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Application of urban agriculture to strengthen availability of private green open space (GOS) on petroleum producing Duri City, Indonesia

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ABSTRACT

Ministry of National Development Planning (PPN) / National Development Planning Agency (Bappenas), the Republic of Indonesia stated that Indonesia is committed to the environment in 2045 with a program towards Indonesia's Green Economy marked by a 41% reduction in emissions. The existence of green open space (GOS) is an important factor in supporting the ecological sustainability of a city, The role of GOS in addition lies in improving temperature and humidity also found in the reduction of CO2 emissions. The main purpose of this research is to plan an integration strategy between GOS and the Urban Agriculture Program. in Duri City, Bengkalis Regency, Riau Province, which is one of the petroleum producing cities in Indonesia. The method of this research using GIS-AHP approach. The strategy action consists of environmental, economic and social commitments are maintained for development sustainability by implementing green technology, green economic regulation and strengthening the green community movement. The main result of research prove that strategic integration of GOS Privat with Urban Agriculture Program u in Duri City contributes GOS Private availability of 14,134%, so that gos private has exceeded the requirement limit of at least 10% based on the mandate of the Spatial Arrangement Act, Republic of Indonesia.

Key words : *Petroleum producing cities, Green open space, Private, Urban agriculture, GIS, AHP*

Introduction

The Ministry of National Development Planning (PPN)/National Development Planning Agency (Bappenas), Republic of Indonesia states that five of the eleven points of Mega Trend World 2045 are global demographics, world urbanization, the role of emerging economies, climate change and technology. It is still sourced from Bappenas that the world population in 2045 is expected to number approximately 9.45 billion with the demographic composition of the world's population living in urban areas reaching approximately 66% and of the total population of the world, 55% are in Asia. These global demographic trends will encourage urbanization, migration flows, and the problem of elderly population.

United Nations projections anticipate that over two-thirds of the global population will live in cities by 2050 (Chandran, 2020; Loker and Francis, 2020). The rapid expansion of the COVID-19 pandemic, engulfing 186 countries between December 2019 and March 2020, has aggravated risks of severe/ extreme food insecurity from 135 million in January 2020 to 265 million by the end of 2020 (Dongyu, 2020; Lal, 2020).

What are we going to eat?" is also a question that arises as a marker of a food availability threat to meet the needs of the entire human population in the future. According to Global Hunger Index data, the hunger rate in Indonesia in 2019 is 20.1 and belongs to a serious category with 70 out of 117 countries. The data is before the Covid-19 pandemic as it is now. The rate of hunger during the 2020 pandemic is likely to rise dramatically (Dzulfaroh, 2019). The issue of food availability has come to the attention of the world, for example by the United Nations through the Food and Agriculture Organization (FAO), which recommends that all agricultural sectors need to be managed using innovative technologies.

Urban agriculture is one of the key components of sustainable community food system development and if designed appropriately will be able to alleviate the problem of food insecurity. In other words, when urban agriculture is developed integratedly is an important alternative in realizing sustainable urban development (Setiawan and Rahmi, 2004). Furthermore, Smith *et al*. (2001) stated that 800 million people worldwide are actively involved in urban farming practices. Furthermore by Zezza and Tasciotti (2010) that urban agriculture can produce an average of 15 to 20 percent of the world's food production. The rate of community participation in urban agricultural activities in developing countries also varies, ranging from 10% in Indonesia to nearly 70% in Vietnam and Nicaragua. The role of urban agriculture, when reviewed from ecological aspects, can provide benefits namely the conservation of land and water resources, improve air quality, create a healthy microclimate, and provide beauty because urban agriculture pays great attention to aesthetics (Blyth and Menagh, 2006; Cofie *et al.,* 2006; Koscica, 2014; Setiawan and Rahmi, 2004; Wolfe and Mc Cans, 2009) as well as as mitigation efforts on climate change (Specht *et al*., 2014).

Urban agriculture is currently considered one of the solutions to reduce air pollution and climate change adaptation in urban areas. The role of urban agriculture from economic aspects has many advantages, including stimulus to strengthen the local economy in the form of opening new jobs, increasing people's incomes and reducing poverty. A study of urban agriculture on home yards in Philadelphia United States of America (USA) found that low income people with home yards can save an average of $150 each planting season (Pinderhughes, 2004).

