

# Ecological Footprint and Biocapacity Analysis for Flooding Prevention in South Sumatera

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**Abstract.** Planning is the beginning of development activities towards sustainable environmental urgently needed and by integrating ecological footprint into development planning in the region, especially the Spatial Plan (RTRW) that is effective and has a strong tenure. This research aims to analyze existing ecological footprint in South Sumatera, to be able to note the condition of regions ecological footprint. Data analysis is carried out through a quantitative analysis, such as calculating where Ecological Footprint (EFA) and Counting Biocapacity (BC). Results of the analysis obtained EF EF = 0.967 and 1.088 that BC = EF < BC which means undershoot, which needs space do not exceed the space available to support the population lives in the region of South Sumatera. Recommendations are given in integrating Ecological Footprint in South Sumatera RTRW is making patterns of spatial use directives that integrate the needs of consumption and waste disposal populations, both individually and as a community.

**KeyWords:** ecological footprint, rtrw, climate change, flooding.

## Introduction

The incident of ecological disaster that hit the country has increased the state budget and the budget of the people. The value is not comparable to a state revenue delivered from the exploitation efforts that contribute to the ecological disaster (Fadli, 2007).

Climate change is a global phenomenon that has been a concern of various parties both at the global, national, and local levels. The impact of the phenomenon is encouraging the international community to address the cause (mitigation) and to anticipate the consequences (adaptation). The cause of climate change is increasing concentrations of greenhouse gases (GHG), especially carbon dioxide (CO<sub>2</sub>) resulting from fossil fuel burning and land use change (Bappenas, 2010).

At every turn of the season, vulnerability to ecological disasters caused by climate change happens over South Sumatera, an

ecological disaster of flooding is the most important issue to be selected for the solution and prevention. This is because the flood conditions in several districts in South Sumatera now start worrying, especially in urban centers, which has undergone changes due to development especially land conversion into residential, roadways, and other open spaces awakened forest, swamp stockpiling, as well as improve the soil cover as a result of development activities that cause global climate change.

This certainly needs to be our concern on how to make the development process can be run while maintaining a balance on the environment that can be maintained sustainability and can help prevent ecological disasters caused by climate change. Planning is a process beginning of an activity, so that development planning is the beginning of the development activities that are oriented towards sustainable environmental is necessary, and environmental planning can be obtained by integrating the ecological footprint

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(Ecological Footprint) into development planning in the region, especially the Spatial Plan (RTRW) that are effective and powerful.

This study has important meaning amidst development which causing various problems of ecological disaster due to global climate change poses a threat to the environment as a place of life, so the necessity for regional development planning that integrates ecological footprint in it so that the construction carried out to maintain balance and preservation of the environment sustainably

Efforts to prevent ecological disasters permanent flooding are repeated due to global climate change requires the completion of the formal planning so that it can become an instrument for policy makers in the development implementation, by knowing the ecological footprint (ecological footprint) and biocapacity in a region expected to provide recommendations for the formulation of planning instruments in the region, especially in the research are the province of South Sumatra.

Based on the background described earlier, can be formulated that there are several issues of interest to study so that the purpose of this study are: Analyzing the ecological footprint (Ecological Footprint) and biocapacity in South Sumatra, that can be known the condition of the ecological footprint in the region, formulate ecological Disaster Prevention strategies Flooding resulting from climate change in South Sumatra based on the analysis of ecological footprint (ecological footprint) and Biocapacity and recommend policies integrating ecological footprint (ecological footprint) in Development Planning region to achieve a sustainable environment.

Disaster is a series of events that threaten the lives and livelihood caused by natural and non-natural factors, as well as the human factor, Causing damage to the environment and the psychological impact. (Haryani, 2014).

Global warming resulting in climate change has not become a multi-stakeholder awareness. Global warming (global warming) has become a major focus of various people of the world, especially the countries that experienced industrialization and consumption patterns of high (consumer lifestyle). Not many indeed who understand and care about the issue of climate change. Because many say, is the environmental impact that usually occurs accumulatively (Putri, 2012).

