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Original Research Article

Exploring Urban Ethnobotany: A Case Study of Medicinal Plants Traded in Gede Hardjonagoro Market, Surakarta, Indonesia

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ABSTRACT

The former royal city of Surakarta, Indonesia, is renowned for a uniquely cosmopolitan culture, blending high Javanese traditions with various *peranakan* (mixed ethnicity). This unique cultural fusion has facilitated the exchange of knowledge, particularly in relation to usage of various plants as phytomedicine by the urban populace. Therefore, this study aimed to explore the variety, utility, and phytogeography of phytomedicine available at Gede Hardjonagoro Market (*Pasar Gede*), the main market of Surakarta and Greater Solo Area (GSA). An ethnobotanical approach was used combining semi-structured interviews, participative observation, and documentation. The utility of plants was assessed through a descriptive and quantitative approach, using Use Value (UV) and Fidelity Level (FL) metrics. The results showed that a total of 76 species were found from 39 families of medicinal plants currently on sale in *Pasar Gede*. *Zingiber officinale* Roscoe had the highest UV, while 7 species had the highest FL (100%) including *Elephantopus scaber* for hepatitis, *Sonchus arvensis* for urolithiasis, and *Gynura pseudochina* for mastitis. Furthermore, *Caesalpinia sappan* was for pruritis, *Myristica fragrans* and *Piper cubeba* for diarrhea, as well as *Curcuma heynaena* for helminthiasis. Most species were native to Indomalayan realm (50 species), divided into Indochinese (21 species), Indian (12 species), Sunda Shelf (9 species), and others (8 species), with only 8 species found on Java Island. The results implied that trade routes and cultural exchange among *peranakan* ethnic group had contributed to the diversity of medicinal plants in Surakarta.

***Keywords*:** Ethnobotany, Peranakan, Phytogeography, Phytomedicine, Urban

Introduction

Surakarta, commonly known by the archaic name of Solo, is an old royal capital city belonging to Surakarta Hadiningrat Kingdom in Central Java, Indonesia. The city was established in 1745 following the aftermath of the 1741-1743 Java War in which the old royal capital of Mataram, Kartasura, was sacked and razed.[1] Although relatively new compared to a few other cities in Java, such as Semarang (1547), Demak (1503), and Pati (1323), Surakarta was built in the long-standing tradition of Javanese urban design and regional administration. This philosophy, known as *Catur Gotra Tunggal*, represents the natural order of the universe (*macrocosm*) in successively smaller scales from the organization of the regional government to urban landscape, and houses, allowing for the harmonious coexistence and function of the percieved natural order within the state.[2]

According to *Catur Gotra Tunggal*, the regional organization of the kingdom is set up into four distinct areas, namely *mancanegara* or borderland dependencies ruled by minor nobility, *negara* or middle region of feudatories ruled by lesser nobility, *Negaragung* or duchies ruled by relatives of the king, and *kutaraja* or the royal capital under direct royal administrations. These four areas serve the kingdom in various mutually supporting roles.

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The hierarchy is also demonstrated in the urban landscapes of each ducal and royal capital, with the grand market, *alun-alun* (central square), mosque, and palace being intentionally built in successively more central places in the city.[2] This uniquely Javanese urban design method showcases the interconnectivity and importance of the mundane (the grand market and square) and sacred (the mosque and the palace).

In modern times, the borders of Greater Solo Area (GSA) still correspond with *Negaragung*, and Surakarta maintains the boundaries as the royal city. The continuity of administration, although no longer under the king, has led to a continuation of culture with distinctly high Javanese traditions still permeating society. Sampeyan dalem Ingkang Sinuhun Kanjeng Susuhunan (SISKS) Pakubuwono XIII (current king of Surakarta) and the royal court plays prominent socio-cultural roles in society and preserving the strict hierarchy of high Javanese culture.[3] The palace serves as a repository and guardian of people's long cultural heritage and knowledge.

As the grand market of Surakarta, Gede Hardjonagoro Market (*Pasar Gede)*, along with minor markets, which traditionally only open on specific days according to the Javanese 5-day cycle called *Pasaran*, were built concurrently with the palace. *The market* is often referred to as *Pasar Gede* in GSA, clearly illustrating the central importance to urban tradition.[2] In the strict hierarchy of high Javanese society, the traditional market is designed to be more than a center for commerce but also serve as an open public space where people of all classes come together.[4-6] The free and open exchange of new ideas and goods has served as a linchpin, connecting the agrarian villages of *Negara* and *Negaragung* with urban residents.[7,8] Through the maritime Silk Road, these traditional markets also connect Surakarta with the wider world.

Java is integral to the maritime Silk Road connecting Arabia, India, and China.[5,9] This complex trade network uses the unique weather patterns of the monsoon cycle, between March – October. Monsoon winds, from

west to east, facilitate extensive trade routes from Arabia and India to Indonesia and China, with the return journey taking place after the monsoon season. Furthermore, Java Island, and specifically the port cities located on the north coast (*pasisir*), has been the source of rice and other foodstuff necessary for long voyages while serving as the distribution point for spices grown in the eastern islands.[10-12] The presence of many trade delegations and traders hosted in the port and the royal cities created a unique cosmopolitan urban environment.[13] A common practice during the lengthy stopover periods, which could last from 3 to 6 months and inherent to the monsoon trading system, was to settle down in the cities and become married into the local populace.[14] The ethnic Indians, Arabs, and Chinese settled in Javanese cities, intermarried with locals, and eventually formed a particular class known as *peranakan.*[15] These people have been mostly assimilated into Surakarta society, despite the ethnic and cultural differences with Javanese people.[16] Historically, interactions between locals and *peranakan* were restricted due to the Dutch colonial policy of *wijkenstelsel*, which required each ethnic group to live in separate and often walled neighborhoods segregated from the local Javanese population. However, traditional markets served as a common ground for different ethnic groups to interact and build substantial social bonds.[4,15,17-19] Each *peranakan* society disseminates cultural knowledge through the traditional markets, further enriching the local Javanese culture.

In the corpus of cultural knowledge disseminated through the traditional markets is the knowledge and consumption of various plants and products. The modern study of cultural plant knowledge is known as ethnobotany.[20-22] Specifically, in cosmopolitan urban centers such as Surakarta, the evolution in the usage of various plants and products has led to the novel science of ethnobotany, creating a unique socio-economic complex. This evolution facilitates various changes such as ecological transformation through the introduction and cultivation of new species, social adaptions with the novel usage of new plants and products in "new urban traditions," and economic opportunities to meet the demands of consumers.[16,23] Traditional markets serve as a repository of historical trends and an indicator of current practices in urban ethnobotany. However, due to the novelty of this field, only a few studies explored traditional markets on Java Island namely in the cities of Kediri, Cikarang, and Yogyakarta.[24,25]

Medicinal plants (phytomedicine) are considered significantly essential by *peranakan* people due to the extensive history of traditional medicine among the three main minority ethnic groups in Surakarta, namely Indians, Arabs, and Chinese.[10-12] Each phytomedicinal tradition is based upon the local environment and regional characteristics, such as the Mediterranean ecosystem of the levant, the alpine ecosystem of the Himalayas, the tropical forests of southern India, and the subtropical evergreen ecosystem of southern China.[26] Due to the urban nature of *peranakan*, the current phytopharmacological usage of these medical plants is no longer limited to the various ethnic groups. The introduction, cultivation, management, and usage of various plants rely on complex relationships with each other and the native Javanese established through the traditional markets.[27] Therefore, ethnobotany must accumulate and catalog the diverse medicinal plants currently in general demand.[20,28,29]

This study, conducted at *Pasar Gede*, aimed to record the existing medicinal plants and diverse applications in phytomedicine. Due to the prevalent use among the Javanese population, particularly in Surakarta, a significant presence of specialized traditional phytomedicine vendors was found in and around *Pasar Gede* [4]. These vendors offer a wide range of phytomedicine, surpassing the offerings available in other markets. The significant number of specialized dealers is a distinctive occurrence, signifying renewed interest in ethnomedicine. This contrasts with the overall decrease of traditional medicine in favor of modern medicine.[30] Additionally, discussions concerning market chains and the phytogeography of medicinal plants traded in *Pasar Gede* were included in this study. The biological, cultural, and linguistic diversity that reflects the origin of these plants is related to an adaptive and complex social-ecological system.[31,32] This diversity is primarily because *Pasar Gede* is a traditional market located in an urban area packed with people of different ethnicities from *peranakan* background. Based on the aforementioned factors and the absence of comparable studies, an urban ethnobotany investigation was conducted to document the traditional phytomedicine traded in *Pasar Gede*. This study aimed to elucidate the function of traditional markets in supplying phytomedicine and preserving cultural knowledge from an ethnobotanical standpoint.

Material and Methods

Study site

This study was conducted in *Pasar Gede,* located specifically on Urip Sumoharjo Street, Jebres District, Surakarta, Central Java Province, with coordinates of 7°34'07" S, 110°49'52" E (Figure 1). The market is well accessible either by private vehicles or public transportation. Additionally, *Pasar Gede* is the largest traditional market in Surakarta,[33] which has a population of 523,008 people with an area of 4272 ha.[34] GSA, including Surakarta and the surrounding satellite towns namely Kartasura, Solo Baru, Palur, Colomadu, Baki, and Ngemplak, is profoundly interconnected and corresponds to *Negaragung* of Surakarta Hadiningrat kingdom. Due to the deep interconnectivity, GSA can be considered a single urban area with a total population of 3,649,254 people.[34] Most inhabitants of Surakarta are of Javanese ethnicity, with substantial Chinese, Indian, and Arab minorities. The majority of Arabs and Indians have been located around *Pasar Kliwon* region since the 19th century, while Chinese are centered in Balong region. The Chinatown of Balong is significant for the many Chinese temples and shrines.

