

The Impact of Infrastructure Development of Ring Road on Ecological and Social Component Through Land Consolidation Program

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Abstract

The relocation of the government center requires the construction of infrastructure facilities, especially the road network. However, in its implementation, land consolidation for road construction often encounters obstacles, so the consolidation process is delayed. This study aims to examine the alignment between the spatial plan of the Pekanbaru City area and the ring road infrastructure development plan. This study uses quantitative and qualitative methods, analyzing the alignment of the spatial layout of the city of Pekanbaru with the road plan through the GIS Web. The results of the study show that in Trase I Tenayan Raya, 20 plots of land do not have clear proof of ownership, 20 plots of land are involved in land disputes, and 3 plots of land reject the land consolidation program for the Pekanbaru city ring road project. In Trase IV B Rumbai, 46 plots of land cannot be continued to the next stage of the Land Consolidation process because they are located in forest areas. In 2020, the Pekanbaru City Regional Spatial Plan has been ratified through Regional Regulation Number 7 of 2020, which covers the period 2020-2040. The Pekanbaru City Government has submitted an application for the release of forest areas. Land that already had rights before the ratification of the RTRW can apply for the release of the Forest Area, and if the rights are granted after the RTRW, the Forest Area can be exchanged. This process is in accordance with SK: 323/Minhut-11/2011, which is based on Government Regulation No. 104/2015 concerning procedures for changing the designation and function of forest areas.

Keywords: *Spatial Planning, Social Impact, Land Consolidation, Infrastructure Development, Forest Area.*

1. Introduction

The development of ring road infrastructure is one of the important national programs to support urban development. Ring roads play an important role in improving connectivity and transportation efficiency, which ultimately contributes to economic growth and community welfare. However, in the process of development, there are often social conflicts related to land ownership, ownership, and use. Land management policies through Land Consolidation, as stipulated in the Regulation of the Minister of ATR/Head of BPN No. 12 of 2019, are intended to ensure the availability of land for development needs and support agrarian reform, but often face social challenges (Bottero, 2019).

Empirically, the construction of ring roads in various cities in Indonesia, including Pekanbaru, shows a high conflict of values and views. For example, the construction of the Padang Bypass road that passes through Bukittinggi City Regency takes a long time due to land consolidation constraints (Pramida & Husodo, 2023). Susanti's research (2022) also shows that land consolidation is often disrupted by administrative errors and the existence of several actors who have conflicting values and views. This emphasizes the complexity of the process, which requires careful planning and active participation from the community to reduce potential conflicts.

This study aims to analyze the social impact of the construction of the ring road in Pekanbaru City and the suitability of urban spatial planning with infrastructure plans using webGIS. The

novelty of this research lies in a comprehensive approach that combines social analysis and GIS technology to understand and mitigate social impacts. The justification for this study is the importance of understanding and managing social conflicts and ensuring spatial conformity in infrastructure development to achieve sustainable and harmonious development (Dai & Zhang, 2023).

The implications of this study are quite significant, namely providing recommendations for better infrastructure planning and more responsive to social and environmental needs. The findings of this study are expected to be used as a basis for more effective policies in land consolidation and ring road infrastructure development, which will ultimately improve community welfare and maintain environmental quality. In addition, this research also offers practical solutions to mitigate social impacts through effective mediation and integration of various development plans in one integrated map (Dai & Zhang, 2023).

Road infrastructure development often carries complex social impacts, both positive and negative, depending on the local context. For example, in Grobogan Regency, road construction shows the potential to reduce poverty and improve the quality of human resources and business opportunities, which ultimately has an impact on the welfare of the community (Armunanto et al., 2021). On the other hand, the negative impacts of road construction must also be watched out, such as land ownership conflicts, livelihood changes, and disruption to local culture. Mitigation strategies that emphasize local wisdom have proven effective in addressing these issues (Priyambodo et al., 2022).

Meanwhile, sustainable road construction, such as the one implemented in Ethiopia, demonstrates the importance of an approach that considers the road life cycle. This approach aims to minimize economic and social impacts by utilizing resources optimally (Habte, 2021). This emphasizes the importance of inclusive spatial data-driven planning in maintaining a balance between economic benefits and environmental conservation, as seen in forest management in Indonesia (Rustiadi & Veriasa, 2022). On the other hand, in the context of land consolidation, road accessibility is a key factor that needs to be considered, especially in remote rural areas (Janus et al., 2017).

