



Investigating Local Resources and Wisdom in Partner Regions Surrounding the Nation's Capital for Road Network Development

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Abstract

The development of the New Indonesia's Capital, called the IKN, will undoubtedly draw many people to come and engage in the IKN region, although not inside the IKN area, since the development is confined to a small area with smart city, blue city, and forest city ideas merged. Restrictions on mobility inside the IKN area will almost definitely create issues for road network connectivity across IKN's surrounding areas, so it was deemed essential to have a road network development model that maintains IKN as a limited area while also functioning as a catalyst for economic growth in partner areas. The focus of this research is to provide a model for developing a road network based on local wisdom and the resources of each partner region surrounding IKN. The method employed in this study is based on gathering secondary data of the surrounding areas, which has local resources and local wisdom. The resources and the local wisdom are considered a trip attractor. The IKN masterplan data was also employed in this study as the main subject. Principles and road network development theory were used to analyze the data. The findings of this research led to the development of a new road network in various regions, including Senoni, Gusig, and Tukuq. This road network is deemed necessary to be developed, due to its trip attraction potential. It is hoped that the implementation of these new road networks will also have positive impacts on the development of partner areas surrounding IKN.

Keywords: National Capital; Smart City; Forest City; Transportation; Road Network Development.

1. Introduction

The capital city plays a critical role in all elements of government activity. As with other areas of government, the capital city's primary duty is to serve as the country's center of political force and economy. Furthermore, the capital city displays the cultural side of the country, demonstrating the country's distinct and unique identity. The capital, as a country's identity, is developed to promote the country so that its people might be prosperous and live comfortably. If the state's development and management are suitable and do not threaten any party, it is considered to develop and expand. Managing capital is not a simple task since it must be properly considered so that it does not cause many issues in the future. When transferring the capital, the state government must evaluate all possible consequences and ensure that they will not bring the country into disrepute.

Indonesian President *Joko Widodo* declared on August 16, 2019, that Indonesia's Capital City (IKN) will be relocated from Jakarta to the province of Kalimantan Timur. As a first stage, the National Development Planning Agency (Bappenas) has accomplished a number of duties associated with the IKN relocation. Bappenas promotes several aspects, including economic development, land development, and the possibility of industrial expansion.

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IKN's migration from Java Island, according to the government, was motivated by economic equality. The concentration of government and business activity on Java Island, especially in DKI Jakarta, has inhibited the growth of new economic centers outside of Java. According to Bambang Brodjonegoro, the head of Bappenas, the regional imbalance has damaged the national economic growth rate. The government believes that the IKN transfer plan would help to promote economic equality and close the gap between Java and the rest of Java Island.

According to the national structure, the island of Kalimantan is strategically located at the archipelago's epicenter. The transition of the capital to East Kalimantan is an attempt to shift the archipelago's economic gravity toward the center. IKN will also provide new investment opportunities. IKN, together with Samarinda and Balikpapan (the two biggest cities in East Kalimantan Province), will be the driving force behind the eastern Indonesian economy, causing local value chains to grow across the country. IKN will be a superhub that is interconnected locally and globally, as well as universally inspired. The three were subsequently included in the creation of the IKN Central Government Core Area (KIPP), which symbolizes the nation's identity while simultaneously attaining social, economic, and environmental sustainability and transforming the city into a smart city.

Hundreds of thousands, if not millions, of public employees (PNS) will be displaced as a result of the capital's relocation. According to the National Development Planning Agency (Bappenas), the number of public employees who would be relocated as a result of the capital transfer ranges from 870,000 to 1.5 million. As the population develops, so does the community's quality of living and welfare, necessitating the development of transportation facilities and infrastructure capable of supporting the people's mobility in their everyday activities, notably road network infrastructure.

Restrictions on travel inside the IKN zone would almost certainly generate difficulties with road network connection in surrounding IKN partner regions, so a road network development plan that retains IKN as a confined area while still functioning as a stimulant for economic growth in partner areas is considered essential. The purpose of this article is to design a plan for developing a new road network based on local wisdom and resources present in each partner region surrounding IKN.

2. Literature Review

2.1. Definition and Function of a Nation's Capital

A nation's capital (a capital city; political capital) is a city intended as a country's seat of government; physically, the country's capital serves as an office hub and a central hub for public officials. The term "*capital*" is derived from the Latin "*capita*", which means "*head*", and is related to the term "*capita*", which refers to the location of the major government center structure [1]. Historically, the capital was founded as a result of a conquest or merger. As the primary economic hub of a region, the capital is also used as a central point of political authority [2]. Therefore, it has its own draw for legal specialists, journalists, and public policy academics, all of whom are required for the effectiveness of government administration. The capital city is an economic, cultural, or intellectual center [3].

