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Sutriadi, Ridwan
School of Architecture, Planning, and Policy Development, Institut Teknologi Bandung

Muhammad Ihsan Yudanto
School of Architecture, Planning, and Policy Development, Institut Teknologi Bandung

Ridho Ansori Romdan
Department of Civil Engineering and Planning, Institut Teknologi Kalimantan

Bintang Atha Araminta
Department of Civil Engineering and Planning, Institut Teknologi Kalimantan

他

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The Multiple Effects of Mining Activities on the Ecology and Economic Development in East Kalimantan Province, Indonesia

Ridwan Sutriadi[1,*], Muhammad Ihsan Yudanto[1], Ridho Ansori Romdan[2], Bintang Atha Araminta[2], Irvisya Alifa[2]

[1]School of Architecture, Planning, and Policy Development, Institut Teknologi Bandung, Indonesia

[2]Department of Civil Engineering and Planning, Institut Teknologi Kalimantan, Indonesia

*Author to whom correspondence should be addressed:
E-mail: ridwansutriadi@gmail.com

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Abstract: Mining is one of the leveraging sectors in East Kalimantan, the province which has the largest coal resources on the island of Kalimantan. The mining and refining sector in East Kalimantan Province has the largest distribution of Gross Regional Domestic Product (GRDP) at constant prices compared to other sectors. However, these brownfield activities certainly have environmental, social, and economic impacts, especially with the development of new Indonesian Capital City, Nusantara. Therefore, it is necessary to see the extent to which the influence of existing mining activities in the development area of East Kalimantan Province. The purpose of this study is to look at the multiplier effect on the socio-economic and environment in the mining sector, especially coal in East Kalimantan Province. This research uses descriptive statistical analysis methods and spatial analysis using GIS. The data used is secondary data from Input-Output Table of East Kalimantan Province. The results showed that the mining and business sector (with the coal and lignite sub-sectors), as well as the mining and oil and gas industry sector (with the coal, oil and gas refinery sub-sectors), had the highest input-output (IO) value of domestic transactions at producer prices in East Kalimantan Province. The coal mining and industrial mining sectors have a significant effect on output multiplication and gross value added to other sectors, but do not have a significant influence on increasing household income. On the ecological multiplier effect, there has been an increase in mining land use in 2012-2022 through the conversion of dry land agriculture and plantation forests. It can be concluded that mining activities have a multiplier effect on the socio-economic and environmental aspects.

Keywords: mining; multiplier-effect; input-output; socio-economics

1. Introduction

In Indonesia, coal is the main energy source with large reserves which will remain the main resource in the future[1)]. Minerals and coal are foreign exchange earners and state revenues need to be transformed to support development and the national economy. The availability of mineral and coal resources is a valuable opportunity for Indonesia to become an industrialized country[2, 3)]. Most of Indonesia's coal mining production is intended for the export market which will generate foreign exchange, but on the other hand, the demand for coal for domestic purposes must also be met[4)].

In general, mining can provide various positive impacts, in terms of land it can develop areas by providing access, increasing added value to land, as well as improving landscape quality. From a socio-economic perspective, mining can create new jobs, increase people's income, contribute to increasing GDP, develop local human resources, and provide various facilities needed[5)]. The mining sector has contributed on a national scale in the form of state revenues through foreign exchange, royalties, other mining fees, taxes, and state revenues from non-taxes which are used to finance national development. Not only that, mining has a multiplier effect that can become a prime mover of national development because it creates various secondary economies[6)].

In the context of the local economy, coal resources and production in Indonesia are mostly spread over four of the 34 provinces, namely East Kalimantan, South Sumatra, South Kalimantan and Central Kalimantan[7)]. According to information from the East Kalimantan Provincial Government, Kalimantan possesses the most extensive coal reserves, totaling 62.80 billion tons, which accounts

for 50.12% of the entire national coal resources. These coal resources are distributed predominantly within East Kalimantan Province, where they amount to 47.58 billion tons[4]. The mining and quarrying sector in East Kalimantan Province has the largest distribution of GRDP at constant prices, namely 46.6%[8]. Spatially, East Kalimantan Province has a distribution of mining areas, including in the new Indonesian Capital City (IKN), namely Nusantara. Several mining areas are still operating in Nusantara development areas which should not be allowed to continue operations.

An examination of the mining sector, which has significant multiplier effects, necessitates a comprehensive assessment involving input-output and multiplier effect analysis. The demand-driven multiplier effect amplifies the demand for goods and services, initiating subsequent cycles of multiplier effects. Variations in the magnitude of these multiplier effects across diverse economic activities signify structural transformations within local and regional economies. Various essential instruments utilized to assess this occurrence include the output multiplier index, income multiplier, and value-added multiplier. However, there are limitations in research related to multiplier effect in the form of the availability of detailed and updated data[9]. Apart from that, the use of national scale IO data is not relevant in the context of a smaller region scope. The IO data released uses past data which can influence differences in the current picture of economic sectors[10].

The method of analysis used Is based on an input-output analysis model, using data sourced from the 2016 Indonesian input-output table, which was officially released by the Central Bureau of Statistics in 2021. Furthermore, it is imperative to explore the multiplier effect within the environmental sector, particularly in relation to alterations in land use due to mining activities and their impact on the land use balance. Extensive surface mining has the potential to change the environment, affecting various aspects including physical elements such as morphology, water systems and quality, land stability, air quality, and biological characteristics[1]. The results derived from this multiplier research concerning the mining sector are expected to provide an initial comprehension of the potential impacts of the mining sector, potentially serving as a foundation for devising mining development policies, particularly within the East Kalimantan Province, which plays a crucial role in the context of the Indonesian National Capital City.

