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Efficiency of Built-up Land Use on the Socio-Economic Conditions of Cities: Case Study of Bandar Lampung City

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ABSTRACT

Dynamic city development has an impact on inefficient levels of land consumption, so that this is socially and economically unsustainable. As the provincial capital and the city closest to the island of Java, Bandar Lampung City experiences the same dynamics regarding the use of built-up land. The article analyzes the decoupling of built-up land, population and local government revenue to clarify the trade-off and synergy between built-up land as urban supply and the existence of population growth and local government revenue as a reciprocal form of demand for built-up land. This article uses NDBI (Normalized Difference Built-Up Index) to describe built-up land, population and LGR (Local Government Revenue) to describe social and economic conditions. Research limitations include the availability of built-up land use, social and economic data only from 2014 to 2022. The results of the NDBI analysis from 2014 to 2022 show that built-up land in Bandar Lampung City has reached 61.67%. In the same period, the city's population increased on average by 6.01% and Bandar Lampung City's LGR increased by an average of 13.55% in 2022. In the decoupling analysis of built-up land to population, Bandar Lampung City has an expansive negative decoupling category indicating that the growth of built-up land is higher than the population. In the analysis of the decoupling of built-up land against LGR, the Expansive coupling category shows that the growth of built-up land is higher than the LGR of Bandar Lampung City. These two conditions indicate that land use is not yet efficient. The Bandar Lampung City Government needs to seriously control space for a sustainable Bandar Lampung City.

***Keywords**: Built-up Land, LGR, Population, Decoupling*

ABSTRAK

Perkembangan kota secara dinamik berdampak pada tingkat konsumsi lahan yang tidak efisien, sehingga ini tidak berkelanjutan secara sosial dan ekonomi. Sebagai ibukota provinsi dan kota paling dekat dengan Pulau Jawa, Kota Bandar Lampung mengalami dinamika yang sama terhadap pemanfaatan lahan terbangun. Maka artikel melakukan analisis decoupling lahan terbangun, jumlah penduduk dan pendapatan asli daerah untuk memperjelas trade-off dan sinergi antara lahan terbangun sebagai supply perkotaan serta keberadaan pertumbuhan penduduk dan Pendapatan Asli Daerah sebagai wujud timbal balik dari permintaan atas lahan terbangun. Artikel ini menggunakan NDBI (Normalized Difference Built-Up Index) untuk menggambarkan lahan terbangun, jumlah penduduk dan PAD (Pendapatan Asli Daerah) untuk menggambarkan kondisi sosial dan ekonomi. Keterbatasan penelitian berupa ketersediaan data penggunaan data lahan terbangun, sosial dan ekonomi hanya berada pada tahun 2014 hingga 2022. Pada hasil analisis NDBI pada tahun 2014 hingga 2022 menunjukkan bahwa lahan terbangun di Kota Bandar Lampung telah mencapai 61,67%. Pada periode yang sama, Jumlah penduduk kota meningkat rata – rata sebesar 6,01% dan PAD Kota Bandar Lampung meningkat rata – rata 13,55% pada tahun 2022. Pada analisis decoupling lahan terbangun terhadap jumlah penduduk, Kota Bandar Lampung memiliki kategori expansive negatife decoupling mengindikasikan pertumbuhan lahan terbangun lebih tinggi dibandingkan dengan jumlah penduduk. Pada analisis decoupling lahan terbangun terhadap PAD, menunjukkan kategori Expansive coupling yang menunjukkan pertumbuhan lahan terbangun lebih tinggi dibandingkan PAD Kota Bandar Lampung. Kedua kondisi tersebut mengindikasikan pemanfaatan lahan belum efisien. Pemerintah Kota Bandar lampung perlu secara serius melakukan pengendalian ruang untuk Kota Bandar Lampung yang berkelanjutan.

Kata Kunci: Lahan Terbangun, Populasi, PAD, Decoupling

1. INTRODUCE

Currently, critical problems are still found in cities throughout the world related to the privatization and reduction of public space, the increase in informal areas, waste of energy, water and natural resources, the need for uncertain settlements and the loss of local identity (Girard et al., 2017). These various problems are problems for urban areas, so developing cities need to find ways to optimize resource consumption (Toboso-Chavero et al., 2019). Built-up land, as part of a resource, has an ever-increasing need, whether used as residential land, industry or trade and services. Limited land capacity needs to be accompanied by public awareness of land limitations and the role of government, so as not to cause irregularities in regional development (Wulandari et al., 2019). Based on various evidence in several cities, there is a need for comprehensive productive use of built-up land from the point of view of economics, environment, cultural and social heritage, employment opportunities and a sense of belonging to a place (Girard et al., 2017). This condition is an urgency for the city to always strive for efficient use of built-up land in accordance with economic and social conditions, so that city productivity can be measured.

