THE AWARENESS AND IMPLEMENTATION OF URBAN GREEN INFRASTRUCTURE PLANNING IN MUKALLA OF YEMEN

BY

OMAR BAGAZI

A thesis submitted in fulfillment of the requirement for the degree of Master of Science in Built Environment

Kulliyyah of Architecture and Environmental Design
International Islamic University Malaysia

SEPTEMBER 2021

ABSTRACT

Green Infrastructure (GI) is a new term that aims to accomplish sustainable development. It is a platform to achieve the balance between environmental preservation and urban development as well as to achieve a set of economic, social, and ecological benefits. However, many countries suffering from a slowdown in GI implementation, especially developing countries. Therefore, this research aims to assess the level of awareness of GI implementation among practitioners in Mukalla city. To achieve the aim of this research, a quantitative research approach was adopted and the questionnaire was designed to contain three main sections. the first section contains a phrase for assessing awareness (knowledge, attitude, and behavior), the second and third sections contain phrases to clarify GI implementation (drivers, barriers, and solutions). The questionnaire was distributed manually to the agencies interested in planning and designing the urban area in Mukalla. The total number of completed questionnaires was 82. Descriptive Statistical and Inferential Statistics tools were used to analyze the data of this study. Regarding objectives 1 and 2, our results show that the level of GI awareness among practitioners in Mukalla city was low at $\bar{x} = 2.87$ and the factors gender and education had a significant effect (P-value < 0.05) on their awareness about GI. regrinding objectives 3 and 4 our results show that the main drivers of having GI in Mukalla are enhanced human health and human wellbeing. While the main barriers to GI implementation in Mukalla are financial constraints and lack of experience. Our result also shows that the best strategy to overcome financial constraints is to gain financial support from public sectors, while the best strategy to overcome lack of experience is to training the practitioners themselves. This research will provide the decision-maker with information about what is happening behind the slowdown of GI implementation. It will lead to more effort to raise the level of knowledge among practitioners. Moreover, this study will be a starting point and basis for other researches in the field of GI. In conclusion, we recommend for researchers conduct more scientific studies in the field of GI, especially in developing countries, as they are in urgent need of sustainable solutions to develop their infrastructure.

