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Research Paper

Bridging the Gap between Land Suitability and Local Wisdom Species in South Sumatra Peatlands, Indonesia

M. Edi Armanto[1]*, Elisa Wildayana[1]

[1] *Faculty of Agriculture, Sriwijaya University, South Sumatra 30820, Indonesia*
***Corresponding author**: mediarmanto@unsri.ac.id

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Abstract
The primary issue with peatlands until now was people's ignorance about land suitability. Changes in patterns and details of the distribution of peatland use based on Local Wisdom Species (LWS) are increasingly unclear. We don't know the suitable locations of cultivated LWS, so peatland productivity is declining and degradation continues. This research aims to evaluate land suitability for LWS in South Sumatra peatlands, Indonesia. Local Wisdom Species and soil samples were taken based on the type of peat land uses, and then laboratory work was carried out. Local Wisdom Species showing direct benefit are divided into two groups, namely LWS producing quickly are usually Purun Tikus (*Eleocharis dulcis*), water spinach (kangkung), bitter melon (paré), floating rice, and auction system for fishing, and LWS recognizing commercially are usually coconut, honeybees, gelam, sago, and jelutong. The level of land suitability of these two groups is S1 (highly suitable); and S2 (moderately suitable) with the only limiting factors being nutrient availability and nutrient retention (except coconut). By using science and technology, such as liming, fertilizing, improving water systems, and avoiding burning, all of these limiting factors can be overcome. Based on local knowledge, four strategies are suggested for sustainable peatland restoration, namely decentralized; conservative; protective; and optimal strategies.

Keywords
Suitability, peatlands, LWS, soil ameliorants

1. INTRODUCTION

Peatlands have been degraded and exploited by industrial plantations (Oil Palm and Acacia) and globalization (Armanto et al., 2023b), especially peatlands in remote areas are under increasing pressure to exceed their carrying capacity (Syakina et al., 2024a,b), even with improved technology for managing peatlands (Byg et al., 2023). To grow and develop, industrial plantations require a decrease in groundwater levels (drainage) every year. This is because the plants do not belong to peat native plants (Holidi et al., 2019). Drainage of peatlands causes forest and land fires and creates ongoing problems for peatlands (Junedi et al., 2017).

Since reclamation, the main challenges faced by peatlands are ignorance about the suitability of peatlands (Abijith and Saravanan, 2022), changes in use patterns (Armanto et al., 2013), and the annual distribution of peatlands based on LWS. Until now, we do not know which areas are suitable for LWS because peatland reclamation is always carried out using the try-and-error method (Guth et al., 2022), so land productivity continues to decline and the process of land degradation continues. Local Wisdom Species differ from local wisdom and knowledge on peatlands (Wildayana and Armanto, 2018d), namely local wisdom and knowledge may include innovative techniques for restoring peatlands (Wildayana and Armanto, 2021).

To overcome this LWS problem, land suitability is a basic concept for sustainable peatland management activities based on a measure of peatland capability (Bhunia et al., 2018). The aim of this concept is primarily to prevent peatlands and their environment from being degraded, so that their existence, sustainability, and function can be realized, and users of peatlands remain in a prosperous condition and/or are not disadvantaged (Armanto et al., 2022). Local Wisdom Species do not destroy peatlands, do not extract them, and do not negatively impact the environment, they can be considered a conservation-based alternative (Wildayana and Armanto, 2018b). If LWS are managed well, they can have a positive impact in the form of restoration improvement, conservation, environmental preservation, and empowerment of rural communities (Armanto et al., 2025).

The condition and potential of the peatlands where LSW begins is a key step in understanding LWS (Wildayana, 2017). The LWS concept places more emphasis on the suitability of location, naturalness, uniqueness (Wildayana and Armanto, 2018c), and authenticity of natural resources (Zuhdi et al., 2019). Therefore, the parameter criteria used to determine land suitability have to consider the condition of the peatland ecosystem resources (Hu et al., 2021). The research benefit is to address the knowledge gap between the mismatch between land suitability and LWS (Lázaro-Lobo and Ervin, 2021), provide the reciprocal contribution requested by rural communities, and an integrated scientific assessment of: (1) how knowledge about land suitability can be integrated into LWS, and (2) provide scientific evidence from research results helping rural communities develop LWS optimally. The responses to these queries will demonstrate the extent to which knowledge systems may support sustainable development in rural areas (Armanto, 2019a). To emphasize the intended discussions, this study concentrated on the following description:

1) Describe that LWS has been proven to develop significantly in rural areas;
2) Outline a specific methodology for collecting LWS and evaluating its content;
3) Suggest problems in rural development where LWS analysis is expected to provide optimal benefits for villages.

