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Suitability Analysis of Green Open Space (Gos) Model Based On Area Characteristics in Kupang City, Indonesia

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----------**ABSTRACT**----------
Appearing of any exotic species at the urban green open space (GOS) is due to the insufficient informations about vegetation suitability for the GOS . This study aims to improve GOS quality that combined the GOS function, GOS model, and location suitability of GOS with any local vegetations into the optimal location of GOS. This study involved a descriptive analysis to determine characteristics of GOS based on local area characteristics at the Kupang city. This study also applied the analytical hierarchy process (AHP) to determine the priority of GOS development based on the GOS function, GOS model, and priority location; analysis of the coefficient ideal-rating (CIR) to evaluate suitability of local vegetation with a GOS function, GOS model, and priority location; the GOS modelling to design the priority location which is suitable with the GOS model and GOS function combined with any local vegetations. Results show that priority location for GOS development based on the ecological functions are the Frans Seda Street, Oebobo Kupang-Indonesia district, which consists of a shading tree (Blackboard tree, Asian palmyra palm and Siamese senna) and any ornamental species (Crinum lily, shoe flower, oleander and snake plant).

KEYWORDS: *GOS, Analytical Hierarchy Process (AHP), the Ideal - Rating Coefficient (IRC)*

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I. INTRODUCTION

The term of Green open space (GOS) has long been introduced into the world of environment, planning, architecture, agriculture, forestry and various other disciplines (Irwan, 2005). Guidelines of the GOS development in urban areas, confirmed that in improving quality of life in urban areas that include earth, water, space and property which contained therein, it is necessary to maintain and develop any green open spaces (Regulation of the Public Work Ministry, 2008; Krisdianto, Soemarno, Udiansyah, Bagyo Januwiadi, 2012). As part of the GOS, vegetation is very useful in modifying quality of urban environment, which is any aesthetical improvement, erosion control, groundwater preserve, air and noise pollution reduce, improving urban environmental comfortable, wastewater control and fouling odors (Regulation of the Public Work Ministry, 2008; Ferry Andriono, Imam Hanafi, Bagyo Yanuwiadi, and Soemarno, 2013). However, in reality the majority of GOS development are based on land area and the amount of vegetations, regardless any functions and characteristics of vegetation that should be adjusted with the location characteristics. This has led entrying of any exotic spesies into the GOS. In addition, the GOS location began to change due to the various buildings as an impacts of economic development ('Red'), residential development ('Yellow') and industry development ('Grey') (Wahyudi, 2009). Degradation of the urban GOS shows that the main problems in the urban GOS are not merely a planning problems, but multidimensional problems (Wang Xiao-Jun. 2009).

Kupang is the capital city of East Nusa Tenggara province, Indonesia, and any development activities have created a continous changing of the GOS pattern duting the last few years and it results in any scarcity of the GOS in supplying any urban ecological services (Regional Spatial Plan of Kupang City, 2010). Therefore in anticipating the GOS scarcity in Kupang city, local government provides GOS areas in order to balance urban land development (Regional Spatial Plan of Kupang City, 2010). Development of the GOS in Kupang City only based on the amount of vegetations, and selection of vegetation is still prioritizing any aesthetical values, without considering the characteristics, types and other functions of vegetation; whereas vegetation on any locations suggested the different functions (Purmonohadi, 2006). The purpose of research is to improve quality of GOS through adjustment of the suitable function, appropriate model and the priority of location in accordance with any local vegetations.

II. RESEARCH METHODS

Field research was conducted in August 2012 - December 2012. Collection of primary data was done by direct field observations which took place at GOS locations, Kupang city , and it represented the GOS conditions and its characteristics associated with the GOS model, GOS function and type of vegetation. Besides that the perceptional survey was performed involving respondents selected by the purposive sampling method (Supranto, 2001). Respondents involved in AHP method were 15 experts, consist of 5 people from local government i.e. Head of the Regional Development Planning Board of Kupang City, head of the Housing and Urban Spatial office, Head of the Environmental Impacts Control Division in the Management Board of Regional Environmental Impact Control of Kupang city, Head of the Regional Forestry and Agriculture Office, Staff of the Regional Secretary of East Nusa Tenggara Province. Key person of the informal leader of urban community was Haji Ustad Amir Kiwang. Keyperson from mass-media was the chief of engineer division of the Kupang Television . The three academic key-persons, namely agriculture lecturer at the State University of Nusa Cendana Kupang, environmental engineering lecturer of the National Institute of Technology Malang, head of engineering planning and urban areas in the National Institute of Technology Malang. The two environmental researchers in the Indonesian Institute of Sciences (LIPI), urban sociology researchers in the Indonesian Institute of Sciences (LIPI). The three persons from the consulting institutions were director of the engineering planning consultant, landscape architecture expert, and director of the layout consulting division. Deployment questionnaire aims to determine the development priority of the GOS in the Kupang city. The secondary data was obtained from the local government institutions , these data in the form of administrative boundaries in the Kupang City, location of the GOS in the Kupang City, and any local vegetation types.
Methods of data analysis are :

1. Qualitative-descriptive Analysis (Burhan, 2008); to evaluate characteristics of GOS based on location properties in Kupang city, functions of GOS (ecological, social, economis, and aesthetical functions), GOS model (Area model, Node model, and Path model), and priority suitable location of GOS.
2. Analytical hierarchy process (AHP) (Saaty, 2002); to analyze priority of GOS development based on the GOS functions (ecological, social, economis, and aesthetical functions), GOS model (Area model, Node model, and Path model), and priority suitable location of GOS.
3. Analysis of the Ideal-Rating Coefficient (IRC) (Hakim and Utomo, 2008); to evaluate suitability of any local vegetation based on the GOS functions (ecological, social, economis, and aesthetical functions), GOS model (Area model, Node model, and Path model), and priority suitable location of GOS.
4. Analysis of the GOS model (Hakim, 2006); to design the GOS based on the GOS functions (ecological, social, economis, and aesthetical functions), GOS model (Area model, Node model, and Path model), and priority suitable location of GOS whinch is combined with any local vegetations.

