

EVALUATING PEATLAND FIRE MANAGEMENT STRATEGIES USING ASEAN FRAMEWORK: A CASE STUDY OF FMU KAYU TANGI, INDONESIA

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ABSTRACT

Deforestation in South Kalimantan has increasingly encroached upon peatlands within the Kayu Tangi Forest Management Unit (FMU/KPH) in Liang Anggang Sub-district, Banjarbaru City. Despite its designation as a protected forest area, ongoing encroachment and land-use conversion have heightened wildfire risks, with 140 hotspots recorded between 2015 and 2025, averaging 14 hotspots per year. This study aims to analyse the strategic management practices of the FMU-Kayu Tangi based on the ASEAN peatland fire management guidelines and subsequently develop a conceptual model for peatland fire management as an adaptive, collaborative, and sustainable fire control system. A qualitative approach was employed using in-depth interviews, observation, and document analysis. The development of management strategies was guided by the peatland fire management framework published by the Association of Southeast Asian Nations (ASEAN) in 2021 and strengthened through SWOT analysis. The findings reveal that FMU Kayu Tangi implements an integrated peatland fire management approach covering prevention, preparedness, response, and recovery strategies. Preparedness efforts include early warning systems, public campaigns, and information dissemination, while response strategies involve collaboration with the Regional Disaster Management Agency (BPBD), the Indonesian National Armed Forces (TNI), and the Indonesian National Police (POLRI). Recovery strategies focus on post-fire rehabilitation, peat-endemic plant cultivation, burned-area monitoring, and law enforcement. Conceptually, this study identifies the Management Strategy of Peatland Fire (MSPF) as a model integrating regulations, peatland management, community participation, institutional capacity, public communication, and fire-monitoring technology. The study concludes that collaborative, ecosystem-based governance can enhance the effectiveness of peatland fire management despite institutional resource constraints.

Keywords: *management strategy, peatland fire disaster, protected forest area*



INTRODUCTION

Indonesia is a country prone to hydrometeorological disasters, including floods, extreme waves, Land and forest fires, drought, and extreme weather (Amri et al. 2016; Susandi et al. 2018; Yanfatriani et al. 2024; Santoro, Piras, and Yu 2025). South Kalimantan Province are ideal locations for observing forest degradation, with an average deforestation rate between 2013 and 2021 of 13,141 hectares, accounting for 2.72% of the national total (Badan Pusat Statistik (BPS), 2024) which is consistent with the findings of several studies, including Muzdalifah, (2020); Schmidt et al., (2024); and Segah et al., (2025).

Deforestation in South Kalimantan has encroached upon peatlands in Liang Anggang Sub-district, Banjarbaru City, South Kalimantan Province. This area falls within the Kayu Tangi Forest Management Unit (KPH), which has been designated as a protected forest area, specifically a water resource conservation and a peatland ecosystem protection area. Logging activities in the Liang Anggang peatland area pose a risk of land fires, particularly during the dry season (Nasruddin et al., 2020; Nasruddin & Muhammad Efendi, 2022), as indicated by Sipongi+ data from 2015 to 2025, which recorded 140 hotspots, an average of 14 hotspots per year. (See Table 1).

Table 1. The number of hotspots in the Kayu Tangi FMUs area, Liang Anggang Subdistrict, and the surrounding area of Banjarbaru City (2015-2025)

Years	Hotspots	Satellite	Significant Data
2015	32	Nasa-Modis	High
2016	1	Nasa-Modis	Medium
2017	5	Nasa-Modis	High
2018	20	Nasa-Modis	High
2019	28	Nasa-Modis	High
2020	1	Nasa-Modis	Medium
2022	2	Nasa-SNPP	Medium
2023	42	Nasa-Modis	High
2024	3	Nasa-Modis	Medium
2025	6	Nasa-SNPP	Medium

Source: Sipongi+, (2025)

The protected forest area in Liang Anggang District, Banjarbaru City, has experienced two fire incidents, namely in 2015 and 2019, and until 2020 land

deforestation continued in Block I with a land conversion of 22.42% or 215.316 ha covering arable Land (13.10%), plantations (8.01%), buildings (1.1%),



agriculture 0.24%) from a total area of 960,233 hectares. Land conversion is a process of change from its original condition caused by human activity to obtain a type of side job, as well as common public knowledge of the ownership status of government-owned Land (Nasruddin et al., 2020). The impacts of these activities include an increased risk of land fires and greater difficulty in extinguishing fires in deep peat layers. The peat ecosystem consists of swamp forest/peat forest (60%), with

the majority of peat depths being moderate at 100-200 cm (40.63%), 200-300 cm (deep to very deep), and >300 cm (37.56%), with the remaining 16.77% comprising shallow peat (50–100 cm), peat soil (<50 cm), and non-peat areas (5.04%) (Nasruddin et al., 2020; Nasruddin & Muhammad Efendi, 2022). The peat depth map of Block 1 Liang Anggang is shown in **Figure 1** and the condition of the peat swamp in Block 1 is shown in **Figure 2**.

