

## ARTICLE

# Exploring Paser Tribe's Ecological Wisdom as A Sustainable Development Framework for Nusantara Capital Region in East Kalimantan through Linguistic Ethnography

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## ABSTRACT

The *Paser* Tribe in East Kalimantan possesses a rich ecological knowledge system that intricately links their linguistic practices to sustainable resource management; however, this knowledge is at risk due to modernization. This study aims to explore the ecological knowledge systems of the *Paser* Tribe, focusing on their traditional practices and the linguistic terms that encapsulate ecological wisdom. Employing participant observation and semi-structured interviews across three villages Telemow, Binuang, and Sepan. This research maps ecological practices to linguistic terms, revealing a traditional ecological calendar that guides resource management. Despite the documented significance of indigenous knowledge systems, there remains a lack of comprehensive understanding regarding how linguistic elements function within these ecological frameworks. The findings illustrate the potential for integrating indigenous ecological knowledge into modern sustainable development frameworks, thereby offering actionable insights for policy development in *Nusantara (IKN)*. The study identifies key practices, such as “*sasi*” (customary prohibition) and “*Manen bijak*” (wise harvesting), which

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demonstrate the tribe's proactive ecological stewardship and their cultural underpinning. Additionally, a sophisticated ecological calendar aligns resource management with seasonal cycles, reflecting deep ecological understanding. This research emphasizes the urgent need to incorporate indigenous ecological knowledge into contemporary development strategies to promote sustainability and cultural preservation. By recognizing the interplay between language, culture, and ecology, effective and culturally sensitive development initiatives can be achieved in the *Nusantara* region.

**Keywords:** Linguistic Ethnography; Toponymy; Indigenous Ecological Knowledge; Local Wisdom; *Penajam Paser Utara (PPU)*

## 1. Introduction

The development of *Nusantara*, Indonesia's newly envisioned capital city in East Kalimantan, portends a landmark shift in the nation's pursuit of sustainable progress and inclusive growth. Conceived as an eco-conscious urban center, *Nusantara* seeks to relieve strain on overburdened infrastructure in Jakarta while cultivating economic vitality across resource-rich *Borneo*. Yet unleashing this ambitious megaproject amid East Kalimantan's intricate socioecological fabric demands judicious planning to harmonize modernization, environmental stewardship and cultural preservation. Here fertile forests, biodiversity hotspots and indigenous communities converge, presenting both promise and perils as development accelerates.

East Kalimantan confronts significant threats to ecological integrity. Tropical rainforests hosting myriad species have declined under land conversion driving palm oil, mining and infrastructure, fragmenting habitats, depleting indigenous flora and fauna and disrupting ecosystem services on which locals and global climate depend. Additionally, industrial activities and urban sprawl exacerbate soil degradation, water insecurity and pollution, jeopardizing the region's natural endowments. Relocating Indonesia's capital intensifies these pressures through population influxes, infrastructure demands and economic activities, underscoring the need for development prioritizing ecological resilience.

Amid challenges, indigenous knowledge systems like those of native *Paser* people offer valuable lessons for sustainability. Evolved wisdom embedded in language and practices reflects centuries interacting harmoniously with the environment, including sustainable resource management, biodiversity conservation and cyclical approaches to agriculture and forestry. However, modernization and land-use changes endanger such knowledge's transmission orally

through the *Paser* lexicon, risking loss of cultural heritage and practical solutions.

Importantly, indigenous knowledge aids development not only through ecological utility but capacity to foster inclusion and ground planning in culture. By integrating *Paser* ecological wisdom, policymakers can address environmental concerns while respecting indigenous rights and contributions. Linguistic ethnography further enhances this through unraveling intricate ties between language, culture and environment, safeguarding indigenous knowledge to leverage for sustainable urban and industrial development rooted in synergy of innovation and tradition. In this context, exploring *Paser* wisdom proves critical for cultivating *Nusantara* as a global sustainability model.

The development of *Nusantara*, Indonesia's new capital city in East Kalimantan, underscores the urgent need to integrate sustainable practices that respect both ecological systems and cultural heritage. However, a significant gap persists in understanding how to properly apply the indigenous ecological knowledge of the *Paser* Tribe in shaping sustainable development frameworks. Despite global recognition of indigenous knowledge as critical for environmental management, there remains limited documentation and analysis of the ecological wisdom of the *Paser* Tribe, particularly as embedded in their unique linguistic and cultural traditions. This gap hinders policymakers and planners from leveraging local knowledge systems that have balanced East Kalimantan's ecosystems for centuries, risking development models that fail to discover locally relevant solutions.

Linguistic ethnography offers a promising yet underused method to bridge this gap, especially for development planning. By investigating the interplay between language, culture, and the environment, linguistic ethnography can uncover subtle ecological insights encoded in indigenous languages, such as concepts within the *Paser* Tribe's vocabulary.

The *Paser* language acts as a storehouse of ecological knowledge, containing ideas of sustainable resource administration, biodiversity protection, and spiritual connections to nature. However, harnessing the potential of linguistic ethnography to inform development planning for *Nusantara* and industrial exploration in East Kalimantan remains largely untapped. Existing studies often focus more broadly on ethnographic or ecological perspectives, with few specifically exploring how linguistic data can guide policy formation or practical implementation for immense undertakings like *Nusantara*.

The *Paser* Tribe's unique environmental viewpoint further underscores the importance of addressing this research gap. Their ecological wisdom, reflected in terms such as "*sasi*" (customary resource restrictions) and "*manen wise*" (prudent harvesting), embodies a holistic comprehension of human-nature relationships that prioritizes balance and regeneration. This perspective contrasts with modern development paradigms that regularly put economic growth over ecological sustainability, as seen in ongoing deforestation and habitat loss in East Kalimantan. The fading of the *Paser* language and culture due to modernization and the dominance of national languages exacerbates the risk of losing this knowledge, necessitating urgent efforts to record and integrate it into development planning. This research seeks to address these challenges by exploring how the *Paser* Tribe's linguistic and ecological knowledge can inform a sustainable development framework for *Nusantara*, ensuring progress aligns with environmental and cultural preservation.

In the case of *Nusantara* which is Indonesia's new capital in East Kalimantan we see an opportunity to put forward indigenous ecological knowledge in with modern sustainable development. This study looks at the *Paser* Tribe which has a great deal of ecological wisdom in their language and culture which we will use to inform the planning and implementation of *Nusantara* and industrial growth in the area. We have put forth three main goals which this study will pursue to in an attempt to close the gaps in the application of indigenous know how in this setting.

First we will look at the documentation of what we may call the *Paser* Tribe's eco linguistic material which includes their environmental terminology, phrases and expressions that they use which in fact is a store of ecological terms like those related to sustainable resource management and biodiversity conservation which in turn display a very in

depth knowledge of their local environment<sup>[1]</sup>. We are to do a systematic collection of this lexicon which in turn will be a effort to preserve what is in many ways a very important cultural element which is at risk from modernization and language decline, also at the same time we are to put in place a base for that which will be used in development planning.

Second we look at which elements of environmental knowledge are put forth by the *Paser* Tribe in this research which also looks at how ecological know how is passed down through the generations. Through oral history, custom based practices, and language which is a part of their daily interaction the *Paser* community passes down info on natural cycles, resource use and spiritual relationships to the environment. Also of import is to study these trans generational processes which in turn will help to see to it that this wisdom is preserved in the face of *Nusantara*'s social economic growth and industrial activities<sup>[2]</sup>.

Third the study puts forth a framework which has grown out of the *Paser* Tribe's ecological knowledge and we will put this into the design of *Nusantara* and in the process of industrial development in East Kalimantan. We will look at language and ecology data to put forth a which puts forward strategies for which we will include in urban design, environmental policy, and industrial practice<sup>[3]</sup>. This framework we put forth a model which at the same time promotes economic growth which at the same time is also protective of the environment and culture which in turn plays into the global sustainability agenda<sup>[4]</sup>.

These goals which together strive to close the gap between traditional knowledge and modern development for East Kalimantan which will see *Nusantara* as a model of sustainable urbanization which at the same time preserves it's ecological and cultural heritage. Ecological linguistics is a field that examines the relationship between language and the environment<sup>[5,6]</sup>. It views language as a system that is shaped by and interacts with the natural and social environments in which it is used<sup>[6]</sup>. At the core of ecological linguistics is the conceptual modeling of language and its interactions with the environment<sup>[5,7]</sup>. Conceptual modeling involves the explicit representation of the key components, relationships, and dynamics of a system at a high level of abstraction<sup>[6,8]</sup>. In ecological linguistics, conceptual modeling captures various factors that influence language evolution, usage, and change, such as geography, climate, culture, and

socioeconomic conditions<sup>[5,8]</sup>.

Conceptual models in ecological linguistics often draw on ontological theories, which provide a formal and rigorous way of representing the structure and behavior of the real world<sup>[6,8]</sup>. Ontologies can define the key concepts, entities, and relationships that constitute ecological linguistics, and reason about the interactions between language and the environment<sup>[6,9]</sup>. The development of conceptual models in ecological linguistics can be informed by various modeling techniques and methodologies, such as the Unified Modeling Language (UML)<sup>[8,10]</sup>. These techniques can help ensure that the conceptual models are detailed and unambiguous while aligning with the underlying ontological theories.

Overall, the theoretical framework of ecological linguistics emphasizes the importance of conceptual modeling and ontological reasoning in understanding the dynamic relationship between language and the environment. Through rigorous and comprehensive conceptual models, researchers in this field can gain deeper insights into the factors shaping language and its evolution over time. At the core of indigenous knowledge systems is the recognition and valuation of traditional, localized, and holistic ways of knowing that have been developed and passed down within indigenous communities over generations<sup>[11–13]</sup>. These knowledge systems are deeply embedded in the cultural identities, worldviews, and lived experiences of indigenous peoples, and are often intimately connected to the natural environments in which they reside<sup>[14,15]</sup>.

Conceptual models and frameworks for understanding indigenous knowledge systems must be grounded in indigenous epistemologies and ontologies, rather than imposing Eurocentric or Western frameworks<sup>[16–18]</sup>. This requires centering indigenous perspectives, values, and modes of knowledge organization and transmission<sup>[19,20]</sup>. Frameworks such as “Two-Eyed Seeing” Reid et al.<sup>[20]</sup> and “Ethical Space” Yarchuk et al.<sup>[21]</sup> provide guidance on how to meaningfully bridge indigenous and Western knowledge systems.

A key aspect of indigenous knowledge systems is their dynamic, contextual, and practice-oriented nature<sup>[15]</sup>. Indigenous knowledge is not merely a static repository of information, but rather a living, evolving set of situated practices, skills, and understandings that are intimately tied to the daily activities and experiences of indigenous communities<sup>[14,15]</sup>.

Preserving and revitalizing indigenous knowledge sys-

tems is crucial for maintaining cultural heritage, promoting self-determination, and addressing contemporary challenges faced by indigenous communities<sup>[22–24]</sup>. This requires collaborative approaches that empower indigenous knowledge holders and communities, and that utilize digital technologies and other innovative methods for documentation and dissemination<sup>[25,26]</sup>.

Overall, the theoretical framework of indigenous knowledge systems emphasizes the importance of centering indigenous perspectives, valuing traditional ways of knowing, and fostering collaborative and equitable partnerships between indigenous and non-indigenous stakeholders in research, policymaking, and problem-solving<sup>[27–29]</sup>.

At the core of sustainable development theory is the recognition that development must balance economic, social, and environmental considerations to meet the needs of the present without compromising the ability of future generations to meet their own needs<sup>[30]</sup>. This holistic and long-term perspective is a key distinguishing feature of sustainable development compared to more narrowly focused development approaches<sup>[31]</sup>.