III. RESULTS AND DISCUSSION

In this study were taken five samples representing the GOS locations, GOS conditions, and GOS characteristics in the Kupang City. There are five GOS of area model, five GOS of node models, and five GOS of path models. Description on each GOS locations, are presented below:

3.1. The Area Model Of GOS

Location 1 is The Sasando Park, it is located in the Kelapa Lima Sub-District, Kelapa Lima Village: this urban park is one of the Kupang city landmark, it serves as an expression of local culture and identity of the Kupang city, it is marked by the sasando statue which is a native musical instrument of the East Nusa Tenggara. Vegetation consists of eleven evergreen species, during the dry season these spesies remain alive and does not shed their leaves, the GOS area about 2.24 Ha.

Location 2 is the Mongonsidi area, it is located in the Kelapa Lima Sub-District, Kelapa Lima Village: GOS has not been used optimally, vegetation are not well maintained and suggest the wildy growth. Vegetation consists of five species, trees are not arranged, in the dry season plants remain alive but shed their leaves, the GOS area about 3 Ha.

Location 3 is the DTKP green open space based on the local government regulation No. 07 /2000, it is located in the Kelapa Lima Sub-District, Kelapa Lima Village: this GOS area about 1.02 hectares (Ha), it is not functioning optimally, it is characterized by tree that shed leaves during the dry season, so the atmosphere feels dry and hot, vegetation consists of five species of tree.

Location 4 is the Nostalgia Park, it is located in the Oebobo Sub-District, Fatululi Village: GOS model of urban parks that serves as a public space, urban recreational location and identity of the Kupang city. Vegetation consists of twelve species, tree are well arranged, in the dry season plants remain alive and do not shed their leaves, cool atmospheric air, GOS area about 45 Ha.

Location 5 is the Jogging Track Area, it is located in the Oebobo Sub-District, Fatululi Village: this model of GOS is a special area for jogging track. The sparse vegetations in the jogging track result in uncomfort atmospheric conditions, dry air and hot. Vegetation consists of five species of tree which are not arranged well, in the dry season these tree remain alive but shed their leaves, dry air and hot atmospheric condition, GOS area about 54 Ha.

3.2. The Node Model Of GOS

Location 1 is the Nefonaek Park, it is located in the Old City Sub-District, Nefonaek Village: GOS is still vacant land that has not been used and untreated. Vegetation consists of 5 (five) species, plants are not organized, in the dry season plants remain alive and does not shed leaves, arid atmosphere, GOS vast of 0.25 Ha.

Location 2 is the Mr. Erik house, it is located in the Old City Sub-District, Nefonaek Village: GOS is high density residential. The yard is untreated and no plants are grown as GOS yard crops. Vegetation consists of 2 (two) species, plants are not organized, in the dry season plants remain alive and does not shed leaves, arid atmosphere, GOS vast of 0.0015 Ha.

Location 3 is the Mr. Andik house, it is located in Kelapa Lima Sub-District, Kelapa Lima Village: GOS is medium density residential. Vegetations planted and arranged in the yard, so as to provide coolness and to beautify the look of the house. Vegetation consists of 7 (seven) species, plants arranged, in the dry season plants remain alive and does not shed leaves, cool atmosphere, GOS vast of 0.0060 Ha.

Location 4 is the Oebobo Field, it is located in Oebobo Sub-District, Oebobo Village: around GOS there the ball field used by Kupang City community, especially the children and youth to play ball. The lack of vegetations and maintenance activities cause people to be less comfortable. Vegetation consists of 4 (four) species, plants are not organized, in the dry season plants remain alive and does not shed leaves, arid atmosphere, GOS vast of 0.25 Ha.

Location 5 is the Nefonaek Field, it is located in the Old City Sub-District, Nefonaek Village: GOS is close to the population and resident, GOS such as a basketball court and a football field are located side by side. Vegetation consists of 5 (five) species, plants are not organized, in the dry season plants remain alive but mengugurkan leaves, arid atmosphere, vast green space of 0.15 Ha.

3.3. The Path Model Of GOS

Location 1 is the Veteran Path, it is located in the Kelapa Lima Sub-District, Kelapa Lima Village: Vegetation consists of 11 (eleven) species, plants are not organized, in the dry season plants remain alive, deos not shed leaves, the atmosphere iscool, 1000 meters long.

Location 2 is the Inaboi Path, it is located in the Kelapa Lima Sub-District, Kelapa Lima Village: Vegetation consists of 4 (four) species, plants are not organized, in the dry season plants remain alive but shed leaves, arid atmosphere, 350 meters length.

Location 3 is the Sk Lerik Path, it is located in the Kelapa Lima Sub-District, Kelapa Lima Village: Vegetation consists of 2 (two) species, plants arranged, in the dry season plants remain alive and does not shed leaves, arid climate, path length 524 meters and 0.5 meters median path width.

