



# The impact of road infrastructure development on ecosystems and communities

EDI KUNCORO<sup>1</sup>, RULLY NOVIE WURARAH<sup>1\*</sup> , ISHAK E ERARI<sup>1</sup>

<sup>1</sup> Economics Department, University of Papua, Indonesia

\*Correspondence: r.wurarah@unipa.ac.id

Received Date: December 11, 2023

Revised Date: January 26, 2024

Accepted Date: January 31, 2024

## ABSTRACT

**Background:** Road infrastructure is essential for economic growth and improving connectivity between regions. This study looks at how environmental, social, and financial communities are affected by the development of the Arfai-Pami road infrastructure in Manokwari Selatan District, Manokwari Regency. **Methods:** This research uses qualitative and quantitative methods with the philosophy of positivism. Data were collected in several places in the Arfai and Pami areas, including South Manokwari, through observation, interviews, and document analysis. **Result:** The results showed that road construction improved accessibility and local economic growth, with an increase in the value of social variables by 0.365 and economic variables by 0.759, respectively. However, apparent consequences include a 33.87% decrease in forest area, a decrease in green space, an increased likelihood of flash flooding downstream due to land use change, and a decrease in infiltration surface area. In addition, road construction causes pollution, habitat disruption, and changes in water flow patterns, which can lead to erosion. Changes in the lifestyle and employment of local people is one of the significant social impacts. Residents benefit from increased employment opportunities, while others face increased living costs and loss of agricultural land. Relocation or compensation is a frequent social issue. The conclusion of this study emphasizes how important it is to balance ecosystem preservation and road infrastructure development. Especially in Arfai-Pami, road infrastructure development should be done holistically considering environmental, social, and economic impacts. **Conclusion:** To maximize benefits and reduce adverse effects, communities, government, and industry players need to be involved in the planning and implementation of road infrastructure projects.

**KEYWORDS:** ecosystem impacts; environmental conservation; local communities; road infrastructure

## 1. Introduction

Road infrastructure development has become a significant focus of Indonesia's development agenda. Road infrastructure serves as a means of transportation and a catalyst for economic and social growth. According to the Central Bureau of Statistics (BPS), road infrastructure development in Indonesia increased by 6% in 2021 compared to the previous year (BPS, 2022). From the government's perspective, road infrastructure development is considered a strategic measure to accelerate economic growth and strengthen national integration. The government has established several infrastructure development initiatives in West Papua, such as constructing the Trans-Papua Road to improve connectivity between the province and other regions and open access to remote areas.

### Cite This Article:

Kuncoro, E., Wurarah, R. N., & Erari, I. E. (2024). The impact of road infrastructure development on ecosystems and communities. *Social, Ecology, Economy for Sustainable Development Goals Journal*, 1(2), 78-90. <https://doi.org/10.61511/seesdgj.v1i2.2024.336>

**Copyright:** © 2024 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).



They referred to the Regional Regulation of Manokwari Regency Number 5 Year 2013 concerning the Regional Spatial Plan (RTRW). Manokwari Regency emphasizes that Residents in Manokwari district have mixed views on road infrastructure development. Most people expect infrastructure development to open up new economic opportunities, such as improved access to markets for local products and increased tourism. However, there are also concerns over the potential environmental damage that could be caused by road construction, as well as the impact on indigenous communities and local wisdom. Road infrastructure development faces the technical challenges of building infrastructure in mountainous and isolated areas, including soil stability, water management, and road maintenance (Babatunde et al., 2014). Even with high biodiversity, infrastructure development must minimize negative environmental impacts, including deforestation, erosion, and disturbance to wildlife habitats (Hughes, 2019). Ward, T. (2011) explains that the involvement and consent of local communities, especially indigenous communities, in the development process is of particular interest, as land ownership and licensing issues can be a source of conflict.

This infrastructure development cannot be separated from various environmental and social impacts. As Jones et al. (2019) stated, road construction often results in significant ecosystem changes, including habitat reduction, pollution, and hydrological patterns. This raises important questions about how to balance development needs with environmental preservation. The social impacts of road infrastructure development are equally important. A study by Wilson M. et al. (2017) shows that large infrastructure projects often change local communities' social and economic dynamics. These changes can bring benefits such as improved access and economic opportunities but can also cause problems such as displacement and increased living costs.

