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IDENTIFICATION OF ENVIRONMENTAL IMPACTS IN ROAD CONSTRUCTION PROJECTS
(Case Study: Campus Ring Road in Alue Peunyareng Village, West Aceh)

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Abstract

Environmental Impact Assessment (EIA) is a crucial activity that must be conducted prior to the development of any project, whether it involves infrastructure, extractive industries, or tourism development. Every infrastructure development should account for potential impacts or effects caused by the activity through monitoring and root cause analysis, ensuring that issues are addressed to prevent the emergence of new problems in the future. The primary purpose of EIA is to protect, reduce, and prevent potential impacts of a project on the environment and society. Potential impacts are analysed by distributing questionnaires and conducting direct interviews with local communities around the project area. The data collected indicates that the perceived impacts include: 58% related to road facilities, 43% traffic flow disturbances, 65% noise pollution, 81% vibrations, 59% air pollution, 54% water pollution, and 15% soil contamination. In conclusion, the most significant effect perceived from the construction of the campus ring road project is noise, with a percentage of 65% Based on the results of the research that has been conducted, it is important to prioritize the analysis of environmental impacts before the implementation of a project in a certain area, so that the effects on the surrounding community can be minimized as much as possible.

Keywords:
Environmental impact analysis (AMDAL); Campus ring road; Construction project.

Abstrak

Analisis Dampak Lingkungan (AMDAL) adalah kegiatan penting yang harus dilakukan sebelum pembangunan sebuah proyek, baik itu proyek infrastruktur, industri ekstraktif, atau pengembangan pariwisata. Setiap pembangunan infrastruktur harusnya perlu memperhitungkan kemungkinan dampak atau efek yang ditimbulkan oleh kegiatan tersebut dengan cara memantau dan mencari akar permasalahan sehingga permasalahan tersebut dapat diselesaikan dan tidak menimbulkan permasalahan baru kemasa yang akan datang. Tujuan utama AMDAL adalah untuk melindungi, mengurangi, dan mencegah potensi dampak yang mungkin ditimbulkan oleh suatu proyek terhadap lingkungan dan masyarakat. Potensi dampak dianalisis dengan cara mendistribusikan kuesioner dan melakukan wawancara langsung dengan masyarakat setempat di sekitar wilayah proyek. Dari hasil data yang didapat menunjukkan persentase dampak yang dirasakan terkait fasilitas jalan sebesar 58%, gangguan arus lalu lintas sebesar 43%, kebisingan sebesar 65%, getaran sebesar 81%, pencemaran udara sebesar 59%, pencemaran air sebesar 54%, dan kontaminasi tanah sebesar 15%. Dapat disimpulkan bahwa efek yang paling besar dirasakan dari pembangunan proyek jalan lingkar kampus adalah kebisingan yaitu sebesar 65%. Berdasarkan dari hasil penelitian yang sudah dilakukan, penting untuk lebih diprioritaskan analisis mengenai dampak lingkungan pada saat sebelum dilaksanakannya proyek di suatu lingkungan, agar dampak yang ditimbulkan untuk masyarakat sekitar dapat diminimalisir sekecil mungkin.

Kata Kunci:
Analisis dampak lingkungan (AMDAL); Jalan lingkar kampus; Proyek konstruksi.

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1. INTRODUCTION

Environmental changes resulting from activities or endeavours, whether positive or negative, are collectively referred to as environmental impacts. Environmental Impact Assessment (EIA) is a systematic study or analysis of the effects generated by a specific activity or project on the environment, aimed at informing policy decisions (Peraturan Menteri Lingkungan Hidup No. 08, 2013). EIA serves as an effective tool for environmental management and assessment (Mantasa et al., 2023). According to Peraturan Menteri LH, EIA is a critical examination of the potential impacts of planned activities or projects on the environment, which facilitates policy formulation related to the implementation of such activities (Peraturan Menteri Lingkungan Hidup No 7, 2014). The proliferation of development projects is concerning, primarily because many are initiated without prior environmental impact analysis. Such analyses are essential components that should be considered by all relevant stakeholders. An evident example is the deterioration of road conditions resulting from high traffic volumes that are not supported by adequate structural capacity (Pramanda et al., 2024). Environmental problems arise due to the numerous activities conducted by humans to meet their needs. Each infrastructure development project must account for the potential impacts or effects resulting from the activity by monitoring and identifying root causes, thereby enabling the resolution of issues and preventing the emergence of new problems in the future. The installation of speed bumps at strategic points is an effective preventive measure to mitigate environmental disturbances, particularly noise pollution and vibrations caused by traffic (Faradilla et al., 2025). Every project inherently carries potential impacts, both positive and negative, as stipulated in Law of the Republic of Indonesia (Undang-Undang Republik Indonesia No. 32, 2009).

