Journal of Regional and City Planning
vol. 35, no. 3, page. 244-259, December 2024
DOI: 10.5614/jpwk.2024.35.3.1

Impact of Toll Road to Agricultural Land Conversion for Sustainable Development: A Systematic Literature Review

Yogi Makbul[1*], Sudrajati Ratnaningtyas[2], and Nurrohman Wijaya[1]

[Received: 10 September, 2023; 1st revision: 12 February, 2024; 2nd revision: 20 August, 2024; accepted in final version: 14 October, 2024]

Abstract*. This study examined the relationship between the impact of toll road development on agricultural land conversion and the transformation of land along with its socioeconomic and environmental consequences. The method employed was a systematic literature review conducted using the PRISMA framework. The result identified eighteen publications discussing the impact of toll road construction on agricultural land conversion. The research concluded that toll road construction plays a role in converting areas into zones, settlements, and other non-agricultural purposes. This transformation can have effects on agricultural land conversion. The evaluation also highlights the importance of policy recommendations to mitigate the impacts of agricultural land conversion to sustainable development and food security, offering a hopeful outlook for the future.*

Keywords: *Agricultural land conversion, food security, sustainable development, systematic literature review, toll roads.*

Abstrak. *Penelitian ini mengkaji hubungan antara dampak pembangunan jalan tol terhadap konversi lahan pertanian dan transformasi lahan beserta konsekuensi sosial ekonomi dan lingkungannya. Metode ini merupakan tinjauan pustaka sistematis yang dilakukan dengan menggunakan kerangka kerja PRISMA. Hasil penelitian mengungkapkan 18 publikasi yang membahas dampak pembangunan jalan tol terhadap konversi lahan pertanian. Penelitian menyimpulkan bahwa pembangunan jalan tol berperan dalam mengubah wilayah menjadi zona, permukiman, dan keperluan non-pertanian lainnya. Transformasi ini dapat berdampak pada konversi lahan pertanian. Evaluasi juga menyoroti pentingnya rekomendasi kebijakan untuk mengurangi dampak konversi lahan pertanian menjadi pembangunan berkelanjutan dan ketahanan pangan, menawarkan prospek yang penuh harapan untuk masa depan.*

Kata kunci: *Jalan tol, ketahanan pangan, konversi lahan pertanian, pembangunan berkelanjutan, tinjauan literatur sistematis.*

Introduction

The development of toll roads has become a part of infrastructure growth in developing countries due to its positive impact on transportation networks, economic progress, and regional connectivity (Dwitasari et al., 2020; Muvawala et al., 2021; Ng et al., 2019). However, it is crucial to acknowledge the drawbacks of toll roads, such as their impact on agricultural land conversion. This conversion can have socio-environmental consequences (Azadi et al., 2020; Makbul et al., 2019). The process of agricultural land conversion refers to the transformation of

[1] School of Architecture, Planning, and Policy Development, Institut Teknologi Bandung, Jl. Ganesha 10, Bandung City, Indonesia. (*corresponding author, email: yogimakbul@itb.ac.id)
[2] School of Business and Management, Institut Teknologi Bandung, Jl. Ganesha 10, Bandung City, Indonesia.

farmland for purposes like urbanization, industrialization, or infrastructure development (Appiah et al., 2019; Partoyo & Shrestha, 2017; Paul & Rashid, 2017). In cases where toll road construction necessitates land purchases, this may result in the displacement of farmers and the destruction of fertile agricultural land (Putri & Marzuki, 2020; Sihombing et al., 2012). A study conducted by Lopez et al. (2021) revealed that towns experienced changes from rural to areas following highway construction. The construction of toll roads can have an impact on the conversion of land despite their role in supporting economic growth. This conversion can significantly reduce food-producing areas, ultimately impacting food security in the region. In addition, the construction of toll roads inherently raises land prices in neighboring areas, further complicating matters. Under the increasing pressure of transportation infrastructure to stimulate economic development and the well-being of rural communities, it is essential to investigate whether toll road construction contributes directly or indirectly to land conversion for agricultural purposes. Furthermore, the construction of new transportation infrastructure will not only increase land values, it could also support the conversion of more land for non-agricultural purposes, which may worsen problems experienced by food production systems (Sheng et al., 2018). This may entice farmers to consider trading their properties for non-agricultural options (Zollinger & Krannich, 2002). According to Meyer et al. (2017), the construction of toll roads can contribute to sprawl, adding pressure on agricultural land as it makes way for residential and commercial development (Tione & Holden, 2020).

The conversion of land for toll roads has significant socio-environmental implications, impacting ecosystems, biodiversity, and human communities. The construction and operation of toll roads lead to habitat fragmentation, which disrupts wildlife movement and increases roadkill incidents, as seen in the study of terrestrial carnivores where roads were found to isolate their populations and affect their long-term viability (Ceia-Hasse et al., 2017). This fragmentation also alters predator-prey interactions, as evidenced by changes in the trophic behavior of carnivores near motorways, where an increase in small mammal biomass was observed closer to roads (Ruiz-Capillas et al., 2021). Furthermore, the abandonment of farmland in mountainous regions, driven by the development of road networks, increases eco-environmental risks, leading to biodiversity loss and reduced ecosystem services, as observed in the Dordi River basin in Nepal (Chaudhary et al., 2019).

The theoretical framework examining the relationship between land value and transportation infrastructure is a crucial topic in location theory, extensively explored by pioneers such as Johann Heinrich von Thünen, Alfred Weber, Walter Christaller, and the Alonso-Muth-Mills model. They offer various perspectives on how transport infrastructure impacts land value. In *The Isolated State*, von Thünen's model illustrates the connection between land value and transport costs through concentric rings around a market, where land closer to the market has higher value due to lower transportation costs, particularly in agricultural contexts (Eaton & Lipsey, 2010). Alfred Weber's theory suggests that industries choose locations to minimize transportation and labor costs, favoring areas with strong transport links like railways or ports to reduce expenses related to moving materials and goods (Pinto, 1997). Walter Christaller's central place theory emphasizes the role of transport in determining the accessibility of cities and towns that provide goods and services to surrounding areas. Efficient transport enhances accessibility, increasing land value in these regions due to heightened economic activity and demand (Pinto, 1997). The Alonso-Muth-Mills model explains how land value is influenced by distance from the city center, with improved transportation making land farther from the center more valuable by reducing travel time and costs (Takahashi, 2014).

