



Strategic Evaluation of the Forest Command Center (FCC) in Ibu Kota Nusantara for Centralized Forest Management Using a SWOT Analysis

I Wayan Koko Suryawan^{1*}

¹Department of Environmental Engineering, Faculty of Infrastructure Planning, Universitas Pertamina, Jakarta, 12220, Indonesia

Info Artikel	Abstrak
Article History Desember	Meningkatnya perhatian terhadap pengelolaan hutan telah mendorong munculnya pendekatan-pendekatan inovatif dalam konservasi, dengan hadirnya <i>Forest Command Center</i> (FCC) di Ibu Kota Nusantara (IKN) sebagai sebuah paradigma baru. Penelitian ini menggunakan metode kualitatif yang diperkuat dengan analisis SWOT (Strengths, Weaknesses, Opportunities, Threats) untuk mengevaluasi efektivitas, tantangan, dan potensi dari FCC. Berdasarkan studi literatur naratif, penelitian ini mengidentifikasi kekuatan utama FCC, seperti pengelolaan yang terpusat, mekanisme respons cepat, optimalisasi sumber daya, dan integrasi teknologi canggih. Secara bersamaan, penelitian ini juga menyoroti kelemahan yang melekat, seperti ketergantungan terhadap teknologi, keterbatasan sumber daya, tumpang tindih birokrasi, dan kekurangan pelatihan. Studi ini juga memetakan berbagai peluang yang tersedia bagi FCC, mulai dari kolaborasi antar-lembaga, kemajuan teknologi, edukasi masyarakat, hingga potensi sumber pendanaan.
Kata Kunci <i>Forest Command Center, Pengelolaan Hutan Terpusat, IKN, Analisis SWOT, Konservasi, Optimalisasi Sumber Daya</i>	Abstract <i>The burgeoning concerns surrounding forest management have led to innovative approaches to conservation, with the Forest Command Center (FCC) in Ibu Kota Nusantara (IKN) emerging as a paradigm. This study employs a qualitative method underscored by a SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis to evaluate the FCC's efficacy, challenges, and potential. Drawing from narrative literature, this research identifies the intrinsic strengths of the FCC, such as centralized management, rapid response mechanisms, resource optimization, and the integration of advanced technology. Concurrently, it underscores the inherent weaknesses, notably technology dependency, resource constraints, bureaucratic overlaps, and training deficits. The study also maps the opportunities available for the FCC, from inter-agency collaborations and technological advancements to community education and potential funding streams.</i>

* E-mail

i.suryawan@universitaspertamina.ac.id

©2026 Published by UNNES. This is an open access

P ISSN: 2252-9195 E-ISSN: 2714-6189

INTRODUCTION

In the evolving global landscape, forest management stands out as one of the pivotal areas demanding intensified attention. Forests, often termed the 'lungs of the earth,' play an indispensable role in maintaining the ecological balance, conserving biodiversity, and aiding carbon sequestration, among numerous other benefits (Pawar and Rothkar 2015). However, the contemporary challenges posed by rapid urbanization, climate change, and increasing anthropogenic activities have accentuated the complexities of forest management (Suhardono et al. 2024a, b; Rahman et al. 2025). Historically, forest conservation strategies were localized, with communities or regions adopting indigenous and traditional practices. But with the advent of globalization and technological advancements, there's a pressing need for a more centralized and technologically driven approach. As per the (Mishenin et al. 2021), integrated forest management systems have shown promising results in various regions, harmonizing economic, social, and environmental interests.

The Forest Command Center (FCC) concept in Ibu Kota Nusantara (IKN) signifies a paradigm shift towards such a centralized approach. Drawing inspiration from the success of command centers in other domains, such as urban planning and disaster management, the FCC aims to bring together technology, expertise, and resources for holistic forest management. However, introducing such innovative systems is not without challenges. Questions about technological dependency, resource limitations, bureaucratic hurdles, and capacity building are inevitable (Vemuri 2008). These challenges also offer growth, collaboration, and advancement avenues. As underlined by (Martos et al. 2021), integrating advanced technologies like satellite monitoring can be a game-changer for forest management, provided the challenges are adeptly addressed. Moreover, the international discourse on sustainable development, epitomized by the Sustainable Development Goals (SDGs) established by the United Nations, accentuates the importance of sustainable forest management. Goal 15 focuses on the sustainable use of terrestrial ecosystems, including forests, underscoring the urgency of the matter.

The study of centralized forest management, particularly within the context of the FCC in IKN, emerges from a recognized need to understand and bridge existing knowledge gaps. While rich in exploring traditional forest management and conservation techniques, current literature offers limited in-depth exploration into innovative solutions like centralized systems such as the FCC. For instance, while the fusion of technology in forest management is well-documented, there's a discernible gap in understanding its integration and implications within a centralized system (Lyons et al. 2016). Similarly, while resource challenges in forest management are acknowledged, a deeper exploration, specifically within the FCC's confines, seems sparse. Being interwoven with communities, governments, and varied stakeholders, forests necessitate a comprehensive research framework that addresses stakeholder engagement (Kliskey et al. 2021; Nguyen et al. 2022). However, literature tailored to these stakeholders' unique role and dynamics within an FCC setting in IKN is noticeably scant. Further, bureaucratic intricacies that centralized systems like FCCs might encounter, especially in interplay with regional governance structures and policies, have not been exhaustively analyzed.

