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Engineering Development Of Passenger Transport Routes In Tarakan City

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ABSTRACT: *The transportation problems of passenger transport (TAP) in Tarakan city are multi-dimensional, such as unstructured and uneven route, uncomfortable and less secure, overload of passengers during peak hours, condition of operator system, increased pollutions and noises and accident rates and traffic violations, and driver behavior. In brief the basic of the problem is the unity between Spatial Area Planning (RTRW) Tarakan City with TAP. The purpose of this study is to develop TAP trajectory in Tarakan City based on descriptive statistical method to: see demand of population movement; route performance, and the performance of transportation infrastructure, and the level of road service. The results found that the development of routes based on the existing performance of TAP in Tarakan City can be optimized for secondary road service level where the increasing of vehicle volume is significantly influenced by high population movement, land use, service level, transportation convenience, load factor, and road condition.*
KEYWORDS:*passenger transport, route, transportation, Tarakan*

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I. INTRODUCTION

Transportation problems in Tarakan City including: increased routes and parking areas, high rates of accidents and traffic violations, widespread congestions and delays, high levels of pollution and noise and reduced driving comfort and safety. While the specific issues are: (a) operational (tariff, convenience, security, punctuality, etc.); (b) management (routes, licenses, fleets, funds, subsidies, etc.); and (c) planning (spatial and environmental, investment, etc.).

Some of the problems that happen in the operation of urban TAP are: (1) the the passengers desire that the available facilities are many, cheap, fast, safe, and convenient, (2) the operator desire to get the maximum profit without paying attention to the passengers' desire; the desire of the driver to get many passengers for high wages and deposits; incompatibility of fleets and movement requirements; and (3) indiscipline of the drivers will increasingly complicated the problem (Tamin, 2005; Riyanto, 2007).

In general, TAP in Indonesia and especially Tarakan City can be grouped into two categories: TAP motor (ojek, bajaj, taxi, mikrolet, minibus, and city bus) and non-motorized TAP (pedicap, andong). The two categories of TAP have characteristics of passenger and goods, speed, cost of operation and maintenance, price, tariff, road space used, safety and environmental impact (Soegijoko, Warpani, 2002).

Complete it. Soegijoko (1991) compares the characteristics of TAP based on: average speed, per km passenger load, road space used, and security. While Tamin (2005) emphasized that detailed and deep review of the characteristics of TAP is also directly related to the larger scale of the region and city. Thus, the assertion of Tamin (2007) TAP problems of city depends on: service level, number of fleets, and effective route system.

The regulation of the urban transportation system in Indonesia is still using the conventional approach, namely prediction and provision (predict and provide). While the new paradigm lead on Transportation Demand Management (TDM) which prioritizes prediction and prevention (predict and prevent). Implementation of the TDM concept leads to change, because of shifting movements such as: time shift; shifting route or location; modal shift; and the shift in destination location (Tamin, 2005; Koesbiantoro, 2006).

Miyamoto (2006) stated that the essence of sustainable transport system (STS) requires the efficiency of transportation by reducing dependence on motor vehicles by replacing alternative modes. The concept of STS

by Matsumoto (2008) can be shortened to the Three E's, namely: economy, environment and equity for resistance to the Three P's: poverty, population, and pollution.

Solving transportation problem to face various options and must be conducted simultaneously and mutually especially the relation with RT RW and development policies of regional and national based on three pillars of approach: land use planning, reduction of the traffic of private vehicle and promotion of public transportation (Riyanto, 2007).

The basic principles of the TAP route system are closely related to the best selected route from the origin point (A / O) to the destination point (T / D), while the route network is the set of routes into one unity of service. This is in line with the direction from the Directorate General of Land Transportation (2014) which considers: land use patterns, TAP passenger movement patterns, population density, areas or service areas, and characteristics of the road network.

The effectiveness and efficiency of the operation and determination of the number of fleets based on the study of several parameters: load factor, the number of passengers transported, the time between (headway), passenger waiting time, travel speed, slowness causes, transport availability, and fuel consumption being parameters for TAD route and operational performance (Directorate General of Land Transportation, 2014).

If simplified, TAP problems in Tarakan city are: 1) congestion in the city center; 2) the presence of underserved community groups, due to limited radius of services; and 3) increased pollution due to TAP, and social, economic, and environmental issues.

