

The Correlation between Road Network Infrastructure and Proliferation of Region in Kotamobagu City

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Abstract- Kotamobagu city is a city which is established as a result of proliferation of region. The proliferation of region is aimed at improving public services for community welfare, including road network infrastructure. This study aims to examine the correlation between road network infrastructure and proliferation of region, in this case the density of the road network after the proliferation of region. The method used to examine the density of the road network was by overlaying maps of the road network in 2000 and 2013. The results of map overlay were calculated using a simple statistical tools in Ms. Excel 2010 and the results were calculated using the formula of road network density and was analyzed descriptively. The results of overlay map of the road network density in 2000 and 2013 indicated the existence of the highest density of the road network in Kotamobagu city spatially after the proliferation of region. The highest density of the road network was in the city center and several surrounding villages. The road network increased in all the main roads spatially in Kotamobagu City after the proliferation of region. The road network density and the improvement of the road network in Kotamobagu City were affected by the proliferation of region.

Index Terms- proliferation of region, road network density, infrastructure

I. BACKGROUND

Kotamobagu City is a city which is established as a result of the proliferation of region, which an autonomous region in North Sulawesi Province. Kotamobagu City is one of the cities in Bolaang Mongondow Regency. The establishment of Kotamobagu City is the implementation of the Law of the Republic of Indonesia Number 04 of 2007. Previously, Kotamobagu City is the subdistrict capital of Bolaang Mongondow Regency, namely Kotamobagu Subdistrict. The purpose of the proliferation of region is to increase public services in order to realize public welfare, including to increase and open new road networks. Law of the Republic of Indonesia Number 22 of 1999 is a milestone of regional government that represents the people of each region to establish new autonomous regions by using proliferation of region system (Harmantyo, 2007).

Kotamobagu City includes four subdistricts, namely Kota Utara Subdistrict, Kota Selatan Subdistrict, Kota Barat Subdistrict, and Kota Timur Subdistrict, consisting of 33 villages with an area of 86.6 Km². The proliferation of region demand the improvement in road network infrastructure, the opening of new road network to connect one place to another within the region,

to connect with the neighboring regions, to facilitate transportation of goods and services, as well as open up isolated areas in order to improve public services and accelerate the realization of community welfare. One of the supporting factors to realize welfare and to improve public service is an increase in the road network and the opening of new road network in order to facilitate accessibility of the movement of people and commodities in various places in Kotamobagu city and outside the city. The opening of a new road network leads to an increase in road network and road network density.

Infrastructure plays an important role in driving economic growth and development. The existence of adequate infrastructure is highly required. Physical facilities and infrastructure are very important parts in public service system. Various physical facilities are vital to support various activities of government, economy, industry and social activities in the community and government. Energy system, road transport, office buildings and schools, telecommunications, houses of worship and clean water service networks requires the support of a reliable infrastructure (Soemardi Biemo W. and Wirahadikusumah Rini D. 2009).

According to Tarin (2010), the proliferation of region is the distribution of administrative authority of a region which was formerly in one administrative area, separated into two or more administrative regions. It is expected that the proliferation of region lead to the increase in public service. Public service is an activity undertaken to realize community welfare, in which the government act as a regulator, guarantor and supervisor (Haryatmoko 2007). One of the types of public service is road network infrastructure that plays a role in facilitating access to support the process of national development.

II. METHODS AND DATA ANALYSIS

Methods used in this study were sampling, survey by combining quantitative and qualitative analysis with descriptive analysis. Secondary data were obtained from the data of the length of road network and the area of road network in 2000 and 2013, map of the road network in 2000 and 2013 in the regional settlement and infrastructure office of Kotamobagu City. The data of the road network map in 2000 and 2013 were overlaid using ArcGIS 10, and the results of the overlay were calculated by using Excel 2010. Furthermore, the density of the road network from the results of overlay was analyzed and calculated using the formula of FAO (Food and Agriculture Organization, 1974) as follows:

$$\text{Road density (RD)} = \frac{\text{Length of road}}{\text{Unit area}}$$

Road network infrastructure plays broad roles and includes a variety of contexts in development, such as physical-environmental, economic, social, cultural, political contexts, and so forth. The road network infrastructure is the infrastructure that has a very important and strategic role in supporting all aspects of life. The road network is needed to support economic, social, political, and defense and security activities. The development of road infrastructure is needed to penetrate isolated regions, lower transportation costs (smoothness and comfort), and open up new industrial areas (ease of access). Theoretically, the construction of roads that open the isolation of regions will encourage the development of land transport sector, including an increase in traffic of vehicles, goods and people further which have positive impact on the improvement of the welfare of the people in the region.