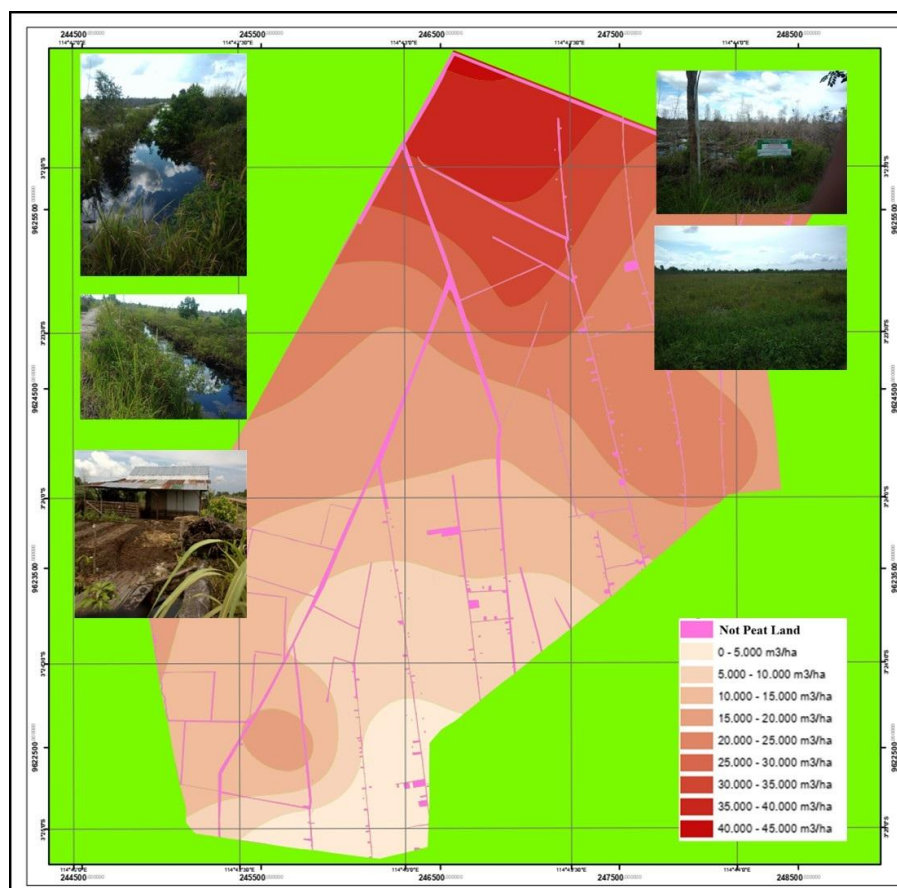


Figure 1. Peat Depth Map for Block 1 Liang Anggang – Kayu Tangi Forest Management Unit

Source: Survey 2023 and Analysis of the Dinas PUPR Banjarbaru City, 2018



Figure 2. Condition of the Peat Swamp in Block 1, Liang Anggang, Kayu Tangi Forest Management Unit (FMU)

Source: Field Survey, 2023

Forest Management Units (FMUs) are government organizations responsible to the Forestry Service at the provincial level, with a relatively uniform organizational structure throughout Indonesia, formed to carry out forest management at the site level (Rahmadanty et al., 2020; Wahyudi et al., 2021; Nugroho et al., 2023). The organizational management of FMUs in each region in Indonesia has characteristics based on landscape and forest area functions, so a relatively different strategy will emerge. FMUs are government-organized organizations formed to maintain sustainable forests. Forests have significant meaning in human life because they serve

ecological, social, and economic functions (Schaafsma et al., 2014; Subekti and Sudrajat, 2019; Hua et al., 2022; Daulay et al., 2023). At the policy level, the President of the Republic of Indonesia issued six directives at the 2021 National Coordination Meeting on Forest and Land Fire Mitigation, namely: 1) prevention must be prioritized and must not be delayed; 2) monitoring and surveillance infrastructure must be accessible; 3) permanent solutions to prevent and manage forest and land fires; 4) management of peatland ecosystems; 5) not allowing fires to spread; 6) strict law enforcement (Praptono, 2021; Arisanty,



Muhaimin, et al., 2021; Sitanggang et al., 2022).

The Association of Southeast Asian Nations (ASEAN) (2021) has established the ASEAN Guidelines on Peatland Fire Management. The guideline was issued taking into account the current conditions, especially the limited resources in the form of money and human resources for extinguishing activities compared to prevention, such as hotspot reduction, hydrological management, and enforcement of regulations. This unbalanced focus on fire management results in large, uncontrolled fires because prevention and preparedness are insufficient across the landscape. Therefore, in these guidelines, agencies and institutions are asked to allocate 70% of their resources to prevention and 10% to preparedness, response, and recovery (Purnomo et al., 2024; Li, 2025; S. et al., 2025).

A strategy is the formulation of a plan to achieve objectives in conditions of uncertainty; it encompasses the steps or methods required to achieve the desired objectives by utilizing available resources to implement strategic measures (Barad 2018; Muzdalifah et al. 2021; Rossita et al. 2023). The ASEAN (2021) mentions the five stages carried

out as guidelines in the management of peatland fires, namely: prevention strategy (weight 70%) covering policies and regulations, peatland fire prevention measures, information and knowledge, planning and coordination, resources and public communications, 2). preparedness strategy (10% weight), 3) response (10% weight), recovery strategy (10% weight), with indicators of policies and regulations, information and knowledge, planning and coordination, and resources.

