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Living heritage: Biocultural conservation on spice cultivation in the Maluku Archipelago, the heartland of Clove and Nutmeg

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ABSTRACT

This study investigates the rich spice culture of the Maluku Islands, Indonesia, focusing on clove (*Syzygium aromaticum*) and nutmeg (*Myristica fragrans*) as key biocultural elements across generations. Through ethnographic fieldwork in historic villages across North Maluku and Maluku Province, it documents traditional knowledge, cultivation practices, and rituals surrounding spice-related daily activities. Local communities distinguish spice quality using indigenous terms and maintain sustainable agricultural methods, such as agroforestry with canary trees and gender-related planting customs. The research highlights the cultural symbolism of spices in community identity, healing traditions, and historical resistance to colonial control. Furthermore, it explores the role of intangible heritage in preserving collective memory and sustaining regional to global pride, exemplified by "*Kota Rempah*" (Spice City) branding to tentative nomination as UNESCO's World Heritage. The study underscores the importance of integrating local knowledge into heritage management to ensure cultural continuity and economic empowerment. Findings advocate for a holistic approach to recognizing spices beyond commodities as vital cultural, ecological, and historical assets.

Keywords: Biocultural conservation, Heritage documentation, Spice culture, Indonesian Archipelago..

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SIGNIFICANCE STATEMENT

This study explores the cultural and historical dimensions of spice cultivation in the Maluku Archipelago, Indonesia, especially well known for its primary production of clove (*Syzygium aromaticum*) and nutmeg (*Myristica fragrans*). By incorporating local ecological knowledge through interviews and field documentation with local farmers and residents, this research fills the gap in biocultural conservation, which tends to be neglected and overshadowed by modern scientific perspectives. The results report several ethnospecies with high cultural importance, such as *Afo* Clove in North Maluku (Ternate, Tidore, and Halmahera) and Banda Nutmeg in the Banda Islands. Other findings highlight that local communities maintain a complex ecological philosophy grounded in sustainable agroforestry, gender-specific planting traditions, collaborative labor practices, and traditional timekeeping systems. This 'living' heritage retains the Outstanding Universal Value (OUV) that facilitates the Maluku Archipelago to gain Tentative List nomination on the global stage.

INTRODUCTION

Clove (*Syzygium aromaticum*) and nutmeg (*Myristica fragrans*) are among the most historically influential plant species in the world, shaping early global trade networks, colonial encounters, and long-distance cultural exchange (Figure 1A and Figure 1B, respectively). Within ethnobiology, these species exemplify how plants function not only as biological resources but also as carriers of cultural meaning, social memory, and locally embedded ecological knowledge. Such relationships are increasingly recognized within the framework of biocultural conservation, which emphasizes the interdependence of biodiversity and cultural practices maintained by indigenous and local communities (Hamilton 2004). From this perspective, plants are understood as living components of cultural systems, sustained through everyday practices rather than preserved solely as historical artifacts.

Ethnobotanical research has traditionally emphasized the medicinal and therapeutic uses of plants, particularly in relation to pharmacological potential and healthcare systems (Schultes 2008). While this focus has generated valuable insights, it can obscure the broader roles plants play in food systems, culinary traditions, and everyday subsistence. Recent scholarship highlights that spices are integral to food security, household economies, and cultural identity, functioning simultaneously as flavoring agents, preservatives, ritual substances, and symbolic markers within daily life (De and De 2019; Nair 2021; Nair 2023). For clove and nutmeg, food-related uses are inseparable from medicinal, ritual, and economic dimensions, underscoring the need for analytical frameworks that capture plants as embedded within lived cultural systems rather than as isolated functional resources.

Across diverse socio-ecological contexts, scholars have documented that the erosion of native biodiversity is frequently accompanied by the gradual loss of traditional ecological knowledge, particularly where modernization, land-use change, and market integration disrupt intergenerational transmission (Hamilton 2004; Tan et al. 2013; Michel et al. 2016; Castro Braga 2021). These processes highlight the vulnerability of knowledge systems that are embedded in everyday practice and oral tradition. As a result, increasing attention has been directed toward documenting and safeguarding not only biological diversity but also the cultural frameworks that sustain it. Within this discourse, ethnobiology plays a critical role in bridging ecological data with lived experience, memory, and cultural meaning.

The Maluku Archipelago, historically known as the Moluccas or the "Spice Islands," occupies a unique position in this regard. Cloves and nutmeg are endemic to this region and have been cultivated, exchanged, and symbolically valued for centuries. Prior to European contact, spices from Maluku circulated through complex trade networks linking the eastern Indo-Malay Archipelago with Arab, Indian, Chinese, and later European traders (Ismail 2009). From the thirteenth century onward, the region became a focal point of global trade and colonial attention, drawing merchants, imperial powers, and naturalists who documented its landscapes and flora (Leirisa 1996; Amal 2010; Andaya 2015; Wallace 1869). Archaeological evidence from the Banda Islands further demonstrates that nutmeg was used by human communities as early as 3,500 years ago, indicating a deep temporal continuity of human–plant relationships in the region (Lape 2018).

Within North Maluku, the political and cultural configuration known as *Moloko Kie Raha*: the "Four Mountains" of Ternate, Tidore, Moti, and Makian, structured both clove production and governance through the Sultanates of Ternate, Tidore, Bacan, and Jailolo. Clove cultivation was closely tied to customary law, land tenure, and expressions of allegiance to the Sultanate, embedding agricultural practice within systems of authority and belief (Leirisa 1996; Amal 2010; Mashad 2011). In Central Maluku, particularly the Banda Islands, nutmeg cultivation developed within distinctive agroforestry systems that integrated shade trees, seasonal rhythms, and communal labor, forming a cultural landscape shaped by both indigenous stewardship and colonial intervention (Ricklefs 1981;

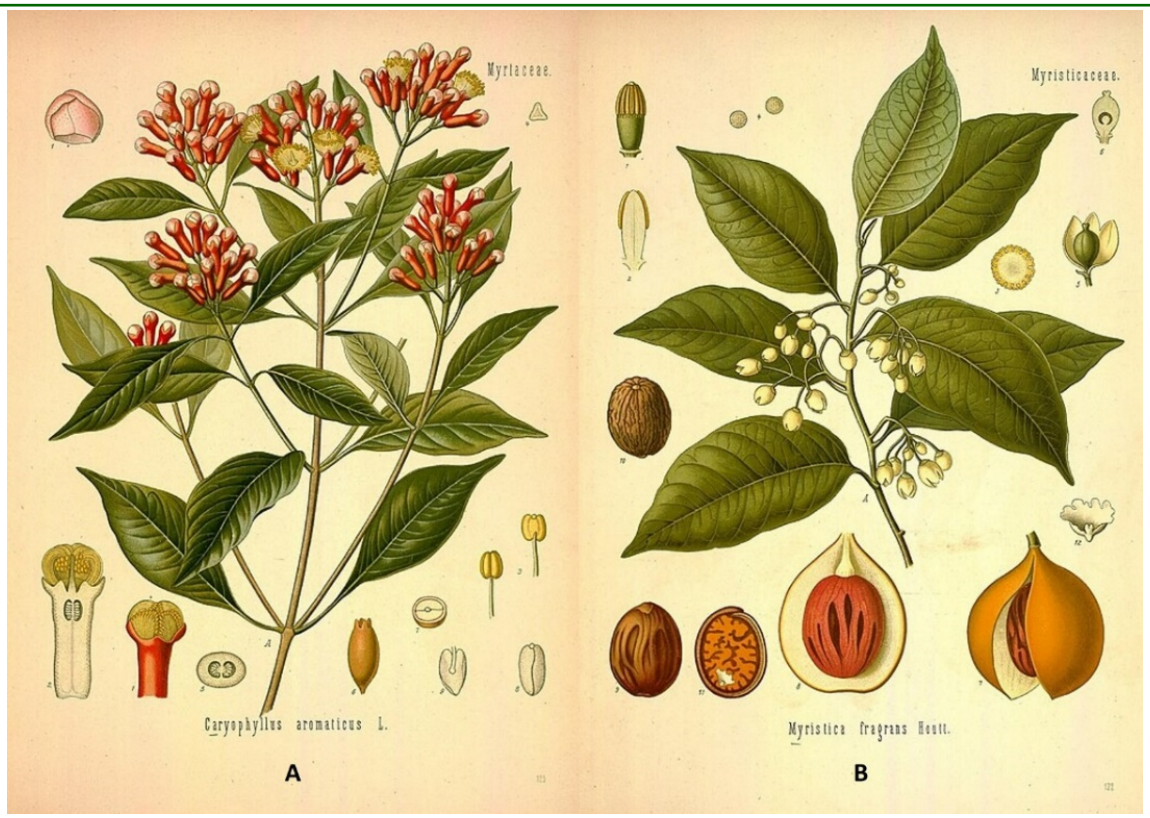

Figure 1. (A) Clove (*Caryophyllus aromaticus* Linn, now revised to *Syzygium aromaticum*) and (B) nutmeg (*Myristica fragrans* Houtt), native to the Maluku Archipelago, are illustrated by Kohler et al. (1883).

Sulistiyono and Rochwulaningsih 2013; Ellen 2019).

Spice cultivation in the Maluku Archipelago has historically developed within complex agroforestry systems that integrate perennial trees, understory crops, seasonal rhythms, and customary management practices. Such systems are increasingly recognized for their ecological resilience, capacity to maintain biodiversity, and adaptability to environmental and socioeconomic change (Brierley 1994; Nirmal Babu et al. 2024). The long-term continuity of clove and nutmeg cultivation reflects not only ecological suitability but also accumulated local knowledge governing planting cycles, harvesting techniques, and landscape stewardship. Understanding these systems requires attention to both environmental processes and culturally embedded management practices that sustain spice landscapes over generations.

In contrast to this rich history, contemporary narratives often reduce clove and nutmeg to commodities, emphasizing yield, quality, and export value while overlooking the living cultural systems that sustain their cultivation. Such reductions obscure the spatial, historical, and social dimensions of spice landscapes, including customary land tenure, agroforestry systems, and collective memory embedded in place. Recent heritage-oriented approaches demonstrate that spice cultivation landscapes are not merely sites of production but complex cultural terrains shaped by long-term human–environment interactions, requiring integrated documentation and interpretation (Kersapati and Grau-Bové 2023). Without this perspective, local voices and practices risk marginalization within conservation and heritage discourse, where scientific and economic narratives often dominate (Hamilton 2004).

The documentation of traditional knowledge is not a neutral or purely technical exercise but is shaped by power relations, representation, and whose voices are prioritized. Critical perspectives emphasize the importance of community-centered narratives, reflexive methodologies, and locally grounded interpretations in ethnobiological and heritage research (Topatimasang 2013). In the context of spice cultivation, this approach foregrounds farmers' experiences, oral histories, and everyday practices as authoritative sources of knowledge, challenging extractive or externally imposed representations of heritage and conservation.