Climate change as a result of global warming. As a global phenomenon, with various impacts of climate change for human life, has become something that is apparent in all countries, including Indonesia. The occurrence of various disasters such as floods, landslides, storms, droughts, water shortages, declining food production, the outbreak of various diseases, and so on, in fact closely related to changes in climate patterns that occurred in recent decades (Londo, P., 2012).

Flood is the event sinks its mainland by water, flooding events arise if the water flooded the land which is usually dry, the flood water is generally caused by a flooding river kelingkungan vicinity as a result of high rainfall. The flood waters also carry smelling mud that could cover everything after the water receded, flooding usually occurs regularly, every year will come. Flooding is a natural phenomenon which is actually the usual frequent and facing almost all countries in the world including Indonesia (Putri, 2010).

Ecological footprint is a system that measures how much land and water required to produce the resources a human population that they spend and absorb the waste it generates. Ecological footprint never again be a country of reference in the development process by looking at the balance of the natural assets (ecology). In 2001, the world has experienced a deficit in the balance of ecology, which at the same time Indonesia still has a balance of ecology. But seeing the trend of trends, it is clear that Indonesia was heading for ecological deficit, with reduced biological capacity every year (Fadli, 2007).

According to the Global Footprint Network (GFN-2006) in Rustiadi Et al (2009), Ecological Footprint is a resource management tool that measures how much land and water needed by the human population to produce the resources it consumes and to absorb the waste on the use of technology. At the moment the demand for ecological resources beyond what can be provided by nature sustainably, known as ecological conditions are exceeded.

Given the complexity of environmental management and issues across sectors and regions, then in the building of the necessary planning and implementation of environmental management in line with the principles of sustainable development, namely economic development, social, cultural, environmental impartial as the pillars are interdependent and reinforce each other (Juanda, 2011).

RTRW compiled as a guide for regional and local governments for the implementation of long-term development as well accommodate the interests of space taken up by the central government, provincial governments, kabupaten.kota, private and public. However, the instrument RTRW has not effectively accommodate the various needs of sustainable development because of the availability of data and information that is inaccurate, and the user sector development planning unsustainable land and not integrated (Bappenas, 2010).

This study was conducted in South Sumatra. This study determined the location decision intentionally (purposive), with the consideration that the South Sumatra is a province with a sizeable population, as well as considerable environmental Resource anyway.

Prevention effort permanent recurrent flooding due to global climate change in South Sumatra requires the completion of the formal planning so that it can become an instrument for policy makers in the development implementation.

The sampling method used is the method of sampling is done intentionally (purposive sampling) to resources (key informant) which is considered to represent the policy makers in planning Spatial Planning (RTRW) in South Sumatra, and the people who were able to give their opinions about the study do. So it will take a sample of 50 people with the details of 10 people per agency or institution to represent the population who meet these criteria.

Data used in this study is Primary data and secondary data. The primary data obtained through interviews with the instrument questionnaires to respondents who are decision makers Spatial planning and conduct ecological disaster handler flooding in South Sumatra as well as public and direct observations in the field.

The survey was conducted in several government agencies and public institutions and interviews with a questionnaire conducted on a number of respondents who are considered to have the ability and understand the problem (key informant), such as (1) Bappeda, (2) Bappenas, (3) the National Agency for Disaster Management, (4 ) the Central Bureau of Statistics (5) Public Works Department South Sumatra (6) Community Leaders, (7) WALHI South Sumatra and 8) Private Parties concerned.

Secondary data in this study were taken through the application of methods of information retrieval that is documented in various government agencies, and private obtained from related institutions such as Bappedalda province of Environment, Local Government of South Sumatra, Central Bureau of Statistics, Department of Public Works, the Department of Revenue , the Forest Service and other agencies related to both the provincial and central level, secondary data were also obtained through literature and literature as well as other data sources that support this research.