In the context of environmental monitoring and management, activities must be grounded in applicable legal norms, while also fostering awareness among the community and considering the development of the surrounding environment. Fundamentally, development activities are undertaken to address existing issues within a given environment; however, experience has shown that such activities can generate negative impacts. These impacts may include environmental degradation or pollution in the vicinity of the construction area, which can adversely affect local communities (Herlina & Supriyatin, 2021). Herlina also emphasized the importance of conducting impact analyses to identify and reduce negative effects. To achieve this, development activities should be environmentally based, taking into account environmental considerations from the planning stage through to the completion of the construction project.

The primary purpose of Environmental Impact Assessment (EIA) is to ensure that development activities can proceed safely and comfortably without causing environmental pollution, thereby fulfilling environmental aspects. In terms of utility, the EIA serves as a foundational material in policymaking processes related to licensing and as a technical guideline for mitigation strategies to address potential negative impacts resulting from development activities or projects, through comprehensive EIA studies. The objective of this research is to identify and analyse the impacts arising from the construction of the campus ring road project in Alue Peunyareng Village, West Aceh. The impacts to be examined encompass seven aspects, including road facilities, traffic flow disruptions, noise, vibrations, air pollution, water pollution, and soil contamination.

One of the author's references in conducting research is previous studies, both in terms of theory and methodology. The author cites several studies to enhance the content of the research:

a. The implementation of the RTA Milono Road widening significantly impacted both the pre-construction and construction phases. During the pre-construction phase, potential impacts were identified, while during the construction phase, impacts affected the physical environment, such as increased noise levels, air pollution, water and soil contamination, and disruptions to hydrological conditions, as well as social, economic, and cultural aspects (Muda, 2016).
b. After conducting a reliability test on the Banda Aceh – Sigli toll road construction, it was found that the project impacted the surrounding environment. The mitigation measures implemented adhered to the Ministry of Environment Regulation No. 12 of 2012 (A. Rani & Azlan, 2024).
c. In the construction of the Cinere-Jagorawi toll road, 45 dominant risks were identified. Further risk assessment revealed that 8 risks were classified as unacceptable, 37 as undesirable, with no risks falling into the acceptable or negligible categories. One of the risks involved in the toll road construction was the difficulty in negotiating land acquisition for project sites and the loss of construction materials at the project location (Faisal & Tenriajeng, 2022).
d. Herlina explains that from the initial planning stage, changes in the surrounding environment and situational conditions caused by development activities must be anticipated and accounted for. The impacts analyzed include two aspects: positive and negative. One approach to achieving this objective is by conducting an Environmental Impact Assessment (EIA) (Herlina & Supriyatin, 2021).

