Landscape Structure Analysis to Develop Green Infrastructure Network in Depok City

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ABSTRACT

Utilization of land for development and living need pushed conversion of green spaces to built up area. Therefore, it is important to plan and manage open green spaces, like: conservation area, parks, lakes, rivers, etc. One thing that should be considered in regional planning was carrying capacity. Carrying capacity from population and build up areas became the limiting as factor for development. In spite of that, regional development should refered to landscape characteristic and local potency which was connected by infrastructure. Green infrastructure was one of city development concept to control development as a strategy for land conservation by establishment of hubs and links as boundary of development. Research to implement green infrastructure concept was carried out in Depok City. This research was aimed at identifying hubs and links in Depok city as a green infrastructure network in order to find an implementation strategy. Methodologies used are: trend analysis of population and build up area, LQ, and Skalogram analysis to determine regional hierarchy; Geographic Information System analysis on aerial photograph and thematic map; created green infrastructure network based on English Nature Greenspaces criteria. The results show that Depok has landscape typologies that can be enhanced to became Hubs and Links in green infrastructure concept, like: Town Forest, Town Park, Lakes, Rivers, Streets, areas along High Electrical Networks, areas along gas pipe, train lines, and other specific location. The green infrastructure network is about 3,609 hectares. Establishment of the green infrastructure network as conservation area is the strategy for implementation of the green infrastructure concept.

Keywords: green infrastructure, green spaces, hub, links, network

Industrial Areas Management Strategy Towards Eco-Industrial Park (Study Case : Industrial Areas in Cilegon, Banten Province

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ABSTRACT

An eco-industrial park is the new concept as an industrial response for global environmental changes. The purpose of this research is to study and propose scenarios, strategies and operational recommendation to develop an eco-industrial park from an existing industrial park in Cilegon-Banten. An eco-industrial park is a community of manufacturing and service businesses located together on a common property. Member businesses seek enhanced environmental, economic, and social performance through collaboration in managing environmental and resource issues. By working together, the community of businesses seeks a collective benefit that is greater than the sum of individual benefits each company would realize by only optimizing its individual performance. The methods of this research, use gap analysis, that by analyzing the existing condition compared with ideal criteria of eco-industrial parks, and the research aspects are synchronized with a sustainable development concept. The researches used participatory prospective analysis and hierarchy analysis process.The data are collected through survey method that represents observation, indepth interviews, questionaires and expert judment. The result show that existing condition Cilegon industrial estate have many gap standard of criteria as an eco-industrial park. The growth of industries in Cilegon area causes land use cover changes outside of planning design industrial area, and this tends to reduce open greenspaces significantly. The results of the quality of environmental analysis that occurs among several parameters namely : BOD, COD, TDS, NH_3 dan Temperature in Cilegon area are higher than the standard. As a result of AHP analysis, prioritization of strategies to develop existing Cilegon industrial park to an eco-industrial park is a green industrial park development, implemented with an optimistic progressive scenario, that six key factors affect an eco industrial park development in Cilegon area, namely to construct an integrated waste treatment, to provide open green spaces at a 30 % minimum, law enforcement to develop an eco-industrial park in Cilegon area, punishment and reward for industries that implement environmentally friendly activities, and defense of water resources or water conservation to support sustainability process industries in Cilegon industrial park.

Keywords : Eco industrial park, Gap analysis, Green industrial park

1. INTRODUCTION

Eco Industrial Park (EIP) is a group of industries (products/services) that is located in a place where its actors are trying to improve their environmental, economic, and social performances (Lowe, 1996). EIP has a concept of development goals as issued by the Presidents Council on Sustainable Development (PCSD, 1996) i.e:*"The goal of an EIP is to improve the economic performance of the participating companies while minimizing their environmental impacts. Components of this approach include green design of park infrastructure and plants (new or retrofitted); cleaner production, pollution prevention; energy efficiency; and inter-company collaborating. An EIP also seeks benefits for neighboring communities to assure that the net impact of its development is positive."*