This research aimed to carry out matching land suitability with LWS in South Sumatra peatlands, Indonesia.

2. EXPERIMENTAL SECTION

2.1 Research Sites

This research was carried out in the peatlands of South Sumatra, Indonesia according to PMRA (Peat and Mangrove Restoration Agency) (2022) from January to June 2024 (Figure 1). Local Wisdom Species sampling and soils were carried out based on the type of peatlands used, then laboratory work was carried out. Soil and water sampling collection was carried out using tracing methods. The collected data consists of LWS, thickness, maturity, and physical and chemical characteristics of the peatlands.

2.2 Survey Method and Data Collection

The data collection method used the quadratic transect method, namely by making a transect perpendicular to the line from the beach toward the land. Each observation location consists of three quadrat transect plots, where each plot consists of a plot (10 x 10) m^2 (for observing trees), a plot (5 x 5) m^2 (for observing saplings), and a plot (2 x 2) m^2 (for observation of seedlings). The determination of sampling points was carried out using the purpose sampling method, and there were 12 peatland observation plots spread evenly in the study area. The collected soil samples were carried out in laboratory work to determine the selected variables studied using the methods presented in Table 1.

2.3 Statistical Analysis

All observed variables (C, N, C/N ratios, P, K, Ca, Mg, and pH), organic matter and nutrient accumulation (dependent variables) are influenced by land cover and peat layers (independent variables) using a two-way analysis of variance (ANOVA) with the SPSS program and the Tukey HSD (Honestly Significant Difference) test at a significance level of 5 % to test whether there are differences in the values of the variables studied and in all testing procedures. The hypothesis level of significance was set at $\alpha = 0.05$.

2.4 Analysis Methods of Soil Suitability

Determining the suitability of peatlands was based on matching with land suitability according to the Ministry of Agriculture Regulation (2021), number 79/Permentan/OT.140/8 /2013 (Armanto, 2019a). The existing land suitability was classified into three land suitability classes, namely S1 (highly suitable); S2 (moderately suitable); S3 (marginally suitable); and not suitable (N).

3. RESULTS AND DISCUSSIONS

3.1 Local Wisdom Species Adapting to Peatlands

Local Wisdom Species adapting to peatlands are species providing direct benefits, applied in the fields, passed down from generation to generation and can be cultivated in flooded peatlands (Table 2). Fast-producing species are species that produce quickly (less than three months), but have lower unit value and are used as food and raw materials for home industry. Proven commercial species are species having commercial value and growing well in peatlands and being used as industrial raw materials. Most these species have not been utilized optimally either by the government, rural communities, or the plantation industry as superior peatland commodities. This happens because there are still many information and market gaps regarding this species. This is relevant with works of Armanto (2019c,b).

To maintain LWS, environmental engineering is required; this means building rural communities by maintaining traditions that have been passed down from generation to generation (Armanto et al., 2024). Unfortunely, only around 10-20 % of LWS was maintained by rural communities due to government policies that provide concessions for industrial plantations and most of the indigenous rural communities work in this sector. There is an opportunity to survive LWS by revitalizing peatlands, which reduce damage to peatlands and provide new source of rural livelihood.

3.2 Key Variables of LWS Suitability in Peatlands

Table 3 outlines important variables for peatland suitability based on various types of permanent land uses. These important variables usually differ from each other and are influenced by the type of land uses. These differences reflect changes in peatland use. All key variables analyzed