e. Mantasa demonstrates that the impacts resulting from the construction of Campus I Parking Area at UNIMEN (Universitas Muhammadiyah Enrekang) include noise pollution, impacts on road facilities within the area, vibrations, and air pollution, with an estimated contribution of approximately 60% (Mantasa et al., 2023).
f. Based on correlation analysis, the influence of land use change along the Pangkajene City ring road indicates that the most influential factors impacting land utilization along the corridor, considering both fixed and independent variables, generally exhibit a very strong positive effect, except for the variable of passenger vehicle volume. Other variables show near-perfect influence and significantly demonstrate that the existence of the city ring road has a substantial impact on population growth, the number of buildings, and the development of new roads. These three variables are inherently interconnected, and it is clear that land use planning and transportation are inseparable and mutually complementary (Khalid et al., 2023).
g. Monitoring and evaluation of the implementation of mitigation measures recommended within the Environmental Impact Assessment (EIA) process are essential, along with further research on the long-term environmental and social impacts of road development. Future prospects include developing more specific guidelines and regulations related to EIAs for road infrastructure development in rural areas (Teras & Zebua, 2023).
h. Environmental Impact Assessment (EIA) plays a vital role in road development projects. It raises awareness among the community regarding the importance of understanding potential impacts from development, such as habitat loss and ecosystem damage in surrounding environments, thereby broadening their understanding of the significance of EIA in sustainable planning (Murwani & Afdhal, 2023).
i. The research findings indicate that the noise levels at the initial environmental condition points along the four targeted locations for the alternative road development project, Matabondu-Lalingato, remain below the regulatory noise standards (Aziz et al., 2024).
j. The study demonstrates an increase in tourist attraction at Pamah Simelir and a subsequent rise in Regional Original Revenue (PAD) from tourism retributions in Langkat Regency. This positive impact is attributed to the benefits of the construction of the alternative road connecting Langkat and Karo Regency (Br Tarigan et al., 2024).
k. The research results suggest that Environmental Impact Assessment (EIA) is an effective implementation technique to reduce adverse impacts and enhance positive effects, thereby supporting sustainable development programs by balancing economic, environmental, social, and cultural factors (Surbakti, 2024).

2. LITERATURE REVIEW

2.1. Highway

Infrastructure development is an endeavor undertaken by communities to enhance regional progress and improve living standards, which can be physically observed in structures such as buildings (A. Rani & Azlan, 2024). A network that primarily functions to support economic, social, cultural, defense, and security activities of a nation is classified as a highway or main road (Undang-Undang Republik Indonesia No. 38, 2004). Highways are designed to facilitate traffic at predetermined speeds and accommodate higher volumes of vehicles, thereby reducing congestion. In highway planning, it is essential to provide optimal service to road users to ensure that the road's intended functions are effectively realized.

In accordance to Undang-undang No. 38 Tahun 2004, road classifications based on status can be divided into:

a. National Roads;
b. Provincial Roads;
c. Regency (District) Roads;
d. City Roads; and
e. Village Roads

2.2. Infrastructure development

Infrastructure encompasses systems and technical facilities, including both hardware and software components, required to provide services to the community and to support network structures (Peraturan Presiden Tentang Kerjasama Pemerintah Dengan Badan Usaha Dalam Penyediaan Infrastruktur, 2015). A well-developed road infrastructure can significantly facilitate the rapid growth of a region and positively impact the economic development of the local community.

3. RESEARCH METHOD

3.1. Location of the study

This environmental impact assessment (EIA) study was conducted on the campus ring road in Alue Peunyareng Village, West Aceh. The road segment has a width of 3 meters, and the surrounding area is characterized by educational centers, plantation zones, and military facilities.

Figure 1. Location of the Study

3.2. Research methodology

To accomplish this research, the chosen methodology involves distributing questionnaires and conducting direct interviews with the community members residing in the vicinity of the road construction site. The primary variable of concern is the negative impacts experienced by the local residents as a result of the campus ring road development project. Data collection techniques include the use of questionnaires (distribution of surveys) and direct interviews with respondents. The main target of this study is the community members who are directly affected by the construction of the campus ring road in Alue Peunyareng Village, West Aceh.

3.3. Data collection methods

The data utilized in this study are primary data, obtained through the distribution of questionnaires to relevant stakeholders. The questionnaires are distributed to the school authorities, KOREM 012/TU, and campuss of Akademi Komunitas Negeri Aceh Barat located around the construction area. Interviews are conducted using questionnaires, where respondents are asked to identify and indicate the impacts they experienced during the road construction project. Subsequently, the percentage of impact levels perceived by respondents will be calculated based on the survey results. The indicators to be evaluated in this research questionnaire relate to the impact of road facility use by the surrounding community, obstacles to traffic flow for road users, noise that occurs during the road construction project, vibrations caused by heavy equipment operating during the road construction process, air pollution, water pollution, and soil pollution caused by dump trucks actively transporting materials and spreading materials at the project site, which results in a lot of dust around the project area. The technique for selecting respondents consists of 15 residents from the project area, 25 road users who work around the campus ring road, and 10 individuals who own land in the road construction area.

3.4. Data analysis method

The steps undertaken in the data processing process are as follows:

a. Calculating the percentage of impact levels experienced based on the survey results;
b. Recording the results of the impact percentage calculations;
c. Creating a graphical representation of the perceived impact percentages.