Some of the implementation models of eco industrial park development in several countries include the establishment of cooperations inter-industries in the area to conduct the exchange of their products (industry by product exchange) by referring to the concept of industrial ecology that aims at reducing the waste potential and resource use efficiency. For example, the sugar industry in South China provides sugar cane waste pulp to be used as raw materials for paper mills and factories of alcohol distillation in the same area. The other interesting and phenomenal example is the implementation of eco industrial park in the area of heavy industries such as Kalundborg, Denmark Covenhagen by applying the industrial symbiosis model in one region in which through partnership inter-industries, they are able to reduce production costs, to fulfill the obligation of environmental regulations, to set and utilize the industrial waste, and to recycle water and wasted energy, for the purpose of efficiency in the industrial area. This collaboration can also improve the welfare of the community (social capital) that participates in this program. The keys of industrial symbiosis are collaboration and the synergistic possibilities that may occur in an industrial area (Chertow, 2007). The other form of the development is a green industrial park i.e. a green industry which is developed in the area of Camden organized by Institute for the Environment (IE) from the University of North Carolina at Chapel Hill (UNC) North Carolina. The term green industrial park refers to an amount of land or area that is created for the purpose of industrial business activity, offices, light industries, warehouses, wholesalers, and/or research activities that combine a number of characterisitcs of the environment. The characteristics, if associated with the term of environmentally friendly, minimize the use of water and energy, reduce run-off water, and reduce or recycle industrial waste. This area has developed rapidly and involved companies producing environmentally friendly products (such as solar boards, windmills and equipment using economical energy or water). Thus, an industrial park is a green area that is environmentally friendly in regards to its design and management, or in regards to the industries that operate in the area, or both ways (UNC report, 2008).

Cilegon is one of the area in Banten Province where heavy industries such as the national steel industry PT. Krakatau Steel, Petrochemical industries and other industries have developed with their level of diversity and complexity of high technology. In accordance with the development pattern of Cilegon, it becomes the center of heavy industries and trading in Banten Province. Moreover, it contributed as much as 54.62 % of the GDP to Banten Province (The evaluation document of the Strategic Plans of Banten Province in 2002-2006, 2007). To date, there have been some issues associated with the occurrence of environmental degradation around the industrial area of Cilegon. Furthermore, there have been a claim and conflict between the industry and the community regarding the gap in welfare and environmental pollution potential in the form of liquids, gas/air, residues resulted from industrial activities, and the technical problems associated with limited sources of water for process, the source of energy generation and control on industrial waste management affecting the process of sustainability of the industries.

Based on the background described above, strategies and management policy of an industrial area to realize an environmently-based and sustainable industrial area (eco industrial park) should be formulated. The objective of this research was to formulate strategies and set up appropriate scenarios for the management of an industrial area towards an eco industrial park based on the study of gap analysis of the existing conditions with the ideal concept and benchmarking of eco industrial park.

2. RESEARCH METHOD

The research was conducted in the industrial area of Cilegon including the industrial area of Anyer (the border city of Cilegon and Serang Regency), Merak, and Cilegon which are located in the Province of Banten. The research conducted for twelve (12) months starting from September 2007 to September 2008. The secondary and primary data were used in this research.

The secondary data were obtained from the result of previous research carried out by the related institutions. The primary data were obtained through direct observation in the area of research, interviews by experts through the questionnaire, results of laboratory analysis, and results of statistical tests using CDP software, arcview and Excel. Data collection was conducted by using the triangulation method which is a combination of direct interviews, literature studies, and field surveys. Data analysis included:

1. Study on the existing conditions by using the methods of spatial analysis and gap analysis
2. Preparation in strategy and scenario on the development of Cilegon industrial area by using hierarchy process analysis (HPA) and prospective analysis

2. RESULTS AND DISCUSSIONS

i. The Existing Conditions of the Industrial Area of Cilegon

The Changes of Land Cover

The results of the Landsat image of land cover in the industrial area of Cilegon of 1982, 1992, 2003, and 2006 and their changes were presented in Figures 1 and 2.