In this study, we introduce and employ the concept of "spice culture" to capture the integrated system of knowledge, practices, beliefs, and material expressions surrounding clove and nutmeg cultivation in the

Maluku Archipelago. Spice culture encompasses agricultural techniques, food and medicinal uses, gender-specific planting traditions, communal labor practices, oral histories, ritual observances, and symbolic meanings attached to spice landscapes. Framed within ethnobiology and heritage studies, this concept positions spices as living biocultural heritage, continuously reproduced through everyday practice and social interaction.

Despite the global historical significance of cloves and nutmeg, existing scholarship has largely approached these species through economic, botanical, or colonial perspectives, often marginalizing the lived cultural systems that sustain their cultivation and meaning in contemporary communities. Consequently, the intergenerational transmission of knowledge, everyday food and ritual practices, and the role of spice landscapes in shaping cultural identity and heritage in the Maluku Islands remain insufficiently documented within ethnobiology and heritage studies. This study addresses the following central research question: How do clove and nutmeg function as biocultural elements within intergenerational knowledge systems, daily practices, and agroforestry landscapes in the Maluku Islands, and how do these relationships contribute to the construction and recognition of spice culture as living heritage?

Accordingly, the objectives of this study are to: (1) document traditional knowledge, cultivation practices, healing-related uses, and ritual activities associated with clove and nutmeg in selected historic villages of North Maluku and Maluku Province; (2) examine how these practices are embedded within agroforestry systems, gender-related planting customs, and indigenous classifications of spice quality; (3) analyze the cultural symbolism of spices in community identity, collective memory, and historical narratives, including forms of resistance and pride; and (4) explore the role of intangible cultural heritage in contemporary heritage initiatives, including local branding such as *Kota Rempah* (Spice City) and its relevance to broader heritage recognition frameworks.

MATERIAL AND METHODS

Study area

The study was performed in several early villages considered the oldest settlements, which retain significant practices of spice cultivation until today, as shown in Figure 2. In North Maluku, the interviews were taken in Moya and Foramadiahi in Ternate, as well as Rum, Afa Afa, and Gurabunga in Tidore. Jailolo (West Halmahera), which has close historical ties with the Sultanate of Ternate, constituted the villages of Tauro, Ulo, Bukubuwalawa, Bukumaadu, and Idamdehe Gamsungi. In Maluku Province, the field surveys were conducted in the Banda Islands, such as Lonthor and Ay Island.

These islands lie in a tropical rainforest biome with active stratovolcanoes: Mt. Gamalama (1,715 m) on Ternate and Kie Matubu on Tidore, producing fertile volcanic soils suited to cloves and nutmeg. The climate is equatorial and stable (Ternate mean $\sim$ 26.0°C, rainfall $\sim$ 2,199 mm), with mountainous forests, coastal mangroves, and high seismic–volcanic activity (Statistics Indonesia – North Maluku Province 2024). Ethno-linguistically, Ternate and Tidore reflect long-standing sultanate influence, with distinct Ternate and Tidore peoples and languages (North Halmahera family). In inland West Halmahera, groups such as the *Togutil* maintain forest-based livelihoods. Historical trade layered indigenous, Arab, and European influences, visible in governance, architecture, and regional Malay dialects (Tukuboya et al. 2024). The Banda Islands form a small volcanic archipelago on the Inner Banda Arc (with Gunung Api), historically central to nutmeg and mace. The climate is tropical monsoon (mean $\sim$ 29°C), with a wetter west monsoon and drier east monsoon. The surrounding Banda Sea reaches $\sim$ 8,000 m depth, moderating extremes and supporting rich marine biodiversity (Statistics Indonesia – Maluku Province 2024). The modern Banda population descends from indigenous Bandanese and later migrants (e.g., Javanese, Ambonese), following 17th-century Dutch VOC depopulation. While the original Banda language is largely extinct on the main islands, a creolized Banda Malay serves as *lingua franca*; related speech persists among descendants in the Kai Islands (e.g., Banda Eli, Banda Elat). Cultural continuity is marked by memories of *Orang Kaya* rule and traditions such as *Cakalele* and *Kora-Kora* (Isnaeni et al. 2025).

Data collection

A total of 25 informants participated in this study across the four research locations (Ternate, Tidore, Halmahera, and Banda). Informants were recruited using purposive and snowball sampling, targeting individuals with extensive knowledge of spice cultivation, traditional practices, and local heritage. The sampling unit consisted of individual adult community members, including farmers and customary leaders, who were directly involved in clove and nutmeg cultivation or related cultural practices. Initial participants were identified through local leaders, farmers' groups, and community elders, after which additional informants were recruited based on recommendations from previous participants. Exclusion criteria included children and adolescents under 18 years of age, as well as individuals with no direct engagement in spice-related

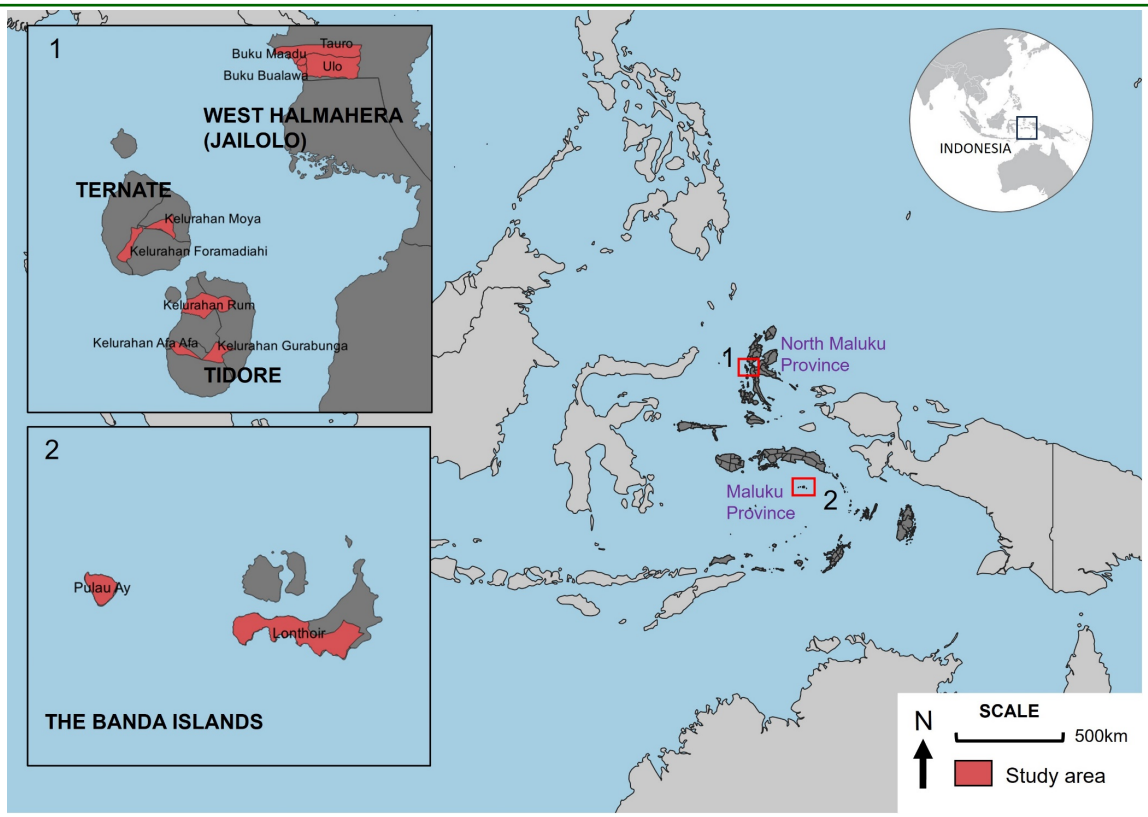

Figure 2. Early villages as the study area: (1) Ternate (Moya and Foramadiahi), Tidore (Rum, Afa Afa, and Gurabunga), and West Halmahera (Tauro, Ulo, Bukubualawa, Bukumaadu, and Idamdehe Gamsungi); (2) The Banda Islands (Lonthor and Ay Island).

livelihoods or traditional knowledge systems.

Semi-structured interviews were conducted with the local community representatives using questionnaires containing open and closed questions for five primary themes: (i) Agricultural basis, (ii) Economic and cultural importance, (iii) Plant knowledge, (iv) Cultivation practices, and (v) Medicinal uses. All participants gave informed consent regarding participation, data protection, and anonymized quotation. Procedures followed qualitative research ethics and the recommendations of the International Society of Ethnobiology (2006), and approved by the National Research and Innovation Agency of Indonesia (No. 161/KE.01/SK/02/2024).

The demographic profile shows that the informants were between 50 and 59 years old (39.13%), followed by those aged 40–49 (26.09%), while only one informant was under 30 (4.35%). Males made up 69.57% of the participants, and females 30.43%. In terms of occupation, most informants were farmers (52.17%), and government officers (30.43%), and smaller proportions were in education (8.70%) or were housewives (8.70%). Regarding education level, most had completed high school (60.87%), followed by elementary school graduates (17.39%), bachelor's degree holders (13.04%), and a few with master's degrees (8.70%).

To complement the interviews, field documentation was conducted through direct observation, audio recordings, and image documentation of cultivation activities, landscapes, and community practices. This approach aimed to capture verbal accounts as well as contextual and material evidence of spice cultivation in daily life.

Data analysis

Once the recordings were transcribed, thematic analysis was performed following the systematic six-step process outlined by Naeem et al. (2023) to ensure rigor and conceptual clarity. This involved initial transcription and familiarization with the data, followed by the selection of meaningful keywords that reflected participants' experiences. Subsequently, data segments were coded based on these keywords, which were then grouped into categories to identify recurring patterns and relationships. Themes were developed from these codes, providing abstract interpretations aligned with the observed aspects. The final steps included conceptualization through the interpretation of

keywords, codes, and themes, and the construction of a conceptual model to represent the findings in a coherent and theory-informed manner. This methodical approach enhanced the reliability and depth of qualitative analysis.

In addition to qualitative thematic analysis, an intensity score was used as a descriptive indicator to summarize the relative prominence of ethnobotanical knowledge and practices associated with clove and nutmeg. Scoring was based on five analytical parameters identified inductively during fieldwork: (1) agricultural basis, (2) economic and cultural importance, (3) plant knowledge, (4) cultivation practices, and (5) medicinal uses, each comprising multiple indicators (e.g., yield stability, household income, plant quality, planting and harvesting practices, and therapeutic applications). Scores were assigned on a 1–5 ordinal scale, reflecting the frequency and consistency of informant statements and the observed regularity of practices in daily life. The resulting scores were used to compare parameters and species as descriptive summaries grounded in qualitative evidence, without statistical inference.