Herbet (1976) in Jonah (2001) states that road network and nodal point between the confluence of several road transport have a considerable role to the development of the city. The results of his studies in the United States shows that the cities in the United States are cities that are conditioned by the development of road infrastructure that the transportation line and developments form seven development categories of urban shapes, namely: (1) The shape of the city during the domination of pedestrians; (2) The shape of the city during the domination animal wagon; (3) The shape of the city during the domination of electric trains; (4) The shape of the city in the period of inter-city trains; (5) The shape of the city during the domination of inter-city automobile; (6) The shape of the city during the development of highway between the cities of the region; (7) The shape of the city during the development of ring roads.

III. DISCUSSION

Road infrastructure has two main roles, namely as a tool to direct the development of urban areas and as an infrastructure for

the movement of people and goods as the results of the activities of the urban area (Tamin, 1997). According Branch (1995), the construction of the city road network will have impacts or changes that will arise due to the accessibility of the movement of people and goods using various transport facilities. Yunus (1994) states that higher accessibility of the city will result in leaf frog development with the emergence of new centers of activity, which promotes the acceleration of change in land use. Catanese and Snyder (1988) state that the relationship between transportation (roads) and land use is very important, because the diversity in land use patterns will generate various needs of transportation. On the contrary, forms and regulation of transport system will also influence the pattern of change in land use.

Road network is a series of nodes, which in this case is in the form of junction/terminal, connected with the stretches of road/lines. In order to make it to recognize the network easier, the road or node is given specific number or name. The road network is a collection of pieces of road that connect to each other as an integrated unity to serve the needs of transportation (Soeharto & Mardikanto, 1985). Roads are the principal means of land transportation. The availability of adequate infrastructure that will greatly help the accessibility and mobility of people in a region, that one of the main land transport infrastructure is the road. The rapid development of the city also demands an increase in road construction.

According to the Law of the Republic of Indonesia Number 38 of 2004, roads are land transport infrastructure which includes all parts of the road, including complementary buildings and equipment that are designated for traffic on the ground, above the ground and below the ground and/or water, as well as above the water surface, except railways, lorries roads and cable road. Roads are infrastructure to facilitate economic activities. The increased development efforts demand also the increase in construction of roads to facilitate transport links between rural areas, border areas and remote areas or within the city. The road network and the quality of the road network in the Kotamobagu City in 2000 were not so crowded so there was no increase in the road network, the quality of the road network was also on average. The condition of the road network in the Kotamobagu City in 2000 is shown in the following map. (Figure 1).

