Environmental Governance and Institutional Capacity in Decentralized Management of Oil Palm Plantations on Wetlands

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Abstract. Wetland-based oil palm plantations present significant environmental challenges due to hydrological sensitivity, peat oxidation risks, and biodiversity loss. Under Indonesia's decentralized governance framework, local government capacity plays a central role in determining whether oil palm management supports or undermines environmental sustainability. This study analyzes the governance structure and institutional capacity of local authorities in Bengkalis District to support sustainable management of oil palm plantations in wetland areas. A MICMAC (Cross-Impact Matrix Multiplication Applied to Classification) approach was applied to identify key governance variables and assess their influence–dependency relationships. Data were collected through expert assessments, stakeholder consultations, and document analysis. Results indicate that regulatory enforcement, institutional capacity, and cross-sectoral coordination are the primary driving forces enabling effective environmental governance. Meanwhile, community participation and technological innovation depend heavily on these governing factors to be impactful. Strengthening institutional mechanisms—particularly environmental monitoring, capacity-building programs, and collaborative governance arrangements—is essential for reducing ecological risks while maintaining rural economic livelihoods. The study contributes to the literature on decentralized environmental governance by demonstrating how institutional resilience can support sustainable resource management in ecologically sensitive landscapes. **Keywords**: Environmental Governance, Wetland Management, Environmental Policy, Institutional Capacity

1 Introduction

The governance of natural resources in ecologically sensitive regions has become a central concern in global environmental policy, particularly in the context of wetlands. Wetlands provide critical ecosystem services, including biodiversity conservation, carbon

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sequestration, and water regulation, yet they are also highly vulnerable to degradation from agricultural expansion and unsustainable land use. Among these pressures, the rapid growth of oil palm plantations has been one of the most significant drivers of ecological change in Southeast Asia, especially in Indonesia, which is the world's largest producer of palm oil. While the industry has contributed substantially to economic development, it has simultaneously generated complex environmental and governance challenges, particularly in regions where wetlands dominate the landscape.

The shift toward decentralized governance in Indonesia, initiated through reforms in the early 2000s, was expected to strengthen local participation, accountability, and responsiveness in natural resource management. Decentralization places substantial authority in the hands of local governments, granting them the mandate to regulate land use, oversee plantation development, and implement environmental policies. However, the effectiveness of decentralized management has been uneven, largely depending on the capacity of local institutions to design, enforce, and coordinate governance mechanisms. In wetland ecosystems, where ecological fragility intersects with economic dependence on palm oil, weak governance can exacerbate deforestation, peatland degradation, and carbon emissions, thereby intensifying ecological and socio-economic risks.

Bengkalis District in Riau Province provides a critical case for examining these governance dynamics. The region's wetlands are both ecologically vital and economically strategic, with oil palm plantations forming a major livelihood base for local communities. Yet, pressures from land conversion, weak regulatory enforcement, and overlapping institutional authority have challenged the realization of sustainable management. While national policies emphasize sustainability and environmental protection, the actual implementation at the district level hinges on institutional capacity, cross-sectoral coordination, and stakeholder engagement. These governance variables not only determine the effectiveness of policy enforcement but also influence the resilience of institutions in addressing long-term sustainability goals.

Previous studies on oil palm governance have highlighted the environmental impacts of plantation expansion and the socio-economic benefits for rural communities, but limited attention has been given to the institutional dimension of decentralized governance in wetland ecosystems. In particular, there is a need to systematically analyze the interdependencies among governance variables that shape sustainability outcomes. Understanding these interrelationships can provide insights into which governance factors act as key drivers and which depend on broader institutional frameworks for their effectiveness.

Against this backdrop, this study applies the MICMAC (Cross-Impact Matrix Multiplication Applied to Classification) method to assess the relative influence and dependency of governance variables in the management of oil palm plantations on wetlands. By focusing on regulatory frameworks, institutional capacity, stakeholder coordination, community participation, and environmental monitoring, this research seeks to identify strategic priorities for strengthening governance under decentralization. The findings contribute to the broader discourse on environmental governance by offering empirical evidence of how institutional capacity at the local level can enhance resilience, reduce ecological risks, and support sustainable management in resource-dependent regions.