Therefore, this research was conducted for response to TAP system problems in Tarakan City, especially on accessibility review in the form of assessment of the effectiveness of structuring arrangement, and the achievement of spatial and transportation synergy in the form of optimization of spatial and transportation interaction.

The purpose of this study are: assess, analyze, and formulate the performance of the TAP route in Tarakan City integrated with RTRW Tarakan City in 2010-2030. The expected benefit is the compilation of information about the performance of the TAP pattern in Tarakan City to obtain the sustainability level.

II. METHOD

This study examines the development of TAP routes in Tarakan City based on the existing performance of TAP based on RTRW Tarakan City in 2010-2030. Collecting secondary data obtained from the Department of Transportation of Tarakan City, Public Works Department of Tarakan City on Bina Marga and Tratalok documents of Tarakan City that representative and relevant to the topic of this study, while primary data is taken directly in the field through observation and survey.

In addition, interviews were conducted directly to TAP driver of Tarakan city on board (on board survey) and observation of selected routes in one trip in Tarakan subdistrict. The analysis of TAP route development in Tarakan City was conducted to find out the significant factors in determining route and service operation of each TAP route and formulated mathematically multiple linear regression as follows:

$$\mathbf{Y_1 = a_1 + b_1X_1 + b_2\ X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8}$$

information :

Y_1 =Dependent variable of route and operation performance

a_1 =Constants of route and operation performance

b_1X_1=Parameter and independentvariable of load factor or filling(man)

b_2X_2=Parameter andindependentvariable of passanger number transported (man)

b_3X_3 =Parameter and independent variable of time between(minutes)

b_4X_4=Parameter and independentvariable of passenger waiting time (minutes)

b_5X_5=Parameter andindependentvariable of travel speed (km/hour)

b_6X_6=Parameter andindependentvariable of slowness caused (activity)

b_7X_7=Parameter andindependentvariable of transportation provider(unit)

b_8X_8=Parameter andindependentvariable of fuel consumtion rate (liter)

To support the selection route of TAP as a function of the optimal route is done with the phase of selection of optimal route that uses the data of travel distance or interaction between regions in the city of Tarakan using Lowry Model and road network data with the best route from one point on the road that has been determined on 4 districts. The process of spatial analysis in the TAP management of optimal route selection using road network data where the best route from one point is determined based on the distance of the road to land use pattern map and population density.

III. RESULT AND DISCUSSION

The plan of spatial structure function of Part of the City (BWK)in 2010 Tarakan City has been determined in 4 BWKs based on the subdistrict and includes: area, main function, and supporting functions. The development of Tarakan City space utilization structure which has been planned in RTRW 2010 - 2030 (Bappeda Tarakan City, 2016) is explained into the strategic area as illustrated in the following map.

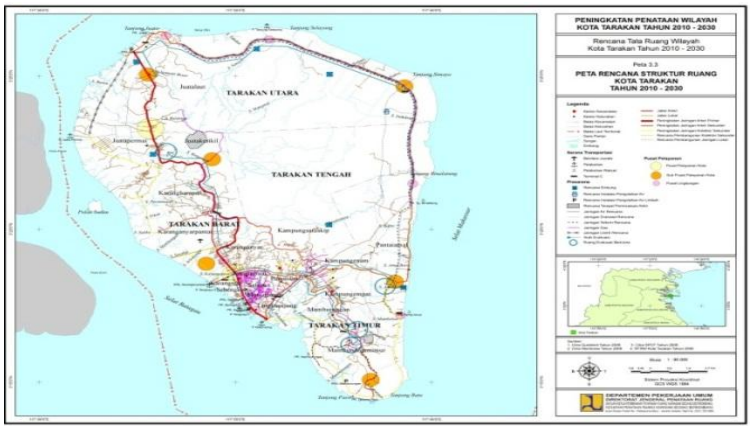


Figure 1. Structure of Space of Tarakan City
(**Source**: RTRW Tarakan City 2010 – 2030)

RTRW Tarakan city has directed the city center in 2 (two) locations, namely Tarakan Old Town Center, covering part of West Tarakan, Central and East districts and New Town Center, which is a new center plan in North Tarakan District. The dynamics of Tarakan City development until 2008 indicate the importance of the role of East Tarakan District in the future. The construction of the University of Borneo and the development of tours in the Amal beach will be a magnet and the attraction of the region's growth. East Tarakan district will tend to develop as an area with the main function of education and tourism area.