Conceptual models and frameworks for understanding sustainable development often draw on systems thinking, which views development as a complex, interconnected, and dynamic process involving multiple stakeholders and scales<sup>[32]</sup>. This systems-based approach emphasizes the importance of considering the interactions and feedbacks between different components of a socio-ecological system, such as the relationships between rural and urban areas, or between economic activities and environmental impacts<sup>[33,34]</sup>. Sustainable development frameworks also frequently incorporate the United Nations’ Sustainable Development Goals (SDGs) as a guiding framework<sup>[35,36]</sup>. The SDGs provide a comprehensive set of 17 interlinked goals and 169 targets that address a wide range of sustainability challenges, from poverty and inequality to climate change and biodiversity loss<sup>[37]</sup>.

A key aspect of sustainable development theory is the recognition of the need to empower local communities and center their knowledge, values, and practices in development processes<sup>[38]</sup>. This includes valuing and integrating indigenous and traditional ecological knowledge systems, as well as fostering participatory and collaborative approaches to development planning and implementation<sup>[39,40]</sup>.

Preserving and enhancing the resilience of socio-ecological systems is also a central tenet of sustainable development theory<sup>[41]</sup>. This involves understanding and strengthening the capacity of systems to absorb disturbances and reorganize while retaining core functions and structures, thereby ensuring long-term sustainability<sup>[42]</sup>.

Overall, the theoretical framework of sustainable development emphasizes the need for holistic, systems-based, and community-centered approaches that balance economic, social, and environmental considerations to meet the needs of present and future generations. The theoretical framework of postcolonial development perspectives emphasizes that development processes and practices are profoundly influenced by the legacies of colonialism and the persistent power imbalances between the Global North and Global South Yeboah<sup>[43]</sup>. This perspective critiques the universalist and Eurocentric assumptions that have historically informed mainstream development theories and approaches<sup>[44]</sup>.

Postcolonial development frameworks stress the necessity of centering the voices, knowledge systems, and lived experiences of marginalized, subaltern, and indigenous communities in development processes<sup>[45,46]</sup>. This requires deconstructing colonial and neocolonial discourses that have traditionally framed development in paternalistic and disempowering manners<sup>[47]</sup>. A crucial element of postcolonial development perspectives is the acknowledgment of hybridity, highlighting the blending of diverse cultural, political, and economic influences in development contexts. This challenges binary and essentialist views of development and modernity, advocating for more nuanced and contextual understandings of development processes<sup>[48]</sup>.

Additionally, postcolonial development frameworks underscore the significance of reflexivity and accountability in development practice, urging practitioners and researchers to critically assess their own positionality and the inherent power dynamics shaping development interventions<sup>[49]</sup>. This includes recognizing the agency and resistance of local communities in influencing development outcomes<sup>[50]</sup>.

Overall, the theoretical framework of postcolonial development perspectives advocates for decolonial, emancipatory, and contextually grounded approaches that contest dominant Eurocentric and neoliberal paradigms<sup>[51]</sup>. This necessitates the integration of postcolonial theory with development studies to forge more equitable and inclusive de-

velopment pathways<sup>[52]</sup>.

## 2. Literature Review

### 2.1. Indigenous Knowledge and Ecological Understanding

Global in Indigenous environmental thought which is rooted in the cultural, spiritual and ecological practices of Indigenous cultures world over and which puts forth invaluable data for sustainable environmental management. Indigenous knowledge systems what we may also term as Traditional Ecological Knowledge (TEK) is characterized by a whole picture approach to the environment which puts forward the idea of all living things' interconnection and the key role of balance and harmony with nature<sup>[2]</sup>. These paradigms are not only present in the cultural practices and languages of Indigenous peoples but also in their governance and stewardship of natural resources which they have been perfecting over generations to ensure sustainability and resilience<sup>[53,54]</sup>. For example the Tuvan people of Siberia present a very nature centered world view in which language and culture is very much a part of environmental stewardship which reflects a great respect for the land and its sentience<sup>[53]</sup>. Also Indigenous communities all around the globe have put in place very complex ecological calendars and resource management practices that go along with natural cycles which shows in great degree their in depth study of biodiversity and ecosystem dynamics<sup>[55,56]</sup>. The integration of Indigenous knowledge into global environmental policies which the like of the Convention on Biological Diversity (CBD) and the Intergovernmental Science Policy Platform on Biodiversity and Ecosystem Services (IPBES) put forth is a sign of the growing recognition of its role in to play in to address present day environmental issues<sup>[57,58]</sup>. But also the erosion of Indigenous knowledge due to globalization and cultural assimilation is a great threat to both cultural and biological diversity which in turn underpins the need for collaborative efforts to preserve and integrate these knowledge systems into larger conservation and sustainability initiatives<sup>[59]</sup>. The field of ethnobiology plays a key role in the documentation and support of Indigenous knowledge which it does so in a ethical way and which also puts forward the case for Indigenous people to be equal partners in environmental<sup>[2,54]</sup>. Thus

Indigenous environmental knowledge paradigms put forward a very important structure for achieving sustainable development goals and in the same breath also for the promotion of ecological resilience in the face of global environmental change<sup>[56]</sup>.

### 2.1.1. Theoretical Approaches to Indigenous Wisdom

Theoretical models of indigenous wisdom present a wide range of views which put forward the idea of traditional knowledge systems' role in present day educational, environmental, and developmental frameworks. Indigenous wisdom what we also term local or traditional knowledge is in the fabric of what communities do and think, it is passed down through the generations. This wisdom is a store of cultural identity but also a practical guide for sustainable living. For example the Makassar tribal culture's 3S (*Sipakatau, Sipakalebbi, and Sipakainge*) which is based in respect, humility, and remembrance which in turn is a base for character growth and social learning thus at the same time is a reinforcement of cultural identity and ethical behavior in academic settings<sup>[60]</sup>. Also we see that the integration of indigenous knowledge into science education does in fact increase student relevance and engagement by putting scientific concepts in the students' social cultural terms which in turn brings about a more complete educational experience<sup>[61]</sup>. Ethnobiology as an inter disciplinary field puts forth the idea of people's dynamic relationship with their environment which in turn puts forward the include of indigenous point of view in biodiversity conservation and sustainable development efforts<sup>[2]</sup>. This put forth also the ideas of systems thinking and knowledge management which are key to sustainable development as we see in rural African settings where local knowledge is used for community based educational and ecological projects<sup>[62]</sup>. Also indigenous knowledge plays a large role in the achievement of SDGs by it's input into sectors like agriculture, health and environmental conservation thus at the same time we see economic growth and ecological preservation<sup>[63]</sup>. Also we see in Indonesia the integration of indigenous wisdom into policy and curriculum development which in turn put forth it's value in academic goals and cultural identity although there are issues with implementation<sup>[64]</sup>. As a whole the theoretical models of indigenous wisdom put out it's great value in the promotion of sustainable practices, in the improvement of educational

results and in the preservation of culture thus they give us very use ful information in the face of today's global issues.

### 2.1.2. Previous Studies on Tribal Ecological Systems

The issue of tribal ecological systems has been looked at through many perspectives which in turn brings out the importance of Traditional Ecological Knowledge (TEK) in issues of sustainable resource management and cultural preservation. In North East India tribal communities have a very large base of TEK that includes sustainable forestry, agricultural, and health care practices, in fact in many cases what they do out does what modern resource management does<sup>[65]</sup>. Also in the Pachmarhi Biosphere Reserve TEK has played a key role in the conservation of biodiversity and in the sustainable use of natural resources, with tribal groups' use of a great variety of plant species for food, medicine and culture<sup>[66]</sup>. In the case of the Matigsalug tribe in the Philippines we see the application of TEK in public health which they use to achieve ecological balance in order to reduce dengue and malaria outbreaks through community practices and natural repellents<sup>[67]</sup>. In Odisha, India the Matbarudahar village's ecology is a result of social and cultural factors in which tribal groups use traditional practices for agriculture and resource management which they do so in the face of development issues<sup>[68]</sup>. Also in Taiwan tribal tourism which is a modern framework is in fact a site which puts TEK to use for sustainable development which in this case the government and community play a key role in the balance between economy and environment<sup>[69]</sup>. Also on the global stage the value of TEK in ecological restoration and in sustainable development is recognized which in turn is putting forth the case for the inclusion of tribal knowledge in modern science to fix ecological issues<sup>[70]</sup>. Also a systematic review reports on the health and economic benefits of TEK which plays a role in food security and in the provision of low cost health care for indigenous people<sup>[71]</sup>. Also in the North Carolina Piedmont we see from archaeological studies that historical tribal settlement was a result of ecological and social interaction which in turn is a great element of tribal ecological systems<sup>[72]</sup>. As a whole these studies put forth the very large role of TEK in the issue of sustainable development and in the building of resilience among tribal communities which in turn is the case for its use in today's eco and development models<sup>[73]</sup>.

## 2.2. Linguistic Ethnography

Linguistic Ethnography (LE) is an approach which puts together linguistic and ethnographic methods to study language in action within social settings which in turn gives us insight into the play between language and social processes. Originating in the UK, LE presents a framework which looks at how individuals via language create meaning and identity which in turn is a product of the social world<sup>[74]</sup>. It is a field which straddles disciplines bringing in from linguistic anthropology and ethnography, and is not a separate field but a meeting point of research interest among scholars<sup>[75,76]</sup>. Methodologically what we see is that LE uses ethnographic fieldwork and micro analysis of as they occur which in turn places local language practices in larger social, political and historical settings<sup>[77,78]</sup>. This approach is very much at home in multilingual settings which it studies via a multi lingual, collaborative and responsive research approach<sup>[77]</sup>. LE has been put to use in many fields from that of the classroom which it helps us to see the social interaction and identity play out in educational settings<sup>[79]</sup>. Study feedback which it in turn brings to light how ideas and institutional structures play a role in what is said and how Copland Donaghue<sup>[80]</sup>. Also although its use is on the rise LE is still a in between activity which plays in the middle of different academic worlds and is still to deal with issues like that of the etic-emic and text-context which it is still working out<sup>[81]</sup>. In total what we see is that LE's methodological base is in its ability to put together linguistic and ethnographic data which in turn gives us a very in depth look at language as a social practice<sup>[82]</sup>.

### 2.2.1. Language as Cultural Ecological Knowledge Repository

Linguistic ethnography is a key tool we use to understand language as a form of cultural ecological knowledge which puts together linguistic and ethnographic methods to study language in its social and cultural settings. This approach as Tusting puts it, brings together ethnographic and linguistic methods to look at linguistic and social questions which they in turn put in a productive tension<sup>[75]</sup>. In the history of linguistic anthropology especially in the US we see language presented as a cultural practice and social resource which we tie in with large scale social conditions<sup>[83]</sup>. Also supported by Supatra which traces linguistic anthropology back to the Sapir-Whorf hypothesis we see language as a

cultural resource and a representation of reality<sup>[84]</sup>. The interdisciplinary make up of linguistic ethnography as pointed out by Shaw, Copland, and Snell which allows for a wide range of social and communication study in many settings although the field does not have a set in stone approach or a dedicated journal<sup>[76]</sup>. Barabás<sup>[85]</sup> puts forth the idea that we should look at larger cultural, historical and political issues in our language study which in turn may reveal how every day practices reflect larger social structures<sup>[85]</sup>. Goico's<sup>[86]</sup> work on deaf youth in Iquitos, Peru which is an example of the use of linguistic ethnography in very specific cultural settings which shows us how language use is a product of social organization<sup>[86]</sup>. Also Collins reports on the value of linguistic ethnography in health care settings which we see language is a product and shaper of the social and cultural context of patient professional interaction<sup>[87]</sup>. As a whole linguistic ethnography gives us a in depth look at language as a cultural ecological knowledge which we see is a part of cultural, social and environmental factors.