The existence of interventions in the development of the National Capital City (IKN) in East Kalimantan Province affected various existing economic activities, including the mining sector, especially coal. There is a plan to close mining activities in the IKN area which could affect the running of the coal mining sector. Based on the memo from Head of IKN Authority number 12 of 2023 regarding mining business permits which were still valid at the time the IKN national strategic area spatial plan was ratified, it is stated that they remain valid until the end of the licensing period and cannot be extended[11]. Based on this, starting from the magnitude of the value and contribution of mining, to the possible positive and negative impacts, a multiplier effect analysis is needed to see the impact of ongoing mining activities on other sectors. This study was conducted through secondary data review and a review of relevant literature, including prior research. It is anticipated that this study, building upon previous research, will generate novel outcomes and insights that can serve as a basis for future research. The primary aim of this research is to provide an overview of the multiplier effect's influence within the mining sector in East Kalimantan.

2. Literature Review

2.1 Multiplier Effect

The Multiplier Effect has several theoretical strategies for urban and regional development, like the economic base theory approach, input-output model, and growth pole theory[12]. In the context of economic base theory, the correlation between the entirety of economic activities and the economic foundation can be explored through local/regional multipliers that can estimate changes in the economic base of employment and the population of cities and regions in the future[13, 14]. Within the framework of the input-output model, the multiplier effect serves as a analytical instrument for gauging the overall impact on production output, employment, or added value. It does so by quantifying the increase in one unit of output within a specific industrial sector[15-17]. According to Indonesian Statistics Center, the multiplier is included in a macroeconomic model terminology that explains the impact that occurs on endogenous variables (variables that are influenced by other variables) due to changes in exogenous variables (variables that affect other variables)[18].

The multiplier for a sector can be determined through Leontief C statistical modeling, a utility-focused approach employed to examine how changes in final demand affect various economic activities. The model can summarize the total required input and output multiplier[15, 17]. The multiplier is not only a multiplier quantity, but also several (groups of) multiplier quantities expressed in the form of a multiplier matrix. The multiplier matrix in the Input-Output Table describes the shifts in different internal variables brought about by changes in one or multiple external variables. The multiplier matrix in the Input-Output Table is used to perform an impact analysis[17]. The multiplier effect can be used as an indicator to measure the variation in the effect of certain activities in microeconomic analysis such as at the regional level[15, 18]. This is in line with several studies which state the use of IO analysis is a method that can calculate the multiplier effect of an economic sector and sub sector[9, 16, 18, 19, 20].

2.2 Input-Output Analysis (Socio-Economics Focus)

Input-output (I/O) analysis, created by Wassily Leontief and introduced in the form of an input-output table in 1936, is both a theoretical framework and a useful economic tool designed for use in a market-oriented economy[15]. Input-output analysis is a form of inter-sectoral analysis where the Input-Output system is constructed on the premise of an idealized economic behavior model, simplifying the framework for assessing the flow of inputs and outputs across various facets of economic activity within a specific area. This accounting system follows the flow of goods and services from one production sector to another[21].

This Input-Output analysis is used to determine the interrelationships between sectors to understand the intricacies of the economy and the prerequisites for sustaining equilibrium between supply and demand. Input-output analysis shows that the economy as a whole is interconnected and interdependent between sectors[16]. This IO table enables the estimation of how the growth of a sector influences the entire country or region, including the level of income of the people in that country/region[22]. The I-O table is an approach to measuring the influence of a sector on other economic sectors or for calculating the multiplier effect[11].

Table I-O provides data on the exchanges of goods and services among economic sectors, presented in a matrix format. The values within the rows of Table I-O signify the distribution of output generated by specific sectors to satisfy both intermediate and final demands. Moreover, the value within the "added value" row elucidates the constituents contributing to the creation of value within each sector. The entries within the columns indicate the composition of inputs utilized by each sector in their production processes, encompassing both intermediate and primary inputs. The fundamental principles adhered to in constructing Table I-O are consistency, comparability, and summation[17].

In Indonesia, the utilized Input-Output Table (Table I-O) is segmented into three distinct sections. In the first quadrant, labeled Quadrant I, it portrays intermediate transactions, providing insights into the interconnections among economic sectors during the production process, specifically illustrating the exchanges of goods and services. Quadrant II, on the other hand, represents final demand, with the entries along its rows detailing the structure of final demand within a particular production sector. Simultaneously, the entries along the columns elucidate the distribution of each constituent within the final demand. Meanwhile, Quadrant III delineates the primary input components or added value. This added value encompasses components such as labor compensation, gross business surplus, and taxes subtracted by other subsidies on production[17, 19].