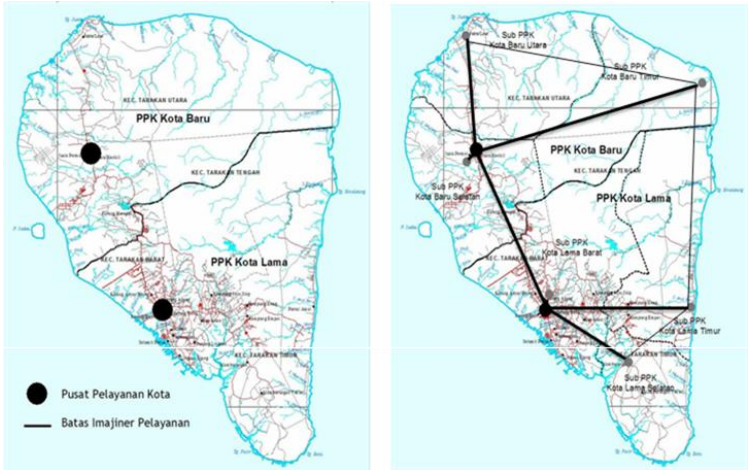


Figure 2. The Center of Tarakan City Services Map
(**Source:** RTRW Tarakan City 2010 – 2030)

1.1 Transportation of Passenger Transpot in Tarakan City

TAP in Tarakan City basically consists of land, water and air modes. Transportation in Tarakan City is specifically dominated by land transportation. These land transportation conditions include road networks, TAP routes and terminals. Based on its status, until 2016 the Tarakan City road network is about 169,037 Km. The road network system in Tarakan City has a linear pattern that connects the northern, central and eastern cities with the city center and grid pattern that located in the settlement.

The development of city transportation system in the form of engineering and transportation management is directed to spur the economic, social and physical development of Tarakan City. The land transport network system in Tarakan City including: (a) traffic network of transportation; and (b)transpostation networks of river, lake, and ferry. While the traffic network of road transpotation, including:

a) Road network

1) Primary road network system that is primary artery, covers segment, P. Aji Iskandar Street; Aki Balak Street, Bhayangkara Street, Mulawarman Street,Yos Sudarso Street,
2) Secondary road network system consists of:

(a) Secondary arterial road network system includes Ring Road Sea of Juata –Amal Beach, Gajah Mada Street, Jenderal Sudirman Street, Kusuma Bangsa Street, REM Artadinata Street, Banda Road, Kalimantan Street, Patimura Street, Sumatera Island Street, Sadau Island Street, Sesayap River Street, Kapuas River Street, Kayan River Street, Mahakam River Street, and Sembakung River Street.

(b) Secondary collector road network system includes the NewBeach Amal Street and Mamburungan Street.

3) The direction of road network system development consists of:

(a) Improved road conditions for both primary and secondary arterial routes; and

(b) Construction of new routes as an extension of existing roads for secondary collector roads;

b) The network of traffic and road transportation infrastructure consists of:

1) Crossroads on Mulawarman Street, Yos Sudarso Street, Gajah Mada Street, Jenderal Sudirman Street, Kusuma Bangsa Street, Diponegoro Street, Panglima Batur Street, Halmahera Street, Sumatera Street, Teuku Umar Street, Martadinata Street, Sesayap River Street, Sadau Street.
2) Availability of median contained in Mulawarwan Street, Yos Sudarso Street, Kusuma Bangsa Street, Gajah Mada Street.

c) The network of traffic services and road transportation includes the terminal development plan. Provision of terminals, linked to planned service center systems at City Service Centers, in Sub Service Centers of the City and in the Juata Sea Crossing Port area. The development of the terminal consists of:

1) The development of C-type terminals includes: (a) The Length Boom Terminals in Pamusian Sub-district, Central Tarakan District; and (b) Terminal of Simpang Tiga in Karanganyar Pantai Sub-district, West Tarakan District.
2) Development of sub-terminal, includes: (a) Subterminal of Amal Beach in Amal Beach Sub-district, East Tarakan District; (b) Simaya Cape sub terminal in Juata Sea sub-district, North Tarakan District, and (c) Sub terminal of Juata Sea in Juata Sea Sub-District, North Tarakan District.

d) Bridges connecting Tarakan City-Bulungan City.

The planned construction of the 5km-long Tarakan-Bulungan bridge will be built in Karang Harapan Sub-district of West Tarakan District and going through Sadau Island, see the following picture.