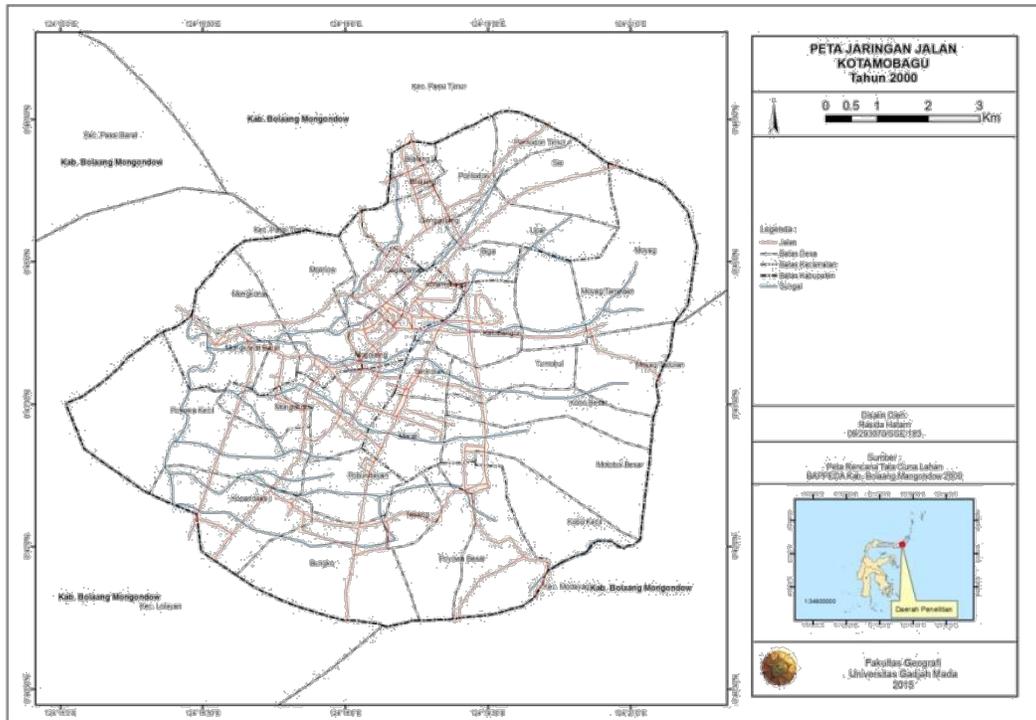


Figure 1. Map of the Road Network in 2000

Figure 1 above shows the condition of the road network in 2000 spatially in Kotamobagu City, showing the condition of the road network is not congested, and the quality of the road is on average, that is 3 meters in every stretch of road in Kotamobagu

City. The road network density and the improvement of the road network in 2000 in Kotamobagu City can be described in Table 1 below.

Table 1. Recapitulation of the calculation of road network density per village in Kotamobagu in 2000

No	Village	Unit Area (Km ²)	Road Area (Km ²)	Density (Km ²)
1	Biga	1.09	4.19	0.03
2	Upai	2.49	1.62	0.00
3	Genggulang	1.58	2.81	0.02
4	Kotobangon	2.23	5.79	0.02
5	Kotamobagu	1.08	5.58	0.05
6	Gogagoman	1.58	5.12	0.03
7	Mogolaing	1.28	5.55	0.04
8	Molinow	4.12	4.00	0.00
9	Mongkonai	2.51	2.54	0.01
10	Sinindian	0.93	2.76	0.02
11	Matali	1.96	5.08	0.02
12	Pobundayaan	2.04	4.10	0.02
13	Mongondow	1.08	2.19	0.02
14	Motoboi Kecil	2.49	7.30	0.02
15	Motoboi Besar	4.66	3.58	0.00
16	Tumubui	1.74	1.68	0.00
17	Kobo Besar	2.32	1.33	0.00

Source: processing of secondary data of the year 2000

Road network is very important infrastructure to support economic activities in order to facilitate the mobility of the population and to facilitate the traffic of goods and services from one region to another. The main function of road is as a traffic or transport infrastructure to support the smooth flow of goods and services as well as community activities. In addition, the road belongs to a road network system which increases and connects the growth centers with the coverage service areas in a hierarchical relationship (BAPPEDA, 2013). In accordance with the Law of the Republic of Indonesia Number 38 of 2004 and Government Regulation No. 26 of 1985 concerning road, roads are divided according to their role in two road network system, namely primary system and secondary system. According to the maintenance authority status, roads are divided into national road, provincial road, regency roads, Municipal Street and rural road.

The values of road network density in Kotamobagu City in 2000 based on the analysis of the road network density map are presented in Table 1. Seventeen villages in the administrative region of Kotamobagu Subdistrict, the densest road network is Kotamobagu Village with a density of 0.05km² out of the area of 1.08 km², the second densest is Mogolaing Village by 0.04km² out of the village area, and the third densest is Gogagoman

Village with a density of 0.03 km² of the total area. The calculation of the road network density did not distinguish the types of road. The density was calculated as a whole. Of the three villages, the highest density of road network is Kotamobagu Village. Kotamobagu Village is the center of city, shops, houses and government offices, educational facilities, and other public service facilities. Mogolaing Village and Gogagoman Village are also shopping center, traditional market, as well as the industrial center of the bread, tofu and tempeh, other public service facilities. However, the value of the road network density has not been able to illustrate the openness of a region, whether the region as a whole is open or there are inaccessible areas. The most important thing in opening road in a region is distribution of location from the road.