The land consolidation process on the Pekanbaru City Ring Road not only requires land optimization and consolidation that takes into account social values such as equality and recognition (de Vries, 2022), but can also benefit from an effective land exchange strategy. By using the priority rule, the exchange of paddy plots has been shown to reduce farmers' travel time by 6.70% to 9.45%, depending on the rules applied (Kurosaka & Onodera, 2022). This approach is in line with the analysis of funding sources and priority factors applied in infrastructure development in the Mandalika SEZ, where environmental and infrastructure aspects are also the main focus (Susanti, 2022). The integration of this strategy can help overcome existing conditions and social conflicts that arise during land consolidation on the Pekanbaru City Ring Road.

2. Research Methods

This study uses a mixed method, which combines quantitative and qualitative research methods to obtain a comprehensive picture of social conformity and conflict in the development of ring road infrastructure. This approach allows researchers to combine numerical data with deep insights from a participant's perspective.

2.1. Research Location

This research was conducted in Pekanbaru City, Riau Province, involving ring road projects in four sub-districts and 10 sub-districts as shown in Figure 1. These areas were chosen because they are the main locations of the ongoing Ring Road Land Consolidation program. The selection of this location is expected to provide a representative picture of the social and spatial dynamics related to the ring road construction project.

Table 1. Research Location

No.	District	Sub-District	Trace
1.	West Rumbai	Muara Fajar Village, Palas Village	IVA
2.	East Rumbai	Okura Village, Sungai Ambang Village, Muara Fajar East Village	IVB, IVC, V
3.	Tenayan Raya	Tuah Negeri Village, Tenayan Industrial Village, Bambu Kuning Village	I, III
4.	Kulim	Kulim Village, Sialang Rampai Village	II

2.2. Data Source

The data used in this study consists of two types, namely quantitative data and qualitative data. Quantitative data includes spatial data from the Geographic Information System (GIS), including land use maps, road networks, and topographic data of the study area, as well as demographic and land use statistical data obtained from the Pekanbaru City Land Office and the National Land Agency (BPN) of Pekanbaru City. Qualitative data were obtained through in-depth interviews with communities affected by land consolidation in the study area, as well as interviews with government officials and land officers at the Pekanbaru City Land Office and Pekanbaru City BPN.

2.3. Data Analytics

Data analysis is carried out using a combination approach that integrates quantitative and qualitative data to obtain comprehensive results. Quantitative analysis was carried out using GIS software to analyze the suitability of spatial planning and land use changes due to the construction of the ring road. Statistical analysis was carried out to identify patterns and trends in demographic and land use data. Qualitative analysis was carried out using interview transcripts that were analyzed using thematic analysis methods to identify the main themes related to social impacts and conflicts arising from land consolidation. The results of the interviews were used to enrich and clarify the findings of the quantitative analysis, as well as provide a more in-depth social context.

3. Results And Discussion

3.1. History and Existing Conditions of Land Consolidation of Pekanbaru City Ring Road.

The rapid development of urban areas has led to development inequality between urban centers and suburban areas. To encourage equitable development to the suburbs, the Pekanbaru City Government based on the Regional Regulation moved the government center to Tenayan Raya District. The relocation of the government center is also contained in the 2017-2022 RPJMD document where the development direction of the Development area in Tenayan Raya District is focused on development, including: (1) Residential areas; (2) Industrial Activity Center; (3) Warehousing Activity Center; (4) Trade Area; (5) City Government Office Area; (6) Tourism Area; (7) Agricultural Area.

Furthermore, to support the development of several areas, the Pekanbaru City government has prepared a plan for the construction of the Pekanbaru City ring road since 2014 through land

consolidation as mandated in the Regulation of the Minister of ATR/Head of BPN Number 12 of 2019 concerning Land Consolidation. To facilitate the process of implementing the consolidation, the 5 Trase plan which originally amounted to 5 Trases was developed into 8 Trase, including: Trase 1, Trase 2, Trase 3, Trase 4, Trase 5, Trase 70 (seventy). Over the past decade or so, there have been changes that affect the implementation of the Ring Road Development Permit as seen in Table 2.