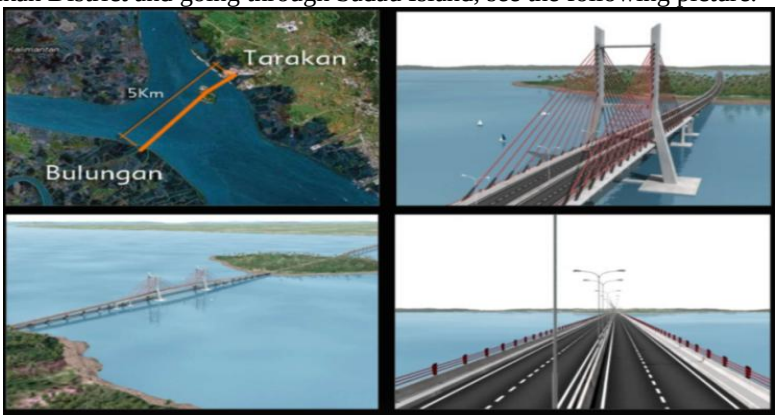


Figure 3. Brige Plan Tarakan – Bulungan

e(**Source :** RTRW Tarakan City 2010 – 2030)

1.2 Performance of TAP Route

The performance of the TAP route in Tarakan City is analyzed and rated based on effectiveness, efficiency, and user satisfaction as well as its qualitative function in the form of capability, effort, and opportunity for businessman in providing TAP.

Performance analysis of TAP route of Tarakan City is calculated by correlation statistic projection and multiple regression analysis, where Y_2 or route performance as dependent variable. While the independent variables are: load factor / charging (X_1), number of passengers transported (X_2), passenger waiting time (X_3), slowness caused (X_4), transportation provider (X_5), fuel consumption rate (X_6) time between (X_7) and travel speed (X_8), assumed as factors that can improve the performance of the TAP route in 4 districts in Tarakan City, the relationship seem real particularly in 3 (three) main routes. Routes ABoom Panjang – Kusuma Bangsa Street – Yos Sudarso Street – Gajah Mada Street – Mulawarman Street – Sudirman Street – Martadinata Street – Sumatra (Ladang) Street –Patimura (Markoni) Street – Slamet Riyadi Street – streets in the city), B (Gusher – Juata Kerikil), and C (Gusher – Juata Kerikil) with the summing scale of the priority route.

Table 1. TAP Route Existence in Trakan City

Route	Existing Route
A	Boom Panjang –Kusumabangsa Street –Yos Sudarso Street – Gajah Mada Street – Mulawarman Street – Sudirman Street –Martadinata Street – Sumatera(Ladang) Street – Patimura (Markoni) Street– Slamet Riyadi Street – streets in the city
B	Gusher Terminal – Juata Kerikil
C	Gusher Terminal – Juata Laut

Sources: Arrangement of Local and Highway Transportation of Tarakan City on 2010

The formulation of correlation and regression analysis result of TAP route performance in Tarakan City is $Y_1 = 50.213 + 0.801X_1\text{-}4.348X_5$. Performance of TAP route of Tarakan City based on the distribution of the route is significantly influenced by load factor (X_1), and significant by the provision of transportation (X_5) , while the number of passengers transported (X_2), time between (X_7), passenger waiting time (X_3), travel speed (X_8), lagging causes (X_4), and fuel consumption rate (X_6) .

Thus it can be concluded that the priority spreading route has followed the normal distribution. The results of analysis and assessment demonstrate that the factors affect the performance of TAP routes in each route is highly varied. Route categories based on various factors and relatively low across all routes; Average category in route B (Gusher - Juata Kerikil), route C (Gusher - Juata Laut), and high category in route A (Boom Panjang - Kusuma Bangsa Street - Yos Sudarso Street - Gajah Mada Street – Mulawarman Street - Sudirman - Jalan Martadinata - Sumatra Street (Field) - Patimura Road (Markoni) Street - Slamet Riyadi Street - streets in the city).

Thus it can be interpreted that the condition is in line with some problems of TAP in Tarakan City, namely: the level of accessibility is still low so that the public have to make several times the movement of transportation until reach the destination, and still there is unofficial urban transport in addition to the use of other modes such as dark taxis on SDF Tengkayu II Port, relatively high waiting time of transportation at non-busy hours, long route distance especially to North Tarakan (Sea Juata and Juata Pebbles), and passenger load factor that fluctuates with short frequency during peak hours : hours left and home from work / school.

