Ethnobotanical uses, biocultural significance, and research trends of *Nypa fruticans* Wurmb.: An integrative review with evidence from Aceh, Indonesia

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Review

Abstract

Background: *Nypa fruticans* Wurmb. is a multipurpose mangrove palm associated with food, household materials, livelihoods, and traditional health practices across coastal communities. In Aceh, Indonesia, recent evidence documents continuing food, craft, livelihood, and medicinal uses of the species, although the depth and geographical coverage of species-focused ethnobotanical documentation remain uneven.

Methods: This integrative review used critical narrative synthesis as the primary interpretive approach, supported by bibliometric mapping of the global scientific literature. Scopus records retrieved on 22 April 2026 were analyzed using Bibliometrix/Biblioshiny and VOSviewer. A supplementary Aceh-focused search incorporated Indonesian-language publications and institutional-repository materials using explicit location- and species-specific inclusion criteria.

Results: Bibliometric mapping of 469 English-language articles published during 1939-2026 showed that research was dominated by ecological, materials, biomass-utilization, and laboratory-oriented themes. In contrast, Aceh-specific evidence documents active people-palm relationships. In East Aceh, *N. fruticans* had a Use Value and Relative Frequency of Citation of 0.96. In Nagan Raya, the fruit was recorded as boiled for fever reduction and thrush. Other sources document roofing, cigarette wrappers, weaving, fruit processing, and livelihood products. Species-specific information on dosage, harvesting, gender-differentiated use, knowledge transmission, and customary management remains uneven.

Conclusions: Available evidence identifies *N. fruticans* as a multipurpose biocultural resource in Aceh. Further ethnobotanical research should compare uses across localities and connect community knowledge with sustainable management, conservation, and equitable benefit-sharing.

Keywords: *Nypa fruticans*; Aceh; ethnobotany; ethnomedicine; biocultural knowledge; coastal livelihoods; mangrove palm

Background

Nypa fruticans Wurmb. commonly known as nipa or nipah palm, is a distinctive mangrove-associated palm that occupies estuarine and brackish environments across the Indo-West Pacific (Syafina *et al*. 2025, Zhang *et al*. 2024). Its ecological position is unusual because it is widely recognized as the only palm adapted to mangrove environments. Its rhizomatous growth, large fronds, floating fruits, and sap-producing inflorescences have made it important to coastal communities. Across Southeast Asia, South Asia, and Oceania, *N. fruticans* has been used for roofing, weaving, fuel, food, sugar, vinegar, alcohol, and medicinal purposes (Cheablam & Chanklap 2020, Rahman *et al*. 2024). This multifunctionality makes the species particularly appropriate for ethnobotanical analysis because its value cannot be reduced to a single chemical constituent or pharmacological endpoint (Chele *et al*. 2025).

For Aceh, Indonesia, the relevance of *N. fruticans* is especially important because coastal settlements, estuarine landscapes, and mangrove-dependent livelihoods are part of the province's social and ecological history (Eddy *et al*. 2024). Acehnese coastal communities have experienced repeated environmental and livelihood pressures, including land-use change, mangrove degradation, disaster recovery, and shifts in rural economies (Lubis *et al*. 2024). Within this setting, mangrove plants may function as biological resources and as cultural resources that support everyday resilience. Therefore, a review focused on *N. fruticans* should ask how the plant is known, harvested, processed, exchanged, and interpreted within coastal community life, rather than simply whether its extracts show laboratory bioactivity (Fitri *et al.* 2023, Nugroho *et al.* 2022, Wang *et al*. 2025).

Previous studies on *Nypa fruticans* have often emphasized phytochemistry, bioactivity, and pharmacological potential, whereas its ethnobotanical and biocultural dimensions remain less integrated into the interpretation of the species (Saengkrajang *et al*. 2021, Siregar *et al*. 2025). This distinction is important because ethnobotanical research requires that chemical or bioassay-based evidence be interpreted within people-plant relationships, cultural practices, local knowledge systems, and applied community contexts. Therefore, in this review, phytochemical and preclinical pharmacological findings are treated as supportive evidence for interpreting reported traditional uses, rather than as the main basis for claiming medicinal efficacy (Islam *et al*. 2026a, Islam *et al*. 2026b).

Although *N. fruticans* has received substantial scientific attention, community-centered ethnobotanical evidence remains less extensively synthesized than ecological, technological, phytochemical, and pharmacological research. Recent Aceh studies provide important empirical evidence of local use. Nursamsu *et al.* (2025) documented *N. fruticans*, locally recorded as "Nipah", among vegetable and spice resources used in five coastal villages of East Aceh and reported a Use Value of 0.96 and Relative Frequency of Citation of 0.96. Wintah *et al.* (2026) documented "Nipah" in Tadu Raya, Nagan Raya, where the fruit was recorded as being used boiled for fever reduction and thrush. These studies establish local importance and selected preparation practices, although species-focused information on dosage, harvesting norms, knowledge transmission, customary management, and variation across Aceh remains incomplete.

