

Economic Aspects Of Alternative Road Network Development Of Gorontalo –Tapa – Atinggola (GTA-Road)

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ABSTRACT: Road is an important infrastructure in supporting of regional development, economy, and accessibility of regions. The idea for building an alternative GTA-Road based on the efficiency and effectiveness of road users and in the area development around in the road. This study aims to explain how the cost retrenchment economic impact of time and Vehicle Operational Cost (VOC) and time value to compare with development costs. Internal Rate of Return (IRR) at the level of traffic and regional economic growth in traffic growth between 2% to 6% is around 13% to 30%.

KEYWORDS: Road Network, Economic Benefit, Investment Return.

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I. INTRODUCTION

The transportation system as a source of development in the economic sector and social because it increases the movement of goods and services that connect the origin to destination, places of community activity or from one region to another. Therefore, the transportation system becomes one of the basic needs for community life [1,2]. Transport, infrastructure plays an important role in supporting household daily activities, distribution of agricultural products, industries and other economic activities. Better infrastructure will provide economic benefits of reduced transportation costs and better economic efficiency [3,4]. The road is one of the most important infrastructures in supporting and accelerating socioeconomic and cultural activities of the community, roads to facilitate rural development, and will improve transport services in the aspects accessibility of the region [5,6,7]. Increased access will ultimately improve the livelihood and opportunity of obtaining high income opportunities, according to the vision, expectation of development with the support of road network infrastructure. The ease of reaching community facilities is necessary for the smooth running of daily life activities, including the ease of reaching agricultural land, markets, schools, health facilities, and other services [1,8]. Inter-regional connectivity in Gorontalo Province, Bone Bolango Regency and North Gorontalo Regency are inseparable from the problem of road infrastructure. North Gorontalo Regency if it is connected to the provincial capital of Gorontalo City has a distance of about 111.2 km in travel within about 3 hours. Gorontalo's existing road to Atinggola is the national road route of Trans Sulawesi primary arterial road as the current liaison between the provinces (Gorontalo-North Sulawesi), at the same time this national road is also used as the main route intercity land transport between districts or regional traffic flows [9].

The construction of the GTA-Road has been set in the Regional Spatial Plan (RSP) of Gorontalo Province in years 2010-2030, and it is based on the efficiency and road effectively by shortening the distance and travelling time from Gorontalo City with the North Bolaang Mongondow Regency of North Sulawesi Province [10,11]. It will open the new accessibility with the connectivity of the road network of Gorontalo – Tapa - Atinggola is considered necessary to be able to provide clarity, the extent of the economic impact and the investment return or Internal Rate of Return (IRR) of road network development as a matter of further consideration of the feasibility of the construction of the road network. The location of this research is in Gorontalo Province, while the road segment to be analyzed is GTA-Road. As in Figure1.

