. Among the *Mangifera* groupings mentioned in *Tatangar*, some exhibit pale yellowish flowers, while others have red ones (known as "*asam-asaman bakambang putih kuning*" and "*asam-asaman bakambang habang*" respectively). *Mangifera* species with pale yellowish flowers include common mango (*M. indica*), hampalam (*M. laurina*), and hambawang putaran (*M. similis*). On the other hand, those with reddish flowers include kuini (*M. odorata*), hambawang damar (*M. foetida*), and kasturi (*M. casturi*). It provides valuable insight into the Banjar community's understanding of *Mangifera* diversity, allowing them to categorize and differentiate these species based on observable characteristics (Figure 3).

This classification within Tatangar is not solely based on flower color but also takes into account the specific indicator roles these species have within Tatangar. Therefore, this categorization system assists the community in distinguishing between different signs within the same *Mangifera* genus, enabling them to interpret and respond to the diverse signals provided by these plants effectively. The *Mangifera* genus is known for its wide variety of fruit sizes, flavors, and ecological adaptability. While the mango (*Mangifera indica*) is the most famous species, the genus includes over 60 other species (Gülçin et al., 2004), producing fruits that range from small and sour to large, sweet, and aromatic. Fruit colors can vary from green to yellow, orange, or red, reflecting the species' adaptability to different climates and altitudes (Hussain et al., 2021). Another distinctive feature of *Mangifera* plants is their small flowers, which range from 5-10 mm in diameter. The perianth usually consists of five petals and sepals that are ovate to lanceolate in shape, covered with fine hairs, and vary in color, commonly appearing white, pale yellow, or greenish (Hussain et al., 2021; Ramírez & Davenport, 2016). These flowers grow in large clusters and attract pollinators with their nectar production (Kumar et al., 2016), eventually giving rise to the characteristic fruits of the genus (Ramírez & Davenport, 2016).

Mangifera's phenology in Tatangar as Banjarese's traditional climate knowledge

Tatangar, as an oral tradition, is deeply revered by the Banjar community as a series of omens or premonitions linked to everything from one's fortune to life's inevitable end. Interestingly, many Tatangar expressions also reveal the Banjar people's harmonious relationship with their environment, showcasing their ability to recognize natural phenomena and associate them with the responses of plants and animals. These responses, in turn, serve as signs for those who observe them, indicating potential climate shifts or alterations in their surroundings.

The blossoming time of the *Mangifera* is frequently used as an indicator or sign of the impending dry season (Figure 4). This practice is rooted in the understanding that Mangifera trees are remarkably sensitive to the local climate. Consequently, the timing of their flowering becomes a significant consideration

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"Bila asam bakambang habang badahulu munculan kambangnya pada asam nang bakambang putih kuning tandanya cagar musim kamarau panjang. Limbahnya cagar babuahan puhun nang ada di kabun. Bila asam bakambang putih kuning tadahulu munculan kambangnya, tandanya cagar musim kamaraunya kada panjang lawan ada ujannya."

Translation:
"If mango trees with reddish flowers blooms before the ones with pale yellowish flowers, it is a sign that a long dry season is approaching. Afterward, the fruit trees in the garden will bear fruit. If the mango trees with pale yellowish flowers blooms first, it signifies that the dry season will not be long and will be accompanied by rain."

Figure 4. *Mangifera* group mentions in Tatangar regarding climate

when interpreting climate varieties. Tatangar serves as a valuable reference point for Banjar communities, particularly for traditional farmers, helping them determine the optimal moment for planting or harvesting, among other activities.

Furthermore, the flowering time of these *Mangifera* species can signify not only the onset of the dry season but also the duration of the dry season and the upcoming harvest season, with different asam-asaman groups representing distinct dry seasons (Figure 4). The Banjar community believes that if the group of asam-asaman with reddish flowers blooms before the group with pale yellowish flowers, it indicates an extended dry season lasting roughly three months or more. Additionally, fruit trees in orchards and garden forests, like dukuh, will begin to bear fruit. Seasonal fruits are a vital commodity in Mandiangin Barat Village (Firdaus & Fauzi, 2018) and have been part of the community's heritage for generations, as well as supporting local food security (Hafizianor, 2015). Conversely, if the group of asam-asaman with pale yellowish flowers blooms first, it indicates a shorter dry season with occasional rainy days. In such conditions, *asam-asaman* with reddish flowers, such as kuini, kasturi, and hambawang damar, may either begin

flowering later or not at all, reflecting the ever-vigilant observation and interpretation of nature by the Banjar people.

Environmental factors like air temperature and rainfall play a pivotal role in influencing the growth and flowering of mango plants (Cavalcante, 2022). Mango plants thrive in an average air temperature range of 25 to 32°C, which aligns closely with the monthly average in Karang Intan Sub-district, ranging from 27 to 28°C (Figure 5). Temperature intricately regulates the blooming process, with excessively low temperatures significantly contributing to flower induction in natural conditions (Clonan et al., 2020). Simultaneously, the interplay with rainfall directly impacts flower bud production in tropical lowlands. This is prompted by a drought period following the rainy season or an absence of rainfall for 60 days (Talib et al., 2020).