Surakarta is located on the northern boundary of the productive Prambanan plain at an elevation of 95 to 105 m asl, adjacent to Bengawan Solo River. Mount Merbabu surrounds the area to the west, Mount Merapi to the southwest, and Mount Lawu to the east. The land surrounding this city is typically rich in nutrients due to the volcanic ash from Mount Merapi. It is well-watered by multiple mountain springs flowing into Bengawan Solo River. Similar to Java Island, Surakarta has a tropical monsoon climate, with the rains lasting from October to March and the dry season from April to September. The average rainfall is 2200 mm, with the wettest months being December to February and an annual average temperature of 30^{0}C.

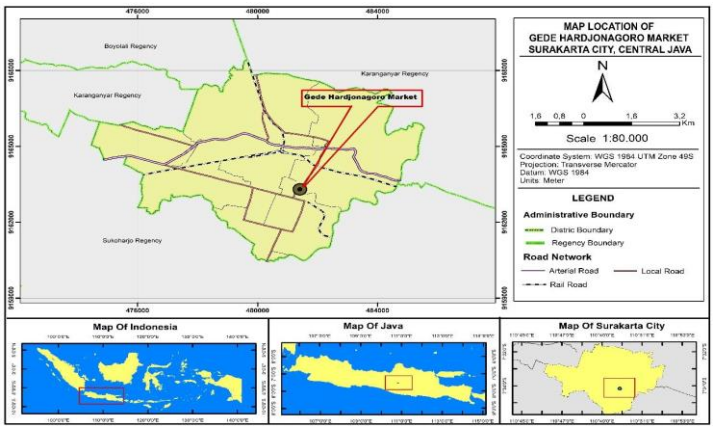

Figure 1: Location of Gede Hardjonagoro Market, Surakarta City, Central Java Province, Indonesia

Figure 2: One of the medicinal plants stall in *Pasar Gede*

Ethnobotanical data collection

Following coordination and permission from the municipal trade administration, including the union of traders "*Rukun Makmur Sejahtera*," data regarding the variety and use of phytomedicine available in *Pasar Gede* was acquired through a combination of semi-structured interviews, participative observation, and documentation. Interviews based on general points were conducted with 40 respondents, comprising 36 females and 4 males specialized in traditional phytomedicine. These interviews were conducted according to the guidelines proposed by previous studies[35-38] with slight modifications.

The questions focused on the variety of phytomedicine for sale, particularly the vernacular names, supply sources, indications for use, preparation methods, and possible outcomes or side effects of each species. Respondents also provided additional demographic data such as names, genders, ages, education levels, and experiences of individuals.[37,39,40] Sample specimens of each species were obtained for further identification and documentation conducted at the Educational Herbarium of the Biology Laboratory in Universitas Muhammadiyah Surakarta. Further verification of scientific names of the sample species was conducted by referring to authoritative sources[41-44] available in books and online formats.

Data analysis

A descriptive and quantitative approach was used to examine the information of respondents, using Use Value (UV) and Fidelity Level (FL) metrics.[45] UV is a quantitative approach that assesses the relative significance of species in a specific locality using the formula: $UV = \Sigma U_i/N$. Specifically, U_i denotes the number of uses indicated by each respondent ($_i$), and N represents the total number of respondents questioned for the particular plant species. FL refers to the proportion of respondents in the study area who reported using specific plant species to treat a given condition. This index can be determined by the mathematical equation: $FL\ (\%) = (I_p/I_u) \times 100$. I_p represents the count of respondents who identified the use of a particular species for a specific ailment, and I_u denotes the overall count of informants who referenced the plant for any significant ailment. A phytogeographic review was also conducted to examine the medicinal plant species used by the people of Surakarta and surrounding regions. The origins and distribution of plants were traced using the primary databases.[43,44]

Results and Discussion

Background and characteristics of medicinal plant traders in Pasar Gede

Based on the principle of *Catur Gotra Tunggal*, *Pasar Gede* is built as part of the ceremonial cosmic axis and is one of the mundane hearts of Surakarta. Therefore, residential areas and various auxiliary traditional markets are built to support the grand market. *Pasar Gede* is located in the center of the city along the banks of Pepe River, a major tributary of Bengawan Solo River,[46] allowing for easy loading and unloading of produce from far-flung provinces and overseas imports.[47] Although traditional markets are still subject to fluctuations, leading to changes in supply and demand, continued existence indicates the success of the urban design conception, the face of modernization, and the thriving regional economy.[4] In modern times, the municipal trade administration, in partnership with the union, called *Rukun Makmur Sejahtera*" administers, maintains, and regulates the grand market composed of shops, kiosks, stalls, and tents owned or managed by small to medium-scale traders (Figure 2).[48] The large distributors and auction houses were detached from the market proper and formed independent corporations. Furthermore, the rapid population growth of the 18th and 19th centuries necessitated the building of auxiliary markets and an abandonment of the 5-day *pasaran* cycle. Traders in the auxiliary markets source produce from *Pasar Gede* including rice, fish, fruit, vegetables, eggs, meat, clothes, and household electronic goods.[48] The market is presently partitioned into blocks designated for various merchandise, and Block IV which houses 9 shops, focuses explicitly on traditional phytomedicine. These shops are generally open from 8 AM – 4 PM, with each stall serviced by 1-3 traders depending on the booth size and the volume of medicinal plants traded.

Interviews using an ethnobotanical questionnaire and documentation were conducted at 7 shops (2 shops declined to give interviews) with 17 shopkeepers and 23 consumers, totaling 40 respondents. Previous ethnobotanical studies found that age, gender, and occupation significantly influenced the transmission of traditional knowledge concerning the use of medicinal plants in each of these ethnic communities.[49]

All phytomedicine traders interviewed in *Pasar Gede* were females aged around 37 – 62 years and natives of Surakarta. Based on the results, diseases were divided into 2 types, namely common and internal. Common diseases, including fevers, coughs, colds, and diarrhea, were attributed to irregular eating habits and overconsumption of cold drinks and spicy foods. On the other hand, internal diseases such as diabetes, cancer, hypertension, hypotension, and liver disorders were considered complex diseases caused by a sedentary lifestyle and an overconsumption of sugar and fatty foods.

Customers of phytomedicine in *Pasar Gede* were predominantly residents of GSA, namely Surakarta, Sragen, Karanganyar, and Boyolali Regencies. These individuals were predominantly females aged 25-70 and could be divided into three general categories, namely herbal medicine sellers, tourists, and residents. Herbal medicine sellers purchased large quantities for resale in many stores across GSA, while residents bought small amounts for personal and family use. The phytomedicine section also served as a tourist destination by the city government.

The diversity of medicinal plants and usage

At *Pasar Gede*, 2 types of phytomedicine were available, namely fresh and dried simplicia, with the majority being dried. Based on the interviews, 76 species from 39 families of traditional phytomedicine are currently available (Figure 3). The phytomedicine most widely traded was from *Zingiberaceae* family, with the following species in high demand: *Zingiber officinale Roscoe*, *Zingiber officinale* Roscoe var. Rubra, *Amomum Cardamomum, Kaempferia galanga, Curcuma domestica, Curcuma zedoaria, Alpinia galanga, Zingiber aromaticum, Zingiber purpureum, Curcuma aeruginosa, Curcuma heynaena, Curcuma xanthorrhiza, Curcuma mangga,* and *Boesenbergia pandurata*. This is significantly higher compared to a previous study,[50] which reported 10 types of rhizomes *Zingiberaceae* traded by herb sellers at Pancur Batu Market in Sumatera Island, Indonesia. Botanically, *Zingiberaceae* is an herbaceous plant, and this allows for easy cultivation even in small gardens, leading to a high volume and wide trading diversity.[51,52]

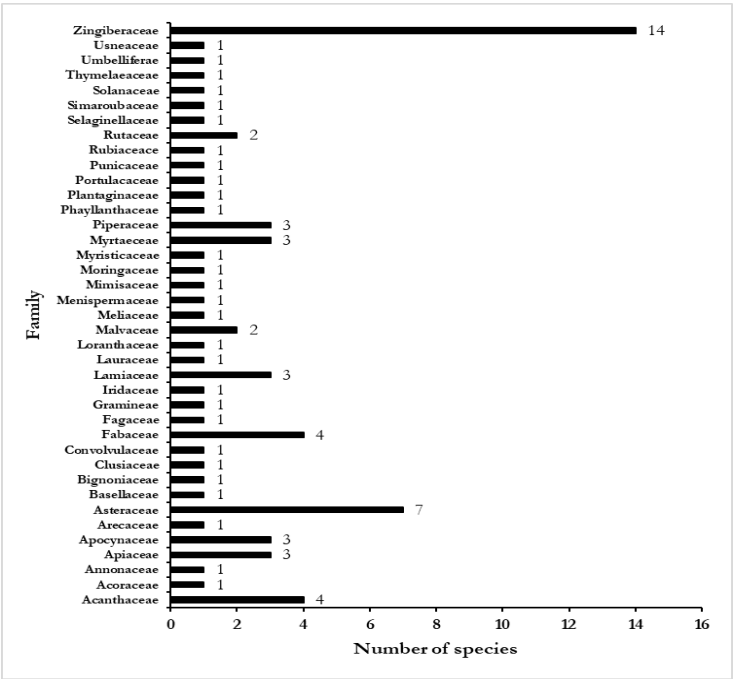

Figure 3: Plant families traded in *Pasar Gede*

The selected of phytomedicine offered at *Pasar Gede* changes annually as traders modify inventory based on client demand, introduction of new species, and fluctuating popularity over time. These phytomedicine were sourced from intermediaries or mongers who purchase from farmers or foresters (collectors). The majority acquired from suppliers were in a dried simplicial form (Figure 4), while only a small number of species were sold in a fresh state.