2.3 Spatial / Land Use Analysis (Ecological Focus)

Land utilization patterns are determined by the attributes of the land and the environmental capacity it can support. These land utilization patterns can be assessed by conducting an evaluation of land resources, enabling the identification of the land's potential for various purposes[23]. Land use changes are influenced by factors such as land erosion, surface runoff, critical watershed conditions, and increased sediment levels[24-26]. One way to evaluate land management and use policies according to Law no. 26 of 2007 and Government Regulation no. 16 of 2004 Article 23 is by way of making a land resource balance that serves to calculate and see how effectively the implemented development can run. With this balance of land resources, it will be possible to know the balance between the availability and the need for tenure, use, and utilization of land according to the function of a particular area made from two points of the year so that it will be known the form of use and the extent of changes in land use from two different points of the year.

One of the requirements in preparing the spatial land resource balance is the classification of land use consisting of various data variables with the main classification consisting of residential land, paddy fields, dry land agriculture, gardens, plantations, mining, industry and tourism, transportation, forested land, land open and inland waters. The classification of land use in the land resource balance is flexible, allowing each land use classification to evolve based on the map's level of detail[27]. GIS technology is utilized for city-scale analysis, primarily for spatial analysis [28, 29].

3. Methodology

3.1 Research Design

This research employs quantitative methodology, utilizing descriptive statistical analysis techniques and spatial analysis. Descriptive statistical analysis is a type of statistical analysis that has the function of expressing research results clearly and concisely through a process called data reduction. Data reduction is a method for summarizing a set of data into a smaller data set that describes initial observations without sacrificing important information. Apart from that, this analysis also shows a measure of central tendency and a measure of data spread. In this study, the information to be obtained is the position and size of the mining sector in the table of input-output of East Kalimantan Province effects. Data collection for this study was conducted through a secondary approach, involving the examination the 2016 East Kalimantan Province Input-Output Table document which was published in 2021 by East Kalimantan Statistics Center.

Spatial analysis focuses on visualizing land use data and uses intersect techniques to see changes in each type of land use. This spatial analysis uses ArcGIS tools with basic data in the form of land use types over a period of 5 years, namely 2012, 2017, and 2022. The data used was collected from Indonesian landform sources (RBI). The

study area for this research is East Kalimantan, a province in Indonesia with an area of 167.320 km^2. East Kalimantan has potential land resource ini the form of protected forests and cultivated forests, but on the other hand is rich in coal resources which dominate nationally. East Kalimantan Province is used as a case study because there is a development of a new Indonesian National Capital City called "Nusantara" which has coal mining land that is still active, especially in its development area.

3.2 Multiplier Effects Analysis Method

The multiplier analysis examined in this study consists of an analysis of the output multiplier, household income multiplier, and gross added value multiplier. The analysis of the output multiplier reveals the influence of changes in final demand of an industry on all industries in a particular region. The output multiplier quantifies the total output generated due to an increase in final demand by one unit of currency. The income multiplier figure shows the amount of household income created as a result of one additional unit of currency in the final demand within that industry or region. The household income multiplier figure shows the increase in final demand in the form of household income[30]. Gross value added is the sum of the components of labour compensation, business surplus, consumption of fixed capital, and taxes minus other subsidies on production[12]. The value-added multiplier can be defined as a one-unit increase in the value of the final demand for each domestic product, resulting in a corresponding one-unit increase in value added, thus generating adequate revenue for the final demand[15].

3.3 Spatial Analysis Method

This study uses an analysis of land use change to see changes in mining land use compiled in the land use balance sheet in East Kalimantan Province. Information summarized and synthesized from expertise and previous studies of spatial Land Use Changes (LUC) explicit models provide insight into two research problems[31]:

1. Description of change, including its dynamics and trends, in the above scientific publications the last three decades
2. Interpretation of the intellectual basis of GIS-based land use change models, and the problems that arise.

The data needed to carry out this spatial analysis is land use maps every 5 years, namely in 2012, 2017, and 2022. The spatial analysis technique used is to overlay/superimpose 3 periods of land use data. The impact of mining activities are in the form of an increase or decrease in the area used for mining land, and the change of land use from non-mining to mining. The output of this analysis is a spatial land resource balance that can compare the composition of the area of each type of land use, especially for mining land use.

4. Result

4.1 Economic Multiplier Effect

The result on the Economic Multiplier Effect consists of input-output tables and multiplier effect analysis which consists of the multiplier effect of output, added value and income. Input-Output of the mining and quarrying Sector and processing industry of East Kalimantan Province are showed in Table 1.

Table 1. Table of Input – Output of the Mining and Quarrying Sector and Processing Industry of East Kalimantan Province

Sectors		Mining and Quarrying	Processing Industry	Intermediate Total Inputs	Gross Value Added	Total Inputs
Agriculture, Forestry and Fisheries	A	9.288	5.430.479	13.478.252	39.635.886	53.114.138
Mining and quarrying	B	39.319.025	19.372.315	121.160.181	214.275.150	335.435.331
Processing industry	C	49.735.507	21.143.607	146.384.256	97.890.776	244.275.033
Procurement of Electricity and Gas	D	2.107.737	597.097	7.787.457	827.653	8.615.110
Water Procurement, Waste Management, Waste and Recycling	E	469	130.293	281.151	385.337	666.488
Construction	F	4.540.706	16.224.117	52.977.195	36.535.778	89.512.973
Large and Retail Trade; Repair and Maintenance of Cars and Motorbikes	G	22.370	7.904.163	19.788.870	27.858.856	47.647.727
Transportation and Warehousing	H	11.235	17.252.666	25.015.363	19.735.441	44.750.804
Provision of Accommodation and Food and Drink	I	714	2.703.437	7.476.469	5.925.673	13.402.142
Information and Communication	J	19.374	748.670	5.171.824	8.054.619	13.226.443
Financial Services and Insurance	K	10.808	280.526	2.264.982	8.366.033	10.631.015
Real Estate	L	1.067	82.423	2.580.420	7.823.665	10.404.085
Company Services	MN	33.749	620.288	3.531.350	4.273.276	7.804.626
Government Administration, Defense and Compulsory Social Security	O	23.456	671.483	6.262.456	7.892.778	14.155.234
Education Services	P	12.593	370.030	3.482.459	6.488.153	9.970.612
Health Services and Social Activities	Q	3.273	1.167.965	2.491.647	2.605.203	5.096.849
Other Services	RSTU	2.385	469.759	2.234.358	3.458.922	5.693.280
Intermediate Total Requests	1800	95.853.756	95.169.318	422.368.690	492.033.199	914.401.889