خلاصة البحث

إنّ مصطلحَ البنيةِ التحْتيةِ الخضراء هو مصطلحٌ جديدٌ يهدف إلى تحقيقِ التنميةِ المستدامة، إذ تُمثّلُ البنية التحتية الخضراء ركيزةً لتحقيقِ التوازنِ بين الحفاظِ على البيئة والتطويرِ الحضري، كما أنّها ترمي إلى تحقيقِ مجموعةٍ من الفوائدِ الاقتصاديةِ والاجتماعيةِ والبيئية. ولكن على الرغم من ذلك ثمةَ بلدانٌ عديدةٌ تعاني من تباطؤٍ في تنفيذ البنية التحتية الخضراء ولا سيما البلدان النامية؛ لذلك يهدفُ هذا البحثُ إلى تقييم مستوى الوعي بتنفيذِ البنية التحتية الخضراء بين الممارسين في مدينة المكلا. ولتحقيقِ هدفِ هذا البحث اعتُمدَ منهجُ البحث الكمّي، وصُمّمت الاستبانةُ بحيث تحتوي على ثلاثةِ أقسامٍ رئيسية: إذ يحتوي القسم الأول على عبارةٍ لتقييم الوعي (المعرفة والموقف والسلوك)، بينما يحتوي القسمان الثاني والثالث على عباراتٍ لتوضيحِ تنفيذ البنية التحتية الخضراء (الدوافع والعوائق والحلول)، ووُزّعَتِ الاستبانةُ يدويًا على الجهاتِ المهتمةِ بتخطيط المنطقة العمرانية وتصميمها في مدينة المكلا. وقد بلغ العدد الإجمالي للاستبانات المكتملة 82 استبانةً، وجرى استخدام أدوات الإحصاء الوصفي والإحصاء الاستدلالي لتحليل بيانات هذه الدراسة. ففيما يتعلق بالهدفين الأول والثاني، أظهرتْ نتائجنا أن مستوى الوعي بالبنية التحتية الخضراء بين الممارسين في مدينة المكلا كان منخفضًا عند $\bar{x} = 2.87$ وأن عاملا الجنس والتعليم كان لهما تأثيرٌ كبيرٌ على وعي الممارسينَ بمفهومِ البنية التحتية الخضراء (إذ كانت قيمة $P < 0.05$). وأما بالنسبةِ للهدفين الثالث والرابع، فقد أظهرتْ نتائجنا أنّ الدوافعَ الرئيسيةَ للحصولِ على بنيةٍ تحتيةٍ خضراءَ في المكلا هي تحسينُ صحةِ الإنسان ورفاهيتِه، في حين أنّ العوائقَ الرئيسيةَ أمام تنفيذ البنية التحتية الخضراء في المكلا تَمثّلتْ في القيودِ الماليةِ ونقصِ الخبرة. وتُظْهِرُ نتائجنا أيضًا أنّ أفضلَ إستراتيجيةٍ للتغلبِ على القيود المالية هي الحصولُ على الدعمِ الماليّ من القطاعاتِ العامة، وأنّ أفضلَ إستراتيجيةٍ للتغلب على نقصِ الخبرة هي رفدُ الممارسين أعينهم بالتدريب في هذا المجال. وسيزود هذا البحثُ صانِعي القرار بمعلوماتٍ عمّا يحدث جراء تباطؤ تنفيذ البنية التحتية الخضراء، وسيؤدي ذلك إلى بذلِ مزيدٍ من الجهد لرفع مستوى المعرفة بين الممارسين. وعلاوة على ذلك ستكونُ هذه الدراسة بمثابةِ نقطةِ انطلاقٍ وأساسٍ لأبحاثٍ أخرى في مجالِ البنيةِ التحتيةِ الخضراء. وفي الختام، نوصي الباحثين بإجراءِ المزيد من الدراساتِ العلميةِ في مجالِ البنيةِ التحتيةِ الخضراء ولا سيما في البلدانِ النامية؛ إذ أنّ هذه البلدان بحاجةٍ ماسةٍ إلى حلولٍ مستدامةٍ لتطويرِ بنيتِها التحتية.

APPROVAL PAGE

I certify that I have supervised and read this study and that in my opinion, it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Master of Science in Built Environment.

……..
M. Zainora Asmawi
Supervisor

……..
Lukman Hakim Mahamod
Co-Supervisor

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a thesis for the degree of Master of Science in Built Environment.

……..
Rustam Khairi Zahari
Internal Examiner

……..
Wan Nurul Mardiah Wan Mohd Rani
External Examiner

This thesis was submitted to the Department of Urban and Regional Planning and is accepted as a fulfillment of the requirement for the degree of Master of Science in Built Environment.

……..
Lukman Hakim Mahamod.
Head, Department of Urban and
Regional Planning

This thesis was submitted to the Kulliyyah of Architecture and Environmental Design and is accepted as a fulfillment of the requirement for the degree of Master of Science in Built Environment.

……..
Abdul Razak Sapian
Dean, Kulliyyah of Architecture and
Environmental Design

DECLARATION

I hereby declare that this thesis is the result of my investigations, except where otherwise stated. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at IIUM or other institutions.

Omar Bagazi

Signature  Date 5/10/2021

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

DECLARATION OF COPYRIGHT AND AFFIRMATION OF FAIR USE OF UNPUBLISHED RESEARCH

AWARENESS AMONG PRACTITIONERS TOWARDS URBAN GREEN INFRASTRUCTURE PLANNING IN MUKALLA CITY OF YEMEN

I declare that the copyright holders of this thesis are jointly owned by the student and IIUM.

No part of this unpublished research may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise without prior written permission of the copyright holder except as provided below

1. Any material contained in or derived from this unpublished research may be used by others in their writing with due acknowledgment.

2. IIUM or its library will have the right to make and transmit copies (print or electronic) for institutional and academic purposes.

3. The IIUM library will have the right to make, store in a retrieved system and supply copies of this unpublished research if requested by other universities and research libraries.

By signing this form, I acknowledged that I have read and understood the IIUM Intellectual Property Right and Commercialization policy.