The intricate supply chain of items intended for trading at *Pasar Gede* comprises a network of numerous suppliers from different locations and ecosystems, ensuring a diverse range of phytomedicine is available (Figure 5). The interplay among farmers, wholesale mongers, and traders results from a long-standing trade practice that has been handed down through generations within the same family for millennia. The suppliers in central Java are located in the regencies of Purworejo, Karanganyar, Wonogiri, Solo, Pati, Boyolali, and Sukoharjo. On the other hand, suppliers from East Java are only found in Ngawi and Magetan. The supply areas corresponded to the former boundaries of *Negaragung* and *Negara*, which were part of Surakarta Hadiningrat kingdom. These locations also demonstrate the continued existence of the previous trading networks. The regions can be classified into three primary ecosystems namely the Mountainous agroecosystem located in Mount Lawu, Merapi, and Merbabu reserve; the hills agroforestry systems of Gunung Sewu and the Sukolilo karst hills; as well as the plains ecosystem of the Prambanan and Bengawan Solo Flood plains.

The presence of many ecosystems is crucial for preserving the extensive range of phytomedicine, as each species flourishes in certain climatic conditions essential for optimal growth. In a similar study, abundant accessibility of herbaceous phytomedicine cultivated in diverse *Anacardium occidentale*-based agroforestry systems was found in the hills of Wonogiri.[53] Phytomedicine is not prioritized as the main source of income in the agroforestry ecosystem but still contributes significantly to the overall income. Furthermore, strategic cultivation was carried out as refugia in the plains and floodplains surroundings for safeguarding the main crops.[54] The farmers who harvest the phytomedicine are also responsible for drying before being sold to the various mongers in bulk. These mongers transport goods to the market on designated days, to sell for traders of *Pasar Gede* through a traditional auction. When mongers do not have the phytomedicine in stock, specifically for novel or rare types, traders can purchase straight from production areas. Purchase from mongers is usually made in bulk form, while traders repackage the raw materials for retail sale in measured quantities.

Among the phytomedicine traded in *Pasar Gede*, 76% are from cultivated plants, with the remaining 24% originating from wild plants. Foresters typically collect wild phytomedicine directly from mountain forests, while cultivated types are sourced from plantings in communities operated by local farmers. Phytomedicine obtained from cultivated plants is purposely grown to maintain a consistent supply and minimize the need for overharvesting wild types.[52] In general, cultivated plants typically command a greater price compared to the wild, primarily because of the favorable and regulated growth conditions. In history, new species have been intentionally introduced and adapted to meet the market desire for innovative phytomedicine. The process of naturalization and hybridization typically adhere to community standards. However, extensive studies are needed to investigate the enduring impact of these invasive species on the native ecosystem.

Pasar Gede can be compared to several other markets located on Java Island, having a total of 76 phytomedicine species traded in both fresh and dry forms. Warungkondang Market in Cianjur, West Java, has a limited selection of only 21 plant species.[55] The greater diversity in *Pasar Gede* can be attributed to the more comprehensive and highly developed supply chain. The distinctive historical background of Surakarta as a royal capital has facilitated privileged access to the resources and agricultural products of *Negara* and *Negaragung*. Conversely, Warungkondang Market is situated in Cianjur, a city that was once a duchy, as well as lacked the territory and resources to establish the required supply chain for maintaining the extensive range of products. Following the civil war in 1680, the kingdom of Banten, which covered the entire region of West Java, fragmented into smaller and fiercely autonomous duchies, hindering the establishment of a highly centralized administration and the semi-tributary commerce system existing in Surakarta Hadiningrat Kingdom. The abundance of phytomedicine species exchanged in *Pasar Gede* is associated with the substantial *peranakan* community, which has led to a rise in demand among the local people.

Phytomedicine refers to the use of specific plant species for medicinal purposes due to the presence of beneficial substances that can prevent, relieve, or treat diseases.[56] These plants grow in the wild and have been customarily used by local communities. Urban development, particularly after the industrial age, can be invasive and destructive,[57] leading to the loss of cultural knowledge regarding phytomedicine and agrarian practices. This loss is worsened by the perception that the practices are not considered relevant to daily life.[58-61] Traditional knowledge of the natural environment, particularly the understanding of plant-based medicines, continues to flourish in urban people in Indonesia.[11] Approximately 23.25% of participants used phytomedicine on a frequency exceeding four times per month, while 67.25% were found to possess a certain level of familiarity with conventional species.[62] A study found that the local community at Kabanjahe Market in North Sumatra used 345 different species as ingredients for traditional medicine.[38] Both studies contend that the significant preservation of cultural phytomedicine knowledge can be attributed to the strong bond between urban participants and relatives residing in rural communities, as well as the deep respect for cultural wisdom.

Figure 4: Traditional phytomedicine in the form of dried Simplicia in *Pasar Gede*

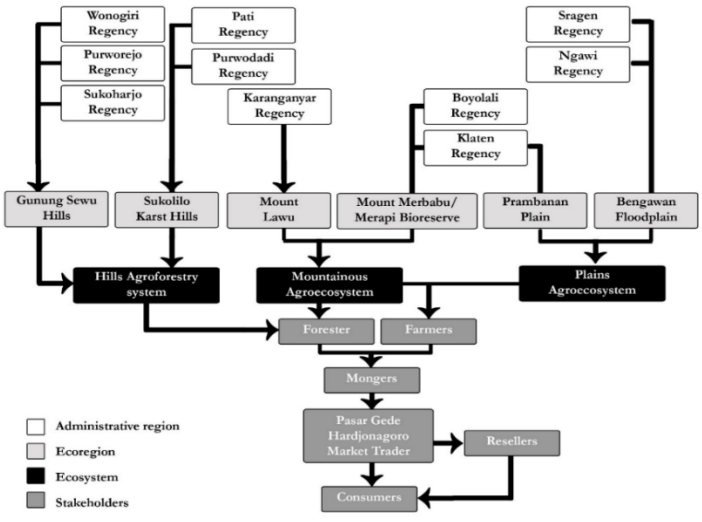

Figure 5: Phytomedicine Supply Chain in *Pasar Gede*

Table 1: Traditional medicinal plants at *Pasar Gede*

No	Family	Local name	Scientific name	Part used	Medicinal use*	FL	Processing method	UV
1	Acanthaceae	Sambiloto	*Andrographis paniculate* Nees	Leaves, stem	Diabetes, dermopathy, general immunity, cancer	91.2	Boiled	0.2
2	Acanthaceae	Keji beling / ngokilo	*Serycocalyx crispus* L.	Leaves	Urolithiasis, diabetes	60	Boiled	0.2
3	Acanthaceae	Dandang gendis	*Chinacanthus nutans* Lindau	Leaves, stem	Diabetes, general immunity	58.3	Boiled	0.1
4	Acanthaceae	Daun ungu	*Graphtophylum pictum* L.	Leaves	Haemorrhoids, constipation	81.8	Boiled	0.1
5	Acoraceae	Dlingo	*Acorus calamus* L.	Rhizome	Dyspepsia, sedative	63.6	Boiled	0.1
6	Annonaceae	Sirsak	*Annona muricata* L.	Leaves	Cancer, diabetes, sore throat	70	Boiled	0.15
7	Apiaceae	Pegagan	*Centella asiatica* L.	Leaves	Vasodilator, muscle aches, haemorrhoids	80	Boiled	0.15
8	Apiaceae	Jinten	*Nigella damascenda* L.	Seed	Dyspepsia, diabetes, cancer	72.7	Boiled	0.15
9	Apiaceae	Purwoceng	*Pimpinella pruatjan* L.	Root	Erectile dysfunction, oliguria, dysuria	77.8	Boiled	0.15
10	Apocynaceae	Pulosari	*Alyxia reinwardtii* Bl.	Bark	Leukorrhea, fever, diarrhoea	61.5	Boiled	0.1
11	Apocynaceae	Kayu rapet	*Parameria laevigata* (Juss.) Moldenke.	Bark	Postpartum pain, general obstetric health	76.9	Boiled	0.1
12	Apocynaceae	Tapak dara	*Catharanthus roseus* L.	Leaves, stem	Hypertension, cancer, cholesterol	73.3	Boiled	0.15
13	Arecaceae	Jambe	*Areca catechu* L.	Fruit	Constipation, postpartum care, dysmenorrhea, helminthiasis	63.6	Boiled	0.2
14	Asteraceae	Daun insulin	*Tithonia diversifolia* (Hemsl.) A. Gray	Leaves	Diabetes, cholesterol, cancer, inflammation	50	Boiled	0.1
15	Asteraceae	Sembung	*Blumea balsamifera* L.	Leaves	Fever, dysmenorrhea, diabetes	57.1	Boiled	0.15
16	Asteraceae	Tapak liman	*Elephantopus scaber* L	All parts of the plant	Hepatitis	100	Boiled	0.05
17	Asteraceae	Luntas	*Pluchea indica* (L.) *Less*	Leaves, stem	Dyspepsia, fever	66.7	Boiled	0.1
18	Asteraceae	Sambung nyowo	*Gynura procumbens* (Lour.) Merr	Leaves	Diabetes, Hypertension	63.6	Boiled	0.05
19	Asteraceae	Tempuyung	*Sonchus arvensis* L.	Leaves	Urolithiasis	100	Boiled	0.05
20	Asteraceae	Daun dewa	*Gynura pseudochina* (Lour.) Dc	Leaves	Mastitis	100	Boiled	0.05