Sectors		Mining and Quarrying	Processing Industry	Intermediate Total Inputs	Gross Value Added	Total Inputs
Household consumption	3011	11.239	21.680.917	102.257.997		
LNPRT consumption	3012	-	6	2.406.272		
Total Government Consumption	3020	-	139.984	22.470.621		
Gross Fixed Capital Formation	3030	7.820.840	3.355.550	150.009.923		
Inventory Changes	3041	(102.884)	149.149	407.452		
Total Eksports	3080	231.852.379	123.780.110	406.835.551		
Total Final Consumption	3090	239.581.574	149.105.715	684.387.816		
Total Outputs	**3100**	**335.435.331**	**244.275.033**	1.106.756.506		

Source: East Kalimantan Province Statistics Center.2021

The highest total input-output (IO) value for domestic transactions at producer prices in East Kalimantan was the mining and refining sector, which amounted to IDR 335 trillion, 36.7% of the total IO, followed by industrial processing, which amounted to IDR 244 trillion (26.7% of total IOs). In the mining sector and its derivatives, the IO value of coal and lignite mining sub-sector is the highest compared to other types of mining, amounting to IDR 237 trillion (26% of the total Mining IO). Whereas in the processing industry sector, the coal, oil and gas refinery sub-sectors had the highest IO value of 138 trillion Rupiah (15.2% of the total processing industry IO).

4.2 Ecological Multiplier Effect

National scale land cover has 22 land cover classes with 7 forest cover categories and 15 non-forest cover categories. The establishment of these classification standards is driven by the specific needs of the Ministry of Environment and Forestry in particular and related institutions at the national level in general. (SNI 7645-2010). After image interpretation, land use in East Kalimantan Province can be divided into several types of land use, namely: (1) water bodies, (2) airports/harbours, (3) swamp thickets, (4) primary dryland forests, (5) secondary dryland forest, (6) primary mangrove forest, (7) secondary mangrove forest, (8) primary swamp forest, (9) secondary swamp forest, (10) plantation forest, (11) plantation, (12) settlements, (13) mining, (14) dryland farming, (15) mixed dryland farming, (16) swamps, (17) paddy fields, (18) shrubs, (19) ponds, (20) open land, (21) transmigration. The spatial distribution of each land use as, as determined through visual interpretation in East Kalimantan Province in 2012, 2017, and 2022 illustrated in Fig. 1 to Fig. 3. The size and proportion of each land use type are detailed in Table 3.

Table 3. Area and Percentage of Land Use in 2012, 2017, and 2022

Land Use	2012		2017		2022	
	Area (Ha)	%	Area (Ha)	%	Area (Ha)	%
Water Bodies	118.705,60	0,9	80.891,80	0,6	119.637,30	0,7
Airport/Harbour	550,9	0	771,3	0	1.126,40	0
Swamp Thickets	552.979,70	4,3	526.793,40	4,2	432.959,60	2,4
Primary dryland forests	2.181.808,60	17	2.188.583,50	18	6.021.769,60	33
Secondary dryland forest	4.215.839,10	33	3.913.210,50	31	6.163.317,90	34
Primary mangrove forest	36.483,40	0,3	30.265,00	0,2	32.882,8	0,2
Secondary mangrove forest	137.956,90	1,1	136.066,70	1,1	161.675,9	0,9
Primary swamp forest	22.673,80	0,2	22.672,30	0,2	74.006,3	0,4
Secondary swamp forest	115.662,60	0,9	111.992,30	0,9	116.517,5	0,6
Plantation Forests	371.076,60	2,9	389.214,80	3,1	641.723,6	3,5
Plantation	1.107.171,50	8,7	1.326.791,00	11	1.588.455,7	8,7
Settlements	58.908,70	0,5	66.930,70	0,5	95.559,9	0,5
Mining	**116.955,00**	**0,9**	**130.559,30**	**1**	**171.395,3**	**1,5**
Dryland Farming	44.144,30	0,3	40.504,40	0,3	55.981,4	0,3
Mixed dryland farming	323.261,20	2,5	443.187,10	3,5	535.193,4	2,9
Swamps	84.128,80	0,7	91.529,20	0,7	84.793,5	0,5
Ricefield	6.475,00	0	9.961,50	0,1	36.705,5	0,2
Shrubs	2.888.941,90	23	2.716.250,80	22	1.566.737,5	8,6
Ponds	117.364,10	0,9	120.266,20	1	118.938,8	0,7
Open land	205.065,60	1,6	175.695,20	1,4	125.221,4	0,7
Transmigration Area	20.673,00	0,2	19.071,90	0,2	15.201,9	0
Total	**12.726.826,30**	**100**	**12.726.826,30**	**100**	**12.726.826,30**	**100**