4. RESULTS AND DISCUSSION

4.1. Results

Based on the methodology used in this study, the results obtained are the percentage levels of impact perceived by the community surrounding the construction of the Campus Ring Road in Alue Peunyareng Village, West Aceh. The environmental conditions around the Campus Ring Road in Alue Peunyareng Village are as follows:

a. East Side of the Campus Ring Road: This area is a central education zone, consisting of four schools (kindergarten/PAUD, elementary school, junior high school, and senior high school in Meureubo) and one college (AKN Aceh Barat).
b. West and South Sides of the Campus Ring Road: This area is predominantly a palm oil plantation zone.
c. North Side of the Campus Ring Road: This area is a military zone, which includes KOREM 012/TU and the Elang Sakti swimming pool (116/GS).

The respondents were selected from the primary target group of this study, which is the community residing around the construction site of the Campus Ring Road in Alue Peunyareng Village, West Aceh. The total number of respondents in this study is 50 individuals. Based on interviews using questionnaires, the percentage of impacts experienced by community members active in and around the construction area was determined. The results are summarized and displayed in a graphical form.

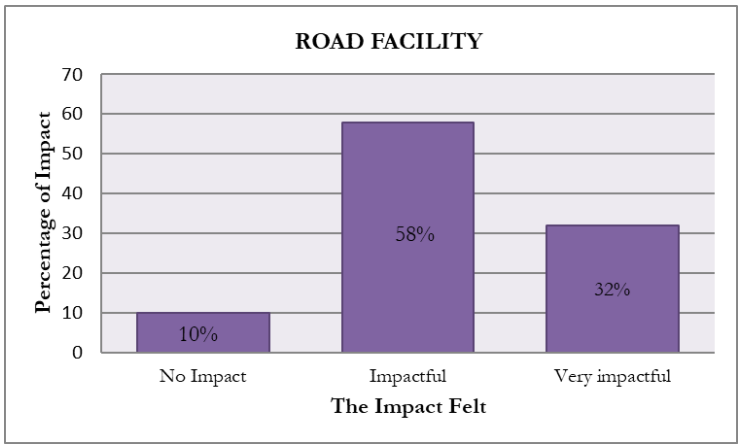

Figure 2. The percentage of impacts perceived concerning road facilities

From Figure 2 above, it is observed that 58% of the community perceives impacts related to the reduction of road facilities and services, particularly during certain hours. One example of this situation is the traffic congestion caused by numerous trucks transporting materials, which contributes to discomfort among road users.

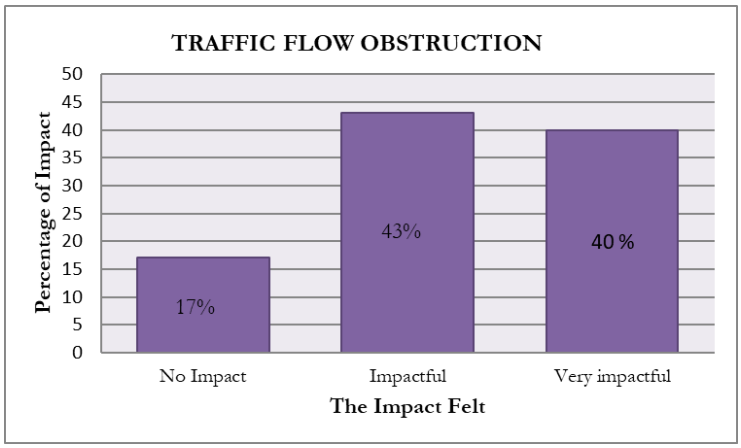

Figure 3. The percentage of impacts perceived concerning traffic flow disruptions

From Figure 3 above, it is noted that 43% of the community perceives impacts related to traffic flow obstacles. This is due to the accumulation of materials on the road surface, which narrows the available space for vehicle movement.