No	Family	Local name	Scientific name	Part used	Medicinal use*	FL	Processing method	UV
21	Basellaceae	Binahong	*Anredera cordifolia* L.	Leaves	Diabetes, hypotension, abdominal pain	75	Boiled	0.15
22	Bignoniaceae	Kayu wolo	*Oroxylum indicum L.*	Stem	Erectile Dysfunction, dyspepsia	69.2	Brewed water	0.1
23	Clusiaceae	Manggis	*Garcinia mangostana* L.	Peel	Cancer, diabetes, cholesterol, stroke	66.7	Boiled	0.2
24	Convolvulaceae	Widara upas	*Merremia mammosa* Chois	Tuber	Diabetes, inflammation, cancer, fever	54.5	Boiled	0.2
25	Fabaceae	Secang	*Caesalpinia satppan* L.	Bark	Pruritis	100	Boiled	0.05
26	Fabaceae	Klabet	*Trigonella foenumgraecum* L.	Seed	Breastmilk stimulant, dysmenorrhea	66.7	Boiled for bathing	0.1
27	Fabaceae	Jati cina	*Senna alexandria* Mill.	Leaves	Lose weight, general immunity, dyspnoea	70	Boiled	0.15
28	Fabaceae	Bunga telang	*Clitoria ternatea* L.	Flower	Cancer, diabetes, asthma	80	Boiled	0.15
29	Fagaceae	Manjakani	*Quercus lusitanica* Lamk	Stem	Leukorrhea, dysmenorrhea	82.4	Boiled	0.1
30	Gramineae	Alang-alang	*Imperata cylindrica* L.	Leaves	Nephropathy, hepatitis	72.7	Boiled	0.1
31	Iridaceae	Bawang Dayak	*Eleutherine palmifolia* (L.) Merr	Tuber	Diabetes, dyspepsia, general liver health	61.5	Brewed water	0.15
32	Lamiaceae	Selasih	*Ocimum basilicum* L	Seed	Dyspepsia, general immunity.	73.3	Boiled	0.1
33	Lamiaceae	Kumis kucing	*Orthoshipon aristatus*(Bl.) Miq.	Leaves	Nephropathy, hypertension, diabetes	69.2	Boiled	0.15
34	Lamiaceae	Menta	*Menta piperita* L.	Leaves	Cough, halitosis, dysmenorrhea	72.7	Boiled	0.15
35	Lauraceae	Kayu manis	*Cinnamomum burmannii* (Nees) BI	Bark	Diabetes, diarrhoea	44.4	Boiled	0.1
36	Loranthaceae	Benalu	*Dendropthoe pentandra L.*	Leaves	Postpartum care, cough	80	Boiled	0.1
37	Malvaceae	Kayu ules	*Helicteres isora* L.	Root	Asthma, cough	58.3	Boiled	0.1
38	Malvaceae	Rosella	*Hibiscus sabdariffa* L.	Flower	Hypertension, cancer	81.8	Boiled / brewed water	0.1
39	Meliaceae	Mahoni	*Swietenia mahagoni* Jacq	Seed	Diabetes, hypertension, cancer, inflammation	68.8	Boiled	0.2

No	Family	Local name	Scientific name	Part used	Medicinal use*	FL	Processing method	UV
40	Menispermaceae	Brotowali	*Tinospora tuberculate L.*	Stem, leaves	Diuretics, fever, scabies	75	Boiled	0.15
41	Mimisaceae	Kedawung	*Parkia javanica* (Lam.) Merr.	Seed	Dyspepsia, dysmenorrhea	72.7	Boiled	0.1
42	Moringaceae	Kelor	*Moringa oleifera* Lam	Leaves	Cancer, diabetes	66.7	Boiled	0.1
43	Myristicacea	Pala	*Myristica fragrans* Houtt.	Fruit, peel	Diarrhea	100	Boiled	0.05
44	Myrtaeceae	Salam	*Syzygium polyanthum* (Wight) Walp.	Leaves	Hyperuricemia, diabetes, hypertension	58.3	Boiled	0.15
45	Myrtaeceae	Cengkeh	*Syzygium aromaticum* L.	Seed, leaves	Inflammation, dental and oral health	66.7	Boiled	0.15
46	Myrtaeceae	Jung rahab	*Baeckea frustescens* L.	Leaves	Rheumatism, fever, cancer	60	Boiled	0.15
47	Piperaceae	Merica bolong/ gelam	*Piper cubeba* L.	Fruit	Diarrhea	100	Boiled	0.05
48	Piperaceae	Cabe jawa	*Piper retrofractum* Vahl	Fruit	Hypotension, headaches, flu	64.3	Boiled	0.15
49	Piperaceae	Suruh	*Piper betle* L.	Leaves	General gynaecology and obstetrics health, dysmenorrhea, oral health	72.2	Boiled	0.15
50	Phayllanthaceae	Meniran	*Phyllantus niruri* L.	Leaves	Nephropathy, general immune health, hypertension, diabetes	78.6	Boiled	0.2
51	Plantaginaceae	Daun sendokan	*Plantago mayor* L	Leaves	Inflammation, nosebleed	64.3	Boiled	0.1
52	Portulacaceae	Gingseng jawa	*Talinum paniculatum* Gaertn	Stem	Upper respiratory tract infection, diarrhoea, leukorrhea, common cold	50	Boiled	0.2
53	Punicaceae	Delima	*Punica granatum* L.	Seed	heart disease, cough, muscle aches, cancer	72.7	Boiled	0.2
54	Rubiaceae	Rumput Mutiara	*Hedyotis corymbosa* L.J Lamk	Leaves, stem	General hepatic health, cancer	45.5	Boiled	0.1
55	Rutaceae	Jeruk nipis	*Citrus aurantiifolia* (Christm. & Panz)	Fruit	Cough, tonsilitis, cholesterol, fever	64.7	Boiled. eaten immediately	0.2

No	Family	Local name	Scientific name	Part used	Medicinal use*	FL	Processing method	UV
56	Rutaceae	Jeruk purut	*Citrus hystrix* DC	Leaves, peel	Sore throat, cough	73.3	Boiled. eaten immediately	0.1
57	Selaginellaceae	Cakar ayam	*Selaginella doederleinii* Hieron	Leaves	Upper Respiratory tract infection, dyspepsia	75	Boiled	0.1
58	Simaroubaceae	Pasak bumi	*Eurycoma longifolia* Jack	Stem	Erectile Dysfunction, Male impotency.	61.5	Boiled	0.1
59	Solanaceae	Ciplukan	*Physalis angulata* Linn	Leaves, fruit	Diabetes, dyspepsia, thrush (candidiasis)	63.6	Boiled	0.15
60	Thymelaeaceae	Mahkota dewa	*Phaleria macrocarpa* L.	Fruit	Diabetes, cancer, allergies	66.7	Boiled	0.15
61	Umbelliferae	Adas	*Foeniculum vulgare* P. Mill.	Leaves	Cancer, anti-inflammation, heart	70	Boiled	0.15
62	Usneaceae	Rasuk angin	*Usnea barbata* (L.) F.H. Wigg	Stem	Flu & fever, aches and pains	57.1	Boiled	0.15
63	Zingiberaceae	Jahe	*Zingiber officinale* Roscoe	Rhizome	Flu & cough, general immunity, dysmenorrhea, dyspepsia, cancer, diabetes	75	Boiled. eaten immediately	0.3
64	Zingiberaceae	Jahe merah	*Zingiber officinale* Roscoe var. Rubra	Rhizome	General immunity, cough, sore throat, asthma, cholesterol, heart disease	78.6	Boiled	0.1
65	Zingiberaceae	Kapulaga	*Amomum Cardamomum* Willd.	Fruit	Cough, flatulence	57.1	Boiled	0.2
66	Zingiberaceae	Kencur	*Kaempferia galanga* Linn.	Rhizome	Cough, hypertension, fever, dyspepsia	73.3	Boiled, eaten immediately	0.25
67	Zingiberaceae	Kunir	*Curcuma domestica* Val	Rhizome	Dyspepsia, anti-inflammation, flatulence, dysmenorrhea, general immunity	76.5	Boiled	0.15
68	Zingiberaceae	Kunir putih	*Curcuma zedoaria* (Christm.) Roscoe	Rhizome	Dyspnea, diarrhea, vomiting	69.2	Boiled	0.1
69	Zingiberaceae	Laos	*Alpinia galanga* (L.) Swartz	Rhizome	Cholesterol, dermatopathy	72.7	Boiled	0.1
70	Zingiberaceae	Lempuyang	*Zingiber aromaticum* Val.	Rhizome	Sore throat, fever	77.8	Boiled	0.2