The analysis also delved into the relative importance of ethnospecies, which was assessed using a community-informed approach based on interviews, participant observation, and comparative valuation across regions. Importance was evaluated along two dimensions: economic importance (e.g., contribution to household income, market value, role as a cash or export crop) and cultural importance (e.g., ancestral value, historical continuity, identity, and symbolic significance). Ethnospecies were assigned scores on an ordinal scale from 0 to 5 for each dimension, based on the frequency and consistency of informant perspectives, supported by ethnographic observations. These scores were used to visualize regional patterns and contrasts between economic and cultural valuations, without implying quantitative ranking or equivalence.

RESULTS AND DISCUSSION

Regional indicators observation

The intensity scoring (Table 1) reveals a clear pattern of strong agronomic capacity across all study sites, expressed by the interviewees with uneven stability in production and differentiated links to household livelihoods and medicinal uses. Several indicators reach the ceiling across regions: Large average annual yield, Alternative crops, Detailed plant parts, Geographic selection indicators, Temporal selection indicators, Planting method, and Harvesting method each register a total of 20/20, reflecting consistent and explicit evidence for robust production potential, diversified crop knowledge, appropriate site and season selection, and well-articulated cultivation techniques. In contrast, Consistent harvest posts the weakest aggregate signal at 6/20, indicating that while yields are described as high, the regularity of harvests is fragile and unevenly sustained across time.

Market integration is broadly strong. Commodity export accumulates 19/20, with Ternate, Tidore, and Banda scoring 5, and Halmahera at 4. This suggests well-established routes for outward flows, with a minor gap in Halmahera relative to the other areas. Quality considerations are present but not uniform: Plant quality totals 16/20, buoyed by Ternate (5), Halmahera (4), and Banda (5), while Tidore (2) contributes to the shortfall, implying a more variable emphasis on attributes such as aroma or oil content in that locality. Environmental pressures are widely acknowledged; Disturbance to plants totals 17/20, with Banda (5) and the other regions at 4, pointing to pervasive risk awareness (wind, pests, storms) and particularly salient disturbance narratives in Banda.

Livelihood-related indicators show differentiated patterns across the study sites. Household income importance totals 11/20, led by Banda (5) and Tidore (4), while Ternate (1) and Halmahera (1) indicate weaker direct dependence on spice-related income. Cultural heritage values are strongest in Ternate and Banda (both scoring 5), reflecting their central role in historical continuity and identity. Medicinal uses constitute a culturally meaningful domain of ethnobotanical knowledge, but their expression is unevenly distributed across regions. Halmahera exhibits the highest concentration of medicinal applications, particularly for respiratory conditions, postpartum care, and skin-related treatments (total scores of 9, 7, and 6, respectively). Ternate shows a moderate presence of medicinal uses, whereas Tidore and Banda register consistently lower scores, indicating that medicinal applications of spices play a more limited role in everyday practices in those communities.

Aggregating across indicators produces a composite profile per region. Banda (60) emerges as the strongest overall performer, combining high yields, export intensity, quality attention, and broad cultivation know-how, with notable vulnerability to consistent harvest (2) and medicinal uses (1). Halmahera (60) follows, with strong yields, exports, and cultivation practice, but comparatively lower emphasis on quality and limited presence of postpartum care in the medicinal domain. Ternate (56) is technically strong and export-connected, yet shows weak income dependence and medicinal themes, and the lowest regularity of harvests per se (consistent harvest = 1). Tidore (55) shows the lowest composite score due to the same twin weaknesses (income and harvest regularity at 1) and slightly lower export intensity (4), despite robust agronomic indicators.

Table 1. Intensity-based quantification of cultural indicators across observed regions.

Aspect	Indicators	Region				Total
		TNT	TDR	WHM	BND	
Agricultural basis	Large average annual yield	5	5	5	5	20
	Consistent harvest	1	2	1	2	6
	Commodity export	5	5	4	5	19
Economic and cultural importance	Household income	1	4	1	5	11
	Cultural heritage	5	3	4	5	17
	Alternative crops	5	5	5	5	20
Plant knowledge	Plant parts	5	5	5	5	20
	Plant quality	5	2	4	5	16
Cultivation practices	Geographic selection indicators	5	5	5	5	20
	Temporal selection indicators	5	5	5	5	20
	Disturbance to plants	4	4	4	5	17
	Planting method	5	5	5	5	20
	Harvesting method	5	5	5	5	20
Medicinal uses	Breathing	3	1	4	1	9
	Postpartum care	1	1	4	1	7
	Skin, blood pressure, etc.	1	1	3	1	6

Legend: TNT: Ternate, TDR: Tidore, WHM: West Halmahera, BND: Banda.

Agricultural basis

There are two primary types of cloves (*Syzygium aromaticum*) cultivated in the Maluku region: *Cengkeh Zanzibar* (Zanzibar cloves) and *Cengkeh local/Ternate* (*Ternate cloves*). In local languages, clove is commonly referred to as *gomode* in Tidore and *bualawa* in Ternate. Among these, Zanzibar cloves, a hybrid variety introduced from Zanzibar, are the most widely cultivated due to their faster harvest time (5–7 years), strong aroma, and high yield, although the fruit size is smaller than that of endemic Maluku varieties (Siswanti et al. 2022). *Afo* cloves, the oldest known variety and culturally significant, have large-diameter buds but are no longer productive.

For nutmeg, Indonesia's primary producing regions include the Maluku Islands, North Sulawesi, West Sumatra, Nanggroe Aceh Darussalam, West Java, and Papua. Among the various species, *Myristica fragrans* (native to the Banda Islands) is the most dominant and valued for its superior quality and productivity. *Myristica argentea* Warb., also known as Papuanoot (*Pala Fakfak*), is native to Papua's Bird's Head region; it grows wild in forests and is considered lower in quality than Banda nutmeg. In the Banda Islands, particularly in Banda Besar (Lonthoir), approximately 97% of nutmeg plants are *Myristica fragrans*, while 3% are *Myristica argentea*, reflecting the dominance of Banda nutmeg in this historically significant spice-producing region (Aini et al. 2020). Figure 3 shows the comparison of the most commonly found cloves and nutmeg in the Maluku Archipelago.

The distribution of harvest intensity and export (Table 2) shows a clear bifurcation between culturally emblematic taxa and commercially dominant ones in Maluku. *Afo* clove is largely unharvested and has no export, functioning as a heritage lineage maintained for identity and memory rather than for markets. By contrast, Zanzibar clove anchors the contemporary clove economy with regular harvests and international export, reflecting its widespread cultivation, standardized quality, and integration into global supply chains. White clove remains limited in harvest with no meaningful export, indicating niche or household-level use. King clove is similarly limited in commerce and non-exported, consistent with its status as an endemic or

Aspect	Zanzibar	Local (Ternate)
Fruit Size	Larger	Smaller
Number of Stems per Fruit Cluster	Many stems, up to 20 per branch	Fewer stems
Productivity	High yield potential, more profitable economically	Lower yield, but holds traditional and cultural value
Fruit Color	Green to reddish	Regular green
Distinct Features	Dense stems, more fruit per branch	Fewer stems and fruit per branch

Aspect	Fakfak (Papuanoot)	Banda
Fruit Size	Larger fruit, with thick flesh and larger seeds	Smaller fruit, thinner flesh, smaller seed
Aroma	Milder aroma, less pungent	Strong, sharp aroma, highly fragrant
Productivity	Grows wild and cultivated, with a moderate yield	Cultivated for high yield, consistent production
Mace Quality	Thicker mace, but lighter in fragrance	Fine mace, deep red, aromatic, priced for quality

Figure 3. Morphology comparison of Zanzibar clove and local/Ternate clove (top); Fakfak nutmeg (Papuanoot) and Banda nutmeg (bottom).

wild lineage valued more for its symbolic "*Raja*" (King) identity than for volume.

Nutmeg exhibits a parallel gradient. Banda nutmeg (*Myristica fragrans*) combines regular harvests with international export, continuing to define the Banda Islands' trade orientation through nutmeg and mace. Other nutmeg taxa occupy more localized roles. Papuanoot nutmeg (*M. argentea*) shows limited harvests and regional trade, while Papua forests nutmeg (*M. schefferi*) is limited and non-exported, largely embedded in local forest use. Island-specific lineages, Bacan (*M. speciosa*) and Halmahera (*M. succedanea*), are regularly harvested at local scales with regional export, signaling stable but geographically bounded value chains tied to island ecologies and community processing capacity.

The alternative crops in the matrix underscore everyday economic resilience. Coconut is regularly harvested with international export via copra and oil, providing a dependable cash backbone across islands while permeating household production and ritual. Cassava and banana are both regularly harvested but non-exported; they circulate through local markets and home consumption, functioning as food-security buffers that stabilize livelihoods when spice incomes fluctuate.

Economic and cultural importance

Factors are identified in considering a significant type of commodity, such as cultural, economic, and ecological factors. Cloves remain a major commodity

Table 2. Harvest intensity and export reach of clove and nutmeg ethnospecies (plus key staples) in Maluku.

Ethnospecies	Harvest	Export
Afo Clove	None/heritage only	None
Zanzibar Clove	Regular	International
White Clove	Limited	None (niche/local)
King Clove	Limited (wild/endemic)	None
Banda Nutmeg (*M. fragrans*)	Regular	International
Papuanoot Nutmeg (*M. argentea*)	Limited	Regional
Papua Forests Nutmeg (*M. schefferi*)	Limited	None
Bacan Island Nutmeg (*M. speciosa*)	Regular (local scale)	Regional
Halmahera Island Nutmeg (*M. succedanea*)	Regular (local scale)	Regional
Coconut (*Cocos nucifera*)	Regular	International (copra/oil)
Cassava (*Manihot esculenta*)	Regular	None (local markets)
Banana (*Musa sp.*)	Regular	None (local markets)

Legend: Harvest: None = currently not for harvest; Limited = small/niche or irregular; Regular = ongoing/common. Export: None = kept local; Regional = inter-village/island/national; International = reaches global trade.

for the Ternate community because they are considered more profitable than other crops, such as coconut or coffee. As an annual plant, cloves only require minimal care but can provide significant economic results, as shown in the quotes below:

"From the perspective of the Tauro community, including myself, we are used to perennial crops, so clove is considered more profitable compared to other plants." (58 years – M)

In addition to the economic aspect, cloves also have strong ancestral cultural values, as reported:

"Economically, clove yields are more than three times higher than nutmeg and coconut... and in terms of history and culture, it is meaningful because it reminds us of previous generations." (59 years – HA)

The community believes that planting and caring for cloves is part of continuing the legacy of previous generations, who have cultivated this native spice since the time of the Sultanate. Therefore, for local people, planting cloves is not only about profit but also about maintaining the cultural identity and ecological balance of their region.