The capital of a nation is generally also the hub of administration, business, and legislative influence in the country. Even in practice, this is not always the case in various nations [4]. For example, in the United States, the capitol is in Washington, while the country's business hub is in New York. Similarly, in Australia, Canberra serves as the country's capital, while Melbourne serves as its business hub. In this regard, Peter Hall (1993), classified 7 types of capital cities, namely: (1) multi-function capitals (London, Paris, Madrid, Stockholm); (2) a subset of the former called global capitals (London, Tokyo); (3) political capitals, without many commercial functions (The Hague, Bonn, Washington, Ottawa, Canberra, Brasilia); (4) former capitals (Berlin, Leningrad, Rio de Janeiro); (5) ex-imperial capitals (London, Madrid, Lisbon, Vienna); (6) provincial capitals that once had greater regional autonomy (Turin, Stuttgart, Munich, Montreal); and (7) super-capitals serving international government and organizations (Brussels, Strasbourg, Geneva, Rome, New York).

2.2. IKN Road Connectivity Concept

The road connection plan will connect the national activity centers of Balikpapan, Tenggarong, Samarinda, and Bontang (National Activity Center/PKN) in the cities of Balikpapan, Tenggarong, Samarinda, and Bontang. The integrated regional transportation network will be designed by KP-IKN (Agency of National Capital Development Area) and will include the main arteries and toll system, the Trans Kalimantan railway dual-track system, the Kaltim Kariangau Terminal port development project, the IKN cross-urban MRT network, and Sepinggan Balikpapan Airport (Figure 1). The river shipping lane network will connect the KP-IKN logistics system through its connection with Balikpapan Main Port. Between shipping lines, several logistics hubs were carefully created [5].

Regional Rail Network:

- 1- The Trans Kalimantan railway dual track will serve a combination of passenger trains and freight trains.
 - Trans Kalimantan Freight Passenger Double Train;

- Passenger Train is from Buluminung - Simpang Sepaku – Balsam Toll Road - KM.25 – KM.13 Samarinda;
 - Freight Train from Buluminung – Balang Island – KKT Port - KM.13 - KM.25 - KM.38 – Samarinda.
- 2- Adjusted to the development plan of the KKT port terminal which will be developed as a logistics port/container supported by the freight train network.
 - 3- IKN cross-urban MRT line and towards Sepinggan Balikpapan Airport.

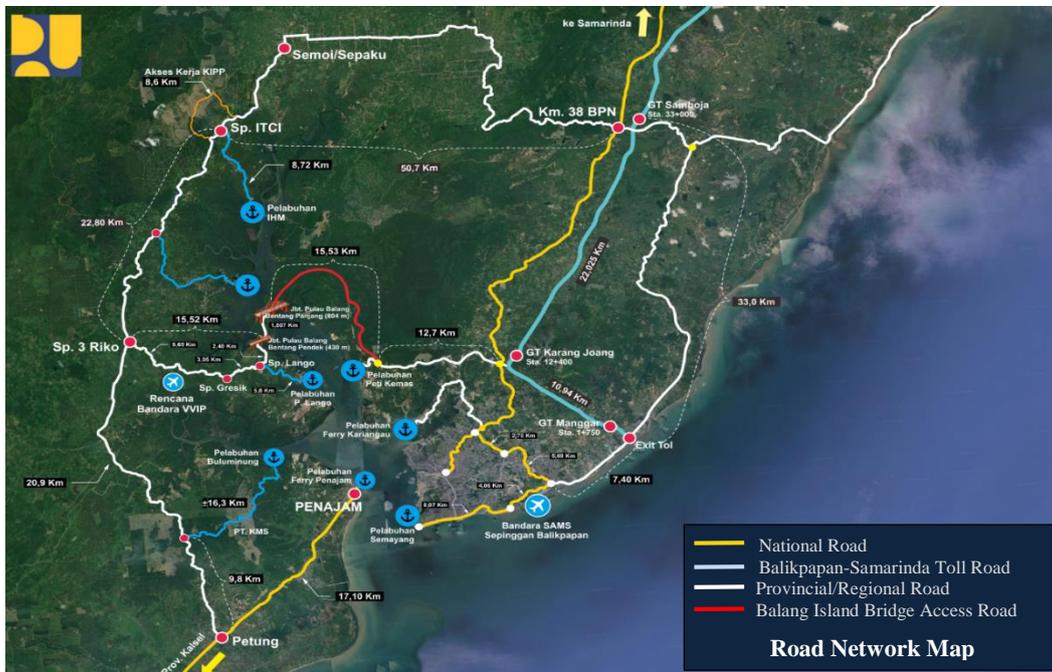


Figure 1. KP-IKN Road and Rail Network Plan Transportation System

A system is a collection of components, units, or integrity that support and collaborate to integrate the system [6]. As a result, if one component fails, the system as a whole is harmed [7]. While transportation in general can be defined as an effort to transfer, or the mobility of people or products, from one location, commonly referred to as the origin site, to another location, commonly referred to as the particular destination, for specific goals utilizing appropriate equipment, transportation in particular can be described as an attempt to distribute, or the mobility of people or products from one location, commonly referred to as the origin site, to another location, commonly referred to as the particular destination, for specific goals utilizing appropriate equipment [7, 8].