The urgency of this study lies in the ecological fragility of wetlands combined with the socio-economic reliance on oil palm plantations. Weak governance in these ecosystems not only threatens biodiversity and carbon storage but also undermines the resilience of rural livelihoods and Indonesia's commitment to sustainable development. Strengthening institutional capacity and governance mechanisms at the local level is therefore essential for reducing ecological risks while ensuring socio-economic stability. By addressing the institutional dimensions of decentralized governance, this research contributes to bridging the gap between national sustainability commitments and local implementation challenges.

By answering these questions, the study offers empirical insights into how decentralized governance can be made more effective through institutional resilience and cross-sectoral coordination. Based on the gaps identified in the literature and the urgency of sustainable oil palm management in wetlands, this study addresses the following questions:

What are the key governance variables influencing the decentralized management of oil palm plantations in wetland ecosystems?

How do these governance variables interact in terms of influence and dependency within a decentralized governance framework?

Which governance factors emerge as strategic drivers for strengthening institutional capacity and achieving sustainable oil palm management in wetlands?

The governance of oil palm development in Indonesia has been widely discussed in the context of sustainability, decentralization, and institutional effectiveness. Several studies highlight the structural challenges embedded in Indonesia's decentralized governance system, particularly when applied to ecologically fragile ecosystems such as wetlands and peatlands.

One of the critical issues is what [1] describe as "hollow governance", where sustainability schemes such as the Indonesian Sustainable Palm Oil (ISPO) certification remain largely ineffective due to overlapping regulations and the absence of coherent enforcement at the district level. This situation reflects a broader pattern of fragmented governance, where national commitments to sustainability are not adequately translated into actionable policies at the local scale. The complexity of multi-level governance is further complicated by weak law enforcement and local political interests, which, according to studies in conservation governance, often create opportunities for illegality and corruption in land management [2].

In addition to regulatory fragmentation, coordination among actors remains a persistent challenge. Research by CIFOR-ICRAF emphasizes the importance of jurisdictional approaches and multi-stakeholder collaboration to strengthen oil palm sustainability initiatives. Local governments are expected to play a crucial role in facilitating cross-sectoral coordination, yet political cycles and institutional rivalries frequently disrupt the continuity of such initiatives. This aligns with findings from climate governance studies [3], which indicate that decentralization may shift authority without necessarily creating stronger incentives for sustainable practices, sometimes even encouraging land conversion to maximize local revenue.

Spatial governance problems also play a major role in shaping oil palm conflicts. As noted in Wetlands Ecology and Management [4], inconsistent and overlapping land-use maps between forestry and agricultural sectors often lead to disputes between local communities, corporations, and government agencies. These conflicts highlight the institutional weaknesses in integrating ecological data into planning processes, which is particularly critical for wetlands where ecological fragility demands precise and coordinated land management.

Beyond regulation and coordination, institutional support for smallholders remains a decisive factor in advancing sustainability. Research using Soft Systems Methodology [5], proposes several institutional models for strengthening independent oil palm farmers, including cooperative-based structures and nucleus-plasma schemes. These models emphasize the role of local governments and intermediary institutions in building capacity for smallholders, ensuring better market access, and fostering compliance with sustainability standards. Yet, the effectiveness of these models still hinges on the broader institutional framework and the capacity of local governance systems.

The literature on peatland and wetland governance also underscores persistent weaknesses in environmental restoration efforts. Reports from WRI Indonesia reveal that despite ambitious peatland restoration programs, bureaucratic fragmentation, weak coordination, and data inconsistencies continue to undermine effectiveness. This indicates that governance improvements cannot be separated from institutional strengthening, particularly in terms of monitoring, enforcement, and cross-sectoral integration.Taken together, these studies demonstrate that the sustainability of oil palm management in wetlands is not solely determined by ecological factors but is deeply intertwined with governance arrangements and institutional capacity at the local level. However, while existing research has identified key challenges - such as fragmented regulation, weak enforcement, limited stakeholder coordination, and institutional support for smallholders—there remains limited empirical work analyzing the interdependencies among these governance variables. This study addresses that gap by applying the MICMAC method to systematically assess the driving and dependent factors influencing environmental governance in decentralized contexts.

