

# Factors Influencing Development of Green Open Space (GOS) as Ecological Function of Rainwater Absorbent in Rungkut District, Surabaya

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**Abstract**— The problem of the development of rapid development, And is not matched by the availability of adequate Green Open Space (GOS) as an ecological function of rainwater absorber, Causing floods / puddles in the District of Rungkut. There are several areas that are inundated in Rungkut District during heavy rain. GOS is part of green infrastructure in the form of interconnection network with function of preserving value and ecosystem and giving benefit to human. The development of GOS is influenced by many factors both from natural resources and human resources. Therefore, the purpose of this study is to analyze the factors that influence the development of GOS as an ecological function of rainwater absorber in Rungkut District, by looking at existing research benchmarks. This research uses descriptive qualitative analysis method, which then validated with delphi technique. Theoretical descriptive analysis is used in descriptive analysis to see the existing conditions and literature review. The result of descriptive analysis is then locked by delphi technique which is done to some stakeholders. These stakeholders present governance, civil society and private sector. Based on the result of the research, there are several factors that influence the development of GOS water absorbent. These factors are the factors of communication, human and financial resources, society, community environment, entrepreneur, GOS quality, building type, physical condition of road and parking lot, and geomorphological condition of city, and tourism.

**Keywords** : Rungkut District; Green open space; GOS of rainwater absorbent

## I. INTRODUCTION

Green Open Space (GOS) as an ecological function of rainwater absorbers is the green space of an area planted with trees and grass that can improve soil structure so that the rate of rainwater absorption can be maintained [1]. The presence of green space as a field capable of absorbing water into underground water carrier layers is necessary in a drainage system [2]. The GOS-supported drainage system is an environmentally sound drainage system.

Changes in the availability of GOS as an ecological function of rainwater absorber in supporting the development of Rungkut area as residential area, trade and services, causing GOS is not sufficient in creating environment free of floods / puddles, this can be seen from the occurrence of floods / puddles in 10 areas in Several kelurahan within the scope of Rungkut District [3]. The addition of water puddle occurred

from 2011 to 2015 relating to the area, length and height of water puddles that still slightly decreased, even no change at some point of standing water in Rungkut District until 2015. Point of standing water is in the wide range of 0.15 ha to 72 ha, the length of the water puddle 40 minutes to 120 minutes, and the puddle height of 4 cm to 50 cm.

The development of GOS associated with its function as a rainwater absorber is expected to be an alternative to reduce the existence of water puddles in the District of Rungkut in particular and the city of Surabaya in general. From this problem, this research is focused to formulate factors influencing GOS development as ecological function of rainwater absorber in reducing environmental degradation in district Rungkut District, Surabaya City.

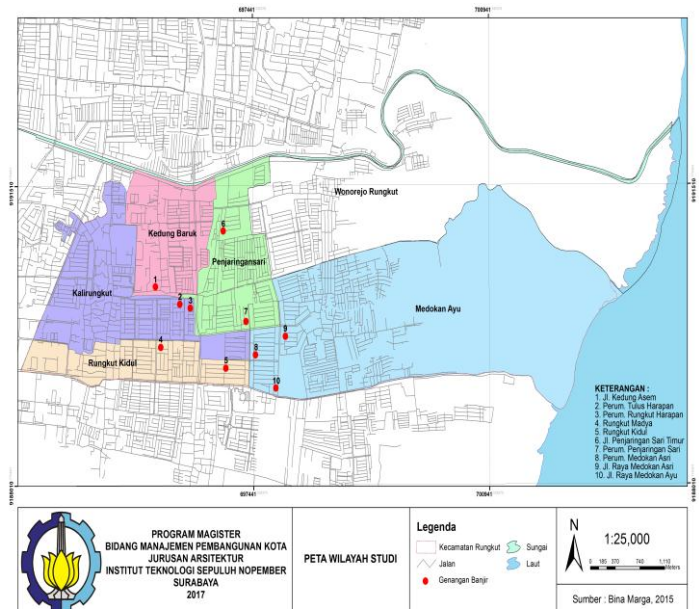


Fig. 1. Water Puddles Area in Rungkut District

## II. LITERATURE REVIEW

### A. Development of GOS Rainwater Absorber

A green open space with a specific function is determined by what plants grow in the green open space. GOS is an open space within which there are perennial woody plants with trees as the main flavoring plants and other plants (shrubs,

