



Change Pattern of Land Use of Jabodetabek Area Through Irio and Dimamic System Approach

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ABSTRACT

The objectives of this research are to examine: (1) patterns of land use change in Jabodetabek and (2) the inter-sector and inter-spatial linkage models in changes in agricultural land use.. The research was conducted by using the analysis of Geographic Information System (GIS), Inter Regional Input-Output (IRIO) and dynamic systems. The result shows that land use change from agricultural land into built up area during 1972-2017 where the built-up area in Jakarta becomes wider with the periphery becomes larger by following of the area where the transportation infrastructure has been built well through rail road or toll road, artery road and Jakarta outer ring road. The change of land use is also influenced by economic linkages among Jakarta Province, Bogor-Depok-Tangerang-Bekasi (Bodetabek) region, and outer of Jabodetabek region. In general, scenario model 2 is the best choice, which provides an impact on the best land use change and the increase impact of economic growth.

Keyword: land use, IRIO, dynamic system

1. INTRODUCTION

Space is something dynamic, for example, which contains the road on one side will intervene in the pattern of human life, but on the other hand it is humans who intervene the road needed because humans need accessibility for their mobility needs. Moreover, with globalization, where humans are required to be able to be anywhere and anytime. Changes in space, is a natural thing. But that does not mean all changes in space for humans. Spatial transformation is a process of spatial change from being characterized as rural to city or can also be denied as a process of urban or suburban area development, human life will push toward the modern (Mc. Gee, 1991). Modern life which is revised through economic activities, will cause two different sides. The economy will attract access to better quality development, but on the other hand encourage people to be more consumptive.

The emphasis of development in the modern urban sector has been shown to increase growth in sectors and locations that only have high productivity levels. The rate of investment growth and capital accumulation is only concentrated in the modern sector. This concept inspired the growth of urban growth centers (Mahrus, Bambang Wicaksono, Nurlina, Cholil, & Sri Wiwoho, 2017). It is hoped that with the development of these growth centers there will be a process of

establishing development to the rear regions (*trickle down process*) and equity will occur by "automatically" from the growth poles to the back regions (*inland*). However, when the development is not determined, there will be a process of hatching the development to the back regions (*trickle down process*) and inspection will occur "automatically" from the growth poles to the back area (*inland*). However, at the time of penetration the development did not take place, and that occurred was drainage. The urban development paradigm can lead to debates about excessive urbanization Excessive urbanization ultimately creates differences in cities and what happens is no longer economies of agglomeration but instead is a scale of diseconomies. Big cities grow quickly as centers of regional growth that often experience changes in function to provide services to rural areas (Rustiadi and Panuju, 2005).

DKI Jakarta as the country's capital and main gate of Indonesia has carried out a series of development activities with its characteristics as a center of government, a center for trade and services. The ongoing development has caused relations and linkages between various economic sectors in DKI Jakarta to move in an increasingly high and complex direction. Changes that occur in one particular sector have a reciprocal effect on various other sectors. In fact, changes that occur in the economic sector in DKI Jakarta have affected the surrounding areas (*hinterland*), including Bogor, Depok, Tangerang and Bekasi (Bodetabek).

According to Hidayat (1994), in accordance with Presidential Instruction of the Republic of Indonesia No. 13 of 1976, Bogor, Tangerang and Bekasi serve as buffer zones for DKI Jakarta, and indirectly imply that the region must be able to accommodate an abundance of activities that are not accommodated by DKI Jakarta, including population, industry and trade overflows. In addition to accommodating settlements, Bogor also functions as a water bag to meet the need for clean water for residents who live in the DKI Jakarta and Bodetabek areas, while Tangerang and Bekasi accommodate settlements and industrial activities. Hidayat (1994) also mentioned that in order to support the implementation of these functions a land use regulation is needed which is associated with the proportion of land available to allocate physical development of the required facilities and infrastructure.