This review therefore synthesizes current knowledge of *N. fruticans* as a people-plant resource, with particular attention to evidence from Aceh. Critical narrative synthesis is used to examine documented livelihood, food, material, medicinal, cultural, and management-related uses. Bibliometric mapping provides supporting context on the development and thematic orientation of the global scientific literature. The integrated analysis then evaluates the geographical and methodological coverage of current Aceh evidence and identifies priorities for strengthening ethnobotanical documentation, sustainable management, conservation, and benefit-sharing.

Materials and Methods

Review design and data sources

This study used an integrative critical review design supported by bibliometric mapping. Research on *Nypa fruticans* spans ethnobotany, mangrove ecology, food systems, biomass utilization, phytochemistry, pharmacology, and sustainable livelihoods. Critical narrative synthesis therefore formed the primary interpretive component of the review, while bibliometric mapping was used to characterize the broader scientific landscape.

Data source, search strategy, and eligibility criteria

Bibliometric data were retrieved from the Scopus database. The search terms were "*Nypa fruticans*", "nipa palm", "nipah palm", and "mangrove palm", applied to the title, abstract, and keyword fields. The search was intentionally species-focused

to characterize the global scientific literature and interpret it alongside ethnobotanical and biocultural evidence (Nasution *et al.* 2025, Nasution *et al.* 2026).

Records were eligible when they addressed *N. fruticans* in relation to ethnobotany, traditional use, local livelihoods, cultural practices, food or sap use, phytochemistry, biological activity, toxicity, mangrove ecology, conservation, restoration, or sustainable management. Records not focused on the species, duplicates, records with insufficient information, and irrelevant document types were excluded.

The initial Scopus search identified 635 records. After applying document-type and language criteria, 469 English-language articles published between 1939 and 2026 were retained for bibliometric analysis. Non-English Scopus records were excluded only from the quantitative bibliometric corpus and did not preclude inclusion of relevant Indonesian-language evidence in the narrative synthesis (Fig. 1).

Data extraction and bibliometric analysis

Bibliographic information was extracted for publication year, authors, affiliations, countries, source titles, citations, references, keywords, abstracts, and document type. For the narrative synthesis, additional information included study location, research design, informant characteristics where available, local names, plant parts, reported uses, preparation or processing methods, quantitative ethnobotanical indices, livelihood information, safety evidence, conservation relevance, and study limitations.

The Scopus dataset was analyzed using Bibliometrix/Biblioshiny and VOSviewer (Aria & Cuccurullo 2017, van Eck & Waltman 2010). Performance indicators included publication growth, citation patterns, country and institutional contributions, international collaboration, and author-level metrics including number of publications (NP), total citations (TC), h-index, g-index, m-index, and first publication year (PY_start) (Egghe 2006, Hirsch 2005, Nasution *et al.* 2027). Keyword co-occurrence and thematic mapping were used to characterize the thematic structure of the literature. Detailed bibliometric performance indicators were interpreted as measures of scientific activity rather than cultural or ethnobotanical importance.

Critical narrative synthesis

Critical narrative synthesis served as the primary interpretive approach. Evidence was appraised according to ethnobotanical relevance, methodological transparency, cultural specificity, and strength of evidence. Formal ethnobotanical surveys were distinguished from medicinal-plant inventories, community-development studies, product-development reports, ecological studies, and other contextual sources.

Particular attention was given to local terminology, informant characteristics, plant parts, preparation methods, documented uses, quantitative indices, livelihood involvement, management practices, and voucher documentation. Study-level demographic information was not interpreted as evidence of species-specific gender patterns unless *N. fruticans* use or management was explicitly disaggregated.

Phytochemical and pharmacological findings were interpreted as supporting evidence for biological plausibility rather than confirmation of traditional efficacy. Likewise, low visibility of community-centered variables in bibliometric networks was interpreted as a feature of the indexed literature rather than evidence that community knowledge or cultural importance was absent.

Ethical and biocultural considerations

As a literature review and bibliometric study, this work did not involve interviews, human participants, new biological sampling, or animal experimentation. Future Aceh-based ethnobotanical research should obtain prior informed consent, appropriate community and ethical approval, and address access and benefit-sharing, protection of community intellectual contributions, and return of findings in formats accessible to participating communities.

