Symbiosis Civicus

Symbiosis Civicus, Month Year, Vol. (No.):Page
DOI: https://doi.org/10.32663/.....

EVALUATION OF THE TESSO NILO NATIONAL PARK ECOSYSTEM RESTORATION PROGRAM 2018 – 2023

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ARTICLE HISTORY

Received :
Revised :
Accepted :

Keywords:
Program Evaluation, Ecosystem Restoration, CIPP Model, National Park, Tesso Nilo

ABSTRACT

This research aims to evaluate the implementation of the Ecosystem Restoration Program (ERP) at Tesso Nilo National Park (TNTN) during the period 2018–2023 as a response to massive ecosystem degradation caused by encroachment, land conversion, and other anthropogenic disturbances. The research uses a descriptive qualitative approach with the CIPP (Context, Input, Process, Product) evaluation model as the analytical framework. The research results indicate that the condition of the TNTN ecosystem before the PE program was at a high level of degradation, characterized by a decrease in natural forest cover, habitat fragmentation, and an increase in human-wildlife conflict. Following the implementation of the PE program, there was an improvement in biophysical conditions in the recovery area, particularly in increased vegetation cover and successful plant growth in most locations. Based on national indicators, the overall effectiveness of the PE program has generally met the success criteria, with an average plant survival rate of ≥75%, although variations in achievement were still found between blocks, and some locations even showed success rates below standard. Factors supporting program success include policy support, multi-stakeholder collaboration, and the availability of technical resources. Meanwhile, limiting factors include degraded soil conditions, wildlife disturbances, limited post-harvest supervision, and low community participation in some areas. From a sustainability perspective, the PE program is projected to have a positive impact on the restoration of TNTN's ecological functions during the 2024–2028 period, particularly in supporting ecosystem resilience, biodiversity protection, and environmental stability in the conservation area.

1. INTRODUCTION

Indonesia is widely recognized as one of the world's megadiverse countries, possessing extraordinary biological richness and complex tropical forest ecosystems that play a crucial role in maintaining global ecological balance. These ecosystems function not only as habitats for diverse flora and fauna but also as regulators of climate systems, carbon storage, and hydrological cycles. Natural forests provide essential ecosystem services that are fundamental to human survival, including microclimate regulation, water cycle stabilization, and biodiversity conservation, as emphasized by Supartono et al. (2020). However, despite their ecological significance, Indonesia's forest ecosystems are currently experiencing severe degradation as a result of increasing anthropogenic pressures. Large-scale plantation expansion, illegal logging, forest and land fires, and uncontrolled land conversion have contributed to the decline of forest cover, habitat fragmentation, loss of biodiversity, and reduced environmental carrying capacity. These processes reflect not only ecological degradation but also a broader socio-ecological crisis driven by economic demands, population growth, and governance challenges.

The degradation of forest ecosystems is not a singular event but a long-term and cumulative process influenced by unsustainable human activities. Desitarani et al. (2020) argue that ecosystem degradation requires systematic and continuous restoration efforts that integrate ecological, social, and institutional dimensions. In the context of conservation, protected areas such as national parks are expected to serve as strongholds for biodiversity preservation and ecological stability. However, in reality, many conservation areas in Indonesia face significant threats from anthropogenic disturbances. Rahmayanti (2022) explains that conservation forests function as strategic instruments for long-term environmental protection, yet their effectiveness is highly dependent on appropriate management practices and the integration of ecological objectives with socio-economic considerations. This perspective highlights that conservation efforts cannot be separated from human dimensions, particularly in areas where local communities rely heavily on natural resources for their livelihoods.

One of the most critical conservation areas facing such challenges is Tesso Nilo National Park (TNTN),

located in Riau Province. As one of the last remaining lowland tropical rainforests in Sumatra, TNTN holds significant ecological value as a habitat for endangered species such as the Sumatran tiger (*Panthera tigris sumatrae*) and the Sumatran elephant (*Elephas maximus sumatranus*). In addition, the park plays a vital role in maintaining regional hydrological systems and serving as a carbon sink for climate change mitigation. Despite its ecological importance, TNTN has experienced severe degradation since the early 2000s due to encroachment, illegal oil palm plantation expansion, forest fires, and wildlife poaching. Empirical data indicate that more than 60% of the park's natural forest has been degraded, with a substantial portion converted into non-forest land uses, particularly illegal plantations. This condition has led to habitat fragmentation, disruption of ecological processes, and a decline in ecosystem resilience.

The ecological degradation of TNTN is closely intertwined with socio-economic dynamics in the surrounding communities. Many local communities depend on oil palm cultivation as their primary source of livelihood, which creates a direct conflict between conservation objectives and economic needs. This condition reflects structural problems related to land tenure conflicts, limited economic alternatives, and weak law enforcement. According to Fikriyani and Mussadun (2014), environmental programs often fail when they do not adequately integrate community participation and socio-economic realities into their design and implementation. Therefore, ecosystem degradation in TNTN cannot be understood solely as a biophysical issue but must be analyzed within a broader socio-ecological framework that considers governance, institutional arrangements, and community behavior.

In response to these challenges, the Indonesian government has prioritized ecosystem restoration as a key policy instrument to rehabilitate degraded conservation areas. Ecosystem restoration is conceptualized as a long-term, systematic, and adaptive process aimed at restoring ecological functions so that ecosystems can regain their natural balance and provide sustainable benefits. Desitarani et al. (2020) emphasize that ecosystem restoration involves a series of interconnected stages, including planning, implementation, monitoring, and evaluation, which must be carried out continuously to achieve sustainable outcomes. This approach differs from conventional reforestation by emphasizing ecological integrity, resilience, and the integration of social and institutional dimensions.

