THE IMPACT OF POSTWAR URBAN DEVELOPMENT ON THE GROUNDWATER QUALITY IN KABUL CITY, AFGHANISTAN

BY

SAFIULLAH ZAHID

A thesis submitted in fulfilment of the requirement for the degree of Master of Science (Built Environment)

Kulliyyah of Architecture and Environmental Design
International Islamic University of Malaysia

JUNE 2020

ABSTRACT

Afghanistan has an old history of urban planning in Central Asia and has been affected by its nearly two decades of war. The conflict has made its adverse effect on the overall living conditions of people, urban planning systems, and environmental issues. However, since 2001, many major cities of the country have faced rapid population and urbanization growth, especially Kabul due to the returning of emigrants and the internal displacement of persons. The population of Kabul city has significantly increased, where about 70% of the residents living in informal settlements, and nearly 72.5% of the inhabitants do not have access to the piped water supply network. Thus, Kabul city drinking water is mainly being supplied by shallow wells of groundwater. Likewise, proper sanitation and its treatment system do not exist in the city. This resulted in a substantial increase in different types of environmental challenges, including the decline of water quality and quantity. Besides, the groundwater pollution associated infection also increased among the citizen, and the groundwater quality showed a negative path due to increases in pollution. Therefore, the main purposes of this study are 1) to investigate the impact of post-war urban development on groundwater quality, 2) to analyse the residents' perceptions about water quality, and 3) to determine the specific recommendations regarding the groundwater quality. To achieve the objectives of this study, the primary and secondary data consisting of both urban development and water quality were collected and analysed. The primary data consisted of survey questionnaires circulated to 429 individuals, which covers the residents' perceptions about water quality, sources of water pollution, the impact of urban development on water quality, and recommendations about the water quality protections. While the secondary data consisted of existing data concerning the 1) pre and post-war urban development of Kabul city, 2) major sources of water pollution identified by the National Environmental Protection Agency of Afghanistan (NEPA), 3) the 54 water supply wells water quality test results for physical and chemical attributes of Kabul city groundwater collected from the Ministry of Energy and Water (MEW), and 4) about 450 water quality test results for biological characteristics of Kabul city groundwater achieved from Afghanistan Urban Water Supply and Sewerage Corporation (AUWSSC). The data was analysed using the SPSS and GIS software and the results derived from analysing both primary and secondary data revealed that post-war urban development has negatively impacted the groundwater quality of the Kabul city. Also, the rapid population growth, septic tank, pit latrine, storm water, watercolour, drainage, and water pollution are the main factors that contribute to the negative impact of urban development on groundwater quality. Meanwhile, nearly half of the respondents agreed on the Kabul city groundwater contamination. Therefore, this study recommends 1) construction of the *Shahtoot* dam as an alternative water supply source, 2) provision of the water treatment system for the water supply network, 3) undertaking awareness programs, 4) provision of proper water filtration method for household use, 5) groundwater management system, and 6) gradually increase access of the residents to sewerage system are the major factors that can help in protecting the groundwater quality in the city and that can also mitigate the adverse impact of the urban development on groundwater quality.