### 2.2.2. Interdisciplinary Research Approaches

Linguistic Ethnography (LE) is an interdisciplinary research approach which puts together linguistic and ethnographic methods to study language in action in social settings. This is not a separate field in itself but a term which covers many of the related interests and methodologies from anthropology, sociology, and linguistics<sup>[75,76]</sup>. What LE brings to the table is its in depth look at the interplay between language and social world which it does through the analysis of how social actors create meaning and identity through their use of language in the framework of large scale social processes<sup>[88]</sup>. Also what we see in LE is its open structure which includes a range of methods like participant observation, field notes, and audio visual recordings to present the full picture of language practices in the natural setting of everyday life<sup>[89]</sup>. This is very much so in the case of sign languages which traditional linguistic methods may not do justice to here LE brings to light the marginalized aspects of language use and communication by looking at micro contexts and the social environment of language users<sup>[90]</sup>. Also what we find is that the interdisciplinary base of LE which supports the work of related fields like cultural geography and ethnogeography which in turn add to the picture of local communities and their ethno cultural landscapes<sup>[91]</sup>. Also what LE does best is to look at the crossroads of language, identity and social

change as seen in the study of deaf communities and the communicative practices of people in many different social settings<sup>[78]</sup>. In total what we see is that the interdisciplinary approach of LE not only improves our study of language in social life but also presents us with new chances for collaboration and methodological growth across many research areas<sup>[92]</sup>.

## 2.3. East Kalimantan's Ecological Landscape

### 2.3.1. Geographical Characteristics

East Kalimantan is a region which has a great variety of geographical features and ecosystems that are a result of both natural and anthropogenic processes. In it we find tropical rainforests like in the Wehea-Kelay landscape which play home to a great diversity of mammals that in turn play a key role in the ecological balance<sup>[93]</sup>. Geomorphologically the area includes the like of the Maratua karstic islands which present fringing reefs, marine terraces and karst ridges, that although they have great tourism potential do present issues of limited fresh water resources<sup>[94]</sup>. In the Paser Regency which is part of the Meratus Mountains we see very diverse geologic settings which in turn present what may become great sites for geotourism although at present there are issues of low fresh water resources<sup>[95]</sup>. It is also true that human action in the form of expansion of oil palm plantations has brought about large scale changes to the landscape which in turn has lead to deforestation and biodiversity loss which in turn has had an impact on local livelihoods and ecological resilience<sup>[96]</sup>. The Punan-Pelancau community's view of the value of the landscape is in terms of the benefits they get out of it which in turn puts forward the case for sustainable management practices<sup>[97]</sup>. Also the forests of the region are key players in the global carbon cycle and are a priority for international frameworks like REDD in terms of reduction of emissions from deforestation<sup>[98]</sup>. That the forest ecosystems are in a state of change in East Kalimantan points to the need for an integrated approach to management which takes into account ecological, economic and social issues<sup>[99]</sup>. In total what we see in East Kalimantan is a very complex play out of natural beauty, bio diversity and human influence which in turn puts the responsibility on us for careful management of its ecology and support of sustainable development.

### 2.3.2. Environmental Challenges

East Kalimantan is a region which is home to a great many environmental issues that mainly stem from large scale resource extraction and infrastructure development. In the past we see that which may be as far back as 1967–1998 the area experienced large scale deforestation from what at the time were very open forest exploitation practices that in turn broke up conservation areas and put at risk bio-diversity including the homes of many important animal species<sup>[100]</sup>. Also into play is the move of Indonesia's capital to East Kalimantan which is putting a greater strain on the environment as the new capital city (*IKN*) brings with it risks to local ecosystems and bio-diversity which in turn require strong government action to promote sustainable development<sup>[101]</sup>. Mining which is very heavy in the area, in particular coal mining, is a large factor in environmental degradation, we see it cause soil and water pollution and also play a role in land use and cultural identity issues which play out in particular with the *Dayak* people<sup>[102,103]</sup>. Also we see a lack of effective regulation and coordination between government bodies which has in turn seen many mining companies flout environmental rules<sup>[104]</sup>. Also in the mix is the growth of oil palm plantations which has lead to deforestation and bio-diversity loss which in turn impacts the livelihoods of local farmers which depend on these natural resources<sup>[96]</sup>. Also we see that infrastructure projects like roads and rail which go in to develop the area are in fact breaking up forests and disrupting the habitat of wide ranging species like orangutans and elephants thus going against conservation efforts<sup>[105]</sup>. Also the *IKN* development is a direct threat to primate populations which in turn highlights the urgent need for conservation strategies that include wildlife corridors and protected areas<sup>[106]</sup>. To fix these issues we see a need for an integrated approach that includes strict law enforcement, community input and the use of new tech for forest management which is key to balance economic growth with environmental protection to in the end secure the eco system of East Kalimantan.

### 2.3.3. Indigenous Community Ecological Interactions

In East Kalimantan which includes the *Dayak* people in particular we see a very complex and rich relationship between the indigenous communities and their environment



which is at the base of their cultural identity and sustainability practices. The *Dayak* look at the forest and land as central to their identity and their which in turn they depend on for their survival<sup>[103]</sup>. In Wehea Forest for example we see that their traditional ecological knowledge and practices play out in the sustainable use of forest resources which in turn support biodiversity and also which have potential for eco tourism development<sup>[107]</sup>. Also in Kutai Barat we see how local wisdom and cultural practices play a role in forest conservation which put forward the importance of community engagement in environmental management<sup>[108]</sup>. But also we see that the expansion of coal mining and oil palm plantations is a great threat to these environments which in turn brings about environmental degradation and issues over land rights which in turn breaks down the *Dayak*'s cultural and ecological relationships<sup>[96,103]</sup>. Yet also we see that there are initiatives like wellness tourism in Kutai Kartanegara and community based conservation in Kayan Mentarang National Park which put forth a model of integrating cultural heritage with ecological preservation which in turn fosters sustainable development and economic betterment for the indigenous communities<sup>[109]</sup>. Planning for Community-based Management of Conservation Areas indigenous forest management and conservation of biodiversity in the kayan mentarang national park, east kalimantan, indonesia 2022. Also these communities' resilience is seen in the adaptive strategies they have in place to maintain their livelihood in the face of ecological change which in large part is a result of the use of indigenous knowledge in the sustainable management of both culture and environment in East Kalimantan<sup>[109]</sup>.

### 3. Methodology

#### 3.1. Research Design

This study reports on a research which we used a qualitative linguistic ethnographic approach for which we looked at the ecological wisdom present in the *Paser* Tribe's regional language lexicon and which we in turn looked at what that has to do with the sustainable development of *Nusantara* and industrial growth in East Kalimantan. Linguistic ethnography as a research methodology allows for in depth look at the interaction between language, culture, and environment which in turn we use for the documentation and analysis of

the *Paser* Tribe's ecological knowledge as put forth through their linguistic. Also this approach does very well in bringing out the fine ways in which the *Paser* community puts forward their environmental relationships, practices and values which in turn we present as a rich data set for what we see as the issue of modern development.

The research approach we took is a mixed method which we found to be very effective in terms of the robustness and depth of the results. This approach which we put together of qualitative methods like ethnographic research and participant observation with also very in depth analysis tools like linguistic discourse and semiotic analysis which we used to get at the *Paser* Tribe's ecological knowledge. In terms of the qualitative element we went for an immersive approach which included collecting naturalistic data from within the *Paser* community which in turn allowed us to interpret the cultural and ecological meaning in their language within the setting of their social and environmental setting. Also we looked at the structured analysis which allowed us to look at the language systems in detail, we were able to identify patterns and the themes that play out which in turn reflect the *Paser*'s ecological wisdom and how it is passed down.

Documentation of the *Paser* Tribe's eco linguistic heritage, analysis of knowledge transfer, and development of a sustainable development framework. Through the use of interview, observation and linguistic data we are able to present a valid and reliable study which at the same time reports the emic views of the *Paser* community and the etic perspectives required for relevant policy recommendations. This approach is in line with the ecolinguistic which puts forth the idea of a reciprocal relationship between language and environment, and also supports our goal to put together indigenous knowledge with present day development planning for *Nusantara*.

#### 3.2. Collection of Data Methods

In a study to look at the full range of ecological wisdom present in the *Paser* Tribe's regional language lexicon and its relatedness to sustainable development in *Nusantara* and East Kalimantan we have used a variety of qualitative data collection methods within a linguistic ethnographic framework. We looked at participant observation, semi structured interviews, linguistic mapping, audio visual documentation

and also we implemented collaborative research protocols which we did to present the complex interaction of language, culture and environment and at the same time to do so in an ethical manner with the *Paser* community.

**Participant Observation:** Participant study is a base element of the data collection process which allows researchers to fully integrate into the *Paser* Tribe's everyday lives and environments. In natural settings like forests, agricultural fields, and at community events in Telemow, Binuang, and Sepan villages we see this approach play out. Researchers play the role of both observer and participant which includes adopting local customs to earn the community's trust and in that which they are able to report on the *Paser* community's use of ecological knowledge for example in their sustainable hunting and farming practices in the course of their daily interactions with the environment.

**Semi-Structured Interviews:** Semi formal interviews we conduct with key informants which include traditional leaders, elders and community members fluent in the *Paser* language and ecological knowledge. We use a native language assistant in this process which helps to cross the linguistic barriers. The interview approach on model of ethnographic interview which includes uses of descriptive structural and contrast questions. For example we ask informants to describe past resource management practices or to put into words what they see as the difference between certain ecological terms. We record the interviews with obtained consent which in turn helps us to accurately document the linguistic data and cultural narratives.

**Linguistic Mapping:** Linguistic mapping is used to present the *Paser* Tribe's ecological lexicon which includes vocabulary, phrases, and expressions related to environmental knowledge. This process is that of a catalog of terms for flora, fauna, natural phenomena, and also of customary practices like "*sasi*" (resource use restrictions) and "*manen wise*" (wise harvesting) and study of their semantic and cultural value. The research is done in association with the community which in turn gives accuracy and context to the work producing a full inventory of ecological language data.

**Audio-Visual Documentation:** Audio visual documentation includes the preservation of oral histories, eco practices, and cultural rituals via audio recordings, photos, and video. We see this as a way to record the oral traditions and performance elements of the *Paser* language which is very

important for study of that language's transmissive methods. We document what we consider to be key activities like forest management or seasonal ceremonies and we do so only with the full permission of the participants to also pay respect to cultural issues.

**Collaborative Research Protocols:** In order to conduct ethical and inclusive research we put in place collaborative protocols which put community at the center and promote mutual benefit. These protocols which include obtaining informed consent, involving the community in research as co-workers or language assistants, and reporting back to the *Paser* community for validation and which they in turn apply we developed. We also have a practice of consulting with traditional and youth leaders which in turn helps us to respect local values and identify what is important to the community thus we foster a very participatory approach to the documentation and preservation of knowledge.

These data collection strategies as a whole allow for a comprehensive look at the *Paser* Tribe's ecological wisdom which in turn presents in depth qualitative data for linguistic and cultural analysis. Through the use of immersive, participatory, and structured techniques the study reports the *Paser* community's voice and knowledge in a true and ethical light which in turn we lay out a strong base for putting together a sustainable development framework for *Nusantara*.