Location 4 is the Eltari Path, it is located in the Oebobo Sub-District, Fatululi Village: Vegetation consists of 11 (eleven) species, plants arranged, in the dry season plants remain alive and does not shed leaves, the atmosphere is cool, 1.328 meters length and 10 meters median path width.

Location 5 is the Frans Seda Path, it is located in the Oebobo Sub-District, Fatululi Village: Vegetation consists of 4 (four) species, plants are not organized, in the dry season plants remain alive but shed leaves, arid climate, path length of 1000 meters and median width of 10 meters.

3.4. Priority Of The GOS Development In The Kupang City

After getting an overview of the characteristics and condition of GOS in the Kupang City, then performed the hierarchy process analysis of the GOS development priorities based on the function, the model and the location of GOS development. The AHP is one of methods to set priorities out of various options by using some criteria (multi-criteria). The AHP process is structurally and logically conducted. The three AHP stages in the priorities setting are:

1. Problem Decomposition
   Decomposition of research problem is GOS model based on the characteristics in the Kupang City.
2. Assessment to compare components of research problems
   These components (elements) consist of the GOS function, the GOS model and the location of GOS.
3. Synthesis of Priorities
   Synthesis of priority is to determine the priority of the GOS function, the GOS model and the location of GOS.

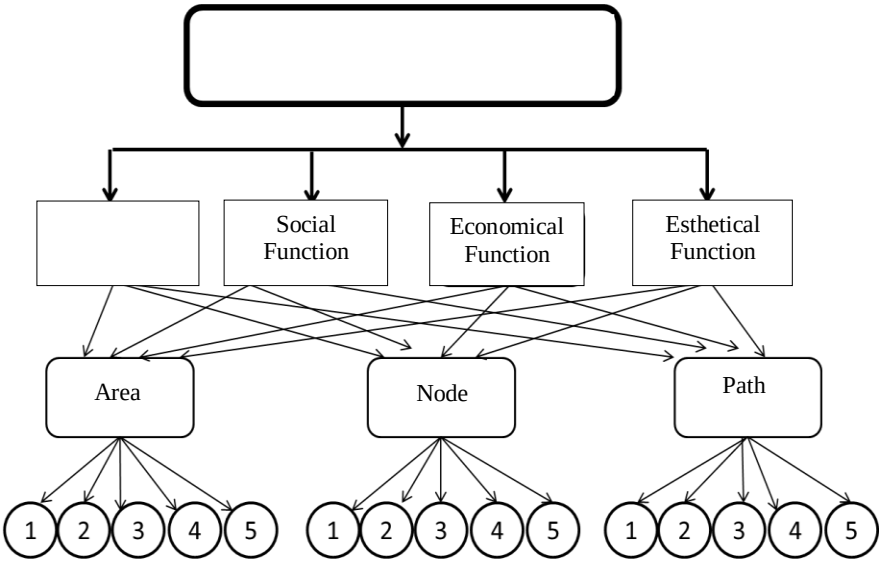

Fig 1. Hypothetical Structure of AHP Hierarchy

Table 1.Fundamental Scale of AHP (Saaty, 2002)

Intensity of Importance	Definition
1	Equally Important
3	Slightly more important than most other elements.
5	Clearly more important
7	Very obvious More Important
9	Absolutely more important
2,4,6,8	The midpoint between two adjacent decision values .
Reversed	If *i* activity has a higher value than *j* activity, then *j* has the reversed value when compared with *i*

The criteria used are (1) GOS functions: ecological, social, economical, and aesthetical function; (2) GOS models: Area, Node, Path, and (3) GOS location: five locations of GOS area models, five locations of GOS node models, and five locations of GOS path models. The AHP analysis is divided into two stages of analysis, namely:

3.4.1. Criteria Value Of Determinant Factor (GOS Function, Model, Location)

The criteria value of the determinant factors are determoined as follow: the AHP questionnaires are distributed to the respondents. Respondents of this study are Regional Heads of the Kupang city governmental institutions, which are the Head of the Kupang City Planning Office, the Head of the Environmental Impact Control, Head of Regional Forestry Office, Staff of the Governor's Office, Informal leaders (religious teachers), Engineer chief of the Kupang Television , Agricultural professor of the Nusa Cendana State University, Environmental Engineering professor of The National Technology Institute, Head of Urban and Regional Planning Department of The National Technology Institute, Urban sociology researcher of the Indonesian Science Institute, Expert of the Consultant Institutions on the Urban planning and Landscape architecture, expert on decision-making processes of urban GOS development. The perceptions of these respondents are considered valid, respresentative and accurate. Data are analyzed by using the comparison paired method, i.e between criteria, between sub-criteria, and consistency test. Calculation of the consistency index used these following formula (Saaty, 2002):

1. Wi = $\sqrt[n]{ai1xai2xai3 \dots xaij}$
   Wi = Principal eigenvector components of each line
2. Xi = $\frac{Wi}{\Sigma Wi}$
   Xi = Eigenvektor (local priorities)
3. λmax = Σaij Xj
   λmax = Max Eigenvalue

4. IK = (λmakx – n) / (n – 1) ,syarat IK ≤0,1
   IK= Consistency index (CI)

After getting calculation results of determinant criteria between each respondent, then average priority value of all respondents are determined. The priority value of average of function criteria, model and location are presented in Table 2 and Table 3.