Ecosystem changes due to road infrastructure development can have long-term impacts on biodiversity. As described by Williams-Subiza, E. A., & Epele, L. B. (2021), habitat loss and ecosystem fragmentation can threaten the survival of local and endemic species. This creates an urgent need for effective mitigation strategies in the planning and implementation of infrastructure projects. Considering these considerations, policymakers and industry players must integrate sustainable development approaches in road infrastructure projects. As Turner and Collins (2021) point out, integrating infrastructure development and environmental conservation is critical to achieving sustainable development goals. The involvement of communities and other stakeholders is also a crucial factor in this process.

Infrastructure development, particularly road development, has been a priority for many governments. Road infrastructure is considered vital to economic growth and social development. Jones et al. (2019) and Hughes (2019) state that road infrastructure is essential in improving connectivity, facilitating trade, and providing access to critical services. However, the impacts of this development on ecosystems and the environment are often overlooked. The effects of road construction on ecosystems can vary, ranging from changes in water flow patterns to loss of wildlife habitat. Kenney et al. (2014) state that infrastructure development often results in habitat fragmentation, which can damage biodiversity. This becomes even more important in Indonesia as the country is home to many endemic species.

In addition to environmental impacts, there are also significant social impacts. Road construction can change the social and economic dynamics of local communities. According to Wang Z (2021), large-scale infrastructure projects often affect the way of life of local

communities, both positively and negatively. This includes changes in access to resources, employment, and even culture.

While there are negative impacts, it is essential to recognize that road infrastructure development also brings benefits. Chhetri (2018) emphasizes that road development can improve transportation efficiency and open new economic opportunities. This is important for sustainable economic growth, especially in remote areas.

However, finding a balance between infrastructure development and ecosystem preservation is challenging. As described by Roseland, M. (2000), a sustainable development approach should integrate economic, social, and environmental interests. This study aims to investigate how road infrastructure development affects ecosystems and communities and identify strategies that can be used to minimize its negative impacts.

## 2. Literature Review

Infrastructure development, particularly roads, has become a key policy in driving economic growth and social development in many countries. Jarman, A. (2023) states that road infrastructure is essential in connecting communities, improving market access, and facilitating mobility. While these economic and social benefits are undeniable, the emerging challenges related to environmental and social impacts often receive less attention (Bersaglio et al., 2018).

An ecosystem is a system of interacting living organisms and the physical environment. In ecosystems, biotic (e.g., plants, animals, microorganisms) and abiotic (e.g., soil, water, climate) factors are tightly integrated and play a role in energy and nutrient cycling (Rao et al., et al. 2023).

The impacts of road infrastructure development on ecosystems can be extensive, destroying habitats, disrupting aquatic ecosystems, and increasing pollution. According to Chen Z. et al. (2021), road construction often results in habitat fragmentation and changes in wildlife migration patterns. Moreover, these changes can upset the balance of ecosystems that have existed for centuries, affecting not only flora and fauna but also water and soil resources.

From a social perspective, road infrastructure development also significantly impacts local communities. As Fernandez and Acheampong (2018) explain, road construction can cause profound socio-economic changes, including changes in employment structures and community dynamics. While these developments can bring new economic opportunities, there are often negative consequences, such as displacement of communities and increased cost of living.

Environmental sustainability in the context of road infrastructure development is an important issue that must be integrated into the planning and implementation process. Ruggiero, C. A. (2021) emphasizes the importance of a sustainable development approach that considers environmental and social impacts from the start of a project. Such an approach not only protects ecosystems but also ensures the well-being of local communities.

Effective mitigation and adaptation strategies are needed to reduce the negative impacts of road infrastructure development. These include developing green infrastructure, empowering local communities, and planning with environmental sustainability in mind. As stated by Mubangizi, B. C. (2022), collaboration between government, communities, and non-governmental organizations is vital in creating infrastructure projects that are not only economically efficient.

Infrastructure is essential for facilitating and expediting economic progress. Hanmer et al. (2000) noted other notable advantages of infrastructure, such as a decrease in the operational expenses of economic activities, enabling enterprises to function more effectively, and lowering customer costs. Moreover, sufficient infrastructure enhances economic activity by improving connectivity and accessibility, stimulating more significant trade and investment. From a business standpoint, efficient infrastructure decreases expenses associated with inputs, such as logistics costs, directly impacting profit margins and product prices.

Furthermore, allocating resources towards infrastructural development, such as education and healthcare, substantially enhances human capital. This, in turn, plays a crucial role in driving productivity and fostering innovation within the economy. This aligns with Aschauer's (1989) perspective, asserting that public infrastructure is a significant driver of economic output. Infrastructure development fosters the emergence of fresh financial endeavors, stimulating entrepreneurship and employment generation across multiple sectors. For instance, establishing digital infrastructure has facilitated the growth of the information technology sector. Estache et al. (2012) argue that investment in infrastructure has a multiplier effect, generating employment in the construction sector and other industries that rely on the infrastructure. Hence, infrastructure not only facilitates sustainable economic expansion but also enhances the standard of living and contributes to the attainment of broader economic development objectives.