Affirmed by Omar Bagazi

Signature

5/10/2021
Date

ACKNOWLEDGEMENTS

All the praises and thanks be to Almighty Allah, the most gracious the most merciful, who gave me the health, knowledge, courage, and patience to accomplish this research, and blessings be upon our Prophet Muhammad Sallallahu Alaihi Wasallam.

Acknowledgment is due to Kulliyyah of Architecture and Environment Design (KAED) and International Islamic University Malaysia (IIUM) for support of this research. I wish to express my deep appreciation to my supervisor Assoc. Prof. TPr. Dr. M. Zainora Asmawi and co-supervisor Asst. Prof. Dr. Lukman Hakim Mahamod for their remarkable guidance and strong and useful comments. I would like to thank all the people who helped me with the data collection and participated in the study. my appreciation is extended to all professionals in the Malaysian government and the people who deal with me as a citizen.

Acknowledgment also is due to Hadhramaut University and Hadhramaut Establishment for giving me the chance to acquire knowledge in Malaysia. I express my special gratitude and remain ever in debt to my family members (father, mother, wife, brother, and sisters). Their love, unlimited support, and encouragement have motivated me over the years.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATION

ANOVA	Analysis of Variance
CBD	Convention on Biological Diversity
EC	European Commission
ES	Ecosystem Services
GI	Green Infrastructure
GIS	Geographic Information System
H0	Null Hypothesis
H1	Alternative Hypothesis
IUCN	International Union for Conservation of Nature
KMO	Kaiser-Meyer-Olkin
LID	Low Impact Development
MEA	Millennium Ecosystem Assessment
NBS	Natural based solution
PCA	Principal Component Analysis
RII	Relative Important Index
SD	Standard Deviation
SUDS	Sustainable Urban Drainage Systems
SVF	Sky View Factor
UB	Urban Biodiversity
UES	Urban Ecosystem Services
UN	United Nations
UNDP	United Nations Development Programme
SDG	Sustainable Development Goals

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

The world is getting more civilized. More than half of the world's population lives in cities. According to United Nations (UN) By 2050, the percentage of people living in the urban areas will increase to 66% (UN, 2011). The human negative impact on the environment became evident after the Industrial Revolution. The temperature of the earth increased because of the accumulation of warm gas in the atmosphere (MacKinnon et al., 2008). Human activity related to the industrial sector and urbanization has increased dramatically, this resulted in a negative impact on the quality of the air, the water quantity and in destroying the biodiversity in cities (some animals and birds have disappeared and many green areas destroyed) (Chibrik et al., 2016). According to the indicators that have been just mentioned, it is clear that humans dominate the planet and threaten other species' life (Vitousek et al., 1997). Some do not mind this development even if it is at the expense of the environment and the life of other species. While others consider it as negative because environmental regulations are not respected (Ellis, 2011).

Green Infrastructure (GI) is a planning approach designed to create a network of green spaces, that bring benefits to humans, achieve biodiversity, and fight fragmentation. The significance of the need to implement GI in the urban area is clear. GI is among the most widely applicable economically viable and effective tools to combat the impact of climate change and help people adapt to or mitigate the adverse effects of climate change. For example, GI helps the environment recover from its current problem, by helping to decrease the temperature of the atmosphere, absorbing

the pollutants, and retaining the ecosystem's biological diversity (Benedict & McMahon, 2002). Also, GI helps to meet the 17 Sustainable Development Goals (SDG), it can alleviate many of the problems that the growing urban population is facing such as economic, social, and ecological problems, thus it contributing towards the 17 SDG especially SDG number 3 (good health and well-being). it helps enhance human wellbeing and human health, by providing social, economic, and environmental benefits as well as providing places for entertainment everywhere (Gelan & Girma, 2021). According to (Dipeolu & Ibem, 2020) improve the quality and quantity of GI in developing countries will help to mitigate the effects of Environment Sustainable Challenges (ESC) such as greenhouse gas emission. Moreover, a study conducted in Swedish revealed that implementing GI project address most of the challenge of urbanization and biodiversity loss (Hagemann et al., 2020).

The establishment of GI contributes positively to the enhancement of the ecosystem services, especially in the developed urban areas (Du Toit et al., 2018). Figure 1.1 shows some actions and their impact on the ecosystem service. It is clear from the figure that establishing more GI is the most appropriate approach to enhance ecosystem services in the developed urban areas (Youngquist, 2009).