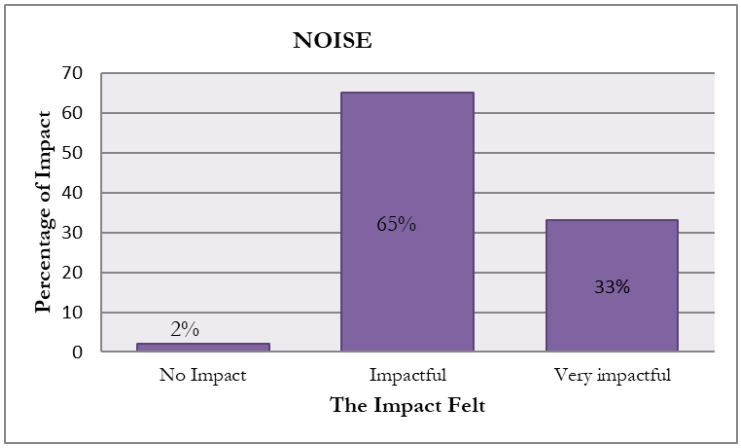

Figure 4. The percentage of impacts perceived concerning noise pollution

From Figure 4 above, it is observed that 65% of the surrounding community perceives impacts related to noise pollution. This is caused by the sounds generated from activities carried out at the construction site.

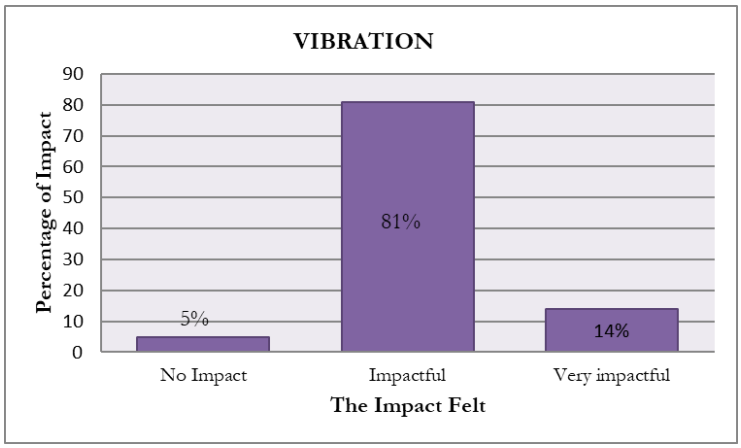

Figure 5. The percentage of impacts perceived concerning vibrations

From Figure 5 above, it is observed that 81% of the community surrounding the campus ring road development perceives impacts related to vibrations. This is caused by the operation of heavy machinery during the construction of the ring road.

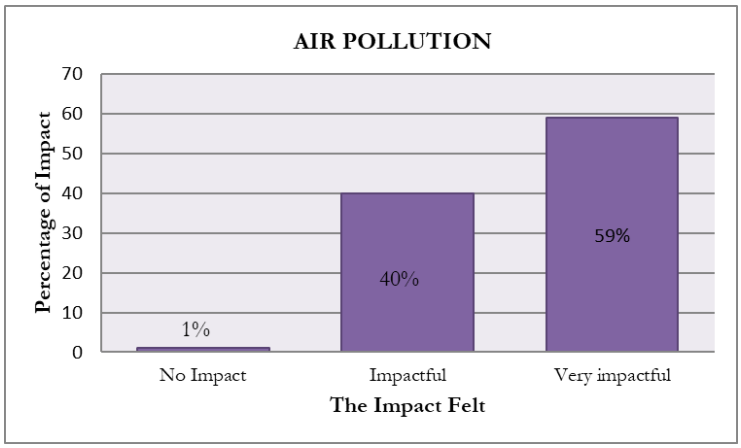

Figure 6. The percentage of impacts perceived concerning air pollution

Based on Figure 6, activities carried out during the project implementation have resulted in air pollution, with the survey indicating that 59% of the community respondents perceive this impact as highly significant.