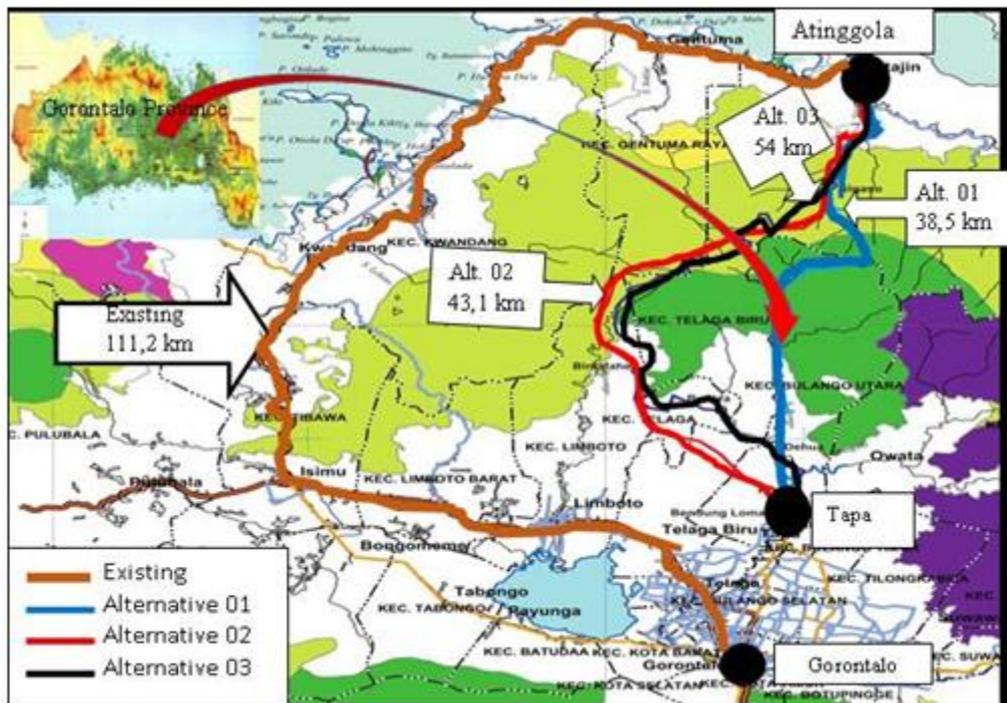


Figure 1. Tapa – Atinggola Roads, Gorontalo Province, Indonesia

II. RESULTS AND DISCUSSION

Choice Route Plans

There are three alternative options for road development of GTA-Road, namely: Alternative 01 is the district connecting network, namely; Tapa - North Bulango - and Atinggola Subdistrict along 38.5 km, alternative 02 is the district connecting network, namely: Tapa – Telaga - Telaga Biru – and Atinggola Subdistrict along 43.1 km and alternative 03 is the district connecting, namely: Tapa - Telaga - Telaga Biru – and Atinggola Subdistrict along 54 km.

The geographical condition of the GTA-Road is a mountain range with elevations ranging from 125 to 875 mdpl, from the three alternatives taking into account the distance aspect, topographical conditions and productive land opportunities along the way of placing alternative 01 which has received many recommendations from both stakeholders either government, community and impact risk observers and in documents contained in provincial, municipal and district regulations.

Traffic Split Opportunities

Flow average daily traffic (ADT) passing through this road is assumed to be a split from the passing vehicle on the existing Kwandang - Atinggola segment, originating and aiming Gorontalo with consideration of the efficiency of distance and travel time. The number of vehicles predicted to switch to alternative routes is as much as 6,500 vehicles with the percentage of vehicle types as in Figure 2.

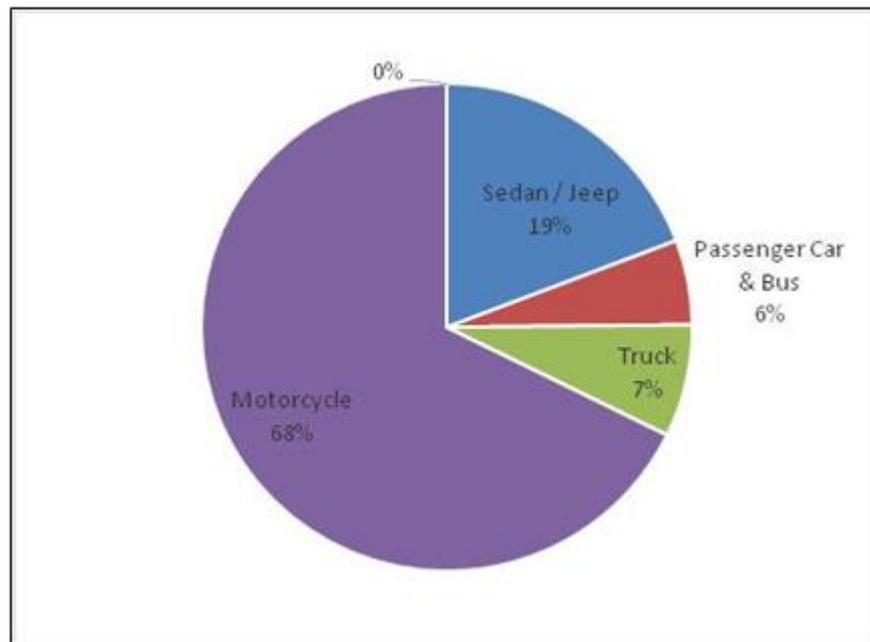


Figure 2. Traffic Split Opportunities according to the Vehicle Type

Benefit of Road Development

Land Use and Commodities

Based on data on the number of commodities in the vicinity of the development of GTA-Road that have potential for land development are rice fields of 4.161 hectares, and land for corn crops 46,613 hectares, livestock sector development estimated 15,000 cows, 6000 goats, and livestock development poultry ranges from 400,000 tails. It is estimated that the economic development of the community around the area of GTA-road development has a potential value of commodities worth IDR 927.6 billion per year. Large agricultural real estate and growing livestock population as supported by production access to market areas. Other benefits that have not been measured are increasing land values that are expected to increase local revenue from the Land and Building Tax (LaBT) sector and the potential for development of industrial or *agropolitan* land.