Based on the foregoing, the transportation system may be considered as a collection of interconnected components that support and collaborate in the procurement of transportation services that serve the region at all levels, from the local (villages and cities) to the national and international. Transportation consists of various components, including [9]:

- A cargo is being conveyed;
- A vehicle serves as a carrier;
- There are paths to take;
- There are two terminals: one at the beginning and one at the end;
- The human and organizational or administrative resources that support such transportation activities.

A region's transportation system may be characterized as a system composed of infrastructure / facilities and service systems that allow movement within the territory, allowing for people mobility, the flow of commodities, and access to all regions [10]. Transportation is extremely crucial in human life. The role of transportation in general can be classified as follows [11]:

- Transportation plays a part in human civilization where originally transportation is still normal, humans travel or move to satisfy the basic demands of existence, especially food, but as the age of human needs increases, so does the necessity for transportation.
- Transportation serves an economic function in bringing all components of producers (resources) closer together, allowing for the utilization of cheaper and higher-quality resources. Because not all locations have the same production factor, the production outcomes (goods and services) will be disseminated or distributed to all locations for consumption (resources).

- Transportation's function in social life is to assist the community's social activities, such as visiting to relations, religious activities, and other social activities. The importance of transportation from a social standpoint also plays a part in raising the social level in society, therefore many villages migrate to major cities in quest of a better life than they had in their native region.
- In the context of politics, transportation may be utilized as a national uniting mechanism, to assist large-scale government, to standardize the application of laws and courts, to improve equitable development, and to protect the state from external threats.

2.3. Macro Transportation System

The macro transport system consists of (Figure 2) [12]:

- Activity System (transport demand): This system is a set of land-use activities that encompasses social, economic, cultural, and other types of activity. The activities that take place in this system involve movement in order to meet everyday demands that cannot be met by land use. The type and intensity of activities performed are directly linked to the magnitude of movement.
- Network System (transportation infrastructure / transport supply): The employment of a mode of transportation (method) and a medium (infrastructure) in the context of people or goods demands the use of a mode of transportation (method) and a medium (infrastructure) through which the mode moves. A network system is a collection of roads, trains, terminals, buses, airports, and seaports that serve as transportation infrastructure.
- Movement System (Traffic): The interaction between the activity system and the network system (Point a, and b) will result in a human/vehicle movement.
- Institutional System (institution): To ensure the occurrence of safe, comfortable, smooth, easy and reliable movements and in accordance with the environment. Then a system is needed that regulates the three systems above. This system is called the institutional system. The institutional systems relating to transport problems are:
 - Activity System: Bappenas, Bappeda level I and II, Local Government;
 - Network Systems: Department of Transportation, Jasa Marga, Bina Marga, Public Works Office, etc.;
 - Movement Systems: DLLAJ, Regional Organizations, Traffic Police, etc. [13].

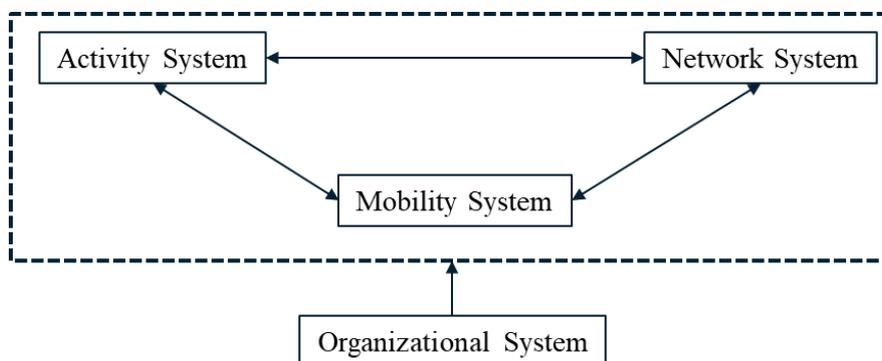


Figure 2. Macro Transport System Scheme

2.4. Road Network

Networking is a mathematical concept that depicts symmetrical or asymmetrical relationships between various items in the form of a graph to reflect the geographical properties of a region's transportation system [14]. Networking is the major way for gathering systematic data regarding road hierarchy and traffic flows in the field of transportation [15]. To put it another way, networks are used to quantitatively describe transportation and other systems that have regional characteristics [16]. As a first step in assessing the state of the transportation system's service, an assessment of the road network is crucial [17]. A road network, according to the reference, is a mathematical concept that may provide quantitative information on the interplay of transportation networks and other systems [18]. The road network must be hierarchical in order to function well in severely crowded areas [19]. The 1980 Road Act oversees road hierarchy, or classification based on road function, whereas the 1992 Traffic and Road Transport Act connects road classification to road role classification. As a result, the choice to build a road network system was made deliberately [20]. The pattern of supply is determined by the presence of a road network in a certain location. In terms of supply, the existence of a road network contained in an area determines the pattern of public transportation service networks [21]. The characteristics of the road network include the type of classification network, capacity and quality of the road [22].