The Ecosystem Restoration Program (ERP) implemented in Tesso Nilo National Park during the 2018–2023 period represents a strategic intervention aimed at addressing severe ecosystem degradation. The program includes forest and land rehabilitation, watershed restoration, natural succession enhancement, and area protection through monitoring and patrol activities. Its primary objective is to restore vegetation cover, improve ecological processes, and enhance habitat quality for wildlife. However, the implementation of the program has shown varying levels of success. While some areas have achieved plant growth rates above the national standard of 75%, others have failed to meet this benchmark due to factors such as degraded soil conditions, wildlife disturbances, flooding, encroachment, and limited post-planting maintenance.

These variations in program outcomes indicate that the success of ecosystem restoration is influenced by multiple interacting factors. Kusuma et al. (2024) highlight that restoration success is determined not only by technical aspects such as species selection and planting methods but also by social, institutional, and environmental conditions. Similarly, Ananti and Asrida (2018) emphasize the importance of stakeholder coordination, consistent monitoring, and community involvement in ensuring the effectiveness of restoration programs. These perspectives suggest that ecosystem restoration should be understood as a multidimensional process requiring integrated and adaptive management approaches.

Despite the growing importance of ecosystem restoration, existing studies in Indonesia tend to focus on partial aspects of restoration, such as technical rehabilitation success or policy analysis, without providing a comprehensive evaluation of program implementation. Most research lacks integration between ecological outcomes, implementation processes, and socio-institutional dynamics. In particular, there is limited empirical research that applies a holistic evaluation framework to assess ecosystem restoration programs in lowland tropical forest conservation areas such as Tesso Nilo National Park. This gap highlights the need for more comprehensive studies that can bridge the divide between policy design and field-level implementation while simultaneously integrating ecological, social, and institutional perspectives.

In this context, the present study offers a novel contribution by applying the CIPP (Context, Input, Process, Product) evaluation model to assess the Ecosystem Restoration Program in Tesso Nilo National Park. This approach enables a comprehensive evaluation that examines not only the outcomes of the program but also its contextual relevance, input adequacy, and implementation processes. By integrating ecological, social, and institutional dimensions, this study provides a more holistic understanding of the factors influencing restoration success and failure. Furthermore, the focus on a lowland tropical rainforest ecosystem, which remains underrepresented in previous research, adds significant empirical value to the study.

2. LITERATURE REVIEW

Conservation forests are state-owned areas that primarily function to preserve biodiversity and maintain the stability of terrestrial ecosystems. Rahmayanti (2022) explains that conservation forests play a strategic role as an instrument for long-term environmental protection. This function is not limited to ecological preservation but also relates to sustainable natural resource management. In line with this, Muhammad Restu Putra Pratama et al. (2025) emphasize that conservation area management must apply the principles of equitable benefit and sustainability. Thus, conservation forests are directed at maintaining ecological balance while providing social and economic contributions to surrounding communities.

In the context of terrestrial conservation areas in Indonesia, Tesso Nilo National Park (TNTN) is one of the remaining lowland tropical rainforests on the island of Sumatra. This area holds strategic value not only ecologically, but also socially and economically. Ecologically, TNTN serves as a habitat for various important flora and fauna species, while socially and economically, the area is closely linked to the existence of communities in the buffer zone. Therefore, the existence of the Tesso Nilo National Park (TNTN) is crucial in supporting environmental conservation efforts while maintaining a balance between conservation interests and sustainable development needs at the regional and national levels.

The establishment of Tesso Nilo National Park was carried out through several stages of land use changes with a clear legal basis. The initial stage of land designation was carried out through Decree of the Minister of Forestry of the Republic of Indonesia No. SK.255/Menhut-II/2004 dated July 19, 2004, concerning the conversion of a portion of the limited production forest area in the Tesso Nilo Forest Group, covering 38,576 hectares, into a national park. Subsequently, through Decree No. SK.663/Menhut-II/2009 dated October 15, 2009, the area was expanded by 44,492 hectares. This brings the total area of Tesso Nilo National Park to 83,068 hectares, a conservation area with strong legal legitimacy.

Natural forest ecosystems play a vital role in human survival, particularly as a buffer for biodiversity and a balancer of ecological systems. Supartono et al. (2020) emphasized that natural forests provide various essential environmental services, including microclimate regulation, carbon storage, and water resource protection. However, increasing population pressure and human activities have led to land degradation and a decline in the quality of forest ecosystems. This condition disrupts the ecological function of conservation areas, necessitating planned and sustainable ecosystem restoration efforts to restore optimal forest function.

Ecosystem restoration is a series of activities aimed at restoring the function of degraded areas so that they can resume their ecological, economic, and social roles. Desitarani et al. (2020) stated that ecosystem restoration is not a one-time activity, but rather a long-term, continuous process. This process includes planning, planting, and periodic monitoring and evaluation. With this approach, ecosystem restoration is expected to improve environmental quality while supporting the long-term sustainability of conservation area management.

In the context of environmental program management, evaluation plays a crucial role as a tool for assessing the effectiveness of activity implementation. Fadhilah (2020) defines evaluation as the process of systematically collecting and analyzing information to determine the extent to which program objectives have been achieved and the factors influencing their outcomes. Evaluation not only assesses outputs but also encompasses aspects of input, process, and implementation context. Therefore, evaluation functions as both a scientific and administrative activity, serving as a control tool in program management, including in the fields of conservation and forestry.