2 Method

This study employed a qualitative-quantitative exploratory design using the MICMAC (Cross-Impact Matrix Multiplication Applied to Classification) analysis to examine the interrelationships among governance variables in decentralized management of oil palm plantations on wetlands. The MICMAC approach allows the identification of variables that act as drivers, linkages, dependent, or autonomous factors within the governance system.Data were collected through a combination of methods:

Expert Judgment – consultation with key experts in environmental governance, local government institutions, NGOs, and academics with knowledge of wetland ecosystems.

Stakeholder Consultations – discussions with representatives of local government, oil palm farmer groups, and community organizations in Bengkalis District.

Document Analysis – review of relevant laws, regulations, government reports, and academic literature on decentralized natural resource governance.

This study focused on five core governance variables considered critical for the management of oil palm plantations in wetland regions. These include regulatory frameworks, institutional capacity, stakeholder coordination, community participation, and environmental monitoring. In addition, technological innovation was examined as a supporting variable that may enhance the overall effectiveness of environmental governance. The selection of these variables was informed by an extensive literature review and stakeholder consultations, ensuring that the analysis captured both theoretical foundations and empirical realities in the context of decentralized natural resource management.

The analysis employed the MICMAC (Cross-Impact Matrix Multiplication Applied to Classification) method, which was implemented in four main stages. First, the identification of variables was carried out based on prior studies and inputs from relevant stakeholders, ensuring the inclusion of contextually significant governance factors. Second, a cross-impact matrix was constructed, where experts evaluated the degree of influence each variable exerted on the others using a four-point scale (0 = no influence, 1 = weak, 2 = moderate, 3 = strong). Third, matrix multiplication and classification were conducted using MICMAC software to generate an influence–dependence map, which categorized the variables into four groups: driving, linkage, dependent, and autonomous. Finally, the interpretation of results was undertaken to identify the dominant driving forces and assess their implications for strengthening decentralized environmental governance.

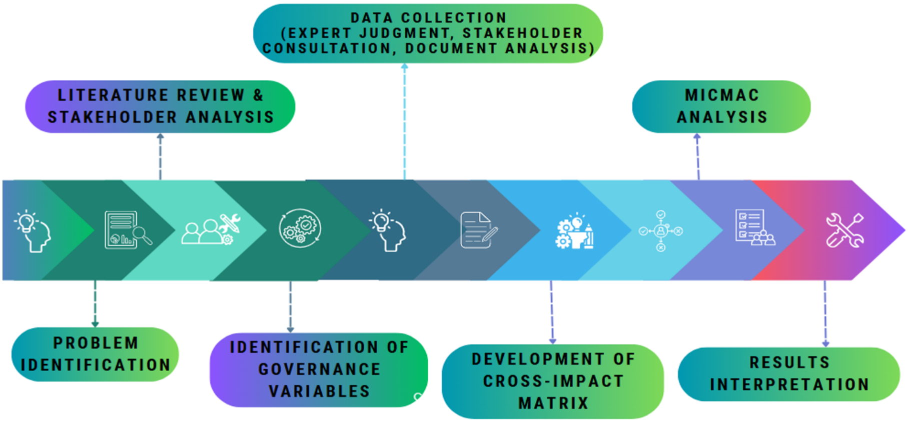

Fig. 1. Research Flowchart.

3 Result and Discussion

The selection of the five key governance variables: regulatory frameworks, institutional capacity, stakeholder coordination, community participation, and environmental monitoring is grounded in both theoretical foundations and empirical evidence. From a theoretical perspective, these variables represent the essential pillars of good environmental governance. Regulatory frameworks embody the principle of the rule of law, while institutional capacity reflects the administrative and managerial strength required to implement policies effectively. Stakeholder coordination corresponds to collaborative governance theory [6], [7], which emphasizes the importance of inter-organizational cooperation in decentralized systems. Community participation resonates with [8] theory of collective action, which highlights the role of local actors in achieving sustainable resource management. Finally, environmental monitoring serves as a key accountability mechanism, consistent with insights from [9] on the importance of adaptive feedback in governance systems.