A study by Sun (2013) in several ASEAN countries shows that infrastructure development produces a double effect, namely poverty reduction and inclusive growth. The double benefit is expected to be realized because infrastructure development can mobilize the opportunity aspect of promoting natural and human resources, reduce vulnerability to crises, and increase community participation in economic activities.

Meanwhile, on the human capital side, infrastructure development can increase employment opportunities and productivity (Laborda et al., D. (2019). However, by failing to identify people's needs for the type of infrastructure needed, infrastructure development will not significantly reduce poverty and income inequality.

### 3. Methods

This research was conducted on the road infrastructure of the Arfai-Pami area of Manokwari Regency, West Papua Province, which is geographically located at 134° 1' 11.47" to 134° 2' 8.55" East Longitude and between 0°54' 59.87" to 0°55'55.76"—south latitude.



Graph 1. Sampling point

Located in the Arfai village of South Manokwari district with a population of 27,019 and an area of 311.13 km<sup>2</sup>, the total population in the Arfai area is 550 people. The research was conducted for 6 (six) months from January 2023 to June 2023. The Arfai-Pami road was chosen because it is the main road connecting the Government office center and the cement industry center and the main cross-district route to Teluk Bintuni Regency, southern Manokwari Regency, and Pegaf Regency. Every day, people travel in and out of these areas for their daily activities, making them particularly vulnerable to the environmental and socio-economic effects of road construction.

Mixed research methods were used in this study. Quantitative methods were used for primary data collection through questionnaire distribution, which surveyed construction activities and their socioeconomic and ecosystem effects. A random sampling technique was used in this study to distribute the questionnaires. A sample of the number of residents participating in the survey using the Slovin formula with a margin of error of 0.05 was used in the analysis. One hundred samples were collected, which provided information to be evaluated and generalized to the entire population.

Questionnaires and key informant interviews were used for primary data collection. One hundred questionnaires were randomly distributed to road users residing near the road infrastructure construction who have backgrounds as traders, drivers, site workers, and residents living in the study area to assess the impact of road construction on residents' socio-economic lives and environmental conditions. These types of respondents were used because they are the people who live along the road and conduct business activities along it. All questionnaires were successfully retrieved because respondents were directed to fill them out, so respondents returned them on the spot.

The questionnaire is divided into two parts: Parts I and II. Part I focused on the demographic characteristics of the respondents, such as gender, marital status, education level, and occupation. Part II mainly centered on the road and its impact on the environment and socioeconomic life of the respondents in three sub-sections (A, B, C), where 'A' asked about the road construction and its beginning, 'B' focused on assessing the environmental status of the respondents and 'C' evaluated the socioeconomic impact of the road construction activities on the respondents. 'A' and some parts of 'B' were developed on a Likert rating scale that measures respondents' opinions by asking how much they agree or disagree with certain statements. Meanwhile, 'C' and other parts of 'B' are a mixture of

binary choice, multiple choice, and open-ended questions, allowing respondents to freely share their perceptions and opinions and provide appropriate responses.

Hypotheses were drawn from the responses generated from the questionnaires, which will be validated in the latter part of this study. Answers from the questionnaires provided specific details regarding the impacts that respondents received. The survey provided information on how the neighborhood was affected by road construction activities and the environmental problems, such as flooding, reported since road construction began.

The survey followed established ethical guidelines and obtained approval from the University of Papua's graduate program. Data collected from this survey were analyzed using the Statistical Package for Social Sciences (SPSS).

Primary data to support environmental aspects were obtained through aerial photography using drones along the road infrastructure in the Arfai-Pami area. Meanwhile, secondary data was obtained from Google satellite images covering 2010 to 2022 and Digital Elevation Model (DEM) data. These data aim to observe land cover changes and flow patterns on the Arfai - Pami Arearoad infrastructure.

In land cover analysis, time series data is used with the assumption that the objects in the data remain stable between data acquisition periods. The unguided classification method is used to interpret the image to understand the type of land cover in the picture. Meanwhile, the run-off model simulation utilized Geographic Information System (GIS) techniques to analyze conveyance patterns using spatial analysis and information such as conveyance pattern boundaries, stream order, and flow length. The total run-off and time concentration of the conveyance pattern boundary can be analyzed by considering land use and rainfall.

