

Land use change and indigenous knowledge systems in the Tampun Juah customary forest: implications for resilience and cultural sustainability

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Abstract. The Tampun Juah Customary Forest, located in Sanggau Regency, West Kalimantan, has a rich history of natural resource management by indigenous communities. This study aims to analyze changes in land use within this customary forest, focusing on the impact of land allocation on the livelihoods of the community. The study integrates spatial analysis tools such as ArcGIS 10.3, Google Earth validation, and temporal analysis using high-resolution satellite imagery (Landsat 8 and Sentinel 2) to evaluate land cover changes. Land cover classification follows the national classification protocols established by the Indonesian Ministry of Environment and Forestry, by SNI 764.591:2014 for cartographic representation at a scale of 1:250,000. Additionally, qualitative methods, including in-depth interviews with 15 indigenous community leaders and members, participatory observation, and Focus Group Discussions (FGDs) involving 6-8 participants per group, were used to gather insights on local knowledge systems and their contributions to ecological resilience and sustainable land. The findings indicate that traditional land management practices, such as mixed cropping, have significantly declined due to the conversion of land for large-scale plantations, adversely affecting the sustainability of both ecosystems and indigenous cultures. These results underscore the importance of integrating indigenous knowledge systems into natural resource management to achieve cultural sustainability and resilience.

1 Introduction

Customary forests are vital to the survival of the ecosystem and provide a means of subsistence for indigenous people. The loss of traditional knowledge and practices is a common result of land conversion for industrial and agricultural use in Indonesia,

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endangering customary forests. However, research shows that integrating indigenous knowledge systems is crucial for creating sustainable and culturally inclusive forest management practices. With the legal recognition of Indigenous community rights through the Constitutional Court's decision No. 35/2013, communities now possess rights over their traditional territories, including the right to engage in sustainable land management practices, such as agriculture. Indigenous peoples have established generations of observations and practices that make up traditional ecological knowledge (TEK), which is essential for building resilience against environmental degradation and climate change as well as the deterioration of the ecosystem [1]. For many years, indigenous groups have lived in harmony with their environment, developing resource management techniques that enhance biodiversity, safeguard ecosystems, and lessen the effects of climate change. Indigenous knowledge is often underrepresented in formal environmental governance, despite its considerable benefits to forest protection and sustainability [2]. The historical disregard for indigenous methods in mainstream forestry emphasizes how important it is for indigenous peoples and government organizations to work together to enhance the results of forest management. The Tampun Juah Customary Forest is one location where there are notable changes in land usage. This study attempts to evaluate the implications of these changes on the cultural sustainability and environmental resilience of Indigenous communities in the region.

In 2021 and 2022, the area of rice paddies in Sanggau Regency was recorded at 33,755 hectares, indicating a decline from the 51,917 hectares noted in 2019. During the same period, non-rice agricultural land encompassed 835,057 hectares, while non-agricultural land amounted to 416,958 hectares in 2022. Consistent with prior years, a significant portion of the non-rice agricultural land in Sanggau Regency in 2022 was allocated to oil palm plantations, which covered 350,073 hectares, constituting 41.92 percent of the total non-rice agricultural area in the region [3].

The expansion of oil palm plantations is transforming rural livelihoods. This transformation presents a critical question for this research. Employing the framework of spatial territorialization [3-4], this study aims to demonstrate that alterations in land use, driven by the management of monoculture plantations, have restricted farmers' access to their living spaces in rural areas, thereby fundamentally altering their sources of livelihood. Indigenous knowledge, cultivated over generations within certain ethnic groups residing near nature, is highly recommended as a reference for the implementation of sustainable development, provided that it is inclusive, grounded in local contexts, and integrated into early intervention programs [5].

Empowerment fosters local participation in all phases, including seeding, production, marketing, and processing. Social change cannot be achieved solely through engineering; it must resonate with the values and needs of local communities. The land management practices utilizing shifting cultivation and agroforestry methods, which were historically employed by communities before the expansion of oil palm plantations in 2018, are posited as equitable and inclusive livelihood sources that honor Indigenous knowledge. This initiative necessitates a holistic examination of management systems and decision-making processes about the stewardship of Indigenous territories [6].