The need for optimal land use certainly occurs in all cities, one of which is the city of Bandar Lampung. The city of Bandar Lampung is the capital of Lampung Province and is the closest city to the island of Java on the Sumatra side, so it has quite dynamic growth. In 2030, the built-up area of Bandar Lampung City will reach 87%, so land suitability will reach its limit (Wulandari et al., 2019). This condition shows that the City of Bandar Lampung will face limited land and this can have an impact on all aspects of city development. With limited land availability, of course the economic and social linkages will become increasingly serious, so it is necessary to find effective land use strategies to balance the need for land for construction and limited land resources (Yu et al., 2019). In carrying out land development, it is necessary to strive for max`imum economic benefits (Liu et al., 2020). By considering policies, the rate of urbanization and economic growth, it can influence land use efficiency (Koroso et al., 2020). The results of the land use efficiency analysis are the first step for the Bandar Lampung City government in developing various strategies to increase land productivity.

As the need for urban land increases, unwise land use will affect regional economic development (Gao et al., 2020). As land use in Bandar Lampung City reaches its limit, it is necessary to measure productivity in social and economic aspects. This article aims to clarify the trade-offs and synergies between built-up land as an element of urban supply and the

existence of population growth and local government revenue as a reciprocal form of demand for built-up land. Decoupling analysis is an important measure of environmental pressure on the economic growth of a particular region (Li et al., 2019). In this article, a decoupling analysis is carried out on the development of built-up land on population and local government revenue in Bandar Lampung City. This analysis can explore the intensity and decoupling of built-up land development with population and local government revenue, so that optimization of the development of built-up land in Bandar Lampung City can be reviewed. The existence of Decoupling analysis can provide a point of view and classification of the conditions of the disconnect between built land, population and local revenue. The results of this research can be input and information for the Bandar Lampung City government regarding the efficiency of urban land use from a social and economic perspective.

2. METHODS

In this article, the process carried out is identifying built-up land which is carried out using NDBI (Normalized Difference Built-Up Index) spatial analysis to determine changes in built-up land from 2014 to 2022. The use of NDBI as a measurement method which aims to highlight the appearance of built-up land compared to other objects is deemed sufficient to describe the condition of built-up land in Bandar Lampung City. NDBI is produced from a comparison of the subtraction and addition between the mid-infrared and near-infrared parts of landsat. The Landsat images used are Landsat 8 in 2014, 2016, 2018, 2020 and 2022 which are sourced from EarthExplorer (usgs.gov). The next stage is to identify the level of land use, population and local government revenue in Bandar Lampung City, Bandar Lampung City from 2014 to 2022. From all the identification results, a decoupling analysis can then be carried out which can reflect the status of resources, the environment and economic growth a region over a period (Luo et al., 2021).

The next stage is to identify the population and local government revenue of Bandar Lampung City from 2014 to 2022. In explaining social conditions, the use of population density is one indicator to measure the level of development of built-up land areas based on population. This can illustrate the community's intensification in land use in Bandar Lampung City. In economic conditions, local government revenue describes the ability of regional governments to explore potential sources of income to the maximum (Nasir, 2019). From all the identification results, a decoupling analysis can then be carried out which can reflect the status of resources, environment and economic growth of a region during a period (Luo et al., 2021).

In the final results, the decoupling point of built-up land, population and local government revenue will be known, so that the phenomenon that occurs can be described in the results of the decoupling analysis. The method used is the tapio decoupling model, taking into account the objectivity and accuracy of the relative quantity and total amount results on a period scale, while being more flexible and stable in time. Decoupling plays the role of identifying separation states with additional flexible boundaries or boundaries based on decoupling elasticity (Tapio, 2005). The level of decoupling elasticity can be adjusted in the decoupling calculation, namely by comparing the growth and initial data of the first variable with the growth and initial data of the second variable, so that the decoupling elasticity point can be identified (Figure 1).