Peat is a type of soil formed from the accumulation of half-decayed plant remains. Therefore, peat has a high organic matter content. Draining peatlands increases the risk of forest and land fires. Dry peat and peat material in dry soil will easily catch fire and be difficult to extinguish due to hotspots that are invisible and difficult for humans to feel, and the location of the hotspots may be quite deep (Yani et al., 2020; Medvedeva et al., 2024), so continuous wetting is needed to prevent the potential for peatland fires. Peatland fires can also be prevented by encouraging the adoption of agroforestry perennial crop systems. Agroforestry can increase income while reducing fire risk. A no-burning approach to land



preparation should be adopted. Government agencies should use knowledge, experience, and data from previous fire seasons to review, refine, and improve strategies and to monitor their effectiveness during the next fire season (ASEAN, 2021).

The protected forest is important in protecting the ecosystems and biodiversity (L Ginoga, Lugina, and Djaenudin 2005; Dimitrakopoulos and Jones 2021). A protected forest, as defined by the Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number 8 of 2021, is a forest area with the primary function of protecting life-support systems by regulating water management, preventing flooding, controlling erosion, preventing seawater intrusion, and maintaining soil fertility. The protection of protected forests in Indonesia remains suboptimal, even though these areas help protect surrounding areas. This is evident in several protected areas that still allow cultivation activities (Nurrochmat et al., 2021; Maskun et al., 2021; Jamin et al., 2022; Wardani, 2021).

Research into peatland fire management strategies is based on a multidimensional conceptual approach, encompassing

collaborative governance that emphasises interaction between stakeholders, ecosystem -based fire management, which focuses on the ecological management of the area, and community-based peatland protection, which integrates regulation, peatland ecosystem restoration, institutional strengthening, community participation and monitoring technology to create an adaptive, collaborative and sustainable fire control system within the framework of the Association of Southeast Asian Nations (ASEAN) Guidelines on Peatland Fire Management (Mansuri, 2004; Peredo & Chrisman, 2006; Ansell & Gash, 2008; Keeley et al., 2009; Donahue et al., 2012; Rideng et al., 2022).

This study focuses on the implementation of management strategies by the Kayu Tangi Forest Management Unit (FMU) in the protected forest area of Liang Anggang Sub-district, Banjarbaru City, in accordance with the ASEAN guidelines on peatland fire management. This study contributes to the development of a holistic conceptual model for peatland fire management as an adaptive, collaborative, and sustainable fire control system.



MATERIALS AND METHODS

This research was conducted in the protected forest area of FMU Kayu Tangi, Liang Anggang District, Banjarbaru City. The choice of location was based on the high frequency of peatland fires and the potential for peatland fires, as well as its geographical proximity to Syamsudin Noor International Airport. The research approach uses a qualitative approach (May, 2002), collecting data through in-depth interviews with six key informants selected through purposive sampling. The selection of these six key informants was based on the relevance of their roles, institutional authority, field experience, and direct involvement in the issue under study. Informants were selected from the South Kalimantan Provincial Forestry Service, the Kayu Tangi FMU, and the Regional Disaster Management Agency, as these three institutions play strategic

roles in area management, forest protection, community empowerment, and preparedness for forest and land fires. The number of six informants was deemed sufficient, as each represents a key actor with in-depth knowledge at both the policy level and the technical implementation in the field. Furthermore, the variation in the informants' institutional backgrounds allows for triangulation of sources, ensuring that the data obtained is more credible, comprehensive, and aligned with the research objectives.

Data collection was also carried out using observation and document study. The preparation of the management strategy refers to the guidelines for managing peatland fires issued by ASEAN in 2021, namely the four strategies of prevention, preparedness, response, and recovery. Informants of this study are presented in **Table 2**.

Table 2. Research Informant

Informant	Organization	Positions
R1	Forestry Service, South Kalimantan Province	Head of Community Empowerment, Extension, and Social Forestry
R2	FMUs Kayu Tangi	Head of FMUs Kayu Tangi
R3	FMUs Kayu Tangi	Ex-Head of FMUs Kayu Tangi
R4	FMUs Kayu Tangi	Head Section of Forest Protection FMUs Kayu Tangi
R5	Regional Disaster Management Agency, South Kalimantan Province	Secretary
R6	Regional Disaster Management Agency, South Kalimantan Province	Head of Preparedness Section

Source: Research Analysis, 2025



The qualitative data processing stages follow the model proposed by Huberman & Miles (2002), namely: data reduction, data display, and data verification. First, restating the data obtained, primarily through interviews, to maintain the authenticity of the field data. Second, a descriptive technique is used to show the trend in both interview and observation data. The third stage, interpretation, is used to extract both explicit and implicit meanings from the data. All the data were analysed contextually to examine relationships among various aspects, namely the strategic management of the Kayu Tangi FMU within the 2021 ASEAN guidelines.

RESULTS AND DISCUSSION

The management of the FMU Kayu Tangi was initially established by the Decree of the Minister of Forestry of the Republic of Indonesia Number 78/MENHUT-II/2010 dated February 10, 2010, and subsequently determined by a Regent Regulation. Since Law No. 23 of 2014, FMU management has been carried out in accordance with South Kalimantan Governor Regulation No. 0144 of 2017.

FMUs Kayu Tangi is a technical implementation unit-level institution under the South Kalimantan Provincial Forestry Service, responsible for managing forest areas at the site level (Tajuddin et al., 2019; Nasruddin et al., 2020; Nasruddin & Muhammad Efendi, 2022).