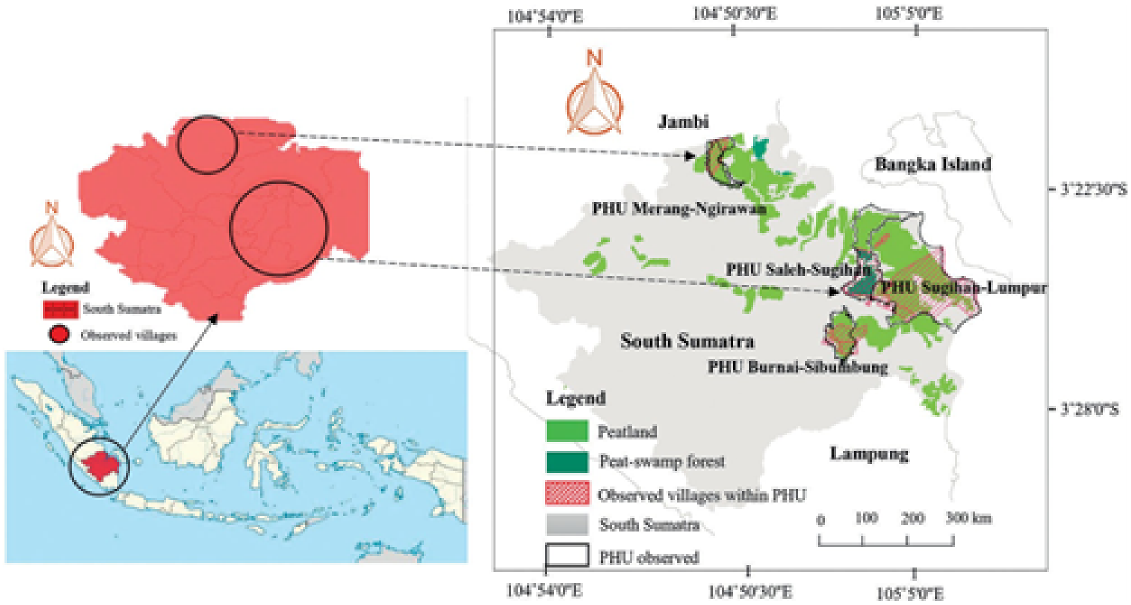

Figure 1. Research location in South Sumatra Province, Indonesia

Table 1. Research variables and their measuring techniques

Parameter and units	Methods
Water content (%)	Oven drying and weigh
Bulk density ($g\,cm^{-3}$)	Ring samples and weigh
Total pore space (%)	Ring samples and weigh
Organic C ($kg\,ha^{-1}$)	Walkey and Black
Total N ($kg\,ha^{-1}$)	Wet ashing with H_2SO_4, spectrophotometer
C/N ratio	Ratio calculation
Peat depth (m)	Boring
Soil acidity, pH value	pH meter
Soil fertility (scale)	Certainty factor methods
Inundation depth (m)	Piezometer
Wet moisture (%)	Air drying and weigh
Dry moisture (%)	Oven drying and weigh
Groundwater level (cm)	Field measurement
Fiber (%)	Sieving and weigh
Ash (%)	High temperature and laboratory analyses
Dried biomass ($kg\,ha^{-1}$)	Weigh and oven-drying
Total biomass ($kg\,ha^{-1}$)	Calculation: 1.74 % × organic C (%)
P total, K, Ca, Mg ($kg\,ha^{-1}$)	Wet ashing with HNO_3 and H_2SO_4, spectrophotometer

Note: C (organic carbon); N (total nitrogen); P (phosphorus); K (potassium); Ca (calcium); Mg (magnesium); H_2SO_4 (sulfuric acid); HNO_3 (nitric acid).

significantly differed between cultivated and uncultivated peatlands, mainly in 5–25 cm depth.

If compared with cultivated peatlands (plot A, plot B) and uncultivated peat (plot D, plot E), the characteristics of the selected peatlands were very different. Plot E experienced the most fires. As a result, many measured variables experienced changes every year due to intentional (sonor system) and unintentional fires (due to fires spreading around the plots). In addition, plot E showed the influence of land uses and drainage. The significant parameter differences in plot E were the result of significant peat degradation. There are two types of peat degradation, the first is the biological decomposition of peatlands, which produces gas emissions, such as CO, NO, and so on. The second is a physical process, such as excessive drainage, which causes peat subsidence, compaction, and an increase

Table 2. Local wisdom species peatlands showing direct benefits

Species group	Name of species	Direct uses
Fast-producing Species (5 species)	Purun tikus (*Eleocharis dulcis*)	Handicraft materials
	Kangkung (*Ipomoea aquatica*)	Vegetables
	Paré (*Momordica charantia*)	Vegetables
	Floating rice (*Oryza sativa*)	Starch, carbohydrates
	Auction system for fishing	Fishes
Proven commercial species (5 species)	Coconut (*Cocos nucifera*)	Edible fruit, oil
	Honeybees (*Apis spp.* L.)	Honey
	Gelam (*Melaleuca cajuputi*)	Eucalyptus oil
	Sago (*Metroxylon sago*)	Starch, Carbohydrates
	Jelutong (*Dyera polyphylla*)	Latex

Source: Analyses of field survey results (2024).

