

# proceedings

International Symposium  
On Construction in Developing Economies:  
Commonalities Among Diversities

*Penang, 5-7 October 2009*



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On Construction in Developing Economies:  
Commonalities Among Diversities**

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# proceedings

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## LAND CONVERSION AND ITS IMPACTS ON ENVIRONMENTAL SUSTAINABILITY: Case Study: Desa Ciburial Kabupaten Bandung West Java – Indonesia

**Bambang Karsono**

School of Housing Building and Planning

Universiti Sains Malaysia

E-mail: myvolkswagen74@yahoo.com

**Julaihi Wahid**

School of Housing Building and Planning

Universiti Sains Malaysia, 11800 Pulau Pinang, Malaysia

E-mail: julaihi@usm.my

### ABSTRACT

*Environmental ecology is the backbone of human life on earth. The damaged on the environmental ecology will cause the inability for the next generation to sustain their living comfort. Rapid urban development in the developing countries has taken place indiscriminately in all areas. Urban needs and activities were usually pushed out into the rural area with the belief that clean air and less built up space are found. Rural areas became the favorite place for the urban-dwellers to seek their urban comfort and amenities which huddles up all the requirements of their needs as required by their life style. Hence, the conversion of rice-field or horticultures-field into leisure purposes is the new phenomenon that is taking place in Desa Ciburial. This phenomenon inadvertently will disturb and affect the linearity of the environmental ecology. Desa Ciburial is located in the northern part of the city of Bandung. The village has a priceless natural asset which has a special character that cannot be found in other areas of Bandung. Its topography which consists of highland creates a panoramic view of Bandung. These views have been enjoyed by the villagers for decades. These phenomenological intrusions trigger a new caution among the villagers which will spread vastly for accommodating the urban needs, majority of which are mainly used for cafés, restaurant and house-villas. Subsequently, the Desa Ciburial became a centre of new land development particularly to cater for the leisure lifestyle of the urbanites. It is also feared that the non-linearity of the environmental balance will cause a break down of the ecological system which later influences the lost of biological diversities and lead to a permanent environmental damaged. The paper also delves into the above negative impact of the land conversion where the data's from the fieldworks, publication in the local newspaper, direct and indirect observations together with an in-depth interviews with the villagers and government representatives were applied. The analysis will be describes further according to the various techniques as commonly used in any exploratory research. Finally, the paper envisages by giving recommendations to improve the damaged on the environmental ecologies.*

**Keywords:** Sustainability, environmental ecologies, non-linearity, irreversibility, Desa Ciburial

## 1.0 INTRODUCTION

The conversion of land from agriculture and horticulture into building structures tends to molest the linearity of ecological environments which are proven to have support the life on earth. The drastic development especially the sensitive area of the peri-urban will affect the urban ecology. The sudden change of use will affect the ecosystem and cause the failure for the next generation to fulfill their basic needs on earth. The destruction on the biological diversities is an irreversible disaster and this will trigger unsustainability. The paper attempts to uncover the situation at Desa Ciburial which is located in the city of Bandung, East Java. The ecological systems in Desa Ciburial tend to break down as a consequence of land conversion. The remaining farmers are struggling to sustain their remaining land for agriculture. The production of the farm also led to an increased usage of chemical based fertilizer. The panoramic view of Bandung city that surrounds the Desa Ciburial has been molested by buildings jutting in the peri-urban landscape and became an alien blend of scenic facades. The urban dwellers keep on pouring into these areas to purchase the land from the villagers, and the land function changed according to the new trend of usage.

## 2.0 SUSTAINABILITY

Most of the phenomenons in the planet cling to the non-linear behaviour. Non-linearity tends to change the limits of ideal parameter in ecosystem. For examples, non-linearity has a relationship with organism's behaviour and the concentration of pollutants in the air (figure 1). If the concentration of pollutants increases it has a consequence decreases on the organism's health and freshness. The increase in the usage of fossil fuel is also an example in the non-linearity phenomenon. Although it can be categorized linear with the human needs for transportation and industry, however, it can be non-linear within global climatic change because of the presence of  $\text{CO}_2$  which emerge as a result of the fossil fuel's burning process.

