



Analysis of the Distribution of Fertilizer Commodities through Multimodal Transportation: West Java, East Java and South Sumatra

Indira Shaffiyah¹

¹Universitas Pendidikan Indonesia, Indonesia
Correspondence: E-mail: indirashaffiyah@upi.edu

ABSTRACTS

The need for both organic and inorganic fertilizers in Indonesia continues to increase, in line with increasing demand from the plantation and agricultural sectors. This also results in supplies from subsidized fertilizer production and fertilizer from large industries sometimes not being able to meet the market. In this scientific article, we will discuss the design and planning of fertilizer distribution from both large industries and small and medium industries which will be reviewed from the distribution of goods in 3 provincial zones which are estimated to have quite high movement of fertilizer products. The method used in this study in general is a literature review where the search for sources and data is carried out by literature study. In the three review zones, the distribution process carried out depends on the amount of production and existing demand. After analyzing the distribution of fertilizer commodities, the results were obtained in the form of growth, production capacity, BOK and transportation rates for each zone.

© 2021 Universitas Pendidikan Indonesia

ARTICLE INFO

Article History:

Received 20 June 2023

Revised 25 July 2023

Accepted 20 September 2023

Available online 31 Sept 2023

Published date 01 Oct 2023

Keyword:

Multi-Mode Transportation,
Fertilizer,
Distribution,
Cost

1. INTRODUCTION

Indonesia is an agricultural country where 29.59 percent of the population are farmers and it is the second largest supporting sector for the economy in Indonesia. Therefore, the agricultural sector in Indonesia has a quite large and important role, because it not only plays a role in producing agricultural goods but also makes other contributions. Therefore, the quality of Indonesian agricultural products must also be maintained throughout agriculture in Indonesia.

Fertilizer has a role and is an important production factor in the agricultural sector, this is because the use of good fertilizer will determine the quantity and quality of agricultural products. Fertilizer is a material that contains one or more nutrients or nutrients for plants to support plant growth and development (BALITTANAH, 2021). There are two types of fertilizer, namely natural fertilizer and artificial fertilizer. Natural fertilizers have an effect on improving the natural properties of the soil such as minerals and nutrients. Meanwhile, artificial fertilizer is fertilizer that contains certain ingredients such as nutrients and is usually made by humans in industry (Zalmi et al., 2019).

The need for both organic and inorganic fertilizers in Indonesia continues to increase, in line with increasing demand from the plantation and agricultural sectors. This also results in supplies from subsidized fertilizer production and fertilizer from large industries sometimes not being able to meet the market. Apart from that, sometimes existing agricultural or plantation areas have quite far and difficult access to fertilizer sources from large industries that provide them. Therefore, small industries emerged which started producing organic and inorganic fertilizers in order to meet existing demand and provide fertilizer with easier accessibility than having to buy from large industries.

As is known, the contours, properties and types of land in Indonesia are different from each other, therefore fertilizer is needed to enable land in poor condition in an area to be used as agricultural land or plantations to produce food for local residents. Therefore, large industries and small industries must distribute to various regions to meet existing demand. In this scientific article, we will discuss the design and planning of fertilizer distribution from both large industries and small and medium industries which will be reviewed from the distribution of goods in 3 provincial zones which are estimated to have quite high movement of fertilizer products. The provinces that will be reviewed include the provinces of West Java, East Java and South Sumatra.

2. METHODS

The method used in this study in general is a literature review where the search for sources and data is carried out by studying existing literature from various official sources on the internet, both national and international sources. The data used by researchers in this research are primary and secondary data, both of which were obtained from relevant literature sources. The primary data obtained is in the form of information and actual data in the field which will then be processed and analyzed using several calculation methods such as multiple linear regression analysis, correlation, MAT, and tariff determination. According to Sugiyono

(2017:275), multiple linear regression analysis is used by researchers, if the researcher predicts how the condition of the dependent variable (criterion) will rise and fall, if two or more independent variables as predictor factors increase and decrease in value.

3. RESULT AND DISCUSSION

3.1 Analysis of Variables / Factors that Influence User Demand

3.1.1 Resource

The resource or resource used as a variable or object in this multimodal transportation planning analysis is fertilizer. Fertilizer is a fairly important item and has quite high movement in Indonesia and is usually included in the chemical goods category.

