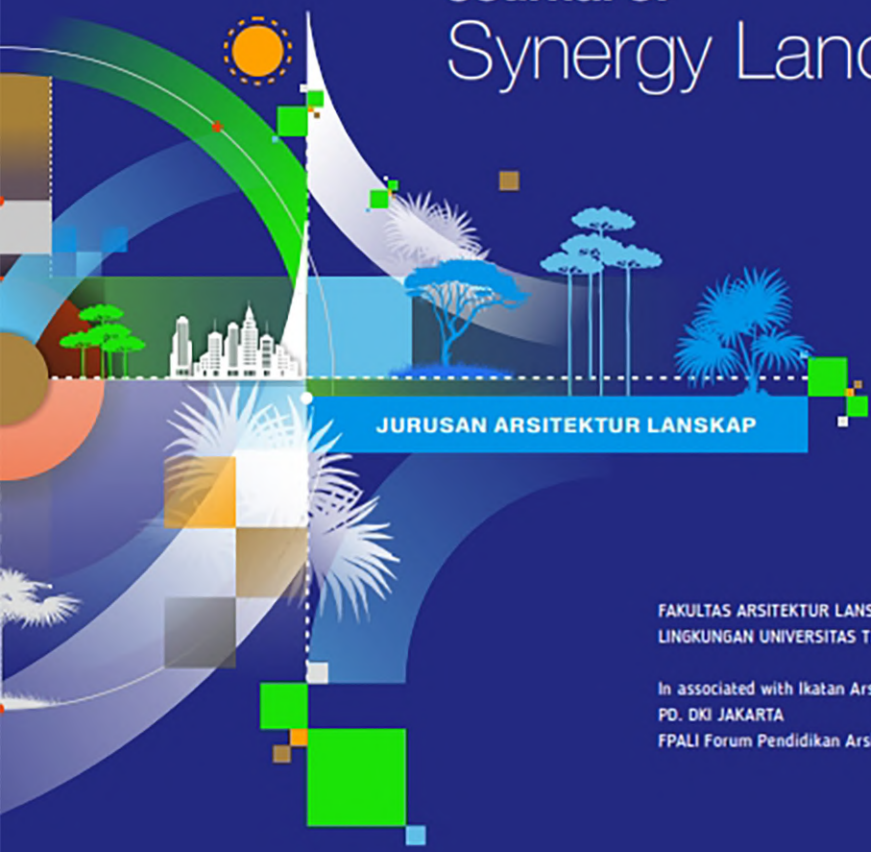
E-ISSN 2807-1077
Volume 3, Nomor 2, February 2024

Journal of Synergy Landscape



FAKULTAS ARSITEKTUR LANSKAP DAN TEKNOLOGI
LINGKUNGAN UNIVERSITAS TRISAKTI, JAKARTA, INDONESIA

In associated with Ikatan Arsitek Lanskap Indonesia (IALI)
PD. DKI JAKARTA
FPALI Forum Pendidikan Arsitektur Lanskap Indonesia

Journal of Synergy Landscape
ISSN 2807-1077 (ONLINE).

JOURNAL OF SYNERGY LANDSCAPE VOL 3. NO. 2 FEBRUARY 2024

Journal of Synergy Landscape
ISSN 2807-1077 (ONLINE).

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ISSN 2807-1077 (ONLINE).
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ISSN 2807-1077 (ONLINE).

THE IMPACT OF THE OPERATION OF THE DURI SELATAN TOLL GATE ON LAND COVER IN PINGGIR SUB-DISTRICT, BENGKALIS REGENCY

Aldyth Dzaki Nugraha[1], Endrawati Fatimah[2], Wisely Yahya[3]
[1, 2,3]Department of Urban and Regional Planning, Faculty of Landscape Architecture and Environmental Technology, Universitas Trisakti, Jakarta, Indonesia, 11440

Corresponding Author: wisely.yahya@trisakti.ac.id

Received : 10 - 10 -2023
Revised : 15 - 12- 2023
Accepted : 24 - 01 – 2024

DOI: https://doi.org/10.25105/tjsl.v1i2.19561

ABSTRACT

The presence of transportation infrastructure has a positive impact on increasing the mobility of people and goods. Another impact that usually accompanies it is the acceleration of changes in land use or land cover. This research is motivated by the construction of the Pekanbaru-Dumai Toll Road (Permai) in Riau Province. The study area is focused around the South Duri Toll Gate, precisely in the Pinggir District, Bengkalis Regency. The selection of the study area is based on the consideration that this toll gate location is only 3 km away from the Balairaja Wildlife Sanctuary and the Sebanga Elephant Training Center Wildlife Sanctuary, which are categorized as areas that should be protected. The aim of this research is to identify the differences in land cover changes in the 5 years before (2012-2017) and 5 years after (2017-2022) the operation of the South Duri Toll Gate. The analysis methods used are spatial analysis and descriptive statistical methods. The results show that both before (2012-2017) and after (2017-2022) the operation of the South Duri Toll Gate, there has been a conversion of forest land at a rate of around 400 ha per year. The majority of forest land cover has changed to plantation and agricultural land. In other words, after 5 years of operation, the presence of the South Duri Toll Gate has not or has not yet had a significant impact on land cover changes in its vicinity.

Keywords: Development, Impact, Land use, Toll Gate.

ISSN 2807-1077 (ONLINE)
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INTRODUCTION

Based on Government Regulation of the Republic of Indonesia Number 15 of 2005, toll road construction is very necessary, especially in areas that have a high level of development. The existence of adequate transportation infrastructure, such as toll roads, will accelerate economic and social development because it can facilitate the movement of people, goods, services, and ideas from one place to another (Kerr, 2012; Susanto & Marsoyo, 2019). The interaction between transportation and land use is widely known as the transportation and land use cycle, which can trigger land use change. According to Prasetyo and Djunaedi (2019), freeways (toll roads) will cause the growth of new areas and kill old areas. This is related to the decline and increase in economic activity that occurs due to changes in land use in the surrounding area. Several previous studies have shown the impact of toll road construction and exit toll gates on changes in surrounding land use, including changes in land use that occur due to the construction and operation of the Jatiasih Toll Road (Haridza et al., 2022), the Semarang-Solo Toll Road (Aji et al., 2019), the Bogor Outer Ring Road (BORR) (Susanto & Maryoso, 2019), and the Trans Java Surabaya-Mojokerto Toll Road (Yunanto & Susetyo, 2019).