The organization vision is "to become one of the pillars of regional development with a stable, independent, sustainable and just area in a partnership scheme" (KPHP Model Banjar, 2015), with the working area covering Banjar Regency, Barito Kuala Regency (Tamban Subdistrict, and Mekar Sari Subdistrict) and Banjarbaru City (Liang Anggang Subdistrict) with a working area of 158,890 hectares, covering (1) protected forest (46,249 hectares); (2) permanent production forest (25,199 hectares); (3) production forest (84,508 hectares); (4) forest areas with special management (2,934 hectares), with a total area of 158,890 hectares. The current resources of FMUs Kayu Tangi consist of 51 human resources, fire facilities, and infrastructure, including (GPS, drones, forest, and land fire posts, slip cars, motorcycles, fire trucks, fire extinguishers, water pumps, generators,



jet Sutter, player, Alkon, hose, safety helmet, fire suit, and location map. The region map of Forest Management

Units Kayu Tangi is presented in **Figure 3** (R2, R3, R4).

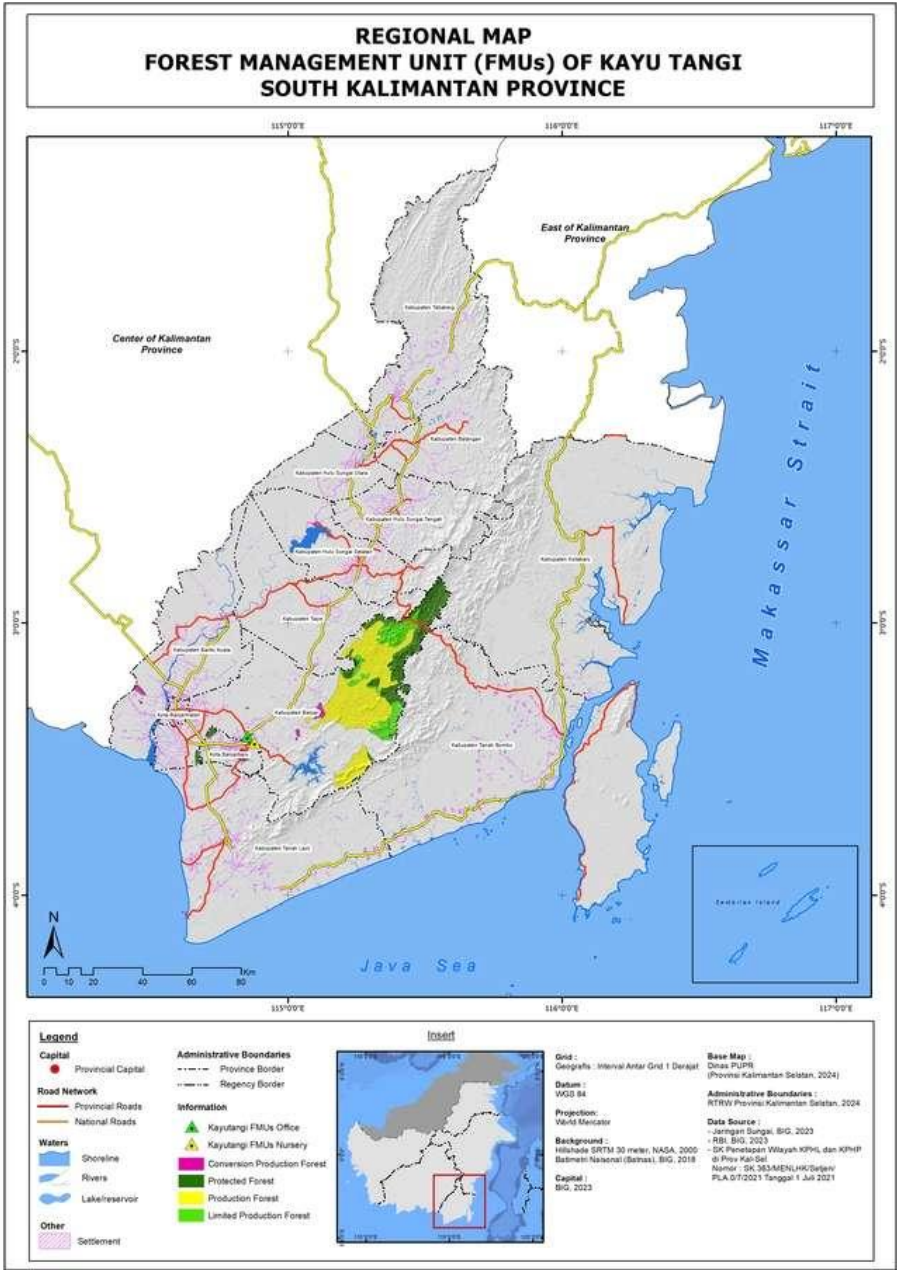


Figure 3. Regional Map of Forest Management Units Kayu Tangi
Source: FMU Kayu Tangi, 2025

1. Prevention Strategy
Prevention strategy: an effort undertaken before the fire to provide protection and

sustainable use of peatland resources (ASEAN, 2021). Prevention is the best strategy because it is relatively more



accessible and cheaper than dealing with fires that have already occurred. Prevention mechanisms implemented through holistic management include landscape arrangement, improved vegetation through rehabilitation, soil and water conservation, and law enforcement against illegal logging and forest encroachment (R1, R2, R3, R4). The strategy stages for each indicator are presented in **Table 3**. Examples of prevention activities are shown in **Figures 4** and **Figure 5**.