In Ternate (Figure 4A), Zanzibar clove (ZAN) shows strong economic importance, while *Afo* clove (AFC) and King clove (KIC) are positioned high along the cultural dimension, reflecting their ancestral value and symbolic association with local identity. Nutmeg types such as Banda nutmeg (BNF) and Halmahera nutmeg (HLN) occupy intermediate positions, indicating moderate cultural relevance but lower economic emphasis. A similar configuration is observed in Tidore (Figure 4B), where ZAN again demonstrates a pronounced economic orientation. In contrast, AFC and KIC maintain high cultural scores, underscoring their historical and symbolic significance within the Sultanate tradition. Subsistence crops and non-endemic species, including cassava (CSV) and banana (BAN), cluster at lower cultural values despite moderate economic relevance.

In Halmahera (Figure 4C), the distribution appears more balanced between economic and cultural dimensions. ZAN retains notable economic importance, while local nutmeg varieties such as Halmahera nutmeg (HLN) and Bacan nutmeg (BCN) display moderate cultural significance. This pattern suggests a more integrated valuation of heritage elements shaped by both livelihood considerations and localized cultural meanings. By contrast, Banda (Figure 4D) exhibits a distinctive profile in which Banda nutmeg (BNF) occupies a dominant position along the cultural axis, reflecting its deep historical continuity and central role in local identity. Other crops, including banana (BAN), cassava (CSV), and coconut (CNC), cluster around mid-range values in both dimensions, indicating their importance for daily subsistence and livelihood support rather than for symbolic or ancestral significance.

Although clove remains a preferred commodity, of-

ten yielding two to three times higher economic returns than nutmeg or coconut, alternative and subsistence crops continue to play a crucial role in everyday life. Coconut (*Cocos nucifera*), for instance, maintains a strong economic presence (score = 4) due to its role as a major cash crop (copra and oil), while its lower cultural score (2) reflects its functional integration into daily practices rather than historical symbolism. Similarly, cassava (*Manihot esculenta*) and banana (*Musa sp.*) are essential for food security and household consumption, reinforcing the complementary relationship between culturally significant spices and staple subsistence crops within local livelihood systems, as reported:

"There are cassava stems, bananas too, but only for consumption." (45 years – N)

These variations highlight the localized prioritization of heritage functions within the Maluku Islands, emphasizing how different communities negotiate between cultural significance and economic potential in valuing their heritage assets.

Plant knowledge

In the local language of North Maluku, the word *ngofa* means "child" and specifically refers to clove buds: the young flower buds harvested before they bloom. Thus, *ngofa lawang* means "clove child," referring directly to the clove bud. This term is commonly used across Ternate, Tidore, Halmahera, and Banda. Meanwhile, *galape* refers to a large and sturdy tree trunk and is a widely used term throughout North Maluku to denote the main trunk of a plant, including both clove and nutmeg trees. In the Jailolo (West Halmahera) region, the phrase *poko ai* is sometimes used to describe tree roots near water sources or moist soil, a contextually important term in local agricultural practices. The word *fale*, or in some dialects *pong*, simply means "tree." It appears in all regional dialects. Table 3 shows the clove parts, while Table 4 shows the nutmeg parts in local languages, depicted in Figure 5.

In assessing the quality of the harvest, local communities use specific terms such as *lawang basah* for cloves that have not yet been dried, and *lawang karing* or *lawang tua* for cloves that have been dried. Cloves of the highest quality are *lawang bagus*, while damaged cloves are called *lawang pecah* or *lawang rosak*. Young cloves are known as *lawang muda*, whereas mature, ready-to-harvest cloves are called *lawang tua*. The clove flower bud, the primary part harvested, is referred to as *ngofa lawang*, meaning "clove child." Nutmeg, which is considered high quality, has a bright yellow outer skin and naturally splits open when ripe. This is referred to as *buah pala bagus* or *buah pala tua*.

In Banda, farmers use the term *buah pala pilihan* to describe premium-grade nutmeg, indicating that the fruit is ready for sale and holds high value. On the other hand, unripe nutmeg that is not yet suitable for harvest is called *buah pala muda*, while fruit damaged by pests or harsh weather is known as *buah pala rosak*, a term commonly used in both Ternate and Banda. Beyond the fruit itself, the mace (fuli, reddish covering of the nutmeg seed) is also judged by its quality. Bright red mace is considered the most valuable and is called *fuli bagus* or *kofuli merah*. Pale mace, whether faded orange or torn, is *fuli biasa* or *fuli lemah*.

In Banda, mace holds significant economic value, and the term *fuli* Banda is internationally recognized as a mark of superior quality from the region. The nutmeg seed (*biji pala*) is evaluated by its shape and aroma. Dense, round seeds with a strong fragrance are called *biji pala bagus* or *biji pala tua*, and are considered premium export commodities. In contrast, shriveled, lightweight, or broken seeds are classified as *biji pala pecah* or *biji rosak*, and are usually reserved for local use or sold at lower prices. This meticulous quality assessment not only determines the market value of nutmeg but also reflects the depth of local knowledge in managing one of the most treasured spices of the Maluku Islands. Many terms follow local Banda Malay or Ambon Malay.

Banda is historically the center of nutmeg cultivation; certain terms, such as fuli, are widely used and even recognized internationally. The terms *gosora* and *gomode* are also known in Banda due to historical and agricultural connections, although they are more commonly used in North Maluku. The term *fuli pala* is generally used to refer to mace, the lacy covering of the nutmeg seed, and is especially renowned as a signature commodity from Banda.

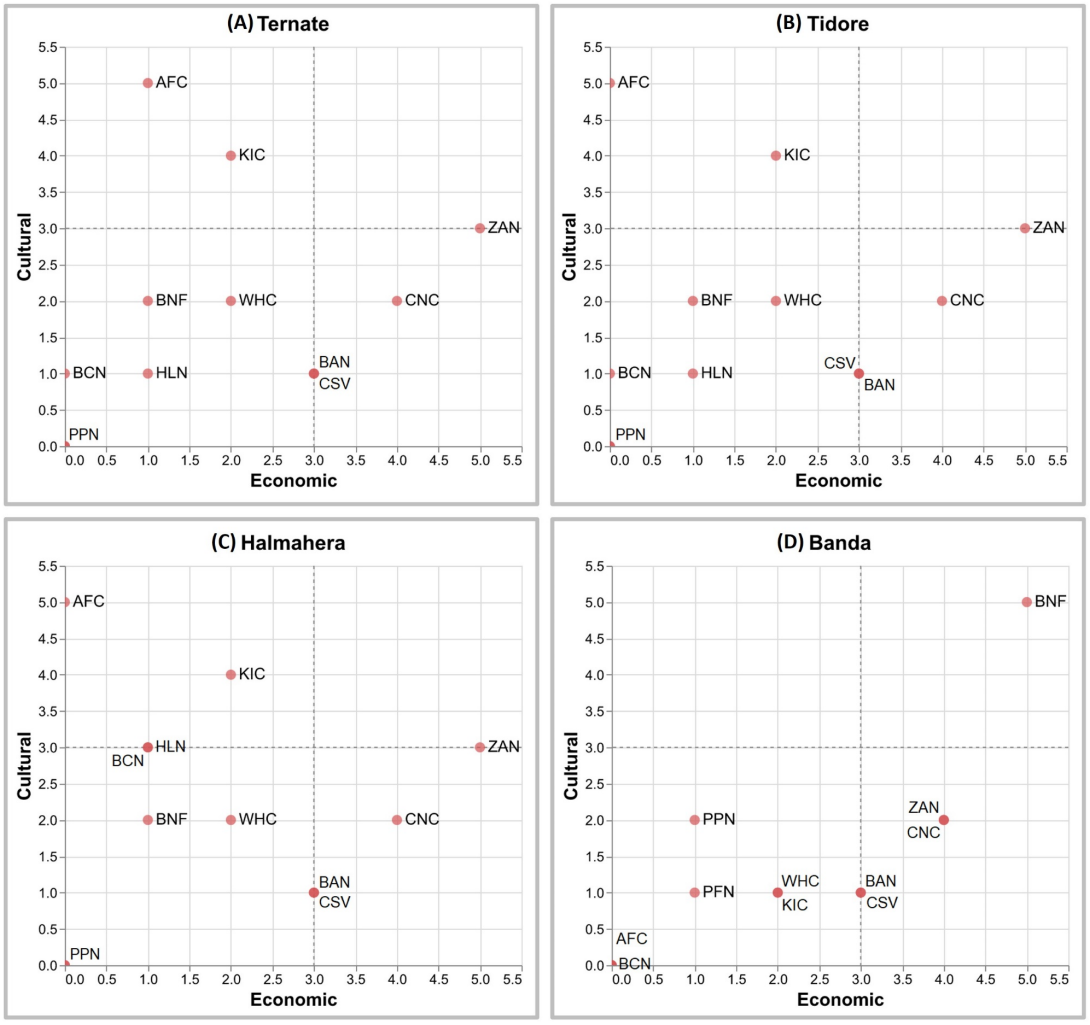

Figure 4. The importance of Ethnospecies (scale 0-5), developed by informants from economic and cultural perspectives across regions: (A) Ternate; (B) Tidore, (C) Halmahera; and (D) Banda.

Table 3. Clove parts in local languages.

Part	Indonesian	Ternate	Tidore	West Halmahera	Banda
Root	*Akar*	*Poko*	*Poko*	*Poko/ Poko ai*	*Poko/ Akar*
Trunk/ Stem	*Batang*	*Galape/ Batang*	*Galape/ Batang*	*Galape/ Batang*	*Batang/ Galape*
Branch	*Cabang/ Dahan*	*Tanga-tanga/ Dahan*	*Tanga-tanga/ Dahan*	*Tanga-tanga/ Dahan*	*Tangkah/ Dahan*
Leaf	*Daun*	*Dahu*	*Dahu*	*Dahu*	*Daon*
Clove bud	*Kuncup cengkeh*	*Ngofa lawang*	*Ngofa lawang*	*Ngofa lawang*	*Ngofa lawang/ Anak lawang*
Clove flower	*Bunga cengkeh*	*Ngofangofa/ Ngofa*	*Ngofa lawang*	*Ngofa lawang*	*Bunga lawang/ Bunga*
Clove fruit	*Buah cengkeh*	*Bualawa Buah lawang*	*Bualawa Buah lawang*	*Bualawa/ Buah lawang*	*Bualawa Cengkeh*
Clove seed	*Biji cengkeh*	*Polong*	*Polong*	*Polong*	*Polong*
Clove tree	*Pohon cengkeh*	*Fale lawang/ Pong lawang*	*Fale lawang/ Pong lawang*	*Fale lawang/ Pong lawang*	*Pohon lawang/ Fale lawang*

Table 4. Nutmeg parts in local languages.