Highway development significantly impacts agricultural land conversion, often leading to substantial losses of arable land. Studies show that proximity to roads increases the likelihood of agricultural land being converted to non-agricultural uses (Asadi et al., 2016; F. Zheng et al., 2021). This conversion is particularly pronounced in urban and peri-urban areas, where highways contribute to urbanization and real estate development (Miljković et al., 2022; Yu et al., 2022). The socio-economic impacts of agricultural land conversion include loss of livelihoods, increased crime rates, and reduced farmers household revenues (Zhang et al., 2023).

The potential impact of toll road construction on the conversion of land carries implications for policymakers, planners, and stakeholders. It highlights the importance of land use planning that strikes a balance between development and the preservation of rural livelihoods and agricultural spaces. It also underscores the need for collaboration with farming communities to ensure that their concerns and interests are considered during the planning and execution phases of toll road projects. Understanding how toll road construction affects the conversion of land can inform policies and practices. This knowledge can help promote modes of transportation implement land conservation measures or provide support to affected farmers. By considering these effects, we can work towards creating an approach to infrastructure development while safeguarding agricultural resources. The impact of toll road construction on agricultural land conversion is a concern that poses threats to the livelihoods of communities and food security. It is crucial to understand this issue in order to inform policy and decision-making processes. Thus, we can ensure that infrastructure development does not come at the expense of land or the communities that rely on it.

The present research aimed to achieve two objectives. Firstly, it systematically synthesized existing literature on the relationship between toll road construction and agricultural land conversion. Secondly it investigated the socio environmental implications of converting land due to toll roads. The findings from this research can be used by policymakers, stakeholders, and planners to make decisions about infrastructure development, land use planning and effective land management techniques. This study also sought to develop evidence-based policy recommendations for minimizing the consequences associated with agricultural land conversion while promoting development and addressing the needs of affected farmers. Additionally, raising awareness about these issues through advocacy efforts was another aspect of our work.

By raising awareness about the environmental impacts of converting agricultural land for toll road construction, this research aimed to generate interest in sustainable development and responsible land use practices among various stakeholders, the public, and advocacy organizations. The academic contribution of this study lies in identifying gaps in the existing literature and paving the way for research in the field of infrastructure development and its impact on agricultural land. Moreover, the insights gained from this research can inform policies that strike a balance between infrastructure growth and the preservation of lands, ultimately promoting long term sustainability across societal and economic dimensions.

Methodology

Using a systematic literature review (SLR), this research tried to analyze the effect of toll road construction on the conversion of agricultural land. We performed an exhaustive literature review through the Scopus database and Google Scholar, limiting our search to articles from 2013 to 2023. The search terms included ‘toll road’ and ‘agricultural land conversion’. Inclusion criteria encompassed peer-reviewed studies that examined the socio-environmental implications of land conversion, while exclusion criteria eliminated non-English publications and those lacking methodological rigor.

The articles were chosen using inclusion and exclusion criteria with quality assessment that enabled us to identify relevant studies. Two independent reviewers assessed quality based on criteria such as the clarity of inclusion and exclusion, comprehensiveness of literature search, and validity of results. Data synthesis followed (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) PRISMA guidelines, which were used to increase transparency and rigor in the reporting process.

The criteria used for inclusion and exclusion by two reviewers to select the article to be used: 1) articles written in English; 2) articles published at least ten years ago or at least published in 2013; 3) articles in the form of peer-reviewed articles or proceedings; 4) articles dealing with toll roads and their impact on land conversion; 5) the research had to present outcome factors based on qualitative or quantitative data related to agricultural land conversion; 6) articles that make a precise analysis and show methodologic quality; and 7) studies that analyzed the effects of development and toll road construction on agricultural land. Articles without these components were excluded from this research.

This methodology aimed to provide a comprehensive understanding of how toll road development influences agricultural land conversion, offering insights for policymakers and stakeholders in balancing infrastructure needs with preserving agricultural land.

Result and Discussion

The research results are illustrated in the PRISMA diagram presented in Figure 1, which outlines the systematic process followed in our literature review. This diagram provides a visual representation of the stages involved, beginning with identifying relevant studies, followed by the screening process to assess their eligibility based on predefined criteria. It details the number of studies initially screened, those sought for retrieval, and the final count of studies included in the review. By clearly mapping out these steps, the PRISMA diagram not only enhances transparency in our methodology but also allows the reader to understand the significance of the final selection of eighteen articles that formed the basis of our analysis.

Searching the Scopus database with the keywords ‘toll road’ AND ‘agricultural land conversion’ on June 6, 2023 yielded seven articles. All the articles were in English, while the range of published years was from 2013 to 2023. The search of Google Scholar with the keywords ‘toll road’ AND ‘agricultural land conversion’ on June 6, 2023 yielded 75 articles. For the English language, 54 articles were found. After processing, only eighteen article were deemded eligible for extraction. A summary of the results is shown in Table 1.

Table 1 provides an overview of the research articles focusing on land use, agriculture, and urban development in Indonesia. The articles explore topics such as sprawl development, agricultural land conversion, food security, urban farming, infrastructure impacts, and legal aspects of land use, highlighting their academic significance. These studies, published over several years, appeared in journals indexed by both Google Scholar and Scopus. They examine the impacts of infrastructure development, urban expansion, and policy implementation on agricultural practices and land use across different regions of Indonesia. The table includes columns listing the authors’ names, article title, publication year, citation count, journal title, and database source. The publication years ranged from 2015 to 2023, with a notable concentration of articles from 2021 and 2022, reflecting recent research trends. The number of citations varied, with the most cited article being Gandharum et al. (2022), which had eight citations, indicating varying levels of academic influence. The research spans regions such as West Java, Jakarta, and Yogyakarta. The most frequently selected publisher is the conference

journal *Earth and Environmental Science*, which featured three articles. The sources of the articles were split between Scopus and Google Scholar, with seven articles indexed in Scopus and the remainder in Google Scholar.