Table 3. Average key variables of peatland suitability and Tukey HSD test***/

Key variables */	Cultivated peatlands		Uncultivated peatlands		
	A**/	B	C	D	E
BD ($g\,cm^{-3}$)	0.23^a	0.23^a	0.14^b	0.15^b	0.16^b
TPS (%)	82^a	84^a	88^b	88^b	93^c
Organic C (%)	41.96^a	43.50^{ab}	49.11^c	48.73^c	45.94^b
Total N (%)	1.79^a	1.78^a	1.99^a	1.95^a	1.80^a
C/N ratios	23.44^a	24.44^a	24.68^a	24.99^a	25.52^a
WM (%)	443^a	468^b	460^b	470^b	473^b
DM (%)	80^a	84^a	80^a	84^a	80^a
GWT (cm)	41^a	39^a	20^b	21^b	24^c
Fiber (%)	23.34^a	24.40^a	37.02^c	30.50^b	23.52^a
Ash (%)	5.36^a	5.42^a	5.89^a	10.12^b	12.36^b

Note:
*/ BD (bulk density); TPS (total pore score); C (organic carbon); N (total nitrogen); WM (wet moisture); DM (dry moisture); GWT (groundwater table)
**/ A (Cultivated forest); B (Oil palm); C (Peat forest); D (Swamp bush); E (Swamp grass)
***/ Individual numbers (means) with the same superscript within each row are not significantly different at a significance level of 5 % according to the Tukey HSD Test.
Source: Analyses of laboratory results (2024).

in bulk density.

Bulk Density (BD) and Total Pore Space (TPS)

Generally, the lowest BD was found in the top layer of peatlands and increases with depth and reaches the highest value in the bottom layer at a depth of 50 cm for all research plots. The deeper layers across the sampling plots showed similarities to each other (range 0.14-0.24 $g\,cm^{-3}$). Uncultivated peatlands had a lower BD (0.14-0.16 $g\,cm^{-3}$) compared to cultivated peatlands (0.23 $g\,cm^{-3}$) and showed a statistically significant difference at a significance level of 5 %. This difference arises because all cultivated peatlands receive dominant human intervention compared to uncultivated peatlands, such as illegal logging, industrial plantations, agriculture, sonor system, grazing livestock, and fisheries.

Fires and other disturbances mainly occurred on the peatland surface, where high temperatures occur during burning producing charcoal through the pyrolysis process. In cultivated peatlands, peatland changes generally occurred (Armanto, 2019b), especially when certain variables of BD increased; ash and fiber content decreased, and organic C decreased. The fine peatland particles and most of the swamp grass at plot E were more susceptible to fire, high temperatures, and water movement. Water movement can transport fine peat particles to other places, allowing them to fill cracks, pores, and voids in the peat surface. This process will have an impact on several peat characters in plot E, this research result is in line with Lázaro-Lobo et al. (2023).

TPS shows the opposite phenomenon to BD; the higher the TPS, the lower the BD. The lowest TPS values were found in cultivated peatlands (82-84 %) and the highest

TPS values were found in uncultivated peatlands (88-93 %). The TPS statistical test shows that the average TPS value on uncultivated peatlands was different from the TPS value on cultivated peatlands, and this difference was very significant compared with plot E (swamp grass). The TPS value made up about 78 % of the BD value, according to the closely related BD regression with the TPS value (R2 = 0.78). Thus, the BD value increases when the TPS value decreases, which indicates that peat compaction occurs.

Organic C, N, and C/N Ratios

Organic C in cultivated peat (41.96-43.50 %) was lower and significantly different than uncultivated peat (45.94-49.11 %). This difference was due to more intensive decomposition in cultivated peatlands, while N values did not show a significant difference. Peatlands were increasingly degraded, reflected by a decrease in the C/N ratio, although the C/N ratio of all sampling plots did not show a significant difference. An increase in the C/N ratio with depths was also reported in several studies of ombrotrophic peat. Repeated fires cause a decrease in soil biomass, in addition to the evaporation of N during peat burning, so that soil N concentrations reduce total N, and the C/N ratio was detected to be higher in uncultivated peatlands. N concentrations decrease in cultivated peatlands during land clearing, which means land clearing is the main cause and this research also concluded in the research results of Imanudin et al. (2019). Recovering crop residue will keep the C/N ratio high.