Secondary dryland forests dominate the area of land use in East Kalimantan Province. Secondary dryland forest is all lowland forest features, hills, and mountains that have shown logged-over features of grooves and patches of logged-overs. The area of secondary dryland forest land reaches 6,163,317.90 Ha with a percentage reaching 33.9% in 2022. Mining land uses have an area and percentage that have continued to increase over the past 10 years. In the 2012-2017 period, there was an increase in the area of mining land by 13,604 Ha. While in the 2017-2022 period, the mining area has increased by 40,836 Ha to a total of 171,395.3 Ha in 2022 or 1.5% of the total land area. This shows that there has been development in the mining sector which is marked by the expansion of mining areas in East Kalimantan Province.

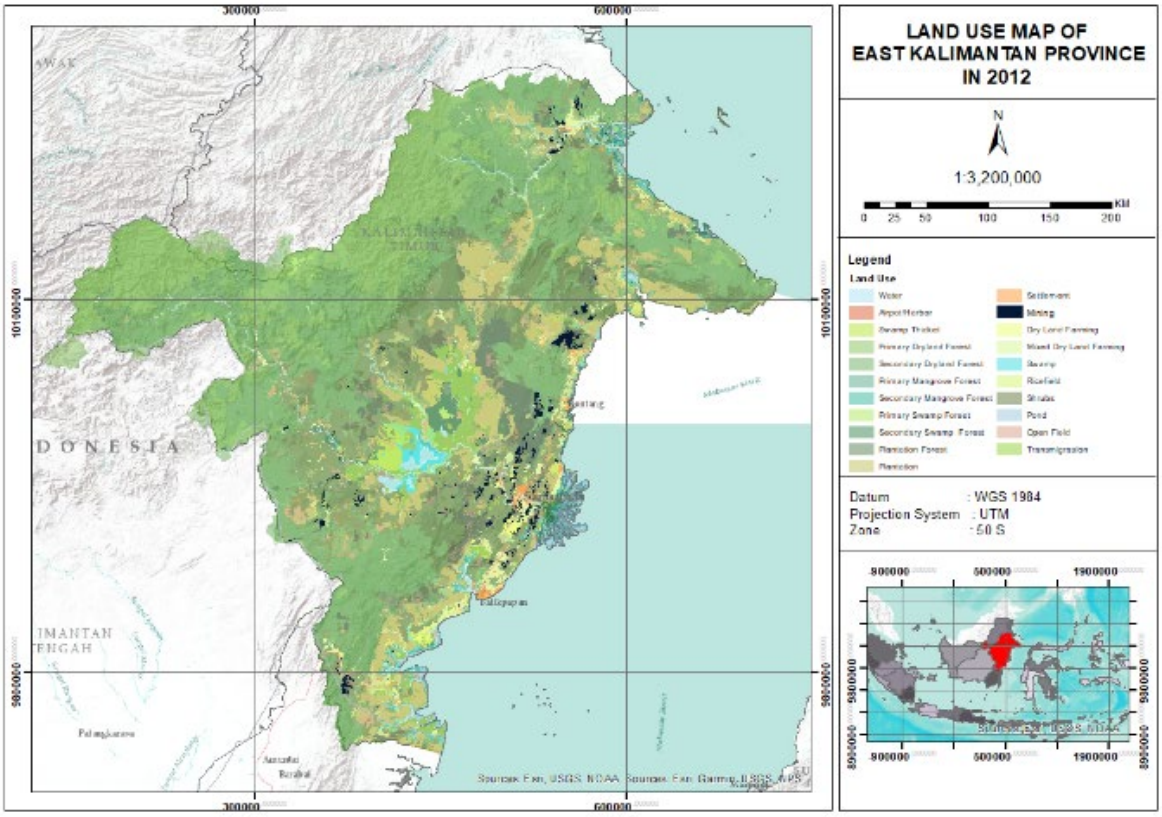

Fig 1. East Kalimantan Province Land Use in 2012

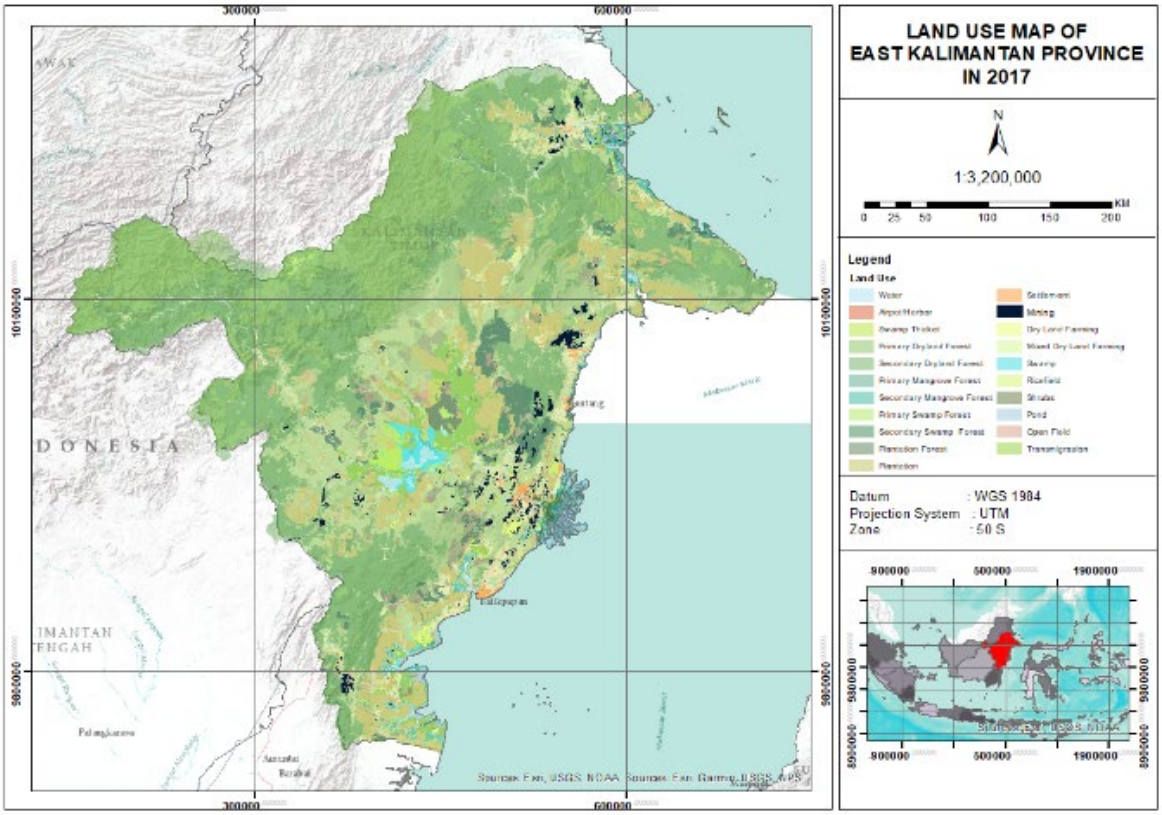

Fig 2. East Kalimantan Province Land Use in 2017

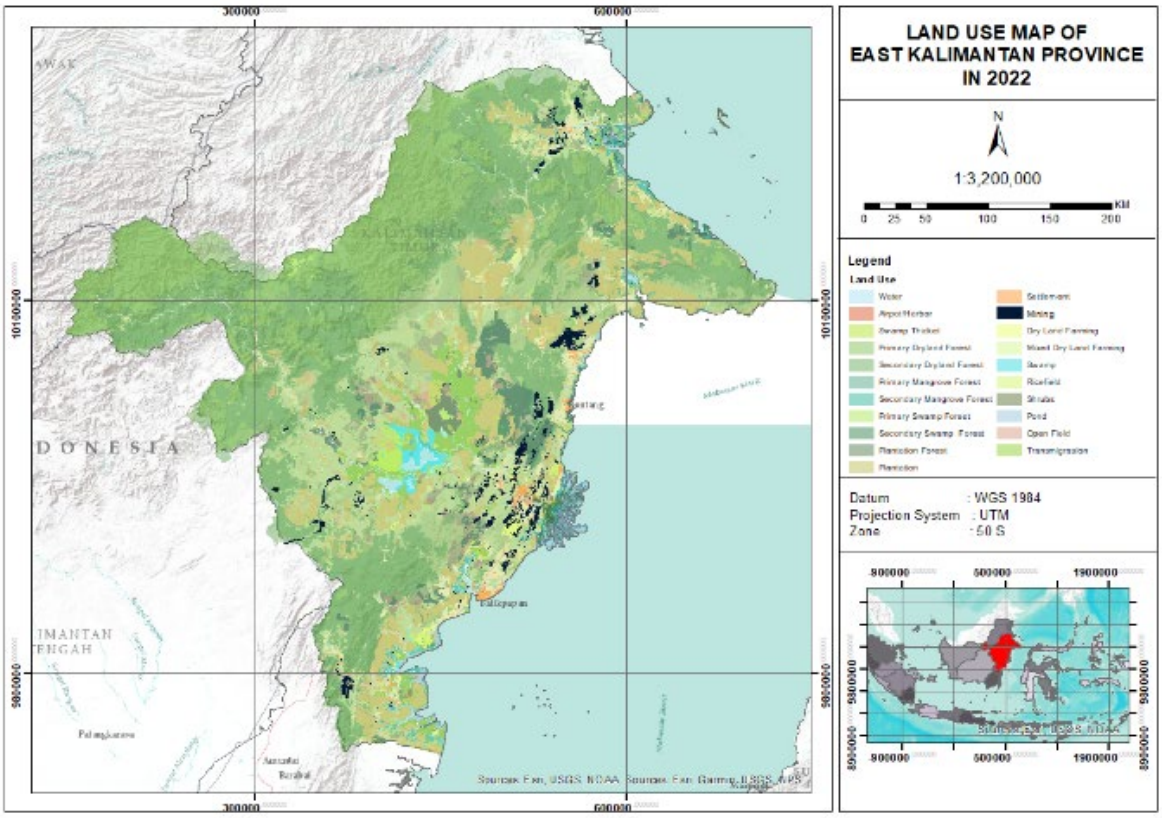

Fig 3. East Kalimantan Province Land Use in 2022

5. Discussion

5.1 Multiplier Effect Analysis

The multiplier effect analysis related to the economy is shown through the value of output, gross added value, and household income in each industry sector. That multiplier effect value in East Kalimantan Province showed in Table 2.