The Pekanbaru-Dumai (Permai) Toll Road, which was built in July 2017 and inaugurated to operate on September 25, 2020, is part of the 131.48 km Trans Sumatra Toll Road (bpjt.pu.go.id, 2020). This road connects the main economic corridors in Riau Province, such as Pekanbaru-Pepatahan-Kandis-Duri-Dumai. The Pekanbaru-Dumai toll road covers the Pekanbaru City area, Bengkalis Regency, Siak Regency, and Dumai City. On the Pekanbaru-Dumai toll road, there are 7 toll gate locations, consisting of Pekanbaru toll gate, Minas toll gate, South Kandis toll gate, North toll gate, South Duri toll gate, North Duri toll gate, and Dumai toll gate. In terms of land use around the toll gate, it is known that around the Duri Selatan toll gate there are more protected areas of land than other toll gates on the toll road.

According to Bengkalis Regency Regional Regulation Number 1 of 2022 concerning the Regional Spatial Plan of Bengkalis Regency for 2022-2042, there are three wildlife reserves, namely Balai Raja Wildlife Reserve located in Pinggir District, Sibanga Wildlife Reserve, and Giam Siak Wildlife Reserve. On the other hand, based on the regulations of Law No. 26 of 2007 concerning spatial planning, it is stated that no land use change is allowed in protected areas in order to protect the preservation of the environment, which includes natural and artificial resources, cultural and historical heritage, and to reduce the impact of natural disasters (Law No. 26 of 2007). Thus, the research question raised is, "What is the impact of the construction of the Duri Selatan Toll Gate on land use change in Pinggir District, Bengkalis Regency?".

ISSN 2807-1077 (ONLINE)
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RESEARCH METHODS

Time and Location

The research is located in the Pinggir sub-district, Bengkalis Regency. The data was processed in 2023. This research uses quantitative and spatial approaches. The description of the location of Pinggir Subdistrict, which is the South Duri exit toll, which is directly adjacent to the Balairaja Wildlife Reserve and the Sebanga Elephant Training Center, can be seen in the following figure.

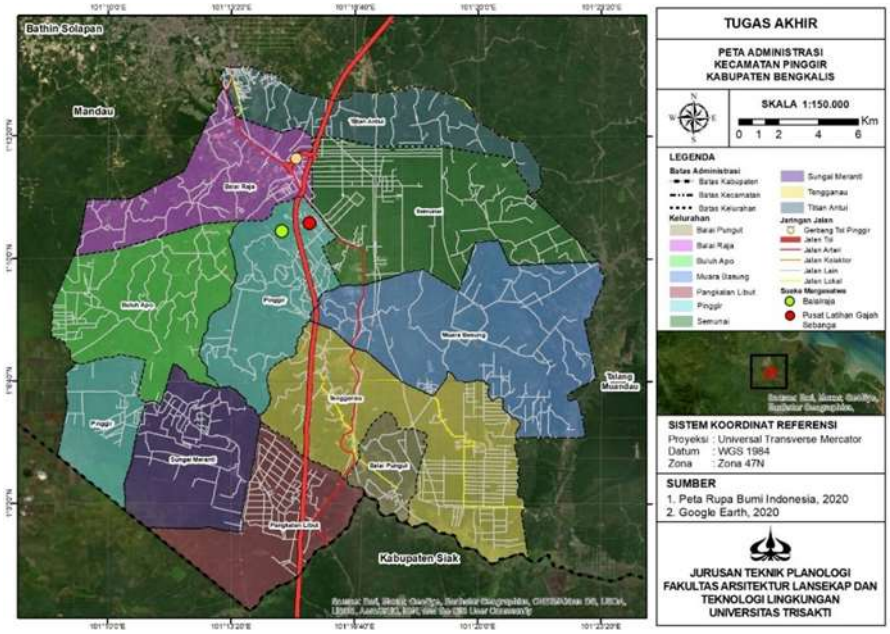

Figure 1. Administrative Map of the Research Area
Source: Indonesia Earth Map, 2020; Google Earth, 2020

Pinggir Sub-district has 10 villages, with the number and population density shown in the following table

Tabel 1 Administration and Population of Pinggir Sub-district

Village/Sub-district	Area (Km^2)	Total Population	Population Density
Pinggir	48.85	8.650	177
Semunai	80.19	8.612	107
Tengganau	92.86	7.097	76
Balai Pungut	9.42	6.586	699
Muara Basung	98.57	1.918	19
Titian Antui	42.06	17.100	407
Balai Raja	49.91	6.563	131
Sungai Meranti	75.30	5.114	68
Pangkalan libut	241.77	3.244	13
Buluh Apo	75.52	2.765	38

Source: Kecamatan Pinggir dalam Angka 2021

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Data Collection

The research used secondary data obtained from the Bengkalis Regency Public Works and Spatial Planning Office and satellite imagery. The relationship between research variables, data needs and data sources can be seen in the following table.