2 Material and method

2.1 Study area

This research was conducted from April to September 2024 in the Tembawang Tampun Juah Customary Forest, located in Lubuk Sabuk Village, Sekayam District, Sanggau Regency, West Kalimantan (Fig.1). Geographically, Lubuk Sabuk Village covers an area of approximately 78.18 km², with a forest area of 17.2 km². The village is home to 3,715 individuals and 1,208 households (KK), including the Tampun Juah Indigenous Community (Masyarakat Hukum Adat, MHA). On September 7, 2018, this area was officially recognized as the Tembawang Tampun Juah Customary Forest, which spans 651 hectares as established by the decree of the Minister of Environment and Forestry, numbered SK 5771/MENLHK-PSKL/PKTHA-PSL-1/9. Lubuk Sabuk Village is bordered by the Entinyu Mountains to the east, which form the boundary with Malaysia. The knowledge and management of forests by local communities are essential in maintaining the ecological sustainability of this area [7].

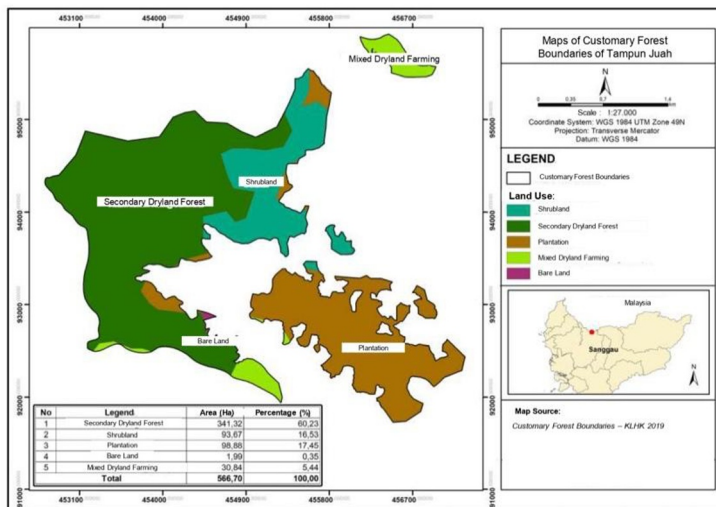


Fig. 1 Map of the Tampun Juah Customary Forest, Source: KLHK, 2023

2.2 Data collection

This research employs a comprehensive spatial analysis approach to elucidate land cover changes within the Tampun Juah Customary Forest area. High-resolution satellite imagery from Landsat 8 and Sentinel 2 serves as the foundational dataset for examining alterations in land cover. The land cover classification adheres to the SNI 764.591:2014 standard for cartographic representations at a scale of 1:250,000. The classification scheme comprises nine distinct land cover categories pertinent to the indigenous forest area.

2.2.1 Satellite imagery

Satellite imagery from Landsat 8 (2013) and Sentinel 2 (2016, 2018, and 2023) was configured to minimize cloud cover to less than 30%. The use of high-resolution satellite imagery enables accurate monitoring of land cover changes over time [7]. KLHK land cover data for the years 2006, 2013, 2018, and 2022 were used to provide a temporal perspective

on land use changes relevant to this analysis. Additionally, Google Earth imagery was used as a validator for the current conditions of the customary forest, enhancing the accuracy of the spatial analysis.

2.3 Analytical processes

The land cover classification was conducted using the SNI 764.591:2014 standard, which is essential for categorizing land cover types relevant to the study area. Accurate classification is crucial for understanding ecological impacts and guiding conservation efforts [1]. Spatial analysis was performed using ArcGIS 10.3, allowing for an examination of the temporal dynamics of land cover changes. These spatial analysis techniques offer insights into the relationships between land use patterns and ecological outcomes, thereby informing sustainable management strategies.