Table 2 Value of Output Multiplier, Gross Added Value, and Income Table I-O of East Kalimantan Province in 2016

Industry Sector	Multipliers		
	Output	Gross Added Value	Household Income
Food Crop Agriculture	1,3315	0,9146	0,5129
Horticultural Plant Agriculture	1,3067	0,9133	0,5211
Annual Plantation	1,4111	0,9074	0,4301
Farm	1,3147	0,876	0,3381
Agricultural and Hunting Services	1,4327	0,8336	0,4182
Forestry and Logging	1,1586	0,9436	0,2771
Fishery	1,2887	0,9475	0,213
Oil, Gas and Geothermal Mining	1,2401	0,8848	0,1343
Coal and Lignite Mining	**1,464**	**0,8548**	**0,2007**
Metal Ore Mining	1,4738	0,8852	0,2242
Mining and Other Quarrying	1,3484	0,891	0,1927
Coal Industry and Oil and Gas Refining	**1,4214**	**0,7692**	**0,1095**
Food and Beverage Industry	2,0222	0,8352	0,311
Tobacco Manufacturing Industry	1	-	-
Textile and Clothing Industry	1,9094	0,6315	0,2562
Leather, Leather Goods and Footwear Industry	1,983	0,769	0,3784
Wood Industry, Wood and Cork Products and Woven from Bamboo, Rattan and the Like	1,6367	0,7778	0,2133
Paper and Paper Goods Industry, Printing and Recording Media Reproduction	1,6564	0,6666	0,1808
Pharmacy, Chemical and Traditional Medicine Industries	1,6655	0,6764	0,1074
Rubber and Plastic Industry	1,7599	0,7611	0,2305
Non-Metallic Minerals Industry	1,6679	0,786	0,2762
Base Metal Industry	1	-	-
Industry of Metal Goods, Computers, Electronic Goods, Optics and Electrical Equipment	1,2745	0,42	0,1489
Machinery and Equipment Industry which Does Not Include Others	1,3601	0,628	0,1654
Transportation Equipment Industry	1,6581	0,7805	0,2582
Furniture Industry	1,5271	0,6791	0,5123
Other Processing Industries, Repair and Installation Services for Machinery and Equipment	1,581	0,7363	0,2678
Electricity	2,9475	0,8013	0,225
Gas Supply and Ice Production	1,5537	0,8757	0,1127
Water Supply, Waste Management, and Recycling	1,6717	0,8384	0,2411
Construction	1,488	0,6744	0,2583
Trade in Cars, Motorcycles and Their Repair	1,4029	0,8235	0,283
Wholesale and Retail Trade, Not Cars and Motorbikes	1,4778	0,831	0,3409
Rail Transport	1	-	-
Land Transportation	1,5869	0,833	0,1859
Sea Freight	1,7502	0,7937	0,2032
River Lake and Crossing Transportation	1,7668	0,777	0,1391
Air Freight	1,8009	0,7965	0,2076
Warehousing and Transportation Support Services, Post and Courier	1,5532	0,842	0,2095
Provision of Accommodation	1,4714	0,8307	0,2909
Serving Food and Beverages	1,7691	0,8102	0,3682
Information and Communication Solutions	1,4412	0,8465	0,1476
Financial Intermediation Services Excluding Central Bank	1,1885	0,9336	0,3466
Insurance and Pension Funds	1,4231	0,9408	0,4664
Other Financial Services	1,3312	0,8947	0,3245
Financial Support Services	1,4279	0,91	0,5585

Industry Sector	Multipliers		
	Output	Gross Added Value	Household Income
Real Estate	1,3529	0,9165	0,1636
Company Services	1,4838	0,8002	0,3268
Public Administration, Regional Defense and Compulsory Social Security	1,5179	0,8059	0,4409
Educational Service	1,3313	0,8191	0,6039
Healthcare Services and Community Engagement	1,6614	0,8165	0,3768
Miscellaneous Services	1,4783	0,8575	0,2892

Source: East Kalimantan Province Statistics Center,2021

5.1.1 Output Multiplier Effect

The electricity industry sector boasts the top rating in the output multiplier analysis. These results indicate that output from the electricity sector plays a central role as an input for numerous other industrial sectors and significantly bolsters their production. In the coal and lignite mining sector, the output multiplier value is 1.4640. This result indicates that for each increase in the final demand for coal and lignite mining by one rupiah, it is estimated that it will have a direct or indirect impact on increasing output in other industrial sectors of 1.4640 rupiah. Meanwhile, in the coal, oil and gas refinery industry, the output multiplier value is 1.4214 which shows that every increase in the industry's final demand of one rupiah will increase output by 1.4214 rupiah. An output multiplier value greater than 1 indicates a positive multiplicative effect on the regional economic sector, including a positive impact on other sectors. In the ranking, both the coal, oil and gas refining industry, along with coal and lignite mining, occupy positions in the lower half of the list, exhibiting a multiplier effect value that falls below the sectoral average. The contribution of mining which is only significant for the mining sector itself shows that the impact of the centralized mining sector indicates that there is a lack of industrial linkage between mining sector activities and goods/service that are still imported from outside the region[20].