Based on the characteristics of the Tesso Nilo National Park Ecosystem Restoration Program for 2018–2023, the most appropriate evaluation model is the CIPP (Context, Input, Process, Product) Model developed by Daniel L. Stufflebeam (1971). This model is widely used in the evaluation of environmental policies and forestry programs due to its comprehensiveness and flexibility. The CIPP model allows for a comprehensive assessment of the appropriateness of the program context, resource adequacy, the effectiveness of the implementation process, and the achievement of program outcomes. Therefore, the use of this model is expected to provide an objective picture of the performance and sustainability of the Ecosystem Restoration Program in Tesso Nilo National Park.

3. METHOD

This research was conducted in the Tesso Nilo National Park (TNTN) area of Riau Province, which is administratively divided into two National Park Management Sections (SPTN): SPTN Region I Lubuk Kembang Bunga and SPTN Region II Gunung Melintang. The research focused on ecosystem restoration sites with plant growth rates below the 75% success standard. The primary sites included Lubuk Kembang Bunga Village and Bagan Limau Village in Ukui District, with varying area sizes and growth rates of 24.67%, 49.31%, and 70.29%, respectively. This research used a qualitative approach with the CIPP (Context, Input, Process, Product) evaluation model developed by Stufflebeam, as it is considered comprehensive in assessing the context, input readiness, implementation process, and program outcomes (Riduwan, 2012). This model allows for a systematic evaluation of the effectiveness of the TNTN Ecosystem Restoration Program for the 2018–2023 period. Data collection was conducted through interviews, documentation, and field observations using purposive sampling techniques to determine informants, involving elements of area management, implementing partners, and the community

(Bungin, 2007; Sugiyono, 2019). The data used consisted of primary and secondary data analyzed using the Miles and Huberman interactive analysis model, including data reduction, data presentation, and conclusion drawing/verification (Sugiyono, 2018; Haryoko et al., 2020). The operationalization of research variables refers to the CIPP components to assess program relevance, resource readiness, implementation effectiveness, and achievement of results and impacts (Stufflebeam, 1971). Thus, this methodology is designed to produce an in-depth, objective evaluation oriented towards improving the sustainability of TNTN ecosystem restoration management.

4. RESULT AND DISCUSSION

Ecosystem Condition of Tesso Nilo National Park Before and After the Implementation of the Ecosystem Restoration Program (PE) in 2018–2023

Tesso Nilo National Park (TNTN) is a strategic conservation area on Sumatra Island that serves as the primary habitat for key wildlife such as the Sumatran Elephant (Elephas maximus sumatranus) and the Sumatran Tiger (Panthera tigris sumatrae). However, since the early 2000s, TNTN has experienced intense anthropogenic pressures in the form of encroachment, conversion of forest to oil palm plantations, forest and land fires, and prolonged tenure conflicts. These conditions have caused serious ecosystem degradation and prompted the government, through the Tesso Nilo National Park Office (BTNTN), to implement a gradual Ecosystem Restoration (PE) Program over the 2018–2023 period. This program is positioned as a policy response to curb the rate of damage and restore the ecological function of the area that has been severely degraded. Prior to the implementation of the PE Program, the condition of the TNTN ecosystem was described as being at a very severe level of damage. Satellite imagery analysis shows approximately 75,293 hectares of forest were damaged during the 2004–2024 period, with oil palm encroachment reaching approximately 56,491 hectares and only approximately 6,720 hectares of natural forest remaining (Dodi Firmansyah, 2024). Key informants emphasized that this condition has fundamentally threatened the area's conservation function (Dodi Firmansyah, 2024). Forest and land fires also accelerate ecosystem degradation, particularly in open areas (Gunawan, 2024). Meanwhile, internal differences of opinion have emerged regarding the effectiveness of artificial rehabilitation compared to natural succession (Ahmad Rivai, 2024).

From a social perspective, conditions prior to the PE Program demonstrated a sharp conflict of interest between conservation goals and the community's economic needs. Communities surrounding the area generally relied on oil palm plantations for their livelihoods, despite being aware of the government's reforestation program. The village head of Bagan Limau stated that the community's economic needs often did not align with the government's conservation targets (Sarifudin, 2024). This perception confirms that the degradation of the TNTN ecosystem is not only an ecological issue, but also a structural problem related to land governance, the area's legitimacy, and the community's economic dependence on unsustainable natural resource use. Following the implementation of the PE Program, the TNTN ecosystem showed partial and uneven changes. In some areas, rehabilitated vegetation growth began to be observed, and the presence of key wildlife was again observed (Gunawan, 2024). However, this success is considered highly vulnerable due to weak area security and the continued strong pressure of encroachment. The Head of the Air Hitam Resort stated that many rehabilitated plants had died or been replaced by oil palms (Ahmad Rivai, 2024). From a social perspective, the PE program began to influence community behavior by demonstrating state involvement in area management, although conflict and encroachment have not been fully resolved (Cardi, 2024).

Synthetically, a comparison of conditions before and after the PE Program shows that before the intervention, the TNTN was in a state of very severe ecosystem degradation. After the PE implementation, there were indications of ecological improvement at the site scale, including vegetation recovery, initial hydrological function, and increased wildlife presence. However, these achievements are not yet sufficient to offset ongoing socio-economic pressures and tenurial conflicts. Therefore, the 2018–2023 Conservation Area Program (PE) can be understood as the initial foundation for TNTN ecosystem recovery, the sustainability of which depends heavily on strengthened law enforcement, the integration of community-based approaches, and consistent conservation area management policies.