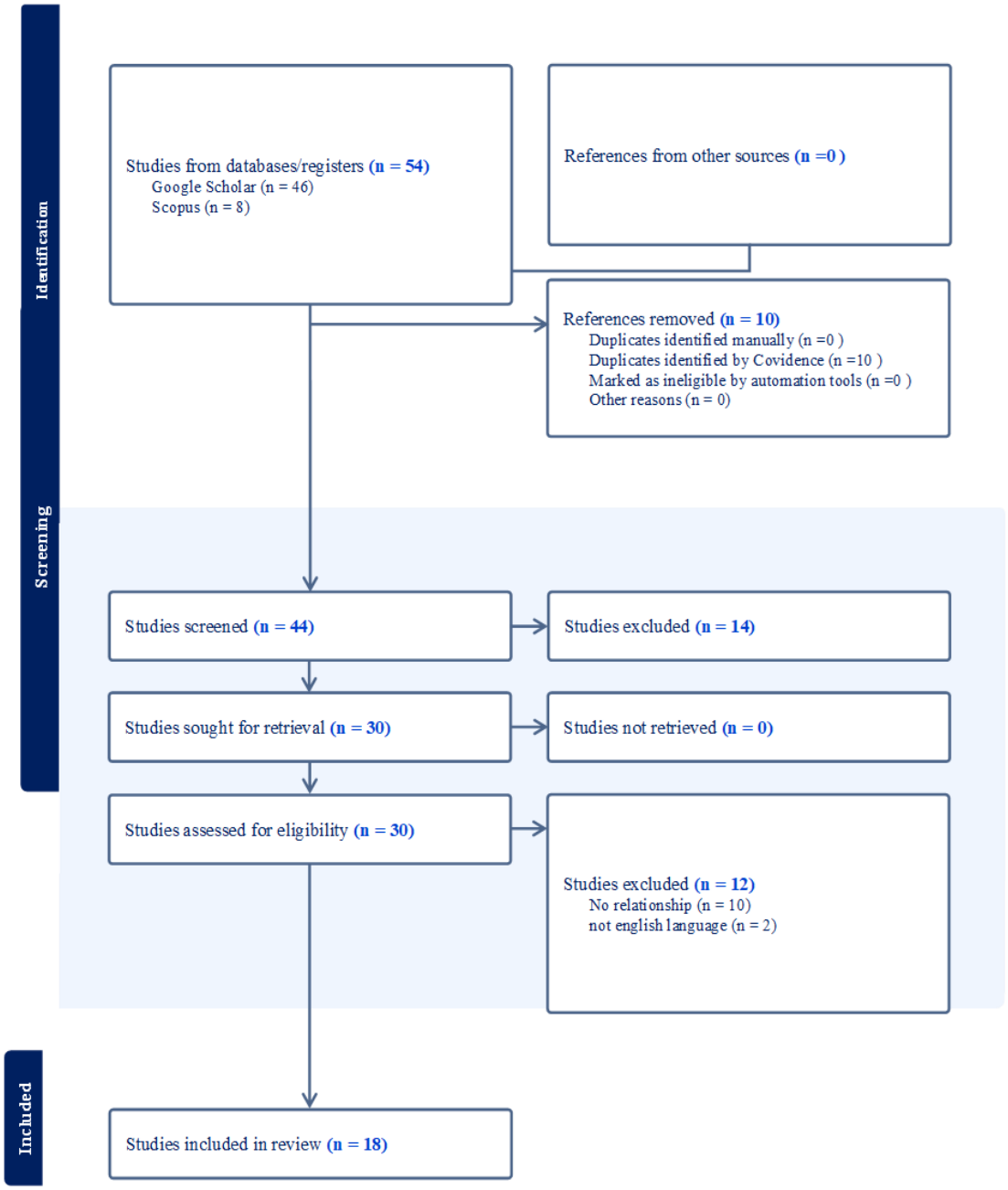

Figure 1. PRISMA diagram.

Table 1. Summary of the articles found

Author	Article Title	Year	Citations	Journal	Source
Aditya & Husna	Identification of Sprawl Development Typologies around Toll Road Gates in Java, Indonesia	2022	3	Tata Loka	Google Scholar
Aldillah	Consistency Regulations Implementing Rules and Regulation of Food Derived Specifically Sustainable Agricultural Land in West Java Province	2015	1	International Journal of Science and Research (IJSR)	Google Scholar
Anggraini et al.	The impact analysis of rice field conversion on food security in Sragen Regency	2021	3	E3S Web of Conferences	Google Scholar
Fiqriyati et al.	The dynamics of rice-field conversion in the surroundings Cipali toll-roads of Subang Regency	2022	6	Earth and Environmental Science	
Gandharum et al.	Monitoring Urban Expansion and Loss of Agriculture on the North Coast of West Java Province, Indonesia, Using Google Earth Engine and Intensity Analysis	2022	37	Hindawi	Scopus
Indrawati	Urban farming model in South Jakarta	2018	13	Earth and Environmental Science	Google Scholar
Kurnia et al.	Understanding Industrial Land Development on Rural-Urban Land Transformation of Jakarta Megacity's Outer Suburb	2022		Land	Scopus
Makbul et al.	Infrastructure Development and Food Security in Indonesia: The Impact of the Trans-Java Toll Road on Rice Paddy Farmers' Desire to Sell Farmland	2019	14	Journal of Regional and City Planning	Scopus
Makbul et al.	Factors that Stimulate Farmers to Convert their Farmland	2017	0	International Journal of Applied Business and Economic Research	Scopus
Mufariq et al.	Innovation for Sustainable Productivity in Agricultural Land Conversion	2022	1	Conference of Indonesian Association for Public Administration	Google Scholar
Mulyani et al.	Potential Land Reserves for Agriculture in Indonesia: Suitability and Legal Aspect Supporting Food Sufficiency	2023	0	Land	Scopus
Mulya et al.	Land use and spatial planning in the border area of Bogor Regency and Bogor City, West Java Province, Indonesia	2022	5	Earth and Environmental Science	Google Scholar
Nainggolan	Land Use Conversion: Evaluation And Strategic Actions (Case of Sumedang Regency	2017	1	Widya praja	Google Scholar

Author	Article Title	Year	Citations	Journal	Source
Nugraha et al.	Structural Equation Model (SEM) of Social Capital with Landowner Intention	2023	7	Economies	Scopus
Prayitno et al.	The impact of incentives on the decision to transfer agricultural land functions to non-agricultural uses	2021	2	Earth and Environmental Science	Google Scholar
Rahajeng et al.	Transformation of Yogyakarta regional development: a shifting perception of economic power among the regions	2022	5	GeoJournal	Scopus
Rumadan et al.	Legal Protection of Farmers' Rights Regarding the Conversion of Agricultural Land Functions for Non-Agricultural Investment Purposes in Indonesia	2022	0	International Journal of Social Science and Human Research	Google Scholar
Tohir et al.	The Problem of The Conversion of Agricultural Land to Housing in The District of Tegal	2022	0	Malapy	Google Scholar

A summary of the results derived from the various articles included in this systematic literature review can be seen in Table 2, which presents a detailed overview of the key findings.

Table 2 presents a PRISMA diagram that outlines how the systematic literature review process was carried out. During the review we found a total of 44 studies from databases and registers like Google Scholar and Scopus. After removing any studies and assessing eligibility we ended up including eighteen studies in our review.