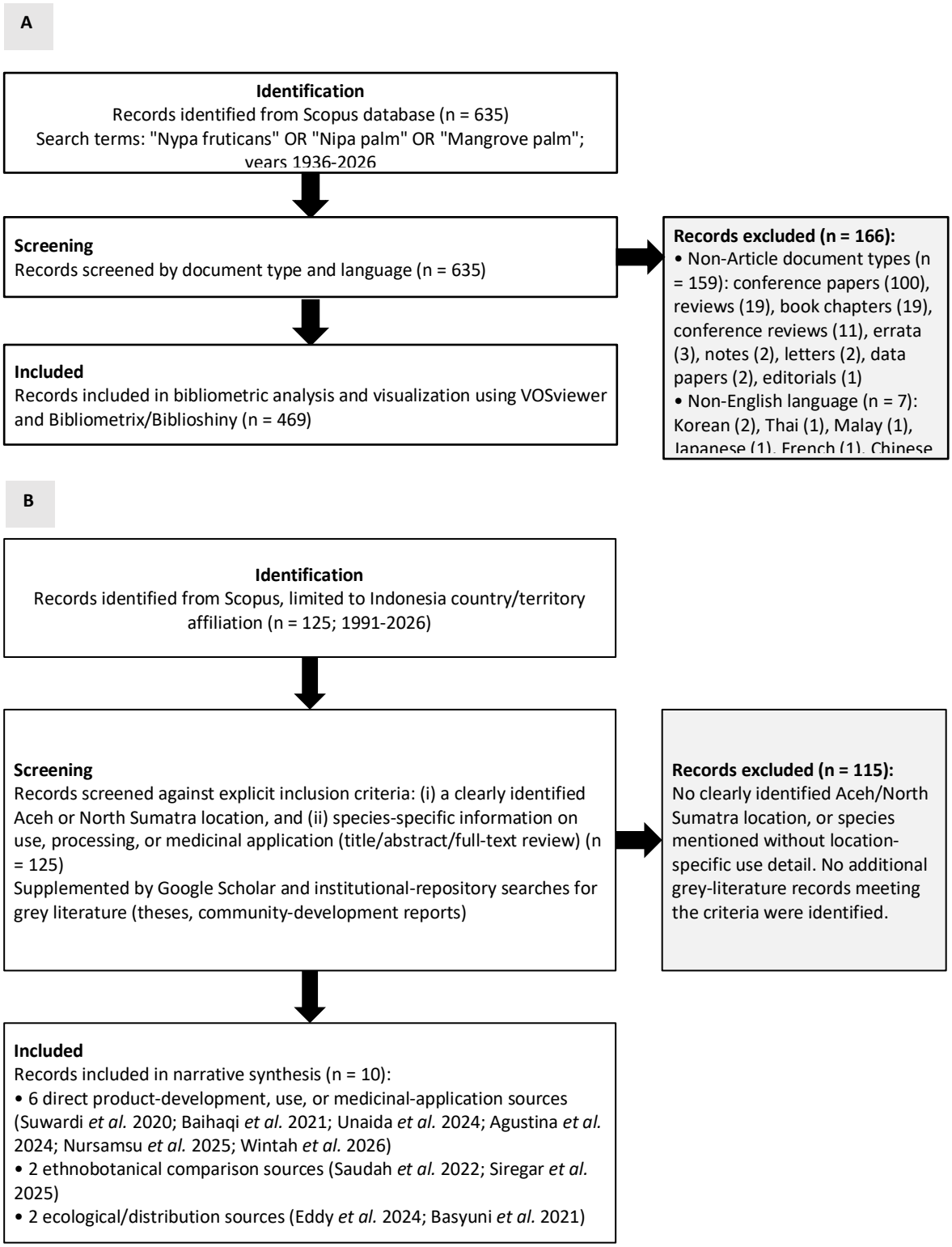

Figure 1. PRISMA-style flow diagrams of study identification and screening, shown as two separate, independently conducted processes reflecting their distinct search criteria and purposes. (a) Identification and screening of records retrieved from Scopus for bibliometric analysis of the global *Nypa fruticans* Wurmb. literature, filtered by document type and language, (b) Identification and screening of the supplementary Aceh/North Sumatra evidence base used for narrative synthesis, filtered by species- and location-specific relevance criteria.

Results and Discussion

Aceh-specific ethnobotanical and biocultural evidence

The available Aceh-specific literature demonstrates that *Nypa fruticans* is not merely an ecologically occurring mangrove palm but a resource that continues to be incorporated into food, household materials, handicrafts, livelihood activities, and traditional health practices. The strength and type of evidence, however, vary substantially among studies. Some sources are formal ethnobotanical or medicinal-plant surveys, whereas others are community- or product-development studies. To provide a structured comparison, Table 1 summarizes studies that directly reported the use, product development, or medicinal application of *N. fruticans* in Aceh. The table compares study location and context, participants where reported, local terminology, plant parts and preparation methods, documented uses, quantitative or livelihood-related evidence, and key limitations. Because these studies differ substantially in design, their findings are interpreted according to their respective scope rather than treated as equivalent forms of ethnobotanical evidence.

Among the retained Aceh sources, the strongest quantitative ethnobotanical evidence comes from Nursamsu *et al.* (2025), who surveyed five coastal villages in East Aceh. *N. fruticans* was recorded under the local name "Nipah", with the fruit identified as the used part and the species recorded as growing wild. Its reported uses extended beyond food to economic, cultural, medicinal, agricultural-tool, and handicraft categories. The species had a Use Value (UV) of 0.96 and Relative Frequency of Citation (RFC) of 0.96, placing it among the most frequently recognized and useful plants in the study. These findings provide quantitative support for the contemporary importance of *N. fruticans* in coastal community life rather than merely demonstrating its botanical presence.