Table 3. The FMU Kayu Tangi of Prevention Strategy

No.	Indicators	Activities
1	Policies and regulations	- Government Regulation of the Republic of Indonesia Number 4 of 2001 concerning Control of Environmental Damage and or Pollution Associated with Forest and or Land Fires (Ganitri et al., 2024) - Regulation of the President of the Republic of Indonesia Number 1 of 2016 concerning the Peat Restoration Agency (Setiadi, 2018; Sari et al., 2021). - Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number P.32/Setjen/Kum. 1/3/2016 concerning Forest and Land Fire Control (Muzaki et al., 2021) - Regional Regulation of South Kalimantan Province Number 7 of 2018 concerning the Green Revolution Movement (Muzdalifah et al., 2021)
2	Peatland Fire Prevention	- Management of water systems in protected forest areas by building a canal to block and maintain peatlands in wet conditions (Urzainki et al., 2020) - Monitoring hotspot and fire spot data in the previous year and the current year regularly (Urzainki et al., 2020) - Regular patrols in the area (Linkie et al., 2015) - Conduct socialization to the community not to carry out land-burning activities in protected forest areas (Syahza et al., 2024) - Provide seeds to communities living in protected forest areas and responsible for managing the Land without burning (Chechina et al., 2018)
3	Information and knowledge	Installing signboards in protected forest areas as an educational tool for the community (Carmody & Prideaux, 2011)
4	Planning and coordination	- Preparation of Detailed Engineering Design Landscape Protection Plans in collaboration with universities (Johari et al., 2022) - Perform regular checks on Fire Fighting Equipment (Tomašková et al., 2024) - Conducting basic training on fighting forest and land fires (Sitanggang et al., 2022)
5	sources	- Forming a Fire Care Community Organization or MPA (Stout, 2013) - Strengthening technical equipment resources for forest and land fires (Budiningsih et al., 2022) - Strengthening Forest and Land Fire Control Brigade Personnel (Ryan, 2025) - Strengthening of Manggala Agni Personnel (Fathoni et al., 2024)
6	Public communication s	- Carry out forestry extension work in the area activities (Odefadehan & Alfred, 2012) - Collaboration through tree planting activities or the green revolution movement (Cardoso Castro Rego et al., 2018)

Source: Research Analysis, 2025



The fire prevention strategy of the Kayu Tangi FMU, as shown in **Table 3**, demonstrates a fairly comprehensive approach to fire prevention (both robust



Figure 4. Forest and Land Fire Suppression Training and Simulation
Source: Field Report, 2022

However, long-term effectiveness remains constrained by limited resources, socio-economic pressures, and the threat of climate change to

and forward-looking) through a combination of regulation, peatland restoration, institutional strengthening, and community empowerment.



Figure 5. Construction of a Canal in Block 1 of Liang Anggang-KPH Kayu Tangi
Source: Field Report, 2021

peatland ecosystems. A SWOT analysis of the prevention strategy is outlined in **Table 4**.

Table 4. Strategic Recommendations Based on SWOT Matrix for FMU Kayu Tangi Prevention

Matrix SWOT	Strategic Recommendations
SO Strategy	Expanding community-led peatland restoration and strengthening technology-based monitoring.
WO Strategy	Enhancing human resource capacity and technical infrastructure through government support and external cooperation.
ST Strategy	Harnessing the power of regulation and patrols to tackle the threat of fires caused by climate change and land clearing.
WT Strategy	Strengthening institutional coordination and enhancing the sustainability of community programmes to reduce long-term vulnerability.

Source: Research Analysis, 2025

2. Preparedness Strategy

Preparedness strategy is an effort made before a disaster occurs (Peteru et al., 2025; ASEAN, 2021). At this stage, a signal indicates that a disaster will occur soon, so all elements must be

prepared and kept on standby to respond, well ahead of the dry season. Failure to communicate and collaborate in disaster management is a weakness in preparedness, as is the need for



appropriate media to provide the public with knowledge about disaster preparedness (Lovreglio et al., 2018). The strategy carried out at this stage, namely the strengthening of the organization and procedures, and the appointment of operational personnel for the implementation of forest fire planning, which pays attention to the duties and functions of the work sector. Simulation of mobilization at various levels, increasing coordination through

work meetings, coordination, and visits, construction, and maintenance of firebreaks, fuel management, green lanes for silvicultural efforts, and maintenance of reservoirs/canals as water sources, installation of easily visible warning signs or prohibitions, especially in fire-prone areas (R1, R2, R3, R4). The stages of the preparedness strategy for each indicator are presented in **Table 5**.