Table 1. Summary of the Ecosystem Restoration Program 2018-2023

Aspect	Description
Ecosystem Restoration Program	The Ecosystem Restoration (ER) Program is a systematic effort to restore the ecological functions of Tesso Nilo National Park, which has been degraded due to encroachment, forest fires, and land conversion. Carried out across ±4,217 hectares, the program utilizes Forest and Land Rehabilitation (RHL) approaches, Watershed Rehabilitation (Rehab DAS), and natural succession supported by area protection and security activities. The primary goals are to increase vegetation cover, restore ecological processes, and improve habitat carrying capacity for a more stable and sustainable ecosystem.

Program Person-in-Charge	The Ministry of Environment and Forestry (KLHK) holds primary responsibility through the Directorate General of Natural Resources and Ecosystem Conservation (Ditjen KSDAE). At the field level, the Tesso Nilo National Park Authority serves as the operational lead, coordinating the planning, implementation, supervision, and evaluation of ecosystem restoration success.
Program Implementers	The ER Program involves multiple stakeholders, including the Tesso Nilo National Park Authority, BPDAS HL Indragiri Rokan, watershed rehabilitation partner companies such as PT Imbang Tata Alam (EMP Malacca Strait) and PT Bumi Siak Pusako, and local communities through self-management and conservation partnership schemes. This multi-stakeholder involvement aims to enhance implementation effectiveness and the sustainability of restoration results.
Successful Programs (≥75%)	RHL and Watershed Rehab activities that met success standards include: 500 Ha RHL by BPDAS HL Indragiri Rokan (80.84% and 76.47%), 592 Ha Watershed Rehab by PT Imbang Tata Alam (83.30%), 250 Ha RHL Block I (86.76%), 300 Ha RHL Block II (84.36%), 250 Ha RHL Block III (91.11%), and a small-scale 10 Ha RHL in 2023 with a survival rate of 87.35–88.33%. This success is attributed to continuous maintenance, intensive supervision, and relatively stable site conditions.
Unsuccessful Programs (<75%)	ER programs that have not yet met success standards include the 2020 self-managed 10 Ha RHL with a survival rate of 24.67%, and Watershed Rehab activities by PT Bumi Siak Pusako covering 613 Ha (49.31%) and 159 Ha (70.29%). Low performance was influenced by site disturbances such as encroachment, land conflicts, fires, flooding, wildlife activity, and limited post-planting maintenance.

Effectiveness of the Ecosystem Restoration Program in Tesso Nilo National Park 2018–2023 Based on the Minimum Plant Growth Success Indicator of 75% as Per National Regulations

1. Context

Overall, the interview results indicate that the Tesso Nilo National Park Ecosystem Restoration Program is conceptually and policy-relevant, but faces challenges in addressing complex and multidimensional field issues. Key informants emphasized ecological and legal relevance, supporting informants highlighted the technical needs of restoration, while communities assessed the program's relevance from the perspective of its impact on their livelihoods. Therefore, the relevance of the Tesso Nilo National Park Ecosystem Restoration Program cannot be assessed in isolation but must be understood as the result of the interaction between policy, ecological conditions, and social realities. These findings indicate the need for adjustments to the program's design and implementation strategy so that its high policy relevance can be more effectively translated into the field context and accepted by all stakeholders.

Table 2. Comparison of Research Findings on Context Indicators with the TNTN Ecosystem Restoration Program Report

Indicator	Research Findings	Ecosystem Restoration Program Report
Initial Ecosystem Damage as the Basis for Program Needs	Interview results indicate that prior to the program, Tesso Nilo National Park (TNTN) suffered from severe and systemic ecosystem degradation. Key informants highlighted massive deforestation caused by illegal oil palm encroachment, forest and land fires, and the loss of natural forest cover, which threatened its function as a national park. Supporting informants at the field level reinforced these findings with evidence of extensive open areas and critical lands. Meanwhile, community perceptions varied between ecological awareness and economic orientation.	The reports identify TNTN as a priority restoration area due to high ecosystem degradation, extensive open areas, illegal palm oil plantations, and declining ecological functions. This condition serves as the foundation for the necessity of planned and sustainable ecosystem restoration interventions.
Driving Factors and Urgency of Restoration Policy	The primary drivers include ecological crises threatening the area's sustainability, the need to reclaim state forest areas, increasing human-wildlife conflicts, and the failure of conventional management to curb degradation. The urgency is rated very high by key and supporting informants, despite internal critical views regarding the effectiveness of planting-based approaches and the high budget requirements.	The reports position the policy as an urgent response (*extraordinary policy*) to halt further degradation, support forestry law enforcement, and fulfill national mandates for forest and land rehabilitation, including watershed rehabilitation and wildlife habitat protection.

Program Relevance to Policy and Field Issues	Normatively, the program is highly relevant to conservation and forest rehabilitation policies. However, at the field level, its relevance is perceived as not yet fully aligned with socio-economic dynamics and ecosystem heterogeneity. Some technical implementers and community members feel the approach does not fully address site-specific issues, particularly land conflicts and community livelihood needs.	The reports affirm the program's relevance to national policies and restoration goals. However, implementation remains heavily focused on ecological and administrative aspects, with relatively limited integration of social factors and local adaptations.