Meteorological, Climatological, and Geophysical Agency (BMKG) of Indonesia categorizes monthly rainfall into four groups: low (0-100 mm/month), medium (100-300 mm/month), high (300-500 mm/month), and very high (> 500 mm/month). Applying this classification, the average monthly rainfall in Mandiangin Barat Village has varied from low to high over the past decade (Figure 6).
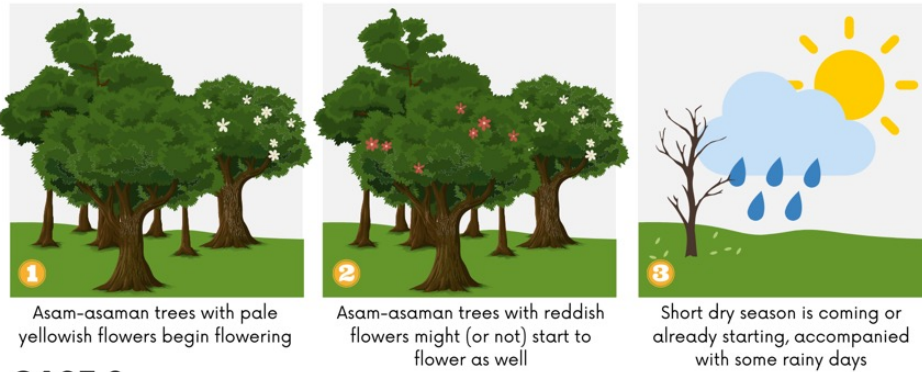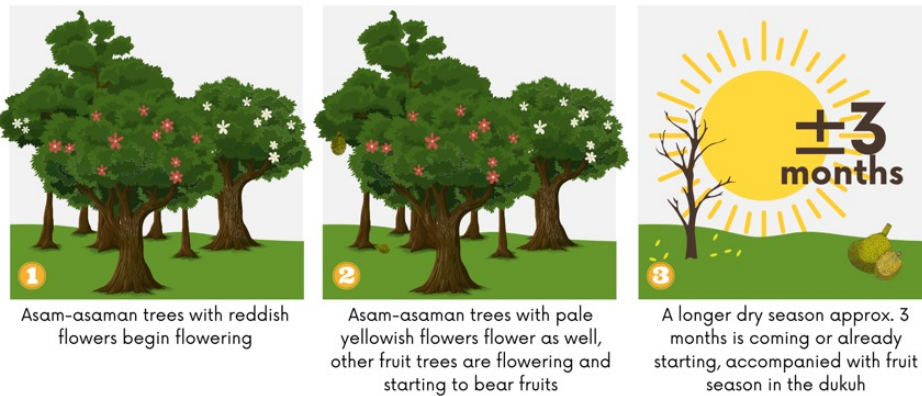
Figure 5. Illustration of asam-asaman phenology as Banjarese's traditional climate knowledge in Tatangar. (Source:Illustration by author)

Specifically, January, February, March, and December experience high-intensity rainfall; April, May, June, October, and November exhibit medium-intensity rainfall, while July, August, and September experience low-intensity rainfall.

In the field observations conducted in June, many mango trees in Mandiangin Barat village were found to be in various stages of flowering, and some already bore fruit, including hambawang putaran, hambawang damar, and kuini. Mango requires a few months of rain during its growing season, followed by rainless dry weather (Naidu et al., 2018); thus, periods with medium to high levels of rainfall may trigger mango growth, and as the number of rainfall days decrease and

the air temperature rises, the flowering stage of mango is induced. Other seasonal fruits in the dukuh, such as durian and cempedak in the Karang Intan sub-district, were beginning to yield fruit as well. Furthermore, the river at Mandiangin Barat indicated a drought condition, signaling the onset of the dry season. Hence, this phenomenon aligns with Tatangar's description in Case 2 (Figure 5).

However, there were fewer kasturi trees in full bloom within the research area. Based on the findings of this research, many kasturi trees in the neighboring villages of Mandiangin Barat were not only in full bloom but also bearing fruit, which was available in the nearby traditional market, Martapura Market. This variation in flowering

patterns could potentially be attributed to the geographical factor of Mandiangin Barat Village's proximity to the mountains. The difference in altitude may lead to a disparity in the timing of flowering (Zhang et al., 2022). Given that mangoes necessitate higher temperatures to initiate the flowering process, the elevated altitude in Mandiangin Barat renders its habitat slightly cooler compared to places like Karang Intan Village and the other surrounding sub-districts that have lower altitudes.

In natural conditions, water stress during the blossoming stage proves beneficial for mango trees (Rao et al., 2016). Drought not only initiates but also expedites and regulates vegetative flushing in tropical settings, allowing more time for floral stimulus to accumulate. When temperature and rainfall conditions are in sync, mango trees tend to undergo reproductive activity after extended periods of branch dormancy. This often happens following a mild drought or during cold temperatures, which usually occur during a season change, that induces flowering. In addition, water stress hinders the growth of new shoots and keeps the plants in a dormant state until the leaves mature, ultimately leading to the initiation of the flowering process (Davenport, 2009).