The Nursamsu *et al.* (2025) study also provides useful information on the population from which ethnobotanical knowledge was obtained. The survey included 100 respondents overall, comprising 78 women and 22 men, and the researchers reported that women were intentionally prominent because of their role in food preparation. However, the published data do not disaggregate *N. fruticans*-specific knowledge or use by gender. The study therefore supports the participation of women in the broader coastal plant-knowledge system but does not demonstrate that use or management of *N. fruticans* itself is female-dominated.

Medicinal evidence is provided by Wintah *et al.* (2026) from Tadu Raya, Nagan Raya. The study interviewed 12 community-recognized informants with knowledge of medicinal plants, including seven women and five men aged 40-80 years. *N. fruticans* was recorded as "Nipah", with the fruit listed as the used part, boiling as the preparation, and fever reduction and thrush as medicinal applications. This evidence is important because it demonstrates that Aceh-specific information on local terminology, plant part, preparation, and health-related use is already available. Nevertheless, the study does not provide species-specific data on dosage, frequency of administration, informant consensus, or gender differentiation, and these characteristics of the study sample should not be interpreted as gender-specific patterns of *N. fruticans* knowledge.

The community-development literature broadens the evidence beyond medicinal and food uses. In East Aceh, the Bungong Chirih women's group developed nipah-stick woven products including tissue boxes, napkins, beverage-packaging boxes, folders, hotel slippers, women's bags, and flower vases, while subsequent development expanded product types and Acehnese-motif variants and incorporated offline and online marketing (Baihaqi *et al.* 2021, Suwardi *et al.* 2020). In North Aceh, documented uses include "bubong oen" roofing and traditional cigarette wrappers, while mature fruits have been introduced as flour (Unaida *et al.* 2024). In Great Aceh, fruits previously consumed mainly fresh in drinks have been processed into sweets, juice, crackers, pudding, and *kolak* (Agustina *et al.* 2024). Although these applied studies do not provide formal ethnobotanical indices, they demonstrate continuing use, product diversification, and livelihood-oriented innovation.

The Aceh evidence already establishes several elements of the local *N. fruticans*-people relationship: the local term "Nipah", multipurpose use, selected preparation practices, quantitative ethnobotanical importance in East Aceh, medicinal application in Nagan Raya, and livelihood-oriented use in several other localities. The evidence is therefore better characterized as geographically and methodologically uneven rather than absent.

Table 1. Aceh-specific evidence on the uses and biocultural relevance of *Nypa fruticans*

Source	Location and study context	Participants/sample	Local name	Plant part and preparation/processing	Documented uses	Quantitative/livelihood evidence	Scope/limitations relevant to synthesis
Suwardi *et al.* (2020)	Matang Gleum Village, Peureulak, East Aceh; community-service program on nipah-stick weaving	22 members of the Bungong Chirih group	NR	*Lidi nipah*; processed through weaving into handicraft products	Tissue boxes, napkin holders, beverage-packaging boxes, folders, hotel slippers, women's bags, and flower vases	Training increased participants' knowledge; 20/22 (90.9%) understood the training materials well and 18/22 (81.8%) were very satisfied; the group also developed an annual business plan	Community empowerment/product-development study, not a formal ethnobotanical survey; no ethnobotanical indices reported
Baihaqi *et al.* (2021)	Matang Gleum Village, Peureulak, East Aceh; development of Acehnese-motif nipah-stick weaving as a creative-economy product	23 members of the Bungong Chirih group	NR	*Lidi nipah*; woven using nipah-stick weaving technology and developed with Acehnese motifs	Diversified woven handicraft products with Acehnese motifs	Product types increased from 10 in 2019 to 34 in 2020, with 24 Acehnese-motif variants; participants were also trained in offline and online marketing	Community/product-development study; no formal ethnobotanical indices reported
Unaida *et al.* (2024)	Paloh Gadeng Village, Dewantara, North Aceh; community training and assistance in processing mature nipah fruit into flour	Community members/partners; exact number not reported	NR	Mature fruit peeled, washed, thinly sliced, sun-dried for one week, ground, and sieved through 80 mesh; the article also reports local use of an unspecified part of the nipah plant for *bubong oen* and traditional cigarette wrappers	*Bubong oen*, traditional cigarette wrappers, and nipah-fruit flour	Partner responses averaged 56% strongly agree and 44% agree; positive impacts were reported particularly for housewives and female school dropouts	Community-service study; exact participant number and formal ethnobotanical indices not reported
Agustina *et al.* (2024)	Naga Umbang Village, Lhoknga, Great Aceh; PRA-based food-diversification/community-service program	Umbang Berjaya farmer group, Warjakir Naga Umbang business partner, and members of the local	NR	Fruit; previously consumed fresh as a component of drinks and subsequently processed into sweets, juice, crackers, pudding, and *kolak*	Fresh fruit in drinks and diversified food products	Participants were reported to acquire skills to make the products independently; the authors describe opportunities for additional income, new family/community	Community-service study; no formal ethnobotanical indices or quantified livelihood outcomes