5.1.2 Gross Added Value Multiplier Effect

The fisheries sector ranks highest in the assessment of the gross value added multiplier effect. These results indicate that the fisheries sector's output has a significant impact on driving income increases in various sectors. In the coal and lignite mining sector, the multiplier value for gross value added was 0.8548, while the coal, oil and gas refining industry sector was 0.7602. This result shows that for each one rupiah increase in the final demand for coal and lignite mining, as well as the coal industry, oil and gas refineries, is projected to result in direct or indirect increase in gross added value of 0.8548 rupiah and 0.7602 rupiah, respectively. In terms of rank, the position of coal and lignite mining is in the upper half position with a multiplier effect value above the average of other sectors. The coal, oil and gas refining industries are in the lower half position with a multiplier effect value below the average of other sectors.

5.1.3 Household Income Multiplier

The sector with the highest score in the analysis of the household income multiplier effect is the education services sector. These results indicate that the output of the education services sector has an influence on increasing household income in various other sectors. In the coal and lignite mining sector, the multiplier value for household income is 0.2007, while the coal industry, oil and gas refining sector are 0.1095. This result shows that for each one rupiah increase in the final demand for coal and lignite mining, as well as the coal industry, oil and gas refineries, is projected to result in direct or indirect increase in household income of 0.2007 rupiah and 0.1095 rupiah, respectively. In terms of ranking, the position of the coal and oil and gas refining industry, as well as coal and lignite mining, are in the lower half position with a multiplier effect value below the average of other sectors. The multiplier value of household income in these two sectors does not have a significant multiplier effect on household income.

5.2 Ecological Multiplier Effect

Based on the analysis, land conversion to mining is dominated by scrub land, mixed dry land agriculture, secondary dry land forests, and plantation forests covering an area of 101,965 Ha. The change in land use to mining cannot be separated from existing polices and investments values. In East Kalimantan Provincial Spatial Plan (2016-2036), there is the development of a strategic area in the form of regional mining cluster area. Apart from that, mining sector (especially coal), is the main economic sector forming the GRDP structure of East Kalimantan. From an investment perspective, this is in line with the increase in the investment realization value of Domestic Investment in the mining sector and the number of mining projects. The investment value increased from 3.85 trillion Rupiah in 2012 to 15 trillion in 2022. Meanwhile the number of projects increased from 12 in 2012 to 305 in 2022[32].

One of the reasons for the high conversion in forest land is land clearing by the community and business world, as well as the low level of reforestation, especially mining land reclamation. Mining areas still have problems in the

form of widespread ex-open-pit mining holes[33]. The existence of open-pit mining has an impact on environmental and land degradation in the form of soil erosion[34]. These impacts need to be intervened through a post-mining activity plan that provides new land uses that are compatible with the environment. Environmental impact assessment is crucial to anticipate potential effects, safeguard the environment, and help mitigate issues post-mining operations[35]. Challenges in the division of authority and coordination between central and regional governments, as well as overlapping regulations related to environmental issues also need to be a concern and need to be addressed in the future [36].

The overall results of this research are the coal mining and industrial mining sectors have a significant effect on output multiplication and gross value added to other sectors, but do not have a significant influence on increasing household income. On the ecological multiplier effect, there has been an increase in mining land use in 2012-2022 through the conversion of dry land agriculture and plantation forests. It can be concluded that mining activities have a multiplier effect on the socio-economic and environmental aspects.

This research has limited by the lack of detailed regional scale data such as in the Input-Output table. Even though it can provide more comprehensive data and analysis. Accurate results from IO techniques depend on high-quality data on the level of economic activity and linkages between economic sectors[24]. Besides that, ecological effect only seen with land use changes, while it can mor explained with ecosystem service/bioregion context and carrying capacity. This research can be a basis for mining policies and activities that consider socio-economic and ecological impacts.

6. Conclusion

This research is important to be carried out to provide an initial description of the impact of the mining sector on other sectors which can provide input in formulating development policies in the mining sector in East Kalimantan Province, especially in the New Capital City of Indonesia. The mining and quarrying sector as well as the mining industry sector has the highest domestic input-output (IO) transaction value at producer prices in East Kalimantan Province. The coal and lignite mining sub-sectors had the highest IO values compared to other types of mining, while the processing industry, coal, oil-gas refining sub-sectors had the highest IO values. The multiplier effect on the coal mining sector and the mining industry has a significant output multiplier effect on other sectors. In the context of the gross added value multiplier effect, the mining and lignite sectors exhibit a notable impact, contributing significantly to the substantial increase in gross added value, while the mining, oil and gas industrial sector does not have a significant effect with values that tend to be smaller than the average other sectors. The household income multiplier effect does not have a significant effect on increasing income with a low-ranking position and effect value. The multiplier effect related to the environment in terms of the land use balance, there has been an increase in mining land use over 10 years (2012-2022). This shows that there has been development in the mining sector which is marked by the expansion of mining areas in East Kalimantan Province. This research is expected to provide new insights that can form the basis for future research. This research can be a basis for mining activity policies, especially regarding the multiplier effect that must be managed by stakeholder, in context of socio-economic and environmental issues. This research it can be studied in more detail on mining area that will be closed in IKN.

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