Many tropical crops are grown in the dukuh, including durian, cempedak, and others. These seasonal fruits require a period of water stress to initiate the flowering phase and bear fruit (Sakhidin et al., 2019). This observation supports Case 2 (Figure 4), wherein the *asam-asaman* with reddish flowers bloom, meaning that a longer dry season will ensue, followed by the blooming of other fruit trees in the dukuh like durian as the conditions are favorable. This dynamic will shift when heavy rain occurs, as it can disrupt the flowering process. Prolonged rain can damage mango pollen and stigma, leading to failed pollination, implying that fertilization and subsequent harvesting may also be thwarted (Triani & Ariffin, 2019). This scenario aligns with Case 1 (Figure 4), where rain can hinder some Mangifera trees like the asam-asaman with reddish flowers from bearing fruit.

Rural smallholder farmers rely on plant phenology indicators such as flowering and fruiting times to predict weather patterns (Elia et al., 2014; Mafongoya et al., 2021) as part of their traditional climate knowledge, including those in Mandiangin Barat Village. This traditional knowledge plays a significant role in their decision-making processes related to farming activities (Paparrizos et al., 2023). Similar indigenous knowledge about Mangifera species as climate indicators can be found in various countries. For instance, in Mahenge and Ismani wards, Tanzania, local communities commonly interpret a slight flowering of the mango tree (M. indica) as a potential sign of an impending drought season (Kijazi et al., 2013). In Zanzibar, another region of Tanzania, the abundant flowering of M. indica serves as an early warning sign of an approaching drought in the upcoming season. Conversely, a sparse yield of mango fruits indicates the potential for a bountiful harvest year. This guidance holds significant importance for rain-fed farmers, as it encourages them to stockpile food and prioritize the cultivation of drought-resistant crops (Salum et al., 2021). Similarly, in Mpumalanga, South Africa, rural smallholder farmers use the fruiting of M. indica as an indicator of the upcoming dry season (Ubisi et al., 2020).

The utilization of traditional climate knowledge holds predominant importance for local communities (Rivero-Romero et al., 2016), especially in agrarian areas like

Mandiangin Barat Village, where the majority of people are smallholder farmers. This knowledge enhances the preparedness of communities, ultimately leading to improved social, economic, and environmental outcomes within their agricultural production systems (Makwara, 2020; Rivero-Romero et al., 2016). This is because many decisions regarding which crops to plant, the duration of planting, and the timing of sowing and harvesting various crops are highly influenced by climate patterns (Marcinkowski & Piniewski, 2018), thereby helping to mitigate risks like crop failure.
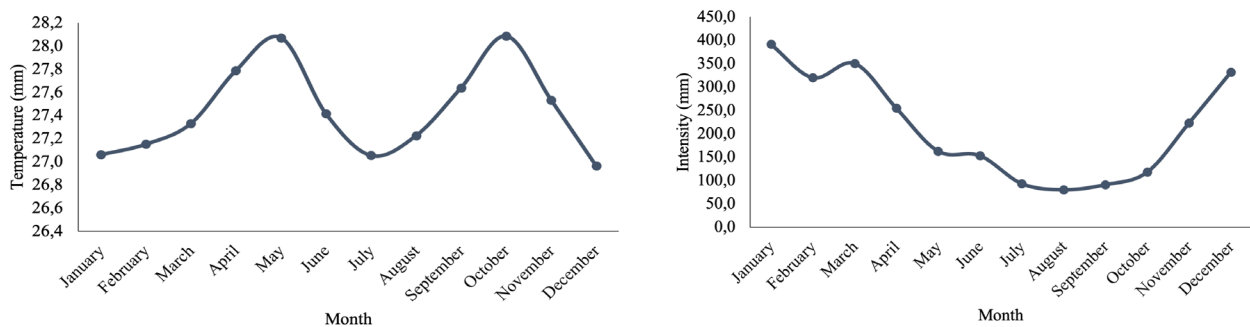

Figure 6. Monthly average data of (A) air temperature and (B) rainfall intensity in Karang Intan Sub-district throug out 2013-2022

CONCLUSION

The Banjar community's reliance on the Mangifera phenology reflects a harmonious relationship with their environment and demonstrates the profound interdependence of culture, nature, and sustainability in Kalimantan. This traditional ecological and climate knowledge not only is valuable to the Banjar community but also has broader implications for enhancing community preparedness to achieve sustainable agriculture and tackle the climate variability in Mandiangin Barat Village.

AUTHOR CONTRIBUTION

The study and initiated the work: E.H.H., R.Y., E.B.W., R.L., J. Conceived and designed the research: E.H.H., R.Y., E.B.W., R.L., J. Carried out field work: E.H.H. Analyzed the data: E.H.H., R.Y., E.B.W., R.L., J. Wrote the paper: E.H.H., R.Y., E.B.W., R.L., J. All authors revised and approved the final version.

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CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest to disclose.

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