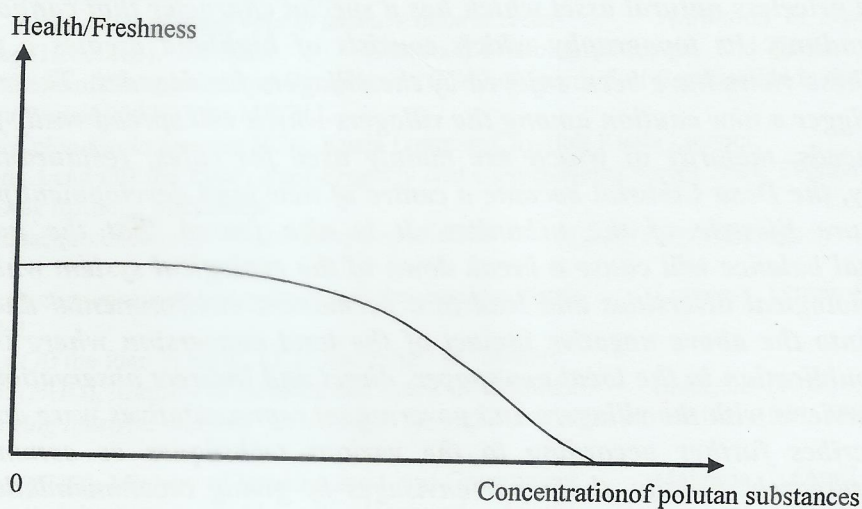


Figure 1: Nonlinearity between health/freshness and concentration of pollutant substances  
(Source: Rao, 2000)

Another phenomenon is the ecosystem resilience. It is a protection capacity or the ability of the species and organisms in the ecosystem to absorb the interferences before any structural changes occurred in the ecosystem. Resilience will be gone if the limiting tolerance in ecosystem intervene negatively by external influences. The loss of resilience will turn the system to be non-linear, for example: once water from the soil explored extensively without considering its resilience, thus it will exceed its tolerance limit. This will cause the water system to dry up and

then depleted. Destruction in environmental system and the extinction of biological species are examples for irreversible environmental disaster. Another example is the concentration of greenhouse gases (GHGs) on the atmospheric layer which has a negative impact on the global climate change. The former explained the cumulative effects from various activities that exceed the tolerance's limit and its negative influence to the linearity of various ecosystem. Figure 2 shows the relationship between response and influence of resilience loss.

According to lowers (1993) there are several important symptoms that tend to show the unsustainability to the environments:

- Increase of human population and natural resources consumption.
- Poverty (urban and rural)
- Depletion non-renewable resources such as fossil fuels and coals
- Pollution due to poisonous substances.
- Atmospheric pollution and ozone depletion.
- Biological species extinction.
- Air and solid waste pollution in urban area.
- Greenhouse effect and global climate change.