3.3 Limiting Factors of LWS Suitability in Peatlands

The most important limiting factors of LWS growing were climate, physical conditions, and soil fertility. Based on the description of each land suitability parameter using the matching method, all LWS can be classified into two land suitability classes, namely classes S1 (highly suitable); S2 (moderately suitable); S3 (marginally suitable), as concluded in Table 4.

In assessing the limitations and suitability of LWS, there are only a few temporary limiting factors that can be improved through the use of science and technology. These factors are na (availability of nutrients N, P, K); a (soil acidity); and nr (nutrient retention, such as CEC, BS, and organic C). For peat depths of more than 3 m, the limiting factor is the peat depth (1-3 m) plus a limiting factor.

3.4 Efforts to Improve Land Suitability for LWS

Various efforts to increase land suitability for LWS are presented in Figure 2. Almost all of these limiting factors can be overcome by farmers.

Improving Peatlands for Local Wisdom Species

Figure 2 states clearly that LWS is very suitable (S1) for peatlands if provided with groundwater level management, non-burning, lime, and NPK fertilizer, especially for fast-producing species. Therefore, farmers have to be equipped with knowledge regarding peat characteristics and the dynamics and balance of the peat ecosystem. For proven commercial species, it is enough to regulate the water system and not burn.

Improving Governmental Policy

To date, rural communities have been required to receive compensation from industrial plantations and the government as part of government policies regarding the restoration of peatlands. So far, the policy has been implemented voluntarily. However, the government has prohibited rural communities from managing agricultural peatlands with depths of more than 3 m which have been designated as a conservation area. In addition, exporting species that have been proven useful (such as Honeybees and Jelutong) requires permission from the government.

Although rural communities and industrial plantations did not pay attention to government policies. To date, government laws have not been implemented in the field (Negassa et al., 2019). Rural communities could choose to retain their rights, and they viewed the injunction as resulting in the loss of rights that would be maintained for subsequent generations. During the use of peatlands with depths of more than 3 m, the drainage produced by industrial plantations also reduced restoration efficiency. Restoration strategies should also be implemented in an environment where the government continues to provide effective subsidies, as many rural communities feel that large-scale industrial plantations produce considerably more environmental degradation than small-scale rural communities. Meanwhile, agricultural and rural votes have less influence on politicians, and rural community associations have a low bargaining position at the national level (Armanto and Wildayana, 2022a). In this context, restoration agencies are depicted as external entities supported by government bureaucracy and focused on industrial plantation businesses rather than the needs of rural communities.

Research results showed that rural communities support the sustainability of industrial plantations. In contrast, most stakeholders were willing to pay to protect peatlands. Therefore, it is necessary to reach an agreement that rural communities can retain their property rights, but they must work together to create a management system that limits the pressure exerted on the peatlands collectively. One of the requirements for any such co-management scheme was that conservation agencies must increase the understanding of all stakeholders, policymakers, and rural communities, about the public commodities (services) provided by peatlands. This result same as the statement of Varone et al. (2021) research results.

Research results showed that LWS is starting to be recognized as the importance of peatlands for the public good. In

Table 4. Rating for peatland limitations and suitability local wisdom species

Species	Origin of species	Peat depth (1-3 m)	Peat depth (> 3 m)
Fast-producing (5 species)			
Purun tikus	Native	S1	S1
Kangkung	Native	S1na, nr, a	S2f, na, nr, wa
Paré	Native	S1na, nr	S2f, na, nr
Floating rice	Invasive	S2na	S3f, na, nr
Auction system for fishing*/	Native	S1na, nr	S2f, na, nr
Proven commercial (5 species)			
Coconut	Invasive	S2tc, na, nr	Nrc, tc, wa
Honeybees**/	Native	S1na, nr	S1na, nr, a
Gelam	Native	S1na, nr	S1na, nr
Sago	Native	S1na, nr	S1na, nr, f
Jelutong	Native	S1na, nr	S1na, nr, wa

Note: S1 (highly suitable); S2 (moderately suitable); S3 (marginally suitable); N (not suitable). tc (temperature); wa (water availability, precipitation and humidity); rc (rooting media); nr (nutrient retention, e.g. CEC, BS; organic C); na (nutrient availability (N, P, K); a (soil acidity); f (flood, e.g. frequency, period; water current speed).
*/ Determining land suitability was only based on the suitability of potential land and water resources for fisheries.
**/ Determining land suitability is based only on potential food availability for honeybees.
Source: Analyses of laboratory results (2024).