Table 2. Changes in the KT for the Implementation of the Pekanbaru City Ring Road Construction in 2014 and 2023

Aspects of Change	Year 2014	Year 2023
Trail Changes	5 Traces	8 Traces
Working Process	19 %	63 %
Design map	There is only an existing map, no design map yet	Design maps have been made available for four Traces.
Land certificate	Land certificates have not been distributed to the community	3 Trace has handed over land certificates to the community.
Location of the sub-district	2 Districts (Tenayan Raya, Rumbai Pesisir)	There has been an expansion into four sub-districts (Tenayan Raya, Kulim, East Rumbai and Rumbai).
OPD Land Office	There is no Land Office yet	There is already a Land Office
Spatial Conditions	Regional Regulation No.4 of 1993	Regional Regulation No. 7 of 2020
Search Coordinator	There is no KT coordinator yet	There is already a KT coordinator for each Trace
Search Post	There is no post yet	There is already a post
MEMORANDUM OF UNDERSTANDING	There is no MOU between BPN and the Pekanbaru City Government	There is already an MOU between BPN and the Pekanbaru City Government
Policy Changes	No Matek yet	Two Trails already have matek
Budget	Pekanbaru City Government	Pekanbaru City Government and BPN
Misinformation in 2013	The position of community land without measurement by BPN	The position of the land was measured by the BPN, then a design map was issued, the position of the land was different from before.

Source: Research Results, data processed

Table 2 showed several changes that affected the implementation of the KT for the construction of the Pekanbaru ring road, namely the establishment of the Pekanbaru City Land Office as the main coordinator for accelerating the implementation of KT, the formation of the KT coordinator per Trase and the signing of an MOU with the National Land Agency. In addition, from the regulatory aspect, PERDA Number 7 of 2020 has been stipulated. The results of the acceleration of the implementation of the Pekanbaru City Ring Road KT show that until 2023, the realization of the project has reached 63% and the submission of community land certificates affected by KT has been carried out in 3 (three) Trase.

Table 3 describe the Existing Conditions of Land Use in the Pekanbaru Ring Road Development Trase. Trase I is dominated by industrial and trade and service areas, Trase II, VA, IVB and V are dominated by residential areas while Trase III is dominated by industrial areas and Trase IVC is dominated by plantation areas. Traces IVA, IVB and V have 30% green open area. Meanwhile, all traces do not have limited production forest areas.

Table 3 : Existing Land Use Condition on the Pekanbaru Ring Road Development Trajectory

NO T	Area	Percentage (%)							
		Trace I	Trace II	Trace III	Trace IV A	Trace IV B	Trace IV C	Trace V	Trace 70
1	Residential areas	40	70	45	70	70	25	70	
2	Kws. Industry Limited	50	-	50	-	-	5	-	
3	Production Forest Area	-	-	-	-	-	-	-	
4	Trade and Service Zone	50	10	5	-	-	-	-	
5	Office Area	10	-	-	-	-	-	-	
6	Plantation Areas	-	-	-	-	-	70	-	
7	Green Open Area	-	-	-	30	30	-	30	
8	Transportation Area	-	20	-	-	-	-	-	

Source: Land Office 2021

The distribution of land use that shows the dominance of industrial and trade and service areas in Trace I and the dominance of industrial areas in Trace III illustrates the importance of these areas as centers of economic activity. This is in line with the findings of Bottero (2019) and Surya Buana et al. (2021) who stated that the integration of industrial and commercial estates in the spatial plan of the city area can encourage local economic growth. The construction of the Pekanbaru City ring road will increase accessibility and logistics efficiency.

Trases II, IV A, IV B, and V which are dominated by residential areas indicate that this ring road project will have a significant impact on residential communities. Based on Susanti's research (2022), infrastructure projects involving residential areas must pay attention to the needs and aspirations of local communities to reduce the risk of social conflict.

The plantation area indicates that the ring road project will also have an impact on agricultural land. According to research by (Pramida & Husodo, 2023), infrastructure development involving agricultural land must consider its impact on agricultural sustainability and the local economy. The relocation of agricultural land and fair compensation for affected farmers are important aspects that must be considered.