Furthermore, in 2007 Kotamobagu Subdistrict was proliferated with 17 villages into Kotamobagu City with 33 villages. The proliferation of this region required the improvement of facilities and infrastructure, including road network. The development and improvement of the road network based on a map of the development of road network in Kotamobagu City in 33 villages is described in the road network map in 2013 below. (Figure 2).

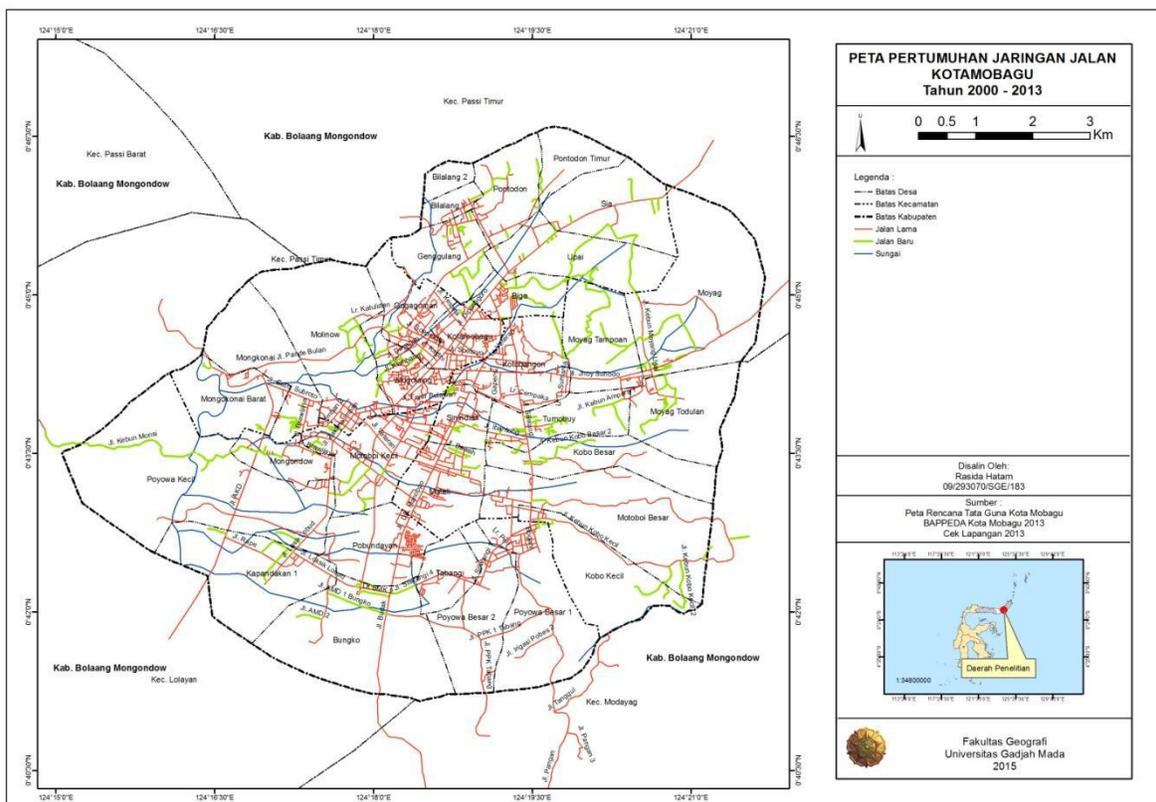


Figure 2. Map of the road network in 2013

Based on the analysis of Figure 2 above about the growth of the road network after the proliferation of region, road network and road network density increased spatially in Kotamobagu City. This increase occurred in almost all the roads in

Kotamobagu City, but the density only occurred in the city center and some of the villages surrounding. The values of increased road network and road network density in 2013 are described in Table 2 below.