Changes in spatial use that do not take into account geobiophysical balance will result in waste or otherwise natural disasters that occur. Optimum space utilization is the utilization of space that gives the opportunity for each component of activities in the space unit to interact maximally according to the carrying capacity of the region which ultimately provides maximum benefits to all stakeholders in a sustainable manner. Human activities, both social and economic, are sources of change in the use of space or area. The social dynamics followed by the dynamics of economic

activity will always bring dynamic spatial changes. Therefore, the dynamic nature needs to be considered in the space use optimization approach (Anwar, 2001).

Based on the background above, this study aims to (1) find out patterns of land use change in Jabodetabek and (2) find out the inter-sector and inter-spatial linkage models in changes in agricultural land use.

2. RESEARCH METHODS

2.1 Research design

In general, this research is descriptive analysis. This study uses a secondary database for analysis and is assisted by mapping techniques with Geographic Information Systems (GIS). This research was conducted in the Greater Jakarta area, namely Jakarta City, Bogor City, Bogor Regency, Depok City, Tangerang City, Tangerang Regency, Bekasi City and Bekasi Regency. This area is estimated to have undergone different spatial transformations and is believed to have an impact on changes in the structure of the region both demographic, social, economic, and physical environment.

Development of modeling with dynamic systems which are divided into three categories, namely economic models, land models, and social models. In this concept, land use change is the result of population change and distribution, technological innovation and economic restructuring, policies and social organizations. The linkages of economic aspects are used by the IRIO model.

2.2 Data collection

Secondary data collection and information is done by: using available secondary data. The making of spatial database units is expected to be able to collect and manage various data related to regional development.

2.2 Analysis and Modeling Techniques

1. Analysis of Geographic Information Systems and Land Suitability

With a spatial data approach, by overlaying maps (land, topography, geology, climate, etc.), land cover and pattern and structure of Presidential Regulation No. 54 of 2010. In principle, land suitability assessment is carried out by matching soil data and physical environment with a land suitability rating table that has been prepared based on land use requirements including the relevant land use requirements, management and conservation.

2. Analisis Interregional Input Output Analysis (IRIO)

The available data is in the form of an IRIO table from a survey in 2002. In the first stage an analysis of various scenarios of population growth, urbanization, lifestyle changes, and economic



growth with explicit consideration concerns changes in land productivity. To update the IRIO Table data at the time of the study, the calculation of the technical coefficients was calculated based on the RAS method where only with agriculture and non-agriculture sectors.

3. Modeling with a Dynamic System

System analysis procedures include the following stages: requirements analysis, problem formulation, system identification, system modeling, model verification and implementation (Eriyatno, 1999). The optimization model will be simulated with the powersim programming language. The feedback structure in the Jabodetabek regional spatial planning system model is composed by three interacting subsystems, namely social subsystems, economic subsystems, and land or biophysical subsystems. For economic submodels, the IRIO table is classified into 2 sectors: the agricultural sector and the non-agricultural sector.

The scenarios in this research model are as follows:

- 1) Scenario 1 (*Pessimistic*) : this scenario, also referred to as the basic scenario, if the initial conditions in the period of 2002 continue until 2040
- 2) Scenario 2. (*Moderate*) : this scenario is Scenario 1 where the increase in DKI building land is allocated to Bodetabek 50%
- 3) Scenario 3 (*Optimistic*) : scenario 3 is scenario 2 agricultural land at least 10% of the total land area of DKI Jakarta, and changes the value of the Capital Output Ratio (KOR) from 5 to 4.
- 4) Scenario 4 (*Very Optimistic*) : Scenario 4 is scenario 3 which is strengthened by increasing the growth rate of investment in the non-agricultural sector by increasing the growth rate of investment assumed to increase by 15% per year.

