Effects of Coal Freight Road Policy Reforms on Transportation and Environmental Economics

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Abstract. Since 2017, the application of the Provincial Government of South Borneo No.3 of 2012 regarding the use of public and particular roads for transportation of mining products and plantation companies has a positive impact on changes in transportation and environmental economics with the principle of benefit, justice, and interests of the nation. This study analyzes the effects of policy changes on coal transportation routes on transportation (traffic congestion) and environmental economics (air pollution, noise, loss value). The research method involved literature reviews and field surveys. The results indicated that after the 2017 policy, there was a decrease in the volume of coal transportation passing public roads by 92.4%, a decrease in speed and traffic congestion of 13% and 0.2 points. The noise level decreased to 4.87 dB (A). CO2 emissions reduced by 44.30%, CO by 48.82%, HC by 46.22%, NOx by 22.03%, SOx by 22.01% and PM10 by 25.66%, the value of losses due to the burden of vehicle emissions decreased by 24.3%. Visually, pedestrians and road users become more comfortable and safe in traffic. The government is expected to support and supervise particular roads for coal transportation to avoid the unexpected effect on roads.

Keywords: policy, coal transportation, economy, environment

1. Introduction
Coal provides a sizeable financial contribution to the region but raises problems from the transportation side from the stockpile to the port. According to Law No. 4/2004 clause 91, the public infrastructure facilities applicable and beneficial for mining purposes [1] granting the permits for coal transportation entrepreneurs to pass public roads in several districts/cities. Thousands of coal transport trucks move from the mine area to the port or factories having a payload of more than eight tons with modified tubs [2], disturbing road users, pedestrians and surrounding community. Regarding transportation, the traffic volume and congestion increase, speed decreases and inconveniences of road users exacerbate the existence of coal transportation. Regarding environmental economics, air pollution from traffic and coal dust, the air temperature increases, noise levels and vehicle emission load the increase.

In 2008 South Kalimantan Province issued regional regulation No.3 of 2008 and revised Regional Regulation No. 3 of 2012 about the use of public and particular roads for the transportation of mining products and the results of plantation companies. According to clause 3 (1), every transport of mining products and the effects of plantation companies are prohibited from passing public roads; (2) Every mining product and yield of a plantation company must transport through a particular road determined by the Governor [3, 4]. Dispensation for two years gives an opportunity for mining companies to build specific roads for coal transportation. The provincial government policy requires District/City supporting systems because it involves intergovernmental relations and building harmonization among stakeholders to accelerate regional socio-economic development. Dissemination of information in
October, November and December 2016 was declared to transport coal to not cross public roads. In January 2017, the integrated team installed a portal on the Banjarmasin-Marabahan national road as a form of law enforcement for coal transportation that does not comply with the regulations. The mixed team oversaw the policy consisting of elements from the South Kalimantan Regional Police, the South Kalimantan Provincial Transportation Agency, Korem 101/Antasari, and the Public Works Center.

The policy is successful if it had a good impact based on mutual interests. Therefore, it is essential to analyze the changes in coal freight policy on transportation (congestion, volume, and speed of traffic) and environmental economics (air pollution and noise levels), for providing road users a comfortable and safe experience.

1.1 Related Literature

1.1.1 Study of the policy of transporting coal, transportation, and the environment

Various strategies of coal transportation present the legal foundation such as Law Number 4 of 2004 about mining of minerals and coal, article 91 concerning RI Law Number 4 of 2009 about Mineral and Coal Mining, that IUP and IUPK Holders can use public infrastructure and facilities for mining purposes after fulfilling the provisions of legislation, as well as Regional Regulation Number 3 of 2008 and Number 3 of 2012 [1, 3, 4]. Coal transportation must go through a particular road that was built by the mining company [5]. In the study of transportation and environmental economics about coal in the world [6], several legal foundation are presented such as in, the Law as Number 22 of 2009 concerning traffic and road transportation rules (clause 210) [7], and Regulation of the Minister of Environment Number 12 of 2012 concerning guidelines for controlling emissions in the region [8].

1.1.2 Motor vehicle emissions, air pollution, loss and noise values

Emissions are substances, energy and other components produced from an activity that enters into ambient air which has potential as a pollutant element [8]. Air pollution threatens public health in various cities in Indonesia, especially large cities such as respiratory diseases, hypertension, impaired kidney function, decreased intellectual ability of children, coronary heart disease, and premature death. The components of air pollution mainly sourced from transportation activities in Indonesia are carbon monoxide (CO), Nitrogen oxides (NOx), Sulfur dioxide (SO2), Hydrocarbons (HC), PM10 and other particles. Similar research on the level of dust around the truck and the highest load of deposited coal is at a distance of one meter from the roadside which is 267.74 tons/km²/month, and the lowest is 200 m from the roadside which is 19.895 tons/km²/month. Dust levels at all sampling points (South Borneo) are above the environmental quality standard of 10 tons/km²/month [8] [9]; the influence of PM10 and PM2.5 on health [10]. NOx affects the respiratory system, SO2 can worsen respiratory or cardiovascular diseases, and CO is poisonous and in high concentrations can lead to unconsciousness and even death [11]. Other related studies include, impact of traffic congestion on health [12]; the environmental effects of changing speed limits (a quantile regression approach) [13]; the effect of economic policy instruments in promoting environmentally sustainable transport [14]. Increased traffic density causes vibrations and noise along the roadside. In theory, if humans are exposed to the intensity of sound in the numbers 55-65 dB(A), it can cause narrowing of the arteries and an increase in heart rate frequency. If it persists, it can increase the chances of heart and blood vessel pain. Noise is an unexpected sound from a business or activity at a certain level and time that can disrupt human health and environmental comfort [15].