Table 5. Preparedness Strategy of FMUs Kayu Tangi

No.	Indicators	Activities
1	Policies and regulations	- Government Regulation of the Republic of Indonesia Number 4 of 2001 concerning Control of Environmental Damage and or Pollution Associated with Forest and or Land Fires (Ganitri et al., 2024) - Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number P.32/Setjen/Kum. 1/3/2016 concerning Forest and Land Fire Control (Muzaki et al., 2021)
2	Information and knowledge	- Provision of map information and WebGIS (Putra et al., 2021) - Conduct early monitoring on the monitoring and evaluation system according to the level of vulnerability of the operating area (Teguh et al., 2021) - Forest and Land fire prevention program campaign through the media and the surrounding community (Sundari et al., 2022)
3	Planning and coordination	- Monitoring and evaluation of the forest and land fire calendar (Sitanggang et al., 2022) - participated in the forest and land fire extinguishing exercise, which is held every year by the South Kalimantan Provincial Forestry Service (Hiratsuka et al., 2019)
4	Resources	- Strengthening of FMUs Kayu Tangi Personnel (Saputra & Dewata, 2019) - Management of Forest and Land Fire Control Brigade personnel (Ryan, 2025) - Manggala Agni personnel management (Fathoni et al., 2024) - Fire Care Community Management or MPA (Stout, 2013)
5	Public communications	Provision of a community reporting system via smartphone through the police, forestry service, and MPA (Gilless et al., 2018)

Source: Research Analysis, 2025

Overall, the Kayu Tangi FMU's preparedness strategy has reflected an adaptive and collaborative approach to

forest and land fire control. The integration of regulations, information technology, human resource



development, and public infrastructure support, and the sustained communication has been a key factor in strengthening of community enhancing fire preparedness. However, participation. A SWOT analysis of the optimising implementation still requires preparedness strategy is outlined in improved technical capacity, **Table 6.**

Table 6. Strategic Recommendations Based on SWOT Matrix for FMU Kayu Tangi Preparedness

Matrix SWOT	Strategic Recommendations
SO Strategy	Optimisation of WebGIS, strengthening multi-stakeholder cooperation, improving education, and regulatory support.
WO Strategy	Capacity building for human resources, communication infrastructure, regular training, and community participation.
ST Strategy	Strengthening coordination of firefighting efforts, the MPA network, hotspot data integration, and regulatory enforcement.
WT Strategy	Institutional strengthening, improved access to emergency communications, automated detection systems, and inter-agency coordination.

Source: Research Analysis, 2025

3. Response Strategy

Response strategy is an effort made when a forest and land fire occurs (Peteru et al., 2025; ASEAN, 2021). Mechanisms carried out: (1) routine patrols within and on the outer boundary area, patrolling and guarding fire-prone areas, processing data, and information on hotspots, establishing alert levels, establishing forest and land firefighting posts and establishing field posts, and (2) routine patrols within and on the outer boundary areas, patrolling and guarding fire-prone areas, processing data, and information on hotspots, establishing alert levels, establishing forest and land fire control posts and establishing field posts (R1, R2, R3, R4). The stages of the response

strategy for each indicator are presented in **Table 7.**

Management of FMUs Kayu Tangi in response to the forest and land fires, namely securing the work area with all potential resources (HR, equipment, and budget), and partner (Cardoso Castro Rego et al., 2018; Suzuki, 2006) with the Regional Disaster Management Agency or BPBD. Partnerships are significant in building community cohesion and awareness of disaster management (Every et al., 2016; Sumaryana et al., 2019; Prior & Eriksen, 2013; McCarthy et al., 2011). Furthermore, in disaster management and risk reduction, it is necessary to understand disaster safety and information facilities or systems that



can detect an impending disaster earlier (Arisanty, Zaenal, et al., 2021; Dore, Fitriana, and Meilina, 2019; Abusalama et al., 2020). Therefore, effective forest fire management does not rely solely on available resources; building partnerships, developing information systems, and increasing public awareness are much more critical.

Table 7. The FMU Kayu Tangi of Response Strategy

No.	Indicators	Activities
1	Policies and regulations	- Government Regulation of the Republic of Indonesia Number 4 of 2001 concerning Control of Environmental Damage and or Pollution Associated with Forest and or Land Fires (Ganitri et al., 2024) - Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number P.32/Setjen/Kum. 1/3/2016 concerning Forest and Land Fire Control (Muzaki et al., 2021)
2	Information and knowledge	- Execute the fire immediately - Submission of emergency forest and land fire disasters to the Forestry Service to be forwarded to the Regional Disaster Management Agency (BPBD), if the resources of the FMUs Kayutangi are unable to cope with the fire (Arisanty, Zaenal, et al., 2021) - Dissemination of emergency fire disaster to the community
3	Planning and coordination	- Coordination with personnel: FMUs, Dalkarhut Brigade, Manggala Agni, and Community Care Fire or MPA (Stout, 2013) - FMUs' coordination with the Forestry Service to be forwarded to BPBD and related agencies, such as the Indonesian National Armed Forces or TNI, and Indonesian National Police or POLRI
4	Resources	- Resources: FMUs, Kayu Tangi, Dalkarhut Brigade, Manggala Agni, MPA, and firefighting equipment (Saputra & Dewata, 2019; Stout, 2013; Fathoni et al., 2024; Ryan, 2025). - BPBD resource support through Ground and Air Operations (Arisanty, Zaenal, et al., 2021) - TNI/POLRI resource support (Nugroho et al., 2023)
5	Public communications	Receive complaints via smartphone access or reports from the public regarding forest and land fires, to be followed up on immediately (Annas et al., 2022)

Source: Research Analysis, 2025

The mechanism for reporting forest and land fires is through requests for operational assistance (Land and air) tailored to the conditions and level of the disaster, which cannot be handled directly due to the difficulty of accessing locations and water sources in the incident area. The mechanism sends requests for assistance through the primary agency, namely the South Kalimantan Province Forestry Service, to the BPBD Operations Control Center of South Kalimantan Province (R5, R6). The flow of reporting on disaster events is presented in **Figure 6**.