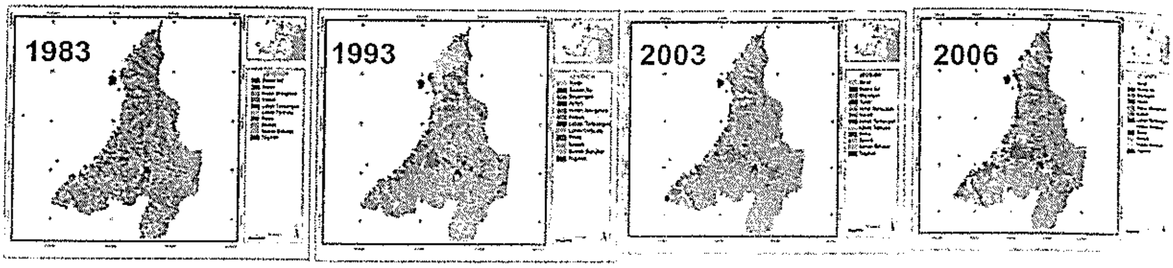

Figure 1. The Maps of Land Cover of Cilegon City Year 1983, 1992, 2003, and 2006

ii. Potentials of Gaps and Solutions of Cilegon Industrial Area towards Eco Industrial Park

The occurring of potential gaps were identified from the criteria in the determination of an industrial area changing into an industrial ecology based (eco industrial park), and such criteria included the operational foundation, the production process, and the impact caused by the implementation of the eco industrial park. The gap and solution are presented at Table 1.

Table 1. **Potentials of the gaps and solutions**

EIP INDICATORS	EXISTING CONDITIONS	GAPS	SOLUTIONS
Gap analysis was based on the Adequacy Criteria of *Eco Industrial Park, namely*:			
1. Operational Foundations in operating the area			
• Environmental Conservation	• Tend to increase land use and chemical parameters of environment above the standard quality were found	• Increasing land use cover change • Limited water resource • Minimum green space area.	• Preparing regulations, infrastructure and integrated facilities of IPAL • Providing tax incentives for the industries applying the environmentally based design
• Selection of locations for the development of an industrial area	• Industrial areas area based on the RTRW and a plan for area development is established • Development of new industries outside the present areas	• The areas have not been optimally utilized • Development of new areas will increase the conversion of productive land • Industrial land utilization does not comply for its use	• The formulation of RTRW of Cilegon must always be based the conditions of the ecological aspects and aspirations of the related community • Arrangement of the industrial area is carried out by prioritizing the protection of the environment • Application of regional regulations regarding the

			obligation that an industry must be located in an industrual area.
• Cooperations among industries in managing the area	• Utilization of products is based on the needs • The management of waste is carried out individually	• No inter-industry cooperation in the utilization and integrated management of waste products	• Cooperations between the industry in utilizing products governed by the regulations • Development of integrated IPAL
• Active participation of the local communities in the area of industry	• Planning is mostly set using a top down approach • Less community participation in the supervision and control of pollution	• The community aspirations are not heard, thus creating social actions • The quality of the environment is declining	• Involving the local communities in decision making • Strengthening the community institutions facilitated by the company through CSR activities to improve their awareness in protecting the environment
2. Factors of production process in *EIP*:			
• The efficiency of resources	• Industries are still dependent on fossil energy sources, water sources of raw materials from the andau swamp, imported raw material, and they produce unutilized industrial waste	• Limited capability in creating innovations for technology and process for energy diversification and raw materials • High amount of product waste which is unutilized, thus creating pollution potential	• Planning and design of material water recycle, rain water recycle and water recycle in the process of industry • industrial symbiosis in the area for the activities of conservations of energy and natural resources to realize OGS (open green area) of minimum 30% of the area, an ecological park, ecological Waterfront as well as to make use of waste in the industrial area
• sustainable competitive advantage	• There are industries which have not applied the standards in protecting the environment	• Access to global economic competition is limited because of low performance of environmental management	• The government as the regulator must increase the awareness of the industries to improve their performance of voluntary environmental management
3. Factors of the impact of the activities in the industrial area:			
• Minimize the environmental pollution	The environmental pollution has not been minimized optimally	• the pollution is above the standard quality of raw materials, thus creating environmental pollution	• Developing IPAL independently or in an integrated way for the related industries
• Improvement of economy and welfare of the communities surrounding the area	The impact of the improvement of the welfare of communities around the area is not evenly distributed	• There is a gap in the welfare of the communities around the industry with those in the industry areas	• Community economic development through corporate social responsibility fund and taxes from the industries supported by the regional regulations based on the amount and management of the fund