3. RESULTS AND DISCUSSION

2.1 Patterns of Change in Land Use

The results of image interpretation, land cover Jabodetabek area from 1972, 1983, 1992, 2000, 2005, 2009 to 2017 underwent a change especially the built up land. Changes in land cover began to be seen clearly in 1992. The increasing land developed in the Greater Jakarta area shows the increasing number of residents in the area

Table 1. Percentage of Land Cover Area to Total Area of Jabodetabek in 2002 – 2017

No	Land Covern	Percentage of Area to Total Area of Jabodetabek						
		1972	1983	1992	2000	2005	2009	2017
1	Water body	1,37	1,59	2,02	2,08	2,08	2,19	1,98
2	Build	2,25	8,88	11,23	25,47	26,06	28,58	35,60



3	Forest	11,87	11,19	10,65	10,39	9,47	5,99	8,62
4	Mixed Gardens	31,07	26,80	32,08	25,19	26,61	27,84	16,86
5	Dryland farming	22,69	16,82	11,49	13,83	11,20	6,13	13,86
6	Grass	6,51	5,95	5,55	4,26	-	4,29	-
7	Field	9,22	11,92	16,55	11,91	11,68	12,04	11,18
8	look at that	15,03	16,84	10,42	6,86	12,90	12,95	11,90
	Jumlah	100	100	100	100	100	100	100

Source: 1972 - 2005 (Rustiadi and P4W Team, 2007) while 2017 was the result of TM image interpretation

The results of the land suitability assessment of the Jabodetabek area on land use for settlement and agriculture. Suitability of land for agriculture Jabodetabek S1 area of 155,580 ha, S2 covering 50,234 ha, S3 covering 402,001 ha and not suitable for area of 58,690 ha while for residential or built land with S1 class area of 298,528 ha, S2 covering 90,165 ha, S3 covering 209,613 ha and not according to an area of 68,199 ha.

To analyze the suitability of the current land use with the spatial pattern and structure map based on Perpres No. 54 of 2008, it was overly carried out through GIS between the two maps. The results show that there is a mismatch, especially the developed land. Land that has been built that is not suitable for the zone of prohibition is Zone N1 and N2 and HP is 2,158 Ha or 0.32% of the total Jabodetabek area.

3. 2 Changes in Land Use with the IRIO approach

Simply stated, from the analysis of interregional input and output results, the contribution of inputs and outputs in DKI Jakarta, Bodetabek, and the rest of Indonesia can be shown that the linkages in Indonesia are very weak. Utilization of output for other regions, in DKI Jakarta was 74.09%, Bodetabek was 73.57%, and the rest of Indonesia was 94.38% of the total national output.

The output of DKI Jakarta used for activities (*input*) in Bodetabek is 0.77% and in the rest of Indonesia it is 25.14% of the total national output. While the Bodeabek output used for activities (*input*) in DKI Jakarta is 2.95% and in the rest of Indonesia 23.38% of the total national output. Output in the rest of Indonesia which is used for activities (*input*) in DKI Jakarta is 4.11% and in Bodetabek at 1.52% of the total national output.

Table 2. Output Multiplier Value in Each Region Against All Regions of Indonesia

No	Economic Sector	DKI Jakarta	Rank	Bodetabek	Rank	Rest of Indonesia	Rank
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1	Agriculture	1,0108	9	1,2239	5	4,6998	2
2	Mining and excavation	1,0455	8	2,6780	2	2,8770	5
3	Industry and Processing	1,9960	3	2,9431	1	5,2831	1
4	Electricity, Gas and Clean Water	1,4419	5	1,1628	7	1,3428	7
5	Building	1,1291	6	1,0767	8	1,3393	8
6	Trade, Hotels and Restaurants	2,1948	2	1,6822	4	3,6332	3
7	Transportation and Communication	1,5218	4	1,1667	6	1,8997	6
8	Finance, Rental and Persh Services	3,2027	1	1,9521	3	2,9558	4
9	Services	1,1051	7	1,0352	9	1,2254	9

Sectors that have large output multipliers in DKI Jakarta are shown in Table 3 are the financial sector, rental and business services, the trade, hotel and restaurant sector and the electricity, gas and water supply sector. As for Bodetabek, it can be seen that the sectors that have a large multiplier or output value are the industrial and processing sectors, the mining and quarrying sector and the financial, rental and business services sectors. In the rest of Indonesia, the sectors that have large output multipliers are the industrial and manufacturing sectors, the agricultural sector and the trade, hotel and restaurant sector.