It's not just challenges that remain under-explored; potential opportunities that FCCs can leverage, be it through technological advancements, external collaborations, or funding avenues, are areas that also require in-depth study. One significant void in the current discourse is the lack of studies contrasting the centralized FCC approach with traditional or decentralized forest management frameworks. This comparison could offer rich insights into the merits and challenges of each method. This study aspires to render a holistic, grounded, and contemporary perspective on FCC's role in IKN's forest management landscape by shedding light on these gaps. This study explores the intricacies of establishing the FCC in IKN, leveraging a SWOT analysis rooted in narrative literature. Through thoroughly exploring the strengths, weaknesses, opportunities, and threats associated with such a centralized command system, the research seeks to pave the way for effective and sustainable forest management in the region.

METHOD

A qualitative approach is deemed most appropriate for this study as it offers a deeper understanding of the context, processes, and inherent meanings of the subject in question (Amaratunga et al. 2002). Integrating SWOT analysis allows us to systematically identify and scrutinize the subject's strengths, weaknesses, opportunities, and threats, offering a comprehensive picture backed by academic literature. Relevant literature will be sourced from academic databases like Google Scholar, PubMed, JSTOR, and ProQuest. Hand-searching key journals and references of retrieved articles will also be done to ensure comprehensiveness. Articles discussing forest management, centralized systems, rapid response mechanisms, and related subjects from 2000 onwards will be included. Only peer-reviewed articles written in English will be considered. Key themes, methodologies, findings, and conclusions from the literature will be collated and summarized in a tabular format.

This approach ensures a rich, multifaceted perspective, underpinning a robust SWOT analysis. Once the pertinent narratives are collated, a thematic analysis will be employed. By following (Braun and Clarke 2006; Kiamanesh et al. 2018) guidelines, the data will be systematically coded, classified, and segmented into themes representing the components of SWOT. (Miller et al. 2022) emphasizes the integrative potential of juxtaposing literature review findings against SWOT analysis outcomes. Such a method validates the primary data and contextualizes the SWOT analysis within the broader academic discourse. This synergy, grounding the SWOT findings in existing literature, provides both depth and breadth to the analysis. Given the absence of primary data collection via interviews, ensuring the credibility of narrative literature becomes even more vital.

Triangulating sources, cross-verifying narratives against established academic literature, and member checking, wherein experts validate the thematic outputs, will be critical strategies to ensure the integrity and authenticity of the SWOT analysis. The limitations inherent in a narrative-driven SWOT analysis are primarily tied to the subjectivity of the sources. While the narratives offer depth, they may also harbor biases. Furthermore, the results, being qualitative, are context-specific. However, this research aims to counterbalance potential biases and limitations by

using various sources and grounding the findings in academic literature.

RESULT AND DISCUSSION CRUCIAL PREVENTIVE STRATEGIES

In the evolving discourse of environmental management, preventive strategies, particularly in air pollution control and forest fire management, have taken center stage. IKN's (Ibu Kota Nusantara) strategic approach to this issue is underscored by the region's immediate and long-term challenges. The detrimental effects of forest fire-induced air pollution on human health have been well-documented. For instance, (Sacramento et al. 2020; Purnomo et al. 2021) highlighted the exponential rise in respiratory and cardiovascular diseases in regions affected by forest fires. While IKN acknowledges these health repercussions, the literature suggests a deeper interconnectedness. Beyond immediate respiratory issues, there is evidence of long-term health effects (Prasad et al. 2020; Grant and Runkle 2022), including increased vulnerability to diseases like asthma and chronic obstructive pulmonary disease.

For IKN, understanding and integrating these long-term insights becomes imperative for formulating comprehensive preventive strategies. IKN's concern about environmental degradation post forest fires aligns with the observations of Sa'adah et al. (2022), who emphasized the cascading effect of such fires on ecosystems. However, the literature also highlights the more insidious effects of air pollution. Reduced visibility, for example, leads to aquatic system changes due to altered sunlight penetration (Achilleos et al. 2019). IKN's strategies can benefit from a deeper dive into such nuanced environmental impacts. While IKN recognizes the economic costs of healthcare and infrastructure maintenance post-forest fires, the literature broadens this perspective. (Rosen et al. 2023) discussed the ripple effects on local economies, from diminished agricultural yields to reduced real estate values in areas persistently affected by forest fires and subsequent air pollution. This extended economic understanding suggests that IKN's preventive focus will have far-reaching fiscal benefits. The broader literature substantiates IKN's perspective on forest fires contributing to climate change. (Singh 2022) forest fires significantly accelerate the release of stored carbon, intensifying global warming. However, the literature also emphasizes feedback loops, where climate change makes regions more susceptible to fires (Senande-Rivera et al. 2022). This cyclical relationship indicates

that IKN's preventive measures are necessary and critical in breaking this feedback cycle.