Table 2. Average Priority Value For The GOS Functions and GOS Model

GOS Functions		GOS Models	
Ecology	0.40	Region	0.34
Social	0.23	Node	0.23
Economy	0.12	Path	0.43
Esthetic	0.25		

Table 3.Average Priority Value For The GOS Locations

GOS Locations					
Region 1	0.16	Node 1	0.17	Path 1	0.24
Region 2	0.15	Node 2	0.09	Path 2	0.18
Region 3	0.12	Node 3	0.12	Path 3	0.15
Region 4	0.23	Node 4	0.31	Path 4	0.16
Region 5	0.34	Node 5	0.31	Path 5	0.26

Based on the priority value of the determinant factor (GOS function, model, and location), then it is multiplied by the weight of each respondent to get the final result of the AHP analysis, it is the priority of GOS.

3.4.2. Analysis Of Respondent Weight

Steps in the respondents weight analysis are: (1) selecting respondents, (2) grouping respondents, (3) describing any competencies and experiences of the selected respondents in relation to the urban GOS, (4) assigning the weight of institutional and personal respondents in accordance with their competencies and experiences in relation to the urban GOS; (5) determining degree of competencies of each respondent by using the 5-level weights, i.e. 5, 4, 3, 2, and 1, (6) assigning the weight for each respondent which involve in decision making on the GOS development in the Kupang city.

3.4.3. Grouping Respondents and The Weight Of Each Respondent

The weight of respondent from Governmental offices: (1) Head of BAPPEDA = 5, (2) Head of Urban and Regional Planning = 5, (3) Head of Division of Environmental Impact Control BAPEDALDA = 5, (4) Head of the Forestry Office = 5, (5) The Governor's Office staff = 5. The weight of Community Leader: Haji Ustad Amir Kiwang = 2. The weight of Mass Media: The Head of the Kupang Television = 2. The weight of Academic staffs: (1) Agricultural Lecturer of State University of Nusa Cendana = 4; (2) Environmental Engineering Lecturer of National Institute of Technology = 3; (3) Head of Department of Urban and Regional Planning of the National Institute of Technology = 4. The weight of Researchers: (1) Environmental Researcher of the Indonesian Institute of Sciences = 3, (2) Researchers in the field of urban sociology of The Indonesian Institute of Sciences = 3. The weight of Consultant: (1) Director of Regional Planning Consultant = 4; (2) The landscape architecture expert = 2; and (3) Director of Urban Spatial Planning Consultant = 3.

The Weight of 5: Respondents Absolutely involved in decision making processes, it means that respondent capable to give consideration "should not be", "should be" , and this is the main requirement in decision making of GOS development. The Weight of 4: Respondents Highly involved in decision making processes, it means that respondent is considered very involved in decision-making of GOS development. The Weight of 3: Respondents Obviously Involved in decision making processes, it means that respondent is considered definite involved in decision making of GOS development. The Weight of 2: Respondents Involved in decision-making, it means that respondent is considered have any role in decision-making of GOS development. The Weight of 1: Respondents have a little involvement in decision making, it means that respondent is considered not influential or somewhat influential in decision making of GOS development.

3.4.4. Priority Analysis

From the priority calculation of the determinant factor and assigning the respondent weight, it is determined the priority of GOS development in the Kupang city. Results of the priority analysis are presented in Table 4 and Table 5.

Table 4. The Priority Of GOS Function and Model

GOS Function		GOS Model	
Ecology	22.00	Area	18.70
Social	12.65	Node	12.65
Economic	6.60	Path	23.65
Esthetic	13.75		

Table 5. The Priority Of GOS Locations

GOS Locations					
Region 1	8.80	Node 1	9.35	Path 1	13.20
Region 2	8.25	Node 2	4.95	Path 2	9.90
Region 3	6.60	Node 3	6.60	Path 3	8.25
Region 4	12.65	Node 4	17.05	Path 4	8.80
Region 5	18.70	Node 5	17.05	Path 5	14.30

Based on the priority value, it can be suggested that priority of GOS development in the Kupang city are more emphasized on the ecological functions, the Path model of GOS, and the priority location for GOS development is the Path 5 , i.e. The Frans Seda Street located in the Oebobo Sub-District, Fatululi Village, Kupang city.

3.5. Analysis Of The Coefficient Of Ideal – Rating (CIR)

This analysis can be done in selecting and determining any local vegetation suit with the GOS function, GOS model and GOS location; it is based on the match of the plant characteristics into the GOS function. Providing the GOS is not only in terms of land size and amount of vegetations, however it should be evaluated suitability of vegetation characteristics and its functions. In order to optimize their benefits, development of GOS should consider any local area characteristics which suit with the local vegetation functions, it is purposed in improving quality of urban GOS.

According to Judge and Utomo (2008), steps in the CIR analysis are: (1) Identification of existing local vegetation in the Kupang city based on taxonomy classification, morphology, benefits, ecology, reproduction and habitat; (2) Grouping existing local vegetation based on their functions. The local vegetation could be grouped into 6 groups according to their functions, such as a shade tree, staple food crops, fruit trees, ornamental plants, vegetables and herbs, and medicine plants; (3) suitability evaluation of vegetation according to the GOS model and GOS location, i.e the green belt of the street (pathway), in which the suit plants are the shade tree and ornamental schrubs; (4) Create a matrix based on the Planning Procedures of Street Landscaping Techniques Number 033/t/bm/1996, to determine the shade tree and ornamental schrubs which are suitable with the GOS function, GOS model and GOS location; (5) create a matrix based on the Ministry Regulation (Nomor 05/prt/m/2008) about the GOS management in urban area, to determine the shade tree and ornamental schrubs which are suitable with the GOS function, GOS model and GOS location; (6) justification of any selected vegetation based on their requirement in relation to GOS development (Gold, 1986).