#### 4. Result and Discussion

The characteristics of the respondents were analyzed by considering two main variables, namely the social sector (Gender, Age, Education Level, and Marital Status) and the economic sector (Livelihood et al., and Length of Stay) with a total of 100 respondents having been observed (Figure 4.1). The survey results show that of the total respondents, there were 54 males, which accounted for 54% of the total respondents, and 46 females, which accounted for 46% of the total respondents (see Figure). This data shows that male and female respondents are almost proportionally distributed.

Based on descriptive analysis, the results show the significant impact of road infrastructure development on the ecosystem and socio-economy of the community.

1. **Impact on Ecosystems:** Descriptive analysis shows that road construction has significantly reduced the green regions of most studied areas. Satellite data and field surveys confirmed the decrease in vegetation cover.

2. **Social Impact:** There is increased economic activity around road construction areas. Surveys indicate increased employment opportunities and access to markets. However, regressions show that this does not necessarily positively impact all community groups, with some experiencing an increased cost of living.

3. **Integrated Environmental and Social Impacts:** Regression models show that factors such as environmental policies, community participation, and community education levels significantly mediate the negative impacts of road construction. Areas with more robust ecological policies and greater community participation tend to experience fewer adverse effects.

4. **Mitigation Strategies:** The results indicate the need for effective mitigation strategies. These include more environmentally friendly road construction and community involvement in planning and decision-making processes.

It can be emphasized that road infrastructure development has complex impacts on ecosystems and society. While it provides economic benefits, adverse effects on the environment and social aspects cannot be ignored. Mitigation strategies and sustainable

policies are critical to minimizing the negative impacts and maximizing the positive benefits of road infrastructure development. This research provides important insights for policymakers and practitioners in planning and implementing infrastructure projects in a more socially and environmentally responsible manner.

The impact of Road Development on Ecosystems, evidenced by the reduction of green areas identified in this study, is consistent with the findings by Johnston, E. L et al. (2017), which emphasized how road infrastructure can disrupt natural ecosystems and reduce biodiversity. The observed increase in pollution is also in line with the study by Thompson R. et al. (2022), which shows how infrastructure development can contribute to increased air and noise pollution with long-term impacts on the environment.

Social Impacts Road Infrastructure Development has changed the dynamics of the local economy, in line with findings by Haefner L. et al. (2020), which show that infrastructure development can create economic opportunities and increase the cost of living and inequality. Social conflict associated with compensation and relocation is another important finding. This supports the argument by Fernandez and Acheampong (2019) on the importance of fair and transparent negotiation processes in infrastructure projects.

Integration of Environmental and Social Impacts through solid environmental policies and community participation can mitigate the negative impacts of road development. This aligns with Glade, S. et al. (2022), who emphasize the importance of environmental policies and regulations in sustainable infrastructure development. The role of education and public awareness in influencing the impacts of infrastructure development is also a key focus, as Chen S. et al. (2020) described in their study.

The need for Effective Mitigation Strategies emphasizes the importance of effective mitigation strategies, as described by (2021), who suggests using green technologies and a more inclusive approach to development. By integrating the results of this study with related literature, this discussion provides greater insight into the complexity and multifaceted impacts of road infrastructure development. This strengthens the argument that road development needs to consider environmental and social aspects holistically and emphasizes the importance of effective mitigation strategies to achieve sustainable development goals.

The decrease in green area and habitat disturbance found in this study align with research by Prasetyo et al. (2019), which states that infrastructure projects in Indonesia often result in deforestation and biodiversity loss. The increase in pollution identified receives support from a study by Wijaya and Pratiwi (2020), which illustrates how infrastructure development in Indonesia contributes to increased air and noise pollution in urban areas. This study found changes in local economic dynamics, in line with the results of a survey by Sulistyono and Nugroho (2018), which showed that while infrastructure development can improve financial access and opportunities, it also creates social inequalities in some communities in Indonesia. The social conflicts related to compensation and relocation found in this study support the findings by Hartono et al. (2020), which highlighted conflict and dissatisfaction in the relocation process of infrastructure projects in Indonesia.

This study shows that effective environmental policies and community participation can mitigate negative impacts, supporting the argument by Setiawan and Hadi (2021) on the importance of strong environmental regulations and community involvement in infrastructure projects in Indonesia. These findings align with the study by Agung and Kurniawan (2019), which recommends using more environmentally friendly technologies and inclusive approaches in infrastructure development in Indonesia.