1.3 The Development of TAP Route in Tarakan City

Based on the analysis result of TAP route performance in Tarakan City, its development is recommended through residential area (mainly medium and high density housing area). It is interpreted that in medium and high density residential areas are generally inhabited by middle and lower income populations, which are more in need of public transport services.

TAP Mode in Tarakan City is served by 2 (two) types of transport, those are oplet / mini cabin and station wagon. In addition, it is also completed by a special bus that serves the factory workers in the Tarakan City. For the condition of vehicles in the Tarakan City, then the motorcycle is a type of vehicle that still dominates its use by communities of Tarakan City.

Although public transport routes in Tarakan City have been determined by Tarakan City Government, but in reality the majority of TAP movements do not follow the specified routes. In general, they pass the route of origin of destination in accordance with the demand of passengers. This makes it difficult to differ one route from another due to uncertain routes, vehicle types and different colors.

Recommendations proposed in the development of transportation systems in Tarakan City is structuring the route system that serves all parts of the city conducted dial following the pattern and structure of urban space.

Figure 4. Atmosphere Around the Boom Panjang Terminal

(**Source:** Researcher Documen, 2017)

TAP infrastructure performance in Tarakan City in support of TAP services is assessed and analyzed based on needs, mode selection, vehicle technology, heaviest load, and road construction and visual observation of conditions and limitations of infrastructure in the field.

In addition, the performance of TAP infrastructure in Kota Tarakan is also assessed based on the effectiveness and efficiency of infrastructure requirements compared to ideal conditions based on applicable standards or regulations. Based on the criteria above, it can be identified the variables that can affect the performance of TAP infrastructure in Tarakan City, which can be predicted in the model of transportation infrastructure.

Figure 5. Atmosphere Around the Gusher Terminal

(**Source**: Researcher Documen, 2017)

The analysis of transportation infrastructure performance that support TAP in Tarakan City is calculated by correlation statistical projection and multiple regression analysis, where Y_2 or transportation infrastructure performance is dependent variable. While the independent variables that can improve the performance of transportation infrastructure are: X_9 is a stop place as a function of the percentage of passenger TAP facilities based on the needs and conditions in the city of Tarakan (% unit); X_{10} is a stop as a function of the percentage of TAP facilities based on the needs and conditions in the city of Tarakan (% unit); X_{11} is bus priority as function of percentage of passenger TAP facility based on needs and condition in Tarakan city (% unit); X_{12} is an information system as a function of the percentage of passenger TAP facilities based on the needs and conditions in Tarakan City (% unit); X_{13} is a road geometry as a function of the percentage of geometry based on the needs and conditions in Tarakan City (% unit); X_{14} is a road condition as a function of percentage of road condition based on good and bad condition in Tarakan City (% state); X_{15} is road capacity as a function of large percentage of road capacity based on existing plans and facts in Tarakan City (% area); and X_{15} is the volume of traffic as a function of the percentage of total traffic based on the plans and facts that exist in Tarakan City.

The result of correlation and regression analysis from TAP infrastructure performance in Tarakan City (East Tarakan district, Mid Tarakan district, West Tarakan district, and North Tarakan district) the regression equation is formulated as: $Y_2 = 115.439 + 0.497X_{14}$. The test results using t-test concluded Sigkonstanta and road network conditions in Tarakan City >Alpha so statistically significant.