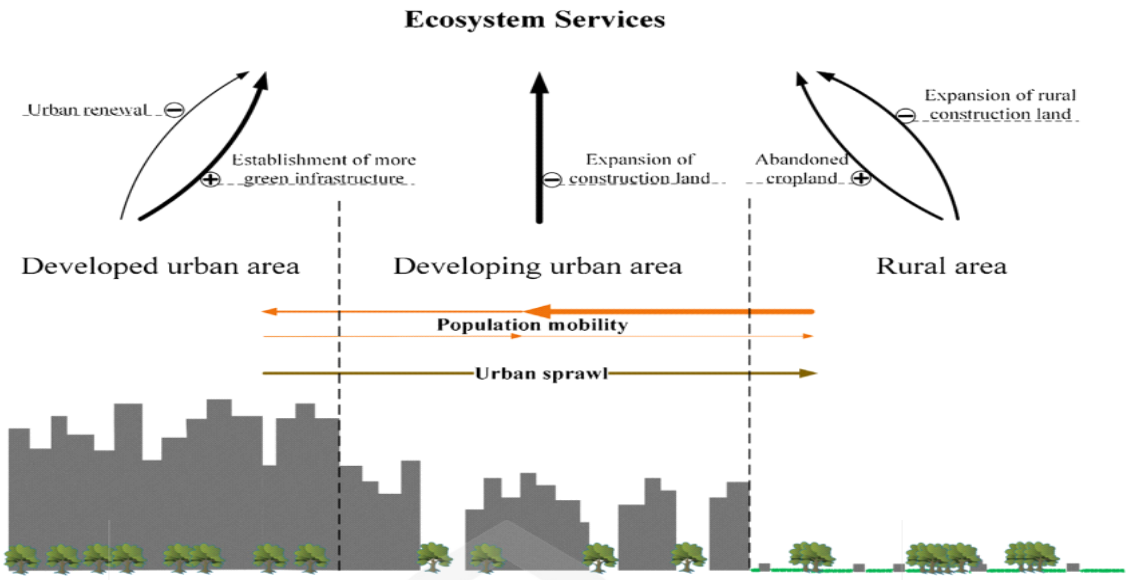

Figure 1.1 The Positive and Aegative Actions to Ecosystem Service in Rural, Developing, and Developed Areas
Source: (Li 2016)

In our time the demands of GI are increasing and it has been recognized by many countries. The United States has incorporated the GI development policy into the legislative framework because they have a strong belief in GI benefits (Roe & Mell, 2013). Unfortunately, several types of research have been conducted on GI planning in developed countries, while very little has been done in developing ones (Girma et al., 2019). However, most of the world countries are still facing challenges that are preventing them from adopting GI in their policy and plans (Bengston et al., 2004). Yemen as one of the developing countries needs GI, especially with weak infrastructure, poor resources, and environmental problems. Therefore, this research studies GI awareness and implementation factors (GI drivers, barriers, and solutions).

1.2 PROBLEM STATEMENTS

Nowadays, the high population density and rapid urbanization in cities harmed the health and vitality of life (Newalkar, 2017). In particular Cities in developing countries struggle with many problems, that due to rapid urbanization and population growth (Kironde, 2006; Turok & McGranahan, 2013). Yemeni cities are getting more and more crowded especially those located in the west. The growth rates of Yemeni cities vary from 3% to 5% (figure 1.2). Mukalla city (study area), which is the economical capital of Hadramout witnessed a big migration wave of people coming to it from inside and outside the country, causing population to increase and heavy constructions to be conducted. The increasing of population density led to intensive construction, which replaced what was before green areas. The problem of this research is summarized in the subsequent subsections