The studies consistently showed that the development of toll roads plays a role in converting agricultural land to commercial and non-agricultural areas. Scholars like Aditya and Husna (2022), Gandharum et al. (2022), and Kurnia et al. (2022) have highlighted how the establishment of toll entrances and exits as the expansion of existing toll roads contribute to this transformation. These changes are expected to bring about shifts in activities leading communities towards involvement in commercial endeavours and urban settlements. Researchers such as Aditya and Husna (2022), Fiqriyati et al. (2022) Gandharum et al. (2022), and Kurnia et al. (2022) have projected that these trends will result in changes related to land use. The estimates ranging from 3,875 hectares in West Java Province (Aldillah, 2015) to 8,000 hectares spread across three districts due to the construction of the Serang Panimbang Interchange/Exit Toll Road (Mufariq et al., 2022). Moreover, it is important to consider the impact on food security due to the decline in activity resulting from these transformations, as pointed out by Makbul et al. (Makbul et al., 2019) and Makbul et al. (2017). The impact of urbanization and the development of infrastructure are clearly demonstrated by this trend, which emphasizes the loss and transformation of land (Mulyani et al., 2023; Nainggolan, 2017; Prayitno et al., 2021; Rahajeng et al., 2022).

Table 2 Summary of Articles

Article	Result
Aditya & Husna, 2022	The development of toll gates has led to land use change in their surrounding areas. This has caused the conversion of agricultural land into commercial areas, as the surrounding community holds commercial activities in the area.
Aldillah, 2015	The construction of 455.57 km of toll roads in West Java Province will use (convert) an area of 3875 ha of land.
Anggraini et al., 2021	The construction of toll roads could contribute to increasing demand for non-agricultural land.
Fiqriyati et al., 2022	The construction of toll roads in the Cipali area has contributed to the conversion of agricultural land, including rice fields, to other uses such as settlements and other facilities.
Gandharum et al., 2022	The exit toll points along the road stimulate new economic growth, accelerating the shift from farmland to developed areas.
Indrawati, 2018	The construction of a toll road passing through the Pesanggrahan district in South Jakarta greatly affects land use and can lead to land conversion.
Kurnia et al., 2022	The proximity to toll road gates is one of the driving factors of land transformation/changes in Bekasi and Tangerang regencies, which includes agricultural land conversion.
Makbul et al., 2019	The development of the Trans-Java Toll Road is likely to lead to agricultural land conversion, which could threaten food security in Indonesia.
Makbul et al., 2017	The toll roads have been shown to have a significant impact on agricultural land conversion.
Mufariq et al., 2022	Toll road construction has an impact on agricultural land conversion. According to the study presented, approximately 8,000 hectares of agricultural land in three districts have shifted from rice fields, and the fields have changed functions due to the construction of the Serang-Panimbang Interchange/Exit Toll Road.
Mulyani et al., 2023	Toll roads cause farmland loss under rapid urbanization.
Mulya et al., 2022	The construction of toll road infrastructure, such as the Jagorawi Kedunghalang-Kemang toll road flyover in 2019, has led to changes in agricultural land use.
Nainggolan, 2017	Toll road construction is one of the factors that can lead to agricultural land conversion. As mentioned in this study, the factors that affect farmers to convert agricultural land include the construction of public facilities and toll roads can fall under this category.
Nugraha et al., 2023	Toll road construction can have an impact on the conversion of agricultural land to non-agricultural use. The construction of the Gempol-Pandaan toll road in Indonesia, for example, has resulted in the conversion of 213.69 hectares of agricultural land in Pandaan District, which is 4.9% of total land use.
Prayitno, Dinanti, Sari, et al., 2021	Toll roads have been identified as one of the factors contributing to the rapid conversion of agricultural land to non-agricultural land in Pandaan District, Pasuruan Regency.
Rahajeng et al., 2022	Toll road construction can have an impact on agricultural land conversion for urban development.
Rumadan et al., 2022	The construction of toll roads, such as the Trans Java toll road, has had an impact on the conversion of agricultural land in Indonesia.
Tohir et al., 2022	The toll road development plan in Tegal Regency can have an impact on agricultural land conversion. The development of the toll road will result in a shift in land use and changes in activities in the area traversed by the toll road.

The articles by Anggraini et al. (2021), Indrawati (2018), Mulya et al. (2022), Nugraha et al. (2023), Rumadan et al. (2022), and Tohir et al. (2022) collectively shed light on the substantial impact of toll road construction on the conversion of agricultural land. Anggraini et al. (2021) highlight that toll road development often increases the demand for land intended for non-agricultural purposes. Indrawati (2018) discusses how toll road projects in South Jakarta have significantly altered land use patterns. Mulya et al. (2022) describe how infrastructure developments, including toll roads, transform agricultural land into urban areas. Nugraha et al. (2023) provide case studies where toll road construction has directly led to the loss of agricultural land. Rumadan et al. (2022) emphasize that the expansion of toll roads has accelerated the shift from farmland to non-agricultural uses. Finally, Tohir et al. (2022) discuss the broader implications of toll road development on land use changes, stressing the importance of careful planning to minimize negative impacts on agricultural communities. These studies highlight the complex relationship between toll road infrastructure and agricultural land conversion, underscoring the need for balanced land use policies.

Various studies have shown that the construction of toll roads can lead to agricultural land being turned into infrastructure, significantly affecting food security. This is because such infrastructures tend to encroach on arable land, thereby curtailing farming space and thus impacting food production. This is more worrying in countries like China, where there is already limited and highly fragmented land with increased rates of cropland abandonment due to high labor costs and fragmented tenure arrangements (L. Zheng et al., 2023). Given the current trends in rapid urbanization and industrialization, this will even worsen if there is a decrease in agricultural land, hence calling for immediate action. This is because food security challenges can be compounded by depletion of agricultural land especially through rapid urbanization and industrialization, which have already resulted in problems like soil erosion, deforestation, abandonment, and pollution as well as posing a threat to ecosystem services and the Sustainable Development Goals (SDGs) (Wang et al., 2023). The construction of toll roads can also lead to increased agricultural input costs, as seen in Indian Punjab, where disruptions in machinery services and input supplies led to higher rents and prices, although the region showed resilience in maintaining food production (Lin et al., 2022).

What we consistently found in these studies is that toll road construction has an impact on converting land for other purposes. When toll roads are built or expanded it often leads to changes in land use where agricultural land is turned into non-agricultural areas especially for commercial purposes. These toll roads have been identified as drivers of development and economic growth, as their presence tends to accelerate the transformation of regions into developed areas. However, this conversion poses challenges to farming practices and food security since it reduces the land for agriculture.