shrubs, grasses, other cover plants) as complementary plants and other objects as a function of GOS [ 4]. Vegetation and its supporting material as land cover have different infiltration capacities, in addition the ability of a land cover to absorb or drain the water depends on the run-off coefficient of each land cover [5].

### B. Factors of GOS Development of Rainwater Absorbers

Development of development makes the GOS a major issue that needs to be considered to find solutions to problem solving. The main issues of GOS availability and sustainability are: 1) The impact of negative impacts on non-compliance with the quantity and quality of green open space such as green space is not available, not functional, land fragmentation reduces land capacity and further reduces environmental capacity, land conversion and function; 2) Weak organization of GOS management; 3) There is still a lack of community or community participation; 4) Inadequate private involvement in the distribution of corporate social responsibility funds; 5) Limitations of urban land for GOS designation [6].

Implementation of a policy is influenced by Communications, Resources, Disposition, and Bureaucratic Structure. Communication is how information can be presented with clear, consistent, and well-informed delivery channels. Resources in a policy implementation consist of human resources and financial resources. While disposition is one of the critical success factors of the policy. In addition, the existing bureaucratic structure within a government agency can support the good implementation, namely clarity main tasks and functions and clarity standard operational procedures [7].

Factors supporting the development of GOS include government programs, budgets, human resources, the natural environment. While the inhibiting factors are the cooperation of various parties, human resource professionalism, and community responsiveness [8].

## III. METHODOLOGY

This research includes qualitative descriptive research, because it is more to write down what are the factors that influence the development of GOS [4]. The research factors obtained will be strengthened with the opinion of stakeholders in delphi analysis related to GOS development. Several methods of research analysis used in this study are:

### A. Analisa Stakeholders

Stakeholders analysis is based on the level of importance and influence. Stakeholders analysis of this research is to determine the parties that are most likely to be affected by influencing both positive and negative effects of a GOS development activity, which will determine what factors influence the development of GOS as an ecological function of rainwater absorber in Rungkut District.

Stages in determining stakeholders :

1. Identifying relevant stakeholders
2. Analyzing the interests and the potential impact of the existing problems of the respective stakeholders
3. Assessing the influence and significance of the respective stakeholders by weighting ranging from

no effect to the highly influential/important with a scale of 1 to 5

From the analysis, six stakeholders deemed important and related to the study was selected.

- Head of Sub-Division of Transportation and Depletion of Bappeko Surabaya
- Staff of Hygiene and Green Open Space Office of Surabaya City
- Head of Physical and Planning Section of Rungkut District
- Head of Physical and Planning Division of PT.YEKAPE Kota Surabaya
- Lecturer Department of Regional and Urban Planning, ITS Surabaya
- Community leaders in Rungkut Harapan housing

### B. Identification of GOS Development Factors

Theoretical Descriptive Analysis is used in conducting descriptive analysis, by looking at the existing conditions and the literature review on the development of the GOS of rainwater absorber. The theoretical descriptive analysis is used to identify factors influencing GOS development as an ecological function of rainwater absorber in Rungkut District.