Based on field identification which is supported by secondary data, local vegetation in the Kupang city consists of 23 species of shade tree, one species of food crop, sixteen species of fruit crops, fifteen species of ornamental schrubs, eight species of vegetable and herbs, and five species of traditional medicinal plants (Regional Office of Agriculture and Forestry, 2012). Due to the GOS model and location selected is path (urban street), only the shade tree and ornamental schrubs will be matrixed based on The Planning Procedures of Street Landscaping Acts No. 033/t/bm/1996 and The Public Work Ministry Acts No. 05/prt/m/2008 to determine the suitable plants for the selected path location, that is the Frans Seda Street.

Table 6. The Recommended Shading Tree

Road Landscape No. 033/t/bm/1996	Regulation of Public Work Minitry No 05/prt/m/2008	Correlation Results
Blackboard tree	Siamese senna	Siamese senna
Asian palmyra palm	Blackboard tree	Blackboard tree
Siamese senna	Asian palmyra palm	Asian palmyra palm
Cotton tree	Flamboyant	Mango
Coconut tree	Gliricidia tree	Avocado
Ornamental palm	Mango	Jambolan plum
Mango	Moringa tree	
Avocado	Avocado	
Jambolan plum	Lac tree	
Jujube plum	Ambarella plum	
	Mahogany	
	Watery rose apple	
	Jambolan plum	

Road Landscape No. 033/t/bm/1996	Regulation of Public Work Minitry No 05/prt/m/2008	Correlation Results
	Tamarind tree	
	Tropical almond	

Table 7. The Recommended Ornamental Plants

Road Landscape No. 033/t/bm/1996	Regulation of Public Work Ministry No 05/prt/m/2008	Correlation Results
Yellow allamanda	Maidenhair fern	Yellow allamanda
Madagascar periwinkle	Yellow allamanda	Crinum lily
Glory bower	Crystal Anthurium	Shoe flower
Crinum lily	Bougainvillea	Oleander
Shoe flower	Crinum lily	Snake plant
Oleander	Shoe flower	
Snake plant	Jungle flame	
	Oleander	
	Snake plant	

Results of the matrix correlation analysis suggest that there are six shade tree and five ornamental schrubs which are suitable with the selected paths, namely Siamese senna, Blackboard tree, Asian palmyra palm, mango, avocado, Jambolan plum (shade tree); and yellow allamanda, crinum lily, shoe flower, oleander, snake plant(ornamental schrubs). The researcher justification on the selected vegetations resulted in three shade tree, namely Siamese senna, Blackboard tree, Asian palmyra palm; and four ornamental schribs, namely crinum lily, shoe flower, oleander, and snake plant.

3.6. Evaluation Of Exotic Species

The main contributor in reducing and eliminating the native species are introduced species into the new environment. These new species can invade new habitats naturally, but exploration and cultivation by human beings can dramatically increase the spread of these species. Species introduced into the environment by human action are called exotical species, alien, or non-native species (Bolitzer and Netusil, 2000). Exotical species can be classified into two categories, namely invasive and non-invasive spesies. Non-invasive exotical species usually come from outside the natural habitat but do not threaten the natural habuitat. The exotic species suggest the rapid grow outside their natural habitat, causing any disruptions and threat of damage to ecosystems, habitats and local species, as well as potentially destroying habitat (Tjitrosemito, 2004).

Based on the justification evaluation, there are seven species in the greenbelt of the roads, namely Siamese senna, Blackboard tree, Asian palmyra palm, Crinum lily, shoe flower, oleander, and snake plant.

1. ***Cassia siamea*** (Siamese senna), an exotic plant from Thailand and is non invasive. Siamese senna is frequently cultivated in mixed cropping systems, either as intercrops, crop the edges or wind barrier. This tree is planted as a shade tree in tea gardens, coffee and cocoa gardens. However, extensive roots can be potentially as major competitors in absorbing nutrients and water, so their planting should be done very carefully (Hossein, *et al.,* 2012). Siamese senna is planted as a shade tree in greenbelt of the roads and ornamental shrubs in urban park. Siamese senna has a high ability to absorb lead and reduce concentration of lead particles in atmosphere (Shirley, 2005). Siamese senna suggested any exotical values, especially the beautiful flowers, its flower included in the category of beautiful flowers (bright yellow and large), the trees are always beautiful green and durable wood (Directorate of Forest Seed and Plant, 2001) .
2. ***Alstonia scholaris*** (Blackboard tree), is native species in the west coast of India, Pakistan, Australia and Solomon. This exotic plant is non invasive. Blackboard tree included in the Cambodians, it preads in Indonesia covering an area of Java, Nusa Tenggara, Gorontalo and North Sulawesi (Sutomo and Dyan, 2005). Blackboard tree tolerants to a various quality of land and habitat, can be grown on a variety of soil conditions. Blackboard tree is widely used for reforestation because it is the evergreen tree, do not shed leaves, lush and widened laterally canopy suggest any comfortable effects (Soehardi, 2000). Blackboard tree is often planted in the homeyard near the fence or planted as an ornamental tree. This tree is very popular, many land developer used it as a "Icon Landscape", because Blackboard tree has a rod shape, texture, color, interesting branches and leaves character (Eye-catching). In landscape design, this tree can be easily combined with other plants and properly used in a broad landscape (Sutomo and Mukaromah, 2006). The ever-increasing utilization of Blackboard tree without balanced with sustainable management has decreased this species in nature to nearly threatened with extinction. According to Naiem (2001, in Prihaningtyas, 2008), the blackboard tree conservation has a high priority, because this tree has various benefits and high economic values. Blackboard tree is often utilized in traditional medicinal plants;