The cities of Daqing (China) and Houston (Texas) are the two cities that have grown rapidly due to mining activities by the petroleum industry over the past 50 years. The development can be seen from the use of land, the dominant changes occurred in rural land, including agricultural land and forests that changed on a large scale into settlements within 30 years, namely from 1977 to 2007 (Yu *et al.,* 2011). In addition to the two petroleum producing cities illustrated above, Duri City is one of the oilfield cities in Bengkalis Regency of Riau Province, Indonesia. Duri Steam Flood Field has been exploited since the 50s and is still produced by PT. Chevron Pacific Indonesia (CPI). Duri, Minas and Dumai account for about 60% of Indonesia's crude oil production, with an average current production of 400,000-500,000 barrels per day. Crude oil produced, is one of the best quality oils in the world, namely Duri Crude. History records that in November 2006, Duri Steam Flood Field reached a record production of 2 billion barrels since it was first explored in 1958.

The fundamental character of urban areas that are growing rapidly due to mining activities by the petroleum industry is an area with a high level of development accompanied by a rapid increase in the population which leads to a decrease in the quality of the environment in the city and the increasing level of land needs for buildings This resulted in a decrease in the quality of the urban environment caused by low groundwater quality, high air pollution and noise in the city. The high frequency of flooding in the city is also due to the disruption of the water system due to the limited water content area and the high volume of surface water. The massive impact of urban development led to the displaced GOS. The loss of GOS greatly affects the stability of environmental ecosystems, while increasing pollution which is bad for the public health of the city.

The description of the loss of GOS illustrated above, in contrast to the mandate of the UU of the Republic of Indonesia No.26 of 2007, on Spatial Arrangement, articles 29 paragraphs 1 and 2 states that the proportion of GOS in the city area is at least 30% of the area of the city and the proportion of public GOS in the city area at least 20% of the city area. The provisions are also contained in the Minister of Public Works Regulation No. 5 of 2008 on Guidelines for the Provision and Utilization of GOS in Urban

Areas. The existence of GOS is an important factor in supporting the ecological sustainability of a city, in addition the existence of GOS also affects the comfort of the air naturally. GOS air comfort is affected by the temperature and humidity described in the thermal comfort index. GOS with good condition will contribute to a 5.86% drop in air temperature and a 4% increase in humidity (Asiani, 2007). It is also supported by the results of research that states that GOS can play a role in reducing the effects of Urban Heat Island (UHI) so as to make urban conditions healthier and more comfortable (Estoque *et al.*, 2017). The role of GOS in addition lies in improving temperature and humidity also found in the reduction of CO2 emissions. Rawung (2015) said in its research that the absorption of existing RTH capable of reducing actual CO2 emissions is approximately 119.73 to 271.18 tons/year.

Referring National Development Planning Agency (Bappenas), the Republic of Indonesia stated that Indonesia is committed to the environment in 2045 with a program towards Indonesia's Green Economy marked by a 41% reduction in emissions and GOS mandate of the UU of the Republic of Indonesia No.26 of 2007, on Spatial Arrangement related to the implementation and realization of GOS 30% with the composition of Public GOS 20% and Privat GOS 10%. Duri City which is one of the producers of natural petroleum resources managed and utilized for the welfare of a city that will naturally potentially reduce against the pattern of public land use. Therefore, the need to integrate the implementation of urban agriculture through the strengthening of private GOS 10% is expected to be a solution to minimize the problems that have been illustrated above, in an effort to realize sustainable urban development,

Materials and Methods

This research was conducted in Duri City which administratively includes part of Bengkalis Regency of Riau Province consisting of Bathin Solapan, Mandau and Pinggir Sub districts with an area of approximately 937.47 km^2 with a population of 256 407 people in 2018. Description of the administrative map of Duri City, Bengkalis Regency, Riau Province presented as in the Fig. 1

The strategy of availability of GOS 30% mandate UU of the Spatial Arrangement of the Republic of Indonesia with the pattern of integration of Private

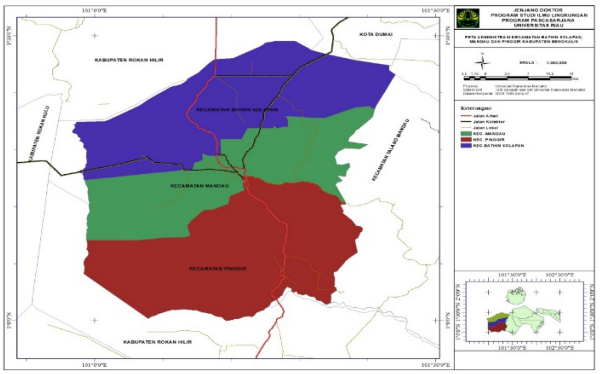

Fig. 1. Duri City Administration Map
Source : GIS Analysis Result

GOS 10% combined with Urban Agriculture in Duri City, Bengkalis Regency of Indonesia is presented as