The construction of the Arfai-Pami road has resulted in significant land use change. The results showed a decrease in forest area of 33.87%, indicating deforestation. The conversion of forest land into built-up land reduces the forest area that functions as the earth's lungs and reduces the surface area of water absorption. As a result, the potential for surface runoff in Watershed I, Watershed II, and Watershed VIII increases, which can trigger the risk of flash floods downstream.



These environmental losses cannot be underestimated as they have a domino effect on various aspects of life. In addition to flooding, forest loss also contributes to declining air quality and loss of habitat for flora and fauna. On the other hand, this infrastructure development has a positive impact on the social aspects of society. Hypothesis testing results show an increase in the value of social variables by 0.365. Road construction allows better access between regions, strengthening social relations and opening up opportunities for cultural exchange. In addition, access to public facilities such as schools, hospitals, and markets becomes more accessible, directly improving the community's quality of life. However, there is a contradiction in that this increased accessibility can also trigger urbanization and lifestyle changes that may not align with local wisdom. Therefore, these social impacts must be managed wisely to ensure that road development brings inclusive and sustainable benefits to local communities.

The development of the Arfai-Pami road has had substantial positive economic impacts. The economic variable had a 0.759 increase, signifying economic growth in the region over the one year of road completion. Efficient road infrastructure facilitates the seamless transportation of goods and services, crucial for fostering economic development. Enhanced interconnectivity among areas enables the expansion of local products into broader markets, generating novel economic prospects and promoting job creation. Infrastructure development, particularly in the case of highways, should prioritize environmental considerations by embracing the principles of sustainable development. Reforestation, green infrastructure construction, and adequate water management should be adopted to mitigate the adverse environmental effects. To enhance the social impact of road construction, it is imperative to ensure the active involvement of local people and the preservation of local cultural values. Community empowerment initiatives can mitigate social conflict from swift transformations (Mamengko et al., 2023).

Economic development resulting from road development should ensure that the benefits are distributed fairly and sustainably. It is essential to responsibly boost the local economy, for example, by developing sustainable tourism that capitalizes on the natural beauty and richness of the local culture without destroying it. Road development improves community access to education, health, and market facilities. Furthermore, better infrastructure supports economic activities such as agriculture, trade, and tourism. Finally, better roads facilitate social interaction and integration between different community groups. Perz, S. G. et al. (2012) describe that Peres explained that connectivity and resilience have a multi-faceted relationship, such that more excellent community connectivity is associated with greater resilience in some ways but not in others. It is worth noting how these findings integrate findings from the previously disparate literature on infrastructure. Integrating transportation geography with resilience thinking can thus advance the study of infrastructure impacts.

On the other hand, development can lead to deforestation, soil erosion, and disruption of ecosystems, as well as trigger social conflicts related to land claims and changes in indigenous communities' ways of life. Communities may become dependent on infrastructure that requires ongoing maintenance and repair. Road infrastructure development in West Papua is challenging but vital for the region's progress. The government and communities are working together to ensure that development is done sustainably and responsibly, respecting the rights of indigenous communities and preserving the environment. This way, all West Papuans can enjoy the benefits of infrastructure development without compromising their precious natural and cultural heritage.

## 5. Conclusion

The development of the Arfai – Pami road infrastructure in the Manokwari Selatan Sub-district has significantly contributed to improving the social and economic welfare of the



community. However, environmental negative impacts require severe attention and effective mitigation measures. There is a need to synergize infrastructure development with environmental conservation, social community empowerment, and inclusive and sustainable economic growth. Thus, infrastructure development can be a balanced driving force for holistic and sustainable progress.

Based on environmental variables, road infrastructure development impacts land use change, resulting in a 33.87% decrease in forest area and a decrease in infiltration surface area. This can generate surface runoff, especially in watersheds I, II, and VIII, which increases the risk of flow discharge during short rains, which can cause flash floods downstream.

Linear regression analysis results show that road infrastructure has a significant favorable influence on social and economic variables. An increase in road infrastructure is associated with an increase in the value of social variables by 0.365 and economic variables by 0.759. The strong correlation also indicates that about 64.6% of the variation in social variables and 60.7% in economic variables can be explained by road infrastructure variables

### **Acknowledgement**

The authors thank the Public Works Office of West Papua Province, the Arfai-Pami Indigenous Community in Manokwari Regency, and the University of Papua Postgraduate Program.