blackboard tree has proven suggest the significance benefit for human life, both in ecological, economic and socio-cultural benefits (Directorate of Forest Seed & Plant, 2001).

3. ***Borassus flabellifer*** (Asian palmyra palm) is a type of Asian palmyra palm (arecas) that grows in Southeast Asia and South Asia. Asian palmyra palm species adaptable in arid areas. Asian palmyra palmis native to East Nusa Tenggara and became the province's floral identity (Sari, 2001). People used all of part of Asian palmyra palm, from roots up to their fruits, therefore Asian palmyra palm is called the "tree of life". It has many ecological benefits as a shade and ornamental plants. Exotic values of Asian palmyrapalm plant lied on the accumulation of the large leaves that gather at the ends of rod and form a rounded canopy, every section of leaves look like the beautiful fan (Heyne, 1987).
4. ***Crinum asiaticum*** (Crinum lily), is a flowering plant of the Amaryllidaceae. It spreads in tropical and subtropical regions around the world from India to Southeast Asia, including Indonesia. Crinum lily has an exotical value, especially due to the large and attractive flowers, the flowers oftenly white or pink colour (Crewe, 2001). These plants beautify homeyard, path (urban roads), and urban parks. Therefore, the crinum lily are cultivated as an ornamental plant (Khalid, 2008). The crinum lily has benefits as traditional medicinal plant, it suggested any benefits as an analgesia and ekspectorant. This plant has long been used as traditional medicine for central nervous system depressant, it is used as a substitute pesticides as bactericides and virucides (Wardiyono, 2012).
5. ***Hibiscus spp***. (Shoe flower) is the Malvaceae shrubs originated from East Asia regions. This exotic plant is non-invasive. It spreads in tropical and subtropical regions around the world, including Indonesia. Their leaves capable to release oxygen into the atmosphere and absorb carbon dioxide and nitrogen substances from the atmosphere (Thompson, 2002). This plant widely cultivated as an ornamental shrubs, it is categorized as shrubs with beautiful flower that suggest any exotical values, especially in its trumpet-shaped flowers. Besides that, the dark-green leaves with a shiny surface and their jaggy leave margins are their accessory exotical values (Lestari and Kencana, 2008).
6. ***Indicum nerium*** (Oleander) is a woody shrub originated from East Asia and Western Europe regions. This exotic plant is non invasive. Oleander is an ornamental shrubs that is planted in homeyard, green belt on the street, and urban parks (Jim and Chen, 2003). Oleander shrubs are included in the category of beautiful ornamental plants that grow the exotical flowers (Wijaya, 2002). Oleander flowers flush alternately and durable, flushing up throughout the year continuously. Figure of lush plants with dark green ribbon leaves and flowers clustered look beautiful and in contrast to the green leaves. Oleander plants are easily augmented, and easy to cultuvate. This plant is also resistant to pests and diseases (Wijayakusuma and Hembing, 1994). Besides as an ornamental shrubs, Oleander also serves as a traditional medicinal plant. Several studies have shown that this plant has efficacy as anticancer, diuretic, herpes, anti-bacterial, anti-fungal, expectorant, and insecticides (Siddiqui *et al.*, 1997; Hembing, 1993).
7. ***Sansevieria trifasciata*** (Snake plant), this plant comes from the State of East Africa, Arab, East India, South Asia and Pakistan. This exotic plant is non invasive. Indonesian society has come to cultivate this plant for a long time ago (Lestari and Kencana, 2008). Sansevieria has developed into an important ornamental plant in the world. Sansevieria exotical value lies in the beauty performance of plants. Sansevieria is an ornamental plant with leaves that are textured beauty charm stiff and hard, grow upright with seedlings around the parent plant, not trunked, flowering and seed. This plant also charm lies in the combination of colors, models, motifs and leaf size (Heru, 2007). Sansevieria uniqueness is resistance to the growing media that do not require special treatment, can be grown with a low fertility media, high drought resistance, and adaptable under various temperature conditions (indoor or outdoor). Sansevieria including succulent plant, as it has leaves that contain a lot of water (Ayuk, 2009). Sansevieria has the high ability to absorb carbon dioxide and produce oxygen during the day and night periode. Sansevieria widely planted alongside a path (urban street) or greenbelt of the roads to reduce air pollution. NASA research results showed that Sansevieria can absorb carbon dioxide very effectively, and it can absorb volatile substances such as benzene, trichlorethylene and formaldehyde from the air (Tajima, 2003).