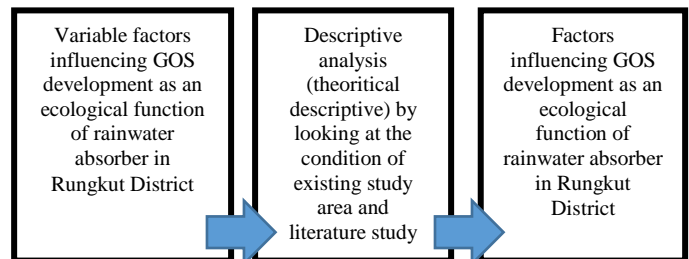


Fig. 2. Stages of Descriptive Analysis

### C. Formulation Analysis of GOS Development Factors

Factors obtained from theoretical descriptive analysis, then validated by delphi analysis. Delphi analysis is an iterative process designed to reach consensus among a group of experts on a particular topic [5]. Delphi analysis is used to get agreement of experts that have been determined from stakeholder analysis to know factors influencing GOS development as an ecological function of rainwater absorber in Rungkut District.

Stages of delphi analysis in formulating factors that influence GOS development as an ecological function of rainwater absorber in Rungkut District are:

1. Specification of issues that are issues that should be commented by the respondents, in this case the respondents can add research-related issues that fit the topic of research
2. Selection of respondents with stakeholders analysis that determines key actors in the research
3. Make a questionnaire
4. First round analysis analyzing the differences and inconsistencies used for the next questionnaire
5. Development of the next questionnaire
6. Analysis of 2 or 3 rounds which then prepare reports on various issues and options that arise and explain the conflicts that occur and the existing argument.

#### IV. ANALYSIS AND RESULTS

Green open space development is influenced by various factors that exist in the study area. To formulate what factors influence the development of GOS as an ecological function of rainwater absorber in Rungkut District, beginning with identification of internal factors.

##### A. Identification of GOS Development Factors

Theoretical descriptive is used in descriptive analysis by looking at existing condition of Rungkut District with literature review or theory related to GOS development based on internal factors obtained from literature review. Theoretical descriptive analysis can be seen in table 1.

TABLE 1. Theoretical Descriptive Analysis

No	Factors	Analysis Results
1	Communication	Communication will support the success of an implementation of government programs [6]. This factor has no effect because it has been applied in District Rungkut, but the communication is still not maximally accepted by the community as a manager of the program, so the purpose of a program can not be realized.
2	Human and Financial Resources	Good human and financial resources lead to the development of a good program [6]. This factor is influential, because the existing condition of some residential areas, trade and services has not provided the GOS according to existing rules due to financial limitations and lack of understanding from the owners of GOS.
3	Disposition	The attitude of the executor with commitment to the special program to be applied becomes the influence that needs to be maintained so that the program can run properly [6]. This factor has no effect, because the existing condition indicates a good disposition has been applied. However, the development of the GOS program has not been well implemented.
4	Structure of Bureaucracy	In a bureaucratic structure required the flow of work and program implementation, so that a program can run properly [6]. This factor has no effect, because the existing condition of the beneficiaries has not been able to understand and apply well the existing flow system.
5	Community	Community participation is related to the realization or absence of government programs well [7]. This factor is influential, because the community has many who understand the importance of cooperation with the government in the development of the program, but there are still not understand and no matter with the existence of the development program.
6	Community Environment	Community concern for the environment is often represented by a group of people in community form [7]. This factor is influential, because the cooperation provided by the community in the development of GOS of rainwater absorption is needed.
7	Entrepreneurs	GOS conservation efforts require private involvement, in this case private involvement is still minimal in the development of GOS [7]. Factors of entrepreneurs are influential, because with various types of existing activities, the cooperation of entrepreneurs such as property, managers of trade and services, education in land and financial provision greatly affect the development of GOS.

8	Relevant Government Agencies	Cooperation between government agencies is urgently needed for program or policy implementation [6]. This factor has no effect, because the government already has a clear regulation, but basically the participation of the local community more influence the development of a program.
9	GOS Quality	The rapid development shows the GOS both from the provision and management of inadequate in providing ecological rainwater absorbing function in Rungkut District. The condition of poor environmental carrying capacity in water absorption will cause flooding / water puddle [8], so there is need for improvement and development of water catchment area.
10	Types of Building	Increased wake land causes a decrease in GOS in water absorption [9], this factor is influential, since it is in accordance with the existing condition of rainwater absorption that is slow in its development due to the increase of building type and the increasing use of waterproof pavement inside.
11	Physical Condition of Road Cover and Parking Lot	This factor is influential, because based on the theory of the use of road cover and parking lot material with pavement [10] in accordance with existing conditions that many change the use of ground cover material pass water with waterproof material, so the ability of water absorption into the soil is reduced.
12	Urban Geomorphological Conditions	The level of soil permeability affects the soil in graduating water [6], then the existing condition with alluvial soil type is a type of soil that is not easy to pass water. This affects the development of GOS vegetation in Rungkut District.