Part	Indonesian	Ternate	Tidore	West Halmahera	Banda
Root	*Akar*	*Poko*	*Poko*	*Poko/Poko ai*	*Akar/Poko*
Trunk/Stem	*Batang*	*Galape/ Batang*	*Galape/ Batang*	*Galape/ Batang*	*Batang/ Galape*
Branch	*Cabang/ Dahan*	*Tanga-tanga/ Dahan*	*Tanga-tanga/ Dahan*	*Tanga-tanga/ Dahan*	*Tangkah/ Dahan*
Flower	*Bunga pala*	*Ngofa pala/ Bunga*	*Ngofa pala/ Bunga*	*Ngofa pala/ Bunga*	*Bunga pala/ Bunga*
Fruit (Nutmeg)	*Buah pala*	*Buah pala*	*Buah pala*	*Buah pala*	*Buah pala/ Buah*
Nutmeg seed (inside)	*Biji pala*	*Biji pala*	*Biji pala*	*Biji pala*	*Biji pala/ Biji*
Mace (seed cover)	*Fuli/ Pembungkus biji*	*Fuli/ Kofuli*	*Fuli/ Kofuli*	*Fuli/ Kofuli*	*Fuli/ Fuli pala*
Nutmeg tree	*Pohon pala*	*Fale pala/ Pong pala*	*Fale pala/ Pong pala*	*Fale pala/ Pong pala*	*Pohon pala/ Fale pala*
Male tree	*Pala jantan*	*Gosora*	*Gosora*	*Gosora*	*Pala laki*
Female/ young tree	*Pala betina/ muda*	*Gomode*	*Gomode*	*Gomode*	*Pala perempuan*
Flower	*Bunga pala*	*Ngofa pala/ Bunga*	*Ngofa pala/ Bunga*	*Ngofa pala/ Bunga*	*Bunga pala/ Bunga*

The local community holds a nuanced understanding of nutmeg tree gender, distinguishing between *pala laki* (male nutmeg) and *pala perempuan* (female nutmeg). It is commonly believed that female trees bear fruit abundantly, while male trees do not bear fruit at all. Farmers often determine the tree's gender through the structure of its roots and branches; for instance, trees with more fibrous roots or two main branches are seen as female, while those with three main branches are considered male. Male seeds are pointed with a protruding tip, while female seeds are round and blunt. Their leaves also differ, with male leaves being broader and rounded, and female leaves narrower and pointed. Branching patterns also vary; male trees have horizontal or downward-leaning branches, while female trees branch slightly upward. The flowers; male flowers are longer and slender, while female flowers are shorter and rounder inside (Rosyid 2022).

This knowledge guides decisions during planting, as it is said that trees planted by women are more likely to be fruitful, embodying a blend of ecological wisdom passed down through generations.

Cultivation practices

In the context of geographical location, particularly in North Maluku (Ternate, Tidore, and Halmahera), such as Tauro, highland or mountain areas (*gunung*) are considered more suitable and productive compared to coastal lowlands (*dataran rendah*). Local farmers emphasize that clove trees thrive better in elevated regions with cooler climates (Figure 6B), a factor locally described as cold (*dingin*), which contributes to healthier growth and larger yields. The soil in these upland areas is typically more fertile (*tanah subur*), especially due to volcanic origins, which enrich the land with essential nutrients. Conversely, coastal areas are often less ideal due to high salt content (*kadar garam tinggi*) in the air and soil, which can negatively affect clove trees, as quoted:

"Yes, Ternate is mountainous, with many mountains and islands... it is actually the volcanic ash that creates sulfur elements which are really needed by spices." (50 years – R)

"In Tauro, there's a saying that the salt content is extremely high, possibly due to the influence of seawater." (30 years – A)

"With tall trees in general, for example, farmers reason that the high salt content reaches the upper leaves, but by the time it gets lower, it has already been filtered... it worked, that's why in the past two months everything has been green." (50 years – MAF)

The historical cultivation of cloves in North Maluku, especially in Halmahera and Jailolo, is deeply intertwined with colonial resistance, customary law, and allegiance to the Sultanate of Ternate. *Cengkeh usaha* refers to clove trees grown from seeds taken from *Afo* cloves, which were historically planted in remote forests of Halmahera, far from settlements (Figure 6A). These trees are not part of communal or commercial plantations but stem from personal effort, hence the term *usaha*, meaning "effort" to get it. The clove seeds were originally transported from Ternate under the directive of the Sultan, as part of the Sultanate's agricultural expansion, and planted secretly in Halmahera during times of colonial control. Locals ventured deep into the forest to find these valuable clove trees, and if they succeeded, they had the right to claim the trees and manage them, particularly for their family's benefit. *Cengkeh usaha* was traditionally marked by placing stones as boundaries, signaling ownership, and preventing disputes, as reported below:

"There is one story about cloves in Tauro, the plantation is called Usaha. Whoever walks and finds that clove becomes theirs. That's why many clove seeds come from that Usaha cultivation." (60 years – TT)

As a manifestation of tribute and allegiance to the Sultanate, the people of Jailolo (West Halmahera) traditionally allocated 3-4 *cupa* (local measure: cups) of cloves from each harvest to the Sultan of Ternate, a practice that persists today. Tribute was seen as both a political obligation and a spiritual safeguard; failure to deliver it was believed to invite illness or misfortune. These practices not only reinforced the authority of the Sultanate but also legitimized *Afo* cloves as the "great-grandfather" of all clove trees in the region. There is a gender-related belief that emphasizes the unique role of women tied to the planting of nutmeg. It is said that when a woman plants nutmeg, the trees are more likely to flourish and bear abundant fruit. This practice reflects a deep-seated cultural philosophy that attributes fertility and nurturing power to women, extending even to agricultural activities.

Newly married women are encouraged to plant nutmeg as a symbolic gesture, marking their connection to the land and the future prosperity of their household. This act is often seen not merely as farming but as a ritual of growth and continuity, blending the spiritual with the practical. While men are typically involved in climbing trees and harvesting, women are entrusted with planting, highlighting their significance in ensuring the longevity and productivity of this treasured spice. The belief that nutmeg planted by women grows better is a matter of superstition and a reflection of local wisdom, passed down through generations.

This traditional land claim system reflects customary law (*hukum adat*) and economic rights, blending cultural heritage with agricultural practice, rooted in a long history of resistance and self-sufficiency in spice cultivation. When the Dutch VOC entered the region, they implemented a policy known as extirpation, whereby they bought all trees, leaves, and roots to

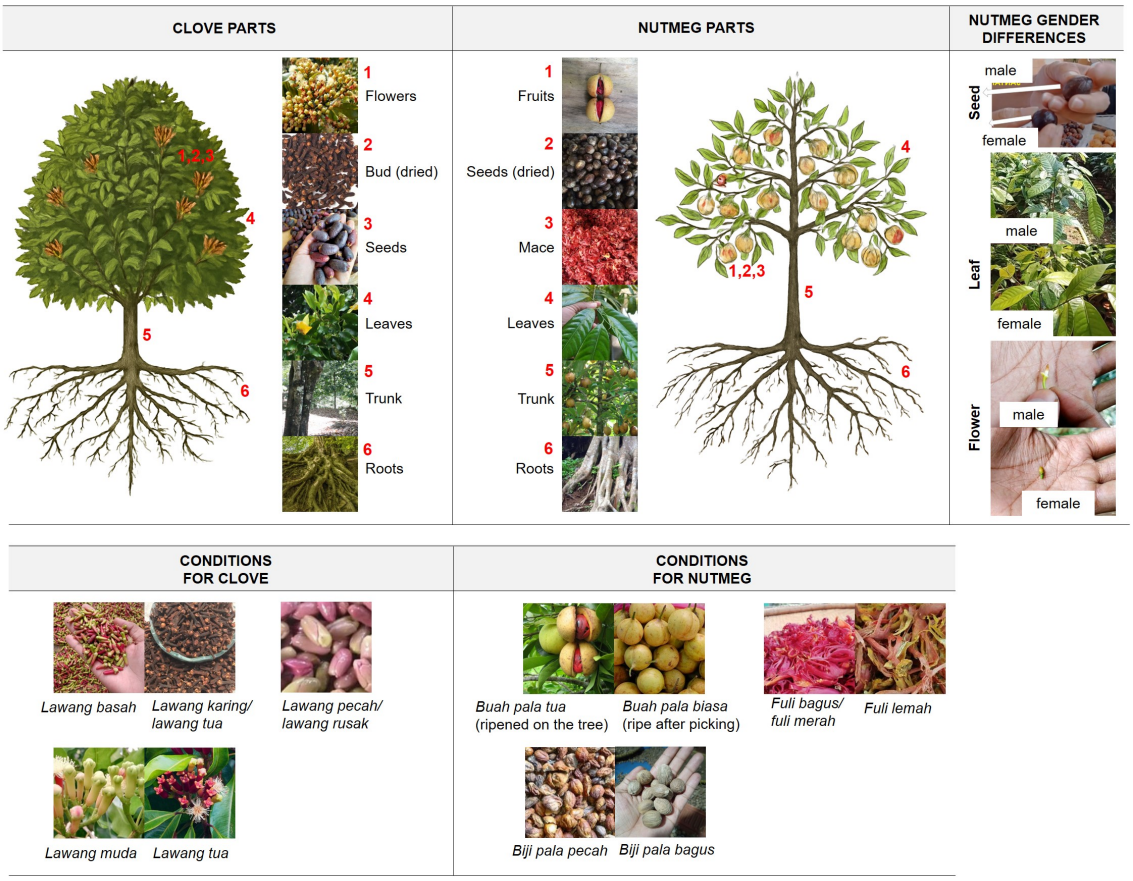

Figure 5. Identification of clove and nutmeg parts, gender (for nutmeg only), and conditions for quality assessment.

burn and destroy them, aiming to monopolize the spice trade. In response, the Sultan of Ternate ordered the rescue of *Afo* clove seeds to be secretly transported and planted in the forests of Halmahera, away from Dutch oversight. This strategic relocation allowed local farmers to continue clove cultivation in hidden plots, preserving both the spice heritage and the economic survival of the people.

In Banda, an appropriate setting for the cultivation must be provided as a form of environmental adaptation. Farmers traditionally use canary trees (*kenari*) as protective shade trees for nutmeg cultivation (Figure 7A). Unlike other crops, the nutmeg plant requires shade and protection, especially in its early years, to grow healthily and remain productive, as reported:

"Nutmeg must have a protective tree like an umbrella; in the forest, trees without protection are damaged or die." (60 years – UL)

Canary trees (*Canarium indicum*) are preferred because their broad leaves act like natural fertilizers when they fall, enriching the soil and enhancing nutmeg growth. It is essential for productive nutmeg trees, especially beyond 5–8 years, when productivity declines without adequate shade. Historically, the Dutch colonial administration in Banda (also known as *perkeniers*, the plantation called *perk*) also planted canary trees alongside nutmeg as part of an agroforestry strategy to protect nutmeg from strong winds and excessive heat, particularly during the monsoon season. Some large canary trees still stand today, though many have fallen due to storms. The colonial planting system also influenced local practice, where the canary served as a practical agricultural canary while becoming part of landscape management traditions in Banda's nutmeg plantation. This long-standing practice shows how ecological adaptation and historical heritage are Banda's iconic spice (Ellen 2019).