Vehicle Operational Cost (VOC)

The benefit of road users represents a cost retrenchment in road users or road user fees gained from the difference prior to development and after road development. The greater the cost retrenchment of road users the more feasible to be developed.

The saving of Vehicle Operational Cost (VOC) on roads to be developed is based on the difference in value of the VOC existing road segment with GTA-Road alternative road. VOC is calculated based on VOC basic cost influenced by element of speed and component of fuel price, lubricant, tire price, vehicle crew cost, maintenance cost, mechanical and spare parts and depreciation. The cost of VOC is obtained by using the research approach [12] after calibration is adjusted to the current price value as follows:

Table 1. Component Cost of VOC

No.	Component	Passenger Car	TRUCK	BUS
1.	Fuel Consumption (liter/1000 km) non tolroad / arterial road	$Y = 0,05693 S^2 - 6,42593 S + 269,18567$	$Y = 0,21557 S^2 - 24,17899 S + 947,80862$	$Y = 0,21692 S^2 - 24,1549 S + 954,78624$
2.	Engine Oil Consumption (liter/1000 km) non tolroad / arterial road	$Y = 0,00037 S^2 - 0,04070 S + 2,20405$	$Y = 0,00186 S^2 - 0,22035 S + 12,06486$	$Y = 0,00209 S^2 - 0,24413 S + 13,29445$
3.	Vehicle Tires (tire/1000 km)	$Y = 0,0008848 S + 0,0045333$	$Y = 0,0015553 S + 0,0059333$	$Y = 0,0012356 S + 0,0065667$
4.	Depreciation (Depreciation / 1000 km) of vehicle price	$Y = 1 / (2,5 S + 125)$	$Y = 1 / (6 S + 300)$	$Y = 1 / (9 S + 450)$
5.	Maintenance (Maintenance/1000 km)	$Y = 0,0000064 S + 0,0005567$	$Y = 0,0000191 S + 0,00154$	$Y = 0,0000332 S + 0,0020891$
6.	Mechanical / Montir (working hours / 1000 km)	$Y = 0,00362 S + 0,36267$	$Y = 0,01511 S + 1,212$	$Y = 0,02311 S + 1,97733$
7.	Traveling Time Drivers & Condors (working hours / 1000 km)	None Because The Driver Is The Owner Of The Vehicle	$Y = 1000 / S$	$Y = 1000 / S$

Source: Result of Analysis, Tamin

The calculation of the VOC component value and the magnitude of the cost of sacrifice to cross the existing road segment of Gorontalo - Atinggola or contrariwise and compare with the GTA-Road alternative segment.

The phenomenon that the characteristics of VOC tendency are inversely proportional to the speed of the vehicle. The highest VOC is the truck, followed by the bus and the lowest passenger cars.