2. Methods

The research was carried out on public roads that were crossed by coal transportation in the Banjarmasin City, Indonesia. The research method was based on the literature review (2012 traffic data) and field survey for eighteen hours of observation in 2012 and 2017.

3. Results and Discussions
3.1. Traffic congestion
Calculated by applying the road capacity \( C \) (smp/hour) formula [16],

\[
C (\text{smp/jam}) = C_0 \times FC_w \times FC_{sp} \times FC_{sf} \times FC_{cs}
\]  

(1)

With \( C_0 \) (basic capacity for certain conditions, smp/hour); \( FC_w \) (Traffic Line Adjustment Factor); \( FC_{sp} \) (Direction Separation Adjustment Factor); \( FC_{sf} \) (Adjustment Factor Side Barriers); \( FC_{cs} \) (City Size Adjustment Factor); \( Q \) (traffic flow capacity, smp/hour). The degree of saturation (\( DS \)) [16]:

\[
DS = \frac{Q}{C}
\]  

(2)

The results of road capacity analysis and degree of saturation before and after policy implementation are explained in Figure 1, with \( C_0 = 2,900 \text{ smp/hour} \); \( FC_w = 1.07 \); \( FC_{sp} = 1 \); \( FC_{sf} = 0.99 \); \( FC_{cs} = 0.94 \) so that \( C = 2,887.7 \text{ smp/hour} \). The equivalent factor of a passenger car (emp) is a light vehicle (\( LV \)) = 1.0; heavy vehicles (\( HV \)) = 1.2 and motorbikes (\( MC \)) = 0.25 [16].

![Figure 1](image1.png)

**Figure 1.** The volume of daily traffic flow (a) and the degree of saturation of peak hours (b) between 2012 and 2017

Figure 1 (a) illustrated the different volume of daily traffic flows. The number of heavy vehicles (trucks) drastically reduced by 92.4%, the number of motorbikes increased after the policy of banning entry of trucks crossed public roads, indicating that motorcyclist began to comfortably and safely cross the street. Figure 1 (b) demonstrates the degree of saturation before policy (2012) 0.88 > 0.85 and falling to 0.68 at peak hours (2017). The average speed of traffic was 23 km/h in 2012, and was 36 km/h in 2017.

3.2. Analysis of vehicle emission loads with Indonesia's emission factors
Vehicle emission load calculations utilize the emission load calculation method [17], through a Tier II approach, with available data in Indonesia.

\[
E = Vehicle \ Volume \times VKT \times FE \times 10 - 6
\]  

(3)
note: $E$: Emission load (ton/year), Vehicle Volume: Number of vehicles (vehicle/year), $VKT$: Total trip length traveled (km), $FE$: Emission factor (g/ km/vehicle).

Figure 2. The percentage of pollutant sources for each type of vehicle

The results of vehicle emission loads of all vehicles in the road segment are presented by using Indonesian emission factor data [17]. The source column diagram of each type of vehicle is a light vehicle (LV), heavy vehicle (HV) and motorcycle (MC). Figure 2 indicates that heavy vehicles look significantly decreased by an average of 93% of the value of the post emission policy load (2016). CO2 emissions decreased by 44.30%, CO by 48.82%, HC by 46.22%, NOx by 22.03%, SOx by 22.01% and PM10 by 25.66%. The result illustrates that this government policy can significantly reduce air pollution from transportation.

3.3. Analysis of the value of losses due to vehicle emissions

Vehicle emissions loss due to increased vehicle volume and congestion assuming costs are based on 2005 pollutant costs from research ($/ton): CO = $ 205/ton, PM10 = $ 3.17/ton, CO2 = $ 205/ton, SO2 = $ 1000/ton, Nox = $ 934/ton and HC = $ 44/ton [18]. The $/tonne emission costs are converted into Indonesian currency (IDR), of which 1 $ = Rp. 13,500 (January 2017) and the value of losses due to the burden of emissions as presented in following Table 1:

| Pollutants | Total price (2012) | Total price (2017) |
|------------|-------------------|-------------------|
|            | LV                | HV                | MC                | LV                | HV                | MC                |
| CO         | 285,061,072       | 136,758,511       | 50,695,127        | 322,522,897       | 10,227,666        | 43,092,765        |
| HC         | 675,753           | 219,169           | 1,275,022         | 764,559           | 16,391            | 1,083,816         |
| NOX        | 10,310,039        | 45,748,186        | 1,330,325         | 11,664,952        | 3,421,339         | 1,130,826         |
| PM10       | 31,877,515        | 4,765,263         | 14,095,964        | 36,066,757        | 356,377           | 11,982,100        |
| SOX        | 527,932           | 2,269,173         | 39,292            | 597,312           | 169,703           | 33,400            |
| CO2        | 1,826             | 12,281            | 3,737             | 2,066             | 918               | 3,176             |
| total      | 585,666,186       | 443,137,019       |