3.1.2 Production Capacity

General fertilizer production capacity can be seen from the data presented by PT Pupuk Indonesia as a state-owned company that handles the distribution and trade of fertilizer from various factories in Indonesia, fertilizer production in Indonesia reached 12.235 million tons throughout 2021. Fertilizer production continues to increase and this figure is estimated to not include production from small industries. From the three zones reviewed, total production data for each province was obtained as follows.

Table 3.1 Total Production of 3 Provinces

Zone	Total Production (Ton)
West Java	1,694,901.17
East java	1,312,736.96
South Sumatera	15,195,748.25

3.1.3 Production Locations

Production locations for this fertilizer commodity are spread across all regions in Indonesia, therefore this analysis will be viewed from movement per province. The provinces that are the review zones in this study are West Java, East Java and South Sumatra. It is recorded that in these three zones there are fertilizer producing companies which are production sources at PT Pupuk Indonesia, including PT Pupuk Kujang Cikampek (West Java), PT Petrokimia Gresik (East Java), and PT Pupuk Sriwidjaja Palembang (South Sumatra). Apart from that, there are small and medium industries that have not been registered.

3.1.4 Production location Network

According to existing data, the production network for fertilizer in Indonesia and connected with PT Pupuk Indonesia includes 2 large producers, namely PT Pupuk Iskandar Muda in Lhokseumawe, Aceh Province and PT Pupuk Kalimantan which is located in Bontang, East Kalimantan Province. Apart from that, there are several small and medium industries spread throughout Indonesia's regions and provinces.

3.1.5 Consumer and Demand Oriented

According to data from the Ministry of Agriculture, the amount of production and availability is not yet able to meet the needs of existing fertilizer consumers. As in In 2021, local and domestic fertilizer production can only meet the need for subsidized fertilizer of 8.87 million tonnes to 9.55 million tonnes from 22.57 tonnes to 26.18 million tonnes per

year. This does not include fulfilling fertilizer requirements for exports, where according to the Ministry of Industry, global demand for fertilizer in 2018 increased and reached 1.141 million tons.

3.2 Analysis of Trip Production dan Trip Attraction Commodity

3.2.1 Determination of Dependent Variable (Y)

The dependent variable taken in the analysis of this study for both *trip production* and *trip attraction* is the amount of production/distribution/movement of fertilizer commodities per ton.

3.2.2 Determination of Independent Variables

In the analysis of this multimodal transportation planning study, several independent variables were used, US follows:

- a. X1 : Labor
- b. X2 : GRDP (GROSS Regional Bruto)
- c. X3 : Number of Business Unit
- d. X4 : Population

3.2.3 Determination of the Analysis Model

There is a determination of the analytical model in the study of fertilizer commodities, so several models are used in the form of movement generation models, with determination using multiple linear regression analysis methods, correlation analysis, and analysis using methods without constraints (unconstrained gravity)

3.2.4 Multiple Regression Analysis

In the regression analysis to be carried out, calculations are first carried out through correlation analysis between variables. Below in table 3.1, the results of the correlation analysis for each dependent and independent variable are displayed

Table 3.2 Correlation Analysis Results

	<i>Y</i>	<i>y</i>	<i>x1</i>	<i>x2</i>	<i>x3</i>	<i>x4</i>
<i>y</i> (b)	1					
<i>y</i> (t)	0,998478376	1				
<i>x1</i>	-0,985454161	-0,993326032	1			
<i>x2</i>	0,360226239	0,411120626	-0,513518874	1		
<i>x3</i>	0,992826989	0,98472319	-0,958067304	0,246109087	1	
<i>x4</i>	-0,965802297	-0,950034824	0,907691536	-0,106034449	-0,989874033	1

Next, we obtained a variable that was highly correlated with the dependent variable, namely variable *x3* which was indicated by a correlation value of more than 0.5. This means that the *x3* variable will then calculate the regression value for the two independent variables which will be displayed in the following two tables.