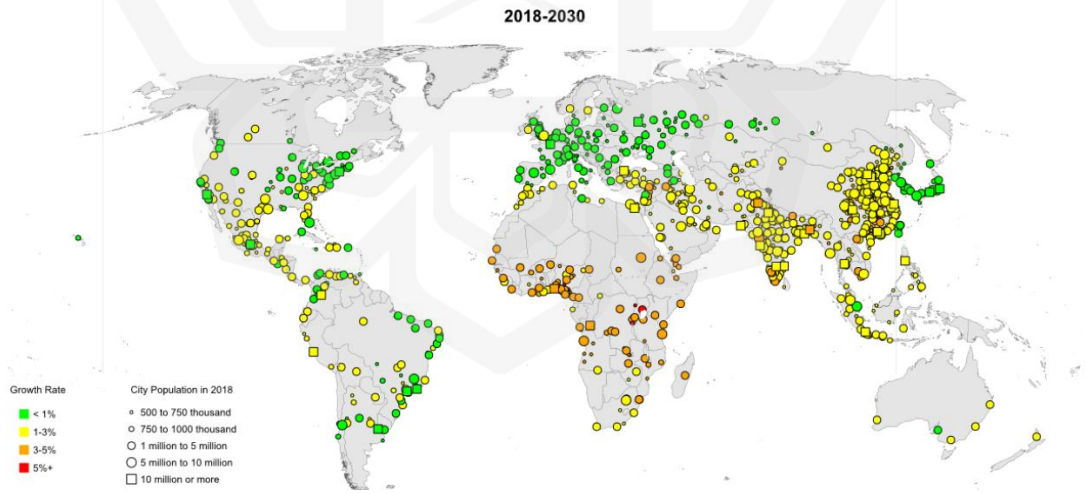

Figure 1.2 Growth Rates and Populations of Agglomerations by Size Class: from 2018 to 2030 Projections
Source: (UN report World Urbanization Prospects, 2018)

1.2.1 Lack of Planning and Implementing of GI

In the present time, there is a lack of implementation of the GI in developing countries. This is due to many barriers, such as low awareness among the professionals, lack of professional experience in the GI domain, outdated documents, and financial constraints (Girma et al., 2019). Despite all the motives, such as population increase and expansion of urbanization, that should push to create green spaces, Mukalla city still suffers from a lack of GI implementation (ministry of planning, 2009). The lack of awareness regarding GI creates so many problems. The problems caused by the lack of GI awareness can be summarized into the following three points:

The lack of awareness regarding the absence of green areas and street trees in the city has caused environmental problems such as high temperature and air pollution. Studies have shown that green areas are cooler than urban areas (Hamada & Ohta, 2010; Jáuregui, 1990). For example, the city of Beijing relies on green spaces for reducing its temperature and reducing air pollution. Green areas help to reduce the energy consumed for cooling purposes. It reduces the percentage of the total energy consumed for cooling by about 60% (B. Zhang et al., 2014).

The lack of awareness regarding the absence of parks and recreation area cause social problems. It makes inhabitants show a state of dissatisfaction. Human beings need to have green space near to their homes and on the road to their work. as a way to show the love of inhabitants to live in a green space area. A report has been conducted in Poland showed that the trees are extremely important and valuable to the inhabitants, it also showed the willingness of inhabitants to pay for planting trees in a place where there are no trees are planted. The study also showed that GI contributes to the enhancement of human wellbeing (Giergiczny & Kronenberg, 2014).

The increase of urban growth (urban extension) leads to an imbalance in the ratio of the land-use between construction area and green space area, which in return will lead to a reduction in the ratio of green space (The more the construction is being done, the more the area of the green space are being reduced). Urbanization leads to the loss of ecosystem service in urban areas. (Lin et al., 2015). Urbanization also leads to an increase of impervious surfaces in the city (roads, building roofs, and pavements), which in return will affect the quality of water and will cause flooding (Wallace & Eggert, 2009).

1.2.2 Lack of Studies on GI Awareness in Developing Countries

Studies that are related to GI are immeasurably more carried out in developed countries, than in developing ones (Girma et al., 2019). Even though Southern European countries are doing a lot of studies related to GI, they are still suffering from the lack of the applied research. A three-sectoral workshop has been done in Italy, Romania, and Finland. All three workshops have shown there is an urgent need to further raise awareness, further effort is needed to get the experiences. However, for African countries, the applied research is almost not existed, which causes a lack of practical knowledge of GI (Ferreira et al., 2020). Like developing countries, Yemen has not revealed a clear picture of the level of awareness among practitioners. This situation needs further research to assess their level of awareness. In regards to Yemen, the literature showed that there is no study has been carried out to assess GI awareness across the agencies that are interested in planning and designing the urban area in Mukalla city.