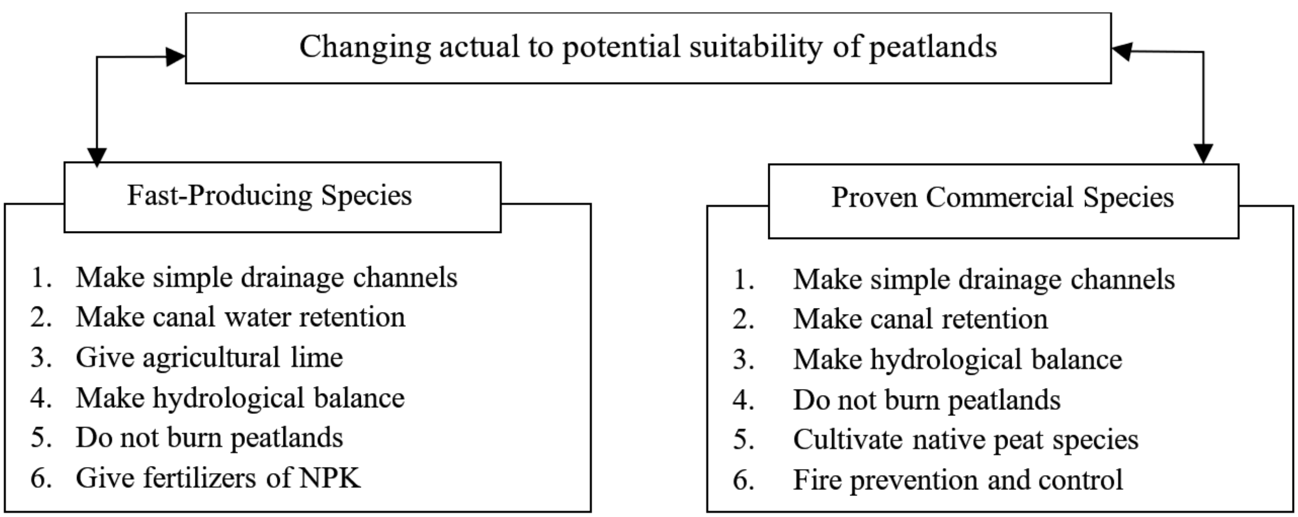

Figure 2. Some efforts to increase land suitability for LWS

general, the application of the LWS concept can be carried out with the following requirements:

1) If there are still remnants of LWS, then hydrological restoration may be sufficient, so that LWS can regenerate naturally, if the area is protected from forest logging and fires.
2) If only a few LWS trees are found left, then enrichment planting with LWS is necessary because there are only a few seeds available in the peatlands to regenerate naturally.
3) If fires have affected a large part of the area, then ecological restoration is required, namely full rewetting and LWS revegetation of the entire peatlands.

3.5 Site-Specific LWS for the Restoration of Peatlands

Various LWS can thrive optimally on peatlands with hemic and sapric maturity and depths of less than 1.0 m, provided that groundwater management is done properly (Table 5). This result was also shown by other researchers (Byg et al., 2023).

However, as the field data showed, the output and income from peatlands was not enough to meet families' growing needs and expenses. The phenomenon can be attributed to three main factors, namely low agricultural productivity (which is often not affected by recent advances in peatland agronomy); unstable agricultural commodity prices (which are not affected by market fluctuations and limited demand from small-area and agro-industrial populations); and inadequate transportation infrastructure (which makes it hard for indigenous farmers to earn a living and is not affected by changes in sale prices). These results were consistent with those of other researchers (Wildayana and Armanto, 2018a), who found that poverty was a constant aspect of life for peatland farmers.