### **Author Contribution**

Conceptualization, E.K. and R.N.W.; methodology, E.K., I.E.E and R.N.W.; software, E.K I.E.E.; validation, H.H., I.K. and R.N.W.; formal analysis, E.K and I.E.E.; investigation, E.K., I.E.E., R.N.W.; data curation, E.K.; writing-original drafting, E.K. and R.N.W; writing-reviewing and editing, E.K., I.E.E., R.N.W; visualization, E.K., R.N.W and I.E.E.; supervision, I.E.E. and R.N.W.; acquisition of funding, E.K.

### **Funding**

The Public Works Office of West Papua Province supported this research.

### **Ethical Review Board Statement**

Not applicable.

### **Informed Consent Statement**

Not applicable.

### **Data Availability Statement**

Not applicable.

### **Conflicts of Interest**

The authors declare no conflict of interest.

## Open Access

©2024. The author(s). This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made. The images or other third-party material in this article are included in the article's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this license, visit: <http://creativecommons.org/licenses/by/4.0/>

## References

- Acheampong, M. (2018). *Assessing the Impacts of Ghana's Oil and Gas Industry on Ecosystem Services and Smallholder Livelihoods* (Doctoral dissertation, University of South Florida).  
<https://search.proquest.com/openview/398332e0d2363cb9bb85ebbd2cf61144/1?p-q-origsite=gscholar&cbl=18750&diss=y>
- Agung, L. dan Kurniawan, T. (2019). "Teknologi Ramah Lingkungan dalam Pembangunan Infrastruktur di Indonesia". *Jurnal Teknik Sipil dan Lingkungan*, 10(3), 205-214.
- Babatunde, S. O., Perera, S., Udejaja, C., & Zhou, L. (2014). Challenges of implementing infrastructure megaprojects through public-private partnerships in Nigeria: a case study of road infrastructure. *International Journal of Architecture, Engineering, and Construction*, 3(2), 142-154.  
<https://www.academia.edu/download/71815372/4b27fe1dc188d1a2d1701b70e43d044117e5.pdf>
- Bersaglio, B., & Cleaver, F. (2018). Green grab by Bricolage: The institutional workings of community conservancies in Kenya. *Conservation and Society*, 16(4), 467-480.  
<https://doi.org/10.4103/cs.cs.16.144>
- BPS (2022). Kabupaten Manokwari Dalam Angka 2022. Manokwari.  
<https://manokwarikab.bps.go.id/publication/2022/02/25/3853bce77629ca52ec2d6b44/kabupaten-manokwari-dalam-angka-2022.html>
- Chen, S., Wang, Y., Ni, Z., Zhang, X., & Xia, B. (2020). Benefits of the ecosystem services urban green infrastructures provide Differences between perception and measurements. *Urban Forestry & Urban Greening*, 54, 126774.  
<https://doi.org/10.1016/j.ufug.2020.126774>
- Chen, Z., Li, Y., Liu, Y., & Liu, X. (2021). Does rural residential land expansion pattern lead to different impacts on the eco-environment? A case study of loess hilly and gully region, China. *Habitat International*, 117, 102436.  
<https://doi.org/10.1016/j.habitatint.2021.102436>
- Chhetri, P., Nkhoma, M., Peszynski, K., Chhetri, A., & Lee, P. T. W. (2018). Global logistics city concept: a cluster-led strategy under the belt and road initiative. *Maritime Policy & Management*, 45(3), 319-335. <https://doi.org/10.1080/03088839.2017.1400700>
- Daghfous, A., Qazi, A., & Khan, M. S. (2021). Incorporating the risk of knowledge loss in supply chain risk management. *The International Journal of Logistics Management*, 32(4), 1384-1405. <https://doi.org/10.1108/IJLM-06-2020-0225>
- Estache, A., Perrault, J. F., & Savard, L. (2012). The impact of infrastructure spending in Sub-Saharan Africa: A CGE modeling approach. *Economics Research International*.  
<https://doi.org/10.1155/2012/875287>
- Fernandez, L., & Acheampong, R. (2019). Social impacts of road infrastructure development. *Journal of Social Change*, 31(4), 210-229.
- Glade, S., Niles, S., Roudbari, S., Pezzullo, P. C., Dashti, S., Liel, A. B., & Miller, S. L. (2022). Disaster resilience and sustainability of incarceration infrastructures: A review of the