Based on a comparative analysis of interviews with key informants, supporters, and the community, the context dimension in the evaluation of the Tesso Nilo National Park (TNTN) Ecosystem Recovery Program demonstrates strong ecological and policy legitimacy, yet faces structural and social challenges in implementation. All informants acknowledged that the initial condition of the TNTN was characterized by severe and systemic ecosystem damage due to illegal palm oil encroachment, forest and land fires, and shrinking natural forest cover, threatening the area's conservation function (Dodi Firmansyah, S.Hut; Gunawan, S.Hut., M.Si). These conditions objectively meet the prerequisites for a high need for ecosystem restoration interventions, although the level of damage varies across locations and indicates the potential for natural succession in some areas (Ahmad Rivai, S.Hut).

From a driving factor perspective, the urgency of the TNTN Ecosystem Recovery policy is influenced by ecological pressures, legal mandates, and national forest and land rehabilitation policies. Key informants interpreted the PE program as a strategic instrument to halt degradation, reclaim state forest areas, and restore the ecological function of national parks (Dodi Firmansyah, S.Hut). The program's relevance was considered high at the normative level because it aligns with conservation and biodiversity protection policies, but on the ground, there was still a gap with the socio-economic realities of the community. Some communities viewed the program as not yet relevant to the needs of palm oil-based livelihoods (Sarifudin), while others considered the program important for improving environmental quality (Erman Maini). These findings confirm that the program's relevance is contextual and influenced by differing actor interests.

2. Input

From an input evaluation perspective, this situation indicates that stakeholder support and coordination for the Tesso Nilo National Park Ecosystem Restoration Program still requires significant strengthening. The involvement of various stakeholders has not been fully integrated into an effective coordination system, resulting in suboptimal synergy between programs and activities. Furthermore, the coordination approach is not fully participatory, resulting in underdevelopment of community support.

Thus, the evaluation of stakeholder support and coordination indicates that although the Tesso Nilo National Park Ecosystem Restoration Program has received support from various parties, the effectiveness of this support is still limited by weak cross-sectoral coordination and the suboptimal integration of ecological and social interests. Strengthening coordination mechanisms, improving communication between stakeholders, and developing a more inclusive partnership model are essential to enhance the success and sustainability of the Tesso Nilo National Park Ecosystem Restoration Program.

Table 3. Comparison of Research Findings on Input Indicators with the TNTN Ecosystem Restoration Program Report

Indicator	Research Findings	Ecosystem Restoration Program Report
Human Resource (HR) Readiness and Capacity	Management personnel possess technical restoration competencies, but the number of staff is highly limited and disproportionate to the vast area and level of damage. This shortage results in low intensity of supervision, community assistance, post-planting maintenance, and area disturbance control.	The reports state that HR has been prepared according to the TNTN Authority's organizational structure and functions, supported by a technical restoration team. However, the reports do not fully elaborate on the gap between field requirements and the quantitative capacity of available HR.
Policy and Program Planning	The program is supported by formal policies and clear planning documents (Ecosystem Restoration Plan/RPE) aligned with conservation mandates. However, field implementation faces hurdles in adapting to social dynamics, particularly land tenure conflicts and community economic needs.	The reports affirm that policy and planning are systematically developed based on spatial data and degradation levels, focusing on handling illegal oil palm plantations and saving natural forests. Social aspects are mentioned but are not yet a primary focus in operational planning.

Budget Availability and Adequacy	Budgeting relies on the State Budget (APBN) and support from related agencies, yet it is deemed insufficient to cover the total area and complexity of issues. Budget constraints lead to selective activities focused on initial planting, with minimal post-planting maintenance and security.	The reports state that funding is allocated according to annual budget capabilities and national priorities. The program is implemented in stages, acknowledging that not all critical areas can be addressed simultaneously.
Facilities, Infrastructure, and Supporting Technology	Basic infrastructure is available but limited in quantity and reach, especially for remote locations. Shortages in transportation, tools, and maintenance facilities impact restoration effectiveness. Technology use is dominant in the planning stage but not yet optimal at the field level.	The reports mention the availability of supporting facilities, including the use of satellite imagery and spatial mapping for planning and monitoring. However, they do not provide a detailed evaluation of the adequacy of operational field equipment and routine monitoring technology.
Implementation Strategy and Restoration Approach	The strategy is designed to be adaptive through a combination of active planting and natural succession. While conceptually sound, implementation is ineffective due to HR, budget, and social support constraints. The success rate of rehabilitation activities is currently considered low.	The reports state that the restoration strategy is tailored to site conditions, with active interventions on open land and area protection to support natural regeneration. Success is measured by technical indicators, though field challenges are acknowledged.
Stakeholder Support and Coordination	Cross-stakeholder support exists, but coordination remains sectoral, partial, and unsustainable. Diverging interests between conservation goals and community economic needs weaken participation and social support for the program.	The reports mention the involvement of various parties, such as BPDAS, local governments, and the community. However, the mechanisms for coordination and cross-sector program integration have not been deeply elaborated within a strong collaborative framework.

Based on interviews with various informants—including key informants, primary informants, supporting informants, and the community—it can be concluded that the Tesso Nilo National Park (TNTN) Ecosystem Restoration Program has the basic input components required for program implementation. However, almost all of these inputs are still at a sufficient level and are not yet optimal. From a human resource perspective, technical competencies in forestry and conservation are available, particularly at the planning and policy-making levels. However, limited field personnel and high workloads have resulted in low levels of supervision, mentoring, and maintenance of restoration activities. This situation limits the effectiveness of program implementation at the field level.