Table 2 Research Variables and Data Needs

No	Variable	Data Needs	Data Use	Data Source
1	Exit Toll Location	Location Pekanbaru-Dumai exit toll location	Knowing the study area's distance to the exit toll	Satellite Imagery
2	Type of Land Use	Type of Land Use in Pinggir Subdistrict in 2012, 2017 and 2022	Knowing the type of land use in Pinggir Subdistrict	Office of Public Works and Spatial Planning of Bengkalis Regency
3	Land use area.	Land Use Area of Pinggir Subdistrict in 2012, 2017 and 2022	Knowing the area of land use before (2012 and 2017) and after the construction (2022) of the Duri Selatan toll gate and changes in land use that occur.	Office of Public Works and Spatial Planning of Bengkalis Regency

Source: Authors,2022

The Data Analysis Method

This research uses descriptive statistics and spatial analysis methods

1) **Spatial Analysis (Mapping and Overlay)**

Spatial analysis is a technique for analyzing data in GIS (geographic information system) processing, the results of which are highly dependent on the survey location. Spatial analysis can also be interpreted as a technique for studying spatial information and perspectives. In this research, spatial analysis was carried out using Arcgis software. Spatial analysis was conducted to obtain an overview and mapping of land use based on the type of land use and its area in 2012, 2017, and 2022.

2) Descriptive Statistical Analysis

According to Healey (2012), simple descriptive statistics can be used when researchers need to describe and summarize univariate variables in the form of percentages, percentage changes, averages, and graphs. Descriptive statistical analysis in this study intends to identify the area per type of land use before and after the operation of the Duri Selatan Toll Gate. Each variable related to land use is treated quantitatively so that the results of its calculation or measurement

ISSN 2807-1077 (ONLINE)
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can be described. In this study, the percentage change (Healey, 2012) will be calculated in the context of the rate of land use change. Thus, land use change can be written with the following formula:

$$\underline{V = Lt - Lt{-}1} \times 100\%$$
$$Lt{-}1$$

Description:

V : Land shrinkage area (%)

Lt: Land area in year t (Ha)

Lt-1 : Land area of the year before t (Ha)

Table 3 Research Analysis Methods

Target	Analysis Technique	Result
Identification of the type and extent of land use before the operation of the Duri Selatan Toll Gate in Bengkalis Regency.	• Spatial analysis (mapping and overlay) • Descriptive statistical analysis	• Land use type before the operation of the South Duri toll gate. • - Land use area before the operation of the Duri Selatan toll gate.
Identification of the type and extent of land use after the operation of the Duri Selatan Toll Gate in Bengkalis Regency	• Spatial analysis (mapping and overlay) • Descriptive statistical analysis	• Land use type before the operation of the South Duri toll gate. • Land use area before the operation of the Duri Selatan toll gate.

Source: Authors,2022

RESULTS AND DISCUSSION

The results of this study are Land Use Change Before the Operation of the Duri Selatan Toll Gate (Years 2012–2017) and After the Operation of the Duri Selatan Toll Gate (Years 2017–2022). There are two wildlife sanctuaries, namely the Balai Raja Wildlife Sanctuary located in Pinggir District and the Sebanga Elephant Training Center Wildlife Sanctuary. Which will cause the growth of new areas and kill old areas. This is related to the decline and increase in economic activity that occurs due to land use changes in the surrounding area.

1. Identified Land Use Changes Before the Construction of the Duri Selatan Toll Gate (Years 2012 - 2017)

The following are in the 2012-2017 period or before the construction of the Duri Selatan Toll Gate, the changes in land use are as follows:

ISSN 2807-1077 (ONLINE)
https://doi.org/10.25105/tjsl.v1i2.19561

Table 4 Research Analysis Methods

Target	Analysis Technique	Result
Identification of the type and extent of land use before the operation of the Duri Selatan Toll Gate in Bengkalis Regency.	• Spatial analysis (mapping and overlay) • Descriptive statistical analysis	• Land use type before the operation of the South Duri toll gate. • - Land use area before the operation of the Duri Selatan toll gate.
Identification of the type and extent of land use after the operation of the Duri Selatan Toll Gate in Bengkalis Regency	• Spatial analysis (mapping and overlay) • Descriptive statistical analysis	• Land use type before the operation of the South Duri toll gate. • Land use area before the operation of the Duri Selatan toll gate.

Source: Authors,2022

The table above shows that the first largest land use in 2012 and 2017 was plantations, and there was an increase in land use change of 1,739.58 ha. The next largest land use was forest, with an area of 5,351.56 hectares in 2012 and decreasing in 2017 to an area of 3,349.15 hectares. This shows a decrease in area of 2,002.41 ha from 2012 to 2017. The area of built-up land and vacant land was identified as having increased from 2012 to 2017.

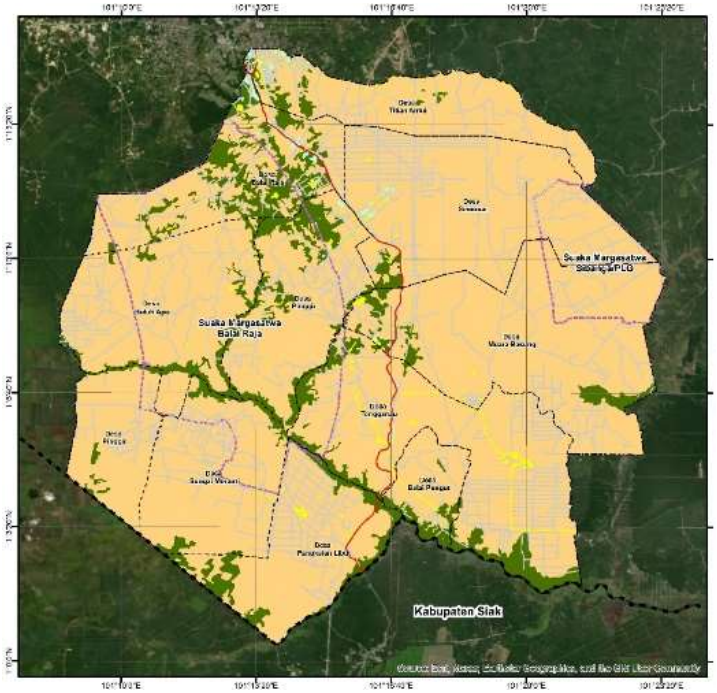

Figure 2 Forest Cover in Pinggir Sub-district in 2012
Source: Indonesia Earth Map, 2020; Google Earth, 2020