The primary constraints that hinder indigenous farmers from engaging in peatland restoration techniques were enumerated, with the most significant one being a lack of awareness regarding the instability of peatlands (cited by 31 % of farmers). This is a result of the populations' transmigration from Java Island, where they were acclimated to upland farming, which is entirely different from peatlands, to the research sites. Up until now, there hasn't been a single government or non-governmental organization in charge of teaching farmers about the temporal and spatial dynamics unique to peatlands. Climate circumstances were unpredictable because the effects of global warming and climate change made this worse.

The lack of medium-term loans indicates that the farmer was not used to trying to use banking services, even if it only makes up 10 % of the issue. In addition, the transmigration areas continuously updated spatial planning conditions result in the unknown peatland ownership and legality aspect playing a very substantial part (20 %). Inadequate institutional capacity, limited access to rural infrastructure, and a lack of commercial economies of scale - 14, 13, and 12 %, respectively - are additional factors that could exacerbate farmers' involvement in peatland restoration. This outcome is comparable to what other researchers have found (Armanto and Wildayana, 2022b).

Cultivating annual as well as seasonal agricultural species, namely food crops, trees and others, can help lessen the adverse consequences of boomerang land expansion-induced increased land conversion; and seasonal mixed farming can increase farmers' income streams while reducing risks. This result was also shown by other workers (Vilas-Boas et al., 2022).

Increasing commercial regional development by exploiting peatland ecosystems has continuously put pressure on indigenous farmers who live in and around peatland agroecosystems. Weak agricultural innovation and limited market access have led them to cultivate existing peatlands in ways that are not environmentally sound and are not well organized. There is an opinion that peatlands with a thickness of more than three meters are considered a potential source of land for future generations. If this happens, then the long-standing conflict between stakeholders regarding who can use natural or cultivated wood for agricultural purposes will be difficult to overcome. Indigenous farmers usually work on a "first come, first serve" basis. In conditions like these, slash-and-burn farming and illegal logging are forms of livelihood that are considered legal and permitted. This result was demonstrated by other workers (Armanto and Wildayana, 2022b).

To preserve LWS - traditions that have been passed down from generation to generation as part of society's social development - environmental engineering is required. It appears from the field results that a variety of LWS can be established, including the use of MPTS, gelam forests and honeybee colonies, sago farming, and fishing auction system (Table 5). Site-specific LWS for peatland restoration have also been studied intensively by other researchers (Wildayana and Armanto, 2018d; Armanto et al., 2023a).

Field data reveals that there were disputes between native farmers and industrial plantations, particularly when it came to overseeing the restoration of the peatlands. Based on local knowledge, four strategies are suggested for sustainable peatland restoration, namely:

1) The decentralized strategy, which is a management, marketing, links, participation, and authority delegation strategy. Commodity zoning, site specificity, and community empowerment are its traits. This can be achieved, for example, by growing MPTS plants, in accordance with the revitalization program, by utilizing technology to benefit stakeholders, beneficiaries, and the environment.
2) The conservative strategy entails selecting a business plan that is expected to yield more profits over time, even if it appears less advantageous in the near run. For instance, peatlands do not require draining for the Gelam forest or honeybee colonies.
3) A protective strategy, which entails safeguarding peatlands whose benefits to nature outweigh their economic potential and aligns with ecological restoration efforts, such as the introduction of sago farming. Peatlands do not need to be drained for sago.
4) An optimal strategy. The best course of action, which is to manage peatlands in accordance with the amount, quality, and time that are most beneficial and long-lasting, can be implemented, namely an auction system for fishing.

4. CONCLUSIONS

Two groups of LWS in peatlands are directly beneficial, namely fast-producing species (namely purun tikus; kangkung, paré; floating rice; and fishes), and proven commercial species (generally in the form of trees, i.e. coconut; honeybees; gelam; sago; and jelutong). These two groups have a very suitable level of land suitability with only limiting factors, namely nutrient availability and nutrient retention,