Toll roads also have socio-environmental implications, impacting ecosystems, biodiversity, and human communities. The construction and operation of toll roads lead to habitat fragmentation, which disrupts wildlife movement and increases roadkill incidents, as seen in the study of terrestrial carnivores, where roads were found to isolate populations and affect their long-term viability (Ceia-Hasse et al., 2017). The conversion of land for toll roads has significant socio-environmental implications, impacting ecosystems, biodiversity, and human communities. The construction and operation of toll roads lead to habitat fragmentation, which disrupts wildlife movement and increases roadkill incidents, as seen in the study of terrestrial carnivores where roads were found to isolate their populations and affect their long-term viability (Ceia-Hasse et al., 2017). This fragmentation also alters predator-prey interactions, as evidenced by changes in the trophic behaviour of carnivores near motorways, where an increase in small mammal biomass was observed closer to roads (Ruiz-Capillas et al., 2021). Furthermore, the

abandonment of farmland in mountainous regions, driven by the development of road networks, increases eco-environmental risks, leading to biodiversity loss and reduced ecosystem services, as observed in the Dordi river basin in Nepal (Chaudhary et al., 2019).

The main purpose of the analysis was to investigate how toll road construction affects the conversion of land and its consequences on society, economy and the environment. After examining the eighteen articles it was concluded that toll road construction leads to agricultural land conversion (Aditya & Husna, 2022; Aldillah, 2015; Alvin & Kurniawan, 2019; Fiqriyati et al., 2022; Gandharum et al., 2022; Kurnia et al., 2022; Makbul et al., 2019; Mufariq et al., 2022; Mulyani et al., 2023; Nainggolan, 2017; Nugraha et al., 2023; Pasaribu et al., 2021; Rahajeng et al., 2022; Rumadan et al., 2022; Tohir et al., 2022). There are many reasons why toll roads have a significant impact on agricultural conversion. For example, the research of Mulyani (2023) found that after toll road construction, there was urbanization that led to agricultural land conversion. Another research found that after toll road development, land around toll road became more valuable when it is used for non-agricultural purposes (Makbul et al., 2019). The research of Kunia (2022) found that proximity to toll gates is a driving factor of land conversion because lad used for non-agricultural purposes is more valuable. In addition the research of Fiqriyati et al. (2022), the construction of toll roads contributed to the conversion of agricultural land, including rice fields, to other uses such as settlements and other facilities. The article also notes that uncontrolled changes in rice fields may negatively impact economic, social, and environmental aspects. The loss of rice fields due to conversion can lead to a decline in rice production and may cause environmental damage since rice fields are catchment areas and reservoirs for excess runoff. From many articles that state that toll road construction has an impact on agricultural land conversion, toll roads appear to have an impact to cause agricultural land conversion. Fiqriyati et al. (2022) is the most comprehensive article on the impact of toll roads on agricultural land conversion. The article found that development of toll roads leads to changes agricultural use and that uncontrolled changes, especially related to rice fields, can threaten food security and have negative socio-economic impacts.

While much of the literature emphasizes the significant impact of toll road construction on agricultural land conversion, there exists a possibility of non-significant effects that warrant consideration. In specific contexts, the development of toll roads may lead to little change in land use patterns, particularly in regions where agricultural practices are deeply entrenched or land use regulations are effectively enforced. Factors such as the availability of alternative transportation routes, the resilience of local agricultural economies, and community resistance to land conversion can mitigate the pressures typically associated with toll road development. Additionally, in some cases, toll roads may enhance access to markets for agricultural products, benefiting farmers rather than displacing them. This nuanced perspective suggests that the relationship between toll roads and agricultural land use is complex and context-dependent, highlighting the need for further empirical research to explore scenarios where toll road impacts may be minimal or even positive for agricultural sustainability.

The analysis strongly emphasizes the necessity for policy recommendations based on evidence to address the impacts of converting land due to toll road development. These recommendations should prioritize supporting farmers while minimizing effects on rural communities and agricultural lands. Furthermore, raising awareness among stakeholders, advocacy groups and the public about the socio-environmental implications is crucial in promoting development amidst toll road expansion.

To sum up, the systematic review of existing literature in this study offers an insight into how constructing toll roads affects the conversion of land and its impact, on the society, the

economy, and the environment. The findings from this review can guide policymakers, stakeholders, and planners in making informed choices regarding infrastructure development, land use planning, and sustainable land management practices. This will ensure progress while addressing the concerns of farmers who are affected by projects.

Throughout this study, the evidence strongly supports the impact that toll road construction has on land conversion. Various studies have consistently shown that building and expanding toll roads lead to a shift in land use from agriculture to non-agricultural purposes. This ultimately drives development that stimulates economic growth and changes local activities and land functions.

However, it is crucial to consider the trade-offs that come with development, particularly regarding agriculture and food security. The extensive conversion of lands poses a pressing challenge to food production in the country. This issue requires attention and intervention. Therefore, this study emphasizes the need for policies that address both development and food security. Future infrastructure plans must carefully consider their impact on lands and develop strategies to mitigate any negative effects. Achieving food production while pursuing growth calls for a comprehensive approach that understands the complexities of these intertwined challenges. The successful management of these interconnected issues will determine the future in terms of urbanization and food security.

Conclusion

This literature review clearly emphasizes the impact of toll road construction on land use in terms of converting agricultural land and stimulating economic growth. The studies in the literature review consistently highlight that the building and expansion of toll roads leads to changes in land use in areas, shifting from agricultural to non-agricultural purposes, particularly commercial usage (Aditya & Husna, 2022; Aldillah, 2015; Anggraini et al., 2021; Fiqriyati et al., 2022; Gandharum et al., 2022; Indrawati, 2018; Kurnia et al., 2022; Mufariq et al., 2022; Nugraha et al., 2023; Rahajeng et al., 2022; Rumadan et al., 2022; Tohir et al., 2022). A significant finding from the literature is that toll roads play a role in driving development and stimulating economic growth. The presence of toll road entrances, for example, accelerates the transformation of land from agricultural areas into developed regions (Gandharum et al., 2022; Kurnia et al., 2022). The construction of infrastructure has led to a transformation of agricultural lands. Toll roads have played a role in this shift, resulting in thousands of hectares being converted for urban purposes. While this conversion promotes growth and urban development it also poses challenges to practices and food security. The reduction in land due to these changes could potentially impact long term food production and sustainability. Therefore, it is crucial to strike a balance between development and ensuring food security. Summing up the available research clearly emphasizes that building toll roads plays a role in promoting economic development. However, it also leads to conversion of land. This understanding emphasizes the importance of policy making that effectively addresses the challenges of stimulating growth while safeguarding agricultural land to ensure food production for future generations.