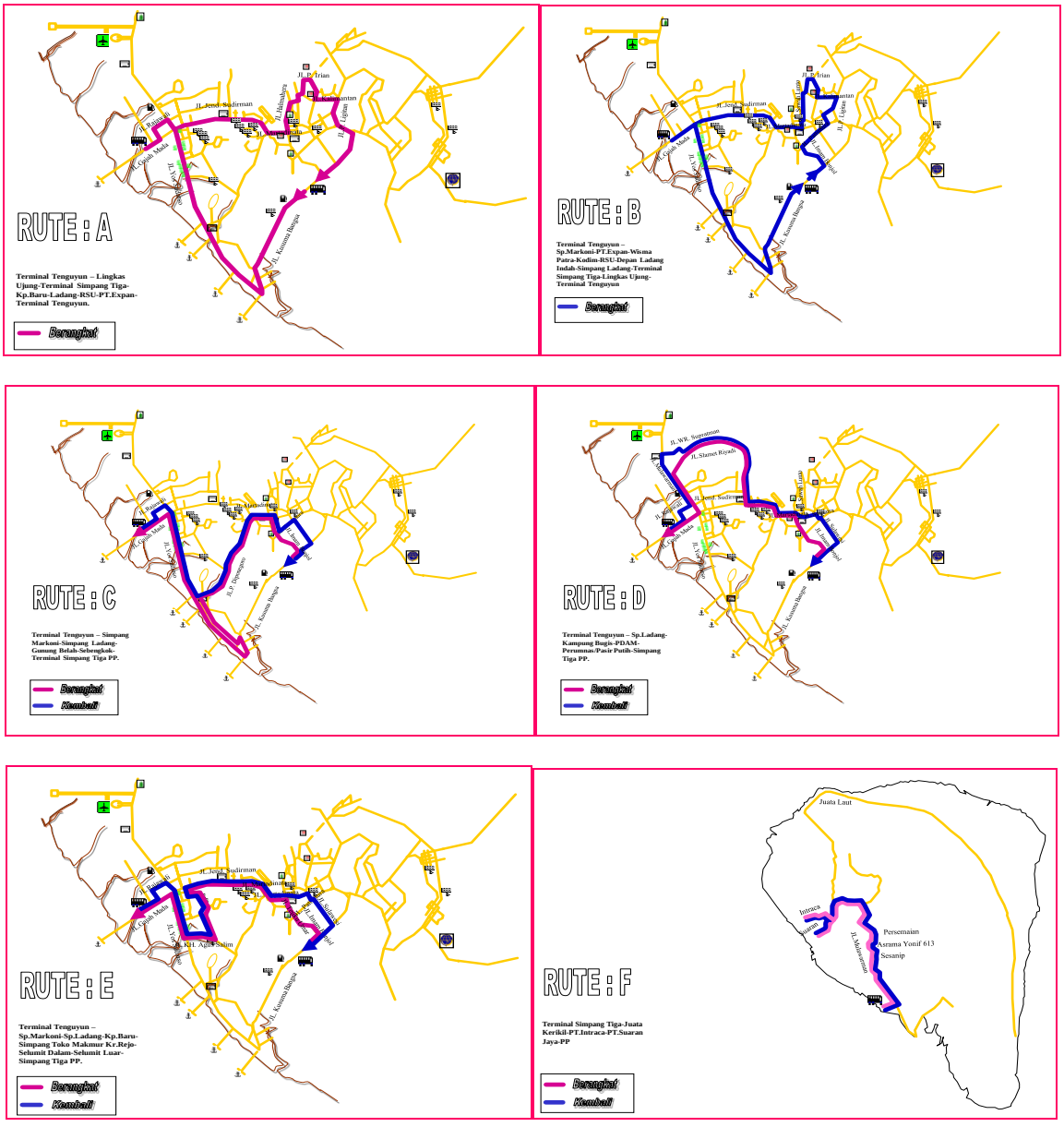
Based on its distribution and potential, transportation infrastructure performance in Tarakan City is generally significant and influenced by road condition factor (X_{14}), while road geometry factors (X_{13}), traffic capacity (X_{16}), road capacity (X_{15}), stop spot (X_9), bus stops (X_{10}), priority bus (X_{11}) and information systems (X_{12}), are less significant. Therefore, it can be said that the performance of TAP infrastructure in Tarakan City has a positive effect on the condition of the road network (0.497). Based on these conditions, the performance of TAP infrastructure in Tarakan City in the future is strongly influenced by the condition of road network condition (69% good condition and 31% damaged).

With the transportation infrastructure as mentioned above, the decreasing of the accessibility level of the city especially during peak hours especially on the main road (Mulawarman Street, Gajah Mada Street, Yos Sudarso Street, Sudirman Street, Martadinata Street) the capacity of the road to the last volume traffic is not sufficient anymore and impact on the occurrence of delay until congestion.

In the future, the performance of transportation infrastructure of Tarakan City is influenced by the condition of road network (X_{14}) as the main factor / variable (East Tarakan district, Midle Tarakan district, West Tarakan district, and North Tarakan district), especially for management function that is transportation control aspect.