2.5. Type of Road Network

Some ideal types of road networks are grid, radial, ring-radial, spinal, hexagonal and delta road networks. Figure 3 shows the type of road network [23].

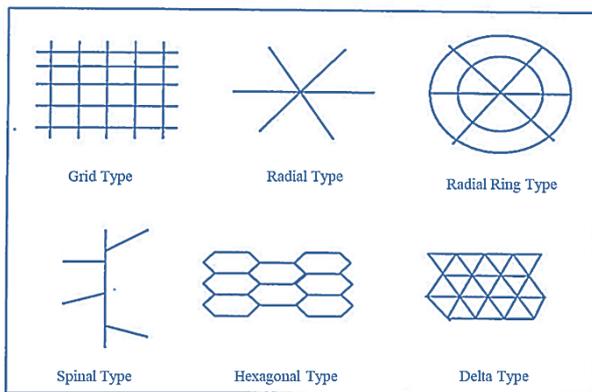


Figure 3. Type of road networks

2.6. Network Analysis

Network analysis is a depiction of a transportation system that made as simple as possible with various purposes that aim to solve a problem. Network analysis aims to find the minimum route of motion as a network to describe its components and relationships to each other with the main characteristics being travel time and cost [24].

2.7. Road Network Quality

The quality of the road network may be divided into three components: connection (connectivity and accessibility), traffic flow, and coverage [25]. The model employed is a basic network of lines (segments) and nodes (regional activity centers, transportation terminals, forks, or point geometry aids). Table 1 shows the network quality components [26].

Table 1. Network quality components

Function	Quality	Information
To connect different nodes of the region	Connectivity	How well nodes connect with each other
	Accessibility	How well a node can be accessed from another and vice versa
For traffic flow	Traffic flow schedule	Quality itinerary for each origin-destination couple.
	Traffic flow stability	Traffic flow performance: speed, delay, stop – traffic engineering
For region coverage	Coverage	How well the area is covered
	Density	How good is the network density

2.8. Connectivity

Connectivity refers to the relationship that exists between one element and another, either in the type of physical, operational, or other indications that may be linked [27]. Connectivity refers to how geographical things are functionally, physically, and logically related to one another. Connectivity is a graph component that describes the degree of connection between points or the number of arcs in a graph [28]. The connectivity index indicates that the area or region connected by the road network has a pattern that may be used to determine the interaction of a region. The road network connectivity index is a mechanism for determining the level of connection in a place by taking existing roads and nodes into account [29].

Connectivity theory in Indonesia may be used to road conditions in the region, as it is used to achieve good outcomes in the manufacturing and use of transportation in Indonesia subsequently. Connection theory is used to analyze connectivity in a region by understanding the character of the place in terms of its people's modernity, the smoothness of current traffic and transportation, and the smooth operation of the local economy [30]. The real state of connectivity in the field, can help plan and build infrastructure and as well as further facilities that support the implementation of regional development in the region concerned. The application of "graph theory" developed by can measure the extent of connectivity networks or road networks in an area which will also be able to reveal how the nature of connectivity or local road networks [31].

Previous researchers created graph theory by comparing the number of cities or locations that have numerous road routes as a way of linking those cities in measuring the potential strength of contact between regions examined from the

structure of the road network as transportation infrastructure. The Connectivity Index, according to Kansky, determines the degree of engagement. The greater the index value, the more road networks there are linking the cities or areas under consideration. Because road infrastructure considerably improves transportation across areas, this has a significant impact on potential movement of people, products, and services [32].

2.9. Quality of Connectivity

The grade of connection is determined by how well nodes are linked to one another across the road network. Improved connectivity can reduce traffic on arterial roads, reduce travel time, create shorter mileage and reduce the number of vehicle-kilometers traveled, provide sustainable and more direct routes for walking and cycling trips, provide greater emergency vehicle access and reduced response times, provide better utility connections, easier maintenance, and more efficient waste retrieval and recycling, lower speeds and lower accident rates [33]. Figures 4 and 5 highlight the benefits of connectivity as well as the efficiency of connectivity [34].