The existence of 30% green open space (RTH) in Trase IV A, IV B, and V shows that there is attention to environmental aspects in project planning. RTH is important for maintaining environmental quality and community welfare, in line with the concept of sustainable development discussed by Dai & Zhang (2023). The integration of green spaces in infrastructure projects helps to reduce the negative impact on local ecosystems and provide recreational spaces for communities. While there are no limited production forest areas along the entire route, the ring road project must ensure that it does not negatively impact forest conservation and biodiversity.

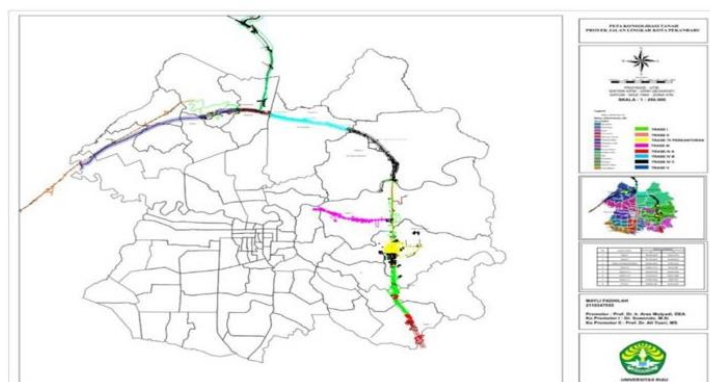


Figure 1: Existing Spatial Conditions of Spatial Land Consolidation

The implementation of the Pekanbaru City Ring Road Land Consolidation was not spared from several obstacles so that the completion was not in accordance with the scheduled time or even not carried out. From the results of monitoring and evaluation, it is known that obstacles or obstacles in the implementation of Consolidation are seen in Table 4.

Table 4 : Land Consolidation Issues

No.	Trace	Area (Ha)	Affected Parcels	% Resolved Parcels	of Problems
1.	Trace I	50,25	257	45 %	Environmental conditions, physical contours of the land.
2.	Trace II	17,737	335	38 %	Institutional weaknesses, there are several plots of land whose owners are unknown
3.	Trace III	87,97	136	25,6 %	There is an overlap in land ownership
4.	Trace IVA	90,93	74	85 %	The construction of the ring road has not been completed by the Pekanbaru city government.
5.	Trace IVB	213	110	70 %	Position of the Land Consolidation area exposed to the Forest area
6.	Trace IVC	552	206	65 %	The location of the Land Consolidation overlaps with the land of PT. SIR
7.	Trace V	90,93	100	45 %	Institutional weaknesses, there are several plots of land whose owners are unknown
8.	Trace 70	60	95	68 %	There is a land dispute.

Source: Research Results 2023, Data Processed

3.2. Conflicts and Land Consolidation Disputes on the Pekanbaru City Ring Road

The result of this study is that Land Consolidation (KT) is a land policy regarding the rearrangement of land tenure and use as well as efforts to acquire land for the benefit of development, improving the quality of the environment and maintaining natural resources by looking at the active participation of the community. The impact of conflicts that arise after the construction of the Land Consolidation ring road can minimize land conflicts, meaning that the construction of the Land Consolidation ring road can minimize existing land conflicts.

Before land consolidation, there was an overlap in land ownership, but after land consolidation, the land was measured cadastrally by the BPN team, and the community knew for sure the coordinates of the land they owned because the boundaries were clear. The results obtained by the communities affected by land consolidation are that BPN and the Pekanbaru City Government have certified the land of communities affected by land consolidation into SHM. So that it can minimize land conflicts.

Based on the results of an interview with the Chief Land Consolidation Coordinator (head of the Land Acquisition section) Mrs. Yuliati Barus, SH stated that:

"There is a lot of vacant land on the Ring Road, many residents or people only invest their land, when data collection is carried out in the field, residents or the community do not know exactly the boundaries of the land, making it difficult for officers to determine the boundaries of the land at the time of measurement. We, the Pekanbaru City Government in carrying out land measurements, jointly carry out measurements in the field with parallel land, RT, RW, Lurah and witnesses of land ownership, so that in the future there will be no conflicts when the measurement results come out".

The results of the interview above concluded that many landowners did not know the boundaries of their respective land, making it difficult for officers in the measurement process. To prevent conflicts, the Pekanbaru City Land Agency involves representatives from land agents, RT, RW and Kelurahan, border parties and land owners. This is done to minimize the occurrence of land conflicts, and land boundary agreements are witnessed directly by land owners and land agents. With the Ring Road Land Consolidation project, the community knows the boundaries of their land, and through the Land Consolidation program, the legality of land rights is increased from a Certificate of Compensation (SKGR) to a Certificate of Property Rights (SHM).