Farmers maintain clove and nutmeg trees, particularly domesticated clove, using traditional methods with minimal external inputs. Typically, they do not use fertilizers, relying instead on natural soil fertility and organic practices. One of the primary maintenance tasks is clearing wild grass (*rumput liar*) around the trees to reduce competition and promote healthy

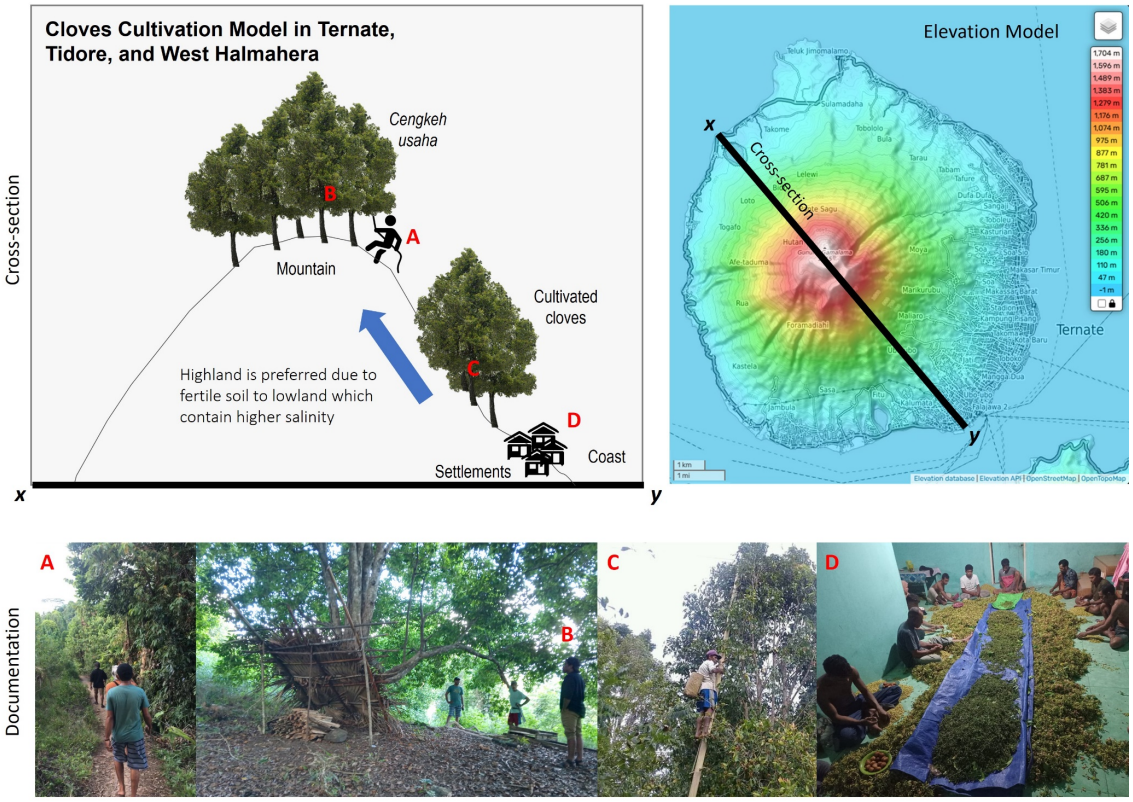

Figure 6. Clove cultivation model in North Maluku and the documentation: (A) Walking to *Cengkeh Usaha*; (B) One of the old clove trees in the *Cengkeh Usaha* area; (C) Picking cloves by climbing; (D) The tradition of *Baku Ambe Tangan*, communally processing the clove harvest.

growth. Grass cutting (*pameri*) is a regular part of nutmeg maintenance. Farmers collect the grass and place it around the roots to enrich the soil naturally. For fungal infections (*jamur pala*), pest control commonly includes caterpillars and grasshoppers (locally called boto-boto) and plant health; farmers practice leaf smoking (*pengasapan daun*), specifically for nutmeg trees. This involves collecting leaves, including from coastal plants, and burning them (*dibakar*) in the hills, allowing the smoke to ward off pests, increase productivity, and prevent the impact of bad weather.

These maintenance and post-harvest practices reflect a deep-rooted tradition of sustainable, low-input agriculture adapted over generations to local environmental conditions. Another method to improve the productivity of nutmeg highlights profound local wisdom referred to as "*menanam pala mundur*", or planting nutmeg backward. This method reflects a cultural belief that the planting orientation, particularly to the setting sun, can influence the tree's productivity. Farmers are mindful of positioning the seed or young tree to face a certain direction, often toward the sunset, so that this brings forth a more fruitful harvest (Figure 7D).

Harvesting cloves in Ternate, Tidore, and Jailolo (Halmahera) is a vital part of community life as an economic activity and a cultural heritage that exemplifies how the communal spirit is nurtured through shared labor during the harvest season. This tradition is known as "*baku ambe tangan*", villagers gather to assist one another, often working from late evening until dawn, strengthening social bonds and fostering a sense of solidarity in their neighborhood (Figure 6D). The term *mo petik* is commonly used to describe picking cloves, which is done by climbing (Figure 6C). Meanwhile, the nutmeg harvesting tradition in Banda is known as "*asar pala*", blending tradition and practicality (Figure 7B). These traditions highlight the value of cooperation (*gotong royong*), reinforcing the community's collective identity and the idea that heritage is not just a memory but a shared responsibility.

After harvesting, the cloves are sun-dried: *jemur lawang* or *panggang* in North Maluku, and *hamur lawang* in Banda, a distinctive term for drying harvested spices. Spice products are dried (*dijemur*) under the sun or via smoke drying, known locally as *para-*

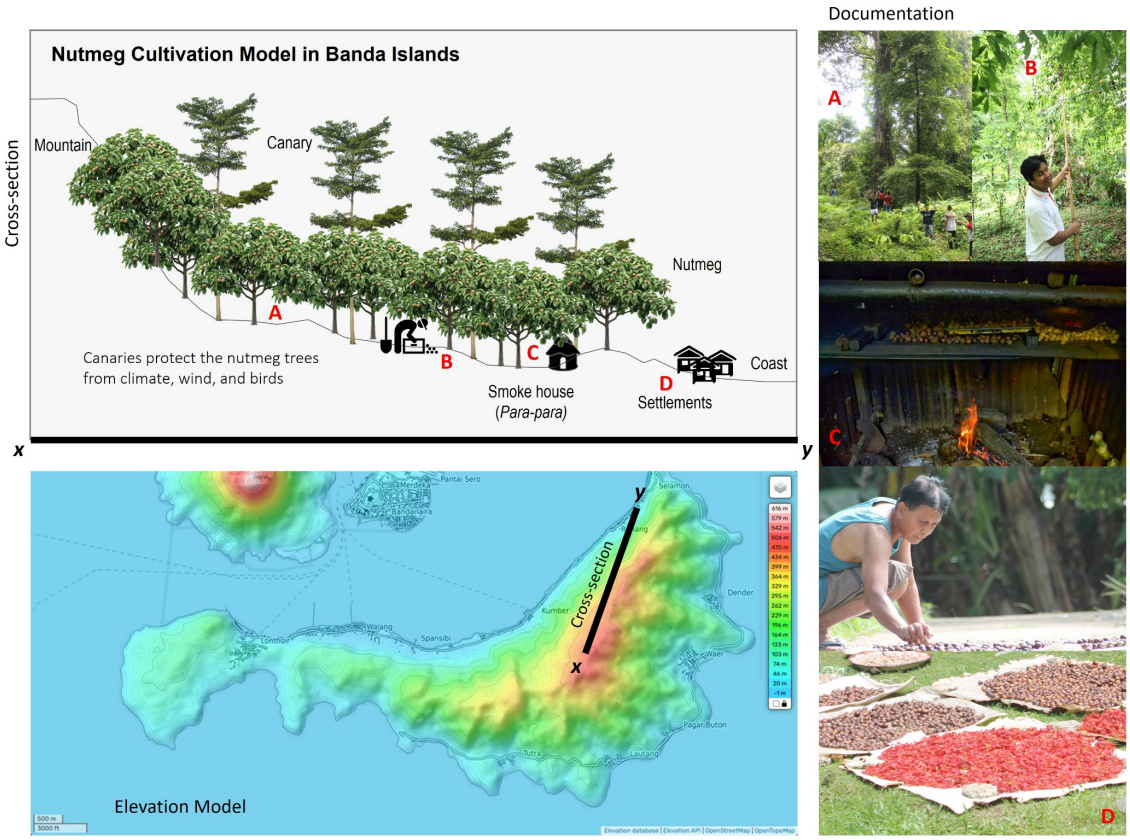

Figure 7. Nutmeg cultivation model in Banda and the documentation based on elevation: (A) Configuration of canary trees as the protectors of nutmeg from bad weather; (B) Picking nutmeg with *gai-gai* (the harvest festival is called *Asar Pala*); (C) drying nutmeg seeds by smoking in *para-para*; (D) drying mace in the sun.

para (Figure 7C), where products are dried above the fire. Although sun drying yields higher quality, smoking is still common, especially in the rainy season.

In Ay Island (Banda), nutmeg cultivation reflects the intimate relationship between humans and nature. This poetic analogy underscores how husband and wife work together in the planting process, likened to a couple's nurturing life. It is believed that planting nutmeg trees mirrors human life, where fertility and partnership are essential for growth and productivity. This knowledge includes specific techniques for ensuring a nutmeg tree will bear fruit. For instance, fibrous roots (*serabut*) affect the tree's fertility. In traditional practice, farmers cut into the trunk and insert a small stick (*lidi*) down to the root, a technique believed to stimulate the growth of fibrous roots. Additionally, when a tree shows limited fibrous root growth, the tip of the trunk is trimmed, and a stone is placed on it. This practice is thought to redistribute the plant's energy to root development, as cited as follows:

"The idea is that if a woman plants it, it will surely bear fruit... so when planted by a woman, it all grows well." (46 years – KR)

"A woman and a man who are husband and wife... are like lovers cultivating the land together." (42 years – DK)

A similar perspective related to gender also occurred in the traditional beliefs of the Ternate community, where specific days and times are considered either favorable or unfavorable for planting crops like cloves. One such belief states that Tuesday is not a good day to plant, as it is a "male day," whereas planting should ideally occur on a "female day." This highlights a symbolic association between fertility and gendered days in which the female is considered the fertile carrier. Other than Tuesday, Sunday and Monday are seen as more auspicious days, believed to promote better growth and yield, as reported:

"You can't plant on Tuesday because it's a male day, not a female day." (50 years – MAF)

The differences in planting patterns are shown in Figure 8. The time of day also matters; planting is avoided at noon, and instead, it is advised to plant either in the early morning or late afternoon, aligning

with the natural rhythm of the day. There is also a mention of Friday being a special day for clove propagation from seed, underscoring the importance of timing and ritual in agricultural practice. These customs reflect a deep connection between the cycles and local cosmology, creating an ecological calendar, which indicates that the success of planting is believed to depend on technique and alignment with natural and spiritual forces (Tukuboya et al. 2024).