Based on the values from the IRIO Table, 2,471.86 ha of DKI Jakarta and 268,147.57 ha are needed for built up land. This need must be provided by changing the function of land from agricultural land to non-agricultural land. However, based on the interpretation of the TM ideals in 2009 and 2017 as shown in the figure, the area of land developed has changed 173.701.86 ha to 237.267.91 ha. Or has increased by 63,566.04 ha. This difference is caused by increasing output does not always increase the area of land to maximum production or to increase this area by making high rise buildings.



Figure 1. Land Cover Jabodetabek Region Results of Image Interpretation in 2009 and 2017

3.3. Changes in Land Use with a Dynamic Model

The model developed in this study is a dynamic model using powersim for simulating land use change as it happens. The model developed in this study is a dynamic model using powersim for simulating land use change as it happens.. Some elements that are commonly considered in the Regional spatial planning are included in this model. Causal loop which consists of three sectors namely land, population, and economy. Interaction between the three sectors is as follows If the population increases it will increase economic activity. Here the relationship between the population and the economy is related to aspects of the supply of labor provided by the population sector to the labor sector. If economic activity improves / increases, it will result in population interest in entering the area. The increasing number of population will cause an increase in land requirements (mainly residential land), which in turn will affect the state of the land (to be reduced). Decreased land will cause a decrease in economic activity or otherwise if economic activity increases, the amount of vacant land will decrease.

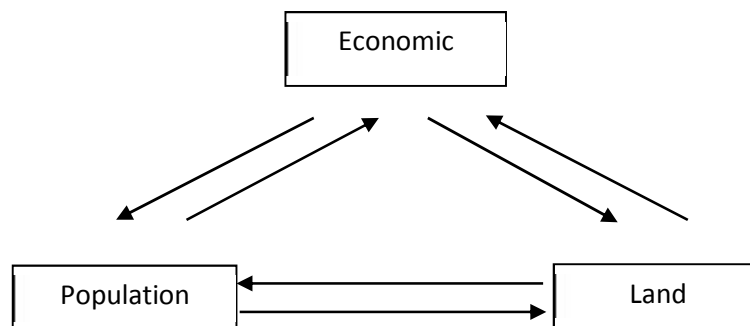


Figure 2. Causal Loop Economy, Population and Land in Jabodetabek

Impact on agricultural land: The results of this first scenario simulation are different from the results of the simulations in the other scenarios. The agricultural land in the first scenario in DKI Jakarta will run out while in Bodetabek scenario 2, 3 and 4 decrease after the agricultural land in DKI is not lacking. This will result in an increase in population (Figure 3)