ISSN 2807-1077 (ONLINE)
https://doi.org/10.25105/tjsl.v1i2.19561

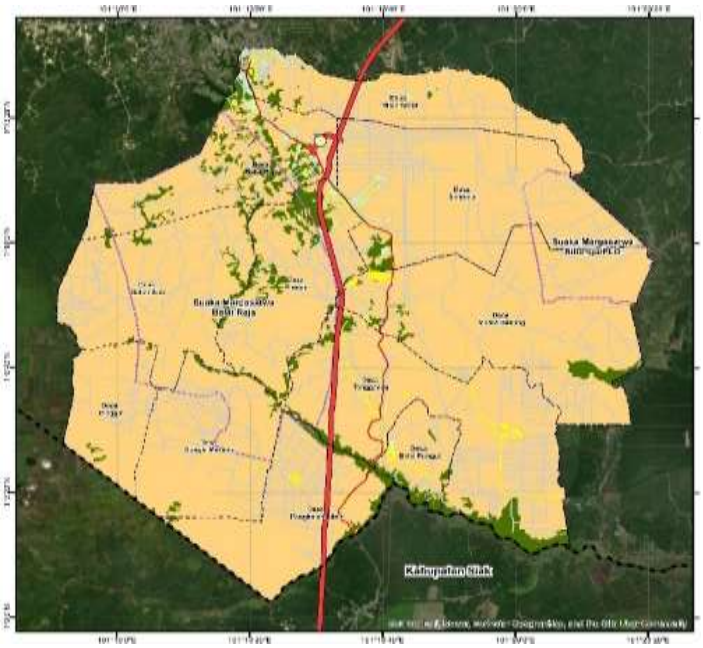

Figure 3 Forest Cover in Pinggir Sub-district in 2017
Source: Indonesia Landform Map, 2020; Google Earth, 2020

2) Identified Land Use Change After the Operation of the Duri Selatan Toll Gate (Year 2017 - 2022)

The Duri Selatan toll gate is located in the Pinggir sub-district, consisting of 10 villages namely Balai Pungut, Balai Raja, Buluh Apo, Muara Basung, Pangkalan Libut, Pinggir, Semunai, Sungai Meranti, Tengganau, Titian Antui which are included in this research area. Land use in this research area consists of 4 types such as Forest, Vacant Land, Plantation and Agriculture and Built-up Land.

Table 5 Land Use 2017-2022

Land Use	Area of 2017	Area of 2022	Land Use Change 2017-2022	Land Use Change per year
Forest	3.349,15 Ha	1.403,01 Ha	-1.946,14 Ha	-389,23 Ha
Vacant Land	374,25 Ha	340,68 Ha	-33,57 Ha	-6,71 Ha
Plantation and Agriculture	47.435,01 Ha	49.251,43 Ha	1.816,42 Ha	363,28 Ha
Built-up Land	898,66 Ha	1.061,96 Ha	163,3 Ha	32,66 Ha
Total	52.057,07 Ha	52.057,08 Ha	0,01 Ha	0

Source: Authors, 2022

Table 5 shows that forest land use after the operation of the Duri Selatan toll gate has decreased from 3,349.15 ha in 2017 to 1,403.01 ha in 2022. This shows a significant land use change of 1,946.16 ha. A decrease in land-use area also occurred on vacant land. This is inversely proportional to the area of plantations, agricultural land use, and built-up land, which has

ISSN 2807-1077 (ONLINE)
https://doi.org/10.25105/tjsl.v1i2.19561

increased significantly. This indicates that the operation of the Duri Selatan toll gate has a significant impact on changes in the area of built-up areas. The following is a land use map of Pinggir Sub-district in 2022.

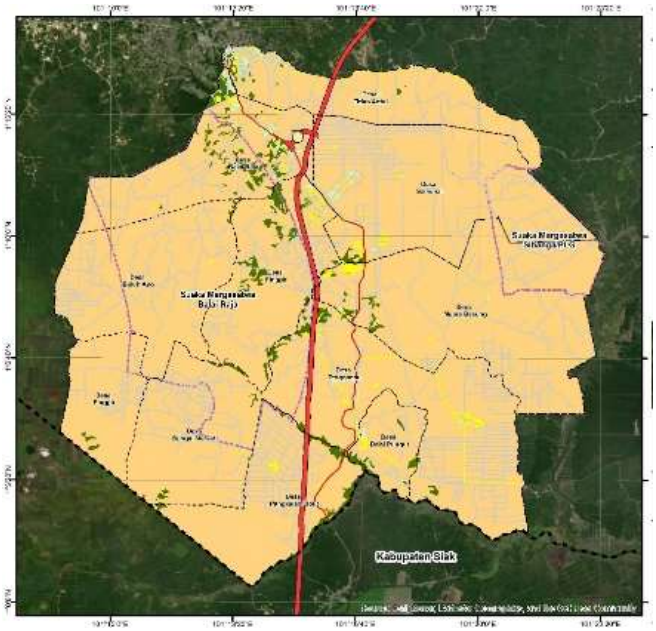

Figure 4 Forest Cover in Pinggir Sub-district in 2022
Source: Indonesia Earth Map, 2020; Google Earth, 2020

Table 6 shows that from 2012 to 2017, the forest area decreased, namely 2,002.41 ha, with a percentage of 37.42%. From 2017 to 2022, it decreased again to 1,946.14 ha, with a percentage of 58.11%. Data from 2012 to 2022 shows that the change in the area of forest land use from 2012 to 2022 has decreased very rapidly, namely 3,948.55 and with a percentage of 73.78%. In addition, the use of vacant land from 2012 to 2017 increased by 53.03 ha with a percentage of 16.51%, while from 2017 to 2022 it decreased by 33.57 ha with a percentage of 8.97%. Furthermore, the land use of plantations and agriculture from 2012 to 2017 was identified to have increased by 1,739.58 ha with a percentage of 3.81%, while from 2017 to 2022 it increased by 1,816.42 ha with a percentage of 3.83. It can be seen that from 2012 to 2022, there was an increase of 3,556.00 ha with a percentage of 7.78%. On the other hand, built-up land increased by 209.80 ha with a percentage of 30.46%, and from 2017 to 2022, it also increased by 163.30 ha with a percentage of 18.17%.