2.4 Analysis of indigenous knowledge systems

The analysis of indigenous knowledge systems involved conducting in-depth interviews with 5 indigenous leaders and community members to extract traditional knowledge and practices. These interviews were vital for understanding how indigenous knowledge systems contribute to resource management and ecological sustainability. Focus group discussions (FGD) were also held with 20 participants, divided into 3 separate groups, each consisting of 6-8 individuals. These participants were selected through purposive sampling, focusing on community leaders, elders, and key informants with deep knowledge of traditional ecological practices. This participatory approach encouraged dialogue and collective reflection on the role of indigenous practices in forest management. The participatory observation was employed to directly observe traditional forest management and land use practices, providing empirical evidence of how Indigenous communities interact with their environment. This method complemented qualitative data and strengthened the findings related to indigenous knowledge systems. The qualitative analysis of data from interviews and FGDs was used to uncover themes related to indigenous knowledge systems and sustainability, revealing the intricacies of local practices and their implications for conservation strategies.

3 Result and discussion

3.1 Changes in land use patterns

The analysis reveals significant changes in land cover between 2006 and 2022, particularly a decline in traditionally managed lands. The previously dominant practice of mixed cropping is increasingly marginalized. These results indicate that indigenous communities face serious challenges in maintaining their traditional land management practices. The analysis reveals significant transformations in land use within the Tampun Juah Indigenous Law Community between 2006 and 2022. Figure 2 presents a series of four maps illustrating these land cover changes, with a focus on the shift from traditional land management practices to more commercial land uses. These maps highlight the reduction in secondary dryland forest and the conversion of large areas into shrubland and commercial plantations, particularly oil palm. Over time, there has been a visible reduction in traditionally managed land, with substantial portions being converted into areas designated for commercial activities, such as oil palm plantations. These visualizations provide a spatial understanding of how land previously used for mixed cropping and subsistence farming has gradually diminished, replaced by monoculture plantations and shrubland.

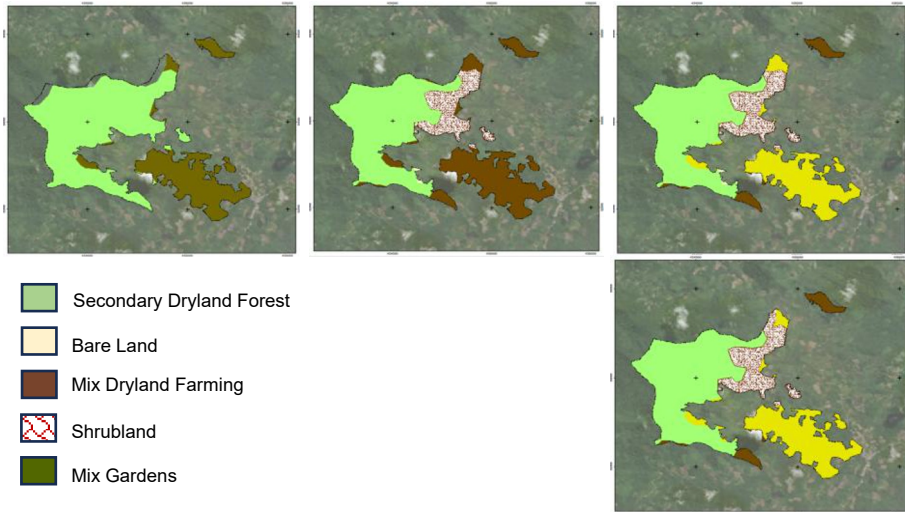


Fig. 2. Land use changes from mixed cropping and subsistence farming to monoculture plantations and shrubland. Source: researcher's documents, 2023

Table 1 illustrates the changes in land cover in Tampun Juah from 2006 to 2022. The total area remains constant at 65,141 hectares during this period, but significant changes are observed in the distribution of land cover types. In 2006, secondary dryland forest covered 43,262 hectares (66.4% of the area). By 2013, this forest area had significantly decreased to 34,052 hectares (52.3%), and it remained stable through 2022 with slight variations, reaching 34,136 hectares in 2022.

Mixed plantations, which accounted for 19,436 hectares (29.8%) in 2006, disappeared completely by 2013. This area was mostly replaced by dryland agriculture mixed with shrubs, which expanded to 21,523 hectares in 2013. However, this category decreased significantly to 3,084 hectares by 2018 and remained at that level in 2022.