3.7. GOS Models Based On The Development Priorities In The Kupang City

Results of priority analysis of GOS development showed that the priority development of GOS in Kupang city is more emphasized on the ecological functions with the path model and its development locations on the sample of path 5 (five) precisely at Frans Seda Street located in the Oebobo Sub-District, Fatululi Kupang Urban Village. Analysis of the Ideal Rating Coefficient (IRC) are based on planning procedures of path landscape engineering 033/t/bm/1996. The Public Work Ministry Regulation No 05/prt/m/2008 showed that local vegetation which is suitable with the path locations are shading tree (Siamese senna, Blackboard tree, Asian palmyra palm) and ornamental plants (crinum lily, shoe flower, oleander, and snake plant).

The concept of landscape arrangement at Frans Seda Path is based on the existing conditions, i.e. utilization of the median (island) path and sidewalk. Existing conditions of Frans Seda Path suggest three separated medians (island) and they served as detour areas.

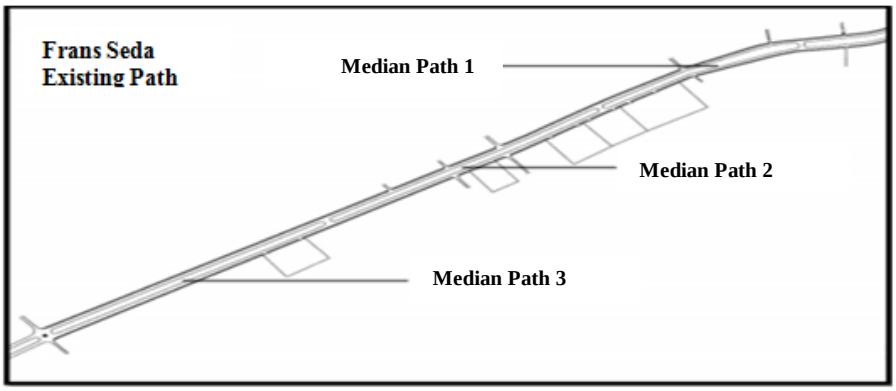

Fig 2. Frans Seda Existing Path

Arrangement of the selected plants in optimizing median areas are shoe flower and oleander planted in alternate patterns. While on the sidewalk are designed for Blackboard, Siamese senna and Asian palmyra palm combined with the shrub ornamental plants and snake plant. Road edges pattern are adjusted to the median distribution pattern, at the edge of the path that is parallel to the first median are planted the Siamese senna, on the edge of path running parallel to the median path 2 are planted the Asian palmyra palm, while on the path running parallel to the edge of the median path 3 are planted the Blackboard tree. For the arrangement of shrubs plant, i.e. crinum lily and snake plant, are planted on the side of the path as a fusion plant trees in Frans Seda Path division area on the edge of the path starting from Frans Seda (parallel to the path island-1) up to the edge of the path in the middle of the path Frans Seda, the snake plantis are planted; while Frans Seda from middle-way up to the end of the path Frans Seda (parallel to the island 3) are planted the crinum lily. More details can be seen in the following design concepts (Figure 3).

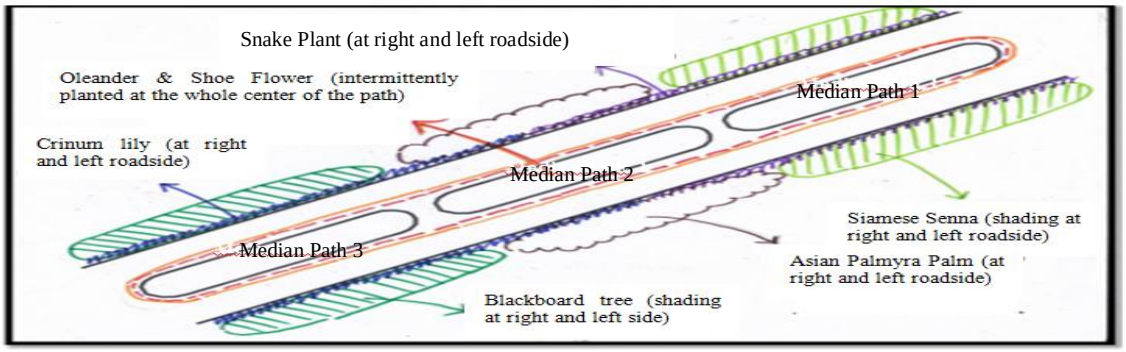

Fig 3. Design Of The Frans Seda Path

Landscape design of the Frans Seda Path is featured by any local conditions of Frans Seda Path which has three separate medians (islands), i.e. median (island) path 1, median (island) path 2, and median (island) path 3. The selected plants are arranged to utilize the median area (island) as the area for ornamental plants of shoe flower and oleander. Shoe flower and oleander are beautiful flower that have any values of exotic flowers (Lestari and Kencana, 2008). Based on the research results conducted by Aminzadeh and Afshar (2004), shoes flower and oleander has a function as noise barriers, vehicle lights barriers, wind breaker, and beautify the environment. In addition, shoe flower has another feature is the ability to produce oxygen and absorb carbon dioxide and nitrogen (Thompson, 2002). While Siamese senna, Asian palmyra palmand Blackboard tree placed on the left and right edge of the Frans Seda path, a type of green plant leaves (chlorophyll). Type of chlorophyll plant utilizes carbon dioxide (CO2) for the biochemical processes with sunlight assists to produce oxygen (O2) required for living creatures. Carbondioxide (CO2) as one of the greenhouse gases can be absorbed by these plants (Ali, 2003).