Table 1 indicates that the value of losses due to vehicle emissions by enforcing policies was able to cut losses by 24.3% and percentage of heavy vehicles to the total price of the emission load decreased significantly by 93% and the difference in price was by IDR. 142,529,167.
3.4. Noise level

The level of noise intensity has an impact on humans such as physiological/psychological disorders, communication disorders, and deafness. Noise level analysis results before policy (2012) are 74.75 dB (A) > 70 dB (A) (unsafe), while after the policy (2017) are 69.88 dB (A) < 70 dB (A) (safe for trade and services) [23].

3.5. Strategy for controlling pollution of coal transportation

Control strategies to cut pollution include green belts, periodic road spraying, periodic truck emission checks and coal packing rules on trucks must follow regulations to reduce coal spills and dust on the passed road, changes in fuel type and a shift in types of vehicle modes.

4. Conclusion

Implementation of the South Kalimantan Provincial Regulation No. 3/2012 acts not only as transportation policy but also as part of environmental, economic policies and effectiveness in reducing congestion, pollution and material losses including coal transportation across public roads and forcing employers to build special roads. This policy also enables road users and pedestrians to be more comfortable and safe. The impact that occurred was the volume of heavy vehicles (trucks) decreased by 92.4%, the degree of saturation dropped to 0.68 at peak hours, the difference in average speed was by 13 km/hour. The percentage of heavy vehicles to the total price of the emissions load decreased significantly by 93%. The noise level decreased by 4.87 dB (A). CO2 emissions decreased by 44.30%, CO by 48.82%, HC by 46.22%, Nox by 22.03%, SOx by 22.01% and PM10 by 25.66%.

4.1 Recommendations

In issuing the policies, relations among the Regional Government, the private sector and civil society must be constructive and collaborative by prioritizing the principles of participation, transparency, and accountability during the government process. Thus local governance is expected to sustain the program. The government needs to support and supervise special roads for coal transportation to avoid unexpec effects on the road.

References

[1] Law of the Republic of Indonesia Number 4 of 2004 Mining of minerals and coal
[2] Yuniar D and Susanto H 2015 Coal stockpile volume deviation analysis with surpac software version 6.3 and manually. J.Polhasains 3 (1). 26-31
[3] Regional Regulation of South Kalimantan Province Number 3 of 2008 Regulations on the Use of Public Roads and Special Roads for the Transport of Mining Products and Results of Plantation Companies. Banjarmasin
[4] Regional Regulation of South Kalimantan Province Number 3 of 20012 Amendment to Number 3 of 2008. Banjarmasin
[5] Yuniar D and Fathihin H 2016 Identification of road damage and handling repairs on the mine road. J. Polhasains. 4 (1), 34-40
[6] Huaman N, Ruth and Xiu T 2014 Energy-related CO2 emissions and the progress on CCS projects: A review. Renewable and Sustainable Energy Reviews. 31, 368-385
[7] Law of the Republic of Indonesia Number 22 of 2009 Traffic and Road Transportation
[8] Regulation of the Minister of Environment Number 12 of 2010 Implementation of Air Pollution Control in the Region. Jakarta
[9] Pratiwi T, Junaidi and Ali Z 2017 Effect of pollutant source distance on sulfate content (SO4) In deposited dust along the coal hauls road. J. Kesehatan Lingkungan Vol. 14 No. 2 July 2017. 533-540
[10] WHO 2011 Burden of disease from environmental noise. Copenhagen: World Health Organisation
[11] Neidell M 2004 Air pollution, health, and socioeconomic status: the effect of outdoor air quality on childhood asthma. *J. Health Econ.* 23, **1209–1236**

[12] Currie J and Walker R 2011 Traffic congestion and infant health: evidence from E-Zpass. *Am. Econ. J. Appl. Econ.* 3, **65–90**

[13] Bel G, Bolance C, Guillen M and Rosell J 2015 The environmental effects of changing speed limits: a quantile regression approach. *Transport Res. Transport Environ.* 36, **76–85**

[14] Elvik R and Ramjerdi F 2014 A comparative analysis of the effects of economic policy instruments in promoting environmentally sustainable transport. *Transp. Policy.* 33, **89–95**

[15] State Minister of Environment, 1996. *Standard Noise Level, Decree of the State Minister of Environment* Number: Kep-48/MENLH/1996/25 November 1996, Jakarta

[16] Department of Public Works 1997 *Indonesian Road Capacity Manual (MKJI).* Directorate General of Highways, Jakarta

[17] Regulation of the Minister of Environment Number 12 of 2010 Implementation of Air Pollution Control in the Region. Jakarta

[18] Victoria Transport Policy Institute 2011 *Transportation Cost and Benefit Analysis II.* Australia