### 3.3. Study Site and Population

The research was precisely conducted within the geographical context of East Kalimantan, Indonesia, focusing specifically on the *Paser* Tribe communities in Telemow, Binuang, and Sepan villages. This indigenous population was selected for their profound ecological knowledge systems and distinctive linguistic practices that have evolved in harmony with their natural environment. The selection process was guided by the communities' historical presence in the region and their continued practice of traditional ecological stewardship, offering invaluable insights into sustainable resource management approaches relevant to the development of *Nusantara*. Ethical considerations were paramount throughout the research process, with rigorous protocols implemented to ensure respect for the *Paser* Tribe's cultural sovereignty and intellectual property rights. Prior to commencing fieldwork, comprehensive informed consent procedures were established, involving transparent commu-

nication with community leaders and participants regarding the research objectives, methodologies, and potential implications. This process included detailed explanations in both Bahasa Indonesia and the *Paser* language, ensuring all participants fully understood their rights to withdraw or limit their participation at any stage of the research.

### 3.4. Data Analysis Techniques

The data analysis employed a multi-faceted approach to capture the nuanced relationship between language, ecology, and cultural practices. Thematic analysis was utilized to identify recurring patterns and concepts within interview transcripts and observational notes, revealing key ecological knowledge frameworks embedded in linguistic expressions. This was complemented by linguistic discourse analysis, which examined how environmental concepts are encoded in the *Paser* lexicon through terms such as “*sasi*” (customary prohibition) and “*Manen bijak*” (wise harvesting). Comparative ecological knowledge mapping facilitated the visualization of relationships between linguistic terms and environmental practices, illustrating how traditional calendars synchronize human activities with natural cycles. Finally, qualitative data interpretation frameworks were applied to contextualize findings within broader theoretical perspectives on ecological linguistics and indigenous knowledge systems, emphasizing the significance of preserving linguistic diversity as a repository of ecological wisdom essential for sustainable development initiatives.

## 4. Results

### 4.1. Linguistic Ecological Taxonomy

The exploration of the *Paser* Tribe’s ecological wisdom, as embedded in their regional language lexicon, reveals a rich and nuanced linguistic ecological taxonomy. This taxonomy encompasses indigenous environmental terminology that reflects the *Paser* community’s deep understanding of

their natural environment, including its flora, fauna, ecological processes, and cultural practices. The documentation of these terms, collected through participant observation, semi-structured interviews, and linguistic mapping in Telemow, Binuang, and Sepan villages, provides a comprehensive inventory of the *Paser* Tribe’s ecological knowledge, highlighting its relevance to sustainable development in *Nusantara* and East Kalimantan.

The indigenous environmental terminology of the *Paser* Tribe is organized into distinct semantic domains, each representing a category of ecological knowledge. These domains include terms for natural resources (e.g., plants, animals, water bodies), environmental management practices (e.g., sustainable harvesting, rotational use), and spiritual-ecological concepts (e.g., ancestral connections to nature). The terminology not only describes physical elements of the environment but also encodes cultural values and practices that emphasize harmony and sustainability. For instance, terms such as “*sasi*” (customary prohibition on resource use) and “*manen wise*” (wise harvesting) reflect principles of ecological balance, ensuring resource regeneration and ecosystem preservation.

A key finding is the specificity and diversity of the *Paser* Tribe’s environmental lexicon. For example, the language includes distinct terms for medicinal plants, seasonal cycles, and land types, each carrying ecological and cultural significance. The term “*kayu ulin*” refers to a durable ironwood species used in traditional construction, while also symbolizing resilience in *Paser* folklore. Similarly, “*sungai bening*” denotes a clear river, associated with purity and spiritual cleansing in community rituals. These terms illustrate how the *Paser* language integrates ecological knowledge with social and spiritual dimensions, reinforcing the tribe’s holistic worldview.

**Table 1** summarizes representative examples of indigenous environmental terminology across key semantic domains, illustrating their meanings and ecological significance:

**Table 1.** Representative Indigenous Environmental Terminology of the *Paser* Tribe.

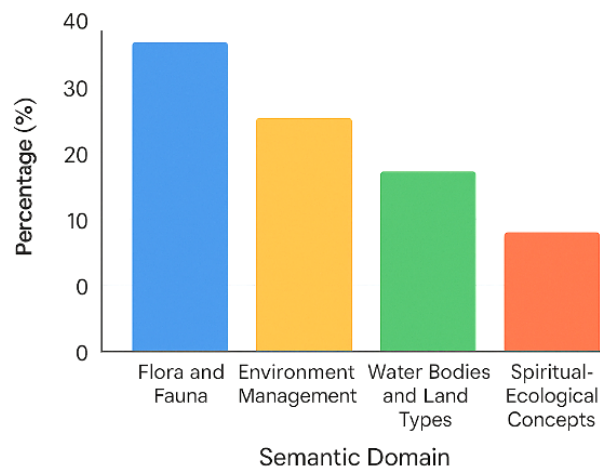
Semantic Domain	<i>Paser</i> Term	English Translation	Ecological/Cultural Significance
Flora	<i>Kayu ulin</i>	Ironwood	Durable timber for construction; symbolizes strength and longevity in folklore.
Fauna	<i>Burung enggang</i>	Hornbill	Sacred bird indicating forest health; used in rituals to signify environmental balance.

Table 1. Cont.

Semantic Domain	Paser Term	English Translation	Ecological/Cultural Significance
Water Bodies	<i>Sungai bening</i>	Clear river	Source of drinking water; associated with spiritual purity and community cleansing rituals.
Environmental Management	<i>Sasi</i>	Customary prohibition	Restricts resource use during specific periods to allow regeneration, ensuring sustainability.
Environmental Management	<i>Manen wise</i>	Wise harvesting	Practice of selective harvesting to maintain ecological balance and resource availability.
Spiritual-Ecological Concept	<i>Tanah leluhur</i>	Ancestral land	Land imbued with spiritual significance, requiring respectful use to honor ancestors.

The distribution of terms across semantic domains highlights the breadth of the *Paser* Tribe's ecological knowledge. Linguistic mapping revealed that approximately 40% of documented terms relate to flora and fauna, 30% to environmental management practices, 20% to water bodies and land types, and 10% to spiritual-ecological

concepts. This distribution underscores the tribe's comprehensive engagement with their environment, with a strong emphasis on biodiversity and sustainable practices. **Figure 1** visualizes this distribution, providing a clear overview of the semantic domains within the *Paser* ecological lexicon:



**Figure 1.** Distribution of *Paser* ecological lexicon by semantic domain.

Note: Percentages are approximate, based on linguistic mapping data collected from *Paser* informants.

**Figure 1** presents the linguistic ecological taxonomy also reveals the *Paser* Tribe's adaptive strategies for environmental stewardship. Terms like “*sasi*” and “*manen wise*” indicate a sophisticated understanding of ecological cycles, aligning with global indigenous practices that prioritize sustainability over exploitation. These findings validate the *Paser* language as a critical repository of ecological wisdom, offering insights that can inform sustainable development policies for *Nusantara*, such as biodiversity conservation and community-based resource management.

In summary, the indigenous environmental terminology documented in this study forms a robust linguistic ecological taxonomy that reflects the *Paser* Tribe's intricate relationship

with their environment. By categorizing and analyzing these terms, the research provides a foundation for understanding how linguistic data can support sustainable development, preserving cultural heritage while addressing contemporary ecological challenges in East Kalimantan.

## 4.2. Linguistic Ecological Taxonomy

The linguistic ecological taxonomy of the *Paser* Tribe, derived from data collected in *Telemow*, *Binuang*, and *Sepan* villages, reveals a sophisticated organization of ecological knowledge within distinct semantic domains. These domains categorize the tribe's environmental terminology, reflect-

ing their comprehensive understanding of the East Kalimantan ecosystem and its cultural significance. The semantic domains identified through linguistic mapping and semi-structured interviews include biodiversity (flora and fauna), environmental management practices, hydrological and terrestrial features, and spiritual-ecological relationships. Each domain encapsulates specific terms that encode ecological wisdom, demonstrating the *Paser* Tribe's adaptive strategies for sustainable living.

**Biodiversity (Flora and Fauna):** This domain is the most extensive, comprising approximately 40% of the documented lexicon, and includes terms for plants, animals, and their ecological roles. For instance, “*pohon ulin*” (ironwood tree) denotes a species valued for its durability in construction and its symbolic role in *Paser* folklore as a marker of resilience. Similarly, “*enggang*” (hornbill) is a sacred species linked to forest health and used in rituals to signify ecological balance. These terms reflect the *Paser* Tribe's detailed knowledge of local biodiversity and its importance for sustenance and cultural identity.

**Environmental Management Practices:** Accounting for about 30% of the lexicon, this domain includes terminology related to sustainable resource use and conservation. The term “*sasi*” refers to customary prohibitions that restrict harvesting during specific periods to allow resource regen-

eration, while “*Manen bijak*” (wise harvesting) describes selective harvesting practices that maintain ecological balance. These terms underscore the tribe's cyclical approach to resource management, aligning with global indigenous practices that prioritize sustainability.

**Hydrological and Terrestrial Features:** Representing approximately 20% of the lexicon, this domain encompasses terms for water bodies, land types, and seasonal cycles. For example, “*Sungai jernih*” (clear river) denotes a pristine water source critical for drinking and spiritual rituals, while “*Tanah ladang*” (farming land) refers to arable soil managed through rotational agriculture. These terms highlight the *Paser* Tribe's understanding of environmental features and their sustainable use.

**Spiritual-Ecological Relationships:** Comprising about 10% of the lexicon, this domain includes terms that connect the environment to spiritual beliefs. “*Tanah leluhur*” (ancestral land) signifies land imbued with spiritual significance, requiring respectful use to honor ancestors. Similarly, “*Roh hutan*” (forest spirit) reflects beliefs in supernatural entities that govern ecological balance, influencing conservation practices.

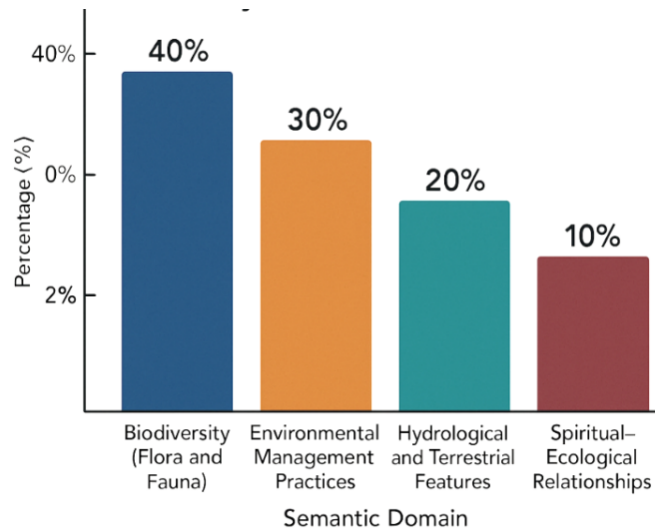
**Table 2** presents representative terms across these semantic domains, illustrating their meanings and ecological-cultural significance:

**Table 2.** Representative terms across semantic domains of *Paser* ecological knowledge.

Semantic Domain	<i>Paser</i> Term	English Translation	Ecological/Cultural Significance
Biodiversity (Flora and Fauna)	<i>Pohon ulin</i>	Ironwood tree	Valued for construction; symbolizes resilience in folklore.
Biodiversity (Flora and Fauna)	<i>Enggang</i>	Hornbill	Sacred species indicating forest health; used in rituals for ecological balance.
Environmental Management Practices	<i>Sasi</i>	Customary prohibition	Restricts resource use to allow regeneration, ensuring sustainability.
Environmental Management Practices	<i>Manen bijak</i>	Wise harvesting	Selective harvesting to maintain ecological balance and resource availability.
Hydrological and Terrestrial Features	<i>Sungai jernih</i>	Clear river	Pristine water source for drinking and spiritual rituals.
Hydrological and Terrestrial Features	<i>Tanah ladang</i>	Farming land	Arable soil managed through rotational agriculture for sustainable farming.
Spiritual-Ecological Relationships	<i>Tanah leluhur</i>	Ancestral land	Spiritually significant land requiring respectful use to honor ancestors.
Spiritual-Ecological Relationships	<i>Roh hutan</i>	Forest spirit	Supernatural entity governing ecological balance, influencing conservation practices.