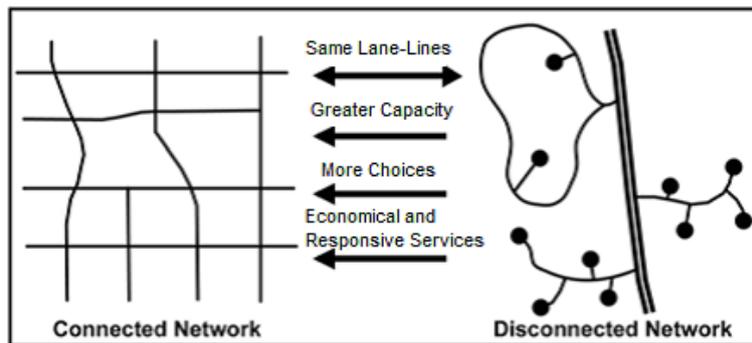


Figure 4. Benefit of Connectivity

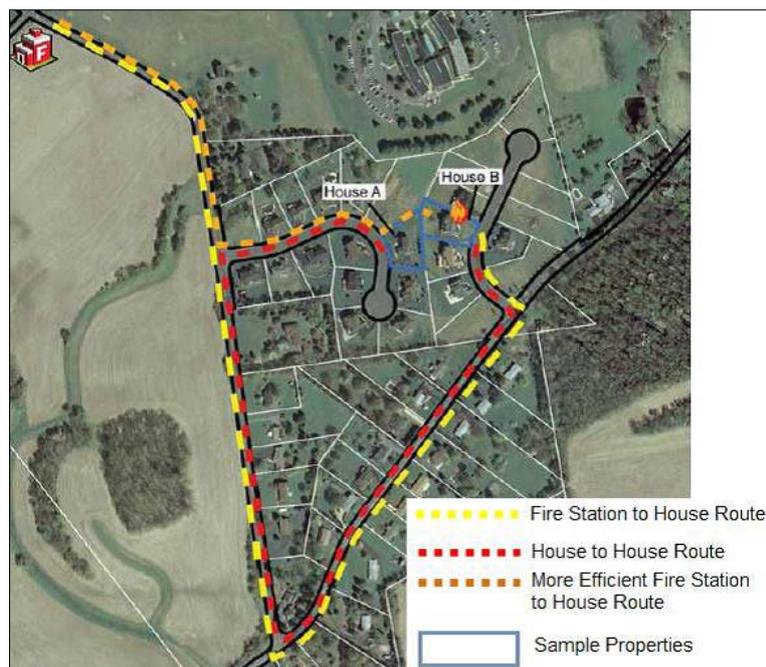


Figure 5. Sample of efficient connectivity

The level of relative connectedness in a transportation network (Information on webspace ship.edu, 2015):

High Connectivity = Low Insulation, High Accessibility.

Low Connectivity = High Insulation, Low Accessibility.

2.10. Accessibility

Accessibility is one of the most important aspects of network analysis. “Accessibility”, is a criteria that must be met in terms of the convenience of getting there. Transportation infrastructure, or ease of accessibility, is crucial to a region's economic growth. In actuality, the province's significant mobility is distributed along arterial roads [35]. One of the market's potential features, is already widely used in transportation planning to evaluate the impact of accessibility on

the construction of transportation infrastructure. Spatial multi-lateral resistance (SMLR) captures the influence of all articles in a system as long as each bilateral particle has a connection [36].

2.11. Mobility

It is measured by the number of travels (movements) made from one location to another as a result of the high level of accessibility between these sites. That is, there is a one-way relationship between accessibility and mobility, implying that the higher the accessibility, the greater the mobility of people, cars, or other objects moving from one location to another [37].

3. Methodology

This study used the study of literature approach, which included data from books, journals and reading materials as well as reputable sources. The data is assessed using transportation theory and road network development theory. The Regional Statistics Agency, the Public Works Office (Development Office), the Spatial Planning Office, and a number of other government entities participating in the IKN development plan provided data for this research. The initial assessment concentrated on the partner region that surrounds the IKN. When assessing local resources that affect development, they are measured from the shortest distance from the IKN's outer ring. The examination then focused on a specific location that appealed to local wisdom and considered the area's growth prospects (Figure 6).