		community; exact *n* not reported				businesses, and job creation, but no quantitative income data were reported	
Nursamsu *et al.* (2025)	Five villages in East Aceh: Kuala Idi, Gampong Aceh, Blang Geulumpang, Ulee Blang, and Titi Baro; ethnobotanical survey of vegetables and spices	100 respondents overall: 78 women and 22 men; ages 15 to >65 years	Nipah	Fruit; growth/source recorded as wild; species-specific preparation method not reported	Food, economy, culture, medicine, agricultural tools, and handicrafts	UV = 0.96; RFC = 0.96; ICS = 6.3	Respondent demographics are study-wide rather than *N. fruticans*-specific; species-specific preparation, medicinal dosage, and gender-disaggregated use were not reported
Wintah *et al.* (2026)	Tadu Raya, Nagan Raya, Aceh; survey of mangrove composition and medicinal use	12 local informants: 7 women and 5 men, aged 40-80 years	Nipah	Fruit; boiled	Fever reducer and thrush	Species-specific medicinal-use record; no ethnobotanical use-value or cultural-importance index was reported for *N. fruticans*	Informant demographics are study-wide; no *N. fruticans*-specific dosage, administration frequency, or gender-disaggregated use was reported

Note: NR = not reported in the source article. UV = Use Value; RFC = Relative Frequency of Citation; ICS = Index of Cultural Significance.

The *Nypa fruticans*-people system: ethnobotanical and biocultural evidence

The broader literature similarly identifies *N. fruticans* as a multipurpose palm embedded in coastal livelihoods and household practices. Across Southeast Asia, South Asia, and Oceania, reported uses include sap production, food, vinegar, sugar, alcohol, roofing, thatching, weaving, fuel, handicrafts, household materials, and traditional health-related applications (Cheablam & Chanklap 2020, Hossain *et al.* 2015, Nugroho *et al.* 2022, Rahman *et al.* 2024). These activities are better interpreted as interconnected components of a people-plant system than as unrelated product categories because leaves, midribs, fruits, and sap move through household, food, craft, livelihood, and health-related pathways.

Traditional medicinal claims reported in the broader literature include uses related to fever, diabetes-related conditions, inflammation, respiratory ailments, and wound healing (Hamilton & Murphy 1988, Nugroho *et al.* 2022). Such regional reports should not automatically be attributed to Acehnese communities. The direct Aceh evidence is more specific: Wintah *et al.* (2026) recorded boiled fruit for fever reduction and thrush, whereas Nursamsu *et al.* (2025) classified *N. fruticans* among plants with medicinal as well as food, economic, cultural, agricultural-tool, and handicraft uses. Other medicinal claims from Southeast Asian or Indo-Pacific literature should therefore be treated as comparative context rather than as evidence of Acehnese practice.

Knowledge continuity is also relevant. Nursamsu *et al.* (2025) identified declining traditional culinary knowledge among younger generations as a concern in coastal communities. For *N. fruticans*, future comparative work should therefore examine which uses persist and how knowledge of harvesting, processing, preparation, and management is learned, transmitted, modified, or discontinued between generations. This distinction is important for separating practices that remain embedded in everyday life from those that are being transformed through contemporary product-development initiatives.

Global research landscape and thematic structure as supporting context

Bibliometric analysis was used to contextualize, rather than define, the ethnobotanical synthesis. The Scopus corpus comprised 469 English-language articles published between 1939 and 2026 across 333 sources, with an annual publication growth rate of 3.86% and 23.45% international co-authorship. Direct comparison with other palm species was not undertaken because standardized bibliometric benchmarks based on comparable search strategies, datasets, and indicators were not identified. These findings indicate that *N. fruticans* has attracted long-term research interest, but they should not be interpreted as measures of cultural importance or the extent of community knowledge.

The disciplinary orientation of the indexed literature is clearer than the individual citation rankings. Highly visible publications were concentrated in biomaterials, polymer science, composite technology, environmental research, biomass utilization, food-related applications, and experimental biological studies. Malaysia and Indonesia were among the major contributing countries, reflecting strong regional research capacity. The keyword co-occurrence network (Fig 2) further illustrates this pattern. The largest and most central terms were *Nypa fruticans*, nipa palm, and mangrove. Three broad research groupings were evident: (1) ecological and coastal research, including mangroves, biodiversity, climate change, restoration, invasive species, and remote sensing; (2) biomass and materials valorization, including composites, nanocellulose, mechanical properties, characterization, and carbon-based materials; and (3) food, fermentation, and health-related applications, including vinegar, acetic acid, antidiabetic research, sap sugar, and waste utilization. These clusters demonstrate broad scientific treatment of the species but do not themselves establish cultural relevance.

Community-centered descriptors such as local names, informant consensus, use value, preparation methods, traditional ecological knowledge, cultural transmission, and community practice were less prominent in the indexed keyword network. This pattern should not be interpreted as evidence that such knowledge is absent. The Aceh evidence summarized in Table 1 already documents local terminology, preparation practices, livelihood activities, and quantitative ethnobotanical indicators. Bibliometric patterns therefore indicate differences in the visibility of research themes within indexed literature rather than the presence or absence of community knowledge.