Table 5. Site-specific local wisdom species for the restoration of peatlands

LWS*/	Field-fact descriptions
MPTS**/	About 10–20 % of LWS has been lost since the government has given peatland concessions to industrial plantations, the majority of which employ indigenous farmers. Reviving this local knowledge will help minimize the degradation of peatlands and provide them with new income sources through peatland restoration. The fact that MPTS produces both wood and non-wood commodities means that farmers may use the latter without having to cut down any trees, which is beneficial from both an ecological and economic perspective.
Gelam Trees	Eucalyptus oil sources are extracted from Gelam Forest, a timber that grows wild in peatland forest settings. Gelam trees are considered hardy trees because they can withstand harsh winds, droughts, and extreme temperatures. If they spread beyond their native region, they may be regarded as weeds. Gelam trees provide lovely landscaping plants for gardens as well. Cajeput, or tea tree oil, is made from the leaves of the Gelam tree and has both medicinal and antibacterial qualities. Their leaves are used to treat stomachaches and the plague. Their trees are used to treat burns, cramps, stomach ache, skin issues, wounds, and a host of other ailments and disorders, including gout and joint diseases. Though this tree's pink/brown gemstone wood has a constant texture and is ideal for carving, the cabinet bark is often used in the boat-building business, especially for insulation between boat board sheets. The dark forest is the most favorite plant among beekeepers to transfer bees since it yields high-quality honey and has year-round flowers.
Honey-bees	A heritage passed down through the generations is beekeeping, which can contribute to the sustainable utilization of resources from peatlands. The risks connected to beekeeping are very low when compared to other commodities. The Gelam forest is a common place to find honeybee hives.
Sago	Rumbia is where sago originates. A staple food that was more extensively consumed than wheat was sago flour. It has long been a raw element in manufacturing. Sago flour is used to make "pempek", a traditional Palembang fish cake made of tapioca and crushed fish meat. Sago evolved into a staple, producing flour other than tapioca, safeguarding the environment, and lowering dependency on imports, all of which helped to preserve sago and preserve Pempek's traditional food and culture. Restoring Sago food security and bolstering environmental-based food security require integrating Sago trees into social forestry and peat restoration initiatives.
Auction System for Fishing	A fishing auction system can contribute to the sustainable use of fisheries resources. This will keep encouraging the sustainable exploitation of fisheries resources in regions with peatlands. The assessment of potential hazards indicates that the potential dangers to river waters with auction status are somewhat manageable when compared to water areas without auction status. Because diverse kinds of fish gather in the remaining puddles, indigenous farmers exploit the dry season—when the water in the canals, rivers, and peatlands recedes—as a time to catch fish. Fish collection, or melebung, is the term for this kind of fishing, which is done with a variety of gear, such as hands, fishing rods, and nets. Only fish that were medium to large (with tails longer than 8 cm) were collected in the past. Fish smaller than 8 cm were abandoned because they would reproduce during the wet season. But all the fish, tiny and large, are gone now. Strangely, as these fish become less in number, humans get more and more "greedy" when fishing, resorting to tactics like battery stuns and poison, and harvesting fish of all sizes. This conclusion is consistent with the findings of other researchers. Since fish is always eaten with rice, fish serves as the primary food source for the indigenous farmers in addition to rice. Fish can be used in many different menu items. Thus, the food situation is more concerning than only land fires because of severe drought. Communities that settled near peatlands during the dry season experienced negative effects, which the government used as a lesson to preserve the remaining peatlands. For example, the government outlawed stockpiling peatlands, disallowed slash-and-burn farming, and forbade the harvesting of fish less than 8 cm. If peatlands are overused, especially in the dry season, many rural communities will surely perish from starvation.
Note:	*/ LWS (Local Wisdom Species). **/ MPTS (Multi-Purpose Tree Species), for examples sugar palm (*Arenga pinnata* (Wurmb) Merr.), guava (*Psidium guajava* L.), cinnamon (*Cinnamomum verum* L.), and petai (*Parkia speciosa* Hassk).

except for coconut. All these limiting factors can be overcome with science and technology, for example improving the water management system, liming, fertilizing, and not burning. In general, the application of the LWS concept can be carried out with the following requirements:

1) If there are still remnants of LWS, then hydrological restoration may be sufficient, so that LWS can regenerate naturally, if the area is protected from forest logging and fires.
2) If only a few LWS trees are found left, then enrichment planting with LWS is necessary because there are only a few seeds available in the peatlands to regenerate naturally.
3) If fires have affected a large part of the area, then ecological restoration is required, namely full rewetting) and LWS revegetation of the entire peatlands.

Based on local knowledge, four strategies are suggested for sustainable peatland restoration, namely decentralized; conservative; protective; and optimal strategies.

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