**Table 2** Presents the proportional distribution of terms across these semantic domains highlights the *Paser* Tribe’s comprehensive engagement with their environment, with a notable emphasis on biodiversity and management practices. Linguistic mapping data indicate that the biodiversity do-

main dominates due to the tribe’s reliance on diverse flora and fauna, while the spiritual-ecological domain, though smaller, is critical for cultural cohesion. **Figure 2** visualizes this distribution, providing a clear overview of the semantic domains within the *Paser* ecological lexicon:



**Figure 2.** Semantic domains of *Paser* ecological knowledge highlighting cultural and ecological interpretations.

Note: Percentages are approximate, based on linguistic mapping data from *Paser* informants.

**Figure 2** presents the semantic domains collectively demonstrate the *Paser* Tribe’s holistic ecological knowledge, integrating practical, cultural, and spiritual dimensions. These findings provide a robust foundation for analyzing knowledge transmission and developing a sustainable development framework for *Nusantara*, as they highlight actionable ecological principles, such as rotational resource use and spiritual respect for nature, that can inform policy and practice.

### 4.3. Linguistic Ecological Taxonomy Language-Environment Interaction Patterns

The linguistic ecological taxonomy of the *Paser* Tribe, derived from data collected through participant observation, semi-structured interviews, and linguistic mapping in Tele-mow, Binuang, and Sepan villages, reveals distinct language-environment interaction patterns. These patterns illustrate how the *Paser* language mediates the tribe’s engagement with their natural environment, encoding ecological knowledge, cultural practices, and spiritual beliefs through specific linguistic structures and terminology. The analysis identifies three primary interaction patterns: descriptive ecological ref-

erences, prescriptive management directives, and symbolic spiritual expressions, each reflecting a unique mode of interaction between the *Paser* community and their ecosystem.

**Descriptive Ecological References:** This pattern involves terminology that describes environmental elements and their ecological roles with precision and detail. Terms such as “*pohon ulin*” (ironwood tree) and “*Sungai jernih*” (clear river) provide specific references to flora, fauna, and hydrological features, embedding ecological knowledge about their uses and significance. For example, “*pohon ulin*” is not only a descriptor for a durable timber species but also indicates its ecological role in stabilizing forest ecosystems. These terms are frequently used in daily activities like farming and foraging, reflecting the *Paser* Tribe’s observational knowledge of their environment.

**Prescriptive Management Directives:** This pattern encompasses terms that prescribe sustainable practices for environmental management, guiding community behavior to maintain ecological balance. The term “*sasi*” (customary prohibition) directs the community to refrain from harvesting resources during specific periods, ensuring regeneration, while “*Manen bijak*” (wise harvesting) instructs selective harvesting to preserve resource availability. These direc-

tives are embedded in oral instructions and customary rules, demonstrating the *Paser* Tribe's proactive approach to sustainability.

**Symbolic Spiritual Expressions:** This pattern includes terms that connect environmental elements to spiritual and cultural meanings, reinforcing respectful interactions with nature. For instance, “*Tanah leluhur*” (ancestral land) signifies land with spiritual significance, requiring careful

stewardship to honor ancestors, while “*Roh hutan*” (forest spirit) invokes beliefs in supernatural entities that govern ecological harmony. These expressions are prevalent in rituals and storytelling, embedding spiritual values in environmental practices.

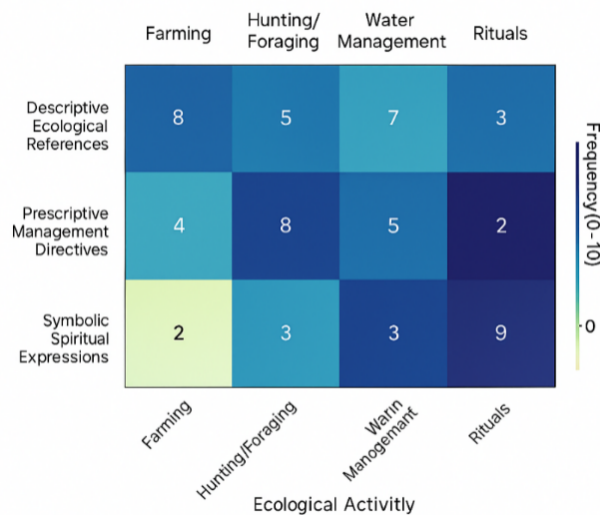
**Table 3** summarizes these interaction patterns, providing representative terms, their contexts, and their ecological-cultural significance:

**Table 3.** Language-environment interaction patterns in the *Paser* tribe's lexicon.

Interaction Pattern	<i>Paser</i> Term	English Translation	Context of Use	Ecological/Cultural Significance
Descriptive Ecological References	<i>Pohon ulin</i>	Ironwood tree	Farming, construction	Describes durable timber; indicates ecological role in forest stability.
Descriptive Ecological References	<i>Sungai jernih</i>	Clear river	Water collection, rituals	Identifies pristine water source; linked to spiritual purity.
Prescriptive Management Directives	<i>Sasi</i>	Customary prohibition	Resource harvesting	Prescribes restricted harvesting periods to ensure regeneration and sustainability.
Prescriptive Management Directives	<i>Manen bijak</i>	Wise harvesting	Foraging, hunting	Instructs selective harvesting to maintain ecological balance and resource availability.
Symbolic Spiritual Expressions	<i>Tanah leluhur</i>	Ancestral land	Land management, rituals	Signifies spiritually significant land requiring respectful use to honor ancestors.
Symbolic Spiritual Expressions	<i>Roh hutan</i>	Forest spirit	Rituals, storytelling	Invokes supernatural entities governing ecological harmony, influencing conservation.

**Table 3** visualized the frequency and context of these interaction patterns, a heatmap was constructed to represent the intensity of term usage across key ecological activities (farming, hunting/foraging, water management, and rituals). The heatmap highlights that descriptive ecological references dominate in farming and water man-

agement, prescriptive directives are prevalent in hunting/foraging, and symbolic expressions are most frequent in rituals, reflecting the contextual specificity of linguistic interactions. **Figure 3** describes the heatmap, with approximate frequency scores (0–10) based on linguistic mapping data:



**Figure 3.** Frequency of language environment interaction patterns across ecological activities.

**Figure 3** presents the interaction patterns demonstrate the *Paser* Tribe’s dynamic engagement with their environment through language, integrating descriptive, prescriptive, and symbolic modes to sustain ecological and cultural balance. The findings provide actionable insights for sustainable development in *Nusantara*, such as incorporating prescriptive directives like “*sasi*” into resource **management** policies or leveraging symbolic expressions to foster community-led conservation initiatives.

#### 4.4. Knowledge Transmission Mechanisms Intergenerational Knowledge Transfer

The investigation into the *Paser* Tribe’s ecological knowledge transmission mechanisms, conducted through participant observation, semi-structured interviews, and audio-visual documentation in Telemow, Binuang, and Sepan villages, reveals robust intergenerational knowledge transfer processes. These processes ensure the perpetuation of ecological wisdom embedded in the *Paser* language, particularly terms related to biodiversity, environmental management, and spiritual-ecological relationships. Intergenerational knowledge transfer is facilitated through three primary mechanisms: oral storytelling, participatory learning, and ritualistic practices, each leveraging linguistic and cultural practices to sustain ecological knowledge across generations.

**Oral Storytelling:** Oral storytelling serves as a foundational mechanism, where elders narrate ecological knowledge through myths, legends, and practical instructions. For example, stories about “*pohon ulin*” (ironwood tree) empha-

size its ecological role in forest stability and its cultural significance as a symbol of resilience, embedding both practical and symbolic knowledge. These narratives, often delivered in the *Paser* language during communal gatherings, reinforce ecological values and practices among younger generations, ensuring linguistic and cultural continuity.

**Participatory Learning:** Participatory learning involves hands-on activities where youth actively engage with elders in ecological practices, such as farming, hunting, or resource management. Terms like “*sasi*” (customary prohibition) and “*Manen bijak*” (wise harvesting) are taught during guided activities, such as rotational farming or selective foraging, allowing younger members to internalize sustainable practices. This experiential learning fosters a direct connection between language use and environmental action, strengthening knowledge retention.

**Ritualistic Practices:** Ritualistic practices integrate ecological knowledge with spiritual beliefs, using ceremonial contexts to transmit terms like “*Tanah leluhur*” (ancestral land) and “*Roh hutan*” (forest spirit). During rituals, such as cleansing ceremonies or harvest festivals, elders articulate ecological principles through chants and prayers, embedding spiritual respect for nature in younger generations. These practices reinforce the cultural significance of ecological terms, ensuring their preservation amidst modernization pressures.

**Table 4** summarizes these intergenerational knowledge transfer mechanisms, providing examples, contexts, and their roles in sustaining ecological wisdom:

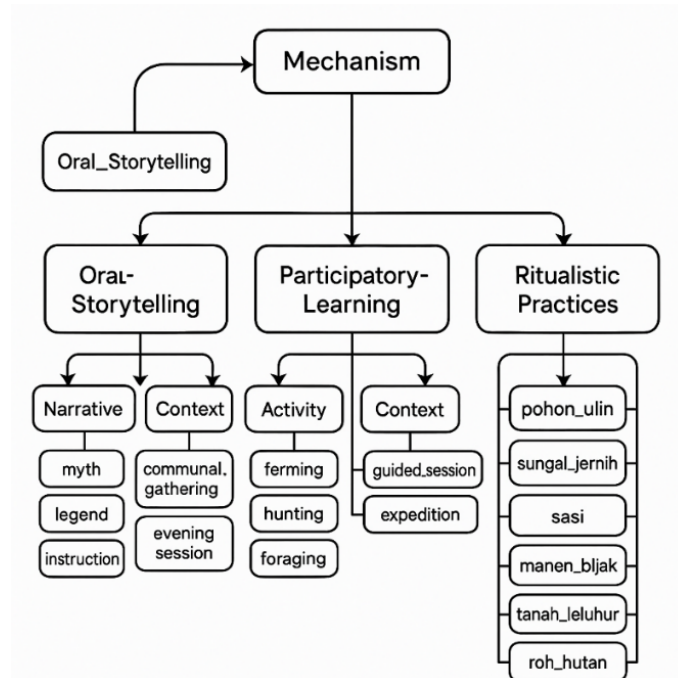
**Table 4.** Intergenerational knowledge transfer mechanisms in the *Paser* tribe.

Transmission Mechanism	Example Term	Context of Transfer	Role in Knowledge Transfer
Oral Storytelling	<i>Pohon ulin</i>	Communal gatherings, evening storytelling	Conveys ecological roles and cultural symbolism through narratives, fostering linguistic continuity.
Oral Storytelling	<i>Sungai jernih</i>	Myths about water purity	Reinforces spiritual and practical significance of water resources.
Participatory Learning	<i>Sasi</i>	Guided farming or foraging sessions	Teaches sustainable resource management through hands-on practice.
Participatory Learning	<i>Manen bijak</i>	Hunting expeditions	Instills selective harvesting practices for ecological balance.
Ritualistic Practices	<i>Tanah leluhur</i>	Land blessing ceremonies	Embeds spiritual respect for ancestral land in ecological practices.
Ritualistic Practices	<i>Roh hutan</i>	Forest protection rituals	Reinforces belief in supernatural entities governing ecological harmony.