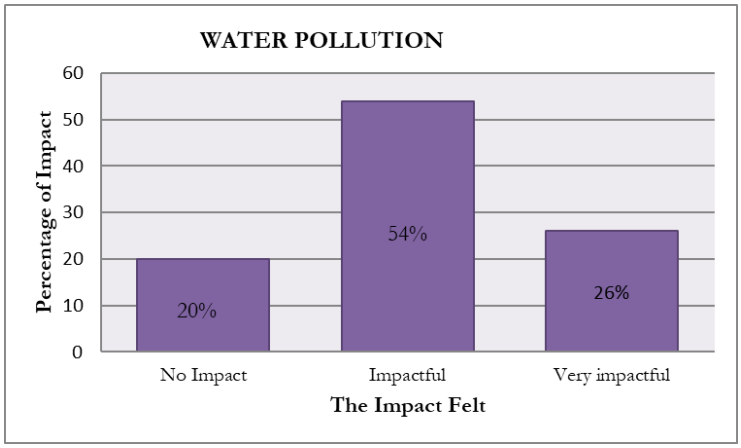

Figure 7. The percentage of impacts perceived concerning water pollution

Based on Figure 7, 54% of respondents perceive impacts related to air pollution leading to contamination of nearby water sources. This is caused by continuous vibrations during construction activities.

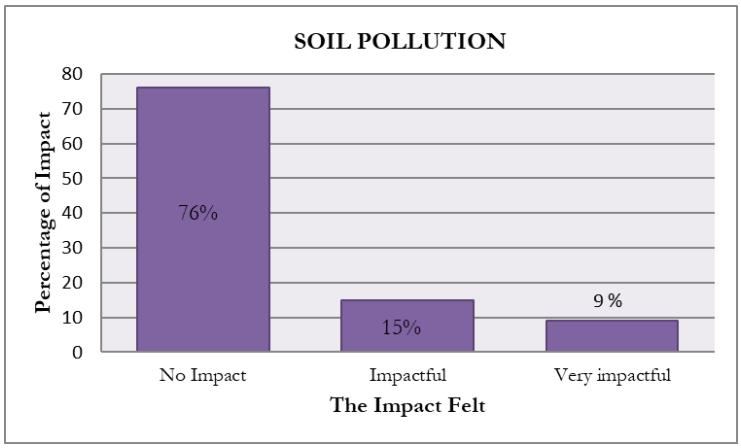

Figure 8. The percentage of impacts perceived concerning soil contamination

Based on the Figure 8, shows that 76% of the community responded that there is no impact on the land around the construction of the ring road of Alue Peunyareng village, West Aceh.

4.2. Discussion

The questionnaire data were collected and processed to produce research results, which will serve as references for problem resolution. The summarized results are presented in graphical form with percentage values. The impact percentages perceived are as follows: 58% regarding road facilities, 43% related to traffic flow disruptions, 65% concerning noise pollution, 81% associated with vibrations, 59% related to air pollution, 54% concerning water pollution, and 15% related to soil contamination. The highest perceived impact is vibrations at 81%, primarily caused by the heavy machinery frequently passing through during the project's construction phase. Conversely, the lowest impact perceived is soil contamination at 15%, which is due to the pollution not significantly affecting the surrounding plants near the construction site of the campus ring road in Alue Peunyareng Village, West Aceh. The results of this research indicate similarities with previous studies that examined the Environmental Impact Assessment (AMDAL) regarding the construction of campus parking facilities. It shows that the impacts resulting from the construction of campus parking I at UNIMEN (Universitas Muhammadiyah Enrekang) include 60% noise, 60% impact on road facilities, 60% vibration impact, 60% air pollution, and 60% air contamination(Mantasa et al., 2023).Regarding the construction of the Banda Aceh–Sigli toll road, it has shown considerable effects on the surrounding environment. The impacts include a decline in air quality experienced by 88% of nearby residents, 66% who feel affected by the increase in air pollution, and landslide-prone areas around the road construction site, with 60% of residents feeling the effects of tree cutting. Furthermore, 30% of residents are affected by the increase in solid waste/material spills, 61% of the population experience reduced water absorption due to the toll road construction, and 88% of the surrounding community feel an increase in noise and vibrations caused by the toll road development activities(A. Rani & Azlan, 2024).

5. CONCLUSSION

Based on the obtained results and discussion, it can be concluded that: the percentage of impacts perceived regarding road facilities is 58%; traffic flow disruptions are 43%; noise impacts are 65%; vibrations have the highest perceived impact at 81%; air pollution impacts are 59%; water contamination impacts are 54%; and soil contamination impacts are 15%. The most prominent impact perceived by the local residents is related to vibrations. This study emphasizes the importance of thoroughly considering the environmental impacts caused by development activities, even though such activities can enhance the economic aspects of the surrounding community through improved transportation networks. However, this does not imply that negative impacts are absent in infrastructure development or construction activities.

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