Road Management Policy Formulation Strategy for Sustainable Development

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ABSTRACT: This study is a discussion of development in the perspective of the Provincial Road Management System (PRMS) which is closely related to the formulation of government policies. The strategy for formulating road management policies for sustainable development involves various aspects that are integrated with other aspects such as economic, social, and environmental. This includes planning, construction, and maintenance of efficient, safe, and environmentally friendly roads, and involves community participation. This study is formulated with two main objectives; 1) formulating the form of road management policy formulation for sustainable development, and 2) outlining the strategy for managing sustainable road development and having an impact on the community. Based on these two objectives, the relevant approach used is the Provincial Road Management System (PRMS). This study uses a literature review method with a descriptive analysis by applying the Theory of Sustainable Development by Gro Harlem Brundtland. The results of this study indicate that there are at least nine points, namely, Spatial Planning, Sustainable Road Development, Sustainable Road Management, Community Participation, Increasing Public Awareness, Public Transportation Development, Technology Application, Local Industry Development, and Environmental Impact Control. Road management policies for sustainable development need to be formulated early with various considerations in order to produce an optimal formulation that can be used for road management, especially for sustainable regional development.

KEY WORDS: Policy Formulation, Road Management, Road Management System, Sustainable Development.

INTRODUCTION

Development can be seen in two forms: physical development and non-physical development. Physical development includes the construction of facilities and infrastructure in each region. Infrastructure development is undoubtedly a fundamental foundation in driving economic growth, enhancing regional connectivity, and promoting equitable national and regional development. Roads, as a part of transportation infrastructure, play a vital role in facilitating the mobility of goods and services and supporting productivity across various sectors, including agriculture, industry, and tourism (Adamu Tafida et al., 2024; Kuncoro et al., 2024; Munaf et al., 2024).

In the context of sustainable development, effective and efficient road infrastructure management is essential to ensure sustainability in environmental, social, and economic aspects. Sustainable road management policy strategies must consider environmental and social dimensions, not just technical and economic aspects. A study conducted by Susanti et al. (2022) stated that the development of sustainable infrastructure policies should be data-driven and participatory, meaning they should involve field data and input from various stakeholders. The study demonstrated improved effectiveness in transportation policy in Central Kalimantan following strengthened data integration (Shamdasani, 2021: Zulkefli et al., 2023; Rahman, 2019; Sahib et al., 2019).

On the other hand, research by Ramadhani (2019) revealed that one of the main obstacles in regional road management is the lack of a reliable and standardized information system as a basis for decision-making. This highlights a gap between the potential of road condition survey data and the still conventional and reactive policy formulation practices.

An important aspect of road management is the lack of proper planning. In other words, road management that is unplanned and not based on data risks inefficiencies in budget allocation, increased road damage, and reduced public accessibility to basic services.

According to the Regional Infrastructure Development Agency Report (2021), one of the biggest challenges in infrastructure development is the weak monitoring and evaluation system for road conditions that is accurate and comprehensive. This results in slow responses to damage and suboptimal maintenance planning. One of the tools developed to address this challenge is the Provincial Kabupaten Road Management System (PKRMS), which aims to systematically collect road pavement condition data. Through this approach, policymakers gain a more accurate picture of the actual road network condition and its maintenance needs.

The Provincial Road Management System (PRMS) is a road management system designed to assist in the planning, programming, and budgeting (PPP) of roads at the provincial and district levels. This system serves as a computer-based tool to manage road data, including road conditions, inventory, project data, and maps, which are then used to make decisions regarding road maintenance and improvement. More specifically, PRMS relies on standardized data for road segments, reference points, inventories, conditions, and traffic. It is a system designed to manage road infrastructure at the provincial and district levels in Indonesia. It bridges the gap between more complex national-level road management systems and the manual or electronic systems used by local governments. PRMS focuses on standardized road data, including attributes, reference points, inventories, condition assessments, and traffic data, to support planning, programming, and budgeting for road maintenance and preservation. According to a study by Yulianto et al. (2020), the use of a PRMS-based system has been proven to significantly improve the reliability and efficiency of road maintenance. One of the strategic issues in managing district roads in Indonesia is the poor physical condition of road infrastructure scattered across various regions. Data from the Ministry of Public Works and Housing (PUPR) shows that more than 40% of district roads are in light to severe damage condition (BPIW, 2021). This directly affects the accessibility and mobility of communities, especially in rural and remote areas. The unavailability of accurate and systematic data on road conditions is a major barrier to planning and decision-making processes. PKRMS emerges as a systematic solution to address this deficiency by providing spatially and historically based data.