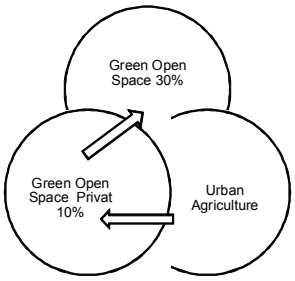

Fig. 2. The relationship between GOS 30% , GOS Privat 10% and Urban Agriculture in Duri City, Indonesia

in the Fig. 2 below

Analytical Hierarchy Processes (AHP) approach method has a specific advantage that is systematically able to match various mutually competitive intentions so that the hierarchy of decision-making to realize GOS 30% is set consisting of five levels as follows level 1 : Goal consist of strategies for GOS availability 30% with integration between Private GOS and Urban Agricultural Practice in Duri City, Bengkalis Regency, Riau Province level 2 : Factors consist of human resources, budget, infrastructure and policy, level3: Actors consist of Government, Community, Private and Higher Education (PT), level 4: Sub Purpose consists of Environment, Economic and Social and level 5 : Action consists of Environmental commitments are maintained for development sustainability by Implementing Green Technology, Economic commitment is maintained for the sustainability of development by Implementing Green Economic Regulation and Social com-

mitment is maintained for the sustainability of development by Strengthening the Green Community Movement.

AHP is one of the decision-making models that is a branch of Multi Criteria Decision Making (MCDM) through questionnaires from experts who are considered competent in their field, among others, Head of Regional Development Planning Agency (Bappeda) Bengkalis Regency as a regulation of government policy making, Head of Bengkalis District Housing and Settlement Office and Head of Publik Work Office and Spatial Arrangement is the Office related to the implementation of GOS in Bengkalis Regency, Head of Food Security Office is the Office of Food Security in Bengkalis Regency and Riau University Lecturers are competent institutions contributing to the field of science to support the strengthening of GOS studies and Urban Agriculture.

Result and Discussion

Referring to the results of research conducted by Nurdiansyah (2012) stated that if the Local Government relies solely on efforts to improve GOS public sector, then the next weakness and obstacle that will be faced for local governments is the inability to be fully involved in the creation and management of GOS which is very complex due to resource factors, both human resources and financial. It is still said by Nurdiansyah (2012) that the existence of private GOS such as residential homes can provide direct benefits to the owner, the availability of residential homes is also one of the components that will contribute to the availability of GOS as a whole. Therefore increasing community participation in the provision of private GOS especially in residential areas is a new step to increase and maintain the area of existing public GOS.

Furthermore, it is still sourced from spatial analysis in Duri City of existing conditions using GIS, that the total implementation achievement of GOS Public in Duri City in 2018 as in the Fig. 3 below

Referencing from Figures 3 above, the availability of total existing Public GOS in Duri City is approximately 3.61 ha or 0.0361 km^2. The ratio of comparison between the availability of existing Public GOS and the total GOS of 30% in Duri City of 281,241 km^2 is approximately 0.002 %.The dynamics of land use change in Duri City which includes Bathin Solapan, Mandau and Pinggir subdistricts as

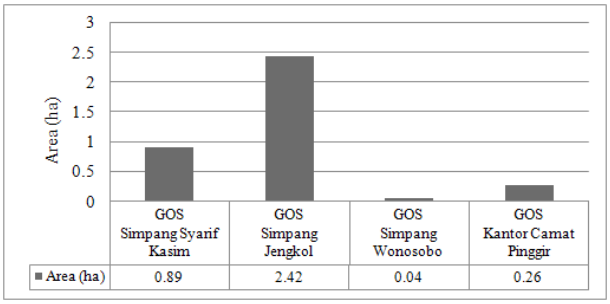

Fig. 3. Availability of Existing Public GOS in Duri City
Sources: GIS Analysis

one of the petroleum producing cities in Indonesia in 2018 is described as in Fig. 4 below

Reference from Fig. 4 above, the change from the type of land cover in Duri City from 2014 to 2018 is presented as in the Table 1 below

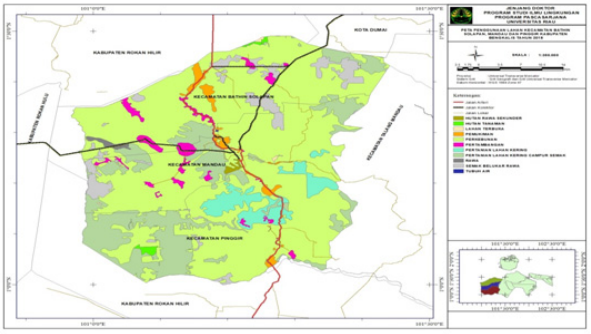

Fig. 4. Duri City Land Use Map in 2018
Source : GIS Analysis Result

Refers to Table. 1 above, the type of land cover for the settlement area of 3,453 ha (1.74%) and Dryland Farm Mixed Bush 34,613.73 ha (17.45%) of the total land cover area in Duri City in 2018 amounted to 198,313, 75 ha (100%). Settlement and Dryland Farm Mixed Bush is types of land cover that have the potential to be used as Private GOS integrated with urban agriculture programs, to support the availability of GOS in accordance with the mandate of the Spatial Arrangement Act of 30%.