In terms of policy, planning, budget, and infrastructure, the TNTN Ecosystem Restoration Program has a regulatory basis and planning documents that align with national policy. However, limitations in budget, transportation, field work tools, and monitoring technology are major limiting factors in program implementation. The restoration strategy, which combines active planting and natural succession, is deemed conceptually sound, but is not adequately supported by other inputs and has not been optimally integrated with the community's socio-economic needs. Furthermore, stakeholder coordination and support remain partial, reducing the program's leverage. Therefore, the input dimension demonstrates moderate readiness, but requires significant strengthening to achieve ecosystem restoration goals effectively and sustainably.

3. Process

From a process evaluation perspective, this situation indicates that constraints and adjustments in the implementation of the TNTN Ecosystem Restoration Program remain major challenges affecting the program's effectiveness. Without comprehensively addressing these constraints and adapting to the region's socio-ecological conditions, the program's implementation process has the potential to continue facing the same obstacles over time. Therefore, the evaluation of constraints and adjustments in the implementation process confirms that the success of the TNTN Ecosystem Restoration Program is determined not only by the quality of planning and the availability of inputs, but also by the implementer's ability to manage constraints and make adaptive, inclusive, and sustainable adjustments. These findings provide an important basis for improving the implementation process of the ecosystem restoration program in Tesso Nilo National Park in the future.

Table 3. Comparison of Research Findings on Process Indicators with the TNTN Ecosystem

DOI: https://doi.org/10.32663/.....

Restoration Program Report

Indicator	Research Findings	Ecosystem Restoration Program Report
Field Implementation of Restoration Activities	Ecosystem restoration has been carried out through planting in open areas and protecting zones to encourage natural succession. However, field implementation is not yet effective or sustainable. Activities often stop at the initial planting stage without adequate maintenance and security, resulting in low success rates and the re-disturbance of treated areas.	The reports state that restoration activities are implemented in stages according to site conditions through planting and area protection. Implementation is considered to be in line with ecosystem restoration principles, though it acknowledges challenges regarding the vastness of the area and high levels of disturbance.
Alignment of Implementation with Planning	Conceptually, implementation refers to the established plans; however, in practice, significant adjustments often occur due to limitations in HR, budget, and facilities, as well as socio-ecological dynamics. The gap between planning and realization is evident in the low rehabilitation success rates and the difficulty of maintaining restoration outcomes.	The reports mention that activities have followed technical planning documents and forest/land rehabilitation policies. Implementation adjustments are regarded as part of an adaptive strategy to field conditions.
Monitoring and Control Mechanisms	Monitoring mechanisms exist but are limited, uneven, and tend to be reactive. The shortage of personnel, the vastness of the area, and minimal supporting facilities result in weak post-planting supervision, leaving restoration results vulnerable to encroachment, fire, and other illegal activities.	The reports explain that supervision is conducted through the Tesso Nilo National Park Authority structure (SPTN and Resort levels) and supported by periodic monitoring. However, the reports do not evaluate in detail the effectiveness of supervision in protecting long-term restoration outcomes.
Community Role and Involvement in Implementation	Community involvement is limited and functional, primarily as labor for planting. Participation is not yet sustainable and does not cover planning, maintenance, or monitoring. Divergent interests between conservation goals and community economic needs weaken social support for the program.	The reports state that the community is involved in restoration activities to increase a sense of ownership of the area. However, involvement remains focused on technical activities rather than long-term partnership directions.
Coordination Between Implementers	Coordination among implementers is established structurally but remains ineffective operationally. Coordination across units and sectors is still administrative and sectoral, causing program implementation to be partial and lacking synergy at the field level.	The reports mention coordination between the Tesso Nilo National Park Authority, internal units, and external agencies like BPDAS. However, coordination is emphasized on programmatic aspects and is not yet fully integrated into field implementation.
Constraints and Adjustments during Implementation	Implementation faces multidimensional constraints, including encroachment pressure, illegal activities, limited HR and budget, conflicts of interest with the community, and severely degraded ecological conditions. Adjustments made are reactive and short-term, failing to address structural root causes.	The reports acknowledge various implementation constraints and state that adjustments are made adaptively based on field conditions. However, they do not deeply evaluate the effectiveness of these adjustments regarding the sustainability of restoration results.

In general, interview results indicate that ecosystem restoration in Tesso Nilo National Park has been carried out in accordance with policy mandates and technical planning through planting, forest and land rehabilitation, and ecosystem function restoration. These activities are routinely carried out by the Tesso Nilo National Park Office, along with implementing units at the SPTN and resort levels. However, the complexity of regional issues,

DOI: https://doi.org/10.32663/.....

limited resources, and social dynamics have led to gaps between planning and implementation on the ground. Monitoring mechanisms are in place, but remain weak due to limited personnel, limited work areas, and poor post-planting security. From a participation and coordination perspective, community involvement in program implementation remains functional and short-term, thus not supporting the sustainability of restoration results. The difference in orientation between conservation goals and community economic needs is a major obstacle. Coordination between implementers is structurally in place, but has not been effectively integrated due to differences in authority and sectoral approaches. Within the CIPP evaluation framework, the Process Dimension indicates that the program's primary challenges lie in the quality and effectiveness of the implementation process, rather than the absence of activities. Therefore, strengthening oversight, coordination, and community participation is necessary.

4. Product

These findings confirm that the program's physical success is not solely measured by planting, but rather by the plants' ability to grow, survive, and reshape the structure and function of the forest ecosystem. Therefore, the physical achievements of the TNTN ecosystem recovery still require strengthening through increased area security, post-planting maintenance, and community involvement to improve plant growth success and substantively achieve the ecosystem restoration goals.