The planting season for cloves typically begins in December, coinciding with the rainy season (*musim hujan*). Farmers prefer this period due to the high rainfall, which supports the growth of young clove trees. The local agricultural practice also incorporates traditional lunar markers, where planting is guided by the "*bulan besar*" (full moon), believed to influence the size and yield of future harvests. Additionally, planting is culturally practiced in the morning, before sunset, to align with local beliefs regarding energy flow and soil moisture retention. Historically, cloves were harvested once a year, but recent years have seen shifts; harvest occurs roughly every five years due to changing climate conditions, resulting in irregular yields. While peak harvests (*panen raya*) used to be annual, now harvests are often scattered throughout months, leading to less uniform production and requiring farmers to adapt their strategies.

Healing tradition

In the medicinal aspect, the existence of *Duduku* is also recognized as Shaman, derived from the *Gamkonora* language (a sub-language of Maluku). Particularly in West Halmahera, the role of *Duduku* is central to creating medicinal concoctions with his/her expertise in utilizing a variety of plants, while preserving cultural values in traditional treatment practices (Sahabu 2022). In their native environment, spices are used for ailments, generally related to skin, headaches, respiratory, and anti-aging recipes as cited as follows:

"Here, cloves and nutmeg are not only for cooking. We use them for skin problems, headaches, breathing difficulties, and also to keep the body young. These are practices we learned from our parents and grandparents." (40 years – FE)

This notion is also reported by relevant scientific investigations, which confirm that the essential oils of clove and nutmeg possess significant anti-aging properties and the capacity to mitigate oxidative stress-induced skin damage (Rahmi et al. 2021). Beyond traditional lore, clinical studies establish clove oil as a potent therapeutic agent for relieving chronic skin irritation (Ibrahim et al. 2017) and alleviating headache intensity through the modulation of neural pain pathways (Dehghan et al. 2025). Furthermore, phytochemicals in nutmeg oil, such as myristicin and terpinene, have been shown to significantly accelerate the healing of wounds and burns (Angilia et al. 2024). While in a specific case of traditional practice, clove helps facilitate childbirth in Idamdehe Gamsungi (West Halmahera), through a traditional practice called *ba'ukup*.

"After a woman gives birth, she must undergo ba'ukup so that when her child is 1 or 2 years old, she does not suffer from headaches, vaginal discharge, premature aging, or body odor." (40 years – FE)

Ba'ukup is a traditional healing practice of the Idamdehe Gamsungi community, utilizing local spices such as clove buds and clove leaves. These ingredients are cooked, and the resulting steam from the burning process is used therapeutically, resembling a sauna-like treatment familiar in modern wellness practices (see Figure 9A). The process begins with the individual, typically a woman who has recently given birth, taking a regular bath (Taib et al. 2021). Once clean, a plate is prepared, and pure coconut oil is poured onto it; this must be authentic, homemade coconut oil, not the kind typically purchased from convenience stores or supermarkets. Next, clove buds are finely ground and thoroughly mixed into the coconut oil until evenly blended. Then, seven pieces of cotton are rolled tightly, resembling cigarettes. One end of each cotton roll is dipped into the clove-infused oil, while the other end is left dry and placed at the edge of the plate. Meanwhile, a mat, a stool, and cloth coverings are arranged in preparation.

Once all materials are ready, the person undergoing *ba'ukup* sits on the stool completely unclothed. The mat is wrapped around them with enough space for slight movement. The individual is covered with a cloth, ensuring no gaps for smoke to escape. The dry ends of three cotton rolls are lit and placed beneath the stool, allowing the aromatic clove smoke to rise and envelop the body. If needed, additional cotton rolls are ignited to maintain the smoke level. The clove-scented steam is believed to be highly beneficial for postpartum recovery, aiding the body's healing process after childbirth through this traditional form of aromatic steam therapy.

Throughout the COVID-19 pandemic, *ba'ukup* served as a vital communal resource (see Figure 9B), acting as a traditional spice-based defense for the local population (Pradipha 2020). This reliance is bolstered by molecular research suggesting that clove-derived compounds may interfere with SARS-CoV-2 protein targets, offering potential anti-viral utility (Vicidomini et al. 2021). Furthermore, recent clinical evidence demonstrates that combining clove-based steam therapy with respiratory care significantly improves oxygen saturation and reduces lung inflammation in patients with severe pneumonia, validating the therapeutic efficacy of traditional inhalation practices for

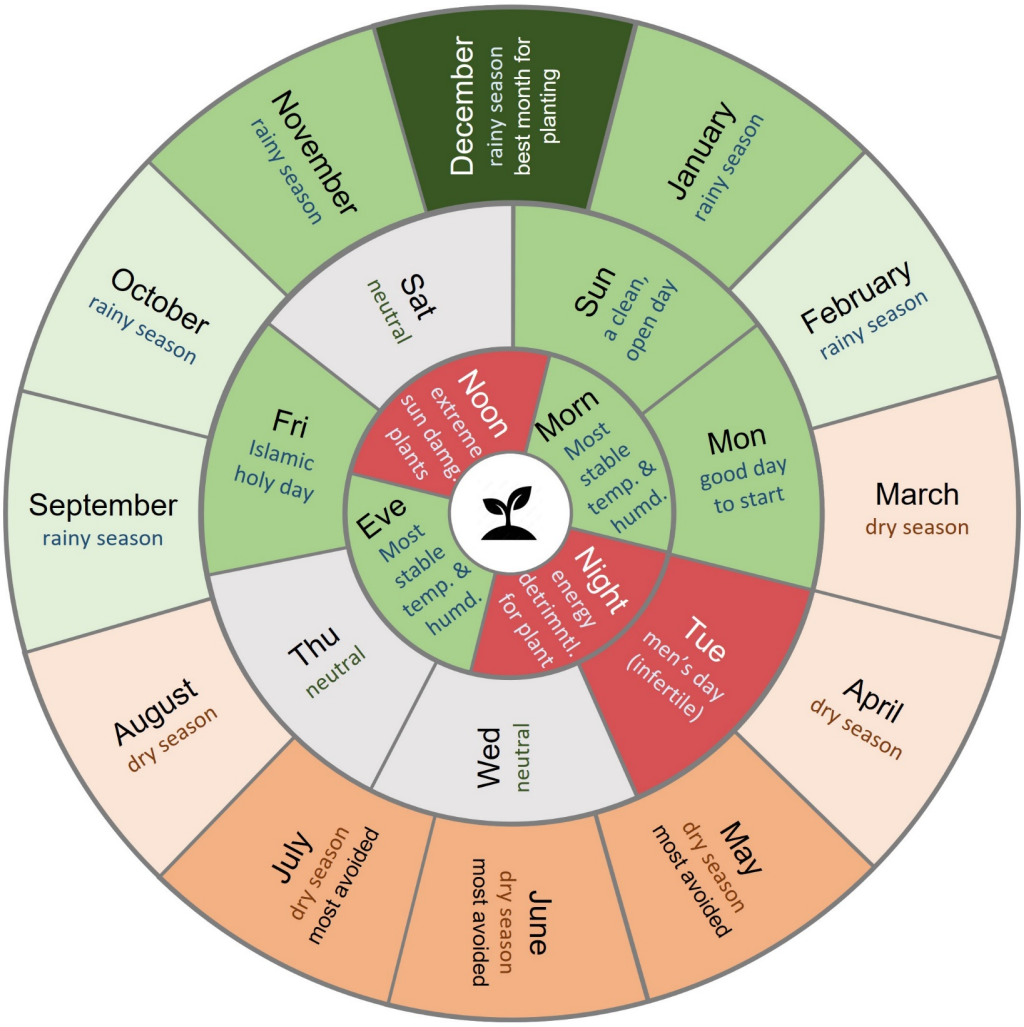

Figure 8. Cultivation cycles according to favorable and unfavorable periods. The innermost circle shows daily patterns, the next ring constitutes the weekly cycle, and the outermost circle represents the annual cycle.

respiratory health (Iftikhar et al. 2024).

Another traditional remedy for gout (an Arthritis symptom) involves pulverizing cloves and lemongrass, blending them with pure coconut oil, and applying the mixture to the affected area as a poultice. An investigation on *Afo* clove conservation reported that the essential oil helps to improve bone health, treat stomach ulcers, and control blood sugar (Tamnge and Yusnaeni 2019; Carvalho et al. 2021). These traditional practices confirmed some main medicinal features of eugenol contained in clove and nutmeg, such as antioxidant, anti-inflammatory, and antimicrobial. Clove leaves are also known to be effective as a mosquito repellent due to their distinctive and strong aroma.

Other healing alternatives are used as ingredients in beverages like coffee or tea. The Banda Islands, while express lowest score of the indicator among observed regions, show the common usage, highlighting primary features of anti-aging and anti-oxidant (Matulyte et al. 2019; Suthisamphat et al. 2020; Abdelmuhsin et al. 2025; Ramírez-Alarcón et al. 2023). Particularly on Ay Island, nutmeg is traditionally employed in therapeutic practices, often by consuming an elixir of nutmeg boiled with tea. Other medicinal preparations include essential oils and finely ground dried nutmeg powder, coconut, or olive oil for various topical applications (Sultan et al. 2023; Al-Rawi et al. 2024).

Inquiry into cultural heritage statements

The idea of recognizing Indonesia's spice culture as an intangible heritage resonates strongly within lo-

Figure 9. *Ba'ukup* tradition for (A) postpartum mothers (Soplanit 2013); (B) to prevent COVID-19 (Pradipha 2020).

cal communities, especially in North Maluku. The interplay of collective memory and local leadership underpins the construction and preservation of intangible cultural heritage. In Tauro village, this is evident in the community's ancestral ties to the Ternate Sultanate, which historically granted the land to its people. The traditional leader (*ketua adat*) serves as custodian of customary knowledge and oral histories, including stories of clove trees in West Halmahera descended from plants saved during Dutch colonial attempts to destroy plantations. Elders, traditional leaders, and customary communities maintain these narratives and manage land stewardship, resolving disputes through customary law and deep historical knowledge. An informant expressed support for such recognition, emphasizing that global acknowledgment would ensure that people understand the origin of these valuable spices, as quoted below:

"Since many people from outside the country consume nutmeg and cloves, it would be good if they were recognized as cultural heritage so that people know they come from here (Maluku)." (68 years – Tobaru tribe traditional leader)

This statement reflects a collective aspiration that the rich heritage of cloves and nutmeg, long central to the identity and economy of Maluku, gains international recognition, such as through UNESCO World Heritage designation. Such acknowledgment is seen as a means to safeguard cultural identity and assert Indonesia's historical role in the global spice trade. Maluku and North Maluku's identity as spice producers is manifested in city branding and national imagery. Ternate, known as "*Kota Rempah*" (Spice City), officially embraces this title, supported by 93% of its residents and formalized by Mayor Regulation No. 29 of 2021 (Figure 10). Collaborations with academic institutions aim to develop products linked to this heritage (Hairudin et al. 2023).