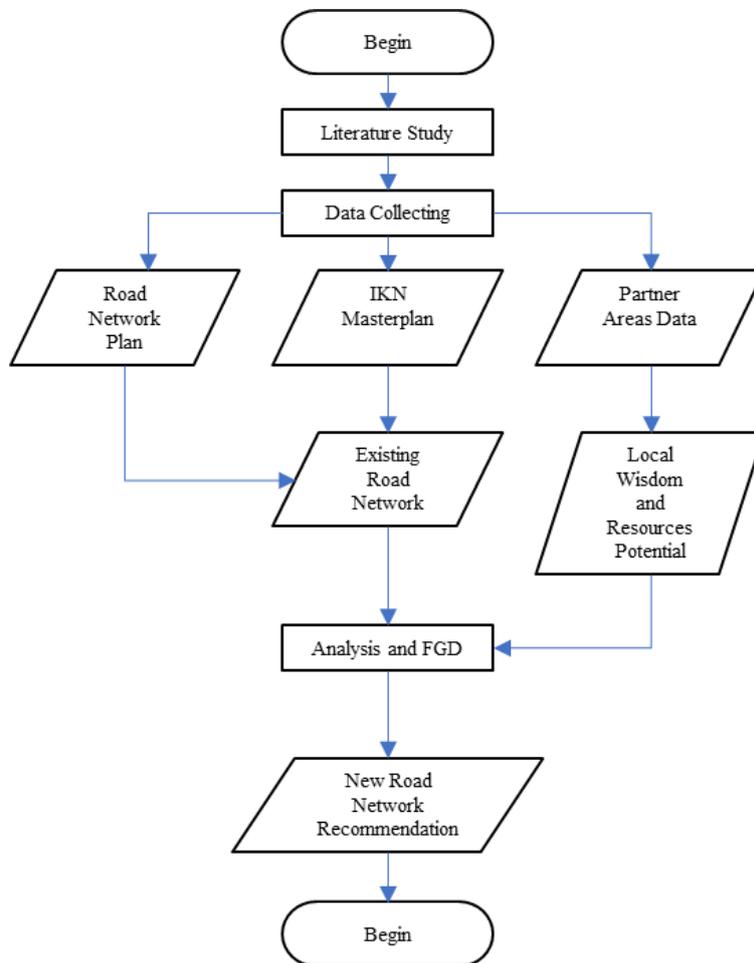


Figure 6. Flowchart of the Research

4. Results and Discussions

4.1. Potential, Resources and Local Wisdom of the Partner area

Kutai Kartanegara Regency

Kutai Kartanegara Regency has a land area of 26,326 km² and a sea management area of 2,220.37 km². Its headquarters are in Tenggarong. With a total population of 538,529 people, this Regency Administrative Area is organized into 18 sub-districts, and the regional development acceleration program is known as *GERBANG DAYAKU* (Dayaku Empowerment Development Movement). This site is also known as a cultural tourism city, with attractions

such as the Kumala Island Fantasy Arena and the Mulawarman Museum, which has Indonesia's earliest royal inscription (IV century). Oil and gas, coal and other mining products, forestry, fishing, livestock, and other businesses all have potential. Plantations, livestock, and freshwater fisheries are all viable options for investors looking for a low-risk investment. The potential and investment possibilities of plantation sub-sectors are centered on a range of commodities, particularly those that attract less attention. The plantation sub-sectors that have witnessed the most development and empowerment include oil palm, cocoa, rubber, sugarcane, banana, abaca, pepper, and rami.

North Penajam Paser Regency

Penajam Paser Utara Regency is an East Kalimantan district (Figure 7). Penajam is its capital. This regency is bounded on the north by Kutai Kartanegara Regency, on the east by the Makassar Strait and Balikpapan City, on the south by Paser Regency, and on the west by West Kutai Regency. Penajam is a Paser Regency expansion area. The area of this regency is 3,333.06 km² with a population of 110,240 (2002) people. North Penajam Paser Regency is located between the coordinates 00° 48' 29" and 01° 36' 37" LS and 116° 19' 30" and 116° 56' 35". The North Penajam Paser Regency has a lot of promise in the plantation industry. There is still a huge area that can be utilized, which might be used to entice investors to invest in this region. To assist investors in this plantation, infrastructure and facilities such as roads and transportation are accessible.

Oil palm, rubber, coconut, coffee, pepper, and cocoa are the most common plantation crops produced in North Penajam Paser Regency. The number of farmers, crops produced, production, and productivity are used to evaluate the agricultural production of plantation crops. Oil palm commodities are the most prominent plantation crops in Penajam Paser Utara.

Kutai Barat Regency

West Kutai Regency is a district in Indonesia's East Kalimantan province. The capital of the district is Sendawar. This district has a population of 136,161 people and spans 33,052 km². The enlargement of Kutai Regency, which was formed in compliance with Law No. 47 of 1999, resulted in the formation of West Kutai Regency. West Kutai is located between 113°04'05" and 116°03'19" E and 1°31'35" and 1°10'16" S. Up until now, the plantation sector has been responsible for the development of rubber and oil palm. A total of 190,451 hectares of plants were employed in this project. Rubber (34,964 tons), oil palm (690,269 tons), robusta coffee (23 tons), and coconut oil are among the outstanding commodity plantings produced by this area.