Toll roads are highly capable in stimulating economic growth with their upgraded transportation infrastructure, which plays a vital role in regional and national development. Toll roads also assist in increasing productivity through better transport infrastructure, which improves the smooth flow of goods and persons, consequently bolstering regional cooperation and integration, particularly where this has lacked implementation within regions globally (Yamamoto & Talvitie, 2011). Beyzatlar et al. (2014), a study in bidirectional Granger-causality between income and transportation of the EU-15 countries, showed that improved

infrastructure such as toll roads could raise levels of income potentially leads even further enhancement with transport infrastructure. Moreover, the sustainability scope could be advanced by combining toll road planning and renewable energy utilization, such as solar cells on sound barriers in highways, which can meet both the demand of emissions reduction to decrease indirectly charging expenses and sustainable development (Coban et al., 2023). Rural transport infrastructure, including toll roads, is a key to reaching several of the Sustainable Development Goals (SDGs), by offering land dimensioned for marketing, thus improving the overall socioeconomic situation in rural areas (Kaiser & Barstow, 2022). Secondly, substantial investment in infrastructure that comes with road construction projects boosts economic growth (Dangui & Jia, 2022). But toll roads are not without economic drawbacks. Economic gains from toll roads may be entry-specific and depend on the quality (or quantity) of infrastructure investment as well as the level of regional development. Asia, one of the fastest growing regions in terms of its transport infrastructure, has attracted considerable investment both domestically and internationally with support from toll roads that have driven economic productivity upward but widened gaps among different cities, suggesting that more equitable distributional effects could be achieved through improved transportation investments (Yamamoto & Talvitie, 2011). In conclusion, while toll roads may contribute to regional economic growth through enhanced transport infrastructure and increased inter-regional connectivity, there are also some aspects that need to be carefully addressed, such as the financial burden, equity in investment, which is highly relevant for maximizing their spillover benefits.

This study systematically synthesized existing literature on the relationship between toll road construction and agricultural land conversion while investigating the socio-environmental implications of such conversions. The methodology employed was a SLR that followed the PRISMA guidelines, allowing for a comprehensive assessment of studies published between 2013 and 2023, focusing on peer-reviewed articles and relevant case studies. The main conclusions drawn from the review indicate that toll road construction significantly contributes to converting agricultural land into non-agricultural uses, such as commercial and residential developments, which poses challenges to food security and the livelihoods of farming communities. The findings underscore the necessity for evidence-based policy recommendations that balance infrastructure development with agricultural land preservation, advocating for strategies that support affected farmers and promote sustainable land management practices.

The recommendations from this study are that policymakers should develop comprehensive land use policies that elevate the preservation of agricultural land over toll road construction. Involving local communities and farmers is vital to understanding what they need and their concerns. Comprehensive environmental and socioeconomic assessments can help make better decisions and programs supporting relevant strategies for the affected farmers in their adaptation. Additional studies to determine the long-term effects on agriculture and food security are included as urgent, along with efforts to provide information to landowners about sustainable farming. We will use these strategies to ensure that development is balanced and protects agricultural land.

The limitations of this research primarily stem from its reliance on a systematic literature review, which, while comprehensive, may only capture some relevant studies due to potential publication bias and the exclusion of grey literature or unpublished works. Additionally, the focus on studies published between 2013 and 2023 may overlook earlier research that could provide valuable insights into the long-term impacts of toll road construction on agricultural land conversion. While global, the review's geographical scope may also limit the applicability of findings to specific contexts, as the socio-economic and environmental conditions

surrounding toll road development can vary significantly across different regions. Furthermore, the methodologies employed in the reviewed studies may differ, leading to challenges in comparing results and drawing generalized conclusions. These limitations highlight the need for further empirical research that addresses these gaps and explores the nuanced effects of toll road development on agricultural land in diverse settings.

Future research may address the efficacy of specific policy interventions or land use strategies in limiting negative impacts on agricultural communities. Further, it is necessary to study novel approaches to the realization of sustainable land management and use them as an element of assessment to assess the socio-economic results for farmers hurt by infrastructure construction. Broadening research syntheses in these areas can assist with grappling more correctly with the dilemmas of matching infrastructure growth and agricultural sustainability.

Most of this article has a strong foundation from the use the SLR method to analyze the effect of agricultural land conversion from toll road construction. Similar objectives, methodology, and findings were thoroughly depicted in a recent article aiming to synthesize profound socio-environmental consequences (Ceia-Hasse et al., 2017). By combining the evidence from multiple studies, conclusions can be made with more confidence, while structuring information in a specific way makes it possible for all issues of importance to be dealt with appropriately. At the same time, strengths and weaknesses can be carefully assessed. Such clarity is essential to alert policymakers and stakeholders of the necessity for a judiciously balanced construction infrastructure that maintains agricultural sustainability and food security.

Acknowledgements

We thank the Institut Teknologi Bandung for funding this research through the Hibah Riset ITB Program (ITB Research Grant Program) under grant number: 7215/IT1.B07.1/TA.00/2022.

References

Aditya, R. B., & Husna, Z. (2022). Identification of Sprawl Development Typologies around Toll Road Gates in Java, Indonesia. *Tataloka*, *24*(1), 1–14. https://doi.org/10.14710/tataloka.24.1.1-14

Aldillah, R. (2015). Consistency Regulations Implementing Rules and Regulation of Food Derived Specifically Sustainable Agricultural Land in West Java Province. *Academia.Edu*, *8*(April), 894–904. https://www.academia.edu/download/80328202/ART20197793.pdf

Alvin, A., & Kurniawan, B. (2019). *Electronic Commerce Use of Agriculture for Creating a New Business Opportunity*. *662*. https://doi.org/10.1088/1757-899X/662/3/032004

Anggraini, D. P., Sutrisno, J., & Barokah, U. (2021). The impact analysis of rice field conversion on food security in Sragen Regency. *E3S Web of Conferences*, *316*. https://doi.org/10.1051/e3sconf/202131602035

Appiah, D. O., Asante, F., & Nketiah, B. (2019). Perspectives on Agricultural Land Use Conversion and Food Security in Rural Ghana. *Sci*. https://www.mdpi.com/2413-4155/1/1/14

Asadi, A., Barati, A. A., Kalantari, K., & Odeh, I. (2016). Study of relationship between roads network development and agricultural land conversion in Iran NorthWest. *International Journal of …*. https://ijer.ut.ac.ir/m/article_56887_0.html

Azadi, H., Taheri, F., Burkart, S., Mahmoudi, H., & ... (2020). Impact of agricultural land conversion on climate change. *Environment …*. https://link.springer.com/content/pdf/10.1007/s10668-020-00712-2.pdf