Ecological Footprint Analysis formula is expressed as follows:

$$EF_{ij} = \frac{DE_{ij}}{Y_{lokij}} + \frac{JM_{ij}}{Y_{regij}} - \frac{EX_{ij}}{Y_{lokij}}$$

Where:

EF<sub>ij</sub> : *Ecological Footprint* in South Sumatera (ha/capita)

DE<sub>ij</sub> : The space required as the region of South Sumatra to-i (ha/capita)

IM<sub>ij</sub> : Produced area sumsel "imported" from elsewhere (ha)

EX<sub>ij</sub> : The type of production that is "exported" to other places (ha)

Y<sub>lokij</sub> : Productivity kind of space needed for the area to the South Sumatra-1 (ha)

Y<sub>regij</sub> : Productivity kind of space for the region of South Sumatra to-i (ha)

Furthermore, optimal resource utilization is achieved when the value of the ecological footprint is equal to the biological capacity (biocapacity / BC) of natural resources in analysis.

$$BC_{lok} = \sum Ak/Yf$$

Where:

BC<sub>lok</sub> : Biocapacity (ha/kapita)

Ak : The area of South Sumatra to category-k (ha)

YF : Yield factor of land cover categories all k

Furthermore, if the value of EF > BC then called overshoot in which the level of need for space has exceeded the ability of space to support the South Sumatra region, and vice versa if the value EF < BC then called undershoot.

Ecological Disaster Prevention strategy formulation Flooding resulting from climate change in South Sumatra done using SWOT analysis (Strength, Weakness, Opportunities and Threats). According Rangkuti (1999), a

tool used to draw up strategic factors is the SWOT matrix.

### **Ecological Footprint (EF) in South Sumatera**

The results of the analysis Ecological Footprint is obtained  $EF = 0.957$ , which means that the conditions Ecological Footprint in a state of alert because of  $EF < 1$ , but because the value is closer to one, the ecological footprint (EF) South Sumatera is still balanced with the ability of South Sumatera to support life the population of this region.

Ecological Footprint (EF) is itself shows that the population in this region are still able to get needs met but on alert, so that the attention of the sustainability of livelihoods especially those based on natural resources needs to immediately get his attention in order to keep its sustainability, if not value EF produced this will continue to decline, so that it becomes deficit.

### **Biocapacity Analysis (BC)**

The results of the South Sumatera Biocapacity analysis is  $BC = 1.088$ , this shows that Biocapacity South Sumatera is still a surplus due to the calculation results of  $BC > 1$ . So to South Sumatera is still possible to do activities fulfillment or consumption of the population through the exploration and expansion of natural resources, in the form of land, mining and forest.

Furthermore, if the value of  $EF > BC$  then called overshoot in which the level of need for space has exceeded the ability of space to support the South Sumatera region, and vice versa if the value  $EF < BC$  then called undershoot.

Calculation of EF and BC South Sumatera obtained  $EF = 0.957$  and  $1.088$  that  $BC = EF < BC$ , then called undershoot which means that the space requirement does not exceed the ability of space to support the population lives in South Sumatera. So from the analysis of the ecological footprint (EF) have shown that in general wilayah Sumatera South is still able to provide space for the life of the population or the population of South Sumatera adequately, but this condition must be maintained so Biocapacity Sumatera Selatan maintained, so that the floods caused by climate change can be anticipated by kondisi environment that is still awake.

EF alert condition, which also impacted on the environment is to be one of the causes of the ecological disaster of floods in South

Sumatra, this is because the ecological footprint already high, and exploitation of the environment to meet the needs of growing populations so dampak environment can not be avoided. Increasing number awake space, and land cover change from forest to agriculture reduced ability to withstand environmental buffer overflow rain water so kedaratan, this is what should be a serious concern of government and society. Flooding caused by climate change in South Sumatera is the impact of high Ecological Footprint South Sumatera, which if not controlled will be able to continue to increase so that the ability of the environment to overshoot, and can increase the risk of flooding in the region of ecological disaster.