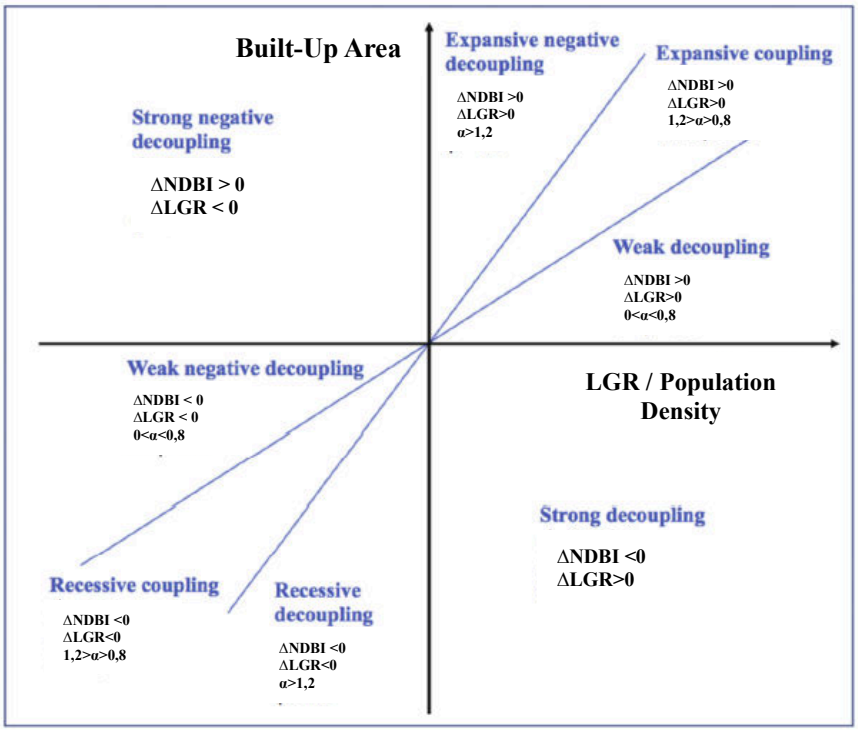


Figure 1. Graph of the separation between built-up land and population and Local Government Revenue
Source :(Chen et al., 2020)

3. DISCUSSION

In NDBI identification, the identification process was carried out in 2014, 2016, 2018, 2020 and 2022. The use of NDBI aims to facilitate the process of identifying urban built-up land using Landsat TM and Landsat OLI imagery. At the beginning of the process, geometric

and radiometric corrections are carried out to improve the pixel values in the satellite image so that they match what they should be. In the NDBI classification, the classification used only uses 2 types of classification, namely built-up land and non-built-up land (Figure 2).