Furthermore, roles are performed at each level (goal, factor, actor, sub purpose and action) based on the results of the expert assessment questionnaire, which for further analysis of AHP using an auxiliary program developed by Simon C Bartrand United Kingdom (SCBUK) Limited.

The role of the Local Government, Bengkalis Regency is very dominant in efforts to innovate policy through the Regent's Regulation, About the Urban

Table. 1. Land Cover Changes in Duri City from 2014 to 2018

No.	Type of Land Cover	Subdistrics of Duri City					
		in 2014		in 2018		Land changes	
		ha	%	ha	%	ha	%
1.	Secondary Swamp Forest	471.37	0.24	391.47	0.20	79.90	-0.04
2.	Open Land	1,661.21	0.84	700.52	0.35	-960.69	-0.48
3.	Open Land	20,027.46	10.10	179.47	0.09	-19,847.99	-10.01
4.	Settlement	3,453.23	1.74	3,453.23	1.74		
5.	Plantation	109,695.89	55.31	134,533.11	67.84	24,837.22	12.52
6.	Mining	4,544.76	2.29	4544.76	2.29		0.00
7.	Dry Land Farming	9337.46	4.74	9180.86	4.63	216.59	-0.11
8.	Dry Land Mixed Bush	17,500.27	8.82	34,613.73	17.45	17,113.45	8.63
9.	Swamp	714.20	0.36	714.20	0.36		
10.	Shrubs						
11.	Swamp Bush	30,830.26	15.55	9,984.77	5.03	-20,845.50	-10.51
12.	Body of Water	17.63	0.01	17.63	0.01		
	Land Cover Area	198,313.75	100.00	198,313.75	100.00	0.00	0.00

Source: GIS Analysis Result

Agriculture Program and the Implementation of Building Permit Regulation Plus (IMB Plus) which requires 10% of the total area of house building to be used as Private GOS by integrating Agricultural Farming Practices to support environmental, economic and social strengthening sectors that contribute to the addition of GOS privat availability area equal to 345,323 ha or 0.174%.

The local government, Bengkalis regency is consistent and commited to the green technology implementation program supporteed by the green community movement is believed to able to restore the quality of agricultural land cover. The application of Fitoremediation and technology and Eco Drain technology that is able control the run off as well as the addition in infiltration process will be able to restore soil fertility so that it can be functioned into non food urban agricultural, restoration of the quality of agricultural land cover 80% of the total area of dry agricultural land cover mix with shrubs, by applying green technology, will contribute to the addition of GOS availability area in Duri city of equal to 27.690,984 ha or equivalent 13.96%. The addition of GOS availability will have a significant impact on improving the environment, economy and social community in Duri City. The total amount between residential area and dryland agriculture was 0.174% plus 13.96% by 14,134%.

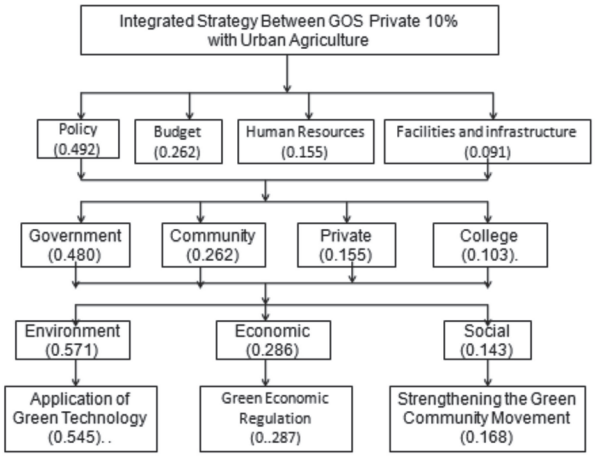

Fig. 5. Decision Tree Weight Value Strategy of Availability GOS 30% between GOS Private with Urban Agriculture

Conclusion

Strategic integration of GOS Privat with Urban Agriculture Program using GIS-AHP approach in Duri City contributes GOS Private availability of 14,134%, so that gos private has exceeded the requirement limit of at least 10% based on the mandate of the Spatial Arrangement Act, Republic of Indonesia.

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