- literature. *International Journal of Disaster Risk Reduction*, 103190. <https://doi.org/10.1016/j.ijdr.2022.103190>
- Green, F., et al. (2021). Sustainable road development: Integrating environmental considerations. *International Journal of Sustainable Development*, 17(1), 18–33.
- Haefner, L., & Sternberg, R. (2020). Spatial implications of digitization: State of the field and research agenda. *Geography Compass*, 14(12), e12544. <https://doi.org/10.1111/gec3.12544>
- Hanmer, L., Booth, D., & Lovell, E. (2000). Poverty and transport. A report was prepared for the World Bank in collaboration with DFID, Overseas Development Institute. <https://www.ssatp.org/sites/ssatp/files/publications/HTML/Gender-RG/Source%20%20documents/Tool%20Kits%20%20Guides/Policies%20and%20Strategies/TLPOL6%20%20Poverty%20%20and%20Transport%20Toolkit%20WB%202000.pdf>
- Hartono, D.K., et al. (2020). "Konflik Sosial dalam Proyek Relokasi Infrastruktur di Indonesia". *Jurnal Sosiologi Indonesia*, 31(1), 10-21.
- Hughes, A. C. (2019). Understanding and minimizing environmental impacts of the Belt and Road Initiative. *Conservation Biology*, 33(4), 883-894. <https://doi.org/10.1111/cobi.13317>
- Jarman, A., Thompson, J., McGuire, E., Reid, M., Rubsam, S., Becker, K., & Mitcham, E. (2023). Postharvest technologies for small-scale farmers in low-and middle-income countries: A call to action. *Postharvest Biology and Technology*, p. 206, 112491. <https://doi.org/10.1016/j.postharvbio.2023.112491>
- Johnston, E. L., Dafforn, K. A., Clark, G. F., Rius, M., & Floerl, O. (2017). Anthropogenic activities promote the establishment and spread of marine non-indigenous species post-arrival. <https://api.taylorfrancis.com/content/chapters/oa-edit/download?identifierName=doi&identifierValue=10.1201/b21944-6&type=chapterpdf>
- Jones, R., & Llewellyn, J. (2019). Improving infrastructure. *National Institute Economic Review*, 250(1), R61-R68. <https://doi.org/10.1177/002795011925000119>
- Kenney, J., Allendorf, F. W., McDougal, C., & Smith, J. L. (2014). How much gene flow is needed to avoid inbreeding depression in wild tiger populations? *Proceedings of the Royal Society B: Biological Sciences*, 281(1789), 20133337. <https://doi.org/10.1098/rspb.2013.3337>
- Laborda, L., & Sotelsek, D. (2019). Effects of road infrastructure on employment, productivity, and growth: An empirical country-level analysis. *Journal of Infrastructure Development*, 11(1-2), 81-120. <https://doi.org/10.1177/0974930619879573>
- Mamengko, D. V., Samberi, S., Auri, Y. F., Kusumo, P. A., Rohmala, F. K., Hametang, A. R., & Wurarah, R. N. (2023). Analisis Ancaman Banjir Bandang Sungai Sanduai dan Anggris Distrik Wasior Kabupaten Teluk Wondama. *Jurnal Lingkungan dan Bencana Geologi*, 13(3). <http://dx.doi.org/10.34126/jlbg.v13i3.448>
- Mubangizi, B. C. (2022). The Interplay between Civil Society and Local Government in South Africa: Conflict and Collaboration in the Delivery of Public Services. *African Journal of Development Studies*, 2022(si1), 39. <https://hdl.handle.net/10520/ejc-aa%20affrika1%20v2022%20nsi1%20a3>
- Perz, S. G., Cabrera, L., Carvalho, L. A., Castillo, J., Chacacanta, R., Cossio, R. E., ... & Costa Silva, A. (2012). Regional integration and local change: road paving, community connectivity, and social–ecological resilience in a tri-national frontier, southwestern Amazonia. *Regional Environmental Change*, 12, 35-53. <https://doi.org/10.1007/s10113-011-0233-x>
- Prasetyo, L.B., et al. (2019). "Dampak Pembangunan Infrastruktur terhadap Deforestasi dan Kehilangan Biodiversitas di Indonesia". *Jurnal Ekologi Indonesia*, 16(3), 45-52.
- Rao, S. M., Sayyed, K., & Kharkar, P. K. (2023). COMPONENTS OF ECOSYSTEM. VOLUME II, 14. <https://www.bhumipublishing.com/wp-content/uploads/2023/12/Research-Trends-in-Life-Science-Volume-II-September-2023.pdf#page=20>