No	Family	Local name	Scientific name	Part used	Medicinal use*	FL	Processing method	UV
71	Zingiberaceae	Bengle	*Zingiber purpureum* Roxb.	Rhizome	Fever, helminthiasis, abdominal pain, constipation	75	Boiled	0.1
72	Zingiberaceae	Temu ireng	*Curcuma aeruginosa* Roxb.	Rhizome	Helminthiasis, dysmenorrhea	63.6	Boiled	0.05
73	Zingiberaceae	Temu giring	*Curcuma heynaena* Val.	Rhizome	Helminthiasis	100	Boiled	0.15
74	Zingiberaceae	Temu lawak	*Curcuma xanthorrhiza* Roxb.	Rhizome	Gastroenteritis, general immunity, general hepatic health	68.8	Boiled	0.2
75	Zingiberaceae	Temu mangga	*Curcuma mangga* Valeton & Zijp	Rhizome	Dyspepsia, diarrhoea, dysmenorrhea, Leukorrhea	70	Boiled	0.15
76	Zingiberaceae	Temu kunci	*Boesenbergia pandurata* (Roxb.) Schlechter	Rhizome	Cough, dyspepsia, breastmilk stimulant	54.5	Boiled	0.2

*The highlighted component represents a pathological condition that exerts a significant influence on the magnitude of Fidelity Level (FL).

The presence of these herbal medicines in urban markets and the willingness of traders to provide information on remedies for specific ailments enable individuals to self-medicate and preserve the significance of traditional herbal knowledge. Therefore, traders fulfill the role of contemporary herbal apothecaries, a practice widely prevalent in ancient times. The transmission of knowledge regarding different phytomedicine and specific treatment recipes is traditionally inherited in trader families across generations. Some of this knowledge has been documented in various books, papers, and social media platforms. However, there is currently no comprehensive compilation of the cultural knowledge pertaining to Javanese phytomedicine. Table 1 presents the data acquired from *Pasar Gede*.

There are several methods of taking phytomedicine including through decoction, direct consumption, or herbal baths. Decoction, the act of boiling plants and products to extract different compounds of either singular or multiple substances based on specific traditional recipes is referred to as *jamu* in Javanese. The process is often regarded as the most simple, efficient, and widely accepted approach to consume phytomedicine.[63] Pre-prepared *jamu* recipes, which are popular, can be acquired in a ready-to-drink form.[64,65] However, direct consumption is not widely favored due to the potent and frequently unpleasant taste of the raw plant material. Herbal baths are infrequently used, underscoring the need for further studies to investigate both the phenomena and the effectiveness.

Figure 6 showed that leaves were the predominant component of plants used in phytomedicine, accounting for 32 species or 39%. Among the Dani tribe of Papua, leaves were the most often used component of the plant because of the abundance and simplicity.[66] The Osing tribe in Banyuwangi, East Java, used leaves as phytomedicine due to the ease of extracting water-soluble biologically active components.[67] A comparable study in the urban region of Saiss, Morocco, also arrived at a similar conclusion.[68]

Quantitative analysis of ethnomedicine data

Use Value (UV)

UV of medicinal plant species describes the level of efficacy in treating a category of disease. Ginger, scientifically known as *Zingiber officinale* Roscoe, had the highest UV (0.35) due to frequent use in traditional medicine. It is commonly used to address ailments such as coughs, flu, dysmenorrhea, dyspepsia, and to enhance overall immune function. The results are consistent with a previous study which reported a UV of 0.78 for ginger among individuals in Vietnam.[51] The effectiveness in alleviating gastrointestinal symptoms has also been demonstrated in multiple clinical trials.[69] The significant use of specific phytomedicine species corresponds to an increased demand and a greater supply. A low UV may be attributed to poor public knowledge rather than lack of efficacy.[70]

From 2006 to 2020, Asia has been the dominant producer of ginger, contributing to 79.3% of the total global production. Indonesia currently holds the fifth position in terms of overall output,[71] producing 247 thousand tons in 2022.[72] The fertile soils and tropical monsoon environment are advantageous for extensive cultivation.[73] Ginger contains phenols, gingerols, and shogaols as the active components. These phenols have been well-proven to possess antioxidant, anti-inflammatory, and antibacterial properties. Furthermore, ginger is known to provide a range of beneficial properties, including anticancer, neuroprotective, cardiovascular protective, pulmonary protective, anti-obesity, antidiabetic, antinausea, and antiemetic agents.[74,75]

Fidelity Level (FL)

FL is the proportion of survey participants that reported using plant species for the same primary purpose. The purpose is to quantify the significance of a species for a specific objective and the results are shown in Table 1. FL obtained in this study demonstrated a wide range of variability, spanning from 44.4% to 100%. A total of 7 plants had FL values of 100%, including *Elephantopus scaber*, for treating hepatitis, *Sonchus arvensis* for urolithiasis, *Gynura pseudochina* for mastitis, *Caesalpinia sappan* for pruritus, *Myristica fragrans* and *Piper cubeba* for diarrhea, as well as *Curcuma heynaena* for helminthiasis.

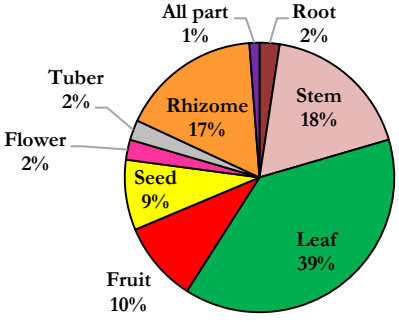

Figure 6: Part of the plant used to cure disease

The literature searches showed that these 7 species of plants have been examined for the constituents and demonstrated therapeutic potential. *Elephantopus scaber* possesses the ability to mitigate inflammation in the course of fulminant hepatitis due to the presence of Deoxyelephantopin (DET), a plentiful sesquiterpene lactone.[76,77] The medicinal properties of *Sonchus arvensis* have been extensively studied in Indonesia due to the efficacy in the treatment of kidney stones.[78] Furthermore, *Gynura pseudochina* contains Quercetin 3-rutinoside and three caffeoyl quinic acids, which possess anti-inflammatory properties.[79] The ethanolic extract of *Caesalpinia sappan* has the potential to be used as an antibacterial agent for treating several types of infections and irritations, including itchy skin.[80,81] *Myristica fragrans* possess antimicrobial resorcinol compounds, namely malabaricone C and B, which contribute to the anti-secretory and anti-diarrheal effects against a range of bacteria and pathogens.[82-84] In addition, locals of Surakarta acknowledge *Piper cubeba* as an effective remedy for diarrhea. Various extracts derived from this plant have antioxidant and antibacterial characteristics traditionally recognized in Indonesia as a remedy for diarrhea.[85] *Curcuma heynaena* possesses sesquiterpenes in the essential oil, which has vermifugal properties.[86,87]

Fitogeography of phytomedicine at Pasar Gede

Figure 7 shows the origin of the species available at *Pasar Gede* based on ecoregions. Among the 76 species available, 50 are indigenous to Indomalayan region. Although the issue of origin is complex to ascertain due to the transplantation and naturalization of species through trade and migration, biogeography realms are an essential tool in assessing and managing ecology specifically pertaining to the origin. These realms are organized by the general distribution of marine and terrestrial species,[88] further divided into specific bioregions and ecoregions. Surakarta is located in Indomalayan realm, which includes the following bioregions: Indian subcontinent, Indochina, Philipines, and Sunda Shelf. Sunda Shelf includes Java Island, specifically the western Java Rainforest ecoregion in which Surakarta and hinterlands are located. Eastern regencies in GSA including Karanganyar, Sragen, and Ngawi lie in the Eastern Java–Bali montane rainforest ecoregion.[89] Although the geological formations in Indomalayan Biogeographic realm vary drastically, the realm comprises Tropical and subtropical moist broadleaf forests (TSMF), sharing a typical monsoon climate.