Bare land remained minimal, covering only 199 hectares in 2013 and 2018, before disappearing entirely in 2022. Shrubland, which was non-existent in 2006, appeared in 2013 with 9,368 hectares, increasing slightly to 9,884 hectares by 2022. The category of plantations or gardens emerged in 2018, covering 18,359 hectares, and slightly decreased to 18,037 hectares in 2022. There was also an area labeled "No Data" covering 2,443 hectares in 2006, but no such area appeared in the following years.

Table 1. Land cover change in Tampun Juah (2006-2022)

Land Cover Classification	2006 (Ha)	2013 (Ha)	2018 (Ha)	2022 (Ha)
Secondary Dryland Forest / Former Logged Forest	43,262	34,052	34,132	34,136
Mixed Plantation	19,436	0	0	0
Dryland Agriculture Mixed with Shrub / Mixed Gardens	0	21,523	3,084	3,084
Bare Land	0	199	199	0
Shrubland	0	9,368	9,368	9,884
Plantation / Garden	0	0	18,359	18,037
No Data	2,443	0	0	0
Total Area (Ha)	65,141	65,141	65,141	65,141

Table 2 provides the percentage breakdown of land cover classifications over time. The data shows a significant reduction in secondary dryland forest, from 66.4% in 2006 to 52.4% by 2022. Mixed plantations have disappeared completely, while shrubland has increased from 14.4% in 2013 to 15.2% in 2022. The growth of plantation or garden areas peaked at 28.2% in 2018 before slightly declining to 27.7% in 2022. This indicates that while commercial plantation activity has expanded, it may be nearing saturation in terms of available land. The appearance of bare land and areas with no data is minimal or absent in recent years, suggesting that land use has become more defined and organized over time.

Table 2. Percentage of land cover (2006-2022)

Land Cover Classification	2006 (%)	2013 (%)	2018 (%)	2022 (%)
Secondary Dryland Forest / Former Logged Forest	66.4	52.3	52.4	52.4
Mixed Plantation	29.8	0	0	0
Dryland Agriculture Mixed with Shrub / Mixed Gardens	0	33.0	4.7	4.7
Bare Land	0	0.3	0.3	0
Shrubland	0	14.4	14.4	15.2
Plantation / Garden	0	0	28.2	27.7
No Data	3.8	0	0	0

Figure 2 offers an interpretation of the spatial analysis, demonstrating a significant increase in agricultural land and large-scale plantations, which have replaced areas previously managed by indigenous practices. This shift has not only changed the local economy but also disturbed the natural productivity regime. The change in land use in the Tampun Juah Indigenous Law Community shows how traditional farming practices interact with contemporary economic development factors.

Consultations with the key stakeholders in the community showed that this shift from agroforestry and subsistence farming to commercial production of palm oil is in line with other cases of land conversion and resource enclosures in the region. The social structure of the community was involved in traditional farming systems, which involved qualities of rotational farming and hunting-gathering, which contributed to good conservation and renewal of resources. Nevertheless, by the beginning of the new millennium, efforts of companies eager to expand palm oil production changed the face of the country. This commercialization gave some of the people in the community economic benefits in the form of plasma farming through land leasing. However, as pointed out by local authorities, this integration of the economy has been at the cost of the indigenous culture – hunting, fishing and the productivity of paddy fields have greatly reduced.

The spatial data (Figure 2) reveals significant land-use transitions, particularly the shift from mixed cropping to monoculture plantations. At the same time, the qualitative data from FGDs and interviews provides insights into how these changes are perceived by the community, highlighting their impact on livelihoods. Together, these data sources illustrate the dynamic interaction between environmental shifts and community responses, offering a deeper understanding of the broader implications of these land-use transitions.