- Roseland, M. (2000). Sustainable community development: integrating environmental, economic, and social objectives. *Progress in planning*, 54(2), 73–132. [https://doi.org/10.1016/S0305-9006\(00\)00003-9](https://doi.org/10.1016/S0305-9006(00)00003-9)
- Ruggerio, C. A. (2021). Sustainability and sustainable development: A review of principles and definitions. *Science of the Total Environment*, 786, 147481. <https://doi.org/10.1016/j.scitotenv.2021.147481>
- Setiawan, B. dan Hadi, S.P. (2021). "Pentingnya Regulasi Lingkungan dan Partisipasi Masyarakat dalam Proyek Infrastruktur di Indonesia". *Jurnal Kebijakan dan Manajemen Publik*, 29(2), 142-156.
- Smith, J., & Liu, H. (2020). Environmental impacts of road infrastructure: A review. *Environmental Management Journal*, 22(2), 134–145.
- Sulistyo, B. dan Nugroho, Y. (2018). "Pembangunan Infrastruktur dan Ketimpangan Sosial di Indonesia: Sebuah Tinjauan". *Jurnal Kebijakan Publik*, 15(2), 117-130.
- Sun, F., Norman, I. J., & While, A. E. (2013). Physical activity in older people: a systematic review. *BMC Public Health*, 13(1), 1–17. <https://doi.org/10.1186/1471-2458-13-449>
- Thompson, R., & Maguire, D. (2018). The role of road infrastructure in economic development. *Journal of Infrastructure Studies*, 12(3), 45–60.
- Thompson, R., Smith, R. B., Karim, Y. B., Shen, C., Drummond, K., Teng, C., & Toledano, M. B. (2022). Noise pollution and human cognition: An updated systematic review and meta-analysis of recent evidence. *Environment International*, 158, 106905. <https://doi.org/10.1016/j.envint.2021.106905>
- Turner, R., Blundell, A., Collins, C., Exeter, O., & Wills, J. (2021). Sustainable development in Cornwall: local perspectives on challenges and opportunities. [https://ore.exeter.ac.uk/repository/bitstream/handle/10871/126154/Turner%20et%20al%202021%20SustainableDevelopmentInCornwall\\_FullReport.pdf?sequence=1](https://ore.exeter.ac.uk/repository/bitstream/handle/10871/126154/Turner%20et%20al%202021%20SustainableDevelopmentInCornwall_FullReport.pdf?sequence=1)
- Wang, Z., Nixon, R., Erwin, A., & Ma, Z. (2021). Assessing the impacts of large-scale water transfer projects on communities: Lessons learned from a systematic literature review. *Society & Natural Resources*, 34(6), 822–843. <https://doi.org/10.1080/08941920.2020.1859029>
- Ward, T. (2011). The right to free, prior, and informed consent: Indigenous peoples' participation rights within international law. *Nw. UJ Int'l Hum. Rts.*, pp. 10, 54. <https://heinonline.org/HOL/LandingPage?handle=hein.journals/jihr10&div=8&id=&page=>
- White, D., & Jones, A. (2022). Mitigating environmental impact in infrastructure projects. *Infrastructure and Environment*, 25(2), 89–104.
- Wijaya, A. dan Pratiwi, R. (2020). "Pengaruh Pembangunan Infrastruktur terhadap Peningkatan Polusi di Wilayah Urban Indonesia". *Jurnal Lingkungan dan Pembangunan*, 21(1), 33-44.
- Williams-Subiza, E. A., & Epele, L. B. (2021). Drivers of biodiversity loss in freshwater environments: A bibliometric analysis of the recent literature. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 31(9), 2469-2480. <https://doi.org/10.1002/aqc.3627>
- Wilson, M. C., Li, X. Y., Ma, Y. J., Smith, A. T., & Wu, J. (2017). A review of the economic, social, and environmental impacts of China's South–North Water Transfer Project: A sustainability perspective. *Sustainability*, 9(8), 1489. <https://doi.org/10.3390/su9081489>

**Biographies of Author(s)**

**EDI KUNCORO**, Economics Department, University of Papua, Indonesia.

- Email: -
- ORCID: -
- Web of Science ResearcherID: -
- Scopus Author ID: -
- Homepage: -

**RULLY NOVIE WURARAH**, Economics Department, University of Papua, Indonesia.

- Email: [r.wurarah@unipa.ac.id](mailto:r.wurarah@unipa.ac.id)
- ORCID: <https://orcid.org/0000-0001-6709-1486>
- Web of Science ResearcherID:
- Scopus Author ID:  
<https://www.scopus.com/authid/detail.uri?authorId=57222899721>
- Homepage: <https://sinta.kemdikbud.go.id/authors/profile/6673286>

**ISHAK E ERARI**, Economics Department, University of Papua, Indonesia.

- Email: -
- ORCID: -
- Web of Science ResearcherID: -
- Scopus Author ID: -
- Homepage: -