The largest contributor, comprising 21 species is the ecoregion of Indochina which also includes the subtropical rainforests of Vietnam and southern China (Figure 7.B). Species from this location include *Caesalpinia satppan, Piper betle., Areca catechu, Helicteres isora, Piper cubeba, Piper retrofractum, Curcuma aeruginosa, Citrus hystrix, Alpinia galanga, Gynura procumbens, Cinnamomum burmannii, Syzygium polyanthum, Baeckea frustescens, Eurycoma longifolia, Zingiber officinale* Roscoe var. Rubra*, Kaempferia galanga, Centella asiatica, Chinacanthus nutans, Alyxia reinwardtii, Parameria laevigata,* and *Boesenbergia pandurate*. The second largest contributor, with 12 species, comprises the ecoregions of India, specifically southern India and Sri Lanka which also share the tropical monsoon climate common to Indomalayan realm. Species from this ecoregion include *Citrus aurantiifolia, Curcuma zedoaria, Andrographis paniculate, Tinospora tuberculate, Moringa oleifera, Zingiber officinale* Roscoe, *Zingiber purpureum, Curcuma domestica, Trigonella foenumgraecum, Elephantopus scaber, Hedyotis corymbosa,* and *Acorus calamus*. Moreover, 8 species namely *Orthoshipon aristatus, Oroxylum indicum, Ocimum basilicum, Dendropthoe pentandra, Merremia mammosa, Blumea balsamifera, Pluchea indica,* and *Gynura pseudochina* are considered native in the entire Indomalayan realm. Among the 50 species native to Indomalaya realm, 8 are known to be indigenous to the ecoregions of Java including *Amomum Cardamomum, Curcuma heynaena, Curcuma mangga, Parkia javanica, Serycocalyx crispus, Pimpinella pruatjan, Zingiber aromaticum, Curcuma xanthorrhiza*, while 1 species namely *Garcinia mangostana* is native to Sumatra (Figure 7C). The results also showed 2 species indigenous to Maluku Island (*Myristica fragrans* and *Syzygium aromaticum*) and 2 native to New Guinea (*Graphtophylum pictum* and *Phaleria macrocarpa*) belonging to the Australasian biogeographic realm despite being administratively part of Indonesia.

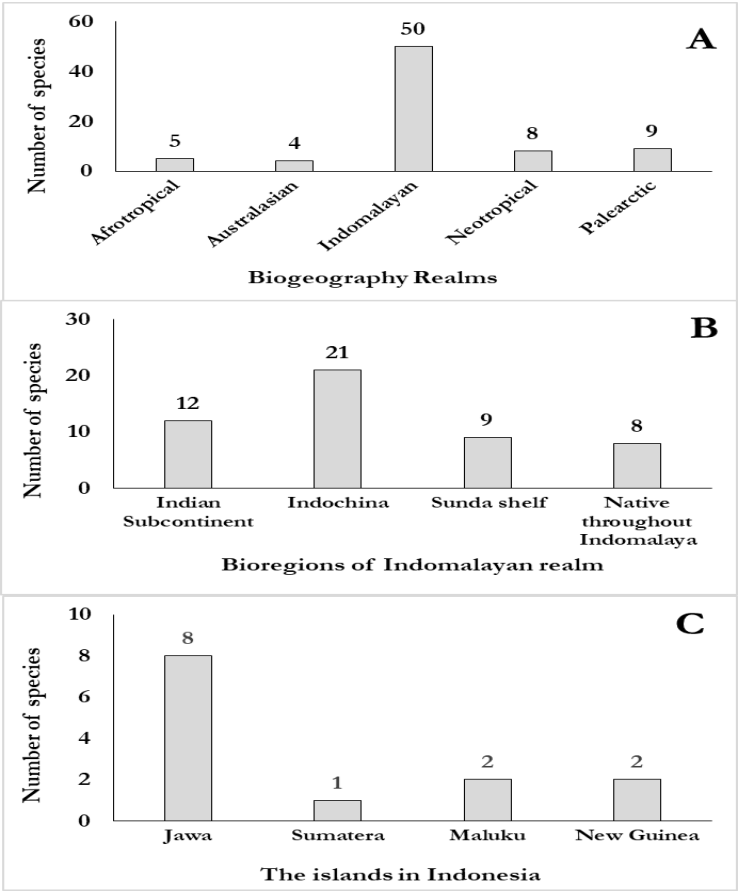

Figure 7: (A) Number species of native plants based on biogeography realm, (B) Number species of Indomalayan native plants based on bioregion, (C) Number species of native plants based on main Indonesia Ecoregion.

The boundaries of Indomalayan ecogeographic zone are consistent with the extent and scale of the ancient Maritime Jade Road as well as the subsequent iteration of commercial networks. The traders who used these trade networks were responsible for the widespread distribution of different species. This was observed in the customs and practices of the Maritime Orang laut tribe, comprised of seafaring ethnic groups and tribes residing in the Indonesian Riau Islands, the peninsular of Malaysia, and Singapore. These communities continue to maintain a semi-nomadic maritime lifestyle.[12,90] Archaeobotanical investigations demonstrated the deliberate movement, relocation, and establishment of plant species, particularly for use as medicinal remedies, by the Austronesian and Polynesian tribes during exploration and migration.[91] Furthermore, the tribes frequently embraced novel phytomedicine that was native to unfamiliar surroundings and disseminated the knowledge to previously unexplored territories. This implied that the unintentional dissemination of specific weeds from tropical Asia across Indomalayan and Australasian bioregions occurred simultaneously with the deliberate dissemination of advantageous species.[92] The foundation and growth of centralized kingdoms focused on maritime trade led to the institutionalization of knowledge and the use of new phytomedicine. This resulted in the implementation of large-scale cultivation and trade to meet the substantial need for these species.

The Palearctic realm (Northern Eurasia), which does not share the sub/tropical climate with Java, contributes 9 species, namely *Selaginella doederleinii, Plantago mayor, Usnea barbata, Quercus lusitanica, Sonchus arvensis, Menta piperita, Foeniculum vulgare, Nigella damascenda,* and *Punica granatum.*[93] The Afrotropical realm, which includes most of Africa, contributes 5 species including *Hibiscus sabdariffa, Clitoria ternatea, Imperata cylindrica, Catharanthus roseus,* and *Senna alexandria*. These species were naturalized during the Maritime Jade Road period, predating European

expansion and colonization.[94] Furthermore, the Neotropical realm that spans central and south America contributes 8 species, namely *Swietenia mahagoni, Tithonia diversifolia, Eleutherine palmifolia, Anredera cordifolia, Talinum paniculatum, Physalis angulata, Annona muricata,* and *Phyllantus niruri*. The presence and continued cultivation of neotropical species in Java are well documented due to European intervention following the Columbian exchange and the subsequent age of colonialism.[95]

Conclusion

As the first ethnobotanical study of phytomedicines at pasar Gede, this study demonstrates the tradition of phytomedicinal use among the Surakartans, as demonstrated by the variety available at Pasar Gede. A total of 76 species were recorded from 39 families with the majority being cultivated; while the remaining are gathered in the wild. All species described are sourced from the surrounding countryside that include: mountainous, hills, and plains agroforestry ecosystens. Data analysis showed that *Zingiber officinale* Roscoe had the highest UV and 7 species having an FL of 100%, including *Elephantopus scaber, Sonchus arvensis, Gynura pseudochina , Caesalpinia sappan , Myristica fragrans , Piper cubeba ,* and *Curcuma heynaena*. This ethnobotanical study can serve as foundational data for forthcoming studies into the phytomedicine species described.

Conflict of Interest

The authors declare no conflict of interest.

Authors' Declaration

The authors hereby declare that the work presented in this article is original and that any liability for claims relating to the content of this article will be borne by them.