The thematic map (Fig 3) provides a complementary representation of the same research landscape. Themes with high centrality and density are more strongly connected and internally developed within the corpus, whereas lower-centrality or lower-density themes may be peripheral, specialized, emerging, or weakly represented. In this review, community-centered ethnobotany refers specifically to documentation of local terminology, informants, plant parts, preparation and processing methods, use categories, cultural transmission, management practices, and voucher-based identification. The thematic map is therefore used to show how indexed scientific attention has been distributed, while the narrative and Aceh-specific evidence are required to evaluate actual people-plant relationships.

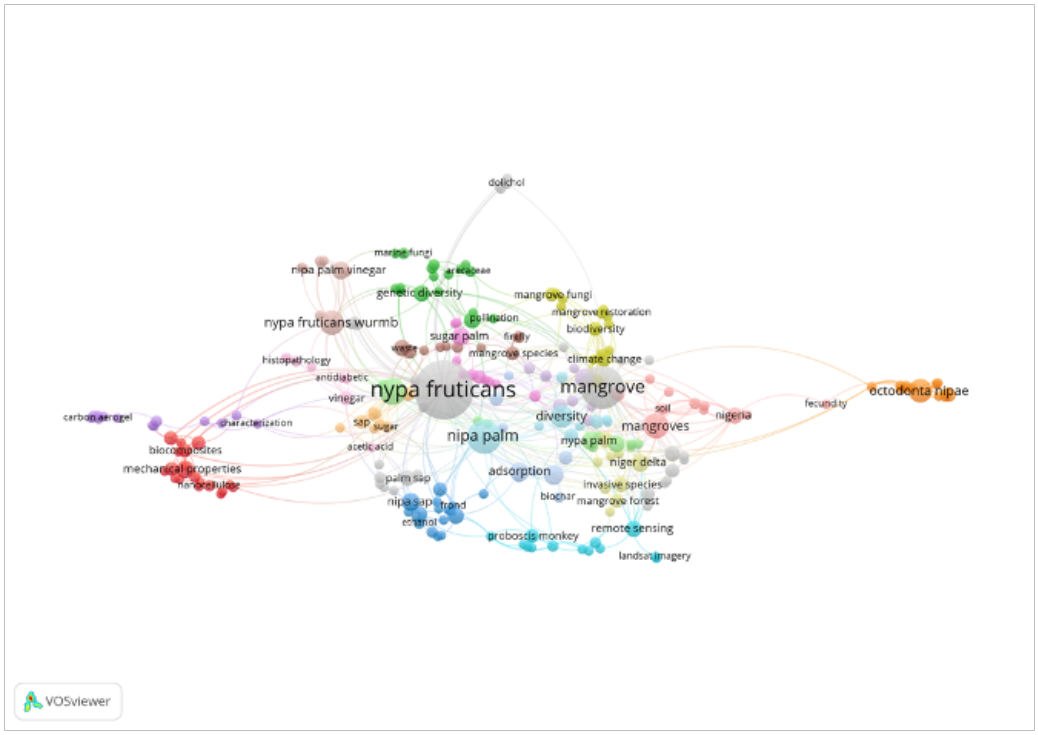

Figure 2. Keyword co-occurrence network of *Nypa fruticans* Wurmb. Research

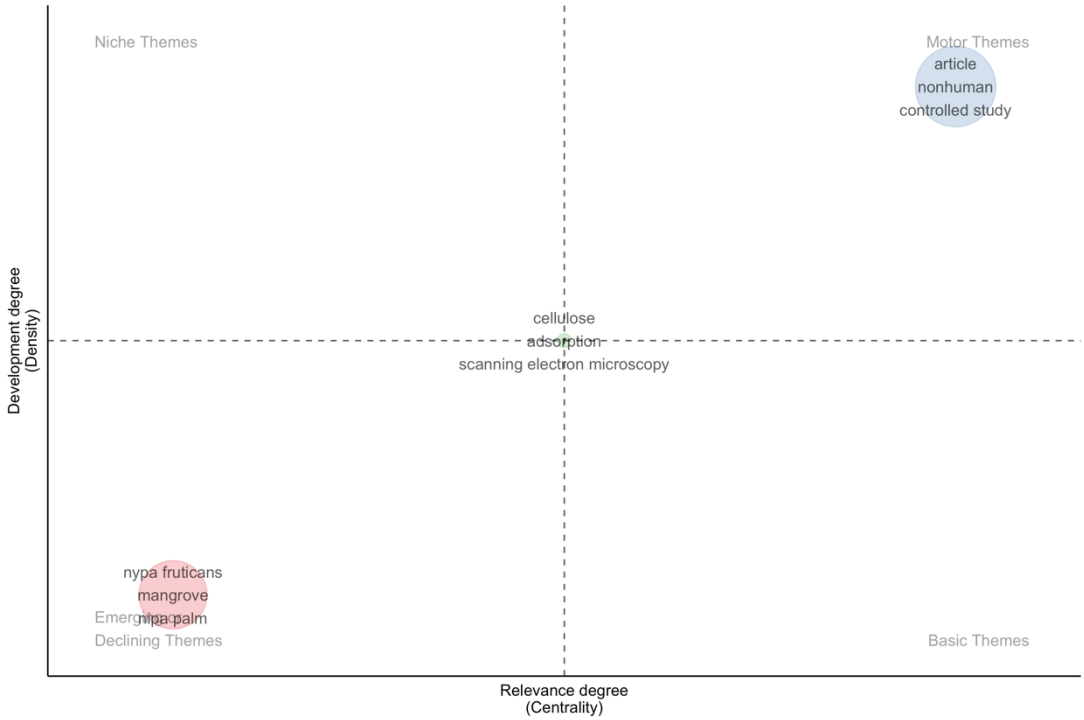

Figure 3. Thematic map of *Nypa fruticans* Wurmb. Research

Biological context for reported medicinal uses

Phytochemical and pharmacological studies provide supporting biological context for selected health-related uses of *N. fruticans*. Reported constituents include polyphenols, flavonoids, alkaloids, tannins, saponins, steroids, and triterpenoids, together with identified or quantified compounds such as chlorogenic acid, protocatechuic acid, and acetic acid (Nugroho *et al.* 2022, Quoc *et al.* 2025). Experimental studies have reported antioxidant, antidiabetic, anti-inflammatory, antimicrobial, and related activities in *N. fruticans* fruits, sap, vinegar, and extracts (Bae & Park 2016, Fitri *et al.* 2023, Martin *et al.* 2017, Yusoff *et al.* 2015).

These findings provide biological plausibility for selected health-related applications but should not be interpreted as clinical validation of Acehnese medicinal practice. Experimental studies commonly use standardized extracts, isolated compounds, enzyme assays, cell models, or animal models that may differ substantially from community preparations in plant part, processing, concentration, dose, and route of administration. For example, the Aceh-specific medicinal record of boiled fruit for fever reduction and thrush provides a culturally grounded preparation that could inform future pharmacological investigation, but its reported traditional use does not establish efficacy.

Preliminary animal safety evidence is available for *N. fruticans* sap (Yahaya *et al.* 2021), but this cannot be generalized to all plant parts or preparations. Safety assessment of community-derived preparations should therefore consider plant part, preparation method, dose, frequency of use, and exposure before therapeutic recommendations are made.

Livelihoods, sustainability, and priorities for Acehnese ethnobotany

The Aceh evidence demonstrates that the value of *N. fruticans* extends beyond subsistence use. Documented value-added uses include nipah-stick weaving and fruit processing, while other reported local uses include roofing materials and traditional cigarette wrappers. Women's-group involvement in nipah-stick weaving in East Aceh illustrates how *N. fruticans* can become embedded in local livelihood pathways (Baihaqi *et al.* 2021, Suwardi *et al.* 2020). However, the available evidence does not establish broader species-specific gender patterns in harvesting, management, processing, or use across Aceh. These observations provide direct evidence of local economic participation while also indicating the need for comparative research on gender- and generation-related roles.