The results of identifying the land cover of Pinggir Subdistrict, Bengkalis Regency, in 2012, 2017, and 2022 show that this area since 2012 (before the operation of the Toll Gate) has been dominated by land cover in the form of plantations and agriculture. In fact, based on data from the Bengkalis Regency Central Statistics Agency in 2017, Pinggir District has the largest area of

ISSN 2807-1077 (ONLINE)
https://doi.org/10.25105/tjsl.v1i2.19561

palm oil plantations in Bengkalis Regency, managed by private companies. The existence of the Pekanbaru-Dumai Toll Road does not or has not shown any impact on land use change because there is no difference between land cover change before and after the operation of the Toll Gate in this sub-district.

The size of the plantation and the provision of a toll gate in this sub-district that connects both to the provincial capital (Pekanbaru) and to Dumai (towards the port) are more aimed at accelerating the flow of goods, especially palm oil production, both to processing and marketing areas. According to Pradono and Pradithasari (2011), functionally, toll roads can improve the effectiveness and efficiency of distribution services for economic activity products from processing centers to marketing centers. However, with the presence of two (two) wildlife sanctuaries that must be protected and located adjacent to this toll gate, in the future, it is necessary to be aware of the long-term multiplier effect of increasing the flow of goods and resource processing activities on the survival of protected animals.

ISSN 2807-1077 (ONLINE)
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Table 5

No	Land Use Type	AREA			Change 2012- 2017			Change 2017-2022			Change 2012-2022		
		2012	2017	2022	Area of Land Use Change (Ha)	Percentage Change in Area of Land Use (%)	Area of land use change per year	Area of Land Use Change (Ha)	Percentage Change in Area of Land Use (%)	Area of land use change per year	Area of Land Use Change (Ha)	Percentage Change in Area of Land Use (%)	Area of land use change per year
1	Forest	5.351,56	3.349,15	1.403,01	-2.002,41	-37,42	-400,48	-1.946,14	-58,11	-389,23	-3.948,55	-73,78	-394,86
2	Vacant Land	321,22	374,25	340,68	53,03	16,51	10,61	-33,57	-8,97	-6,71	19,45	6,06	1,95
3	Plantation and Agriculture	45.695,43	47.435,01	49.251,43	1.739,58	3,81	347,92	1.816,42	3,83	363,28	3.556,00	7,78	355,6
4	Built-up Land	688,86	898,66	1.061,96	209,8	30,46	41,96	163,3	18,17	32,66	373,1	54,16	37,31

Source: Authors, 2022

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CONCLUSION

The existence of the Pekanbaru-Dumai Toll Road and the existence of the Duri Selatan Toll Gate in Pinggir District, Bengkalis Regency, have not had an impact on land cover change. The results of land cover identification before the operation of the Duri Selatan toll gate, namely in the period 2012–2017, showed a decrease in forest cover area of 400.48 ha per year and in the period after operation (2017–2022) of 389.23 ha per year. Changes in forest land cover mostly become plantation and agriculture designations. Land use for plantations and agriculture covers almost the entire area of 49,251.43 ha, or about 90% of the area.

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Cek Similarity Synergy Tol Duri

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Submission date: 24-Mar-2024 09:52PM (UTC+0700)
Submission ID: 2321879892
File name: document-51.pdf (601.1K)
Word count: 3505
Character count: 17396

Journal of Synergy Landscape
ISSN 2807-1077 (ONLINE)

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[1, 2,3]Department of Urban and Regional Planning, Faculty of Landscape Architecture and Environmental Technology, Universitas Trisakti, Jakarta, Indonesia, 11440

Corresponding Author: wisely.yahya@trisakti.ac.id

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Based on Government Regulation of the Republic of Indonesia Number 15 of 2005, toll road construction is very necessary, especially in areas that have a high level of development. The existence of adequate transportation infrastructure, such as toll roads, will accelerate economic and social development because it can facilitate the movement of people, goods, services, and ideas from one place to another (Kerr, 2012; Susanto & Marsoyo, 2019). The interaction between transportation and land use is widely known as the transportation and land use cycle, which can trigger land use change. According to Prasetyo and Djunaedi (2019), freeways (toll roads) will cause the growth of new areas and kill old areas. This is related to the decline and increase in economic activity that occurs due to changes in land use in the surrounding area. Several previous studies have shown the impact of toll road construction and exit toll gates on changes in surrounding land use, including changes in land use that occur due to the construction and operation of the Jatiasih Toll Road (Haridza et al., 2022), the Semarang-Solo Toll Road (Aji et al., 2019), the Bogor Outer Ring Road (BORR) (Susanto & Maryoso, 2019), and the Trans Java Surabaya-Mojokerto Toll Road (Yunanto & Susetyo, 2019).

The Pekanbaru-Dumai (Permai) Toll Road, which was built in July 2017 and inaugurated to operate on September 25, 2020, is part of the 131.48 km Trans Sumatra Toll Road (bpjt.pu.go.id, 2020). This road connects the main economic corridors in Riau Province, such as Pekanbaru-Pepatahan-Kandis-Duri-Dumai. The Pekanbaru-Dumai toll road covers the Pekanbaru City area, Bengkalis Regency, Siak Regency, and Dumai City. On the Pekanbaru-Dumai toll road, there are 7 toll gate locations, consisting of Pekanbaru toll gate, Minas toll gate, South Kandis toll gate, North toll gate, South Duri toll gate, North Duri toll gate, and Dumai toll gate. In terms of land use around the toll gate, it is known that around the Duri Selatan toll gate there are more protected areas of land than other toll gates on the toll road.