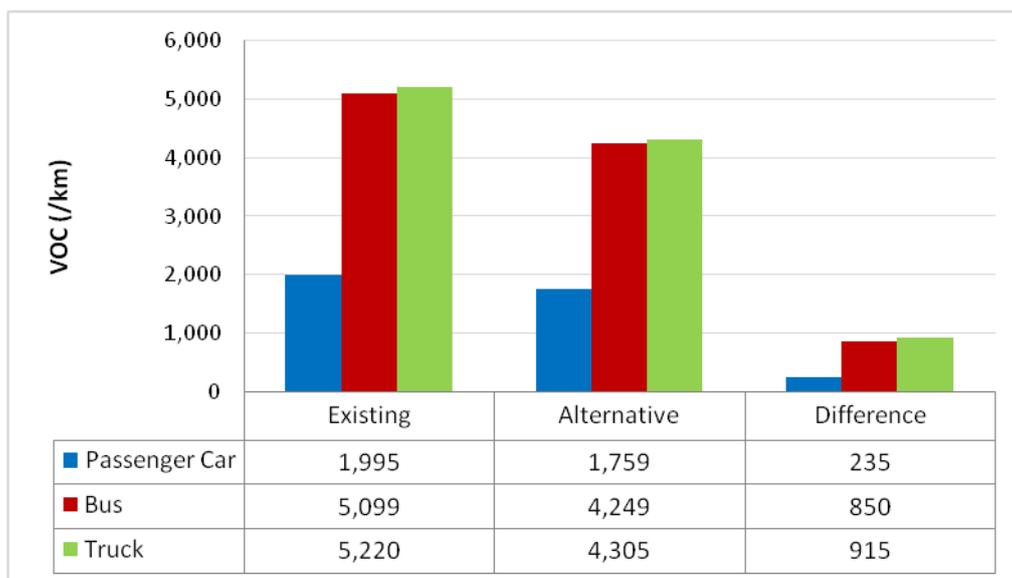


Figure 3. VOC Basic Price Each vehicle

The result of the analysis shows that VOC passing through alternative road gives the saving value of passenger car equal to 11,79%, bus 16,67%, truck 17,53%. Total the saving of VOC vehicle per day based on the VOC value of each vehicle with daily traffic volume-average of each vehicle, passenger car around IDR 413 million, bus 32 million, and truck IDR 209 million or VOC total retrenchment on alternative roads ranges from IDR 238 billion per year.

Time Value

The time value based on the per capita income method is influenced by the average income level and the number of hours worked, as in the following equation:

Time value = f (GRDP, Total Population, Number of Hours)

Average income is comparison between GRDP of Gorontalo province in 2016 with population for the same year. Working hours in a month are based on daily working hours of 8 hours per day, and weekdays 5 days per week, as well as an average monthly work time approach of 4 weeks. Thus, the number of working hours a month is about 160 hours. Based on PDRB Gorontalo province in 2016 of IDR 31.823 trillion and the population of 2016 amounted to 1,150,765 inhabitants. Approximate income per capita obtained IDR 2.304.492 per month is more or less in accordance with provincial minimum wage or an average of IDR 14,403 per hour, the time value according to the vehicle type as follows:

Table 1. Time value of vehicle type

Vehicle Type	Total Passenger	Passenger Time Value (IDR / hour / person)	Percentage of Productive Opportunities	Time Value (IDR/Vehicle/Hour
Passenger Car	7	14.403	50%	50.410,77
Bus	18,5	14.403	50%	133.228,47
Truck	3	14.403	90%	38.888,31

Source: Result of Analysis, 2017

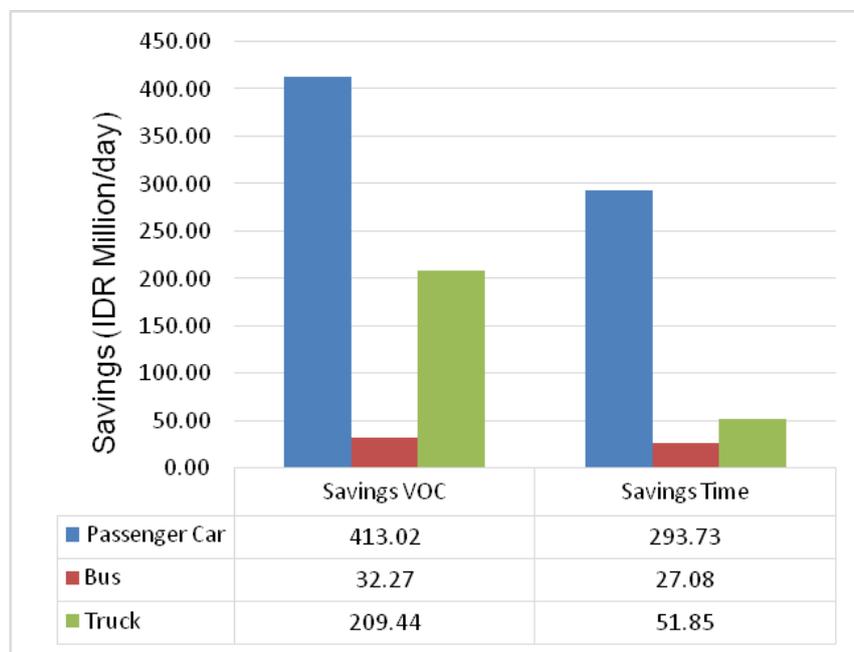


Figure 4. Saving of VOC and Time Value

The value of time saving of vehicles per day that pass alternative roads with the assumption of the average vehicle speed of 50 km/hour (planning) for the three types of vehicles with distance difference of approximately 72.7 km between existing roads and alternative road segments respectively IDR 293 million for passenger car, bus IDR 27 million, truck IDR 51 million, for a total of IDR 373 million per day or about IDR 136 billion saving time value in a year. The cost split of road users on the road construction plan is the sum of the total saving of VOC and time value per day IDR 1.027 billion or equivalent to 374.998 billion per year.