One of them was marked when the Ministry of Environment and Forestry granted recognition to the Tembawang Tampun Juah Customary Forest in 2018, where 651 hectares of land were given protection under the customary law system. Most importantly this legal recognition has been vital in enabling the community to reclaim and continue with the conservation of their land as more and more spaces are developed under large-scale farming. These changes discerned today in Tampun Juah therefore accurately portray or mirror what's happening in other indigenous communities across Southeast Asia today. Provide

documentary pieces of evidence of a similar conflict between the indigenous peoples' customary rights over the land and state-supported commercial farming. These studies illustrate how the Indigenous people have suffered the loss of their traditional teachings and ways of living owing to the tension between the expanded capitalist development and present-day land policies [8]. The timeline of key events related to the recognition of Tembawang Tampun Juah Customary Forest and the ongoing conflict between indigenous land rights and commercial agricultural expansion is illustrated in Figure 3. This figure highlights important milestones, including legal recognition, community responses, and the socio-economic impacts of large-scale farming on indigenous practices.

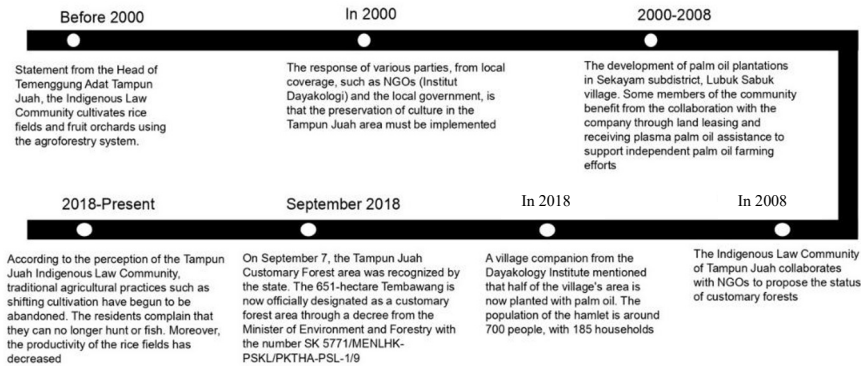


Fig. 3. Timeline of key events in the recognition of tembawang tampun juah customary forest and the impact of agricultural expansion. Source: From an in-depth interview with the Chairman of the Tampun Juah Indigenous Law Community, 2024.

3.2 Traditional planting practices in Tampun Juah

The development of Tembawang forest areas in the form of traditional agroforestry is a major source of income that plays an important role in the economic improvement and social well-being of people in Lubuk Sabuk Village, Sanggau District. Most of the people are farmers, who use the privately owned Tembawang forest land for farming to feed themselves. Now the people of the community are involved in growing vegetation plantations around their houses, which are cultivable. All these plots are being used to grow crops that meet local requirements and animals that can be sold to breeders, collectors, or for local consumption. The use of Agroforestry technology can also be practiced on degraded peatlands where farming and conservation are encouraged. In general, the patterns of agroforestry are carried out in peatland areas that are in dry conditions, so it is imperative to consider the sorts of plants that may survive well in these sorts of ecosystems. Agroforestry is gradually acknowledged as one of the most effective means to improve land management for the narrowing of the gap in perceiving other land users and the global and local environment. Agroforestry is one of the eco-farming strategies, which has attracted interest because it helps to improve the climatic factors that create income for the farmers involved in the agroforestry systems [9].

Awareness of the value of customary forest areas for purposes of realizing the opportunities of the extent of the numerous challenges of raising the productivity of the land is therefore important as a tactical step. Farmers' knowledge in the use of these areas is therefore more practical, participatory, pragmatic, and purposeful because it empowers them to well coordinate and manage their agronomic enterprises for optimum productivity and profit [10]. Therefore, any effort to provide information regarding the possible utilization of peatland regions will inform communities and users on the best practices of sustainable land