According to Bengkalis Regency Regional Regulation Number 1 of 2022 concerning the Regional Spatial Plan of Bengkalis Regency for 2022-2042, there are three wildlife reserves, namely Balai Raja Wildlife Reserve located in Pinggir District, Sibanga Wildlife Reserve, and Giam Siak Wildlife Reserve. On the other hand, based on the regulations of Law No. 26 of 2007 concerning spatial planning, it is stated that no land use change is allowed in protected areas in order to protect the preservation of the environment, which includes natural and artificial resources, cultural and historical heritage, and to reduce the impact of natural disasters (Law No. 26 of 2007). Thus, the research question raised is, "What is the impact of the construction of the Duri Selatan Toll Gate on land use change in Pinggir District, Bengkalis Regency?".

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RESEARCH METHODS

Time and Location

The research is located in the Pinggir sub-district, Bengkalis Regency. The data was processed in 2023. This research uses quantitative and spatial approaches. The description of the location of Pinggir Subdistrict, which is the South Duri exit toll, which is directly adjacent to the Balairaja Wildlife Reserve and the Sebanga Elephant Training Center, can be seen in the following figure.

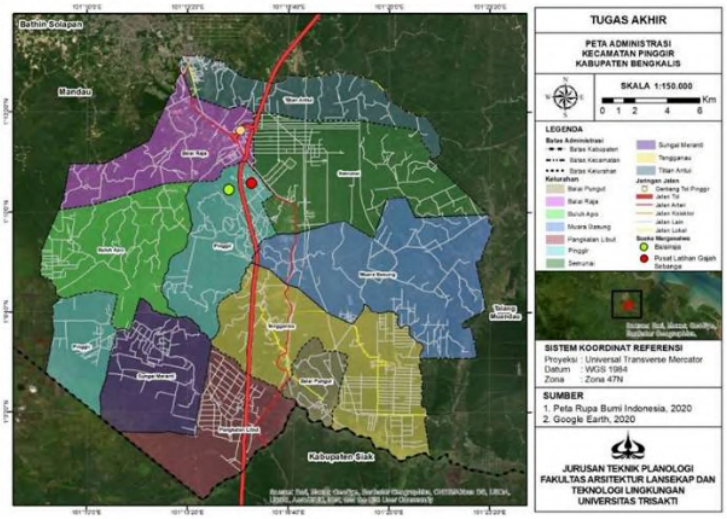

Figure 1. Administrative Map of the Research Area
Source: Indonesia Earth Map, 2020; Google Earth, 2020

Pinggir Sub-district has 10 villages, with the number and population density shown in the following table

Tabel 1 Administration and Population of Pinggir Sub-district

Village/Sub-district	Area (Km^2)	Total Population	Population Density
Pinggir	48.85	8.650	177
Semunai	80.19	8.612	107
Tengganau	92.86	7.097	76
Balai Pungut	9.42	6.586	699
Muara Basung	98.57	1.918	19
Titian Antui	42.06	17.100	407
Balai Raja	49.91	6.563	131
Sungai Meranti	75.30	5.114	68
Pangkalan libut	241.77	3.244	13
Buluh Apo	75.52	2.765	38

Source: Kecamatan Pinggir dalam Angka 2021

Data Collection

The research used secondary data obtained from the Bengkalis Regency Public Works and Spatial Planning Office and satellite imagery. The relationship between research variables, data needs and data sources can be seen in the following table.

Table 2 Research Variables and Data Needs

No	Variable	Data Needs	Data Use	Data Source
1	Exit Toll Location	Location Pekanbaru-Dumai exit toll location	Knowing the study area's distance to the exit toll	Satellite Imagery
2	Type of Land Use	Type of Land Use in Pinggir Subdistrict in 2012, 2017 and 2022	Knowing the type of land use in Pinggir Subdistrict	Office of Public Works and Spatial Planning of Bengkalis Regency
3	Land use area.	Land Use Area of Pinggir Subdistrict in 2012, 2017 and 2022	Knowing the area of land use before (2012 and 2017) and after the construction (2022) of the Duri Selatan toll gate and changes in land use that occur.	Office of Public Works and Spatial Planning of Bengkalis Regency

Source: Authors,2022

The Data Analysis Method

This research uses descriptive statistics and spatial analysis methods

1) **Spatial Analysis (Mapping and Overlay)**

Spatial analysis is a technique for analyzing data in GIS (geographic information system) processing, the results of which are highly dependent on the survey location. Spatial analysis can also be interpreted as a technique for studying spatial information and perspectives. In this research, spatial analysis was carried out using Arcgis software. Spatial analysis was conducted to obtain an overview and mapping of land use based on the type of land use and its area in 2012, 2017, and 2022.

2) Descriptive Statistical Analysis

According to Healey (2012), simple descriptive statistics can be used when researchers need to describe and summarize univariate variables in the form of percentages, percentage changes, averages, and graphs. Descriptive statistical analysis in this study intends to identify the area per type of land use before and after the operation of the Duri Selatan Toll Gate. Each variable related to land use is treated quantitatively so that the results of its calculation or measurement

can be described. In this study, the percentage change (Healey, 2012) will be calculated in the context of the rate of land use change. Thus, land use change can be written with the following formula:

$$\frac{V = Lt - Lt{-}1}{Lt{-}1} \times 100\%$$

Description:

V : Land shrinkage area (%)

Lt: Land area in year t (Ha)

Lt-1 : Land area of the year before t (Ha)

Table 3 Research Analysis Methods

Target	Analysis Technique	Result
Identification of the type and extent of land use before the operation of the Duri Selatan Toll Gate in Bengkalis Regency.	• Spatial analysis (mapping and overlay) • Descriptive statistical analysis	• Land use type before the operation of the South Duri toll gate. • - Land use area before the operation of the Duri Selatan toll gate.
Identification of the type and extent of land use after the operation of the Duri Selatan Toll Gate in Bengkalis Regency	• Spatial analysis (mapping and overlay) • Descriptive statistical analysis	• Land use type before the operation of the South Duri toll gate. • Land use area before the operation of the Duri Selatan toll gate.