Some things that need to be considered in this context are: 1. Accurate Data Collection Accurate and clear land data collection is the first step to avoid ownership conflicts and facilitate sustainable regional development. 2. Community Participation Involving the community in the land measurement process, by involving RTs, RWs, and Village Heads, can increase public confidence in the measurement results and reduce the potential for conflict. 3. Socialization and Education Socializing and educating the public about the importance of knowing and documenting their own land boundaries can help overcome this ambiguity. Transparency of the Measurement Process Ensuring transparency in the soil measurement process is key to ensuring that the measurement process is transparent. 4. Considering the use of technology such as digital mapping or geographic information systems (GIS) can help make land mapping more accurate and accessible. 5. Handling Conflicts Effectively The government can consider effective conflict resolution approaches in the event of a conflict of ownership. Land consolidation is one of the alternatives to providing land for the construction of public facilities (Bustami, 2020).

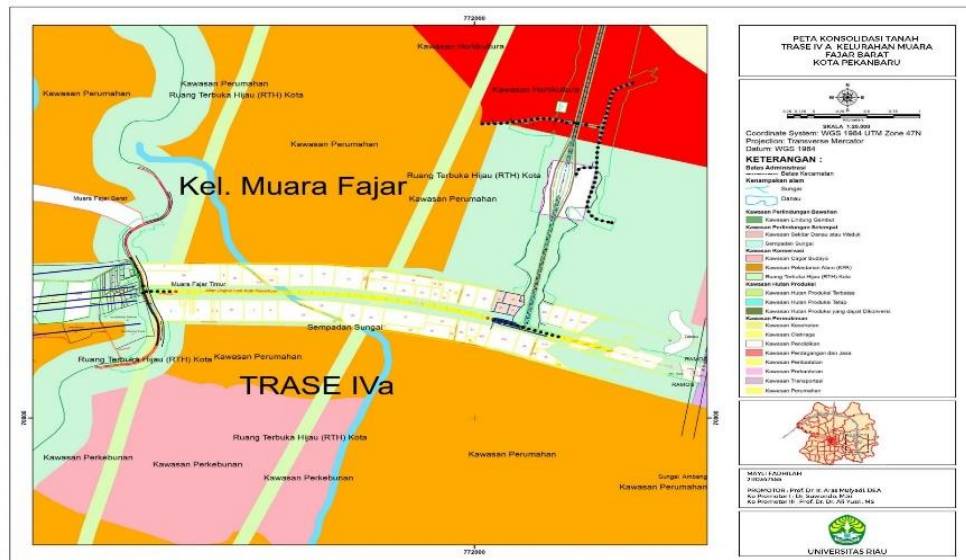


Figure 3 : Land Consolidation Map of Line IV A, Muara Fajar Barat Village, Pekanbaru City