Beyzatlar, M. A., Karacal, M., & Yetkiner, H. (2014). Granger-causality between transportation and GDP: A panel data approach. *Transportation Research Part A: Policy and Practice*, *63*, 43–55. https://doi.org/https://doi.org/10.1016/j.tra.2014.03.001

Ceia-Hasse, A., Borda-de-Água, L., Grilo, C., & Pereira, H. M. (2017). Global exposure of carnivores to roads. *Global Ecology and Biogeography*, *26*(5), 592–600. https://doi.org/10.1111/geb.12564

Chaudhary, S., Wang, Y., Dixit, A. M., Khanal, N. R., Xu, P., Yan, K., Liu, Q., Lu, Y., & Li, M. (2019). Eco-Environmental Risk Evaluation for Land Use Planning in Areas of Potential Farmland Abandonment in the High Mountains of Nepal Himalayas. *Sustainability*, *11*(24). https://doi.org/10.3390/su11246931

Coban, H. H., Lewicki, W., Miśkiewicz, R., & Drożdż, W. (2023). The Economic Dimension of Using the Integration of Highway Sound Screens with Solar Panels in the Process of Generating Green Energy. *Energies*, *16*(1). https://doi.org/10.3390/en16010178

Dangui, K., & Jia, S. (2022). Water Infrastructure Performance in Sub-Saharan Africa: An Investigation of the Drivers and Impact on Economic Growth. *Water*, *14*(21). https://doi.org/10.3390/w14213522

Dwitasari, R., Perdana, Y. R., Gusleni, Y., & Meyrawati, Z. (2020). The Impact of the Trans-Sumatran Highway Development on Logistic Cost Efficiency. *IPTEK Journal of Proceedings Series*, *0*(5), 13. https://doi.org/10.12962/j23546026.y2020i5.7924

Eaton, B. C., & Lipsey, R. G. (2010). Location Theory: The Contributions of von Thünen and Lösch. In *Famous Figures and Diagrams in Economics*. Edward Elgar Publishing. https://doi.org/10.4337/9781849806466.00032

Fiqriyati, A. R., Panuju, D. R., & Mulya, S. P. (2022). The dynamics of rice-field conversion in the surroundings Cipali toll-roads of Subang Regency. *IOP Conference Series: Earth and Environmental Science*, *950*(1). https://doi.org/10.1088/1755-1315/950/1/012094

Gandharum, L., Hartono, D. M., Karsidi, A., & Ahmad, M. (2022). Monitoring Urban Expansion and Loss of Agriculture on the North Coast of West Java Province, Indonesia, Using Google Earth Engine and Intensity Analysis. *Scientific World Journal*, *2022*(Sdg 2). https://doi.org/10.1155/2022/3123788

Garcia-López, M.-À., Sole-Olle, A., & Viladecans-Marsal, E. (2021). Do Land Use Policies Follow Road Construction? *SSRN Electronic Journal*, *4672*. https://doi.org/10.2139/ssrn.2411432

Indrawati, E. (2018). Urban farming model in South Jakarta. *IOP Conference Series: Earth and Environmental Science*, *106*(1). https://doi.org/10.1088/1755-1315/106/1/012052

Kaiser, N., & Barstow, C. K. (2022). Rural Transportation Infrastructure in Low- and Middle-Income Countries: A Review of Impacts, Implications, and Interventions. *Sustainability*, *14*(4). https://doi.org/10.3390/su14042149

Kurnia, A. A., Rustiadi, E., Fauzi, A., Pravitasari, A. E., Saizen, I., & Ženka, J. (2022). Understanding Industrial Land Development on Rural-Urban Land Transformation of Jakarta Megacity's Outer Suburb. *Land*, *11*(5). https://doi.org/10.3390/land11050670

Lin, X., Qi, L., Pan, H., & Sharp, B. (2022). COVID-19 Pandemic, Technological Progress and Food Security Based on a Dynamic CGE Model. *Sustainability*, *14*(3). https://doi.org/10.3390/su14031842

Makbul, Y., Faoziyah, U., Ratnaningtyas, S., & Kombaitan, B. (2019). Infrastructure development and food security in Indonesia: The impact of the trans-Java toll road on rice paddy farmers' desire to sell farmland. *Journal of Regional and City Planning*, *30*(2), 140–156. https://doi.org/10.5614/jpwk.2019.30.2.4

Makbul, Y., Ratnaningtyas, S., Pradono, Lohjiwa, V., Farag, A., & Darsono. (2017). Factors that stimulate farmers to convert their farmland. *International Journal of Applied Business and Economic Research*, *15*(19), 457–462.

Meyer, J., Becker, H., Bösch, P. M., & Axhausen, K. W. (2017). Autonomous vehicles: The next jump in accessibilities? *Research in Transportation Economics*, *62*, 80–91. https://doi.org/10.1016/j.retrec.2017.03.005

Miljković, J. Ž., D\vzelebd\vzić, O., & \vColić, N. (2022). Land-Use Change Dynamics of Agricultural Land within Belgrade–Novi Sad Highway Corridor: A Spatial Planning Perspective. *Land*. https://api.semanticscholar.org/CorpusID:252626900

Mufariq, A., Ningrum, S., Irawati, I., & Widianingsih, I. (2022). Innovation for Sustainable Productivity in Agricultural Land Conversion. *KnE Social Sciences*, *2022*(1), 708–719. https://doi.org/10.18502/kss.v7i5.10588

Mulya, S. P., Munif, M., Pravitasari, A. E., Rustiadi, E., & Widiatmaka. (2022). Land use and spatial planning in the border area of Bogor Regency and Bogor City, West Java Province, Indonesia. *IOP Conference Series: Earth and Environmental Science*, *950*(1). https://doi.org/10.1088/1755-1315/950/1/012099

Mulyani, A., Mulyanto, B., Barus, B., Panuju, D. R., & Husnain. (2023). Potential Land Reserves for Agriculture in Indonesia: Suitability and Legal Aspect Supporting Food Sufficiency. *Land*, *12*(5). https://doi.org/10.3390/land12050970

Muvawala, J., Sebukeera, H., & Ssebulime, K. (2021). Socio-economic impacts of transport infrastructure investment in Uganda: Insight from frontloading expenditure on Uganda's urban roads and highways. *Research in Transportation Economics*, *88*, 100971. https://doi.org/https://doi.org/10.1016/j.retrec.2020.100971

Nainggolan, R. R. (2017). Land Use Conversion: Evaluation and Strategic Actions. *Jurnal Ilmu Pemerintahan Widya Praja*, *43*(1), 21–32. https://doi.org/10.33701/jipwp.v43i1.58