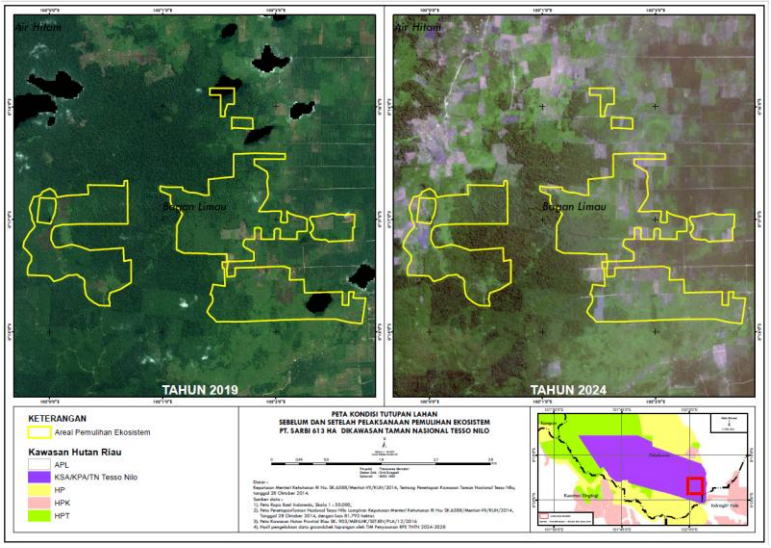

Figure 1. Map of Conditions Before and After Implementation of the 613 Ha PT. Sarbi Ecosystem Recovery Program in the Tesso Nilo National Park Area

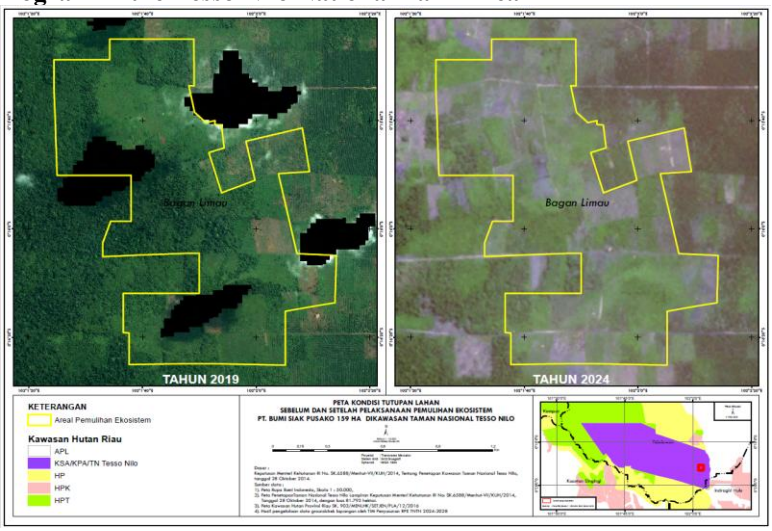

Figure 2. Map of Conditions Before and After the Implementation of the PT. Bumi Siak Pusako Ecosystem Recovery Program, 159 Ha in the Tesso Nilo National Park Area

Symbiosis Civicus

Symbiosis Civicus, Month Year, Vol. (No.):Page
DOI: https://doi.org/10.32663/.....

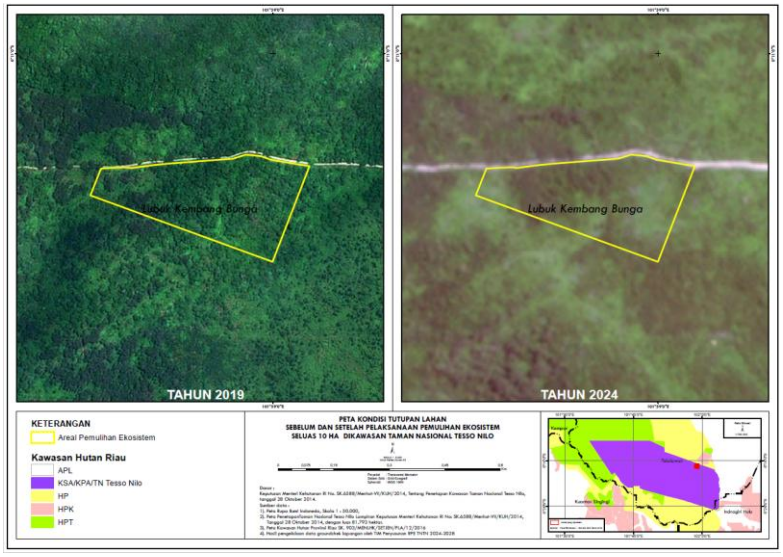

Figure 3. Map of Conditions Before and After Implementation of the 10-Ha Ecosystem Restoration Program in the Tesso Nilo National Park Area

Overall, the impact of the Tesso Nilo National Park Ecosystem Restoration Program on ecological and social conditions remains suboptimal and tends to be limited. Although the program has resulted in physical restoration interventions, the expected ecological impacts have not materialized significantly due to re-disturbance and limited post-planting management. Furthermore, the program's social impacts have not yet provided direct benefits to the community, resulting in weak social support for the program.