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References

1. Nuh M. Forts in Indonesia. Jakarta: The Ministry of Education and Culture Republic of Indonesia; 2012. 327 p.
2. Aliyah I, Setioko B, Pradoto W. The roles of traditional markets as the main component of Javanese culture urban space (case study: the city of Surakarta, Indonesia). IAFOR J Sustain Energy Environ. 2016;3(1):103–120.
3. Sutherland H. Notes on Java's Regent Families: Part II. In: Indonesia. 1973. p. 1–42.
4. Aliyah I. Conceptual Understanding of Traditional Markets in Urban Areas. Cakra Wisata. 2017;18(2):1–16.
5. Hall KR. A History of Early Southeast Asia. Maryland: Rowman & Littlefield Publishers, Inc.; 2011. 384 p.
6. Harison AT, Huwae S, Santoso JMJP. The existence of the Sindang Traditional Market, Koja, as a public space for the surrounding community. J Sains, Teknol Urban, Perancangan, Arsit. 2023;4(2):1391–1404.
7. Ariyanto AF. Design of the Gedhe Hardjonagoro Market Cultural House as a Solo City Tourism Destination. Acintya J Penelit Seni Budaya. 2018;10(1):1–13.
8. Marlina E, Ronald A, Sudaryono, Dharoko A. Market as a space for *seduluran* in Javanese society. J Hum. 2015;27(1):81–95.
9. Tripati S, Raut LN. Monsoon wind and maritime trade: A case study of historical evidence from Orissa, India. Curr Sci. 2006;90(6):864–871.
10. Christie JW. Javanese Markets and the Asian Sea Trade Boom of the Tenth to Thirteenth Centuries A.D. J Econ Soc Hist Orient. 1998;41(3):344–381.
11. Respess A, Niziolek LC. Exchanges and Transformations in Gendered Medicine on the Maritime Silk Road: Evidence from the Thirteenth-Century Java Sea Wreck. In: Winterbottom A, Tesfaye F, editors. Histories of Medicine and Healing in the Indian Ocean World. Spinger Link; 2016. p. 63–97.
12. Bellina B. Southeast Asia and the Early Maritime Silk Road. In: Guy J, editor. Lost Kingdoms Hindu-Buddhist Sculpture of Early Southeast Asia. New Haven: Yale University Press; 2014. p. 22–24.
13. Acri A. "Local" vs "Cosmopolitan" in the Study of Premodern Southeast Asia. Suvannabhumi. 2017;9(1):7–52.
14. Noor FA. When the World Came to Banten: Images of Cosmopolitanism and Pruralism in Java in the Writings of Theodore de Bry 1601. Kawalu J Local Cult. 2018;5(2):195–214.
15. Surya RA, Fikriya R. Chinese merchants role of Java Trade in 19th Century. Hist J Pendidik dan Peneliti Sej. 2021;4(1):19–26.
16. Rahmatulloh OR, Purwani O, Rahayu P. The Consumption of Tradition and Heritage Areas in the Grebeg Sudiro Event in Surakarta. Int J Built Environ Sustain. 2020;7(3):49–58.
17. Kokot W, Giordano C, Gandelsman-Trier M. Diaspora as a resource : comparative studies in strategies, networks and urban space. Zürich: LIT Verlag Münster; 2013. 308 p.
18. Riyadi, Liana C, Aji RNB. The Social Change of the Tionghoa Community in Surakarta in Age XX. In: Advances in Social Science, Education and Humanities Research. 2018. p. 35–38.
19. Fatimah I. Chinatown Growth in Surakarta from The Colonial Era to The Millennium Era (XVIII-XX Century). Sinolingua J Chinese Stud. 2023;1(1):15–38.
20. Albuquerque UP, Ladio A, Almada ED, Vandebroek I, Silva MTP, da Fonseca-Kruel VS. Exploring biocultural diversity in urban ecosystems: an ethnobiological perspective. Ethnobiol Conserv. 2023;12(10):1–12.
21. Humaedi MA. Ethnography of healing cultural practices, concoctions & suggestions of the Tau Taa Vana indigenous community. Yogyakarta: LKis Pelangi Aksara; 2016. 442 p.
22. Gerritesen A, Cleetus B. Health, medicine and trade in the Indian Ocean world. In: Cleetus B, Gerritsen A, editors. Histories of Health and Materiality in the Indian Ocean World. London: Bloomsbury Publishing; 2023. p. 1–24.
23. Emery MR, Hurley PT. Ethnobiology in the City: Embracing the Urban Ecological Moment. J Ethnobiol. 2016;36(4):807–819.
24. Sedayu A, Azka SA. Adaptation of Urban Community Herbal Medicine Culture: Economic Botanical Survey of Herbal Medicine Producers-Sellers and Consumers in Cikarang, West Java. Pharm J Farm Indones (Pharmaceutical J Indones. 2021;18(2):380–391.
25. Yurlisa K, Maghfoer MD, Aini N, Sumiya W, Permanasari PN. Survey and Documentation of Local Vegetables in Traditional Markets in Kediri Regency and City, East Java. J Biodjati. 2017;2(1):52–63.
26. Pei S, Alan H, Wang Y. Vital roles for ethnobotany in conservation and sustainable development. Plant Divers. 2020;42(6):399–400.
27. Neto EM de F, Albuquerque UP. Theories of Niche Construction and Optimal Foraging: weaknesses and virtues in understanding the early stages of domestication. Ethnobiol Conserv. 2018;7(7):1–6.
28. Ladio AH, Albuquerque UP. Ethnobiology and Conservation. Ethnobiol Conserv. 2014;3(6):1–9.

29. Ladio AH, Albuquerque UP. The concept of hybridization and its contribution to urban ethnobiology. Ethnobiol Conserv. 2014;3(2014):1–9.
30. Alqethami A, Hawkins JA, Teixidor-Toneu I. Medicinal plants used by women in Mecca: Urban, Muslim and gendered knowledge. J Ethnobiol Ethnomed. 2017;13(1):807–819.
31. Iskandar BS, Iskandar J, Suroso, Alfian RL, Mulyanto D. Non-edible plants traded in traditional markets of Beringharjo, Yogyakarta and Pasar Baru, East Kalimantan, Indonesia: The role of biocultural system. Biodiversitas. 2022;23(9):4657–4669.
32. Franco FM, Chaw LL, Bakar N, Abas SNH. Socialising over fruits and vegetables: The biocultural importance of an open-air market in Bandar Seri Begawan, Brunei Darussalam. J Ethnobiol Ethnomed. 2020;16(1):1–19.
33. Ariyanto AF, Gozali A. Identification the Interior Design of Gedhe Hardjonagoro Market as a Tourism Destination in the City of Solo. In: National Seminar: Arts, Technology and Society II. 2017. p. 110–125.
34. BPS. Surakarta City Central Statistics Agency [Internet]. 2022 [cited 2023 Nov 20]. Available from: https://surakartakota.bps.go.id/
35. Alexiades MN, Sheldon JW. Selected guidelines for ethnobotanical research: a field manual. Alexiades MN, Sheldon JW, editors. New York: The New York Botanical Garden, Scientific Publications Department; 1996. 199–239 p.
36. Idu M, Erhabor JO, Efijuemue HM. Documentation on medicinal plants sold in markets in Abeokuta, Nigeria. Trop J Pharm Res. 2010;9(2):110–118.
37. Martin GJ. Ethnobotany, A 'people and Plants' Conservation Manual. London, UK: Chapman and Hall; 1995. 67–136 p.
38. Silalahi M, Nisyawati, Walujo EB, Supriatna J, Mangunwardoyo W. The local knowledge of medicinal plants trader and diversity of medicinal plants in the Kabanjahe traditional market, North Sumatra, Indonesia. J Ethnopharmacol. 2015;175:432–443.
39. Cunningham AB. Applied Ethnobotany: People Wild Plant Use and Conservation. London, UK: Earthscan Publications; 2001. 322 p.
40. Given DR, Harris W. Techniques and Methods of Ethnobotany: As an aid to the study, evaluation, conservation and sustainable use of biodiversity. London: Commonwealth Secretariat Publications; 1994. 148 p.
41. Hutapea J, Djumidi, Sutjipto, Sugiarso S. Inventory of Indonesian Medicinal Plants (I), Ministry of Health & Social Welfare Republic of Indonesia Health Research and Development Agency. Jakarta: Republic of Indonesia Department of Health & Social Welfare, Health Research and Development Agency; 2001. 1–50 p.
42. Widiyastuti Y, B AS, Widodo H, Widayat T. Top 100 Indonesian medicinal plants. Karanganyar: Indonesian Ministry of Health, Center for Research and Development of Medicinal Plants and Traditional Medicine; 2023. 201 p.
43. WFO. World Flora Online. [Internet]. 2023 [cited 2023 Dec 16]. Available from: http://www.worldfloraonline.org
44. POWO. Plants of the World Online. Facilitated by the Royal Botanic Gardens, Kew [Internet]. 2023 [cited 2023 Dec 16]. Available from: https://powo.science.kew.org/
45. Chaachouay N, Benkhnigue O, Fadli M, El Ibaoui H, Zidane L. Ethnobotanical and ethnopharmacological studies of medicinal and aromatic plants used in the treatment of metabolic diseases in the Moroccan Rif. Heliyon. 2019;5(10):e02191.
46. Anna AN, Priyono KD, Suharjo, Priyana Y. Using Water Balance to Analyze Water Availability for Communities (A Case Study in Some Areas of Bengawan Solo Watershed). Forum Geogr. 2016;30(2):166–175.
47. Alauddin MM, Pramitasari D. Placemaking Approach to Improve the Quality of Pepe River in the Central City Area of Surakarta. SINEKTIKA J Arsit. 2023;20(2):182–91.
48. Syarifuddin D. Traditional Markets in the Perspective of Tourist Attraction Value. J Manaj Resort dan Leis. 2018;15(1):19–32.
49. Hanin F. Plant Inventory at Ponorogo Station Market as a Biology Learning Resource for Students of the Natural Sciences Tadris Department, Ponorogo State Islamic Institute. SEMESTA J Sci Educ Teach. 2019;2(2):44–53.
50. Silalahi M, Nisyawati, Purba EC, Abinawanto DW, Wahyuningtyas RS. Ethnobotanical Study of Zingiberaceae Rhizomes as Traditional Medicine Ingredients by Medicinal Plant Traders in the Pancur Batu Traditional Market, North Sumatera, Indonesia. J Trop Ethnobiol. 2021;4(2):78–95.
51. Nguyen TS, Xia NH, Van Chu T, Van Sam H. Ethnobotanical study on medicinal plants in traditional markets of son la province, Vietnam. For Soc. 2019;3(2):171–192.
52. Irwanta E, Hikmat A, Zuhud EAM. Diversity of Vegetable Simplisia and Traditional Medicine Products on the Market in Pati Regency, Central Java. Media Konserv. 2015;20(3):197–204.
53. Khoirunisa A, Santhyami. Composition, dominance and utilization of cashew agroforestry weeds (*Anacardium occidentale* L.) in Gemawang village, Ngadirojo subdistrict, Wonogiri regency. Biosci J Ilm Biol. 2023;11(1):656–673.
54. Santhyami, Sulistyawati E. Medicinal Knowledge of Traditional Community in Kampung Dukuh, Garut Regency, West Java. Al-Kauniyah J Biol. 2021;14(1):162–183.
55. Nuraeni S, Supangkat B, Iskandar J. Ethnobotanical Study of Spice Plants as Spices, Medicines and Herbs. Umbara. 2023 Nov 17;7(2):27-38.
56. Schulz V, Hänsel R, Blumenthal M, Tyler VE. Medicinal Plants, Phytomedicines, and Phytotherapy. In: Schulz V, Hänsel R, Blumenthal M, Tyler VE, editors. Rational Phytotherapy. Berlin, Heidelberg: Springer Berlin Heidelberg; 2004. p. 1–42.
57. Knight GR. Sugar, Steam and Steel. Adelaide: University of Adelaide Press; 2014. 256 p.
58. Mattila H, Olsson P, Lappi T-R, Ojanen K. Ethnographic Knowledge in Urban Planning – Bridging the Gap between the Theories of Knowledge-Based and Communicative Planning. Plan Theory Pract. 2022;23(1):11–25.
59. Naheed S, Shooshtarian S. The Role of Cultural Heritage in Promoting Urban Sustainability: A Brief Review. Land. 2022;11(1508):1–17.
60. Harris J, van Zonneveld M, Achigan-Dako EG, Bajwa B, Brouwer ID, Choudhury D, et al. Fruit and vegetable biodiversity for nutritionally diverse diets: Challenges, opportunities, and knowledge gaps. Glob Food Sec. 2022;33:100618.
61. Sillitoe P. Investigating Local Knowledge: New Directions, New Approaches (1st ed.). London: Routledge; 2004. 238 p.
62. Maharianingsih NM. The Relationship between Knowledge and Attitudes towards Patterns of Using Traditional Medicines for Self-Medication in Denpasar City Communities. Indones J Pharm Educ. 2023;3(1):51-62.
63. Kusuma TM, Wulandari E, Widiyanto T, Kartika D. Relationship between Knowledge Level and Attitude towards Herbal Medicine Consumption Habits in the Magelang Community in 2019. Pharmacon J Farm Indones. 2020;Special Ed(Rakerda, Seminar, PID IAI):29–34.
64. Destryana RA, Ismawati. Ethnobotany and the use of wild plants as traditional medicine by the Madurese people (studies in Lenteng, Guluk - Guluk, and Bluto Districts). J Food Technol Agroindustry. 2019;1(2):1–8.
65. Yoshimi S, Triana H, Katrin R. Relationship between Customers and Jamu Gendong in Central Java, Indonesia: Focusing on the Use of Herbal Beverages in Daily Life. People Cult Ocean. 2023;38:51–67.