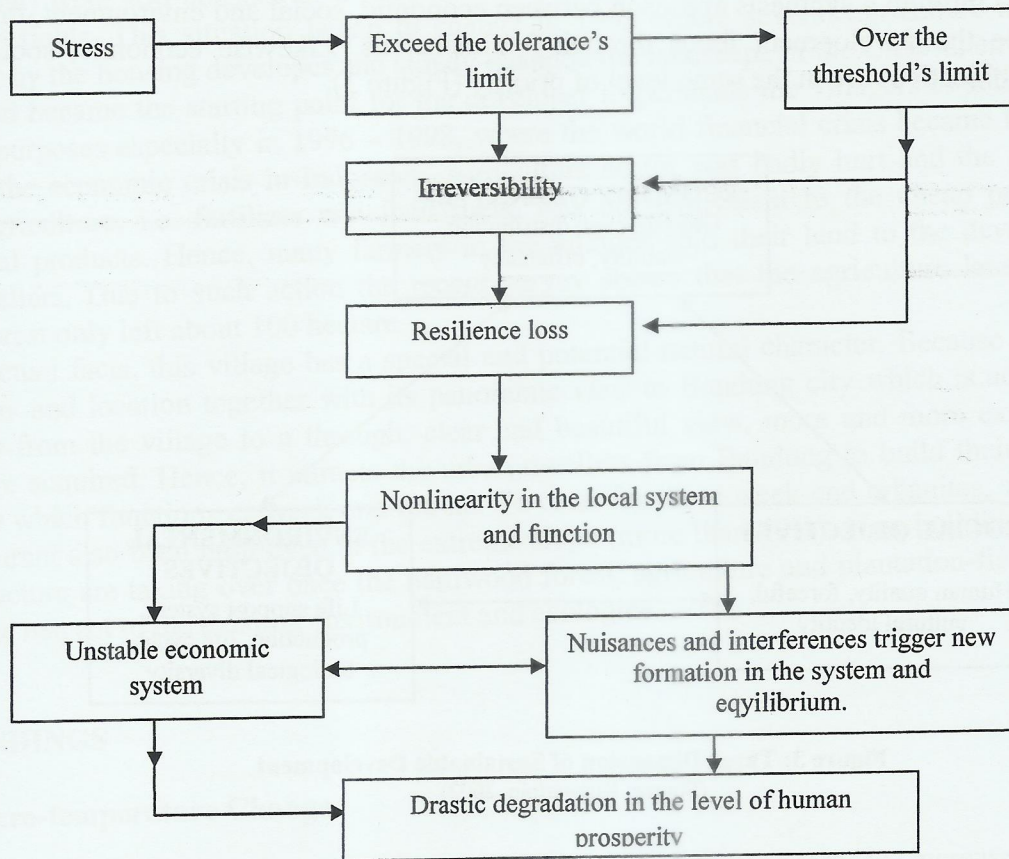
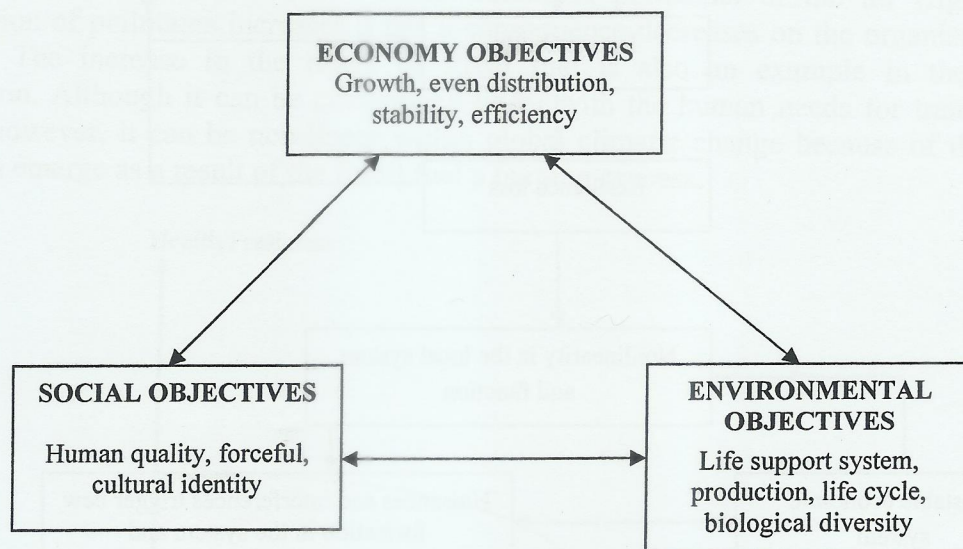


Figure 2: Relationship between response and influence of resilience loss  
(Source: Rao, 2000)