Table 4. Comparison of Research Findings on Product Indicators with the TNTN Ecosystem Restoration Program Report

Indicator	Research Findings	Conditions Based on the Ecosystem Restoration Program Report
Physical Achievements of Ecosystem Restoration	Research indicates that the Ecosystem Restoration Program has produced physical outputs in the form of forest and land rehabilitation through planting in degraded areas. However, these achievements have not been followed by adequate ecological success. The average plant survival rate ranges between 30–60%, generally remaining below the national minimum standard of 75%. This highlights a gap between administrative completion and substantive ecological success.	The reports assess physical achievements based on the realization of planting activities, the total area of rehabilitation, and the number of seedlings planted according to the work plan. Program success is emphasized through the fulfillment of activity targets and administrative documentation, with an acknowledgment that plant growth still faces field challenges.
Quality and Sustainability of Restoration Results	The quality of restoration results is considered low and vulnerable to re-disturbance. Rehabilitated plants have not yet formed stable forest stands due to limited post-planting maintenance, weak area security, and pressures from encroachment and fires. The sustainability of restoration outcomes is not yet optimally established and remains heavily dependent on external intervention.	The reports view the sustainability of restoration as an ongoing, long-term process. Sustainability is assumed to be achievable over time through continued restoration and protection activities, although the reports have not yet evaluated the resilience of restoration outcomes at the field level in detail.
Program Impact on Ecological and Social Conditions	The ecological and social impacts of the program are considered limited. Ecologically, restoration has not produced significant changes to the overall condition of the area due to recurring disturbances and low plant survival rates. Socially, the	The reports position program impacts as medium- to long-term effects expected to emerge over time. Ecological and social impacts are understood as cumulative results of restoration interventions, although evidence of tangible change in

	program has not provided direct benefits perceived by the community, resulting in weak social support and participation. Program impacts tend to be potential (expected impacts) rather than actual and measurable.	the field remained limited during the evaluation period.

The product dimension in the evaluation of the Tesso Nilo National Park Ecosystem Recovery Program indicates that the program has achieved physical and administrative outputs in the form of forest and land rehabilitation activities, in accordance with formal targets. However, these achievements have not yet been translated into strong ecological and social outcomes and impacts. The success rate of plant growth during the 2018–2023 period remains below the national standard of 75%, with a range of 30–60%, indicating a gap between activity realization and the substantive restoration of ecosystem functions. This condition indicates that vegetation restoration, as the foundation of the ecosystem, has not been optimal and remains vulnerable to re-disturbance. In terms of impact, the program has not yet produced significant and sustainable ecological and social changes. Ecological impacts remain potential due to pressure from encroachment, fires, and weak area security, while social impacts are considered by the community to have not provided tangible benefits for welfare and livelihoods. The low success rate of plant growth, as emphasized by Sudiyono (2014), Fikriyani and Mussadun (2014), and Kusuma et al. (2024) and Wahyuni (2023) have direct implications for program effectiveness. These findings emphasize the need to strengthen the integration of ecological goals and social needs so that programs can produce real, sustainable impacts that are acceptable to stakeholders.

5. CONCLUSIONS

This study concludes that the implementation of the Ecosystem Restoration Program (ERP) in Tesso Nilo National Park during the 2018–2023 period has contributed to initial ecological recovery, particularly in the form of vegetation growth and the gradual re-establishment of ecological functions in several restoration sites. However, these improvements remain partial and uneven, as a significant portion of the restoration areas still exhibit plant growth rates below the national success standard of 75%. In addition, many restored areas remain highly vulnerable to re-disturbance due to ongoing encroachment, weak area protection, and limited post-planting maintenance, indicating that the restoration outcomes have not yet reached a stable and sustainable condition.

From the perspective of the CIPP (Context, Input, Process, Product) evaluation model, the program demonstrates strong relevance in terms of context, as it responds directly to severe ecosystem degradation and aligns with national conservation policies. However, the input dimension reveals that the availability of resources, including human resources, budget, and supporting infrastructure, remains limited and insufficient to address the scale and complexity of the problem. In the process dimension, although restoration activities have been implemented in accordance with planning documents, significant gaps persist between planning and field execution due to weak supervision, limited coordination among stakeholders, and low levels of sustained community participation. Meanwhile, in the product dimension, the program has achieved administrative and physical outputs, particularly in terms of planting realization, but these outputs have not yet been translated into substantial ecological and social outcomes.

Furthermore, the findings highlight that the effectiveness of ecosystem restoration is influenced not only by technical factors but also by socio-economic and institutional dynamics. The dependence of local communities on oil palm cultivation, unresolved land tenure issues, and limited alternative livelihoods create structural barriers to successful restoration. At the same time, weak cross-sectoral coordination and the limited integration of community participation into program implementation reduce the sustainability and long-term impact of restoration efforts. These conditions indicate that the ERP implementation in Tesso Nilo National Park remains predominantly administrative and project-oriented, rather than fully adaptive, participatory, and ecosystem-based.

Therefore, improving the effectiveness and sustainability of ecosystem restoration requires a more integrated and adaptive approach. Strengthening area protection and law enforcement is essential to prevent recurring disturbances, while increasing the capacity and number of human resources, along with ensuring adequate and continuous funding, is necessary to support effective implementation. In addition, enhancing stakeholder coordination and promoting more inclusive, community-based restoration approaches are crucial to aligning conservation objectives with local socio-economic needs. Integrating restoration programs with livelihood support initiatives can help reduce conflicts of interest and foster greater community involvement. Ultimately, a shift toward a more holistic, collaborative, and socio-ecologically integrated restoration model is necessary to ensure the long-term success of ecosystem restoration and the sustainability of conservation area management in Indonesia.

6. ACKNOWLEDGEMENT

The authors would like to thank the Tesso Nilo National Park Office for their data support, field access, and facilitation during the research. Appreciation is also extended to all key informants, primary informants, supporting informants, and the local community who participated and provided valuable information. Thanks are also extended to the supervisors and academic staff who provided scientific guidance. This research is expected to contribute to strengthening ecosystem restoration policies and sustainable conservation area management.

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