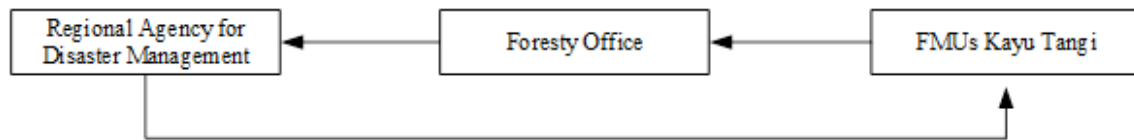


Figure 6. Forest and Land Fire Disaster Reporting Flow of FMU's Kayu Tangi

Source: R5 and R6, 2025

Regional Disaster Management Agency or BPBD South Kalimantan Province currently has 3 task units within the Command Post unit, namely: (1) land task force, (2) law enforcement task force, and (3) air task force. In disaster preparedness, a joint task force can be formed comprising various elements, including the Forestry Service, FMUs Kayu Tangi, TNI/Polri, and community organizations, to address disaster emergencies. The main equipment owned by BPDB South Kalimantan Province includes fire trucks (2 units), cars (2 units), pumps (2 units), generators (2 units), and a helicopter for waterbombing and patrol (1 unit) owned by the National Agency for Disaster Management.

The Kayu Tangi FMU's response strategy for forest and land fire control has demonstrated an integrated emergency response approach through regulatory support, multi-stakeholder coordination, resource readiness, and public communication. The strategy is implemented through rapid fire

suppression, reporting the emergency status to the Forestry Department and the Regional Disaster Management Agency (BPBD) should the FMU's capacity prove insufficient, and disseminating fire-related information to the public. Coordination among the FMU, the Dalkarhut Brigade, Manggala Agni, the MPA, the BPBD, the TNI, and the POLRI enhances the effectiveness of fire management, particularly in high-risk areas. Furthermore, support from ground and aerial operations, along with a smartphone-based community reporting system, helps to accelerate the detection and follow-up of fires in the field. Overall, the Kayu Tangi FMU's response strategy reflects a collaborative and adaptive fire management system, although it still requires strengthening of personnel capacity, equipment, and communication infrastructure to enhance the sustainability of response effectiveness. A SWOT analysis of the response strategy is outlined in **Table 8**.

Table 8. Strategic Recommendations Based on SWOT Matrix for FMU Kayu Tangi
 Response

Matrix SWOT	Strategic Recommendations
SO Strategy	Optimising multi-stakeholder coordination, leveraging regulatory support, and accelerating IT-based responses.
WO Strategy	Improvements to staff capacity, firefighting equipment, emergency communication systems, and fire response training.
ST Strategy	Strengthening joint operations among the FMU, BPBD, TNI, and POLRI; integrating public reports; and rapid response to hotspots.
WT Strategy	Strengthening logistical support, improving access to vulnerable areas, developing automated response systems, and ensuring ongoing inter-agency coordination.

Source: Research Analysis, 2025

4. Recovery Strategy administering, and being accountable
 The Recovery Strategy was an effort for the implementation of forest and
 carried out after the peatland fire land fire management. The stages and
 disaster (Peteru et al., 2025; ASEAN, indicators of the implemented recovery
 2021). The mechanism is organizing, strategy are presented in **Table 9**.

Table 9. The FMU Kayu Tangi of Recovery Strategy

No.	Indicators	Activities
1	Policies and regulations	- Government Regulation of the Republic of Indonesia Number 4 of 2001 concerning Control of Environmental Damage and or Pollution Associated with Forest and or Land Fires (Ganitri et al., 2024) - Regulation of the President of the Republic of Indonesia Number 1 of 2016 concerning the Peat Restoration Agency (Setiadi, 2018; Sari et al., 2021). - Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number P.32/Setjen/Kum. 1/3/2016 concerning Forest and Land Fire Control (Muzaki et al., 2021) - Regional Regulation of South Kalimantan Province Number 7 of 2018 concerning the Green Revolution Movement (Muzdalifah et al., 2021)
2	Information and knowledge	Socialization through the mass media about the impact of forest and land fires (Yuliana et al., 2021)
3	Planning and coordination	- Mapping and monitoring of burnt areas (Putra et al., 2021) - Cause and impact investigation and analysis (Arisanty, Muhaimin, et al., 2021) - Carrying out forest rehabilitation and reclamation after land fires through a peat endemic plant cultivation program (Tangney et al., 2022), (Parks and Wildlife Service, 2014) - Law enforcement, if a case is found that requires legal action (Schmidt et al., 2024)
4	Resources	FMUs, Kayu Tangi personnel, the Forest Service, relevant agencies, private sectors, educational institutions, and public (Saputra & Dewata, 2019; Stout, 2013; Fathoni et al., 2024; Ryan, 2025).
5	Public communications	- Community development to avoid clearing Land using fire (Purnomo et al., 2024) - Construction of the FMU Kayu Tangi guard post (Urzainki et al., 2020)