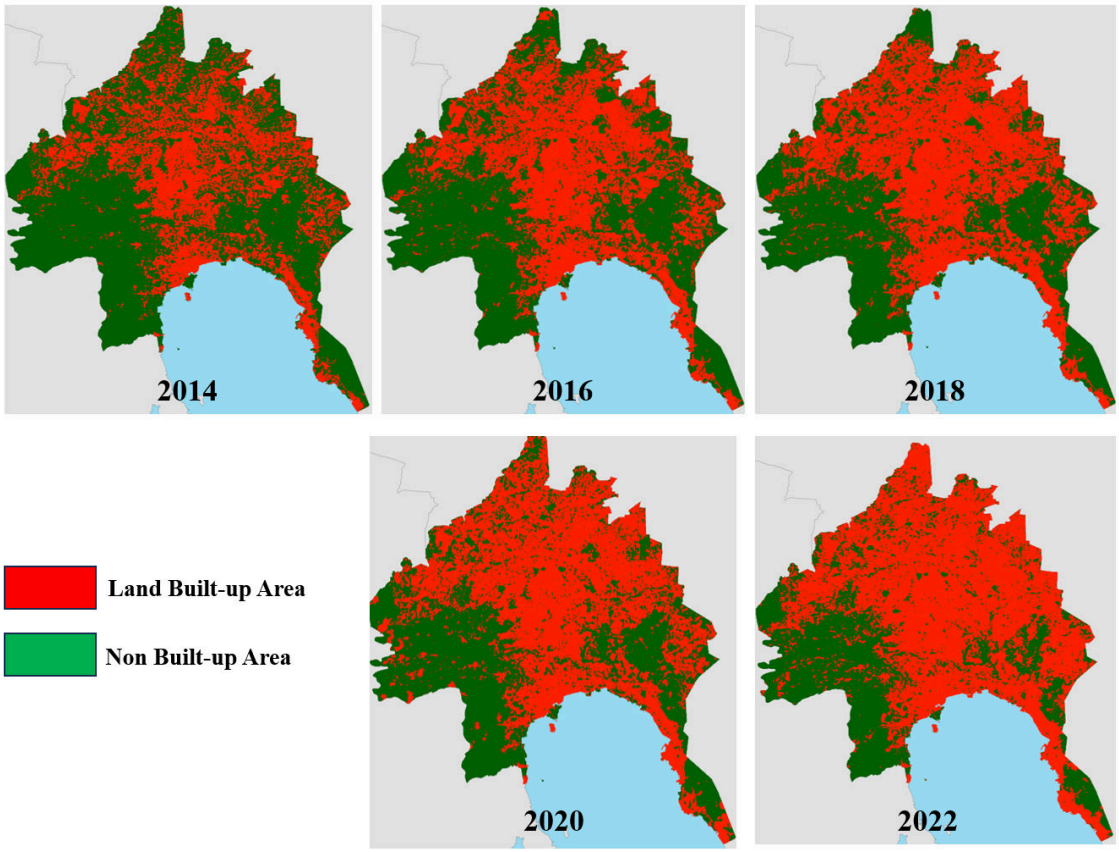


Figure 2. Map of Built-up Land for Bandar Lampung City 2014 - 2022
Source: 2024 Analysis Results

The NDBI identification results show that there has been a significant increase in built-up land. The most significant land changes occurred between 2014 with an area of 6,862.29 Ha to 2016 which reached 8,706 Ha, so it had a growth rate of 26.87% (Figure 3). The minimum land changes occurred from 2018 to 2020 with a percentage value of only 4.90%, which coincided with the passage of the pandemic, resulting in reduced development activities. At the end of the calculation in 2022, the built-up land area of Bandar Lampung City has reached 12,163.72 Ha, which is 61.67% of the total area of Bandar Lampung City. This condition indicates that the city of Bandar Lampung will experience a maximum limit of lateral land use, so that urban scale control is needed, and requires a transformation of land use patterns from lateral expansion to land use intensification (Liu et al., 2020).

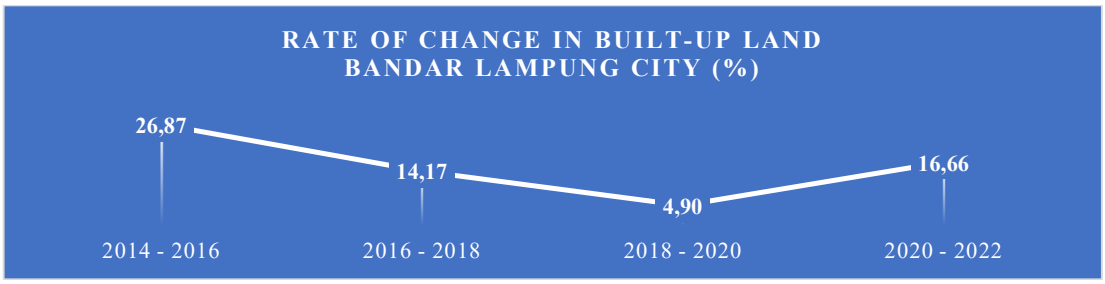


Figure 3. Rate of Change in Built-up Land , Bandar Lampung City 2014 – 2022
Source: Bandar Lampung Berau of Statistic, 2023

The development of built-up land in cities aims to accommodate the population, so it is necessary to identify population density. In 2014, Bandar Lampung City had 960,695 residents until 2022 it has reached 1,209,937, resulting in an increase of 25.94%. This of course has an impact on population density, from 2014 – 2022 the population density of Bandar Lampung City has fluctuated (Figure 4). This is because the growth of built-up land is positive and higher than population growth, thereby reducing density figures periodically.