While IKN's concern about its reputation is valid, the literature discusses the psychological and sociological impacts on residents. This adds another dimension to IKN's preventive approach, emphasizing the holistic well-being of its residents. IKN's focus on biodiversity aligns with sentiments in the literature, particularly the works of (Clarke et al. 2021), who underscored the irreversible loss of species and habitats in post-fire scenarios. However, the literature also elucidates the long-term genetic impact on species, with many facing reduced genetic diversity, making them more susceptible to diseases (Clarke et al. 2021; Dove et al. 2022). By integrating these insights, IKN can craft a more holistic, far-reaching, and adaptive strategy, ensuring the safety, prosperity, and sustainability of the region and its inhabitants in the face of forest fires and their cascading effects.

The increasing concern surrounding forest fires, especially in regions affected by climatic phenomena such as El Nino, is hard to ignore. Even though recent data indicates a relatively low incidence of forest fires over the past two years, the looming prediction of prolonged drought due to El Nino underscores the importance of robust preventive strategies.

1. Significance of Focused Activities for Fire Control and Prevention

A targeted approach is pivotal in addressing any complex problem. Focusing on activities specifically related to fire control and prevention enables resources and efforts to be directed precisely where they are most needed. A study by (Bandyopadhyay et al. 2020; Budiningsih et al. 2022) emphasizes that areas prone to drought, particularly during El Nino events, require specialized fire management practices. The rationale is simple: A dedicated approach can more effectively mitigate fire risks than a more general, spread-out effort.

2. Annual Planning Coordination for Fire Prevention and Control

The significance of annually coordinated planning cannot be overstated. This strategy facilitates a proactive, rather than reactive, approach to potential fire outbreaks. According to (Jazebi et al. 2019; Halba et al. 2022), planned and coordinated controlled burns, carried out in safer conditions, can significantly reduce wildfire fuel,

making spontaneous large fires less likely during drought periods. Integrating such burns into annual plans ensures they are carried out methodically and safely.

3. Coordination in the Implementation of Prevention and Management

Fire prevention and management are not just about planning but also about seamless execution. Efficient coordination during the implementation phase ensures that various tasks, such as controlled burns, monitoring, and emergency response, are well synchronized. A paper by (Kirschner et al. 2023; Pandey et al. 2023) highlighted that areas with successful fire management regimes often boast high coordination among different agencies and stakeholders. Such collaboration ensures that, during a crisis, response times are quick and there's minimal confusion.

4. Monitoring, Evaluation, and Learning from Incidents or Drills

Continuous learning is a cornerstone of effective fire management. Monitoring and evaluating actual fire incidents and training exercises provide invaluable data for refining strategies. This iterative process of learning and adapting is crucial. In their comprehensive review, (Cochrane and Bowman 2021) argue that the most successful fire management regimes are adaptive. They evolve based on past experiences and are better prepared for future challenges. Comparing the identified strategies with the broader literature reveals both alignments and gaps. While the strategies emphasize planning, coordination, and learning, the literature also stresses community involvement, infrastructure readiness, and public education as key components of a holistic environmental and adaptive management approach (Imelda et al. 2024; Suryawan et al. 2024, 2025a, b, c; Sofiyah et al. 2025; Suhardono et al. 2025b, a; Suryawan and Lee 2025; Yang et al. 2025). Additionally, long-term climatic predictions, such as those involving El Nino, should be woven into fire management policies, ensuring that strategies remain relevant and adaptive to broader environmental shifts.

CRUCIAL PREVENTIVE STRATEGIES

Establishing a centralized Forest Command Center (FCC) is crucial for regions grappling with the challenges of forest fire management. When considering IKN (Ibu Kota Nusantara) and its

unique geographical and socio-economic contexts, the importance of an FCC amplifies manifold. An FCC ensures a single, centralized hub that continually monitors forest conditions, potential fire triggers, and ongoing incidents. This centralization allows for swift, coordinated responses, minimizing the reaction time between identifying and acting upon a potential threat.

An FCC would be equipped with advanced technologies like satellite imagery, drone surveillance, and AI-powered predictive analysis. This data's continuous collection and examination assist in immediate fire prevention and understanding long-term trends and patterns. This insight is invaluable for crafting more effective, adaptive prevention strategies over time (Suryawan and Lee 2023; Sutrisno et al. 2023). One of the significant challenges in forest fire management is the coordination between various agencies, departments, and stakeholders (Kirschner et al. 2023; Pandey et al. 2023). An FCC serves as a nexus for communication, ensuring that everyone, from firefighters on the ground to policymakers, is on the same page, leading to more synchronized efforts. An FCC can play a pivotal role in public engagement. Disseminating real-time information, safety protocols, and evacuation plans can ensure that the public is informed and prepared. Awareness campaigns orchestrated through the command center can also educate the populace about preventive measures, transforming the community into proactive stakeholders in forest fire prevention. Apart from its operational roles, an FCC can be an epicenter for training and capacity-building. Regular drills, simulations, and workshops can be conducted, ensuring that all personnel are updated with the latest techniques, technologies, and strategies in forest fire management.