### 3.0 SUSTAINABLE DEVELOPMENT

World Commission on Environment and Development (WCED) define sustainable development as the fulfillment of the recent needs without threatening the next generation. The term is commonly used as a comparison to a comprehensive development which covers the environmental protection. The concept is based on a separation between human and nature. People chose several items with regards to nature, such as trees, forest, lakes, etc, and then create a boundry around them, trying to show a protection through the border. On the other hand human activities outside the border utilized the land use for housing, economic activities, manufacturing, transportation, etc. These activities are seen as negative influences to the natural environment. Thus the idea on sustainable development must be more creative than just a mere environmental protection. It must be realized that sustainable development also need economic and social change to improve human welfare.

Scientists identify 3 main elements of sustainable development, i.e.: economy sustainability, environmental sustainability and social sustainability. The problem is how far these approaches can be the anthropocentric's social and economic objectives to be liased with the ecocentric's ecologic objectives. This understanding shows that sustainable development does not only focus on increasing the quality of life for the people but also the quality of natural environment and the conservation of natural resources which gives benefit to life support system for human. If sustainable development can be achieved through a synthesis approach between economic, social and environment, thus this concept will be the development focus through 3 dimensions. Likewise economic, social and environmental objectives are in the same level of priority (Figure 3).



**Figure 3: Three Dimension of Sustainable Development**  
(Source: Kuswartojo, 2002)

## CASE STUDY: DESA CIBURIAL

Desa Ciburial is located on the northern part of the city of Bandung which is adjacent to Bandung Municipal border. It has an area of 599.216 hectare and located in the highland (700 – 1.200 meters above sea level). The area is characterized by its hilly topography and various slopes between 25% and even up to more than 40%. Basically, Desa Ciburial is a vegetable producing area for cabbages, carrots, tomatoes, onions, to name a few. Because of its hilly's topography, the irrigation system relies entirely on the rain. Although there are two rivers running through the village, i.e. Cikapundung and Cidurian (the word "ci" in Bandung means river), but it cannot to be channeled to the rice and horticulture fields. These conditions also evoke the villagers to cultivate their fields only once a year, i.e. during the rainy season.

Geographically, the soil types in Desa Ciburial consist of layers of sedimentary rocks with its top soil covers with 2 to 10 meters thick of fertile volcanic ashes (Kuswartojo, 2002). The soil has a special characteristic where it cannot absorb water to the lower most of the soil. Water can be absorbed to the soft soil in the upper layer and if it already exceeds its surface the water will rush down finding its way to the lower land. However, the area that has an extreme topography between 25% until 40% has a very high risk for soil erosion.

It was recorded in the 1990s that the landscapes in the area (about 450 hectare; or about 75% of total land) were still consists of a pool of hard wood's forest, fruits and spice plantations and agriculture fields. This situation began to change in 1993 where several agriculture-fields were taken over by the housing developer and slowly changed the landscape of the Ciburial environment. This period became the starting point for the developer to persuade the villagers to sell their land for other purposes especially in 1996 – 1998, where the world financial crisis became the turning point for the economic crisis in Indonesia. Agriculture sector was badly hurt and the production cost in agriculture, i.e. fertilizer and fossil fuels, was not equivalent to the cheap price of the agricultural products. Hence, many farmers in the villages sold their land to the developer and urban-dwellers. Due to such action the recent survey shows that the agriculture land and hard wood's forest only left about 100 hectare.

In actual facts, this village has a special and potential natural character. Because of its hilly topography and location together with its panoramic view to Bandung city which is accessible at any angle from the village to a through, clear and beautiful view, more and more extreme hilly slope were acquired. Hence, it attracts the urban dwellers from Bandung to build their villas and bungalow which functions as week-end retreat. To cater for these week-end urbanites, several café and restaurant also been built even at the extreme slope (more than 40%). New buildings and man made structure are taking over once the hardwood forest, agriculture and plantation-fields without giving due respect to the existing environment and ecologies.