Economic Feasibility

The economic feasibility of alternative roads is calculated by comparing the economic value of the road users with the amount of construction costs during the investment period or the life of the plan, i.e. the value of VOC saving and time value.

The value of road investment is a component of project cost consisting of construction cost, cost of preparation of detail engineering design, supervision cost, operational cost and regular and periodic maintenance. The calculation of project cost is based on prevailing prices in Gorontalo Province. In the preparation of project costs selected alternative path 01 with the shortest distance consideration of 38.5 km and the lowest trajectory topography.

A component of the investment cost of development of an alternative road network of GTA-road is IDR 1.78 trillion, after conversion and comparing the construction cost of Gorontalo Outer Ring Roads (GORR) with an estimated age of investment for 10 years. During this period routine maintenance is done eight times at a cost of IDR 286 billion, - and periodic maintenance at a cost of IDR 179 billion [14,15].

The economic benefits of alternative GTA-road development as measured by the probability indicators of the GTA-road development are based on road development costs taking into account construction costs, project administration, DED, supervision, routine maintenance and periodical GORR road segment one as far as 16 km the construction cost of approximately 46.3 billion miles. Thus, the estimated cost of construction of alternative roads along the 38.5 km is 1.788 trillion. The economic benefits of VOC savings and time value, the value of public opportunities and the assumption of traffic growth are as in Figure 6.

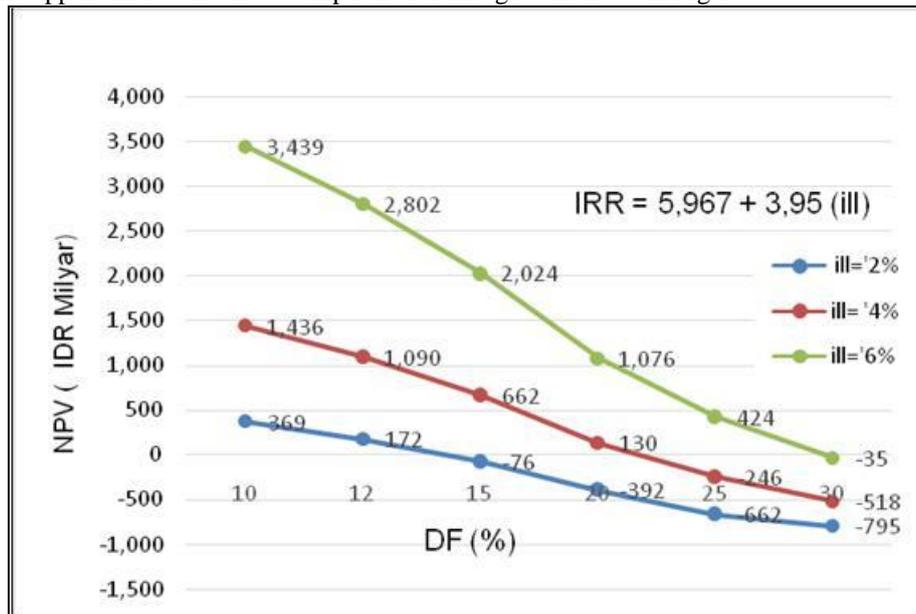


Figure 6. NPV and IRR vs. Traffic Growth

The rate of return on investment in accordance with the predicted traffic growth between 2% to 6% is IRR between 14% to 30%. Other economic benefits are the prospects for agricultural land development and agro-industry and the increase in the value of land that is expected to contribute revenue from Land and Building Tax (LaBT) and regional economic development.

III. CONCLUSION

The development of alternative road segments Gorontalo-Tapa-Atinggola based on the economic potential of the region, has the opportunity to develop agricultural land and the prospects of *agropolitan* and agro-industrial development. The return on investment ranges from 14% to 30% of traffic split, growth of 2% to 6%. VOC retrenchment and time values are inversely proportional to the operational speed of vehicles on alternative roads. Other prospects that benefit the development of roads are the improvement of the region's economy, the Sales Value of Taxable Object (SVTO) of land which may ultimately increase the regional income of the tax collector.

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