A command center can be a hub where external experts, international agencies, and NGOs converge to share knowledge, resources, and technologies. This collaborative approach can provide IKN with global insights and best practices, enhancing its local prevention efforts. After a fire incident, it's crucial to understand its causes, progression, and impacts to prevent future occurrences. An FCC can systematically document each incident, analyze them, and draw lessons to refine strategies and protocols. Equipped with advanced technologies and predictive algorithms, an FCC can provide early warning signals for areas that are at high risk. Before a potential fire starts, these early warnings can initiate preventive actions, like controlled burns or evacuations.

FCC's strengths lie at the intersection of centralized management, rapid responsiveness, optimal resource allocation, and technology integration (Figure 1). Centralized management, as highlighted by (Bustamante et al. 2016) is pivotal to efficiently gathering, analyzing, and monitoring forest data, fostering enhanced conservation efforts. On the other hand, responding promptly, especially during forest fires, holds paramount importance. (Kelly and Fuster 2010) accentuated that coordinated interventions drastically reduce environmental and economic repercussions. Furthermore, the essence of effective resource management cannot be dismissed. (Mary et al. 2023) showcased how adeptly managing resources, personnel, equipment, and funds directly corresponds with the sustainability of forest resources. Lastly, the infusion of cutting-edge technology into forest management, especially tools like early detection systems and satellite monitoring, revolutionizes the realm of conservation. As (Salomon et al. 2018) asserted, embracing contemporary technology magnifies the impact of conservation and management endeavors.

While the FCC embodies many strengths, it grapples with specific intrinsic weaknesses that warrant attention. Though beneficial, the FCC's profound dependency on technology is a double-edged sword. Such unexpected interruptions can impede the flow of critical operations, especially in environments as delicate as forest management. For entities like the FCC, such mismanagement can harm its operations and the broader ecosystems it oversees. The intricacies of bureaucracy constitute another point of concern. (Zafarullah and Ferdous 2023; Schnelzer et al. 2023) documented that bureaucratic setup, especially in larger organizations, often engenders risks related to role overlaps or coordination bottlenecks amongst varying departments or units. In the context of the FCC, such bureaucratic entanglements could hamper swift and effective forest management responses. The gap in training, particularly concerning new technologies or systems, is a vulnerability. According to (Alliou and Mourdi 2023; Török 2023), as technology continually evolves, specialized training becomes paramount. Without it, personnel could either underutilize or misuse the technology, undermining the objectives the technology aims to achieve for the FCC.

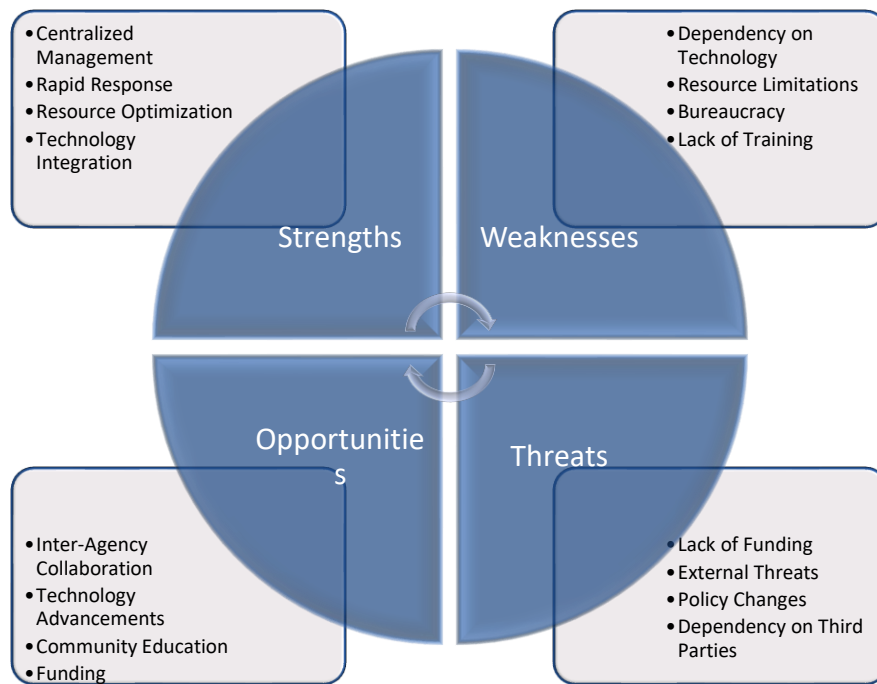


Figure 1. SWOT analysis

The opportunity to enhance inter-agency collaboration can significantly fortify the effectiveness of forest management strategies. As highlighted by (Luu 2022), synergizing efforts between institutions and agencies broadens the pool of expertise and resources, which can lead to innovative, holistic solutions. Moreover, as technology continually evolves, forest management stands to gain from these advancements. Recent research by (Chen et al. 2021) underscores how technological progress can transform monitoring capabilities and data analysis in forest conservation. Furthermore, the role of community education in environmental conservation has been repeatedly emphasized in the literature. (Fernández-Llamazares et al. 2021; Sattayapanich et al. 2022) note that an informed community can actively contribute to safeguarding their ecosystems. Lastly, the potential for securing diversified funding sources, both nationally and internationally, presents a promising avenue for enhancing the FCC's capabilities, as articulated.