Translation of local use into value-added products should nevertheless follow an explicitly biocultural pathway. Product development should document the community knowledge on which an application is based, protect local intellectual contributions, secure appropriate permission, consider sustainable harvesting, and incorporate equitable benefit-sharing. This is especially relevant where traditional materials or practices are transformed into commercial foods, herbal products, crafts, cosmetics, or other marketable products.

Current evidence does not establish that harvesting of *N. fruticans* in Aceh is causing population decline, and overharvesting should therefore not be presented as a demonstrated threat. The reviewed Aceh studies document the use and processing of nipah sticks, fruits, and other plant material but do not provide the vital-rate or harvest-impact data required to determine sustainable extraction thresholds. Future ecological-ethnobotanical studies should quantify harvest intensity and frequency, part-specific removal, seasonal availability, reproductive output, seedling recruitment, clonal regeneration, and post-harvest recovery before extraction limits are proposed.

Future ethnobotanical research should build on, rather than repeat, the information already available. The local name "Nipah", selected preparation practices, multipurpose use, UV and RFC values from East Aceh, medicinal use from Nagan Raya, and livelihood activities from other Aceh localities are already documented. Comparative multi-site research should now determine how these practices vary among communities and districts. Priority questions include which household or community members harvest, process, manage, sell, and use *N. fruticans*; whether these roles differ by gender or generation; how extensively the species and its products are used across localities; how harvesting and product availability vary seasonally; and how use has changed over time.

Additional research should also examine dialectal terminology beyond the documented term "Nipah", species-specific medicinal dosage and frequency, customary rules of access or management, market pathways, and intergenerational transmission. Historical change should be investigated through oral histories and, where available, archival, press, linguistic, historical, and belief-related sources. Such evidence would help determine whether particular products or practices were more or less common in the past and whether cultural meanings have changed alongside livelihood and coastal-environmental change.

Quantitative ethnobotanical work can extend the existing evidence by comparing Use Value and Relative Frequency of Citation across localities and, where appropriate, adding measures such as Fidelity Level, Informant Consensus Factor, and Cultural Importance. These measures should be interpreted together with qualitative accounts rather than treated as substitutes for information on meaning, management, knowledge transmission, and livelihood context.