• Harmonious social relationship of the communities	• Recruitment of labor from the local community is not yet based on the aspirations of the community • Development of through CSR activities has not run optimally	• The emergence of social jealousy from the local workers towards the laborers from outside the area • CSR fund is still small and ineffective	• Prioritizing the recruitment of local labor proportionally based on the need of the company and the skill of the existing workforce • Increasing the fund of the community development which is managed through CSR activities

iii. Strategy and Scenario of the Development of an Industrial Area towards an *Eco Industrial Park*

Analysis of industrial development strategy was formulated in five (5) levels including the focus, goals, goal criteria, actors, and options of strategies, and the results of the analysis were presented in Figure 2.

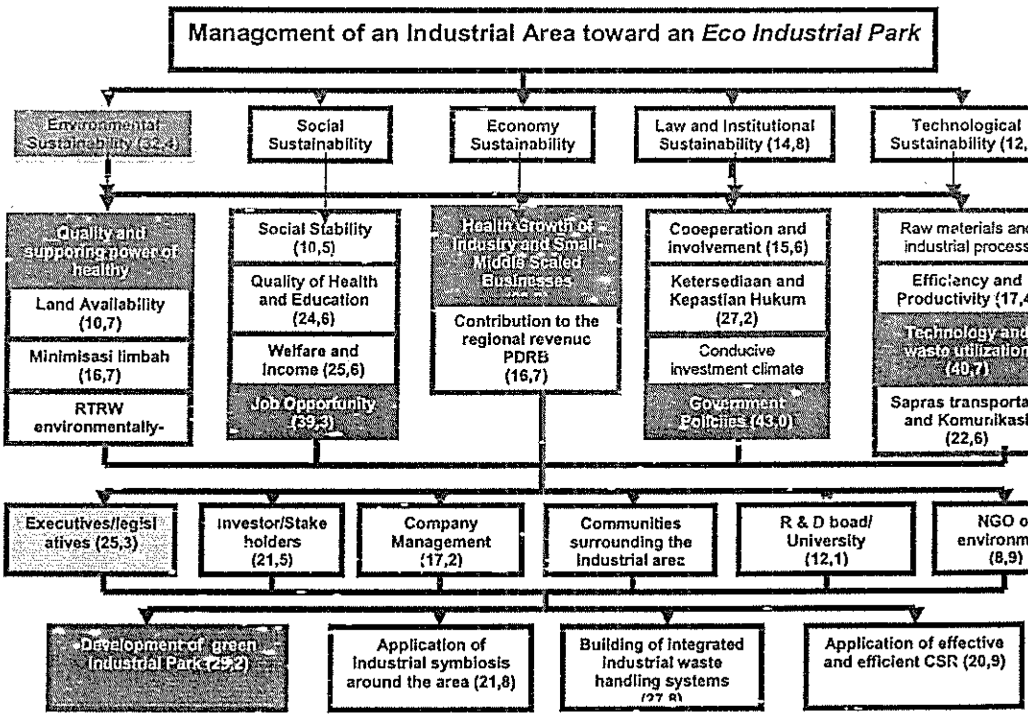

Figure 2. Hierarchy Structure and Results of AHP

The research results as presented at Figure 2 showed that the strategy to develop industrial green industrial park became the first priority to be developed. The goal are achieved in the management of the industrial eco industrial park included the sustainability of the environment/ecology. Meanwhile, the main goal in the ecological criteria was to achieve the quality and supporting capacity of a healthy environment. To achieve the goals, the government (executive and legislative) as the actor plays a major role acting as a facilitator, dynamist, and a regulator.

In a green industrial park, a number of programs were required to develop in order to support the priority strategy in changing the green industrial park to eco industrial park as presented at table 2. Prospective analysis results showed that there were six program priorities that had to be considered seriously in developing Cilegon into a green industrial park. The six programs included: (1) Installation of Integrated Waste Processing (IIWP); (2)

the provision of open green space (OGS) as much as 30% of the area that is utilized by each industry; (3) strict law enforcement against the law breakers that have been made for the management area; (4) the provision of sanctions for the industry which is non-pro to the environment; and (5) establishment of a special institution to manage the area towards a green industrial park, and (6) maintainance of water absorption areas to ensure water availability for company operational.