Theoretical descriptive analysis results determine factors influencing GOS development as an ecological function of rainwater absorber in Rungkut District. Such factors as in table 2.

TABLE 2. GOS Development Factors

No	Factors
1	Communication
2	Human and Financial Resources
3	Community
4	Community Environment
5	Entrepreneurs
6	Green Open Space Quality
7	Types of Building
8	Physical Condition of Road Cover and Parking Lot
9	Urban Geomorphological Conditions

##### B. Formulation of GOS Development Factors

Delphi is very important in exploring and forecasting technology. Delphi technique evolved with the aim of making a discussion of experts without allowing the usual social interactive behavior in the discussion in general and the formation of opinions that impede each other's decision. Delphi techniques enable experts to systematically approve decisions from complex issues. Delphi analysis techniques are basically used to solve deficiencies that occur in conventional activities, such as difficult meetings [11].



TABLE 3. Results of Delphi Phase I (Exploration)

No	Factors	R1	R2	R3	R4	R5	R6
1	Communication	V	V	V	V	V	V
2	Human and Financial Resources	X	V	V	V	V	V
3	Community	V	V	V	V	V	V
4	Community Environment	V	V	V	V	V	V
5	Entrepreneurs	V	V	V	V	V	V
6	GOS Quality	V	V	V	V	V	V
7	Types of Building	V	V	V	V	V	V
8	Physical Condition of Road Cover and Parking Lot	X	V	V	X	X	V
9	Urban Geomorphological Conditions	V	V	V	V	X	V
10	Tourism Conditions	X	X	X	V	X	X

Information :

V : Agreed

X : Disagree\*

\*) If there are respondents disagree (X) then have not reached consensus and will be iterated

R : Respondent

Based on the exploration result in the above table, some factors have not reached agreement (consensus) and addition of tourism factor from respondent (R4), so that factors need to be done iteration stage.

The conclusion of phase I delphi (exploration) is as follows :

1. Communication, the agreement is achieved because with good communication will affect the understanding of the community as a party who received the impact and benefits of GOS development, and will later facilitate the development of GOS absorbent of rain water.
2. Human and Financial Resources, Some respondents disagree because they think the development of GOS is more dependent on government policy, not on society's ability in funding and management.
3. Community, Agreement is reached because the understanding and awareness of the community in the provision and management of GOS greatly affects the development of GOS.
4. Community Environment, an agreement is reached because the environmental community is a representative of the communities that participate in the monitoring and management of the existing GOS.
5. Entrepreneurs, agreement is reached because the participation of entrepreneurs is needed in the development of GOS, both from funding and management.
6. The quality of GOS, the agreement is achieved because the good quality of green open space in the fulfillment of land availability, benefits and functions will affect the development of GOS.
7. Types of Building, agreement is reached because the type of building will affect the area of land provided for GOS in the yard and outside the yard.
8. Physical Condition of Road Cover and Parking Lot, Some respondents disagree because the provisions of the material for the road cover have been arranged based on the strength of the material in holding the load of charge passing through it. Thus, it is not related to rainwater absorbing GOS.

9. Urban Geomorphological Conditions, Some respondents did not agree because the existing natural conditions can not be changed to follow the development of the GOS of the rainwater absorber. Urban activities are more influential on the development of GOS.

10. Tourism Conditions, the developer added the tourism factor due to the wonorejo reservoir that also influences the development of GOS of rainwater absorption indirectly in Rungkut District.