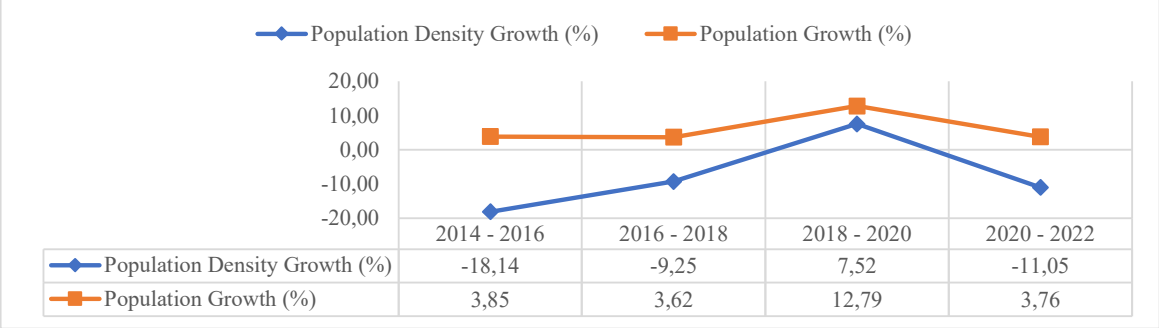


Figure 4. Density Rate and Population Bandar Lampung City 2014 – 2022
Source: Result of analysis, 2024

Based on population data and population density in Bandar Lampung City, it shows quite interesting conditions. The average population density shows negative growth except in 2018 – 2022, although population growth in general has increased by an average of 6.01%. This is because the development of built-up land is higher than population growth, so it is indicated that population ownership of built-up land is quite large.

Table 1. Decoupling analysis of Built-up Land and Population Bandar Lampung City 2014 – 2022

Classification	2014 - 2016	2016 - 2018	2018 - 2020	2020 - 2022
Built-up Land Growth	26,87	14,17	4,90	16,66
Population Growth	3,85	3,62	12,79	3,76

Classification	2014 - 2016	2016 - 2018	2018 - 2020	2020 - 2022
Decoupling NDBI to the Ratio of Local Government Revenue and built-up land	6,97	3,92	0,38	4,43
Decoupling Index	Expansive negative decoupling	Expansive negative decoupling	Weak decoupling	Expansive negative decoupling

Source: Result of analysis, 2024

Based on the decoupling analysis between the growth of built-up land and population, it shows two conditions in 4 periods, namely 2014 to 2022. In the periods 2014 - 2016, 2016 - 2018 and 2020 - 2022 they are included in the expansive negative decoupling category. This shows that the growth of built-up land is quite far above population growth, so there are indications that development is not adjusting to the number of people that can be accommodated. In land use, of course this indicates inefficiency because land growth is much higher than the population that can be accommodated. Responding to conditions during this period, the government must ensure whether all built-up land can meet the residential needs of urban communities in order to ensure that all built-up land truly accommodates the entire community.

In the 2018 – 2020 period, Bandar Lampung City showed a decoupling index in the weak decoupling category. The data shows positive conditions because the amount of land growth is quite far below population growth, so that in this phase it is indicated that there is a process of readjusting the use of built-up land by the entire city population.

The next identification is a change in the identification of Local Government Revenue which is a description of the value generated from taxes, levies and legal management of land in Bandar Lampung City. Based on data from the Bandar Lampung City Central Statistics Agency, LGR realization in 2014 reached IDR 394 billion, in 2016 it reached IDR 483 billion, in 2018 it reached IDR 550 billion, in 2020 it reached IDR 537 billion and in 2022 it reached IDR 645 billion (Figure 5). This data shows an increase, although it started to decline in 2018 - 2020 due to the pandemic. In general, from 2014 to 2018 the average LGR growth reached 13.55%, so this is a positive thing in describing the use of built-up land as contributing to the local government revenue of Bandar Lampung City.