**Figure 4** visualized the intergenerational knowledge transfer mechanisms highlight the *Paser* Tribe's resilience in preserving ecological wisdom amidst modernization pressures. The findings underscore the critical role of oral traditions, ex-

periential learning, and spiritual practices in sustaining linguistic and ecological knowledge, offering valuable insights for integrating these mechanisms into educational and conservation initiatives for *Nusantara's* sustainable development.



**Figure 4.** Intergenerational knowledge transfer mechanisms highlight the *Paser* Tribe's resilience in preserving ecological wisdom.

#### 4.5. Knowledge Transmission Mechanisms Oral Tradition and Ecological Wisdom

The investigation into the *Paser* Tribe's knowledge transmission mechanisms, conducted through participant observation, semi-structured interviews, and audio-visual documentation in Telemow, Binuang, and Sepan villages, highlights the pivotal role of oral tradition in preserving and disseminating ecological wisdom. Oral traditions, encompassing myths, instructional narratives, and ritual songs, serve as a primary vehicle for transmitting ecological knowledge embedded in the *Paser* language, ensuring its continuity across generations amidst modernization pressures. These traditions encode ecological wisdom in the form of terminology, practices, and cultural values, reinforcing the tribe's harmonious relationship with their environment.

**Myths and Legends:** Myths and legends are central to oral tradition, narrating the ecological and cultural significance of environmental elements. For example, the myth of "*pohon ulin*" (ironwood tree) recounts its role as a guardian of forest stability, teaching younger generations about its ecological

importance and symbolic resilience. These stories, shared during communal gatherings, embed terms like "*Sungai jernih*" (clear river) within narratives that emphasize water purity and spiritual cleansing, fostering ecological awareness.

**Instructional Narratives:** Instructional narratives provide practical guidance on sustainable practices, using ecological terminology to convey management principles. The term "*sasi*" (customary prohibition) is taught through stories that explain restricted harvesting periods to ensure resource regeneration, while "*Manen bijak*" (wise harvesting) is conveyed through tales of selective foraging. These narratives, often shared by elders during farming or hunting activities, link linguistic terms to actionable ecological knowledge, promoting sustainable behavior.

**Ritual Songs and Chants:** Ritual songs and chants integrate ecological wisdom with spiritual beliefs, using melodic structures to transmit terms like "*Tanah leluhur*" (ancestral land) and "*Roh hutan*" (forest spirit). Sung during ceremonies such as harvest festivals or land blessings, these songs reinforce the spiritual significance of environmental

stewardship, embedding respect for nature in cultural practices. The repetitive nature of chants enhances memorization, ensuring the retention of ecological terms among.

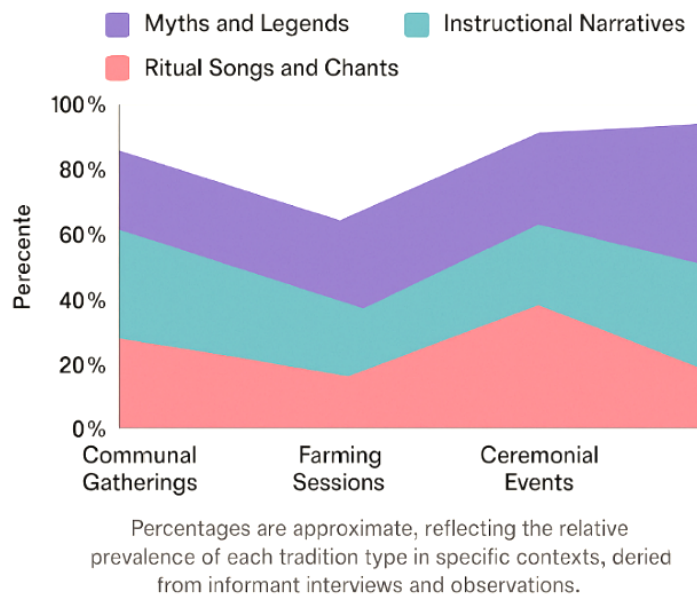
**Table 5** summarizes these oral tradition practices, providing examples, contexts, and their roles in transmitting ecological wisdom:

**Table 5.** Oral tradition practices in transmitting *Paser* Tribe's ecological wisdom.

Oral Tradition Type	Example Term	Context of Transmission	Role in Ecological Wisdom Transmission
Myths and Legends	<i>Pohon ulin</i>	Communal storytelling evenings	Embeds ecological roles and cultural symbolism, fostering environmental awareness.
Myths and Legends	<i>Sungai jernih</i>	Village gatherings	Reinforces spiritual and ecological significance of water resources through narratives.
Instructional Narratives	<i>Sasi</i>	Farming or foraging sessions	Teaches sustainable resource management principles via practical guidance.
Instructional Narratives	<i>Manen bijak</i>	Hunting storytelling	Promotes selective harvesting practices for ecological balance.
Ritual Songs and Chants	<i>Tanah leluhur</i>	Harvest festival ceremonies	Integrates spiritual respect for land with ecological stewardship through song.
Ritual Songs and Chants	<i>Roh hutan</i>	Forest protection rituals	Embeds belief in supernatural entities governing ecological harmony, enhancing conservation.

**Table 5** visualized the prevalence of these oral tradition types across community contexts (e.g., communal gatherings, farming sessions, ceremonial events), a stacked area chart was constructed. The chart illustrates the cumulative contribution of myths, instructional narra-

tives, and ritual songs to ecological wisdom transmission, highlighting their varying prominence in different settings. **Figure 5** describes the chart, with approximate prevalence scores (0–100%) based on interview and observation data:



**Figure 5.** Prevalence of oral tradition types across community contexts.

**Figure 5** visualized the oral tradition practices demonstrate the *Paser* Tribe's effective mechanisms for transmitting ecological wisdom, leveraging linguistic richness to sustain environmental knowledge. The findings offer action-

able insights for integrating oral traditions into educational programs and community-based conservation initiatives for *Nusantara*'s sustainable development, ensuring the preservation of both ecological and cultural heritage.

#### 4.6. Knowledge Transmission Mechanisms Cultural Preservation Strategies

The exploration of the *Paser* Tribe's knowledge transmission mechanisms, conducted through participant observation, semi-structured interviews, and audio-visual documentation in Telemow, Binuang, and Sepan villages, reveals robust cultural preservation strategies that safeguard ecological wisdom embedded in their language and practices. These strategies are critical for maintaining the *Paser* Tribe's cultural heritage and ecological knowledge amidst modernization pressures driven by the development of *Nusantara* and industrial exploration in East Kalimantan. The identified strategies include community-based language revitalization, ritual reinforcement, and intergenerational mentorship, each leveraging linguistic and cultural practices to ensure the continuity of ecological wisdom.

**Community-Based Language Revitalization:** The *Paser* community actively promotes the use of their language through organized storytelling sessions and language workshops, focusing on ecological terms such as “*sasi*” (customary prohibition) and “*Manen bijak*” (wise harvesting). These initiatives, led by elders and community leaders, encourage youth to learn and use the *Paser* lexicon in everyday contexts, such as farming or foraging, thereby preserving linguistic knowledge tied to ecological practices. Language

workshops often incorporate traditional narratives, ensuring that terms like “*pohon ulin*” (ironwood tree) are contextualized within their ecological and cultural significance.

**Ritual Reinforcement:** Rituals serve as a powerful mechanism for cultural preservation, embedding ecological wisdom in ceremonial practices that reinforce community identity. Terms like “*Tanah leluhur*” (ancestral land) and “*Roh hutan*” (forest spirit) are prominently featured in rituals, such as land blessing ceremonies and harvest festivals, which emphasize spiritual respect for nature. These events, attended by all age groups, provide a platform for transmitting ecological knowledge through chants and prayers, strengthening cultural cohesion and environmental stewardship.

**Intergenerational Mentorship:** This strategy involves direct knowledge transfer from elders to youth through structured mentorship programs, such as guided ecological activities. Elders teach terms like “*Sungai jernih*” (clear river) and “*sasi*” during hands-on sessions, such as river conservation or rotational farming, ensuring that ecological practices are learned in context. These mentorship programs foster a sense of responsibility among youth to preserve both the language and the environment, countering the erosion of traditional knowledge due to modernization.

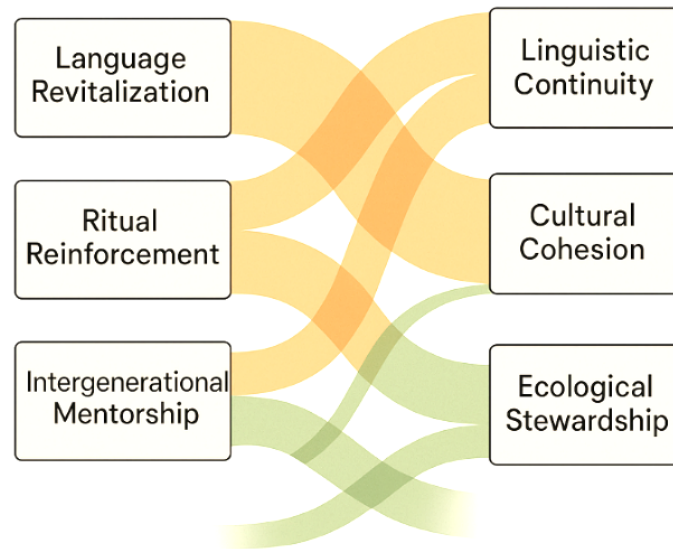
**Table 6** summarizes these cultural preservation strategies, providing examples, contexts, and their roles in sustaining ecological wisdom:

**Table 6.** Cultural preservation strategies for *Paser* Tribe's ecological wisdom.

Preservation Strategy	Example Term	Context of Implementation	Role in Cultural Preservation
Community-Based Language Revitalization	<i>Pohon ulin</i>	Storytelling sessions, language workshops	Promotes linguistic use and contextualizes ecological terms, ensuring youth engagement.
Community-Based Language Revitalization	<i>Sasi</i>	Community language classes	Reinforces sustainable resource management terminology through active learning.
Ritual Reinforcement	<i>Tanah leluhur</i>	Land blessing ceremonies	Embeds spiritual-ecological values in rituals, strengthening cultural identity.
Ritual Reinforcement	<i>Roh hutan</i>	Harvest festival chants	Reinforces environmental stewardship through spiritual expressions.
Intergenerational Mentorship	<i>Sungai jernih</i>	River conservation activities	Teaches ecological practices and terminology through hands-on mentorship.
Intergenerational Mentorship	<i>Manen bijak</i>	Rotational farming sessions	Instills sustainable harvesting practices, fostering environmental responsibility.

**Table 6** visualized the flow of ecological knowledge through these preservation strategies and their impact on community engagement, a Sankey diagram was constructed. The diagram illustrates how knowledge (represented by key terms)

flows from strategies to specific outcomes, such as linguistic continuity, ecological stewardship, and cultural cohesion. **Figure 6** describes the Sankey diagram, with approximate flow weights based on interview and observation data:



**Figure 6.** Flow of ecological knowledge through cultural preservation strategies.

**Figure 6** presents the cultural preservation strategies underscore the *Paser* Tribe’s proactive efforts to safeguard their ecological wisdom, leveraging linguistic and cultural practices to counter modernization’s erosive effects. The findings provide actionable insights for integrating these strategies into community engagement and educational initiatives for *Nusantara*’s sustainable development, ensuring the preservation of both ecological knowledge and cultural heritage.