Source: Authors,2022

RESULTS AND DISCUSSION

The results of this study are Land Use Change Before the Operation of the Duri Selatan Toll Gate (Years 2012–2017) and After the Operation of the Duri Selatan Toll Gate (Years 2017–2022). There are two wildlife sanctuaries, namely the Balai Raja Wildlife Sanctuary located in Pinggir District and the Sebanga Elephant Training Center Wildlife Sanctuary. Which will cause the growth of new areas and kill old areas. This is related to the decline and increase in economic activity that occurs due to land use changes in the surrounding area.

1. Identified Land Use Changes Before the Construction of the Duri Selatan Toll Gate (Years 2012 - 2017)

   The following are in the 2012-2017 period or before the construction of the Duri Selatan Toll Gate, the changes in land use are as follows:

Table 4 Research Analysis Methods

Target	Analysis Technique	Result
Identification of the type and extent of land use before the operation of the Duri Selatan Toll Gate in Bengkalis Regency.	• Spatial analysis (mapping and overlay) • Descriptive statistical analysis	• Land use type before the operation of the South Duri toll gate. • - Land use area before the operation of the Duri Selatan toll gate.
Identification of the type and extent of land use after the operation of the Duri Selatan Toll Gate in Bengkalis Regency	• Spatial analysis (mapping and overlay) • Descriptive statistical analysis	• Land use type before the operation of the South Duri toll gate. • Land use area before the operation of the Duri Selatan toll gate.

Source: Authors,2022

The table above shows that the first largest land use in 2012 and 2017 was plantations, and there was an increase in land use change of 1,739.58 ha. The next largest land use was forest, with an area of 5,351.56 hectares in 2012 and decreasing in 2017 to an area of 3,349.15 hectares. This shows a decrease in area of 2,002.41 ha from 2012 to 2017. The area of built-up land and vacant land was identified as having increased from 2012 to 2017.

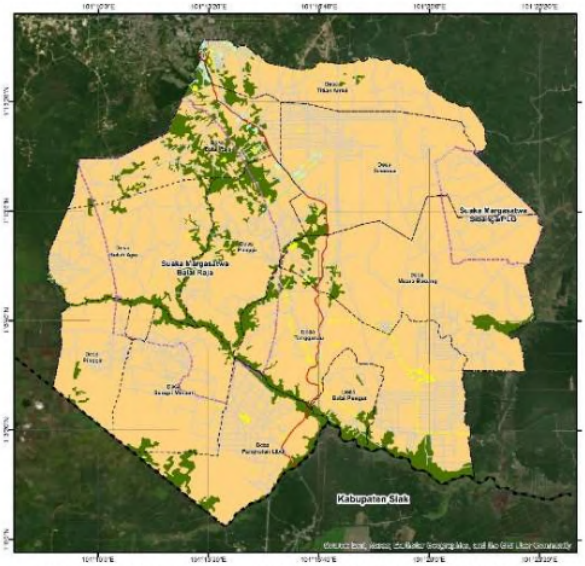

Figure 2 Forest Cover in Pinggir Sub-district in 2012
Source: Indonesia Earth Map, 2020; Google Earth, 2020

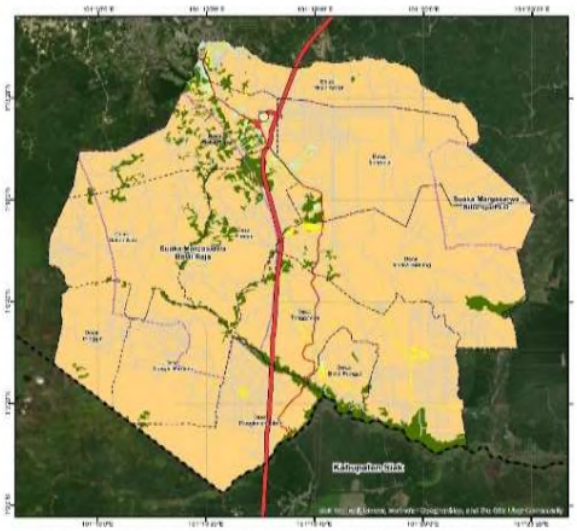

Figure 3 Forest Cover in Pinggir Sub-district in 2017
Source: Indonesia Landform Map, 2020; Google Earth, 2020

2) Identified Land Use Change After the Operation of the Duri Selatan Toll Gate (Year 2017 - 2022)

The Duri Selatan toll gate is located in the Pinggir sub-district, consisting of 10 villages namely Balai Pungut, Balai Raja, Buluh Apo, Muara Basung, Pangkalan Libut, Pinggir, Semunai, Sungai Meranti, Tengganau, Titian Antui which are included in this research area. Land use in this research area consists of 4 types such as Forest, Vacant Land, Plantation and Agriculture and Built-up Land.