Many districts still rely on external consultants for the operation and maintenance of PKRMS. This dependency results in high operational costs and poses risks to system sustainability once consultant contracts end. A potential policy solution is to offer incentives to districts that establish independent PKRMS management units and provide performance awards for digital-based road management. These strategic issues indicate that implementing PKRMS requires more than just technology adoption — it necessitates a comprehensive policy transformation. Recommended policy strategies include: (1) strengthening human resource and institutional capacity at the local level; (2) standardizing systems and ensuring data interoperability; (3) integrating PRMS into regional planning and budgeting systems; and (4) performance-based monitoring and evaluation. With this approach, the system can become an essential instrument for realizing efficient, transparent, and sustainable district road management.

LITERATURE REVIEW

1. Literature Review: Road Management Policy for Sustainable Development

Infrastructure development, particularly road infrastructure, is widely acknowledged as a critical component of national and regional development strategies. As noted by Susanti et al. (2022), physical infrastructure, especially roads, plays a central role in enhancing regional connectivity, promoting economic productivity, and ensuring equitable access to essential services. Roads serve as key enablers of growth across various sectors such as agriculture, industry, and tourism, facilitating the mobility of goods and services. In the context of sustainable development, effective and efficient road infrastructure management is vital. This requires a shift from conventional, reactive approaches to strategies that are participatory, data-driven, and environmentally conscious. According to Susanti et al. (2022), the formulation of sustainable road infrastructure policy must be grounded in accurate data and inclusive stakeholder engagement. Their study in Central Kalimantan demonstrated that strengthening data integration significantly improved the effectiveness of transportation policies.

Despite this, challenges persist. Ramadhani (2019) highlights the lack of reliable and standardized information systems as a major barrier to effective road management at the regional level. This gap between available survey data and policy-making practices has resulted in inefficient budget allocation, poor maintenance planning, and declining road accessibility in many districts. The absence of data-based planning mechanisms has also contributed to increased infrastructure degradation and service delivery inequalities.

Government reports, such as the one from the Regional Infrastructure Development Agency (BPIW, 2021), further emphasize the weaknesses in monitoring and evaluating road conditions. The lack of accurate and comprehensive systems hampers timely responses to road damage and undermines long-term infrastructure sustainability (Vahabzadeh et al., 2025). To address these issues, the Provincial Road Management System (PRMS) and its district-level adaptation, PKRMS, have been introduced as tools to support planning, programming, and budgeting (PPP) processes in road management.

PRMS is a computerized system designed to collect and manage standardized data on road segments, condition assessments, inventories, and traffic. As Yulianto et al. (2020) demonstrate, the use of PRMS significantly improves the reliability and efficiency of road maintenance, especially when integrated into regional planning frameworks. However, implementation challenges remain.

Many local governments still rely heavily on external consultants to operate PRMS, which raises sustainability concerns once consultant contracts expire.

Another pressing issue is the widespread damage to district roads. According to data from the Ministry of Public Works and Housing (PUPR, 2021), over 40% of district roads are classified as damaged, affecting rural and remote communities the most. The lack of systematic and historical data further exacerbates this issue, limiting informed decision-making. PKRMS, by providing spatially-based data, offers a potential solution to bridge these information gaps.

To maximize the impact of PRMS and PKRMS, scholars and policy experts advocate for comprehensive policy transformation. Recommendations include strengthening local human resources and institutional capacity, standardizing systems for data interoperability, integrating PRMS into local planning and budgeting, and implementing performance-based monitoring and evaluation (Yulianto et al., 2020; BPIW, 2021).

2. Sustainable Road Infrastructure Management and Policy Strategy

The discourse on sustainable development consistently highlights infrastructure as a foundational element, with road systems serving as a key enabler for economic growth, social equity, and environmental stability. Infrastructure development is generally classified into physical and non-physical aspects, with the former including transportation networks such as roads, which are vital for mobility, accessibility, and regional integration (Susanti et al., 2022). Roads, in particular, contribute significantly to the productivity of sectors like agriculture, tourism, and manufacturing, especially in remote or underdeveloped areas (Gebresilasse, 2023; Sun et al., 2023).

Several studies emphasize the importance of a data-driven and participatory approach in managing road infrastructure sustainably. Susanti et al. (2022) found that policy development for transportation infrastructure in Central Kalimantan showed marked improvement after integrating field data with stakeholder input. This participatory model strengthens the decision-making process and ensures that infrastructure development aligns with the real needs and conditions on the ground.