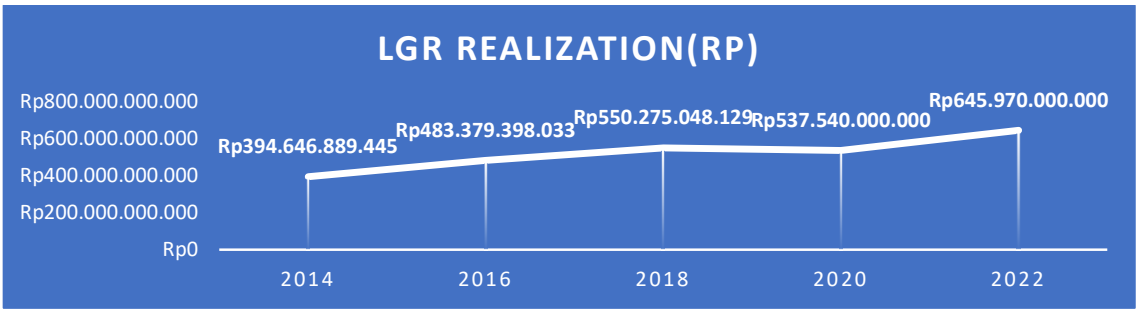
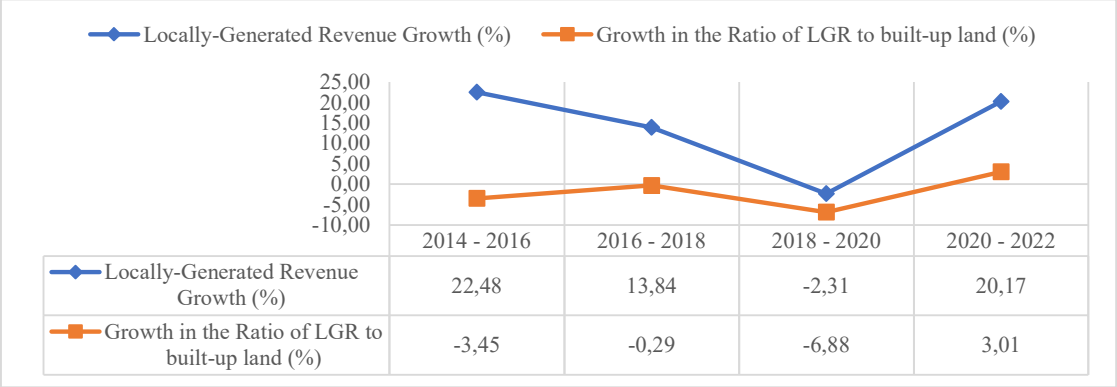


Figure 5. The rate of change in the LGR of Bandar Lampung City 2014 – 2022
Source: Bandar Lampung Berau of Statistic, 2023

Based on the data on built-up land and LGR that has been presented, the ratio of LGR values per hectare on built-up land in Bandar Lampung City can be identified. This is quite interesting because the ratio of LGR to built-up land tends to decrease. In 2014 the ratio of LGR to built-up land reached IDR 57,509,503. This ratio has decreased until 2020 reaching IDR 51,552,304, but in 2022 it will increase by 3.01% reaching IDR 53,106,286 (Figure 6). This condition illustrates that the use of built-up land in Bandar Lampung City which continues to be positive does not actually contribute positively to Bandar Lampung City's LGR.



	2014 - 2016	2016 - 2018	2018 - 2020	2020 - 2022
Locally-Generated Revenue Growth (%)	22,48	13,84	-2,31	20,17
Growth in the Ratio of LGR to built-up land (%)	-3,45	-0,29	-6,88	3,01

Figure 6. Growth of LGR Ratio Per Hectare of Built-up Land (%) Bandar Lampung City 2014 – 2022
Source: Result of analysis, 2024

These two data describe the condition of built-up land and LGR in Bandar Lampung City from 2014 to 2022. Data on the ratio of local government revenue per hectare shows that there has been a periodic decline, especially in the 2018 – 2020 period. This condition illustrates that development of built-up land is not in line with local government revenue growth, so there is an indication of a decline in the government's ability to extract local government revenue from land that has been built up. Based on this data, the next step is to identify the degree of decoupling of built-up land and LGR in Bandar Lampung City. The decoupling elasticity level is produced from a comparison between the growth and preliminary

data of the first variable with the growth and preliminary data of the second variable (Table 1), so that it can be seen that the decoupling elasticity point is in accordance with Figure 1.

Table 2. Calculation table for decoupling analysis of Built-up Land and LGR Bandar Lampung City 2014 – 2022

Classification	2014 - 2016	2016 - 2018	2018 - 2020	2020 - 2022
Built-up Land Growth	26,87	14,17	4,90	16,66
LGR Growth	22,48	13,84	-2,31	20,17
Decoupling NDBI to LGR Ratio and built-up land	1,19	1,02	-2,12	0,83
Decoupling Index	*Expansive Coupling*	*Expansive Coupling*	*Strong Negative Decoupling*	*Expansive Coupling*