66. Mabel Y, Simbala H, Koneri R. Identification and Utilization of Dani Tribe Medicinal Plants in Jayawijaya Regency, Papua. J MIPA Unsrat Online. 2016;5(2):103–107.
67. Khotimah K, Nurcahyati N, Ridho R. Ethnobotanical Study of Medicinal Plants Based on Local Knowledge of the Osing Tribe Community in Licin District, Banyuwangi. Biosense. 2018;1(1):36–50.
68. Habchaoui J, Saad I, Khomsi M El, Fadli M, Bourkhiss B. Ethnobotanical Study of Medicinal Herbs in the Saïss Urban Commune (Region of Fez/Morocco). Trop J Nat Prod Res. 2023;7(11):5034–5039.
69. Teles AM, Santos BA dos, Ferreira CG, Mouchreck AN, Calabrese K da S, Abreu-Silva AL, et al. Ginger (*Zingiber officinale*) Antimicrobial Potential: A Review. In: Wang H, editor. Ginger Cultivation and Its Antimicrobial and Pharmacological Potentials. Rijeka: IntechOpen; 2019. p. Chapter 7.
70. Umair M, Altaf M, Bussmann RW, Abbasi AM. Ethnomedicinal uses of the local flora in Chenab riverine area, Punjab province Pakistan. J Ethnobiol Ethnomed. 2019;15(7):1–31.
71. FAOSTAT. Food and agriculture data [Internet]. Food and Agriculture Organization. 2020 [cited 2023 Dec 17]. Available from: https://www.fao.org/faostat/en/
72. BPS. Biopharmaceutical (Medicine) Plant Production, 2021-2022 [Internet]. Central Bureau of Statistics. 2022. Available from: https://www.bps.go.id/id/statistics-table/2/NjMjMg%3D%3D/produksi-tanaman-biofarmaka--obat-.html.
73. Aditama LG, Yulianto E, Wilopo. The Influence of Production and Exchange Rates on Export Volume (Study on Export Volume of Indonesian Ginger to Japan for the 1994-2013 Period). J Adm Bisnis. 2015;25(1):1–9.
74. Mao Q-Q, Xu X-Y, Cao S-Y, Gan R-Y, Corke H, Beta T, et al. Bioactive Compounds and Bioactivities of Ginger (*Zingiber officinale* Roscoe). Foods. 2019;8(185):1–21.
75. Anugrahini CPH, Wahyuni AS. Narrative Review: Antidiabetic Activities of Traditional Plants on the Island of Java. Pharmacon J Farm Indones. 2021;Special Ed(Rakerda-Seminar IAI Jateng):120–131.
76. Huang C-C, Lin K-J, Cheng Y-W, Hsu C-A, Yang S-S, Shyur L-F. Hepatoprotective effect and mechanistic insights of deoxyelephantopin, a phyto-sesquiterpene lactone, against fulminant hepatitis. J Nutr Biochem. 2013;24(3):516–530.
77. Eni NNS, Sukenti K, Muspiah A, Rohyani IS. Ethnobotanical Study of Medicinal Plants in the Hindu Community of Jagaraga Village, West Lombok Regency, West Nusa Tenggara. Biotropika J Trop Biol |. 2019;7(3):121–128.
78. Hidayat R, Reagan M, Hayati L. Tempuyung leaves (*Sonchus arvensis*) ameliorates monosodium urate crystal-induced gouty arthritis in rats through anti-inflammatory effects. Open Access Maced J Med Sci. 2020;8(A):220–224.
79. Siriwatanametanon N, Heinrich M. The Thai medicinal plant *Gynura pseudochina* var. hispida: Chemical composition and in vitro NF-κB inhibitory activity. Nat Prod Commun. 2011;6(5):627–630.
80. Nirmal NP, Panichayupakaranant P. Antioxidant, antibacterial, and anti-inflammatory activities of standardized brazilin-rich *Caesalpinia sappan* extract. Pharm Biol. 2015;53(9):1339–1343.
81. Srinivasan R, Selvam GG, Karthik S, Mathivanan K, Baskaran R, Karthikeyan M, et al. In vitro antimicrobial activity of *Caesalpinia sappan* L. Asian Pac J Trop Biomed. 2012;2(1):136–139.
82. Grover JK, Khandkar S, Vats V, Dhunnoo Y, Das D. Pharmacological studies on *Myristica fragrans*--antidiarrheal, hypnotic, analgesic and hemodynamic (blood pressure) parameters. Methods Find Exp Clin Pharmacol. 2002;24(10):675–680.
83. Sultan MT, Saeed F, Raza H, Ilyas A, Sadiq F, Musarrat A, et al. Nutritional and therapeutic potential of nutmeg (*Myristica fragrans*): A concurrent review. Cogent Food Agric. 2023;9(2279701):1–21.
84. Ha MT, Vu NK, Tran TH, Kim JA, Woo MH, Min BS. Phytochemical and pharmacological properties of *Myristica fragrans* Houtt.: an updated review. Arch Pharm Res. 2020;43(11):1067–1092.
85. Drissi B, Mahdi I, Yassir M, Ben Bakrim W, Bouissane L, Sobeh M. Cubeb (*Piper cubeba* L.f.): A comprehensive review of its botany, phytochemistry, traditional uses, and pharmacological properties. Front Nutr. 2022;9(1048520):1–25.
86. Woelansari ED, Puspitasari A, Rachmaniyah. Effect of rimpang temu giring (*Curcuma Heyneana* Val. & V. Zijp.) and rimpang temu hitam (*Curcuma aeruginosa* Roxb.) boiled water on mortality of *Fasciola hepatica* worm in vitro. Folia Medica Indones. 2013;49(1):62–65.
87. Subandriyono, Sartika T, Suhardono, Gray G. Worm control for small ruminants in Indonesia. In: Sani RA, Gray GD, Baker RL, editors. Worm Control for Small Ruminants in Tropical Asia Worm Control for Small Ruminants in Tropical Asia. Canberra: Australian Centre for International Agricultural Research; 2004. p. 113.
88. Loveland TR, Merchant JM. Ecoregions and Ecoregionalization: Geographical and Ecological Perspectives. Environ Manage. 2004;34(1):1–13.
89. OneEarth. Bioregions: Nature's Map of the Earth [Internet]. 2023 [cited 2023 Dec 19]. Available from: https://www.oneearth.org/bioregions/
90. Barnard TP. Celates, Rayat-Laut, Pirates: The Orang Laut and Their Decline in History. J Malays Branch R Asiat Soc. 2007;80(2):33–49.
91. Thompson J, Jordan F, Hawkins J. Phylogenetic reconstructions of Polynesian medicinal plant use reveal adaptive strategies to meet health needs. bioRxiv. 2022;1(1):1–24.
92. Abbott IA, Shimazu C. The geographic origin of the plants most commonly used for medicine by Hawaiians. J Ethnopharmacol. 1985;14(2–3):213–222.
93. Yadav UCS, Baquer NZ. Pharmacological effects of *Trigonella foenum-graecum* L. in health and disease. Pharm Biol. 2014;52(2):243–254.
94. Cameron J. A Prehistoric Maritime Silk Road: Merchants, Boats, Cloth and Jade. In: Paper presented at The 6th Session of Academic Forum of China Maritime Museum 2015. 2015. p. 58–69.
95. Leal F, Paull RE. The soursop (*Annona muricata*): Botany, horticulture, and utilization. Crop Sci. 2023;63(2):362–389.