Table 5 Land Use 2017-2022

Land Use	Area of 2017	Area of 2022	Land Use Change 2017-2022	Land Use Change per year
Forest	3.349,15 Ha	1.403,01 Ha	-1.946,14 Ha	-389,23 Ha
Vacant Land	374,25 Ha	340,68 Ha	-33,57 Ha	-6,71 Ha
Plantation and Agriculture	47.435,01 Ha	49.251,43 Ha	1.816,42 Ha	363,28 Ha
Built-up Land	898,66 Ha	1.061,96 Ha	163,3 Ha	32,66 Ha
Total	52.057,07 Ha	52.057,08 Ha	0,01 Ha	0

Source: Authors, 2022

Table 5 shows that forest land use after the operation of the Duri Selatan toll gate has decreased from 3,349.15 ha in 2017 to 1,403.01 ha in 2022. This shows a significant land use change of 1,946.16 ha. A decrease in land-use area also occurred on vacant land. This is inversely proportional to the area of plantations, agricultural land use, and built-up land, which has

ISSN 2807-1077 (ONLINE)

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increased significantly. This indicates that the operation of the Duri Selatan toll gate has a significant impact on changes in the area of built-up areas. The following is a land use map of Pinggir Sub-district in 2022.

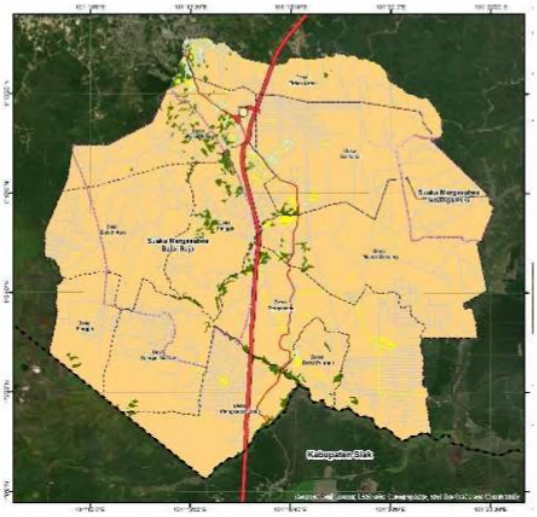

Figure 4 Forest Cover in Pinggir Sub-district in 2022
Source: Indonesia Earth Map, 2020; Google Earth, 2020

Table 6 shows that from 2012 to 2017, the forest area decreased, namely 2,002.41 ha, with a percentage of 37.42%. From 2017 to 2022, it decreased again to 1,946.14 ha, with a percentage of 58.11%. Data from 2012 to 2022 shows that the change in the area of forest land use from 2012 to 2022 has decreased very rapidly, namely 3,948.55 and with a percentage of 73.78%. In addition, the use of vacant land from 2012 to 2017 increased by 53.03 ha with a percentage of 16.51%, while from 2017 to 2022 it decreased by 33.57 ha with a percentage of 8.97%. Furthermore, the land use of plantations and agriculture from 2012 to 2017 was identified to have increased by 1,739.58 ha with a percentage of 3.81%, while from 2017 to 2022 it increased by 1,816.42 ha with a percentage of 3.83. It can be seen that from 2012 to 2022, there was an increase of 3,556.00 ha with a percentage of 7.78%. On the other hand, built-up land increased by 209.80 ha with a percentage of 30.46%, and from 2017 to 2022, it also increased by 163.30 ha with a percentage of 18.17%.

The results of identifying the land cover of Pinggir Subdistrict, Bengkalis Regency, in 2012, 2017, and 2022 show that this area since 2012 (before the operation of the Toll Gate) has been dominated by land cover in the form of plantations and agriculture. In fact, based on data from the Bengkalis Regency Central Statistics Agency in 2017, Pinggir District has the largest area of

palm oil plantations in Bengkalis Regency, managed by private companies. The existence of the Pekanbaru-Dumai Toll Road does not or has not shown any impact on land use change because there is no difference between land cover change before and after the operation of the Toll Gate in this sub-district.

The size of the plantation and the provision of a toll gate in this sub-district that connects both to the provincial capital (Pekanbaru) and to Dumai (towards the port) are more aimed at accelerating the flow of goods, especially palm oil production, both to processing and marketing areas. According to Pradono and Pradithasari (2011), functionally, toll roads can improve the effectiveness and efficiency of distribution services for economic activity products from processing centers to marketing centers. However, with the presence of two (two) wildlife sanctuaries that must be protected and located adjacent to this toll gate, in the future, it is necessary to be aware of the long-term multiplier effect of increasing the flow of goods and resource processing activities on the survival of protected animals.

ISSN 2807-1077 (ONLINE)

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Table 5

No	Land Use Type	AREA			Change 2012- 2017			Change 2017-2022			Change 2012-2022		
		2012	2017	2022	Area of Land Use Change (Ha)	Percentage Change in Area of Land Use (%)	Area of land use change per year	Area of Land Use Change (Ha)	Percentage Change in Area of Land Use (%)	Area of land use change per year	Area of Land Use Change (Ha)	Percentage Change in Area of Land Use (%)	Area of land use change per year
1	Forest	5.351,56	3.349,15	1.403,01	-2.002,41	-37,42	-400,48	-1.946,14	-58,11	-389,23	-3.948,55	-73,78	-394,86
2	Vacant Land	321,22	374,25	340,68	53,03	16,51	10,61	-33,57	-8,97	-6,71	19,45	6,06	1,95
3	Plantation and Agriculture	45.695,43	47.435,01	49.251,43	1.739,58	3,81	347,92	1.816,42	3,83	363,28	3.556,00	7,78	355,6
4	Built-up Land	688,86	898,66	1.061,96	209,8	30,46	41,96	163,3	18,17	32,66	373,1	54,16	37,31

Source: Authors, 2022

CONCLUSION

The existence of the Pekanbaru-Dumai Toll Road and the existence of the Duri Selatan Toll Gate in Pinggir District, Bengkalis Regency, have not had an impact on land cover change. The results of land cover identification before the operation of the Duri Selatan toll gate, namely in the period 2012–2017, showed a decrease in forest cover area of 400.48 ha per year and in the period after operation (2017–2022) of 389.23 ha per year. Changes in forest land cover mostly become plantation and agriculture designations. Land use for plantations and agriculture covers almost the entire area of 49,251.43 ha, or about 90% of the area.

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