Critical appraisal and limitations

The reviewed evidence consistently positions *N. fruticans* as a multipurpose mangrove palm with ecological, livelihood, nutritional, material, and health-related relevance. For Aceh specifically, the evidence is stronger than a simple statement of cultural underdocumentation would suggest. Nursamsu *et al.* (2025) provide quantitative ethnobotanical evidence from East Aceh, Wintah *et al.* (2026) provide location-specific medicinal-use documentation from Nagan Raya, and community-development and Indonesian-language sources document household materials, weaving, food processing, product diversification, and livelihood activities in other Aceh localities. These forms of evidence are complementary but not methodologically equivalent.

Important limitations nevertheless remain. Study-level demographic information cannot be interpreted as evidence of species-specific gender roles unless use, harvesting, or management data are disaggregated for *N. fruticans*. Likewise, documentation of "Nipah", boiled fruit, or specific products in individual localities cannot be generalized to all Acehnese communities. Species-specific data on medicinal dosage and frequency, harvesting norms, informant consensus, knowledge transmission, customary governance, and voucher specimens remain uneven across the province.

No species-specific evidence on historical changes in use, religious or belief-related associations, or broader dialectal variation beyond the documented term "Nipah" was identified among the retained Aceh sources. The available evidence also does not provide sufficient archival, press, linguistic, or oral-history material to reconstruct how the use and cultural significance of *N. fruticans* have changed over time. These dimensions therefore require targeted archival, linguistic, press, and oral-history research rather than inference from the currently available ethnobotanical and community-development literature.

The English-language Scopus corpus also cannot represent the complete Aceh people-palm system. The supplementary narrative search therefore incorporated relevant Indonesian-language sources separately from the bibliometric calculations and also screened university repositories and grey literature. No additional grey-literature records meeting the inclusion criteria were retained. This broader search strategy reduces language and indexing bias but does not constitute an exhaustive archival or historical review of all Acehnese material. Some locally held knowledge, unpublished documents, oral histories, or inaccessible records may remain unrepresented.

The biological evidence presents a different limitation. Phytochemical and pharmacological studies are heterogeneous in plant part, extraction procedure, concentration, analytical method, and experimental model and remain predominantly preclinical. Such studies can generate hypotheses and provide biological context for documented traditional uses but cannot establish the efficacy or safety of community preparations without preparation-specific investigation.

Finally, this review did not conduct primary interviews, participant observation, voucher collection, or ecological harvest measurements. Its contribution is therefore to establish what is already documented, distinguish the strength and scope of different forms of evidence, and identify the specific questions that require primary fieldwork. The available literature supports the interpretation of *N. fruticans* as an active biocultural and livelihood resource in Aceh while showing that the depth and geographic coverage of species-specific ethnobotanical documentation remain uneven.

Conclusion

The available evidence identifies *Nypa fruticans* as a multipurpose biocultural resource with established roles in food, household materials, handicrafts, livelihoods, and traditional health practices. Although global indexed research has been dominated by ecological, technological, materials-related, food, phytochemical, and pharmacological themes, evidence from Aceh demonstrates continuing and locally grounded people-palm relationships. Quantitative ethnobotanical research in East Aceh has documented high use value and frequency of citation, while evidence from Nagan Raya records the local name "Nipah", use of the fruit, boiling as a preparation method, and medicinal applications for fever reduction and thrush. Other Aceh sources further document roofing, traditional cigarette wrappers, weaving, fruit processing, product diversification, and livelihood-oriented activities.

These findings show that *N. fruticans* has contemporary ethnobotanical and biocultural relevance in Aceh, although the depth and geographical coverage of species-specific documentation remain uneven. Further research should therefore build on the existing evidence by comparing uses across communities and districts and documenting harvesting practices, medicinal dosage and frequency, gender- and generation-related knowledge, customary management, historical changes in use, and market and livelihood pathways. Integrating these dimensions with ecological monitoring, protection of traditional

knowledge, community governance, and equitable benefit-sharing would strengthen the contribution of *N. fruticans* research to biocultural conservation and sustainable resource management.

Declarations

List of abbreviations: ICS - Index of Cultural Significance; NP - Number of Publications; NR - Not Reported; PRA - Participatory Rural Appraisal; PRISMA - Preferred Reporting Items for Systematic Reviews and Meta-Analyses; PY_start - First Publication Year; RFC - Relative Frequency of Citation; TC - Total Citations; UV - Use Value.

Ethics approval and consent to participate: This study was a literature review and bibliometric analysis and did not involve human participants, animals, primary biological sampling, or new access to genetic resources or associated traditional knowledge. Therefore, ethics approval and informed consent were not required.

Consent for publication: Not applicable.

Availability of data and materials: The bibliometric data analyzed in this study were obtained from the Scopus database on 22 April 2026. The processed data used to support the findings of this review are available from the corresponding author upon reasonable request.

Competing interests: The authors declare no conflict of interest.

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