No.	Village	Unit Area (Km ²)	Road Area (Km ²)	Density (%)
1. Utara Subdistrict				
1	Biga	1,09	0,04	0,03
2	Upai	2,49	0,03	0,01
3	Genggulang	1,58	0,05	0,03
4	Pontodon	1,68	0,04	0,02
5	Pontodon Timur	1,07	0,01	0,01
6	Bilalang I	0,46	0,01	0,02
7	Bilalang II			
8	Sia	2,50	0,02	0,01
2. Kota Barat Subdistrict				
9	Kotamobagu	1,08	0,06	0,06
10	Gogagoman	1,58	0,07	0,04
11	Mogolaing	1,28	0,06	0,05
12	Molinow	4,12	0,04	0,01
13	Mongkonai	2,51	0,02	0,01
14	Mongkonai Barat	1,95	0,02	0,01
3. Kota Selatan Subdistrict				
15	Kopandakan I	3,46	0,06	0,01
16	Bungko	4,91	0,06	0,01
17	Tabang	1,09	0,02	0,02
18	Poyowa Besar I	3,50	0,05	0,01
19	Poyowa Besar II	2,50	0,03	0,01
20	Pobundayaan	2,04	0,07	0,03
21	Motoboi Kecil	2,49	0,07	0,04
22	Mongondow	1,08	0,03	0,02
23	Poyowa Kecil	7,46	0,07	0,00
4. Kota Timur Subdistrict				
24	Matali	1,96	0,08	0,04
25	Motoboi Besar	4,66	0,05	0,01
26	Kobo Kecil	2,62	0,01	0,00
27	Moyag	5,24	0,03	0,00
28	Moyag Tudulan	2,49	0,01	0,00
29	Moyag Tampoan	2,19	0,02	0,01
30	Kotobangon	2,23	0,05	0,04
31	Sinindian	0,93	0,02	0,02
32	Tumubui	1,74	0,03	0,02
33	Kobo Besar	2,32	0,02	0,01

Source : Source: processing of Secondary data of the year 2013

Based on the above data, the increase in the road network is greatly varied spatially. High density occurs in the village as the center of the city and its surrounding areas, namely Kotamobagu village, Gogagoman village, Mogolaing village, Molinow village, and Matali village. According to the authority of maintenance of the road, Kotamobagu City has national road, provincial road, regency road, municipal street and village road.

These roads serve to support community and connect one village to another village or connect Kotamobagu City to other cities.

Road density is a unit of total length of roads within a region. The value of road density is obtained by dividing the total length of road with the area. The data in the second table 2 shows the condition of density and increase in the road network in Kota Utara Subdistrict; Kota Barat Subdistrict; Kota Selatan Subdistrict; and Kota Timur Subdistrict which consist of 33 villages and has various road network density spatially. Kota

Utara Subdistrict consists of 8 (eight) villages and the densest road network is Biga Village with a density of 0.03 km² of the total area and Genggulang Village with a density of 0.03 km² of the total area. This is triggered by the fact that in Biga Village there is housing complex of Perbinda Permai that invites the opening of many roads in the residential complex, besides the opening of new roads that connects to other villages. Similarly, in Genggulang Village new roads are opened to connect the village with the other regions. Furthermore, six other villages in the administrative region of Kota Utara District have also a new road network, but the increase is on average only 0.01km² until 0.02km² of the total area.

Kota Barat Subdistrict is a subdistrict which has six (6) villages and is the city center. Based on the spatial analysis of the road network density map, the village which has the highest density is Kotamobagu Village with a density of 0.06 km² of the total area, then the second highest is Mogolaing Village with a density 0.05 km² of the total area and the third highest is Gogagoman Village with a density 0.04 km² of the total area. In this three villages the road network density increased by an average of 1 km² from the density before the proliferation of region (in 2000), while the contributing factor is that there are many new roads are opened. The road network density in other villages included in the administrative area of the Kota Barat Subdistrict also increase, but its value is small or low.

Furthermore, Kota Selatan Subdistrict is the largest subdistrict of the three (3) Subdistrict in the administrative region of Kotamobagu City. Kota Selatan Subdistrict consists of 9 (nine) villages. Of the nine villages, the densest road network is Motoboi Kecil Village by 0.04 km² of the total area and Pobundayan Village by 0.03 km² of the total area. The factors causing the rise in the value of the road network density in both villages because in Motoboi Kecil Village a new road network is opened that connects between villages, while in Pobundayan Village there is a housing complex that opens a lot of road network. There is no change in the value of road network density in the other villages included in the administrative region of Kota Selatan Subdistrict.