## 5.0 FINDINGS

### 5.1 Micro-temperature Change

Lost of green space and forest in certain areas significantly triggers an increase in micro-temperature. Plants, especially large crown trees are functioned as sun's buffer through to ground surface by forming shadow. Besides, through photosynthesis process, plants help to absorb carbon dioxide gas produced by motor vehicles, factories and services from the buildings. The increased in motor vehicles also led to the clearance of land for road expansion and also an increased in the property market. The greener space is decreasing tremendously.

Another factor that contributes to an increase in micro-temperature is human's activities. Many of the new built-environments are fabricated from artificial or composite materials such as:



iron, zinc, glass and concrete. Basically these materials have an effect on heat absorption from the sun that is reflected from the roof surface or other metallic materials on the site. The heat discharging process will influence negatively to the environment. If the processes are taking place during the day, the surface area of the materials will conduct heat from the sun and the process will have an adverse effect on the micro-temperature especially from the materials used on the buildings. The surface of the materials also influenced the discharge of the heat in the surrounding. Textured surface does not reflect the heat and on the contrary slicked surface has a stronger reflection. These characteristics are commonly found in the metal decking which are widely used by the inhabitants.

The findings through observation in several areas in Desa Ciburial also shows that most of the new buildings built in an ex-agricultural - fields did not leave any space for replanting of trees as a trade off to replace the green space. The owner of the building optimizes their land to accommodate their needs. As a result the BCR (Building Coverage Ratio/floor area ratio) is high without any attention to ecological environments. Furthermore most of the building materials were mainly plastered brick wall, metal decking and ceramic roof tile. Although, each building does not contribute significantly to an increase in micro-temperature but the accumulative number seriously contribute an increase in the micro-temperature. Evidently the increase in micro-temperature in Desa Ciburial was recorded from the data available at the Climate and Geophysical Department in Bandung. After a period of 20 years the micro-temperature in this area has been increased to about 5 degrees Celsius. In 1980 a mean day time temperature was only 25 degree Celsius; however by the end of 1990 there is an increase to 30 degree Celsius.

The increase of micro-temperature can be reduced by active participation of the inhabitants by planting more green space specifically trees to replace the previous cut trees in certain area. Tall trees will provide canopy and help to reduce the reflection and emission of heat from the building and built environment materials. The increase of vegetations also help to absorb carbon dioxide from the environment. However, there should be a guidelines for the application of building materials and the usage should be chosen selectively; the aesthetic objectives and the function should be balanced by the ability of the materials to reduce the reflection and emission effect of the heat.

## 5.2 The Increase of Run-off Water

Generally the amount of surge of run-off water is influenced by the ability of soil to soak up. If the soil can absorb large amount of run-off water, hence, the quantity of water to be drain down can be reduced. The ability of soil to absorb water is influenced by the soil type and the condition of its surface.

According to *AMDAL Wilayah Inti Bandung Raya Bagian Utara 1995* (Environmental Impact Analysis in the Core of North Bandung), Cidurian which is located in Desa Ciburial is one of the several drainage system serving the Ciwangi hill, Ciburial hill and Cimenyan hill. During rainy season, this river naturally served as discharge flow for the run-off water in large quantity to the Southern part of Bandung. However, large amount of water collected in Desa Ciburial area is flow down and accumulated to Cidurian River. The soil type in Desa Ciburial is soft with its upper layer composed of very hard rock. Sedimentary rock cannot absorb water and only the soft soil in upper layer. Since Desa Ciburial topography is hilly and the ability to absorb water is limited, so the surface water will flow down to Cidurian and Cikapundung. If the soil's surface became barren and the run-off water flow down in large quantity, thus it will lead to soil erosion.

The data from the council shows that the land area of Desa Ciburial has been covered by buildings and paved by concrete to almost 62%. In addition, many of the trees and green area has been chopped which was basically served as a protection and maintain the equilibrium of the soil. Hence, the increase in the quantity of run-off water in the river will accumulate as ragging torrent in Bandung city area which is situated at the lower land in the southern of Desa Ciburial.