Ng, C. P., Law, T. H., Jakarni, F. M., & Kulanthayan, S. (2019). Road infrastructure development and economic growth. *IOP Conference Series: Materials Science and Engineering*, *512*(1). https://doi.org/10.1088/1757-899X/512/1/012045

Nugraha, A. T., Prayitno, G., Azizi, F. A., Sari, N., Hidayana, I. I., Auliah, A., & Siankwilimba, E. (2023). Structural Equation Model (SEM) of Social Capital with Landowner Intention. *Economies*, *11*(4), 1–16. https://doi.org/10.3390/economies11040127

Partoyo, & Shrestha, R. P. (2017). *Chapter 5 - Modeling Effect of Conservation and Livelihood Policies on Community Land Use and Management in Yogyakarta* (G. P. Shivakoti, U. Pradhan, & B. T.-R. D. & D. of N. R. M. in A. Helmi Volume 1 (eds.); pp. 67–90). Elsevier. https://doi.org/https://doi.org/10.1016/B978-0-12-805454-3.00005-0

Pasaribu, D., Murwani, A., & Setiawan, I. (2021). Foreign Direct Investment in Indonesia ' s Agriculture. *Policy Paper*, *35*. https://www.econstor.eu/bitstream/10419/249415/1/CIPS-PP35.pdf

Paul, B. K., & Rashid, H. (2017). *Chapter Six - Land Use Change and Coastal Management* (B. K. Paul & H. B. T.-C. H. in C. B. Rashid (eds.); pp. 183–207). Butterworth-Heinemann. https://doi.org/https://doi.org/10.1016/B978-0-12-805276-1.00006-5

Pinto, J. V. (1997). *English economists: Descriptive accounts of location theory: Working paper series--97-03*. https://api.semanticscholar.org/CorpusID:149380867

Prayitno, G., Dinanti, D., Hidayana, I. I., & Nugraha, A. T. (2021). Place attachment and agricultural land conversion for sustainable agriculture in Indonesia. *Heliyon*, *7*(7), 1–12. https://doi.org/10.1016/j.heliyon.2021.e07546

Prayitno, G., Dinanti, D., Sari, N., Hidayana, I. I., & Azizi, F. A. A. (2021). The impact of incentives on the decision to transfer agricultural land functions to non-agricultural uses. *IOP Conference Series: Earth and Environmental Science*, *916*(1). https://doi.org/10.1088/1755-1315/916/1/012029

Putri, K., & Marzuki, P. (2020). Model of land acquisition productivity performance for toll road projects in Indonesia. *Civil and Environmental Science*, *003*(02), 84–94. https://doi.org/10.21776/ub.civense.2020.00302.3

Rahajeng, A., Jaya, W. K., Pangaribowo, E., & Darwin, M. (2022). Transformation of yogyakarta regional development: a shifting perception of economic power among the regions. *GeoJournal*, *88*(2), 1671–1686. https://doi.org/10.1007/s10708-022-10708-2

Ruiz-Capillas, P., Mata, C., Fernández, B., Fernandes, C., & Malo, J. E. (2021). Do Roads Alter the Trophic Behavior of the Mesocarnivore Community Living Close to Them? *Diversity*, *13*(4). https://doi.org/10.3390/d13040173

Rumadan, I., Teguh, P. P., Husin, U., Salamah, U., Masidin, M., Hamrin, H., & Mayasari, I. (2022). Legal Protection of Farmers' Rights Regarding the Conversion of Agricultural Land Functions for Non-Agricultural Investment Purposes in Indonesia. *International Journal of Social Science And Human Research*, *05*(12), 5391–5397. https://doi.org/10.47191/ijsshr/v5-i12-21

Sheng, Y., Jackson, T., & Lawson, K. (2018). Evaluating the benefits from transport infrastructure in agriculture: a hedonic analysis of farmland prices. *Australian Journal of Agricultural and Resource Economics*, *62*(2), 237–255. https://doi.org/10.1111/1467-8489.12243

Sihombing, L. B., Soepandji, B. S., Abidin, I. S., & Latief, Y. (2012). The Impact of Land Acquisition Delay in Toll Road Development. *SSRN Electronic Journal*, 1–10. https://doi.org/10.2139/ssrn.1653775

Takahashi, T. (2014). Location competition in an Alonso–Mills–Muth city. *Regional Science and Urban Economics*, *48*, 82–93. https://api.semanticscholar.org/CorpusID:155083837

Tione, S. E., & Holden, S. T. (2020). Urban proximity, demand for land and land shadow prices in Malawi. *Land Use Policy*, *94*(January), 104509. https://doi.org/10.1016/j.landusepol.2020.104509

Tohir, A., Sanusi, S., & Nuridin, N. (2022). *The Problem of The Conversion of Agricultural Land to Housing in The District of Tegal*. https://doi.org/10.4108/eai.28-5-2022.2320547

Wang, Y., Lopez-Carr, D., Gong, J., & Gao, J. (2023). Editorial: Sustainable cultivated land use and management. *Frontiers in Environmental Science*, *11*. https://doi.org/10.3389/fenvs.2023.1162769

Yamamoto, T., & Talvitie, A. (2011). Transport infrastructure and services: an Asia and developing world. *Transportation*, *38*(5), 715–717. https://doi.org/10.1007/s11116-011-9371-8

Yu, M., Chen, Z., Long, Y., & Mansury, Y. (2022). Urbanization, land conversion, and arable land in Chinese cities: The ripple effects of high-speed rail. *Applied Geography*. https://api.semanticscholar.org/CorpusID:250546335

Zhang, Z., Ghazali, S., Miceikienė, A., Zejak, D., Choobchian, S., Pietrzykowski, M., & Azadi, H. (2023). Socio-economic impacts of agricultural land conversion: A meta-analysis. *Land Use Policy*. https://api.semanticscholar.org/CorpusID:260593676

Zheng, F., Huang, J., Feng, Z., & Xiao, C. (2021). Impact of the Kunming–Bangkok Highway on Land Use Changes along the Route between Laos and Thailand. *Land*. https://api.semanticscholar.org/CorpusID:240566097

Zheng, L., Su, L., & Jin, S. (2023). Reducing land fragmentation to curb cropland abandonment: Evidence from rural China. *Canadian Journal of Agricultural Economics/Revue Canadienne d'agroeconomie*, *71*(3–4), 355–373. https://doi.org/https://doi.org/10.1111/cjag.12335

Zollinger, B., & Krannich, R. S. (2002). Factors influencing farmers' expectations to sell agricultural land for non-agricultural uses. *Rural Sociology*, *67*(3), 442–463. https://doi.org/10.1111/j.1549-0831.2002.tb00112.x