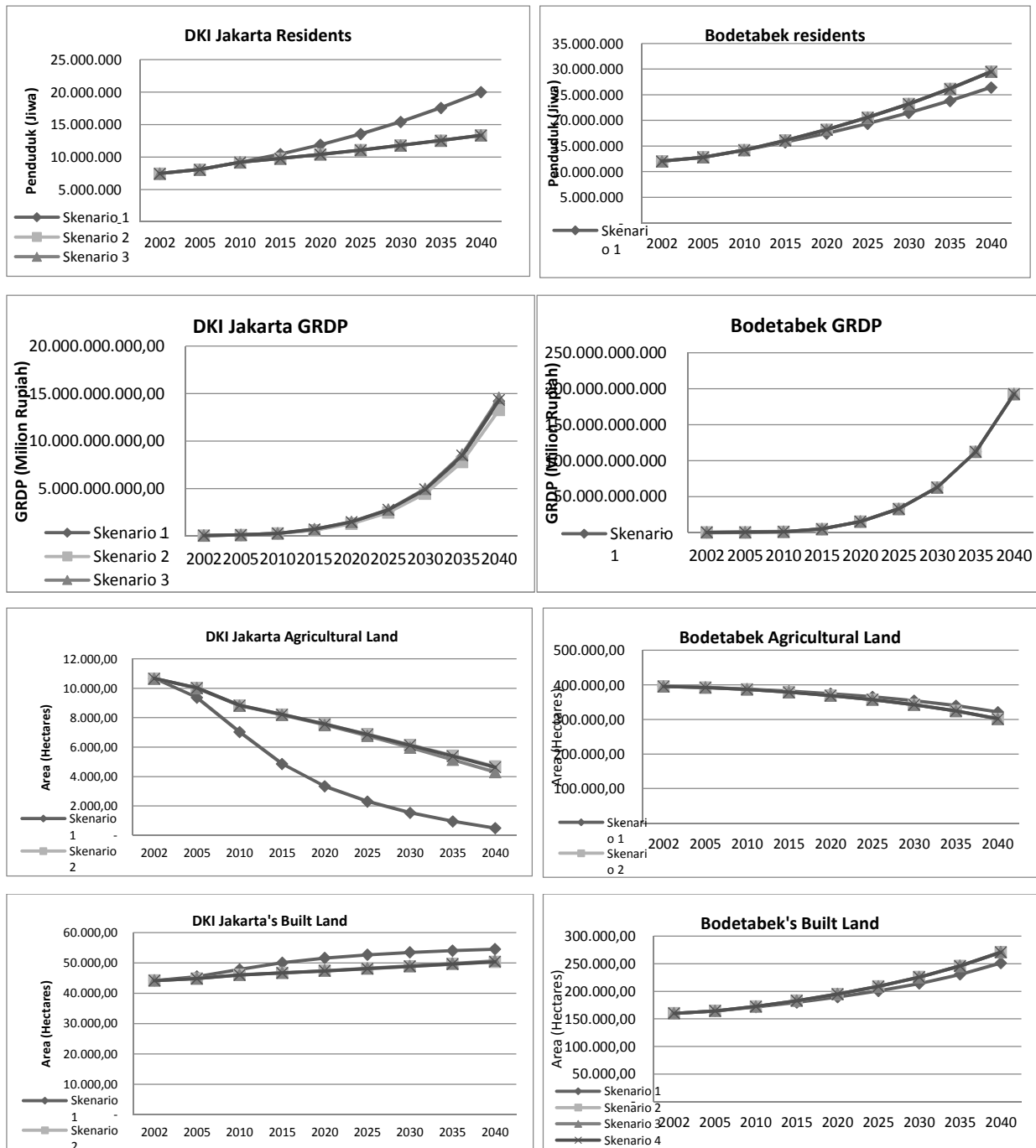


Figure 3. Modeling Results through the Dynamic System

The selection of scenarios is based on per capita GRDP criteria, unemployment, spatial violations, population, population growth, investment, protected areas and spatial productivity using a composite performance index (CPI) (Marimin, 2004). The analysis shows that Sceneraio 2 (moderate) is able to accommodate changes in land use that is sustainable, thus planning spatial patterns and structures refer to the parameters and initial values of scenario 2 (moderate) models.



3.4. Land Use Allocation

Based on the analysis of land suitability and land requirements based on scenario 2, until 2020 land use allocation can be fulfilled according to the land allocation direction pattern. Table 3.

Table 3. Needs and Directions for Allocation of Land Use in Jabodetabek Area

No	Land Use	Present condition	Land requirements (Ha)		Referral Allocation (Ha)
			2020	2025	
1	Water body	13.189	12.742	12.125	13.189
2	Land Awakened	206.268	229.520	242.218	273.028
3	Agricultural land	398.580	377.117	366.758	398.580
4	Forest and bush	48.469	47.126	45.404	48.469

4. CONCLUSIONS

Based on the research results above, it can be concluded

1. The population of the Greater Jakarta area, especially in DKI Jakarta, is increasing, so the area of land built has also increased in the Jabodetabek area. The pattern of land use change from agricultural land to developed land began in 1972 - 2017 with a pattern to follow the increasingly widespread city of Jakarta, which is the greater the circumference of land built by DKI Jakarta. Then the land that is built is getting bigger following adequate transportation facilities either by train or toll road, arteries or the Jakarta ring road. Due to an increase in the area of developed land there is 0.32% which is not in accordance with Perpres number 54 of 2008.
2. The economic structure in DKI Jakarta and Bodetabek is very diverse resulting in the existence of linkages between economic sectors. In general, there are links between economic sectors, if the rate of economic growth is increased in Jakarta, it will result in changes in land use in Bodetabek.
3. In general scenario 2 is the best choice, which gives the best impact on land changes while the impact on others generally increases

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