Despite the abundant opportunities, there are inherent threats that the FCC must navigate. One of the primary concerns is consistent funding. Studies by (Ye et al. 2020; Sun et al. 2022) have detailed how financial instabilities can lead to significant operational disruptions, especially in environmental projects. Externally, natural calamities like forest fires or floods can severely test the limits of any organization, and the unpredictability of such events remains a looming challenge. Another critical aspect is the ever-

changing political landscape. Policies and regulations are in constant flux, and as (Orsi et al. 2020; Silva Junior et al. 2020) suggest, these dynamics can considerably impact operational strategies in environmental management. Additionally, the dependency on third-party vendors, especially in an era driven by specialized technological solutions, introduces vulnerabilities that can't be overlooked, echoing the concerns on the challenges posed by external dependencies in organizational operations.

CRUCIAL PREVENTIVE STRATEGIES

The Forest Command Center's (FCC) SWOT analysis uncovers several integral areas that, if addressed appropriately, could significantly enhance the forest management efforts in IKN. The efficacy of centralized management is evident (Charnley et al., 2018). To bolster this strength, investing in more robust digital platforms that allow for real-time data analytics would be prudent. A centralized database with AI-driven predictive analysis tools could forecast potential risks and enable more proactive management. Given the crucial importance of timely reactions in forest management (Thrippleton et al. 2020), it's vital to establish localized rapid response teams. These teams should be strategically positioned throughout the region, ensuring that any threat is addressed within a minimum time frame. Simultaneously, investment in communication tools to facilitate instantaneous information dissemination is paramount. Resource limitations pose a significant challenge. Following the insights

of (Meharajbegum et al. 2023), a meticulous, long-term resource allocation plan should be drawn. Such a plan should factor in both the immediate operational needs and future scalability requirements.

The inevitable evolution of technology mandates continuous learning. Training programs should be institutionalized, both in-house and in collaboration with tech providers or specialized institutions. As personnel become more adept with emerging tools, the risk of technological dependency, as highlighted in our analysis, can be mitigated. The dangers of bureaucratic overlaps are evident, and streamlined processes are the antidote. Adopting a "single-window" system for critical operations can minimize coordination hiccups. Such a system could serve as a unified point of contact for all departments, fostering more efficient communication and decision-making. (Aukes et al. 2022) elucidated that collaborations can propel innovative solutions. The FCC should actively seek partnerships with national and international research institutions, tech firms, and environmental NGOs. Joint ventures, research projects, and collaborative interventions can offer fresh perspectives and resources.

Community-based forest management, backed by (Asmin et al. 2019; Purnomo et al. 2020), emphasizes local communities' pivotal role. Educational campaigns, workshops, and citizen engagement programs should be initiated. The community can act as the first line of defense against potential threats by instilling a sense of collective responsibility. The apprehensions related to funding consistency necessitate a diversified financial approach. While national grants and funds remain primary, efforts should be made to tap into international grants, private sector partnerships, and crowd-sourced funding platforms. Diversified funding can ensure stability and foster innovative projects. Reformed by the realities highlighted by (Rana and Fleischman 2023), proactive measures can offer a shield against unforeseen calamities. Establishing emergency response protocols, disaster recovery plans, the ever-evolving policy landscape demands vigilance. Establishing a dedicated policy analysis and advocacy team can be beneficial and this team can monitor policy changes, advise on potential implications, and lobby for favorable regulations.

CONCLUSION

The centralized approach of the Forest Command Center (FCC) in IKN signifies a transformative step in forest management and conservation. This research has diligently investigated the intricacies of the FCC system, mapping its strengths such as streamlined management, rapid response capabilities, effective resource optimization, and modern technology integration. At the same time, it has also highlighted potential challenges, particularly concerning technology dependency, resource constraints, bureaucratic hurdles, and training requisites.

Through a comprehensive literature review and SWOT analysis, the study has identified avenues for potential collaborations, technological enhancements, community engagement, and funding pathways, which can serve as key opportunities to bolster FCC's impact. On the other hand, external threats like inconsistent funding, unforeseen natural disasters, policy changes, and over-reliance on third parties underscore the importance of strategic foresight in ensuring the FCC's resilience and sustainability. The gap analysis reaffirms the study's contribution in bridging existing knowledge chasms, especially in comprehending the unique facets and challenges of centralized systems in forest management. By juxtaposing FCC's model against the backdrop of traditional and decentralized forest management frameworks, the research offers a nuanced understanding of its value proposition in the contemporary forest management landscape. While the FCC in IKN has ushered in a novel paradigm in forest conservation, its ongoing success will invariably hinge on adaptive management, continuous learning, and proactive stakeholder engagement.