The results of the MICMAC analysis confirm the centrality of these variables. Regulatory enforcement and institutional capacity were classified as dominant driving forces, exerting strong influence on the governance system while showing relatively low dependence. This outcome validates earlier studies [10] that emphasize the critical role of legal frameworks and institutional resilience in shaping sustainable governance under decentralization. Similarly, cross-sectoral coordination also emerged as a strong driver, reinforcing the collaborative governance perspective that integrated policy action is essential to avoid fragmentation in decentralized contexts.

On the other hand, community participation and technological innovation were categorized as dependent variables, relying heavily on stronger institutional and regulatory support. This reflects [8] proposition that collective action requires enabling structures to be effective. Meanwhile, environmental monitoring occupied a linkage position, serving as both an influencer and a recipient of influence, highlighting its dual role as a stabilizer in the governance system. By integrating insights from international literature, national governance experiences, and local stakeholder perspectives, alongside the MICMAC results, this study demonstrates that the chosen governance variables not only have strong theoretical grounding but also empirical significance in the decentralized management of wetlands.

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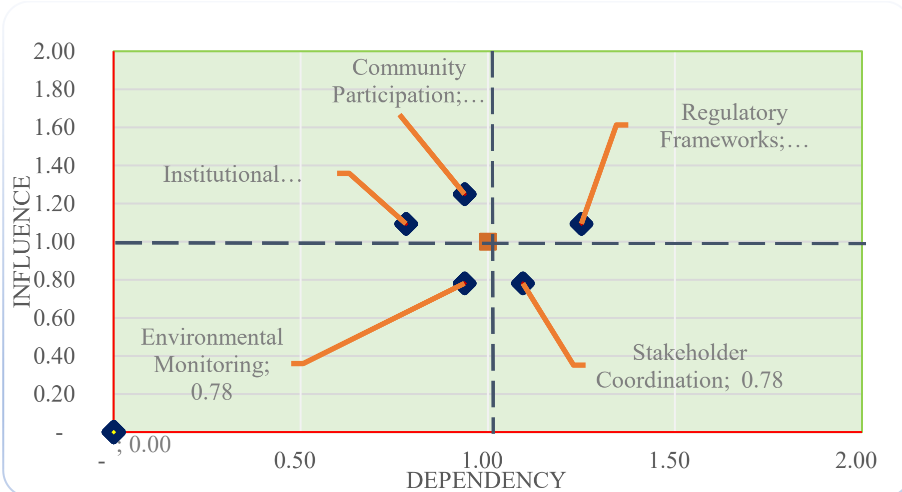

Fig.2. MICMAC analysis of Variables (Source: Research results).

The MICMAC analysis provided an influence–dependence map that illustrates the relative role of governance variables in decentralized management of oil palm plantations in wetlands (Figure 2). The distribution of variables across the quadrants reveals significant insights into the dynamics of environmental governance under decentralization.

Regulatory frameworks (1.09) and institutional capacity (1.09) emerged as strong driving variables, positioned in the quadrant of high influence with relatively moderate dependency. This finding highlights that regulatory enforcement and local government capacity are central to determining the effectiveness of decentralized governance. Without clear and enforceable regulations, as well as strong institutional structures, the system risks becoming fragmented and unsustainable. These results are consistent with [11], who emphasize that decentralization can only succeed when it is underpinned by robust institutional capacity and legal enforcement mechanisms.

Community participation (1.25) appears as a dependent variable, showing high dependency on other governance elements despite having considerable influence. This position indicates that while communities can play an important role in ensuring sustainable practices, their participation is contingent upon supportive institutional and regulatory frameworks. This aligns with [8] collective action theory, which suggests that community-based governance requires enabling institutional conditions to be effective.