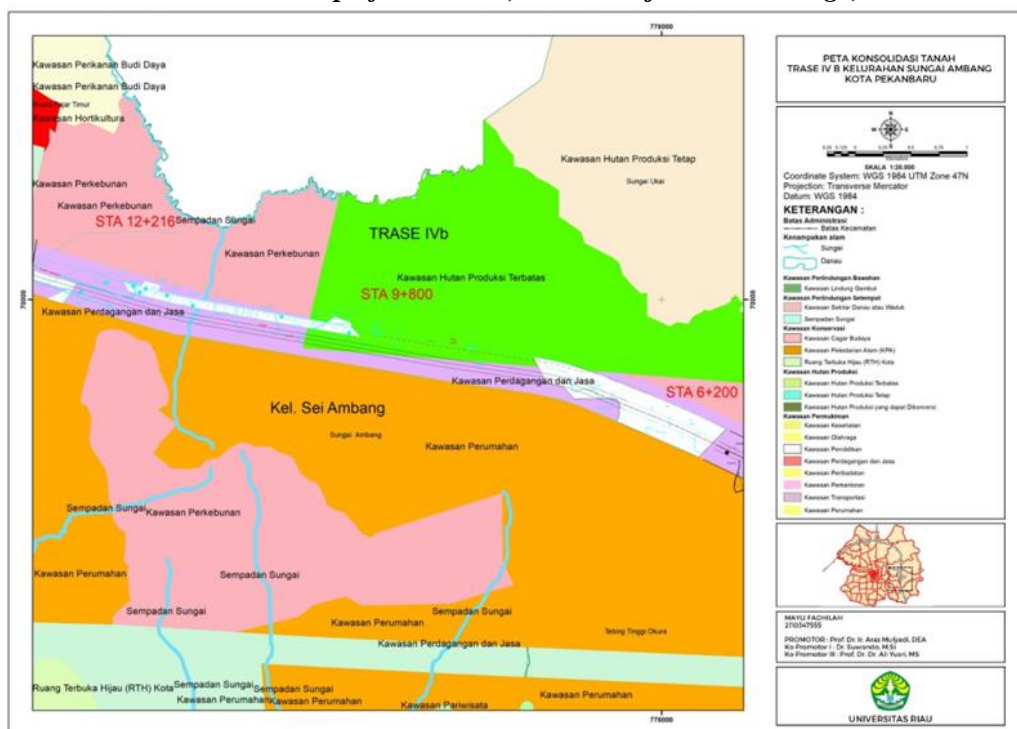


Figure 4 : Land Consolidation Map of Trase IV B Sungai Ambang Village, Pekanbaru City

Changes to Limited Production Forests based on Government Regulation No. 104/2015, namely plantation business activities whose permits are issued by local governments based on the spatial plan of the Province/Regency/City area stipulated by regional regulations before the enactment of Law No. 104/2015, 26/2007 concerning Spatial Planning and based on the applicable spatial plan remains in accordance with the previously applicable spatial plan but based on the Forestry Law, The area is according to the final forest area: (a) is a production forest area that can be converted. Spatial planning policies must be transparent and fair (Matondang, A, 2022). the quality of life and the environment can be improved by planning roads and public areas (Patil & Anbalagan, 2023).

4. Conclusion

Social conflicts that occurred due to the construction of the ring road due to land acquisition were 20 plots of community land to which no rights were found, 20 plots of conflict land and 3 plots of land that refused land consolidation. In 2020, the Pekanbaru City Regional Spatial Plan has been ratified through Regional Regulation Number 7 of 2020 concerning the Pekanbaru City Regional Spatial Plan for 2020-2040. As a result, there are 46 plots of land in Trase IV A that are affected by the Production Forest Area and cannot continue the Land Consolidation process to the next stage. The Pekanbaru City Government submitted an application for a permit for the release of Forest Areas in accordance with SK: 323/Minister of Forestry-11/2011 which states that land whose certificates have been issued before the RTRW is ratified can apply for the release of Forest Areas, if it is issued above the RTRW, then the Forest Areas will be exchanged, in accordance with Government Regulation No. 104 Years. The Pekanbaru City RTRW was ratified through Regional Regulation Number 7 of 2020 concerning Regional Spatial Planning. Pekanbaru City in 2020-2040. As a result, there are 46 plots of land in Trase IV A that are affected by the Production Forest Area and cannot continue the Land Consolidation process to the next stage. The Pekanbaru City Government submitted an application for a permit for the release of Forest Areas in accordance with Decree: 323/Minister of Forestry - 11/2011 which states that land certificates issued before the RTRW was ratified can apply for the release of Forest Areas, if issued above the RTRW, the Forest Areas will be exchanged, in accordance with Government Regulation No. 104 of the Year.

Author Contributions

Fadhilah conducts literature studies, uses spatial webgis data in research, collects and analyzes data. Mulyadi, A organizes and designs research. Suwondo, A analyzed and interpreted the data, Yusri, A prepared the script. Afriyanni analyzed the data, added references and refined the manuscript.

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Conflict Of Interest

The authors report no potential conflicts of interest associated with the publication of this work. In addition, all ethical considerations, such as plagiarism, consent, errors, falsification or fabrication of data, double publication or filing, and redundancy, have been thoroughly addressed by the authors.

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Abbreviations List Table

%	Percentage
KT	Land Consolidation
RTRW	Regional Spatial Plan
GIS	Geographic information system
RTH	Green open space
MFB	West Dawn Estuary

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