### **Flood Ecology Disaster Prevention Strategies of Climate Change in South Sumatera**

Ecological Disaster Prevention strategy formulation Flooding resulting from climate change in South Sumatera done using SWOT analysis (Strength, Weakness, Opportunities and Threats). In analyzing the prevention strategies swot to get an ecological disaster of flooding due to climate change in South Sumatera, then there are four indicators were identified, namely: Strength (strength), weakness (weakness), opportunities (opportunities) and threats (Threats).

#### **Strength**

Potential power that can be utilized in tackling Ecological Disaster Flood In South Sumatera, among others: Comparison of EF and BC are  $EF < BC$  so-called undershoot which means South Sumatera are still able to support the population with adequate life. Flood-prone points in South Sumatera is still not too much so that the response can still be done optimally.

#### **Weakness**

Weaknesses that need to be addressed in tackling the ecological disaster of floods in South Sumatera are: Lack of prevention efforts consistently on the control environment and natural resources in anticipation of flooding in South Sumatera, areas prone to floods in South Sumatera average is watershed (DAS) and residential communities were concentrated in the region along the river. Footprint Ecological bersatus vigilant so that has the potential

to overshoot if not performed the way of life population control efforts in meeting the consumption and disposal of waste, which has great potential also be the cause of flooding in the region of South Sumatra.

### Opportunities

Opportunities that can be used for disaster relief efforts ecological flooding in South Sumatra: still the availability of forests and uncultivated land which, if preserved will still be able to become environmental buffer to prevent flooding are repeated in South Sumatra, as well as other opportunities in the form of watersheds (DAS ) that is still functioning properly.

### Threats

Threats that require immediate action to prevent flooding due to climate change in South Sumatra are: the increasing number of population in the region of South Sumatra, leading to higher ecological footprint in South Sumatra. The declining biocapacity as land clearing activities and use changes into a green open space and undeveloped land more in development activities and meeting the needs of the population as well as waste disposal.

### Recommendations for Integrating Ecological Footprint in South Sumatra province RTRW

Results Based Spatial identification document RTRW South Sumatra Province is known that in general the actual RTRWP South Sumatra has mengintegrasikan Ecological Footprint as an indicator variable RTRWP role in South Sumatra. Each variable in the form of a population area of land required, the amount of exports and imports existing South Sumatra region, as well as productivity sumsel area to meet the needs of the population has been included in RTRWP (Bappeda Sumsel, 2014).

However in RTRWP South Sumatra has not been seen Tutorial Space Utilization Patterns for waste disposal or landfill. Tutorial beneficiaries listed in RTRWP space is only for the disposal of waste or landfill in a residential area, but for other areas there has been no landing allotment of space for waste disposal such as mining areas, industrial areas and farm area.

When viewed from the direction of the pattern pemnafaatan RTRWP space in South

Sumatra, it appears that the designation of protected areas is quite low at 15.53 percent of the total area of South Sumatra. This is one cause Ecological Footprint South Sumatra, which is based on the analysis of less than one ( $EF < 1$ ) which is to be in alert status, which needs populasiyang high causing semamin shrinking space for protected area that serves as a buffer environment and prevent disasters ecological flooding in South Sumatra.

Whereas the spatial allocation for farm area that is equal to 82.66 percent of the total area of South Sumatra. This suggests that the conditions EF bersatus vigilant, so that most of the space reserved for the agricultural cultivation area for the purposes of meeting the needs of the population consumption in South Sumatra. So the density of population size led to an increased demand for space farm area. What is needed now is a preventive action in order to area of space protected area is not on the wane due to the expansion of agricultural land continuously..

Efforts to make agricultural intensification must be the government's attention so expansive land agricultural activities can be controlled and Biocapacity not decreased continuously, which can lead to a variety of ecological disasters of flooding in South Sumatra. Biocapacity are maintained to reduce the risk of flooding, because the environmental capacity still exceeds the needs of the population so that the level of environmental damage as peenyebab flooding can be minimized, and flooded areas are not growing.