Table 3.3 ANOVA from Generated Regression

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	44272403640644	44272403640644	69	0
Residual	1	642032565316	642032565316		
Total	2	44914436205961			

Table 3.3 Generated Regression

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95,0%</i>	<i>Upper 95,0%</i>
Intercept	2560770,466	885611,6378	2,891527569	0,211970313	13813533,25	8691992,321	13813533,25	8691992,321
x3	58607,72087	7057,758776	8,304013034	0,076296711	31069,60712	148285,0489	31069,60712	148285,0489

Table 3.4 ANOVA of Attraction Regression

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	17016566152076	17016566152076	32	0
Residual	1	532079117257	532079117257		
Total	2	17548645269333			

Table 3.5 Attraction Regression

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>Pvalue</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95,0%</i>	<i>Upper 95,0%</i>
Intercept	-177581	806219	0	1	-10421562	10066399	-10421562	10066399
x3	36335	6425	6	0	-45303	117973	-45303	117973

3.3 Analysis of Growth in Commodity Production Needs

3.3.1 Determining Term Strategy

As is known, the need for fertilizer increases along with the increase in food or production needs in agriculture or plantations. Therefore, it is necessary to improve not only the distribution system to be more even but also the level of fertilizer production which must be kept growing. Therefore, several companies and the government are working together to increase production but also reduce the price of existing fertilizers. This is also done by establishing several new factories to meet existing production targets. Apart from that, as reported in an article related to increasing the availability of fertilizer in East Kalimantan, PT Pupuk Indonesia also stated that to maximize existing production and distribution capacity, the company has implemented industry 4.0-based technology. This includes Smart Operation, Smart Maintenance, Smart Distribution, and the Digital Performance Management System.

3.3.2 Determining production Capacity

Fertilizer production capacity in Indonesia continues to increase. For example, in 2011 production capacity increased by 6% from the previous year. Production capacity is determined by various factors, among others raw material factors, machines/tools, labor force, and working capital. This has a big influence on increasing production capacity. Apart from that, in fact, PT Pupuk Indonesia succeeded in exceeding the production target in 2020, which was 12,254,676 tons from the RKAP target which was estimated at 10,472,000. This is done by not only increasing these factors which are realized with the construction of new factories, but also increasing with

3.3.3 Penentuan Ekspansi Komoditas

Fertilizer is a commodity that is needed in large quantities and is used on a scale and continuously. Therefore, to meet market demand and the agricultural or plantation industry, production of this commodity must be expanded. This is considered to be able to streamline

the spread and distribution of fertilizer to meet the needs of the entire region. For example, at an NPK fertilizer company, in the process of fulfilling demand on islands outside Java, the factory expanded to Central Kalimantan, West Kalimantan, East Kalimantan, Riau and Palembang (Saraswati Fertilizer Div., 2016). This was also done to stem imports of NPK fertilizer from abroad.

3.4 Sistem Supply Chain Analyse

3.4.1 Determining the Production Operating

System The production operating system is an information system processing process that converts input into output in the form of goods or services. The process of making fertilizer differs based on the type. For example, the following is the production and distribution process for urea fertilizer.

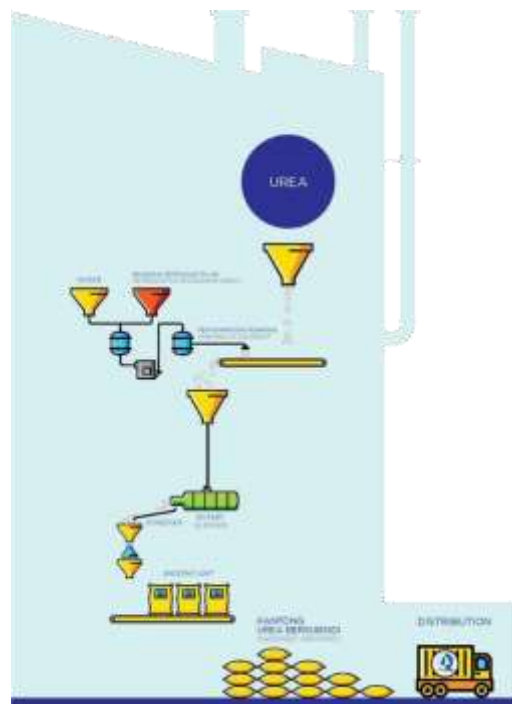


Figure 3.1 Urea Fertilizer Production Scheme

Figure 3.1 shows the urea fertilizer production scheme starting from importing the raw materials, *then* processing the fertilizer and packaging, and then the fertilizer will be ready to be distributed.

3.4.2 Determining the Distribution System

Berikut system pendistribusian barang dari perupa bahan baku sampai dengan end customer.