The six prioritized programs were formulated to prepare the formulation of future scenarios using the conditions (situations) stated at Table 3. From the possibilities that occured from the conditions mentioned above, three scenario groups of the strategies were established in order to develop the sustainable green industrial park in Cilegon in which this park has a great potential in the future. The strategy are as follows:

(1) Pesimistic-conservative scenario i.e. by maintaining the current condition or by making a reasonable improvement of the key factors.
(2) Moderate-Optimistic scenario i.e. by making some improvements of the key factors but the improvements are not carried out optimally.
(3) Progressive-Optimistic scenario i.e. by making improvements of the whole key factors.

The scenarios are presented at Table 3 below.

Table 2. **The condition of each key factor in the Development of a *green industrial park* in the industrial area of Cilegon**

Factors	Conditions (State)		
Integrated IPAL development	1A Not applicabale	1B Applicable	1C
Sanctions for industries which are non-pro environment	2A Not applicable	2B Applicable but only for some industries	2C Optimally applicable
Provision of as much as 30% (OGS) in each industry	3A Not applicable	3B Only a small amount of area is provided	3C Provided by all industries
Strict law enforcement	4A Not applicable	4B Applied but not optimal	4C Strictly applied
Special form of institutions for the management of green industrial park	5A Not apllicable	5B Applicable	5C
Maintenance of water absorption areas	6A Drastic decrease of water absorption areas	6B Available in small quantity	6C Large areas of water absorption ares

Table 3. **Scenarios of Developmental Strategies in the Development of a Green *Industrial Park* in the industrial area of Cilegon**

No.	Scenarios of Strategies	Factor Order
0	Existing conditions	1A, 2A, 3A, 4A, 5A, 6A
1.	Conservative-Pessimistic	1B, 2A, 3A, 4A, 5A, 6A
2.	Moderate-Optimistic	1B, 2B, 3B, 4B, 5B, 6B
3.	Progressive-Optimistic	1B, 2C, 3C, 4C, 5B, 6C

When viewed from the conditions of each factor in the third scenario, the third scenario implementing all improvements to the overall key factors is the appropriate choice to accelerate the industrial development of a green industrial park. However, this should be carried out by considering the factors of the available costs or budget, energy and time.

4. CONCLUSIONS AND RECOMMENDATIONS

a. Conclusions

Land cover of Cilegon City area is dominated by vegetation such as forests and agricultural crops. However, the amount of cover by land vegetation is declining as the area has expanded. In the area of management , there are still some gaps as a result of incompatibility with the criteria set for the eco industrial park. For axample, industrial expansion results are conversion of land, thus reducing the open green space and causing levels of pollution to be high. Based on the results of the analysis parameters of liquid waste, chemical waste, air, ground water and seawater show some basic parameters on the quality of the environment. There were 23 stakeholders who are in quadrant III indicating that all stakeholders have a high interest and influence in the management of the industrial, and there were 3 stakeholders in quadrant II indicating that they have interest in the management of the industrial area but their influence on the other stakeholders were low.

Management strategy towards industrial Eco Industrial Park (EIP) is to develop an industrial green park. The actor playing a major role in the development of the industrial area of Cilegon towards eco industrial park is the government. The major goal to be achieved in the management of the industrial area towards eco industrial park is a the sub-level of the sustainability of the environment/ ecology. For the goal of environment, the benefit that are most expected are the quality and supporting capacity of a healthy environment. There are six programs of priorities in the development of green industrial park towards eco industrial park in Cilegon, namely: (1) development of integrated waste processing installation; (2) the provision of open green space of 30% in each area utilized by each industry; (3) strict law enforcement ; (4) maintainance of water absorption areas to ensure water availability for industrial processes; and (5) establishment of a special institution in the management of an industrial area towarda a green industrial park; and (6) sanctions for the industry which are non pro-environment.

b. Recommendation

Consistency of the government as the most influential actor in the implementation of the application of the lay out of the industrial area is necessary so that overlapping land use and violations by the stakeholders on any changes in land use can be avoided including the strict law enforcement in managing an industrial area towards an eco industrial park.

ACKNOWLEDGEMENTS

Thank`s to DIKTI and IPB Block Grant Program 2009 for Doctoral Research.

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