UNESCO took a major step toward formalizing global attention to cultural traditions in 1989 by issuing its first international guideline focused on intangible expressions, the *Recommendation on the Safeguarding of Traditional Culture and Folklore*. The momentum toward broader recognition of intangible heritage further increased with the 1992 United Nations Convention on Biological Diversity, which underscored the importance of valuing and protecting indigenous and local knowledge systems. These traditional practices were acknowledged not only for their cultural significance but also for their critical role in the conservation and sustainable management of biodiversity (Aikawa 2004).

In response to this, the Banda Islands were designated as a Tentative List in 2015 under the title

Figure 10. The "*Kota Rempah*" monument (clove and nutmeg symbols) in Ternate, a branding of Spice City.

Historic and Marine Landscape of the Banda Islands, highlighting cultural criteria (iv) and (vi), and the natural criterion (x) (UNESCO 2015). This development is further reinforced by ongoing research and historical explorations of spice culture conducted by various actors across interdisciplinary fields, strengthening the position of the Maluku Islands as the starting point of the world's spice origin. Table 5 shows the Outstanding Universal Values (OUV) associated with spice biocultural heritage in the Maluku Archipelago.

The recent development in 2025, this heritage property successfully gained attention under the title *The Land Below the Wind: Spice Trade Route from the 13th to 18th Century AD* (UNESCO 2025). This nomination includes several key spice trade nodes: the Banda Islands, Ternate, Makassar, and the Old Town of Batavia (present-day Jakarta). It substantiates the site's OUV under cultural criteria (ii) and (iv), while also emphasizing the authenticity and integrity of the *perk* (plantation systems) established in the 17th century, many of which survive today as community-managed gardens in Banda. Similarly, clove plantations in Ternate and Tidore continue to operate using the same traditional system as in the 17th century, a continuity evidenced by the still-active plantations on the slopes of Mount Gamalama, which remain under the stewardship of the Sultanate (Nasution et al. 2025).

Table 5. Outstanding Universal Values (OUV) reflecting the intertwined biocultural significance of spice heritage within the Maluku Archipelago.

Nomination	Criteria	Associated biocultural properties	Assessment at the global threshold
Historic and Marine Landscape of the Banda Islands	(iv) to be an outstanding example of a type of building, architectural or technological ensemble or landscape which illustrates (a) significant stage(s) in human history	The historic nutmeg plantations (*perk*) and agroforestry systems integrating canary trees demonstrate a living continuum of colonial and indigenous cultivation. The cultural landscape retains original spatial patterns, plantation houses, and processing structures (e.g., *para-para* smokehouse).	Demonstrates exceptional integrity and authenticity as the earliest and best-preserved nutmeg-producing landscape in the world, linking ecological adaptation with global maritime trade history.
	(vi) to be directly or tangibly associated with events or living traditions, with ideas, or with beliefs, with artistic and literary works of outstanding universal significance. (The Committee considers that this criterion should preferably be used in conjunction with other criteria)	Traditional rituals such as *Asar Pala* (nutmeg harvest festival) and oral histories of *Orang Kaya* governance express enduring cultural continuity. Women's planting rituals symbolize fertility and intergenerational transmission of knowledge.	Exemplifies the living cultural memory of the spice trade and its influence on global exchanges, comparable to other transoceanic trade heritage routes.
	(x) to contain the most significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation	The Banda Islands preserve endemic nutmeg species (*Myristica fragrans*) and shade-based agroforestry ecosystems supporting high biodiversity, integrating human stewardship with natural habitats.	Represents a rare fusion of biodiversity and cultural heritage within a small-island ecosystem, illustrating sustainable co-adaptation over millennia.
The Land Below the Wind: Spice Trade Route from the 13th to 18th Century AD	(ii) to exhibit an important interchange of human values, over a span of time or within a cultural area of the world, on developments in architecture or technology, monumental arts, town-planning, or landscape design	The Maluku nodes (Banda, Ternate, Tidore) formed the nucleus of the global spice trade network, facilitating cross-cultural exchanges among Arab, Indian, Chinese, and European civilizations.	Highlights the Maluku Archipelago's pivotal role as the epicenter of early globalization through the spice trade, shaping global maritime, cultural, and economic systems.
	(vi) to be directly or tangibly associated with events or living traditions, with ideas, or with beliefs, with artistic and literary works of outstanding universal significance. (The Committee considers that this criterion should preferably be used in conjunction with other criteria)	The continuing practices of clove (*Syzygium aromaticum*) cultivation, *Cengkeh Usaha* in Halmahera, and the *Baku Ambe Tangan* communal harvest in Ternate and Tidore embody local resistance, spirituality, and collective identity.	Reflects the intangible living heritage of the spice route, linking ancestral resilience, gendered traditions, and local ecological wisdom to global narratives of cultural exchange.

Conservation challenges and strategies

Despite the recognition of spice cultivation as cultural heritage properties, growing concerns persist regarding the preservation of the rich collective memory surrounding clove cultivation in North Maluku, which has yet to establish sufficient protocols. While local communities retain knowledge of the history, place names, and traditional practices associated with cloves, this collective memory remains fragmented and largely undocumented, primarily due to the absence of systematic research and formal articulation. Many individuals recount their lived experiences, yet they often lack the institutional support or conceptual frameworks necessary to position this knowledge within a heritage discourse. At the same time, the deeper social and historical dimensions of the spice landscape, such as the roles of local communities, customary governance, and traditional land tenure systems, remain underexplored and largely overlooked, with minimal governmental initiatives aimed at interpretation or conservation.

At the same time, today, spices like clove and nutmeg are often treated merely as commodities, harvested and sold to middlemen, and then processed into final products elsewhere. As a result, local people are disconnected from the full value of their spices economically and culturally. There is little understanding of how these spices are transformed and no real sense of ownership or pride in them. The idea of Maluku as a spice origin risks becoming hollow, especially when local communities do not benefit directly or see spices as part of daily life, traditions, and identity.

What is missing is a way to bring spices back into the heart of community life, not only as a source of income but also through shared practices, storytelling, and cultural expression. Everyday acts such as harvesting together, preparing spice-based food, or celebrating traditions could help reconnect people to their heritage. There is a need for local leaders or community groups to champion this effort, creating spaces where this enjoyment is not just sold but lived, shared, and transmitted through a sustainable framework (Kersapati et al. 2022). Without this, efforts to brand the region as part of the spice trade or gain global recognition will remain disconnected from the real experiences of those who have long lived among the spices.

This also legitimizes the role of ethnobiology and related disciplines as a strategy in viewing the spices as the "biocultural heritage" of indigenous and traditional communities, which includes biological diversity, cultural knowledge, and their conservation (Rangel-Landa et al. 2016; Rivera 2024). Heritage experts investigate interdisciplinary frameworks to document this biocultural heritage, such as Kaiser (2004), who worked on the sensory dimension of endangered plants, particularly the olfactory element, contributing to volatile organic compounds (VOC) preservation of lost chemistry. In the linguistic dimension, Wu and PeronoCacciafoco (2025) constructed a comprehensive and systematized dataset containing names of healing plants with medicinal properties from endangered languages through a linguistic documentation method. This procedure is similarly can also be implemented for oral tradition materials (Bakar et al. 2023) and sacred rituals (Isnaeni et al. 2025).

Limitations of the study

This study has several limitations that should be considered when interpreting the findings. First, the research is based on qualitative ethnographic fieldwork conducted in selected historic villages in North Maluku and the Banda Islands. While this approach allows for in-depth documentation of local knowledge and practices, the findings are not intended to be statistically representative of all communities in the Maluku Archipelago. Second, the semi-quantitative scoring used to describe the intensity of ethnobotanical practices and the economic and cultural importance of ethnospecies is based on informant perceptions and observed practices. These scores function as descriptive tools to support qualitative interpretation rather than as precise quantitative measurements, and they may reflect localized priorities that differ across contexts. Finally, the study focuses on clove and nutmeg as key ethnospecies, which may limit attention to other plants that also contribute to local livelihood systems and cultural landscapes. Future research could expand the comparative scope to include a broader range of species and communities, as well as longitudinal approaches to examine changes in knowledge transmission over time.

CONCLUSION

This study reveals that the spice culture of the Maluku Archipelago represents a living biocultural heritage where ecological knowledge, social identity, and historical memory are deeply intertwined. The research successfully addresses the central research question by demonstrating that clove and nutmeg function as foundational biocultural elements sustained through intergenerational knowledge systems. These systems are expressed through sophisticated indigenous classifications of plant quality and anatomy, such as *ngofa lawang* and gendered distinctions in nutmeg trees, which guide traditional agricultural decisions. Such knowledge is further reinforced by ancestral rituals and gender-specific planting customs that symbolize fertility and ensure the continuity of these treasured

species.

Furthermore, the study confirms that these spices are integrated into the fabric of daily life through traditional healing practices, such as *ba'ukup*, which utilize the antimicrobial and anti-inflammatory properties of clove and nutmeg. These therapeutic traditions served as vital communal defenses during the COVID-19 pandemic and continue to bridge the gap between ancestral lore and modern clinical application. The cultivation of these spices is inextricably linked to resilient agroforestry landscapes, exemplified by the symbiotic use of canary trees to protect nutmeg from environmental stress. These landscapes are not merely productive sites but are cultural terrains shaped by collective labor traditions such as *baku ambe tangan* and historical narratives of resistance, such as the *Cengkeh Usaha* in Halmahera.

Ultimately, these complex relationships contribute to the construction and recognition of spice culture as a living heritage by providing the Outstanding Universal Value (OUV) necessary for global recognition. The findings illustrate that the continuity of these practices sustains regional identity and regional pride, facilitating the Maluku Archipelago's placement on UNESCO's Tentative List. By positioning spices as living biocultural heritage rather than mere commodities, this study underscores the necessity of integrating local ecological wisdom into formal heritage management to ensure that the bond between land, memory, and identity remains enduring for future generations.

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DATA AVAILABILITY

The data used to support the findings of this study are available in a figshare repository https://doi.org/10.6084/m9.figshare.29041079.v1.

CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

CONTRIBUTION STATEMENT

Conceived and designed the conceptual framework: HR.
Supervised the research and edited the final manuscript: MIK.
Conducted field investigation and documented cultural practices: MF, MAV.
Analyzed agricultural management aspects: AA.
Collected field data and conducted community interviews: FF, ZN.
Transcribed data and managed funding administration: MAT, PNS.
Wrote the first draft of the manuscript: HR, MIK.

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The authors used ChatGPT-5.2 to assist in improving language clarity. The content was reviewed and edited by the authors to ensure accuracy and appropriateness.

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