REFERENCE

- Achilleos S, Al-Ozairi E, Alahmad B, et al (2019) Acute effects of air pollution on mortality: A 17-year analysis in Kuwait. *Environ Int* 126:476–483.
<https://doi.org/https://doi.org/10.1016/j.envint.2019.01.072>
- Allioui H, Mourdi Y (2023) Unleashing the Potential of AI: Investigating Cutting-Edge Technologies That Are Transforming Businesses. *Int J Comput Eng Data Sci* 3:1–12
- Amaratunga D, Baldry D, Sarshar M, Newton R (2002) Quantitative and qualitative research in the built environment:

- application of “mixed” research approach. *Work Study* 51:17–31. <https://doi.org/10.1108/00438020210415488>
- Asmin F, Darusman D, Ichwandi I, Suharjito D (2019) Mainstreaming community-based forest management in west sumatra: Social forestry arguments, support, and implementation. *For Soc* 3:77–96. <https://doi.org/10.24259/fs.v3i1.4047>
- Aukes E, Stegmaier P, Schleyer C (2022) Guiding the guides: Doing ‘Constructive Innovation Assessment’ as part of innovating forest ecosystem service governance. *Ecosyst Serv* 58:101482
- Bandyopadhyay N, Bhuiyan C, Saha AK (2020) Drought mitigation: Critical analysis and proposal for a new drought policy with special reference to Gujarat (India). *Prog Disaster Sci* 5:100049
- Braun V, Clarke V (2006) Using thematic analysis in psychology. *Qual Res Psychol* 3:77–101. <https://doi.org/10.1191/1478088706qp0630a>
- Budiningsih K, Nurfatriani F, Salminah M, et al (2022) Forest Management Units’s Performance in Forest Fire Management Implementation in Central Kalimantan and South Sumatra. *Forests* 13
- Bustamante MMC, Roitman I, Aide TM, et al (2016) Toward an integrated monitoring framework to assess the effects of tropical forest degradation and recovery on carbon stocks and biodiversity. *Glob Chang Biol* 22:92–109. <https://doi.org/https://doi.org/10.1111/gcb.13087>
- Chen H-C, Tseng T-P, Cheng K, et al (2021) Conducting an Evaluation Framework of Importance-Performance Analysis for Sustainable Forest Management in a Rural Area. *Forests* 12
- Clarke MF, Kelly LT, Avitabile SC, et al (2021) Fire and Its Interactions With Other Drivers Shape a Distinctive, Semi-Arid ‘Mallee’ Ecosystem. *Front. Ecol. Evol.* 9
- Cochrane MA, Bowman DMJS (2021) Manage fire regimes, not fires. *Nat Geosci* 14:455–457
- Dove NC, Taş N, Hart SC (2022) Ecological and genomic responses of soil microbiomes to high-severity wildfire: linking community assembly to functional potential. *ISME J* 16:1853–1863. <https://doi.org/10.1038/s41396-022-01232-9>
- Fernández-Llamazares Á, Lepofsky D, Lertzman K, et al (2021) Scientists’ warning to humanity on threats to indigenous and local knowledge systems. *J Ethnobiol* 41:144–169
- Grant E, Runkle JD (2022) Long-term health effects of wildfire exposure: A scoping review. *J Clim Chang Heal* 6:100110. <https://doi.org/https://doi.org/10.1016/j.joclim.2021.100110>
- Halba A, Vidyarthi PK, Arora P (2022) Gasification as a potential solution for forest fires in the Indian Himalayan Region: A review. *Bioresour Technol Reports* 19:101162. <https://doi.org/https://doi.org/10.1016/j.biteb.2022.101162>
- Imelda S, Lee C-H, Wang H-J, Kim D-C (2024) Determinant of importance-performance and willingness to participate in Komodo adaptive conservation programs. *J Nat Conserv* 126697. <https://doi.org/https://doi.org/10.1016/j.jnc.2024.126697>
- Jazebi S, De Leon F, Nelson A (2019) Review of wildfire management techniques—Part I: Causes, prevention, detection, suppression, and data analytics. *IEEE Trans Power Deliv* 35:430–439
- Kelly BB, Fuster V (2010) Promoting cardiovascular health in the developing world: a critical challenge to achieve global health
- Kiamanesh P, Olafsen KS, Drozd F (2018) Understanding factors that promote and limit the use of video guidance in child protection services: A SWOT analysis. *Child Fam Soc Work* 23:582–589. <https://doi.org/https://doi.org/10.1111/cfs.12447>
- Kirschner JA, Clark J, Boustras G (2023) Governing wildfires: toward a systematic analytical framework. *Ecol Soc* 28:
- Kliskey A, Williams P, Griffith DL, et al (2021) Thinking Big and Thinking Small: A Conceptual Framework for Best Practices in Community and Stakeholder Engagement in Food, Energy, and Water Systems. *Sustainability* 13
- Luu TT (2022) Fostering green service innovation perceptions through green entrepreneurial orientation: the roles of employee green creativity and customer involvement. *Int J Contemp Hosp Manag* 34:2640–2663
- Lyons K, Walters P, Riddell E (2016) The Role of Faith-based Organizations in Environmental Governance: the Case of Forestry in Solomon Islands. *J Environ*