In contrast, Ramadhani (2019) identified a major barrier in regional road management: the lack of reliable and standardized information systems. Without robust systems to guide policy formulation and maintenance scheduling, many regions continue to rely on outdated, reactive approaches. This inefficiency often leads to rapid road deterioration, poor budget allocation, and decreased accessibility to basic public services.

These issues are confirmed in national-level assessments, such as the BPIW (2021) report, which reveals that over 40% of district roads in Indonesia are in light to severe damage conditions. One of the root causes is the weak monitoring and evaluation system for road conditions. In response, the Provincial and Kabupaten Road Management Systems (PRMS and PKRMS) were developed as digital tools to support more systematic planning, programming, and budgeting (PPP) of road infrastructure.

Yulianto et al. (2020) provide empirical evidence supporting the effectiveness of PRMS. Their research shows that utilizing PRMS improves the accuracy of road condition assessment and supports long-term maintenance planning. However, implementation is uneven across districts, largely due to dependence on external consultants. This reliance raises concerns about the sustainability of the system after the termination of consultant contracts.

Moreover, accurate and spatially organized road condition data remain scarce at the district level. PKRMS, as an adaptation of PRMS, aims to fill this gap by enabling local governments to manage and update road condition data independently. Nevertheless, many regions still face institutional and technical capacity limitations. To address these challenges, Yulianto et al. (2020) and BPIW (2021) recommend a multi-faceted policy approach that includes:

1. Strengthening human resources and institutional capacity at the local level;
2. Standardizing system interoperability and data formats;
3. Integrating road management systems into regional planning frameworks; and
4. Implementing performance-based monitoring and evaluation mechanisms.

Overall, the literature underscores a critical shift from merely building infrastructure to managing it sustainably through digital tools, data integration, and institutional reforms. While PRMS and PKRMS represent significant progress, their success hinges on long-term capacity building and policy support that prioritizes sustainability, transparency, and local ownership.

METHOD

This study employs a qualitative research approach with a case study design to explore and analyze the formulation of sustainable road management policies at the district level through the utilization of the Provincial and Kabupaten Road Management System (PRMS/PKRMS). The research was conducted in selected districts in Indonesia that have implemented PRMS, with a focus on understanding the system's integration into local policy planning, programming, and budgeting. Data collection was carried out through semi-structured interviews, document analysis, and direct field observations. Key informants included local government officials, road management staff, infrastructure planning consultants, and representatives from the Ministry of Public Works and Housing (PUPR). The interview questions were designed to gain insights into the implementation challenges, benefits, and institutional responses related to the PRMS system.

In addition to primary data, the study also involved a review of policy documents, technical manuals, and PRMS-related reports, such as the BPIW Road Infrastructure Development Report (2021) and regional development plans (RPJMD). These documents provided contextual background and supported triangulation of findings. Data analysis was conducted using thematic analysis, where codes and categories were developed inductively based on recurring patterns across the data. Themes such as data reliability, system integration, institutional capacity, and policy outcomes were then synthesized to draw conclusions about the effectiveness and limitations of PRMS in supporting sustainable infrastructure development. The research also considered the social, economic, and environmental dimensions of sustainability in evaluating the policy formulation process.

FINDINGS AND DISCUSSION

3.1 Road Management Syste\m

The Provincial Road Management System (PRMS) assists in managing various aspects related to roads, including road conditions, inventories, project data, and maps with PPP (Planning, Programming, and Budgeting) tools. This system is designed to support the PPP process at both provincial and district levels. The key components of the road management system include: a) computer-based platform, b) integrated road data,c) multi-criteria analysis,d) transparency and flexibility, and e) support for road preservation. The following explains each point in more detail:

1. Computer-Based Program:

PRMS is a computer application that facilitates decision-making in road management. This program plays a critical role in road administration. However, a major challenge in its implementation is the need for a skilled programmer to operate the system effectively.

2. Integrated Road Data:

PRMS stores data on road conditions, inventories, project data, and maps, which serve as the foundation for road planning and programming.

3. Multi-Criteria Analysis:

Some PRMS implementations apply multi-criteria analysis (MCA) to determine road management priorities by considering both technical and non-technical aspects, such as road conditions, traffic volume, usage density, natural environment, topography, and regional priorities.

4. Transparent and Flexible:

PRMS is designed to be transparent and flexible in its application, including integration with other mapping software such as QGIS (Quantum Geographic Information System). QGIS is a free, open-source GIS software that allows users to create, edit, visualize, analyze, and publish geospatial data. It provides powerful capabilities, including: a) Data visualization – displaying geographic data on maps, b) Data editing – creating and modifying spatial data, c) Spatial analysis – conducting geographic data computations to gain insights, and d) Mapping – producing visually informative and appealing maps.