#### 4.7. Ecological Classification Systems Native Species Categorization

The investigation into the *Paser* Tribe’s ecological classification systems, conducted through participant observation, semi-structured interviews, and linguistic mapping in Telemow, Binuang, and Sepan villages, reveals a sophisticated native species categorization framework embedded in their language. This framework organizes flora and fauna based on ecological roles, cultural significance, and practical uses, reflecting the tribe’s deep understanding of East Kalimantan’s biodiversity. The categorization system not only supports sustainable resource management but also informs cultural practices, providing a foundation for integrating indigenous knowledge into the sustainable development of *Nusantara*.

The *Paser* Tribe’s native species categorization is structured into four primary categories: medicinal and edible

plants, structural and tool-making flora, culturally significant fauna, and indicator species. Each category is defined by specific linguistic terms that encode ecological and cultural knowledge, facilitating the transmission of environmental wisdom across generations. This system demonstrates the tribe’s ability to classify species based on their utility and symbolic roles, aligning with global indigenous ethnobiological practices.

**Medicinal and Edible Plants:** This category includes plants valued for their therapeutic and nutritional properties, comprising approximately 35% of documented species terms. For example, “*daun sirih*” (betel leaf) is used for medicinal purposes, such as treating wounds, and holds cultural significance in rituals, while “*padi hutan*” (wild rice) is a staple food source. These terms reflect the *Paser* Tribe’s knowledge of plant-based remedies and sustainable foraging practices.

**Structural and Tool-Making Flora:** Representing about 25% of the lexicon, this category includes plants used for construction and crafting. The term “*pohon ulin*” (ironwood tree) denotes a durable species for building homes, valued for its ecological role in forest stability, while “*Rotan*” (rattan) is used for weaving tools and baskets. These terms highlight the tribe’s resource-efficient use of flora, minimizing environmental impact.

**Culturally Significant Fauna:** This category, accounting for 20% of terms, includes animals with symbolic or

ritual importance. The term “*enggang*” (hornbill) signifies a sacred species indicating forest health and is used in ceremonial headdresses, while “*Rusa*” (deer) is associated with hunting rituals. These terms underscore the integration of ecological and cultural values in species classification.

**Indicator Species:** Comprising 20% of the lexicon, this category includes species that signal environmental conditions. For example, “*Burung kutilang*” (sooty-headed bul-

bul) indicates fertile land suitable for farming, while “*Ikan seluang*” (rasbora fish) signals clean river water. These terms reflect the *Paser* Tribe’s observational skills in using species as ecological indicators, supporting sustainable land and water management.

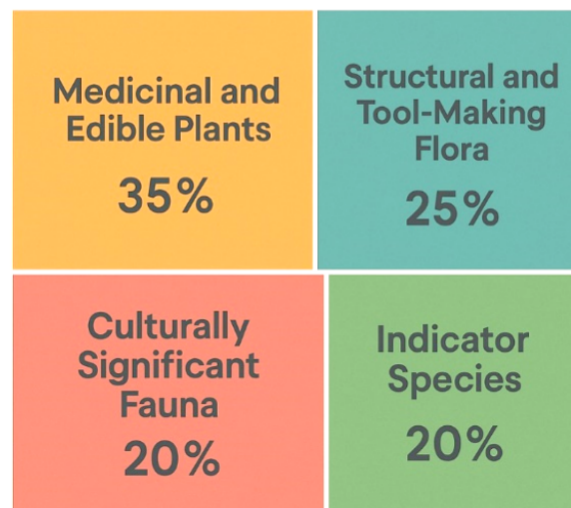
**Table 7** summarizes these native species categorizations, providing examples, uses, and their ecological-cultural significance:

**Table 7.** Native species categorization in the *Paser* Tribe’s ecological classification system.

Species Category	<i>Paser</i> Term	English Translation	Use/Significance	Ecological/Cultural Role
Medicinal and Edible Plants	<i>Daun sirih</i>	Betel leaf	Medicinal (wound healing), ritual use	Supports health and cultural practices; sustainable foraging.
Medicinal and Edible Plants	<i>Padi hutan</i>	Wild rice	Food source	Staple nutrition; promotes biodiversity through cultivation.
Structural and Tool-Making Flora	<i>Pohon ulin</i>	Ironwood tree	Construction (homes)	Durable material; stabilizes forest ecosystems, symbolizes resilience.
Structural and Tool-Making Flora	<i>Rotan</i>	Rattan	Tool and basket weaving	Resource-efficient crafting; supports sustainable harvesting.
Culturally Significant Fauna	<i>Enggang</i>	Hornbill	Ritual headdresses, forest health indicator	Sacred species; links ecological health to cultural practices.
Culturally Significant Fauna	<i>Rusa</i>	Deer	Hunting rituals	Symbolic in ceremonies; managed through sustainable hunting.
Indicator Species	<i>Burung kutilang</i>	Sooty-headed bulbul	Signals fertile land	Guides farming decisions; supports land management.
Indicator Species	<i>Ikan seluang</i>	Rasbora fish	Signals clean river water	Indicates water quality; informs sustainable water use.

**Table 7** presents the hierarchical distribution of these species categories based on their ecological and cultural significance, a treemap was constructed. The treemap illustrates the proportional representation of each category, with sizes

reflecting the relative number of terms and colors indicating their primary roles (e.g., medicinal, structural, cultural, indicator). **Figure 7** describes the treemap, with approximate proportions based on linguistic mapping data:



**Figure 7.** Distribution of native species categories in *Paser* ecological classification.

**Figure 7** visualized the native species categorizations highlight the *Paser* Tribe’s intricate ecological classification system, integrating practical, cultural, and observational knowledge. The findings provide actionable insights for incorporating indigenous species knowledge into biodiversity conservation and resource management policies for *Nusantara*, ensuring sustainable development that respects local ecological wisdom.

#### 4.8. Ecological Classification Systems Environmental Management Practices

The analysis of the *Paser* Tribe’s ecological classification systems, based on data collected through participant observation, semi-structured interviews, and linguistic mapping in Telemow, Binuang, and Sepan villages, reveals a sophisticated set of environmental management practices embedded in their linguistic and cultural framework. These practices, articulated through specific ecological terminology, demonstrate the tribe’s commitment to sustainable resource use and ecosystem preservation, offering valuable insights for the sustainable development of *Nusantara* and industrial exploration in East Kalimantan. The identified practices include customary resource restrictions, selective harvesting, rotational land use, and water conservation techniques, each reflecting the *Paser* Tribe’s deep ecological knowledge and adaptive.

**Customary Resource Restrictions:** The practice of “*sasi*” (customary prohibition) regulates resource harvesting by imposing temporary bans on activities such as fishing or logging in specific areas to allow ecosystem recovery.

For example, “*sasi sungai*” restricts fishing in certain river sections during spawning seasons, ensuring fish population sustainability. This practice is enforced through community agreements and oral directives, reflecting a collective commitment to ecological balance.

**Selective Harvesting:** Known as “*Manen bijak*” (wise harvesting), this practice involves the careful selection of resources to minimize environmental impact. For instance, when harvesting “*Rotan*” (rattan), only mature stems are cut, leaving younger plants to regenerate. This approach, taught through intergenerational mentorship, ensures long-term resource availability and supports biodiversity.

**Rotational Land Use:** The *Paser* Tribe employs rotational farming, referred to as “*Ladang berpindah*,” where agricultural plots are alternated to maintain soil fertility. The term “*Tanah ladang*” (farming land) is used to designate active plots, which are left fallow after a few seasons to recover. This practice prevents soil degradation and promotes sustainable agriculture, aligning with traditional agroforestry principles.

**Water Conservation Techniques:** The term “*Sungai jernih*” (clear river) is associated with practices that protect water quality, such as prohibiting waste disposal near rivers and maintaining riparian vegetation. These techniques, often reinforced through ritualistic practices, ensure clean water for drinking and irrigation, reflecting the tribe’s holistic approach to hydrological management.

**Table 8** summarizes these environmental management practices, providing examples, contexts, and their ecological significance:

**Table 8.** Environmental Management Practices in the *Paser* Tribe’s ecological classification system.

Management Practice	<i>Paser</i> Term	English Translation	Context of Application	Ecological Significance
Customary Resource Restrictions	<i>Sasi</i>	Customary prohibition	River fishing, forest logging	Ensures ecosystem recovery by restricting resource use, promoting sustainability.
Customary Resource Restrictions	<i>Sasi sungai</i>	River prohibition	Fish spawning seasons	Protects fish populations, maintaining aquatic biodiversity.
Selective Harvesting	<i>Manen bijak</i>	Wise harvesting	Rattan and fruit harvesting	Minimizes environmental impact, ensuring long-term resource availability.
Selective Harvesting	<i>Rotan</i>	Rattan	Tool-making, weaving	Supports biodiversity by preserving younger plants for regeneration.
Rotational Land Use	<i>Ladang berpindah</i>	Rotational farming	Agricultural fields	Maintains soil fertility, preventing degradation and promoting sustainable agriculture.

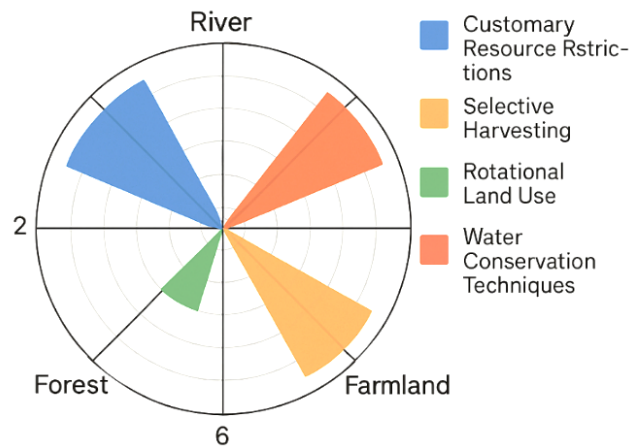


Table 8. Cont.

Management Practice	Paser Term	English Translation	Context of Application	Ecological Significance
Rotational Land Use	<i>Tanah ladang</i>	Farming land	Active farming plots	Facilitates fallow periods for soil recovery, enhancing ecosystem resilience.
Water Conservation Techniques	<i>Sungai jernih</i>	Clear river	River management	Protects water quality for drinking and irrigation, supporting community health.
Water Conservation Techniques	<i>Tanah pinggir</i>	Riparian land	Vegetation maintenance	Preserves riparian zones, preventing erosion and maintaining hydrological balance.

**Table 8** visualized the relative frequency of these environmental management practices across different ecological contexts (forest, river, farmland), a polar bar chart was constructed. The chart illustrates the prominence of each practice in specific contexts, with radial bars reflect-

ing their frequency of application, emphasizing the cyclical and interconnected nature of *Paser* ecological management. **Figure 8** describes the polar bar chart, with approximate frequency scores (0–10) based on interview and observation data:



**Figure 8.** Frequency of environmental management practices across ecological contexts.

**Figure 8** represents the environmental management practices demonstrate the *Paser* Tribe's proactive approach to ecological stewardship, integrating linguistic terminology with sustainable actions. The findings offer actionable insights for developing resource management policies for *Nusantara*, such as adopting customary restrictions like “*sasi*” for biodiversity conservation or rotational land use for sustainable agriculture, ensuring development aligns with local ecological wisdom.

#### 4.9. Traditional Ecological Calendars

The investigation into the *Paser* Tribe's ecological classification systems, conducted through participant observation, semi-structured interviews, and linguistic mapping in Telemow, Binuang, and Sepan villages, reveals a sophisticated traditional ecological calendar embedded in their lin-

guistic and cultural framework. This calendar organizes environmental activities based on seasonal cycles, ecological indicators, and cultural practices, reflecting the tribe's deep understanding of temporal patterns in East Kalimantan's ecosystem. The ecological calendar not only guides sustainable resource management but also reinforces cultural identity, offering valuable insights for integrating indigenous temporal knowledge into the sustainable development of *Nusantara*.