3.7.1. GOS Design of the Median (island) Path 1: The selected plants are arranged to utilize the median (island) area to plant the ornamental schrubs, i.e. shoe flower and oleander; the edges of path are planted by the shade tree, i.e. Siamese senna. Siamese senna is oftenly planted in mixed cropping systems, either as intercrops, the edges plant or the wind barrier plant. Siamese senna also known as a shade tree on the roadside and

ornamental trees in anu urban park. Siamese senna has a high ability to absorb lead and reduce lead particles in urban atmosphere (Shirley, 2005). The Siamese senna has an aesthetical values, especially the exotic flowers; Siamese senna flushes any beautiful flowers, bright yellow and large bunches of flower (Directorate of Forest Seed and Plant, 2001). The shrub ornamental plant on the median (island) is the snake plant placed on the both sides of the path in-between the Siamese senna trees.

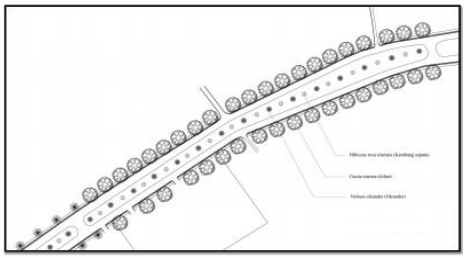

Fig 4. Layout of Frans Seda Median Path 1

Fig 5. 3D Layout of Frans Seda Median Path 1

3.7.2. GOS design of the Median (Island) Path 2: The selected plants are arranged to utilize the median (island) area as the location of ornamental plants of shoe flower and oleander, while the edge of the path is to plant the shading tree of Asian palmyra palm. Asian palmyra palm tree suggests any exotic values i.e. the similar fan leaves (Heyne, 2000). Asian palmyra palm are capable to absorb carbon dioxide and produce oxygen, as well as serving the path direction (Ali, 2003). Arrangement of the shrub plants in the median (island) 2, the crinum lily and snake are planted in both sides of the path as a fusion with Asian palmyra palm.

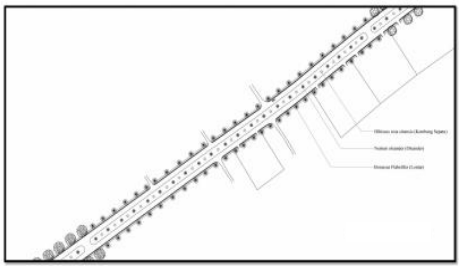

Fig 6. Layout of Frans Seda Median Path 2

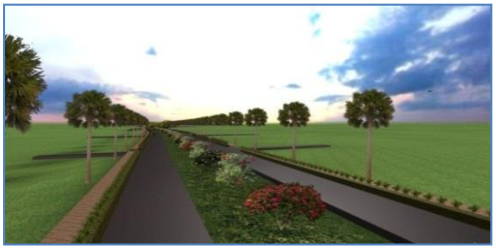

Fig 7. 3D Layout of Frans Seda Median Path 2

3.7.3. GOS design of the Median (Island) 3 Path: The selected plants are arranged to optimize the median (island) area as the location of ornamental plants i.e. shoe flower and oleander; edges of the path are planted the shading tree i.e. Blackboard tree. The Blackboard tree are oftenly planted in the homeyard near the fences, in the highway greenbelt, in the urban park, as the shading tree integrated with any ornamental plants (Ikbal, 2005). Blackboard tree are widely used for reforestation because of the kind of evergreen tree, do not shed leaves, the lush and widened lateral canopy suggests any cooling effects on urban air (Soehardi, 2000). The Blackboard tree are capable to absorb carbon dioxide and produce oxygen (Ali, 2003). The unique arrangement of the shrub ornamental plants on the median (island) 3 is the crinum lily are located on the both sides of the path in-between the Blackboard tree.

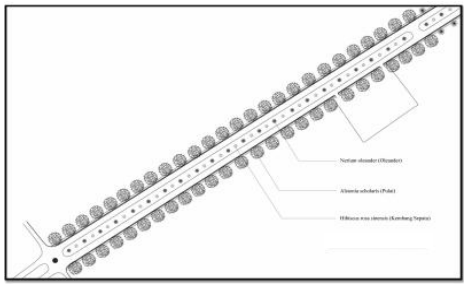

Fig 8. Layout of the Frans Seda Median Path 3

Fig 9. 3D Layout of the Frans Seda Median Path 3

IV. CONCLUSION

Three GOS models which characterized the Kupang city are the GOS model areas, GOS node models and GOS path models. Priority of GOS development in Kupang city which emphasis the ecological functions are the GOS model of Frans Seda path, Oebobo Kupang sub-district, with the shading tree (Blackboard tree,

Asian palmyra palm, siamesesenna) and ornamental herbs (crinum lily, shoe flower, oleander, and snake plant). Location design priorities in accordance with the GOS function and GOS model consist of three GOS path designs. These designs are well adapted to the local conditions of Frans Seda street which have three medians (island) as a separate line, each median (island) suggest the specific design and typical vegetation.

The city government attempts to provide the green open space (GOS) in order to balance the developed lands and the undeveloped lands and to create the comfort urban environment. However, there are still a lot of GOS in which the vegetation character and its function is unsuitable with the local characteristics; GOS are quite general, emphasis multi-function, the sparse vegetation becomes a limiting factor in determining quality of GOS. It should be considered that the GOS maintenance goals are the comfortable urban environment, the beautiful city and the suitable urban vegetation.

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