### 5.3. Waste Water

The increased number of inhabitant as a consequence of land conversion in Desa Ciburial will induce the increase of clean water consumption and waste water discharge from new settlement. Most of the drainage systems in this area are openly channeled to Cidurian without any treatment process. Some of the waste water were absorbed to the surface and large quantity are flowing down as run-off water to the river. It is observed that the drainage system already result in the problems although there is a need to investigate the result by a proper research. The result from the interview with the villagers shows that there is an indication in the colour change of the water and most of the time the clear water of Ciburial became murky and lost of biological's biodiversity i.e. fresh water fish.

### 6.0 CONCLUSION AND RECOMMENDATIONS

Any new addition of structure to the built environment without taking consideration to the natural character and ecological characteristics of the local context will evoke a nuisance on the equilibrium of the natural systems. Land conversion which has been examined in Desa Ciburial showed the negative impact to the environmental sustainability i.e, micro-temperature change, an increases of run-off water in large quantity, and an increases of waste-water from the new buildings. To improve the ecological and environmental damaged in Desa Ciburial, there is a need to concern for several actions to restore the environmental equilibrium. There are several recommendations which are related to an effort for the improvement of Desa Ciburial:

- Establish the BCR standard.  
Will confer a space in soil's surface to absorb water and reduce the flow of run-off water to the river.
- Planting Trees in the yard.  
It is an obligation for the owner to plant one tree for every 20 square meter of their land.
- Prohibition the felling of trees.  
Special attention should be given to the trees which are located at the extreme slope.
- Prohibition to cover the soil surface by using water-proofed materials.
- Prohibition to build on the extreme slopes of 40% or more.
- The usage of building material which can reduce heat reflection, as an effort to reduce an adverse effect on the micro-temperature.

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#### Author's Biodata

##### **Bambang Karsono**

##### *Education Background:*

- M.T. (Master of Technique) in Landscape Architecture, Institute Technology of Bandung (ITB), 2005.
- Bachelor of Architecture, Institute Technology of Medan (ITM), 1999.

##### *Working Experienced:*

- 2008, assigned as Architect on designing Medical Faculty Building, and Campus III of University Prima Indonesia, Medan – Indonesia.
- 2008, assigned as Project Architect at PT. Free Port Consultant. Project: Masterplan of Blang Kolam Leisure Place, North Aceh – Indonesia.
- 2008, architect on designing single house 465 sqM, Medan – Indonesia.
- 2007, assigned as Project Architect on master-planning of Government and Indonesian Legislative Assembly Complex in Samosir State, North Sumatera – Indonesia.
- 2007, Project Architect at PT. Citra Diecōna Consulting Engineers. Project: Housing Design (The Soeltan Palace), Perbaungan, North Sumatera – Indonesia.
- 2006 - 2007, assigned as architect at PT. Seni Bina Konsolindo. Project: Survey Investigation and Design on Revitalization and Rehabilitation PUSKESMAS and health facilities in Nanggroe Aceh Darusalam after Tsunami disaster, BRR Programmed.
- 2006, assigned as Project Architect at PT. Free Port Consultant. Project: preliminary design of General Hospital, located in Lhoksukon, North Aceh
- 1994-recent time, free lance architect at several single and private houses in Medan and Lhokseumawe.
- 1993-1994, assigned as Assistant architect at PT. Pancaranjang Pratama, Medan - Indonesia



**Assoc. Prof. Dr. Julaihi** is a lecturer in Architecture Department at the School of HBP. He is also a chairman for Post Graduate Program and a coordinator for Housing Program at the School of HBP. He graduated with a B.Sc (Arch. Studies) and B. Arch (NAAB) from Washington, Master of Architecture (Community/Urban Design) from Kansas and Ph.D. from New Castle. His specialisation include building design especially commercial complexes and mixed development. He also specialise in the field of Community and Urban Design and Housing Studies.