Stakeholder coordination (0.78) and environmental monitoring (0.78) are positioned closer to the linkage quadrant, meaning they both influence and are influenced by other variables. Their dual role underscores the importance of effective coordination among government agencies, private sector, and local communities to avoid policy fragmentation. Similarly, environmental monitoring serves as a feedback mechanism that not only supports enforcement and capacity building but also depends on them for continuity and credibility. This resonates with findings by [9], who argue that monitoring is essential for adaptive governance and accountability, particularly in fragile ecosystems like wetlands.

The distribution of variables across quadrants demonstrates that decentralized governance of oil palm plantations in wetlands relies heavily on institutional and regulatory drivers, while community participation and innovation remain dependent outcomes. Strengthening institutional resilience and regulatory frameworks therefore emerges as a priority for sustainable governance. Furthermore, reinforcing stakeholder coordination and monitoring systems is necessary to create stabilizing linkages that connect top-down policies with bottom-up practices.

The MICMAC results emphasize that sustainable decentralized governance in wetland-based oil palm plantations requires: (1) stronger regulatory enforcement, (2) enhanced local institutional capacity, (3) integrated stakeholder coordination, (4) reliable monitoring systems, and (5) empowerment of community participation within supportive governance frameworks. These findings contribute to the broader discourse on environmental governance by showing how institutional resilience and multi-actor collaboration serve as the foundation for balancing ecological protection with socio-economic needs in resource-dependent regions.

3.1 Driving Forces of Decentralized Environmental Governance

The MICMAC analysis revealed that regulatory frameworks, institutional capacity, and stakeholder coordination function as dominant driving forces in the decentralized governance of oil palm plantations on wetlands. These variables exhibit strong influence on the governance system while maintaining relatively low levels of dependence, which positions them as foundational elements in shaping sustainable outcomes.

Regulatory frameworks emerged as a critical determinant, underscoring the necessity of clear and enforceable rules to guide plantation management in ecologically sensitive wetlands. In the absence of strong regulatory enforcement, decentralized governance risks producing fragmented policies, legal loopholes, and inconsistent implementation across local jurisdictions. This result resonates with previous studies [11], which highlight that decentralization without a robust legal foundation often undermines environmental sustainability.

Equally important is institutional capacity, which reflects the administrative and managerial strength of local governments. The findings demonstrate that the ability of local institutions to design, implement, and monitor policies directly influences the effectiveness of decentralized management. Weak institutional capacity, often marked by limited resources, inadequate expertise, and insufficient autonomy, has been a recurrent challenge in Indonesia's natural resource governance [13], [14]. Strengthening institutional resilience therefore becomes an urgent priority for achieving sustainable governance in wetlands.

The third driving force, stakeholder coordination, emphasizes the collaborative dimension of decentralized governance. Cross-sectoral and multi-actor coordination helps bridge policy gaps, harmonize competing interests, and integrate environmental objectives with socio-economic development goals. The positioning of stakeholder coordination as a driver reinforces the notion that fragmented governance can be overcome only through collaborative mechanisms [10], [11].

Together, these three driving variables highlight that the effectiveness of decentralized environmental governance is contingent upon a strong legal framework, resilient institutions, and cohesive stakeholder collaboration. They form the structural backbone upon which other governance variables such as community participation, technological innovation, and environmental monitoring depend for successful implementation

3.2 Linkage and Dependent Variables in Sustainable Wetland Management

In addition to the dominant drivers, the MICMAC analysis positioned environmental monitoring as a linkage variable and community participation together with technological innovation as dependent variables. These findings suggest that while these factors are vital for sustainable management, their effectiveness relies heavily on the strength of regulatory frameworks, institutional capacity, and coordination mechanisms.Environmental monitoring occupies a unique role as a linkage variable, exerting influence on and simultaneously being influenced by other governance dimensions. Monitoring systems serve as a feedback loop that connects institutional enforcement and community-level practices, providing data to evaluate policy effectiveness and guide adaptive decision-making. However, weak monitoring capacity can undermine accountability and transparency, limiting the ability of local governments to respond effectively to ecological risks. This result supports the arguments of [15] who emphasize that environmental monitoring is not only a technical function but also a governance instrument that stabilizes the overall system.