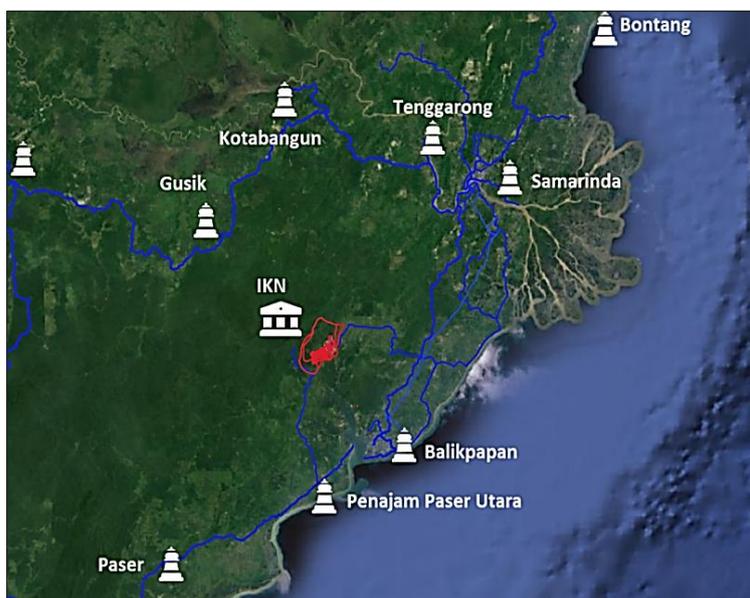


Figure 7. East Kalimantan Province road network map

Boundaries of Central Kalimantan Province

Joko Widodo, President of the Republic of Indonesia, has recognized Central Kalimantan Province as a food estate development region with the potential to become a national food barn. The food barn is located on 165,000 hectares in the Pulang Pisau and Kapuas Regencies. A "food estate" is a concept for food growth in a given area that includes crops, plantations, and even animals. Food estate is one of the national strategic plans from 2020 to 2024. In Central Kalimantan, the food estate effort has resulted in a variety of positive outcomes, including infrastructure development, employment creation, and economic growth.

4.2. Analysis of Local Wisdom

The study was carried out in this case by looking for the shortest distance immediately from the outer ring road IKN to the next sub-district/village with the potential for resources and local wisdom, while also considering the potential for regional development and new economic growth regions (Figure 8). The following are some of the regions that were picked:

- Senoni, Sebulu. Kutai Kartanegara Regency. The IKN outer ring road design is 57.97 kilometers away from Senoni. Mountain boulders, coal, rubber, fruit, and a variety of fish in the Mahakam River are among the natural riches that Senoni Village has to offer. Byproducts of waste coal burning might be used as fly ash for additional concrete strengthening elements, boosting the industrial sector of the construction industry, notably coal, which is the province's basis.
- The Mahakam River could be used to create a marine tourist destination on the water's edge. The Kutai Kartanegara Regency, which has attractions like the Kutai Kartanegara royal museum, Dayak ethnic dance, and other local wisdom, is also accessible from this town.
- Muara Gusik is located in the district of Bongan, Kutai Barat Regency. Muara Gusik is 53.93 kilometers from the IKN outer ring road layout. Muara Gusik Village is located near the borders of West Kalimantan and North Kalimantan Provinces, as well as the Malaysian border.
- Tukuq is in the West Kutai Regency's Bentian Besar District, and it shares a border with Central Kalimantan Province. The IKN outer ring road plan is 109.46 kilometers away from Tukuq. Tukuq, as a food estate development effort with the potential to become a national food barn, serves as a gateway to Central Kalimantan Province.

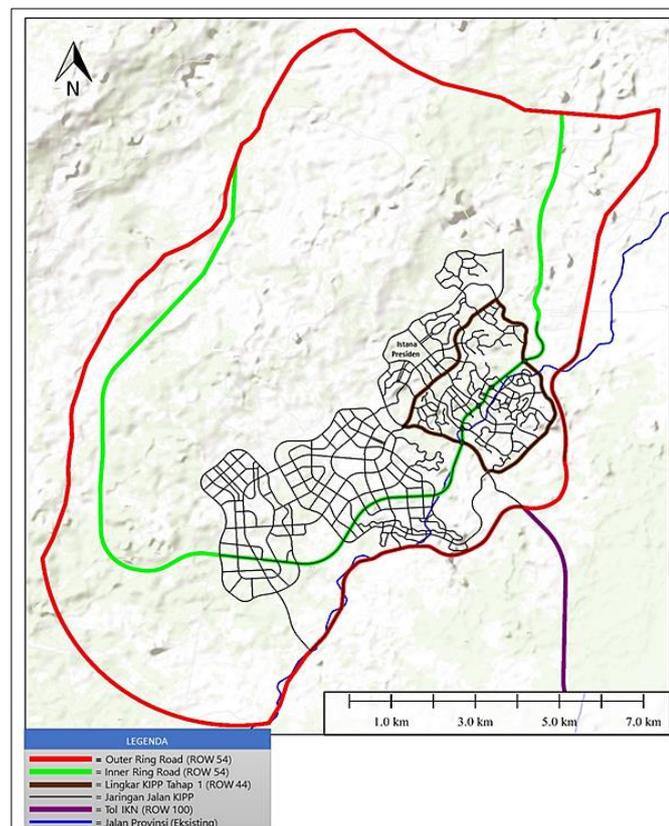


Figure 8. IKN Area road network map

4.3. Economic Opportunities in The New Capital

Kutai Kartanegara and Penajam Paser Utara's Economic Potential Mining activity at the site will likely end once the capital is formally relocated. Furthermore, oil palm harvests can only be sustained for a certain amount of time. Once the capital is formed, mining will undoubtedly end. The goods and services sector, of course, will dominate because it will offer food, vegetables, fruits, accommodation, and cooking materials to the 1.5 million people who will migrate. The regencies of Penajam Paser Utara and Kutai Kartanegara may be able to take advantage of opportunities and satisfy the need for a new capital city by exploiting existing local resources as well as the environmentally friendly industrial sector linked to product and service demands.