Considerating the existing performance of passenger transport routes and the performance of transportation facilities and infrastructure, and the increasing demand for passenger and population movement to TAP in Tarakan City, the diversification and or development of modes of transportation becomes a necessity. In line with the directives in Tratalok and RTRW Tarakan City 2010 - 2030 insertion.

The recommendation proposed for the development of the TAP route in Tarakan City is the implementation of BRT Trans Tarakan constructed as one of public transport mode based on spatial with participatory approach. Therefore, stakeholder involvement in the management of BRT Trans Tarakan process will be conducted.



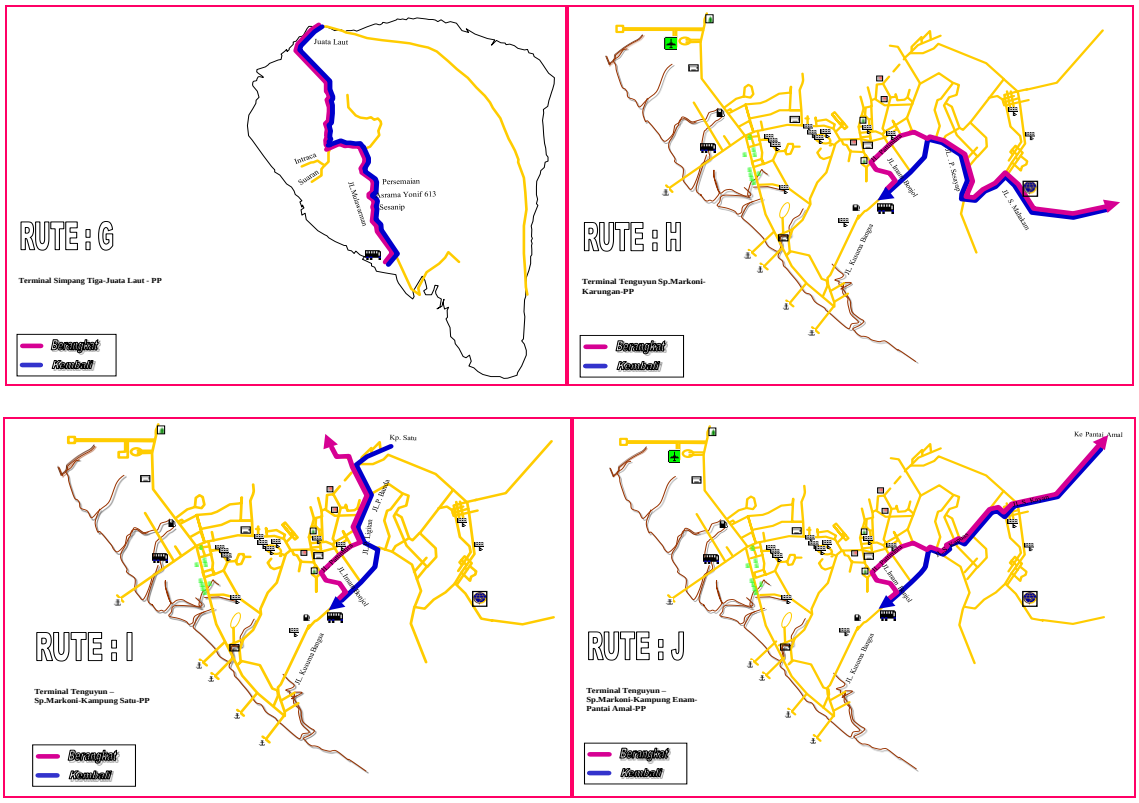


Figure 6. Development of TAP Route in Tarakan City

Figure7. The Existing of 10 Bus Prepared for the Begining of BRT Trans Tarakan System

IV. CONCLUSSION

Based on the results of analysis and discussion described above can be concluded:

a. The existing performance of transportation route pattern in Tarakan City is not yet optimal in the main road service level in secondary roads because vehicle volume increasing significantly influenced by high population movement, land use, transportation service level, transportation convenience, load factor, and road condition;
b. The pattern of passenger transportation movement in Tarakan City based on the origin place in the same direction with the route and social activities is dominantly occurred in Midle Tarakan and West Tarakan districts.
c. The area of transportation services for transport in Tarakan City that need development and improvement of quality and quantity are North Tarakan and East Tarakan districts.
d. To hasten the operation of BRT Trans Tarakan as a diversification and development of sustainable mode of transportation based on a realistic and prospective scenario according to the key factors in its management.

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