Community participation, classified as a dependent variable, highlights the reliance of local engagement on enabling governance structures. While communities are key actors in promoting sustainable practices, their ability to contribute effectively depends on supportive institutional and regulatory environments. This finding is consistent with [12] theory of collective action, which asserts that local participation can only succeed when rules are clear, institutions are trusted, and incentives are aligned with sustainability goals. Without institutional backing, participation risks becoming symbolic rather than substantive.

Similarly, technological innovation also emerged as a dependent factor. Although innovation holds potential to enhance the sustainability of oil palm management in wetlands—such as through precision agriculture, water management systems, or eco-friendly cultivation techniquesits adoption is contingent upon institutional support, financial incentives, and regulatory encouragement. This underscores the need for proactive governance strategies to facilitate technology transfer and incentivize environmentally sound practices.Together, these results show that monitoring, community participation, and innovation cannot operate independently; rather, they must be embedded within a governance framework supported by strong regulations, institutional resilience, and stakeholder collaboration. In this sense, the effectiveness of dependent and linkage variables serves as a measure of how well the driving forces have been institutionalized within decentralized governance systems.

4 Conclusion

The MICMAC analysis demonstrates that effective decentralized management of oil palm plantations in wetlands depends primarily on the strength of regulatory frameworks and local institutional capacity. These two factors emerged as dominant driving forces, underscoring their central role in shaping governance outcomes. Without robust regulations and capable institutions, decentralization risks leading to fragmented policies and unsustainable practices.

Community participation, while influential, was identified as a dependent variable, highlighting the need for supportive governance structures to translate local engagement into meaningful sustainability outcomes. Meanwhile, stakeholder coordination and environmental monitoring occupy linkage positions, serving as both influencers and recipients of influence within the governance system. Their strategic role suggests that improved coordination mechanisms and reliable monitoring systems can act as bridges between institutional drivers and community-level action.

The findings point to the importance of strengthening institutional resilience and governance mechanisms at the local level as a foundation for sustainable environmental management. Policy interventions should prioritize reinforcing regulatory enforcement, enhancing institutional capacity, and promoting cross-sectoral collaboration, while at the same time enabling community participation and fostering technological innovation. By integrating these elements, decentralized governance can better balance ecological protection with socio-economic needs, ensuring the long-term sustainability of wetland-based oil palm plantations.

5 Policy and Practical Implications

The findings of this study carry several important policy and practical implications for strengthening decentralized environmental governance in wetland-based oil palm plantations. First, the identification of regulatory frameworks and institutional capacity as dominant driving forces underscores the need for stronger legal enforcement and institutional resilience at the local level. Policymakers should ensure that local regulations are well aligned with national environmental laws, while also providing sufficient administrative resources and technical expertise to local agencies. This alignment will reduce policy fragmentation and improve the capacity of local governments to implement sustainable management practices.

Second, the position of stakeholder coordination and environmental monitoring as linkage variables highlights their critical function as stabilizers within the governance system. Effective cross-sectoral coordination mechanisms are necessary to bridge policy design and implementation across government, private sector, and civil society. Similarly, strengthening environmental monitoring—through both traditional field assessments and digital technologies such as remote sensing—will enhance transparency and accountability, enabling adaptive governance in ecologically sensitive regions. Third, the classification of community participation as a dependent variable suggests that local engagement alone cannot guarantee sustainability outcomes unless supported by institutional and regulatory drivers. Practical interventions should therefore focus on empowering communities through participatory planning processes, community-based monitoring, and equitable benefit-sharing mechanisms, all of which require enabling structures provided by local institutions.

Finally, the results indicate the importance of technological innovation as an emerging dependent factor. Practical measures such as promoting sustainable agricultural technologies, incentivizing eco-friendly practices, and facilitating knowledge transfer can help bridge the gap between policy ambitions and ground-level realities. The policy and practical implications of this study point to the urgent need for a governance approach that combines robust institutional frameworks, effective coordination, reliable monitoring, and empowered community participation. Such an integrated strategy will not only mitigate ecological risks in wetlands but also balance sustainability with socio-economic development in resource-dependent regions.

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