usage which can subsequently improve the welfare of society. Tembawang has the distinct quality of enshrining the local wisdom of the said Indigenous Dayak people of Kalimantan. Further studies on the Tembawang community may supplement existing knowledge in the areas of formulating and implementing relevant policies and policies on community-based forest management. The agricultural practices that are said to be culturally linked with land use are land clearing (slash and burn), rice transplantation, weeding, pest control, ripening, rice reaping, threshing and drying and the harvest festival Gawai (*Miso Padi*). Tembawang functions as a culture maintenance tool that is versatile, though it assumes control over the transformation of the Iban Dayak people's beliefs and practices that define women gradually in consonance with evolving trends in society [11]. Land management practices within Tembawang continue to rely on traditional methods and rudimentary tools. Implements utilized include smooth stones, blowpipes, machetes, and snares, and are often supplemented by dogs, nets, or bows for fishing. The changes in these practices have sharp implications for the people of the community that is involved in the management of Tembawang to have more responsibilities to meet the needs of their families. Tembawang agroforestry system is organized in several groups to suit the community group focused on personal use, nuclear households, extended families, and the villages as a whole. This framework is deeply rooted in socio-cultural importance, which is well embodied by the norms of the community where conformity to set regulations depends on every individual's share of responsibility. Most importantly, tree harvesting is approved only with the consensus of all the members of the extended family, which is a significant barrier against the depletion of the environment, and the possible elimination of some tree species due to the uncontrolled cutting of trees that destroys the abilities of trees to regenerate.

The Tembawang agroforestry system, transmitted across five or six generations, embodies extraordinary significance for the sustainability and conservation of future generations. Such practices as growth and maintenance of long-turn growing tree species like Tengkawang (*Shorea stenoptera*), jelutong (*Dyera costulata*), nyatuh (*Palaquium rostratum*), and kemenyan (*Styrax Benzoine*), are therefore foresight; it serves the present need while at the same time enhancing the ecological and cultural value of the generations to come. In addition, the Tembawang agroforestry system may be described as a tradition that evolved systematically over generations, and as such it is culturally, traditionally and, in fact, customary to the Dayak community. As for this system, it is shown that there interconnection between sustainable land management and cultural context, indicating how indigenous knowledge could promote the management and use of biological diversity for sustainable development. The Tampun Juah Indigenous Law Community practices *Nugal* as a form of participatory conservation where the community practices upland rice farming. This practice is in line with a whole set of a rotational farming system, which provides soil fertility by having periods of regeneration. *Nugal* involves clearing a small portion of land and it is done manually maybe using machetes as weapons and it is done in a group. Rice is the foremost crop raised using this technique; however, other crops such as cassava and corn can also be grown. Food gathering through fishing and hunting also has cultural and religious importance not only as a source of sustenance but especially at times of sowing when the community is involved in the tilling of the fields. Dove in the book [13], has classified *nugal* as shifting cultivation practices that are part of indigenous land management since it draws its origins from the people's understanding of ecology.

In Figure 4, the people of *nugal* seen are those from the Tampun Juah Indigenous Law Community. Some of the photographs depict the development of farming where the communal aspects of such practices are captured together with a view of how they maintain the balance of ecology and culture.



Fig. 4. The activity of *nugal* in different area: (a) shrubland area and (b) woodland. Source: author documentation, 2024.

3.3 Implications for indigenous knowledge systems

For the indigenous knowledge to be passed to the young generations it has to be passed down through tradition, and due to the modern world changing its principles and forms, the preservation of indigenous knowledge stands to be compromised. Possible improvement of climate impact resistance and effective promotion of sustainable land management could be achieved through the integration of Traditional Ecological Knowledge (TEK) into present-day management practices [1]. Tampun Juah's indigenous knowledge systems have been threatened by the changing measures of land use, especially the pace at which the conversion takes place. Traditional ecological knowledge transmitted from one generation to the other through techniques in shifting cultivation, forest management, and their day-to-day social interactions with the environment they live in is now at the receiving end as more lands are grabbed for monoculture oil palm plantations.

When Indigenous communities lose access to their customary lands, they experience a disconnect from practicing TEK, which impairs their ability to respond to environmental changes, including climate change. In the case of the Tampun Juah community, limited access to land and the loss of forest resources have significantly reduced opportunities to transmit these practices to younger generations. The community leader further explained:

"Several economic solutions have been proposed, such as providing excavators to help us open land without burning, assigning residents as firefighters to prevent land clearing by fire, or creating lowland rain-fed rice fields. However, these solutions do not fully take into account the community's views on shifting cultivation practices. For some of us, economic-based solutions might be suitable, but for those who still rely heavily on the customary system, these solutions are not always appropriate."