The *Paser* Tribe's traditional ecological calendar is structured around four key seasonal phases: wet season planting, dry season harvesting, resource restriction periods, and ritual preparation periods. Each phase is associated with specific linguistic terms that encode ecological and cultural knowledge, facilitating the coordination of activities such as farming, fishing, and ceremonies. This temporal framework demonstrates the tribe's ability to synchronize human ac-

tivities with natural cycles, aligning with global indigenous practices that emphasize ecological harmony.

**Wet Season Planting:** This phase, termed “*Musim tanam*” (planting season), occurs during the rainy months (typically November to March) and is marked by the cultivation of crops like “*padi hutan*” (wild rice). The term “*hujan berkat*” (blessing rain) signifies abundant rainfall that supports planting, reflecting the tribe’s reliance on seasonal precipitation. This phase involves preparing “*Tanah ladang*” (farming land) through rotational farming, ensuring soil fertility.

**Dry Season Harvesting:** Known as “*Musim panen*” (harvest season), this phase spans the drier months (April to August) and focuses on harvesting crops and forest resources. The term “*Manen bijak*” (wise harvesting) guides selective harvesting of “*Rotan*” (rattan) and fruits, minimizing environmental impact. This phase aligns with optimal weather conditions for gathering resources, ensuring sustainability.

**Resource Restriction Periods:** Referred to as “*Musim*

*sasi*” (prohibition season), this phase involves temporary bans on resource use, such as “*sasi sungai*” (river prohibition) during fish spawning periods. These restrictions, often enforced from September to October, allow ecosystems to regenerate, reflecting the tribe’s cyclical approach to resource management. The term “*sasi*” is central to this phase, embedding ecological conservation principles.

**Ritual Preparation Periods:** This phase, termed “*Musim upacara*” (ceremony season), occurs at transitional points between seasons (e.g., late October or March) and involves preparing for rituals like land blessings or harvest festivals. Terms like “*Tanah leluhur*” (ancestral land) and “*Roh hutan*” (forest spirit) are used in ceremonial contexts, reinforcing spiritual connections to the environment and ensuring cultural continuity.

**Table 9** summarizes these traditional ecological calendar phases, providing examples, associated terms, and their ecological-cultural significance:

**Table 9.** Traditional ecological calendar phases in the *Paser* Tribe’s classification system.

Calendar Phase	<i>Paser</i> Term	English Translation	Associated Activity	Ecological/Cultural Significance
Wet Season Planting	<i>Musim tanam</i>	Planting season	Crop cultivation	Guides planting of crops like wild rice, ensuring soil fertility through rotational farming.
Wet Season Planting	<i>Hujan berkat</i>	Blessing rain	Land preparation	Signifies abundant rainfall supporting agriculture, reflecting ecological reliance.
Dry Season Harvesting	<i>Musim panen</i>	Harvest season	Resource harvesting	Facilitates selective harvesting of rattan and fruits, promoting sustainability.
Dry Season Harvesting	<i>Manen bijak</i>	Wise harvesting	Foraging, gathering	Ensures minimal environmental impact, maintaining resource availability.
Resource Restriction Periods	<i>Musim sasi</i>	Prohibition season	Resource bans	Enforces temporary restrictions for ecosystem regeneration, supporting biodiversity.
Resource Restriction Periods	<i>Sasi sungai</i>	River prohibition	Fishing bans	Protects fish populations during spawning, ensuring aquatic ecosystem health.
Ritual Preparation Periods	<i>Musim upacara</i>	Ceremony season	Ritual preparations	Aligns ceremonies with seasonal transitions, reinforcing spiritual-ecological connections.
Ritual Preparation Periods	<i>Tanah leluhur</i>	Ancestral land	Land blessing rituals	Embeds cultural respect for land, ensuring sustainable use and community cohesion.

**Table 9** visualized the temporal distribution of these ecological calendar phases and their associated activities across the annual cycle, a circular timeline chart was constructed. The chart illustrates the cyclical nature of the *Paser* Tribe’s ecological calendar, with each phase represented as a segment of a circular arc, sized according to its duration and colored to reflect its primary activity. **Figure 9** describes the circular timeline chart, with approximate durations based on

interview and observation data.

**Figure 9** visualized the traditional ecological calendars highlight the *Paser* Tribe’s temporal ecological knowledge, synchronizing human activities with natural cycles to ensure sustainability. The findings provide actionable insights for developing seasonal management frameworks for *Nusantara*, such as aligning infrastructure projects with resource restriction periods or incorporating ritual preparation periods



into cultural preservation initiatives, ensuring development respects indigenous ecological wisdom.

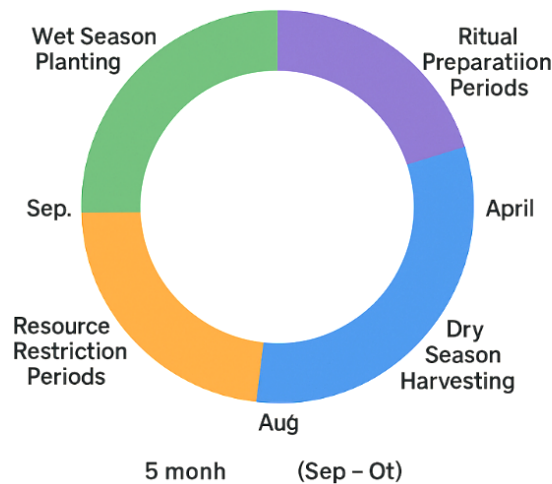


Figure 9. Temporal distribution of *Paser* ecological calendar phases.

## 5. Discussion

The study of the *Paser* Tribe's linguistic ecology offers an in-depth examination of the complex interplay between language, culture, and the environment. The comparative analysis indicates that indigenous ecological terminology not only serves practical purposes in resource management but also encapsulates cultural elements and practices that promote sustainability. This finding aligns with existing literature in ecological linguistics, which emphasizes the role of language as a tool in human-environment interaction<sup>[5,6]</sup>. Terms such as “*sasi*” (customary prohibition) and “*Manen bijak*” (wise harvesting) exemplify a cultural framework that values ecological balance, a critical component often overlooked in large-scale development models prioritizing economic growth over environmental sustainability<sup>[2]</sup>.

From a theoretical perspective, this study delves into the domain of ecological linguistics by examining how language structures convey ecological wisdom and cultural practices. It affirms Berkes's<sup>[110]</sup> assertion that indigenous knowledge systems are inherently tied to the environments from which they originate. By documenting the *Paser* Tribe's ecological vocabulary, the research highlights the role of language as a living repository of ecological knowledge and cultural identity. Additionally, it posits that languages extend beyond mere tools for communication; they serve as frameworks through which communities construct their worldviews<sup>[111]</sup>. This aligns with findings in global indigenous studies<sup>[2]</sup>, which indicate that the loss of linguistic diversity

correlates with the erosion of vital ecological knowledge and cultural identity.

Furthermore, the study underscores the importance of integrating indigenous knowledge into contemporary sustainable development models. The case of the *Paser* Tribe illustrates how traditional ecological practices can inform the design of sustainable development projects in urban areas like *Nusantara*. By juxtaposing traditional environmental knowledge with modern practices, a hybrid model emerges that leverages the strengths of both approaches to address ecological challenges<sup>[112]</sup>. This synthesis has the potential to enhance policy development while improving community-based development initiatives by incorporating local wisdom into large-scale sustainability plans.

The outcomes of the comparative analysis support the basis of contemporary sustainable development theories advocating for an inclusive approach to resource management. This research aligns with the UN's Sustainable Development Goals, particularly those emphasizing community involvement and knowledge integration<sup>[35]</sup>. Incorporating the ecological insights of the *Paser* Tribe into development frameworks promotes a model that prioritizes biodiversity conservation alongside socio-economic growth. This approach resonates with the central tenets of postcolonial development studies, which advocate for equity and representation in policymaking processes while recognizing the roles of indigenous communities<sup>[47,113]</sup>.

The analysis also suggests the establishment of inter-

generational forums for the exchange of environmental information that include linguistic and cultural elements of indigenous groups<sup>[1]</sup>. Such forums honor the contributions of indigenous communities and foster resilience in the face of current and future environmental changes.

In summary, the results of this analysis emphasize the significant role of indigenous ecological knowledge as a foundation for sustainable development. The links between language, culture, and environmental practice illustrate the need for policy transformations that support and utilize local knowledge systems. For sustainable development to be effective and sensitive to both cultural and ecological contexts, a paradigm shift is necessary that incorporates ecological wisdom from indigenous perspectives into development initiatives.

## 6. Conclusions

This research has highlighted key findings regarding the ecological knowledge systems of the *Paser* Tribe and their relevance to sustainable development frameworks in the *Nusantara* capital region. The investigation revealed that the *Paser* Tribe's linguistic ecological lexicon contains a wealth of ecological knowledge that not only serves practical purposes in resource management but also encapsulates cultural values that promote sustainability. Terms such as “*sasi*” (customary prohibition) and “*Manen bijak*” (wise harvesting) embody principles of ecological balance and resource regeneration. These findings align with existing literature in ecological linguistics, emphasizing the significant role language plays in human-environment interactions and the importance of preserving indigenous knowledge<sup>[5,6]</sup>.

The research also offers theoretical and practical implications for sustainable development. By integrating the ecological practices and perspectives of the *Paser* Tribe into contemporary development frameworks, policymakers can address critical environmental challenges while fostering cultural preservation. This study advocates for a hybrid development model that incorporates traditional ecological wisdom alongside modern practices, thus providing actionable insights for sustainable urbanization in *Nusantara*. The evidence presented underscores the necessity of valuing local knowledge systems to enhance community engagement

and ecological resilience in the face of rapid socio-economic changes.

Furthermore, the findings suggest the establishment of intergenerational knowledge transfer mechanisms, which serve as essential tools for preserving the *Paser* Tribe's ecological wisdom in the context of modernization. Utilizing oral traditions, participatory learning experiences, and ritual practices, these mechanisms help sustain linguistic diversity and cultural identity while promoting sustainable resource management. The research highlights the importance of fostering collaborative relationships between indigenous communities and policymakers to create inclusive development strategies that resonate with local needs, desires, and ecological realities.

In conclusion, this study emphasizes the urgent need for a paradigm shift in development approaches, advocating for the integration of indigenous ecological knowledge as a foundation for sustainable development. By recognizing and valuing the intricate connections between language, culture, and ecology, future development initiatives can ensure that they are effective, culturally sensitive, and environmentally sustainable. The *Paser* Tribe's ecological wisdom provides a vital framework for addressing contemporary environmental challenges, laying a strong foundation for a more sustainable and equitable future in the *Nusantara* region and beyond.

## Author Contributions

Conceptualization, I.Z. and R.S.I.; methodology, K.H.P.; software, K.H.P.; resources, K.H.P.; validation, I.Z., R.S.I., R., M., and H.; formal analysis, I.Z. and S.; investigation, I.Z. and D.S.; data curation, J.; original draft preparation, I.Z.; writing review and editing, R. and A.T.; visualization, K.H.P.; supervision, R.; project administration, A.T.; funding acquisition, R.S.I. All authors have read and agreed to the published version of the manuscript.

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## Institutional Review Board Statement

Not applicable.

## Informed Consent Statement

Not applicable.

## Data Availability Statement

The data generated and analyzed during this study are not publicly available due to privacy concerns. Access to the data can be granted upon reasonable request and with appropriate ethical approvals. For inquiries regarding data access, please contact the corresponding author.

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## Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this manuscript. All authors have disclosed any financial or personal relationships that could influence the work described in this article.

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