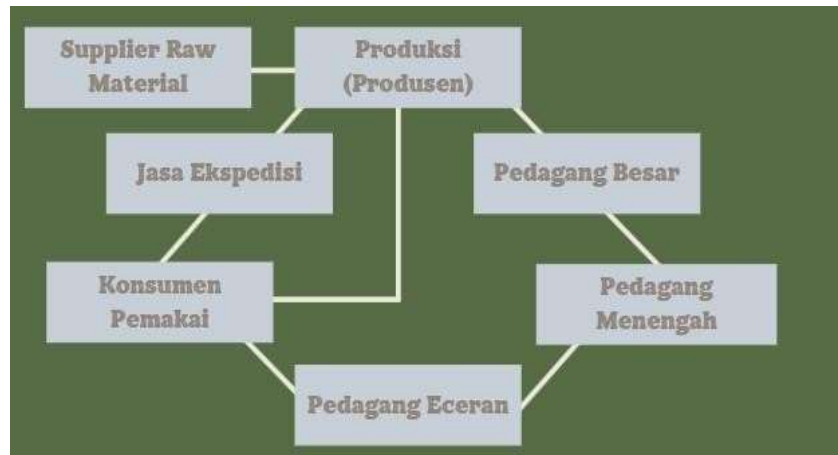


Figure 3.2 *Supply Chain*

Figure 3.2 shows the process from the beginning when the raw materials are sent from the supplier to the manufacturer and then processed according to the scheme in Figure 3.1. After that, the producers are divided into 3 distribution channels, the first is expedition services or delivery trucks which will send products to consumers directly, then there are direct consumer users who buy or obtain products from the producers directly. Finally, distribution is carried out to large traders who can then be sold to middle level traders and then sold to retail traders and end up at end customers or consumer users.

3.4.3 Determining the Marketing System

This fertilizer marketing strategy can be carried out based on SWOT analysis. Here are some of them

- a. Improving product quality and maintaining product continuity in the market
- b. Increasing cooperation and maintaining a good name with various good networks suppliers and customers
- c. Increasing market demand for good quality and affordable prices and durable
- d. Carry out promotional activities both conventionally and digitally by utilizing technological advances
- e. Collaborate with various partners or institutions to promote target product
- f. Expanding business both domestically and abroad

3.4.4 Determining the Warehousing system

The warehousing system must be adapted to the characteristics and properties of the products it stores. Fertilizers have different characteristics so some have to be adjusted for storage because they contain chemicals, and some are resistant to various room conditions and temperatures. Most warehousing systems for fertilizer commodities have implemented high technology in their operations, such as at PT Petrokimia Gresik in East Java which is also the review zone for this study. PT Petrokimia Gresik uses the Warehouse Management

System (WMS) as a system that assists operations in coordinating and

organizing warehousing issues. This WMS is useful in controlling the movement of fertilizer and its storage in the warehouse, including optimizing labor processing time.

3.5 Distribution Systems Analysis

3.5.1 Determination of Production and Consumption Zones

The production and consumption zones for fertilizer commodities determined in this study are in the provinces of West Java, East Java and South Sumatra. The determination of the zone is seen from the production point and source of factories and large industries for fertilizer commodities in the areas. Apart from being a regions that produces a lots of fertilizer, the characteristics of a regions that uses a lots of fertilizer is that the majority of the population is a farmer or the agricultural areas is still said to be large.

3.5.2 Penentuan Kapasitas Zona Asal dan Tujuan

Table 3.6 Capacity and Numbers of Movements in Origin and Destinations Zones (Tons)

	West java	East java	South sumatera
West java	883147	127784	66269
East java	78558	770975	23038
South sumatera	1270555	879171	7031270

3.5.3 Determining Growth in Origin and Destinations Zones Along

Along with demand growth, of course the frequency and quantity of production also increases. In understand with existing data, production growth cand to increase and continues to increase every years. Figures 3.3 shows a graph of the general growth of fertilizer production in Indonesia, and it is assumed that this will continue to increase.