- Policy Plan 18:342–360.
<https://doi.org/10.1080/1523908X.2015.1098524>
- Martos V, Ahmad A, Cartujo P, Ordoñez J (2021) Ensuring Agricultural Sustainability through Remote Sensing in the Era of Agriculture 5.0. *Appl. Sci.* 11
- Mary H, Acharya SS, Padmanaban S, Pandian S (2023) Challenges and opportunities associated with different forms of waste resources utilizations. *Valorization Wastes Sustain Dev* 3–32
- Meharajbegum A, Gadipelli P, Rani AJI, et al (2023) LAND RESOURCE MANAGEMENT AND PLANNING USING REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEMS. *J Data Acquis Process* 38:6871
- Miller E, Reddy M, Banerjee P, et al (2022) Strengthening institutions for public health education: results of an SWOT analysis from India to inform global best practices. *Hum Resour Health* 20:19.
<https://doi.org/10.1186/s12960-022-00714-3>
- Mishenin Y, Yarova I, Koblianska I (2021) Ecologically Harmonized Agricultural Management for Global Food Security BT - Ecological Intensification of Natural Resources for Sustainable Agriculture. In: Jhariya MK, Meena RS, Banerjee A (eds). Springer Singapore, Singapore, pp 29–76
- Nguyen VV, Phan TTT, Chun-Hung L (2022) Integrating multiple aspects of human–elephant conflict management in Dong Nai Biosphere Reserve, Vietnam. *Glob Ecol Conserv* 39:e02285.
<https://doi.org/https://doi.org/10.1016/j.gecco.2022.e02285>
- Orsi F, Ciolli M, Primmer E, et al (2020) Mapping hotspots and bundles of forest ecosystem services across the European Union. *Land use policy* 99:104840.
<https://doi.org/https://doi.org/10.1016/j.landusepol.2020.104840>
- Pandey P, Huidobro G, Lopes LF, et al (2023) A global outlook on increasing wildfire risk: current policy situation and future pathways. *Trees, For People* 100431
- Pawar K V, Rothkar R V (2015) Forest Conservation & Environmental Awareness. *Procedia Earth Planet Sci* 11:212–215.
<https://doi.org/https://doi.org/10.1016/j.proeps.2015.06.027>
- Prasad S, Gao C, Borg B, et al (2020) Chronic Obstructive Pulmonary Disease in adults exposed to fine particles from a coal mine fire. *medRxiv* 2020.10.14.20213033.
<https://doi.org/10.1101/2020.10.14.20213033>
- Purnomo EP, Rahmasari FV, Trisnawati DW, et al (2021) Observed Data of Forest Fire Hotspots effects on Respiratory Disorder by Arc-GIS in Riau Province, Indonesia. *IOP Conf Ser Earth Environ Sci* 717:12036.
<https://doi.org/10.1088/1755-1315/717/1/012036>
- Purnomo EP, Ramdani R, Salsabila L, Choi J-W (2020) Challenges of community-based forest management with local institutional differences between South Korea and Indonesia. *Dev Pract* 30:1082–1093.
<https://doi.org/10.1080/09614524.2020.1749561>
- Rahman A, Suhardono S, Sofiyah ES, et al (2025) Impact of COVID-19 on visitor attitude and management strategies at Komodo National Park: Insights for enhancing park adaptive experience. *Trees, For People* 20:100825.
<https://doi.org/https://doi.org/10.1016/j.tfp.2025.100825>
- Rana P, Fleischman F (2023) Indian forest governance during the COVID-19 pandemic. *Int For Rev* 25:105–120
- Rosen Z, Henery G, Slater KD, et al (2023) A Culture of Fire: Identifying Community Risk Perceptions Surrounding Prescribed Burning in the Flint Hills, Kansas. *J Appl Commun* 106:..
<https://doi.org/10.4148/1051-0834.2455>
- Sacramento DS, Martins LC, Arbex MA, Pamplona Y de AP (2020) Atmospheric Pollution and Hospitalization for Cardiovascular and Respiratory Diseases in the City of Manaus from 2008 to 2012. *Sci World J* 2020:8458359.
<https://doi.org/10.1155/2020/8458359>
- Salomon AK, Lertzman K, Brown K, et al (2018) Democratizing conservation science and practice. *Ecol Soc* 23:
- Sattayapanich T, Janmaimool P, Chontanawat J (2022) Factors Affecting Community Participation in Environmental Corporate Social Responsibility Projects: Evidence from Mangrove Forest Management Project. *J Open Innov Technol Mark Complex* 8:209
- Schnelzer J, Franz Y, Mocca E, Kazepov Y (2023) The role of institutional opportunity structures for refugee integration in Vienna. Learnings and modifications in the aftermath of the long summer of migration in 2015. *Innov Eur J Soc Sci Res* 36:190–209.