This perspective highlights the disparity between externally imposed solutions and the traditional practices of the community. The integration of TEK into modern land management practices could enhance both ecological resilience and cultural sustainability. TEK should not be viewed as outdated knowledge but as an essential component of contemporary strategies to address climate challenges and land degradation.

In the case of the Tampun Juah, strengthening indigenous land rights would not only reduce land conflicts but also facilitate the regeneration of local knowledge that can be passed on to future generations. Policymakers and development agencies must encourage the active participation of indigenous communities in land management and planning. By integrating TEK into contemporary management systems, both environmental sustainability and the

adaptive capacity of Indigenous communities to navigate the rapidly changing environmental and economic landscape can be supported. The vast majority of the Tampun Juah Indigenous Law Community has diversified its agricultural efforts to adapt to modern economic pressures while preserving key elements of its traditional practices. Figure 5 illustrates the community's mixed cropping system, locally referred to as *kebun campur*, which involves the cultivation of a variety of crops such as corn and cassava (*Manihot esculenta*). Additionally, the community has integrated the cultivation of economically significant tree species like *Jabon* (*Anthocephalus cadamba*), renowned for its rapid growth and high demand in the timber industry. Another prominent crop displayed in Figure 5 is pepper (*Piper nigrum*), highly prized for its considerable economic returns. The majority of landowners in the community have chosen to cultivate pepper, as it currently commands a lucrative price of approximately IDR 150.000 per kilogram.

This combination of diverse crops exemplifies the community's strategic adaptation to evolving economic circumstances while maintaining sustainable land-use practices. By cultivating a mixture of subsistence and high-value crops, the Tampun Juah community not only preserves its traditional ecological knowledge but also secures economic resilience in the face of an increasingly dynamic agricultural landscape.



Fig. 5. The community's mixed cropping system. Source: author documentation, 2024

Integrating Indigenous Knowledge Systems (IKS) into contemporary land management faces several challenges, particularly the lack of legal recognition of indigenous land rights. Without legal protection, communities are often unable to defend their land from commercial exploitation, and their traditional land management systems are marginalized. In addition, the expansion of commercial agriculture, driven by global markets, has intensified the pressure on indigenous communities to abandon their traditional farming systems in favor of more profitable monoculture plantations. This has created a conflict between the modern economic model and traditional ecological knowledge.

Despite these challenges, there are significant opportunities for integrating IKS into contemporary land management practices. Legal recognition, such as the Tembawang Tampun Juah Customary Forest's protection, has provided a model for securing Indigenous lands and promoting sustainable land-use practices. Community-based conservation efforts, which combine traditional ecological knowledge with modern conservation techniques, can create a more sustainable approach to land management. This integration not only protects the environment but also strengthens the cultural ties of Indigenous communities to their land, ensuring that knowledge is passed down to future generations. Additionally, policies that include indigenous knowledge in land-use planning could support biodiversity conservation and ensure sustainable resource management, promoting a more holistic approach to addressing global environmental challenges.

4 Conclusion

In conclusion, this research emphasizes the urgent need to integrate Indigenous Knowledge Systems (IKS) into natural resource management as a means to address the land-use changes observed in the Tampun Juah Indigenous Law Community. The significant transformations in land cover from 2006 to 2022, particularly the shift from mixed cropping to monoculture plantations, as shown in the spatial analysis (Fig. 2), reflect the vulnerabilities of indigenous communities in preserving their traditional land management practices. This decline in traditional practices is exacerbated by economic pressures and state policies favoring commercial agricultural expansion, particularly oil palm plantations.

The integration of Indigenous Knowledge into land management is vital for ensuring the sustainability of both the environment and cultural heritage of Indigenous communities. The results of this study, which include changes in land cover and community responses (Table 1 and Table 2), show that traditional agricultural practices, such as mixed cropping and rotational farming, have been largely displaced by commercial practices. However, the legal recognition of the Tembawang Tampun Juah Customary Forest in 2018 represents a positive step toward securing land rights and promoting sustainable land use.

This study underscores the importance of strengthening Indigenous land rights and involving Indigenous communities in decision-making processes related to land use. The community's participation in land management, utilizing both traditional ecological knowledge and modern conservation practices, offers a promising pathway to reducing the negative impacts of land commodification.