Kota Timur Subdistrict has more villages than other 3 (three) subdistricts in the administrative area of Kotamobagu City. Kota Timur Subdistrict consists of 10 (ten) villages, namely Matali, Sinindian, Kotobangon, Tumubui, Motoboi Besar, Kobo Besar, Kobo Kecil, Moyag, Moyag Tudulan, Moyag Tampoan. Of the ten villages, the densest road network is Matali Village and Kotobangon Village by 0.04 km² of the total area respectively. The contributing factor is in both villages the new road network is opened that connects between regions of the villages. In addition, in Kotobangon Village of a new road is opened, namely the plantation road connecting Kotobangon Village with plantation areas in Upai Village. The road is also opened within the village namely in Matali Village and in Kotobangon Village. Meanwhile, there is no increase in the road network density based on the network development road map in 2000 until 2013 in the other villages in the administrative region of Kota Timur Subdistrict.

IV. CONCLUSION

1. The results of the density map overlay of the road network in 2000 and 2013 show the highest spatial density of the road network in the city of Kotamobagu after the proliferation of region. The highest density of the road network occurs in the center of city and several villages surrounding.
2. The road network increases spatially in all the main roads in Kotamobagu city after the proliferation of region.

The road network density and the increase in the road network in Kotamobagu City are influenced by the proliferation of region.

REFERENCES

- [1] Branch, Melville., 1995. *Perencanaan Kota Komprehensif*. Pengantar dan Penjelasan (terjemahan). Gadjah Mada University Press, Yogyakarta.
- [2] BAPPEDA Kota Kotamobagu, 2013. *Rencana Tata Ruang Wilayah Kota Kotamobagu*
- [3] Catanese, dan Snyder., 1988. *Peranan Kota*. Penerbit Erlangga.
- [4] F.A.O., 1974. *Code of Practice for Forest Harvesting in Asia-Pacific*. FAO Nations Regional Office for Asia and Pacific, Bangkok.
- [5] F.A.O., 1974. *Logging and Log Transport in Made Forest in Developing Countries*. F.A.O, Roma.
- [6] Haryamtyo, Djoko., 2007. *Pemekaran Daerah dan Konflik Keruangan Kebijakan Otonomi dan Implementasinya di Indonesia*. Makara Journal Of science 11 (1) : 16-22.
- [7] Haryatmoko., 2007. *Etika Komunikasi, Manipulasi Media, Kekerasan dan Pornografi*. Yogyakarta: Penerbit Kanisius.
- [8] Tamin, Ofyar Z., 1997. *Perencanaan dan Permodelan Transportasi*. Penerbit ITB Bandung.
- [9] Tarigan, Antonius., 2010. *Dampak Pemekaran Wilayah*. Majalah Perencanaan Pembangunan 01: 22-26.
- [10] Soemardi W Biemo, & Wirahadikusuma Rini D., 2009. *Kebutuhan dan Tantangan "Prosiding Seminar Nasional Pembangunan Infrastruktur Untuk Semua*. Kerja Sama UI-UGM-ITB. 29-Oktober 2009 Bandung.
- [11] Soeparto. RS, dan Mardikato., 1985. *Pembukaan Wilayah Hutan dan Angkutan (Major Transportasi)*. Diklat Pengawas Eksploitasi Hutan. Proyek Pendidikan Latihan dan Pengendalian Tenaga Kerja Pengusahaan Hutan, Kantor Wilayah Departemen Kehutanan Kalimantan Barat, Pontianak.
- [12] Yunus, Hadi Sabari., 2001. *Perubahan Pemanfaatan Lahan di Daerah Pinggiran Kota, Kasus di Pinggiran Kota Yoyakarta*, Disertasi. Fakultas Geografi UGM. Yogyakarta.
- [13] _____., 1994. *Teori dan Model Struktur Keruangan Kota*. Pustaka Pelajar. Yogyakarta
- [14] Law of the Republic of Indonesia Number 04 of 2007 on Establishment of Kotamobagu City
- [15] Law of the Republic of Indonesia Number 38 of 2004 on Road
- [16] Law of the Republic of Indonesia Number 22 of 1999 on Regional Government
- [17] Government Regulation No. 26 of 1985 on Road

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