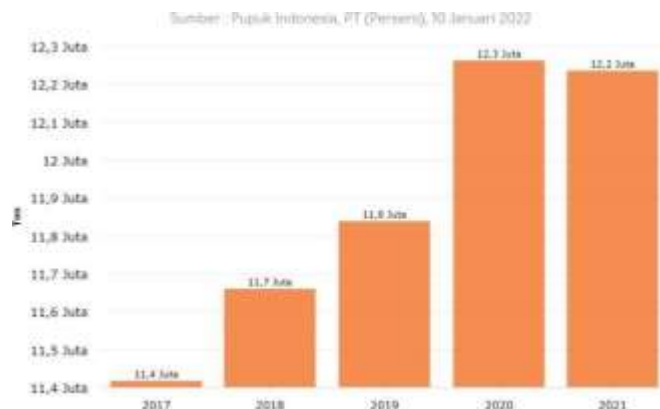


Figure 3.3 Growth in Fertilizer Production in Indonesia 2017 - 2021

3.5.4 Determination of the Origin Destinations Matrix

Table 3.7 Matriks biaya

Ke	West java	East java	South sumatera
Dari			
West java	17,80	4,70	626,59
East java	2,92	2,97	819,76

South sumatera	670,28	648,19	6,33
----------------	--------	--------	------

Table 3.8 Regression Calculations

No	[Cid]=Xi	[Tid]	log e [Tid]=Yi	XiYi	(Xi)^2
	[1]	[2]	[3]=log e [2]	[4]=[1]*[3]	[5]=[1]^2
1	17,8	883147	13,691247	243,6801256	316,7774183
2	4,7	127784	11,758090	55,22374183	22,05860785
3	626,6	66269	11,101477	6956,052413	392612,5096
4	2,9	78558	11,271592	32,94110128	8,540940007
5	3,0	770975	13,555411	40,2959774	8,836860692
6	819,8	23038	10,044900	8234,367921	672000,0025
7	670,3	1270555	14,054964	9420,715199	449270,865
8	648,2	879171	13,686734	8871,565897	420146,6565
9	6,3	7031270	15,765878	99,78192098	40,05598388
Total	2799,527	11130767	114,9302943	33954,6243	1934426,303
Average	311,05856		12,7700327		

Table 3.9 Exponential Matrix

To	West java	East java	South sumatera	Oi
From				
West java	0,970402	0,992103	0,347249175	1077200
East java	0,995079	0,994995	0,250626803	872571
South sumatera	0,322561	0,334816	0,989373225	9180996
Dd	2232260	1777930	7120577	11130767

Table 3.10 Final MAT

To	Kota Batam	Kab. Karawang	Kota Depok	oi	Oi	Ei	Ai
From							
Kota Batam	292844,7	238458,2	334269,797	865572,6984	1077200	1,244493966	1
Kab. Karawang	243247	193722,7	195428,4819	632398,141	872571	1,379781096	1
Kota Depok	829643,4	685891,5	8117261,202	9632796,161	9180996	0,953097714	1

dd	1365735	1118072	8646959,481	11130767			
Dd	2232260	1777930	7120577		11130767		
Ed	1,634475	1,590174	0,823477549				1
Bd	1	1	1				

3.5.5 Determining the Desire Line for the Origin Destinations

These are desire lines from three provinces, West java – East java – South sumatera.



Figure 3.4 Desire Line West java & East java



Figure 3.5 Desire Line West java & South sumatera



Figure 3.6 Desire Line East java & South sumatera

3.5 Analysis of Determining Transportation Modes

3.5.1 Determining Appropriate Modes

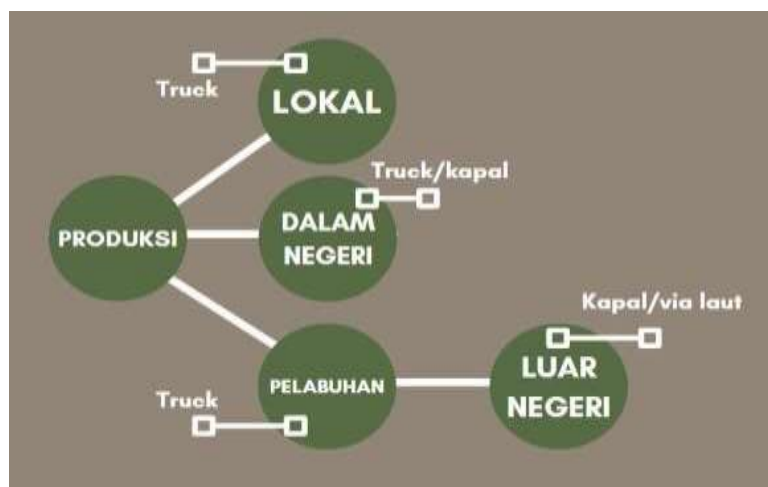


Figure 3.7 *Transport Chain*

Based on the picture above, it can be seen that distribution of fertilizer commodities from factories or producers can use ships and trucks. Furthermore, it will be distributed according to its purpose, whether local, within the country or on different islands, and abroad.