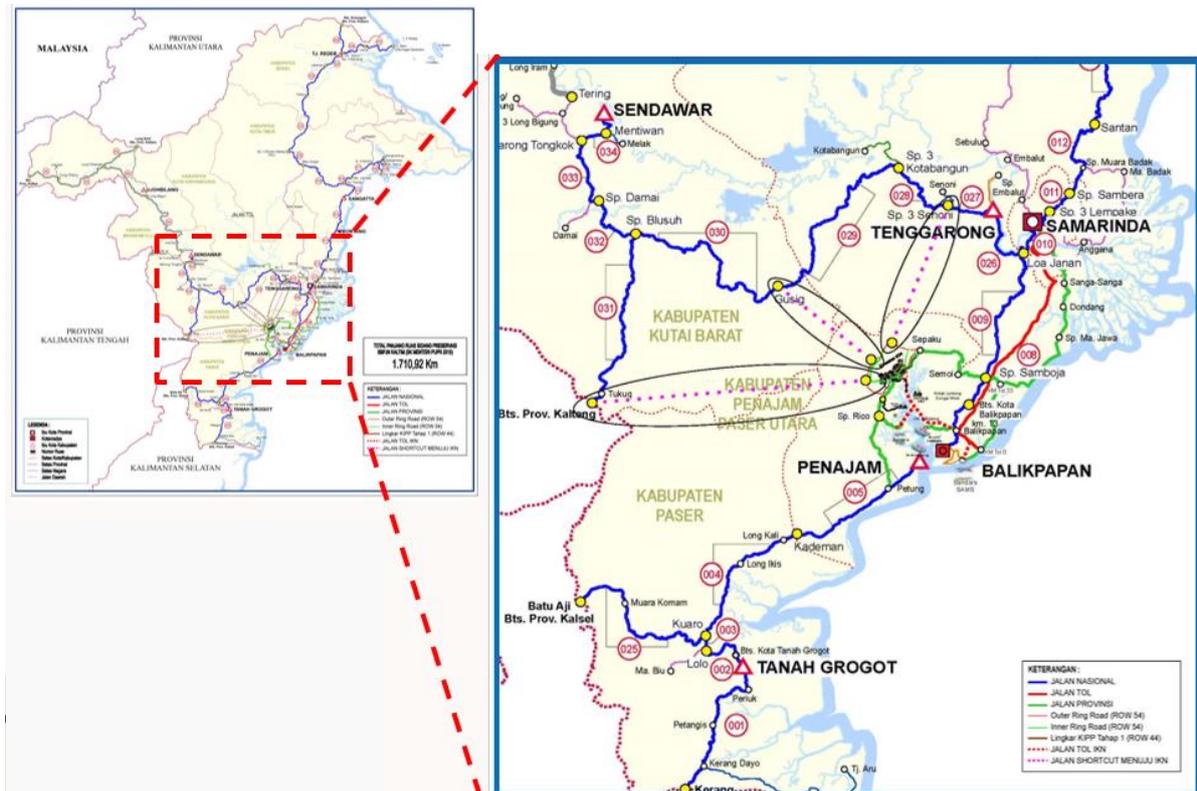


Figure 9. Road Network Development Concept in the Area around IKN Partners

4.4. Business Opportunities for The Community

Based on the aforementioned circumstances, the potential business opportunities of various business sectors that will undoubtedly develop around the state capital, which is administratively located in East Kalimantan, specifically in Kutai Kartanegara regency and North Penajam Paser regency, are very promising if government policy policies in the economic and development sectors are optimally mandated, planned, and supported. Culinary, residential and hospitality businesses, travel agencies, home industries, construction, transportation, agriculture, farming, and a variety of other businesses are examples.

5. Conclusion

The idea of extending a new road network to numerous locations, including Senoni (Kutai Kartanegara), Gusig (West Kutai Regency), and Tukuq (Central Kalimantan Province Border), is considered to be able to increase economic development, investment opportunities, and the potential for alignment of transportation networks between the inner ring and outer ring of the IKN area. These three locations were chosen because they offer the potential for resources and local wisdom, as well as the opportunity to create new areas and economic growth zones. Senoni, with its local wisdom and water resources, may be exploited as an entertainment and tourist destination. This has the potential to attract a large number of investors interested in building tourist regions, as well as provide chances for local inhabitants to offer goods or services in these locations. Tukuq can be used as a food source for the IKN area and the surrounding area. This opens opportunities for the integration of sustainable food security for stakeholders and the community. Meanwhile, Gusig can become the potential of a new city area that can be used for retail investment, logistics, entertainment centers, industry, and so on. With a large area of free land, the development pattern in Gusig is the most strategic when it comes to investment.

6. Declarations

6.1. Author Contributions

J., S.A.A., M.S.P., and M.I.R. contributed to the design and implementation of the research, to the analysis of the results and to the writing of the manuscript. All authors have read and agreed to the published version of the manuscript.

6.2. Data Availability Statement

Data sharing is not applicable to this article.

6.3. Funding

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6.4. Acknowledgements

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6.5. Conflicts of Interest

The authors declare no conflict of interest.

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