The findings highlight that the preservation and revitalization of traditional practices, such as agroforestry and rotational farming, not only contribute to ecological resilience but also support the cultural sustainability of indigenous peoples. Policymakers must ensure that Indigenous Knowledge is recognized and integrated into contemporary management strategies to protect both the environment and indigenous ways of life. The granting of legal recognition to the Tembawang Tampun Juah Customary Forest in 2018 is a huge step in the fight against the violation of indigenous peoples' property rights. But, to the people of the community, those problems indicate that there is a necessitate for organizing better policy approaches that include TEK to practices of ecosystem management. Supporting the Indigenous peoples' right to decide on the management of their lands and utilizing Indigenous knowledge and innovative approaches to addressing social and ecological deficits created by land commercialization are the main ways of reducing the negative impact of land commodification [26].

5 Recommendations

The views of clients that were elicited from FGDs indicated that they want their culture to be recognized and supported. There is a need to promote Indigenous decision-makers in policy since their aims and objectives are in congruence with development and conservation. The Tampun Juah like other indigenous people has engaged in agricultural practices like shifting cultivation to date. However, this system in the same manner makes provision for the natural regeneration of the soil over other cycles in farming for example by rotation farming production that helps in the provision of constant regeneration of the soil fertility and ground aplenty. But more so in the last few decades, the use of this land has drastically changed. Agricultural land that was once productive for crop production is now covered by most land, open space, and monoculture plantations, especially oil palm. These changes give rise to serious challenges for indigenous peoples. The earlier works reveal the fact that the increase in oil palm plantations reduces space for indigenous communities and also highly impacts the overall biological and physical environment. When forests and rich soils are carved out

for plantations Indigenous people are deprived of natural resources they rely on for their day-to-day needs including fruits, herbs, medicines from the forests, and fertile land for cultivation.

Moreover, the environmental degradation resulting from land conversion exacerbates the local ecosystem's fragility. The loss of biodiversity and the increase in soil erosion worsens agricultural conditions, which are already under threat from climate change. Ecological impacts further undermine food security and disrupt the ecological balance, directly affecting the well-being of indigenous communities. From the perspective of *Cultural Ecology*, as introduced by Beneth [16], the close relationship between human culture and the environment is jeopardized by these commercial land-use changes. Indigenous land management systems, which have proven to be ecologically sustainable over centuries, are often disregarded in development policies, marginalizing the rights of indigenous peoples. Land conversion also exacerbates social inequality, as highlighted by *Political Ecology* theory [11], which suggests that environmental changes are frequently controlled by political and economic forces that disadvantage indigenous peoples.

Political Ecology provides an essential framework for understanding the dynamics of land-use change in the context of power relations, economic pressures, and environmental governance. This theory emphasizes the role of state policies, corporate interests, and global market forces in shaping land management practices. In the case of the Tampun Juah community, the shift to commercial farming, particularly oil palm plantations, is not solely an environmental change but also a political and economic one. Political Ecology helps explain how external economic pressures, such as the demand for cash crops, often push indigenous communities into abandoning their traditional agricultural practices in favor of more economically viable options, like large-scale plantations.

In the context of the Tampun Juah community, the loss of rights to their customary lands and environmental degradation have placed immense economic and social pressure on them. To address this issue, there is an urgent need for policies that genuinely uphold indigenous land rights. Recent research by Wright et al [18], underscores the importance of involving Indigenous peoples in decision-making processes related to land management, as this can help reduce deforestation and promote sustainable resource management. This is further supported by Oberlack et al. [20-22], who argue that approaches that strengthen indigenous land rights and integrate local wisdom into land management policies can effectively preserve environmental sustainability and enhance local livelihoods. As a recommendation, policymakers must not only recognize the land rights of indigenous communities but also actively involve them in planning and land management [23]. Equitable approaches, such as recognizing customary land management rights and integrating community-based sustainable farming practices like agroforestry, will help balance economic development with environmental conservation. By adopting these approaches, the goals of sustainable development and environmental conservation can be achieved, while ensuring the survival and well-being of marginalized indigenous communities [24-25].

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