Source: Result of analysis, 2024

Table 2 shows that the periods 2014 – 2016, 2016 – 2018 and 2020 – 2022 show a degree of decoupling of 1.19, 1.02 and 0.83. This is included in the Expansive Coupling category, which means that the increase in use of built-up land and the growth of local government revenue both increase simultaneously, but the growth of built-up land is higher than the growth of LGR. This illustrates that economic development in Bandar Lampung City is still below the addition of built-up land, so it cannot be assumed that there will be intensification of existing built-up land to increase the local government revenue ment of Bandar Lampung City. This condition could be a threat to the economy of Bandar Lampung City, because the land utilized in 2022 will reach 61.67%. Through these two conditions, the degree of decoupling shows that the concept of efficient use of resources, especially land, is needed to produce an efficient economy (Halleux et al., 2012). This is also in line with city governance that is not utilized productively and is not connected which often has an impact on the environment and ecosystem (Guastella et al., 2017). The Bandar Lampung City Government requires various forms of innovation to ensure that all built-up land can contribute to local revenue.

In the 2018 - 2020 period, it shows a different phenomenon, the degree of decoupling shows a negative number of 2.12, which means it is in the strong negative decoupling category. Strong negative decoupling implies an increase in built-up land use growth, but local government revenue growth actually decreases. This illustrates the phenomenon that when the city of Bandar Lampung was facing the Covid pandemic, the government was having difficulty increasing local government revenue. Facing these conditions, to meet the demands of economic growth, it is necessary to intensify urban land development (Hui et al., 2015) and increase the diversification of government programs to diversify built land as a source of local government revenue for the City of Bandar Lampung.

4. CONCLUSION

Based on the results of the identification that has been carried out, conclusions can be drawn regarding the identification of decoupling of built-up land on the population and LGR of Bandar Lampung City as follows. The development of Bandar Lampung City has experienced a positive increase from 2014 to 2022. The increase in built-up land in 2022 has reached 61.67%, so that the City of Bandar Lampung will reach its land use capacity limit and this could have complex impacts.

Socially, population growth has periodically increased, but the population density of Bandar Lampung City has decreased. Based on the decoupling index for built-up land growth and population growth, it shows that the periods 2014 – 2016, 2016 – 2018 and 2020 – 2022 are included in the expansive negative decoupling category. This shows that the growth of built-up land is quite far above population growth, so there are indications that the use of built-up land is not adjusted to the number of people that can be accommodated. In the 2018 – 2020 period, Bandar Lampung City showed a decoupling index in the weak decoupling category, population growth grew far above land growth. This condition shows that the use of built-up land is moving towards a positive condition, because the use of built-up land is getting lower but is able to accommodate the increasing population.

In terms of economic conditions, the growth of Bandar Lampung City's Local Government Revenue (LGR) is experiencing a positive trend, although data on the ratio of local government revenue per hectare shows a periodic decline, especially in the 2018 – 2020 period. This condition illustrates that the development of built-up land is not in line with growth in local government revenue, so that land use is less efficient towards local government revenue. Based on the decoupling index, the periods 2014 - 2016, 2016 - 2018 and 2020 - 2022 show a degree of decoupling of 1.19, 1.02 and 0.83. Included in the Expansive Coupling category, which means that the increase in use of built-up land and growth in local revenue both increase simultaneously, but the growth of built-up land is higher than the growth of LGR. This condition indicates that additional built-up land does not contribute to increasing the LGR of Bandar Lampung City. In the 2018 - 2020 period, it shows a different phenomenon, the degree of decoupling shows a negative number of 2.12, which means it is in the strong negative decoupling category. Strong negative decoupling indicates that Bandar Lampung City is in a very inefficient land use condition from an economic perspective. In this period, built-up land continues to grow, but the growth in the number of LGRs is actually negative, so this condition

must be controlled as an effort to ensure the city remains productive. Although in other conditions, it shows that during that period the world was facing the Covid pandemic.

Based on these conditions, of course the City of Bandar Lampung shows that population growth and local government revenue are still below the growth of built-up land. Massive and unproductive use of built-up land can certainly have an impact on the sustainability of Bandar Lampung City. If the entire land city has been built and the population continues to grow, then there is the potential for informal spaces to emerge as a response to the population's inability to access land. Similar to economic conditions, the Bandar Lampung City Government is obliged to have land use regulations, so that the use of built-up land is not used as speculation and an investment instrument. This condition encourages the city government to have policies and regulations for controlling space to realize productivity and efficiency in the use of built-up land.

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