To get the consensus of the factors that have not reached consensus in stage delphi I, performed stage delphi II (Iteration I). The result of interview in stage I iteration can be seen in table 4.

TABLE 4. Results of Delphi Phase II (Iteration I)

No	Factors	R1	R2	R3	R4	R5	R6
1	Human and Financial Resources	V	V	V	V	V	V
2	Physical Condition of Road Cover and Parking Lot	V	V	V	V	V	V
3	Urban Geomorphological Conditions	V	V	V	V	V	V
4	Tourism Conditions	X	V	X	V	V	V

Information :

V : Agreed

X : Disagree\*

\*) If there are respondents disagree (X) then have not reached consensus and will be iterated

R : Respondent

Based on the result of iteration I in the above table, all factors have reached agreement (consensus), but tourism factor has not reached agreement (consensus), so that factor need to be done stage iteration II.

The conclusion of phase II delphi (iteration I) is as follows :

1. Human and Financial Resources, Agreement is reached because the understanding of the people in the management of GOS depends on the mastery of knowledge or information received. The ability of human resources in government also plays an important role in controlling the development of GOS, as well as the financial condition of a region and the community itself in the provision and development of GOS.
2. Physical Condition of Road Cover and Parking Lot, Agreement is reached because land cover selection can be utilized in handling water absorption problem. So in the development of GOS absorbed rain water is greatly influenced by the use of land cover materials, both roads and parking lots as GOS supporters.
3. Urban Geomorphological Conditions, Agreement reached because the type of soil, rocks and groundwater surface will affect the development of GOS both for the type of vegetation and rainwater control building that is applied.
4. Tourism Conditions, Some respondents disagreed because the policy on tourism development did not always support the development of GOS. Tourism agencies are different from GOS agencies.

To get the consensus of tourism factor which has not reached consensus in stage II delphi, done stage delphi III (Iteration II). The result of the interview at stage II iteration can be seen in table 5.

TABLE 5. Results of Delphi Phase III (Iteration II)

No	Factors	R1	R2	R3	R4	R5	R6
1	Tourism Conditions	V	V	V	V	V	V

Information :

V : Agreed

X : Disagree\*

\*) If there are respondents disagree (X) then have not reached consensus and will be iterated

R : Respondent

Based on the result of iteration II in the table above, tourism factor has reached agreement (consensus).

The conclusion of phase III delphi (iteration II) is as follows:

1. Tourism Conditions Factor, Agreement is reached because GOS development that is green open space as an ecological function of rainwater absorbent in District of Rungkut influenced by existence of demand about requirement of development of tourism sector. This is also by looking at the Wonorejo Reservoir which is currently known by the community as part of the GOS of rainwater absorber and natural attractions..

From the result of delphi stage III analysis that is Iteration II, got agreement among respondent to factors influencing GOS development as an ecological function of rainwater absorber in Rungkut District. All respondents stated that the factors that influence the development of GOS need to be considered in planning, managing and supervising the development of GOS of rainwater absorbent in Rungkut District, so GOS function as rainwater absorber can be realized in District of Rungkut to overcome the flood / water puddles.

Delphi analysis results formulate the factors that influence the development of GOS as an ecological function of rainwater absorber in Rungkut District, is as follows :

1. Communication
2. Human and Financial Resources
3. Community
4. Community Environment
5. Entrepreneurs
6. The quality of GOS
7. Types of Building
8. Physical Condition of Road Cover and Parking Lot
9. Urban Geomorphological Conditions
10. Tourism Conditions

## V. CONCLUSION

The conclusion that can be drawn from this research is that in Green Open Space development as an ecological function of rainwater absorber that can overcome or reduce the

occurrence of floods / water puddles in District Rungkut, influenced by many factors. Government policy factors, community conditions and GOS governance organizations, green open space factors, urban infrastructure factors, urban geomorphological factors and tourism can influence the development of the GOS. So in realizing the GOS that can serve as a good water absorber, these factors should be more concerned in the planning, management and supervision of its development.

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