### Identification of Flooded Areas in South Sumatra

Areas that are potentially flooded in South Sumatra are Lahat, Ogan Ilir, and Muba District and the city of Palembang. All four counties have an estimated potential administrative areas experiencing flooding ecological disaster. Third district Lahat, Ogan Ilir and Muba been at risk of flooding medium, while in the city of Palembang own high flood-prone areas. So the city of Palembang city in flood risk level is very high in the region around the river Musi, and this would require more attention in the fight against floods, compared to other regions in Palembang

Territory of Palembang city prone to flooding are the districts Ilir Barat I, Ilir Barat II, Ilir Timur I, Ilir Timur II, Seberang Ulu I, Seberang Ulu II, so that from the data obtained through the Regional Disaster

Management Agency flood-prone areas spread in almost all Palembang city with a high degree of risk.

As for the other in the county outside the city of Palembang, districts might experience flooding is Babat Toman, Appeal, Mount Megang, Indralaya, Jarai, Lahat, Talang Ubi, Kuang Muara, Muara Lakitan and Pemulutan. Daerh this area could potentially flood the secondary level. When viewed from the geographical conditions of flood-prone areas this is the area bordered by a river or watershed. So it can be the first cause of flood disasters is rising sea levels which impact on the rising water level of the river so if it rains the river will overflow occurs kedaratan, and cause ecological disasters flood. This shows climate change is affecting the environment around the watershed, and cause potential flooding faster than before.

### Recommendations for Integrating Ecological Footprint (EF)

Recommendations can be given on the identification RTRWP South Sumatra (South Sumatra Bappeda, 2014) in the integration of Ecological Footprint is: RTRWP should also memuat direction on the pattern of utilization of space for waste disposal for industrial areas, mining and farm area, because the RTRW document currently only contains the designation for waste disposal in residential areas population. Allotment of protected areas is still too weak, kana also will be further reduced with the construction of the port of Tanjung Api-Api misalnya. sehingga the recommendations suggested in the integration Ecological Footprint is RTRW should be more assertive provide direction pattern of utilization of space does not allow the extent of protected areas on the wane. Applying the pattern of allotment area based agricultural intensification is not expansive land, so it is still available and swamp forests are able to become environmental buffer. Applying the pattern of allotment area based agricultural intensification is not expansive land, so it is still available and swamp forests are able to become environmental buffer. RTRWP should also contain the location of designation for a new residential development, so that the location of settlements is clear and does not damage the environment, such as hoarding swamps and deforestation and land conversion of agricultural food. Map of flood-prone areas should also be made referrals spatial use as an alternative to flood prevention efforts through

the structure of space. The spatial use in a watershed that can be directed as well as a protected area, so the vegetation of mangrove forest watersheds can dilestraikan that as well as beneficial to hold the river floods kedaratan on flooding.

### Conclusions

Ecological Footprint South Sumatra produced from research in that is equal to 0.967 and Biocapacity South Sumatra amounting to 1,088, so that  $EF < BC$ , then called undershoot which means that the space requirement does not exceed the space requirements to support the region's population lives in South Sumatra.

Ecological disaster prevention strategy of flooding due to climate change in South Sumatra, which can be formulated from the research in is: Keeping EF remains undershoot. Consistency in controlling environmental damage. Preserve protected areas. Reduce land conversion as a result of development activities.

Integration policy recommendations Ecological Footprint in South Sumatra RTRW is Making use directives pattern that integrates spatial patterns Ecological Footprint components, namely consumption and waste disposal populations, both individually and as a community.

Suggestions are given on the results of this study are Southern Sumatra provincial government should start considering the allotment of land to meet the waste disposal populations of other areas such as industrial areas, agricultural areas, so the spatial allocation for this obvious waste contains not only the landing pattern for residential waste only.

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