- <https://doi.org/10.1080/13511610.2022.2071239>
- Senande-Rivera M, Insua-Costa D, Miguez-Macho G (2022) Spatial and temporal expansion of global wildland fire activity in response to climate change. *Nat Commun* 13:1208. <https://doi.org/10.1038/s41467-022-28835-2>
- Silva Junior CHL, Aragão LEOC, Anderson LO, et al (2020) Persistent collapse of biomass in Amazonian forest edges following deforestation leads to unaccounted carbon losses. *Sci Adv* 6:eaz8360
- Singh S (2022) "Forest fire emissions: A contribution to global climate change" . *Front. For. Glob. Chang.* 5
- Sofiyah ES, Ridhosari B, Suhardono S, et al (2025) Impact of COVID-19 on Subjective Well-being and Community Im-portance-Performance in Sanitation Programs in Jakarta, Indonesia. In: *Forum Geografi*. pp 64–78
- Suhardono S, Fitria L, Septiariva IY, et al (2024a) Community-centric importance and performance evaluation of Human-Orangutan Conflict management in Aceh, Indonesia. *Trees, For People* 15:100510. <https://doi.org/https://doi.org/10.1016/j.tfp.2024.100510>
- Suhardono S, Lee C-H, Suryawan IWK (2025a) Influence of adaptive management indicators on willingness to adapt to single-use plastic ban. *Environ Econ Policy Stud.* <https://doi.org/10.1007/s10018-025-00439-2>
- Suhardono S, Lee C-H, Thuy Phan TT, Suryawan IWK (2025b) Resident action in smart waste management during landfill disclosure transition: Insights from Yogyakarta's smart city initiatives. *Clean Prod Lett* 100093. <https://doi.org/https://doi.org/10.1016/j.clpl.2025.100093>
- Suhardono S, Septiariva IY, Mulyana R, et al (2024b) Human activities and forest fires in Indonesia: An analysis of the Bromo incident and implications for conservation tourism. *Trees , For People* 15:
- Sun L, Fang S, Iqbal S, Bilal AR (2022) Financial stability role on climate risks, and climate change mitigation: implications for green economic recovery. *Environ Sci Pollut Res* 29:33063–33074
- Suryawan IWK, Gunawan VD, Lee C-H (2025a) The role of local adaptive capacity in marine ecotourism scenarios. *Tour Manag* 107:105039. <https://doi.org/https://doi.org/10.1016/j.tourman.2024.105039>
- Suryawan IWK, Gunawan VD, Lee C-H (2024) Assessing the importance-performance analysis of adaptive capacity programs for sustainable mangrove conservation in the Taman Nasional Bali Barat conservation area. *Ocean Coast Manag* 257:107345. <https://doi.org/https://doi.org/10.1016/j.ocecoaman.2024.107345>
- Suryawan IWK, Lee C-H (2025) Green transition management: The key role of community participation in developing resilient waste management policies for coastal and inland communities. *Environ Sci Pollut Res.* <https://doi.org/10.1007/s11356-025-36185-x>
- Suryawan IWK, Lee C-H (2023) Citizens' willingness to pay for adaptive municipal solid waste management services in Jakarta, Indonesia. *Sustain Cities Soc* 97:. <https://doi.org/https://doi.org/10.1016/j.scs.2023.104765>
- Suryawan IWK, Sianipar IMJ, Lee C-H (2025b) Community importance-performance preferences and policy adaptiveness in marine debris management: A case study from the Komodo Subdistrict, Indonesia. *Mar Policy* 174:106592. <https://doi.org/https://doi.org/10.1016/j.marpol.2025.106592>
- Suryawan IWK, Suhardono S, Nguyen VV, Lee C-H (2025c) Importance-Performance Evaluation of Coral Reef Conservation in Advancing the Bioeconomy of Marine Tourism in Bali, Indonesia. *Aquat Conserv Mar Freshw Ecosyst* 35:e70085. <https://doi.org/https://doi.org/10.1002/aqc.70085>
- Sutrisno AD, Chen Y-J, Suryawan IW, Lee C-H (2023) Building a Community's Adaptive Capacity for Post-Mining Plans Based on Important Performance Analysis: Case Study from Indonesia. *Land* 12
- Thrippleton T, Lüscher F, Bugmann H (2020) Climate change impacts across a large forest enterprise in the Northern Pre-Alps: dynamic forest modelling as a tool for decision support. *Eur J For Res* 139:483–498
- Török DF (2023) Polyphenols and Sensory Traits in Reverse Osmosis NoLo Wines. *J Knowl Learn Sci Technol* ISSN 2959-6386 2:
- Vemuri A (2008) Joint Forest Management in

India: An Unavoidable and Conflicting Common Property Regime in Natural Resource Management . J Dev Soc Transform 5:81–90

Yang B-C, Lee C-H, Suryawan IWK (2025) Resilient socio-technical systems for adaptive consumer e-waste management. Sustain Cities Soc 106026. <https://doi.org/https://doi.org/10.1016/j.scs.2024.106026>

Ye Y, Yeung ACL, Huo B (2020) Maintaining stability while boosting growth? The long-term impact of environmental accreditations on firms' financial risk and sales growth. Int J Oper Prod Manag 40:1829–1856

Zafarullah H, Ferdous J (2023) Metropolitan Governance and Interorganizational Coordination: Study of a City Corporation in Bangladesh. Public Organ Rev. <https://doi.org/10.1007/s11115-023-00749-7>