5. Supporting Road Preservation:

PRMS aids in road preservation planning, which includes routine maintenance, periodic maintenance, rehabilitation, and reconstruction. In essence, PRMS is a vital tool for local governments to manage roads effectively and efficiently, ensuring that road infrastructure remains in good condition, well-maintained, and capable of meeting community needs.

PRMS is specifically designed to assist in planning, programming, and budgeting road infrastructure development. Several principles and strategies that can be applied include:

a) Spatial Planning-Based Development:

Road planning must align with spatial planning at national, provincial, and local levels to ensure optimal connectivity and avoid adverse environmental impacts.

b) Sustainable Road Development:

Sustainable road development involves several key principles:

• Efficiency: Using efficient construction technologies and materials to minimize operational costs and environmental impacts. Efficiency here refers not only to low cost but also to the optimal use of resources to achieve maximum impact.

• Safety: Designing roads to be safe for all users, including pedestrians, cyclists, and vehicle drivers. Safety is paramount and an integral part of improving public welfare.

• Accessibility: Ensuring that roads are accessible to all users, including persons with disabilities. Good road accessibility encourages local economic growth and community productivity.

• Environmentally Friendly: Employing eco-friendly materials, reducing greenhouse gas emissions, and minimizing ecological damage. Environmentally sustainable development has become a global imperative and collective responsibility.

c) Sustainable Road Management Includes:

a) Routine and Periodic Maintenance – Regular maintenance extends road life and ensures consistent quality. b) Road Quality Improvement – Using durable, eco-friendly road repair technologies to reduce long-term maintenance costs.

d) Community Participation for Shared Benefit:

Public involvement in planning, implementation, and monitoring of road development is essential to accommodate community interests and foster a sense of ownership in the project, directly or indirectly.

e) Raising Public Awareness:

Beyond involving communities, increasing public awareness is essential, particularly in protecting the environment and road ecosystems. Roads are shared assets meant to benefit all users.

f) Public Transportation Development:

In urban areas, the development of public transport continues to be promoted to reduce congestion, lower pollution, and improve mobility. While this study does not focus on large urban infrastructure, it emphasizes the need for integrated, sustainable transport systems that reduce reliance on private vehicles and enhance accessibility and comfort.

g) Application of Effective Technology:

Utilizing information and communication technology for more efficient road management, such as real-time monitoring systems, intelligent traffic management, and easily controlled infrastructure.

h) Development of Local Industry:

Encouraging the growth of local industries related to road construction and maintenance helps generate employment and stimulate regional economies. Among all points above, environmental impact should receive special attention, as the success of any development project must not ignore ecological concerns, which are now global priorities.

i. Environmental Impact Control:

Efforts should be made to minimize the negative environmental effects of road development, such as erosion, flooding, and habitat destruction, through comprehensive AMDAL (Environmental Impact Assessment) studies.

AMDAL is a formal process in Indonesia that evaluates the potential environmental impacts of a planned project. It ensures that development projects are environmentally sustainable by identifying, predicting, and mitigating negative consequences.

A more detailed breakdown includes: 1) Purpose: To provide decision-making insights and prevent environmental harm. 2) Scope: Includes assessments of natural landscape changes, pollution, resource use, and community impacts. 3) Regulation: AMDAL is a legal requirement for any project likely to significantly impact the environment. 4) The process involves scoping, impact analysis, mitigation planning, and monitoring. The resulting AMDAL report is used to determine whether the project should be approved and under what conditions. Benefits include better planning, protection of the environment, and alignment with sustainability goals.

By applying these strategies, road management can positively contribute to sustainable development, which aims to meet present needs without compromising the ability of future generations to meet theirs.

CONCLUSION

Based on the previous explanation, this study has identified six strategies that can be used to achieve sustainable development. These six strategies are: the fulfillment of social rights and security, community participation and the utilization of local wisdom, infrastructure provision, the use of technology, information, and communication, strong political and legal commitment, and multi-stakeholder collaboration.

The findings of this study show that there are at least nine key points, namely: Spatial-Based Planning, Sustainable Road Development, Sustainable Road Management, Community Participation, Public Awareness Enhancement, Public Transportation Development, Technology Implementation, Local Industry Development, and Environmental Impact Control.

Policies for road management toward sustainable development need to be formulated early on, taking into account various considerations in order to produce optimal strategies that can be utilized for road management, particularly in support of sustainable regional development.

The implication of this study is that it may encourage government bodies, road development planners, and field implementers to utilize the PRMS technology in planning and executing road construction projects that contribute to sustainable development.

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