Source: Research Analysis, 2025



The Kayu Tangi FMU’s recovery strategy for forest and land fire control focuses on ecosystem restoration, land rehabilitation, raising public awareness, and cross-sectoral coordination. This strategy is supported by various national and regional regulations, such as the Presidential Regulation on the Peatland Restoration Agency and the Regional Regulation on the Green Revolution Movement, which reinforce the direction of post-fire environmental recovery. Recovery efforts are carried out through mapping and monitoring of burnt areas, analysis of the causes and impacts of fires, forest rehabilitation, land reclamation through the cultivation of endemic peatland plants, and law enforcement against identified violations. The involvement of the FMU, the forestry department, the private sector, educational institutions, and the community demonstrates a collaborative approach to the recovery process. Furthermore, community development initiatives to prevent land-clearing by burning and the construction of FMU guard posts are crucial steps toward strengthening environmental resilience and preventing future fire recurrence. Strategic Recommendations Based on the SWOT Matrix for the Restoration of the Tangi Wood FMU are shown in **Table 10**.

Table 10. Strategic Recommendations Based on SWOT Matrix for FMU Kayu Tangi Recovery

Matrix SWOT	Strategic Recommendations
SO Strategy	Optimising peatland rehabilitation programmes, strengthening multi-stakeholder collaboration, and utilising environmental restoration regulations.
WO Strategy	Enhancing land rehabilitation capacity, strengthening monitoring of burnt areas, and ongoing public education.
ST Strategy	Strengthening law enforcement, ecosystem-based rehabilitation, and monitoring of fire-prone areas.
WT Strategy	Increased funding for recovery efforts, improved monitoring facilities, a reduction in land-clearing by burning, and sustained cross-sectoral coordination.

Source: Research Analysis, 2025

In theory, the strategic management of peatland fire prevention, preparedness, response, and recovery by the Kayu Tangi Forest Management Unit (FMU) serves as a model for collaborative governance, ecosystem -based fire management, and community-based peatland protection that integrates regulation, peatland ecosystem restoration, institutional strengthening, community participation, and monitoring technology to create an adaptive,



collaborative, and sustainable fire control system (Mansuri, 2004; Peredo & Chrisman, 2006; Ansell & Gash, 2008; Keeley et al., 2009; Donahue et al., 2012; Rideng et al., 2022).

The Management Strategy of Peatland Fire (MSPF) can be conceptualized as a function of regulations and policies, peatland management, community participation, institutional capacity, public communication, and fire monitoring technology:

$$\text{MSPF} = f(\text{R} + \text{P} + \text{C} + \text{I} + \text{Pc} + \text{F})$$

where:

MSPF = Management Strategy of Peatland Fire

R = Regulations and policies

P = Peatland management (canal blocking, hydrological restoration)

C = Community participation (MPA, Manggala Agni, educational sessions, outreach programs)

I = Institutional capacity (human resources, patrols, and training)

Pc = Public communication and environmental education

F = Fire monitoring technology (hotspot, firespot, early warning system)

CONCLUSIONS

This study demonstrates that the forest and peatland fire management strategy implemented by the Kayu Tangi Forest Management Unit (FMU) has been relatively effective in reducing the risk of catastrophic forest and peatland fires. The strategy is reflected through integrated actions in prevention, preparedness, response, and recovery.

The prevention strategy includes enforcing policies and regulations, managing peatland water through canal blocking and hydrological restoration, routine hotspot and firespot monitoring, regular patrols, public outreach, environmental education, and strengthening community-based fire organizations. In addition, the Green Revolution movement and community participation programs have contributed to increasing environmental awareness and reducing land-clearing practices using fire.

The preparedness strategy emphasizes early warning systems, information dissemination, public campaigns, and community-based communication systems that improve public awareness and preparedness toward fire risks. Despite limited institutional resources, FMU Kayu Tangi has demonstrated



adaptive institutional capacity through collaboration with the Regional Disaster Management Agency (BPBD), the Indonesian National Armed Forces (TNI), and the Indonesian National Police (POLRI) in emergency response and fire suppression activities.

The recovery strategy focuses on post-fire rehabilitation and reclamation through peat-endemic plant cultivation, burned-area mapping and monitoring, impact assessment, public information dissemination, and law enforcement to prevent recurring fires.

Conceptually, this study finds that FMU Kayu Tangi's peatland fire management exemplifies collaborative governance, ecosystem-based fire management, and community-based peatland protection. The management strategy integrates regulations, peatland restoration, institutional strengthening, community participation, public communication, and fire-monitoring technology to create an adaptive, sustainable fire management system. The conceptual formulation can be expressed as: $MSPF = f(R + P + C + I + Pc + F)$

where:

R = Regulations and policies

P = Peatland management (canal blocking, hydrological restoration)

C = Community participation (MPA, Manggala Agni, educational sessions, outreach programs)

I = Institutional capacity (human resources, patrols, and training)

Pc = Public communication and environmental education

F = Fire monitoring technology (hotspot, firespot, early warning system)

The findings also challenge the assumption that organizations with limited resources are inherently ineffective in performing their functions. In the case of FMU Kayu Tangi, institutional collaboration, community engagement, and adaptive governance have enabled the organization to maintain operational effectiveness despite resource constraints.

However, this study is limited to the protected forest area of Liang Anggang District within the FMU Kayu Tangi working area. Therefore, the findings cannot be generalized to all FMU areas in South Kalimantan. Future research is recommended to examine comparative fire management strategies across



different forest typologies and FMU jurisdictions in Indonesia.

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