3.5.2 Determining User Captive dan Choice

Distribution of fertilizer from South Sumatra Province to West Java and East Java or vice versa, using user choice, namely the choice of modes for distributing fertilizer commodities. The mode choices include using boats and trucks.

3.5.3 Determination of Transport Capacity

The following is the transport capacity of the transportation modes used in each zone. This capacity calculations is adjusted to the volume of goods transported in tons and the amount generated by each zone per years. The amount generated per years is divided into per day (25 operations days) and then divided again by the number of city/ districts areas in each province to see the number of goods transported per day from one area in the province of origin. Furthermore, from the results of these calculations, the volume transported will be divided by the capacity of the transportation mode US below to produce transportation per trip.

Table 3.11 Transport Mode Capacity

No	Zone	Jenis Moda	Kapasitas Moda yang digunakan
1	West java - West java	TRUCK	10
2	West java - East java	TRUCK	6
3	West java - Tanjung Priok	TRUCK	10
4	Tanjung Priok - Boom baru	TRUCK TANPA	10000

		BAW A GAO S KAKI	
5	East java - East java	TRU CK	10
6	East java - West java	TRU CK	10
7	East java - Tanjung Perak	TRU CK	2,5
8	Tanjung Perak - Boom Baru	TRU CK TAN PA BAW A GAO S KAKI	10000
9	South sumatera - South sumatera	TRU CK	20
10	South sumatera - Boom Baru	TRU CK	20
11	Boom baru - Tanjung Priok	TRU CK TAN PA BAW A GAO S KAKI	10000
12	Boom Baru - Tanjung Perak	TRU CK TAN PA BAW A GAO S KAKI	10000

3.5.4 Determination of Distribution Routes/Path

- a. West Java delivery to West Java
- b. East Java to East Java and South Sumatra to South Sumatra: between districts/cities
- c. Delivery from West Java to East Java and vice versa: between provisions via existing city/district
- d. Delivery to West Java/East Java and vice versa: existing city/district to ports and from ports to ports of destination

3.5.5 Determination of BOK

Determination of vehicle operating costs (BOOK) is carried out based on several related costs and several influencing factors. These influencing factors include the capacity of the transportation mode and the type of mode used, the volume of goods transported on one trip, the frequency of trips, the number of operations days, and so on. Apart from that, the costs that influence this include vehicle costs, large and small service costs, operations costs (drivers, fuel, etc.), documents and other costs which will then be calculated and the results will be summarized as follows.

Determination of vehicle operating costs (BOOK) is carried out based on several related costs and several influencing factors. These influencing factors include the capacity of the transportation mode and the type of mode used, the volume of goods transported on one trip, the frequency of trips, the number of operations days, and so on. Apart from that, the costs that influence this include vehicle costs, large and small service costs, operations costs (drivers, fuel, etc.), documents and other costs which will then be calculated and the results will be summarized as follows.

Table 3.12 BOOK

No	Tujuan	Transportasi	Total BOK
1	West java - West java	TRUCK	Rp 177.982.420
2	West java - East java	TRUCK	Rp 46.966.592
3	West java - South sumatera	TRUCK TANPA BAWA GAOS KAKI +TRUCK	Rp 6.265.879.903
4	East java - East java	TRUCK	Rp 29.726.858
5	East java - West java	TRUCK	Rp 29.224.887
6	East java - South sumatera	TRUCK	Rp 8.197.560.628
7	South sumatera - South sumatera	TRUCK TANPA BAWA GAOS KAKI +TRUCK	Rp 63.289.797
8	South sumatera - West java	TRUCK TANPA	Rp 6.702.767.078

		BAWA GAOS KAKI +TRUCK	
9	South sumatera - East java	TRUCK TANPA BAWA GAOS KAKI +TRUCK	Rp 6.481.872.079

3.6.7 Determination of Freight Rates

Determination of transport rates is taken from the results of previous BOOK calculations. So this tariffs is the daily transportation cost of each vehicle in a predetermined zone and adjusted mode.

Table 3.13 Freight Rates

No	Tujuan	Transportasi	Tarif
1	West java - West java	TRUCK	Rp 593.275
2	West java - East java	TRUCK	Rp 156.555
3	West java - South sumatera	TRUCK TANPA BAWA GAOS KAKI +TRUCK	Rp 2.348.071
4	East java - East java	TRUCK	Rp 99.090
5	East java - West java	TRUCK	Rp 97.416
6	East java - South sumatera	TRUCK	Rp 8.783.520
7	South sumatera - South sumatera	TRUCK TANPA BAWA GAOS KAKI +TRUCK	Rp 210.966
8	South sumatera - West java	TRUCK TANPA BAWA GAOS KAKI +TRUCK	Rp 3.804.361
9	South sumatera - East java	TRUCK TANPA BAWA GAOS KAKI +TRUCK	Rp 3.064.558

4. CONCLUSION

The need for both organic and inorganic fertilizers in Indonesia continues to increase, in line with increasing demand from the plantation and agricultural sectors. In the analysis of the distribution of fertilizer commodities using a multi-modal transportation system, three zones were used, namely West Java, East Java and South Sumatra Provinces. In the three review zones, the distribution process carried out depends on the amount of production and existing demand, where a high level of distribution occurs in the province of South Sumatra because it has a higher level of production. Apart from that, the movement of commodities in other provinces is also felt to be high because demand is quite high, this also affects the costs incurred in the distribution process. From the results of the generations and attraction analysis which are then processed into determining BOOK and tariffs, It can be seen that distribution to South Sumatra province has more expensive rates than to others destinations. This is because the distance traveled and the volume of goods transported have quite a large value.

7. REFERENCES

- Badan Pusat Statistik Provinsi West java*. Bps.go.id. <https://jabar.bps.go.id/>
- BPS Provinsi East java*. Bps.go.id. <https://jatim.bps.go.id/>
- BPS Prov South sumatera*. Bps.go.id. <https://sumsel.bps.go.id/>
- ATTN Barang*. (2022). *ATTN Barang*. <https://attn-barang.dephub.go.id/>
- Saraswati Fertilizer Div*. (2016). *Ekspansi Pupuk ke Kalimantan & Sumatera*. Pupukindonesia.id. <https://pupukindonesia.id/saraswanti-ekspansi-pupuk-ke-kalimantan-dan-sumatera/>
- Balai Penelitian Tanah*. (2021). *Pengertian Pupuk*. Pertanian.go.id. <https://balittanah.litbang.pertanian.go.id/ind/index.php/en/berita-terbaru-topmenu-58/1059->
- Pupuk Indonesia | Pupuk*. (2022). *Pupuk Indonesia | Pupuk*. <https://www.pupuk-indonesia.com/>
- NI, NYOMAN PARINING, & GEDE, I. (2016, January 19). *Strategi Pemasaran untuk Meningkatkan Penjualan Pupuk Organik (Studi Kasus pada Simantri 174 Gapoktan Dharma Pertiwi Kelurahan Lukluk, Kecamatan Mengwi, Kabupaten Badung)*. *Jurnal Agribisnis Dan Agrowisata (Journal of Agribusiness and Agritourism)*. <https://ojs.unud.ac.id/index.php/JAA/article/view/18658>

- Zalmi, H., Iqbal, M., & Rahmadani, A. (2019, May 7). *JENIS JENIS PUPUK DAN INDUSTRI PUPUK YANG BERADA DI INDONESIA*. ResearchGate; unknown. https://www.researchgate.net/publication/332923717_JENIS_JENIS_PUPUK_DAN_INDUSTRI_PUPUK_YANG_BERADA_DI_INDONESIA
- Vika Azkiya Dihni. (2022, January 12). *Produksi Pupuk Indonesia Capai 12,2 Juta Ton pada 2021*. Katadata.co.id; Databoks. [https://databoks.katadata.co.id/datapublish/2022/01/12/produksi-pupuk-indonesia-capai-122-juta-ton-pada-2021#:~:text=Produksi%20PT%20Pupuk%20Indonesia%20\(2017%2D2021\)&text=PT%20Pupuk%20Indonesia%20\(Persero\)%20memproduksi,produksi%20pupuk%20Indonesia%20cenderung%20meningkat](https://databoks.katadata.co.id/datapublish/2022/01/12/produksi-pupuk-indonesia-capai-122-juta-ton-pada-2021#:~:text=Produksi%20PT%20Pupuk%20Indonesia%20(2017%2D2021)&text=PT%20Pupuk%20Indonesia%20(Persero)%20memproduksi,produksi%20pupuk%20Indonesia%20cenderung%20meningkat).