ملخص البحث

لقد مرت أفغانستان، التي لها تاريخ قديم في التخطيط الحضري في آسيا الوسطى، بحوالي عقدين من الحرب في البلد. و لقد ترك النزاع آثاره السلبية و الخطيرة على الظروف المعيشية العامة للناس ونظم التخطيط الحضري والقضايا البيئية. ومع ذلك، منذ عام 2001، واجهت العديد من المدن الرئيسية في أفغانستان نموًا سريعًا في عدد السكان والتحضر، وخاصة في مدينة كابول بسبب عودة المهاجرين والتشريد الداخلي للأشخاص. و علاوة علي ذلك، ازداد عدد سكان مدينة كابول بشكل كبير، حيث حوالي 70 ٪ من سكان كابول يعيشون في مستوطنات غير رسمية، وحوالي 72.5 ٪ من السكان لا يستطيعون الوصول إلى المياه من شبكة أنابيب إمداد المياه. وبالتالي، يتم توفير مياه الشرب في مدينة كابول بشكل رئيس من الآبار الضحلة من المياه الجوفية. و كذلك لا يوجد الصرف الصحي المناسب و نظام العلاج في المدينة. وقد أدى ذلك إلى زيادة كبيرة في أنواع مختلفة من التحديات البيئية، بما في ذلك انخفاض نوعية المياه وكميتها. إلي جانب ذلك، ازداد التلوث المرتبط بتلوث المياه الجوفية بين المواطنين، و أظهرت جودة المياه الجوفية مساراً سلبياً بسبب زيادة التلوث. لذلك، فإن الهدف الرئيس لهذه الدراسة هي 1) التحقيق في تأثير التنمية الحضرية بعد الحرب على جودة المياه الجوفية، 2) تحليل تصورات السكان حول جودة المياه، و 3) تحديد التوصيات المحددة المتعلقة بنوعية المياه الجوفية. لذلك، لتحقيق أهداف هذه الدراسة، تم جمع وتحليل البيانات الأولية والثانوية التي تتكون من كل من التنمية الحضرية وجودة المياه. وأما البيانات الأولية فإنها تضمنت استبيانات و الدراسات الاستقصائية التي تم توزيعها على 429 فردًا، والتي تغطي تصورات السكان حول جودة المياه، ومصادر تلوث المياه، وتأثير التنمية الحضرية على جودة المياه، وتوصياتهم بشأن حماية جودة المياه. في حين أن البيانات الثانوية تتكون من البيانات الموجودة المتعلقة 1) بالتنمية الحضرية قبل وبعد الحرب في مدينة كابول، 2) المصادر الرئيسة لتلوث المياه التي عيّنت بواسطة الوكالة الوطنية لحماية البيئة في أفغانستان (NEPA) ، 3 نتائج اختبار جودة المياه لـ 54 آبار إمداد المياه بما فيها صفاتها الفيزيائية والكيميائية للمياه الجوفية في مدينة كابول التي تم جمعها بواسطة وزارة الطاقة والمياه (MEW) ، و 4) حوالي 450 نتائج اختبار جودة المياه للخصائص البيولوجية للمياه الجوفية لمدينة كابول التي تم الحصول عليها من شركة أفغانستان لتزويد المياه والصرف الصحي في المناطق الحضرية في أفغانستان (AUWSSC) . ثم بعد ذلك تم تحليل البيانات باستخدام برنامج SPSS و GIS، وكشفت النتائج المستمدة من تحليل البيانات الأولية والثانوية أن التنمية الحضرية بعد الحرب أثرت سلبًا على جودة المياه الجوفية لمدينة كابول. كما أن النمو السكاني السريع، وخزان الصرف الصحي، ومراحيض الحفر، ومياه العواصف ولون المياه والصرف الصحي وتلوث المياه هي العوامل الرئيسية التي

تساهم في التأثير السلبي للتنمية الحضرية على جودة المياه الجوفية. في نفس الوقت، اتفق قرابة نصف المجيبين علي الدراسة الاستقصائية على تلوث المياه الجوفية في مدينة كابول. لذلك، توصي هذه الدراسة بما يلي: 1) بناء سد شاتوت كمصدر بديل لإمدادات المياه، 2) توفير نظام معالجة المياه لشبكة أنابيب المياه، 3) تنفيذ برامج التوعية، 4) توفير طريقة مناسبة لترشيح المياه للاستخدام المنزلي ، 5) نظام إدارة المياه الجوفية، و 6) زيادة تدريجية في وصول السكان إلى نظام الصرف الصحي هي العوامل الرئيسية التي يمكن أن تساعد في حماية جودة المياه الجوفية في المدينة والتي يمكن أن تخفف أيضًا من التأثير السلبي للتنمية الحضرية على جودة المياه الجوفية.

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 thesis for the degree of Master of Science (Built Environment).

……..
M. Zainora Asmawi
Main Supervisor

……..
Muhammad Faris Abdullah
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 (Built Environment).

……..
Rustam Khairi Zahari
Internal Examiner

……..
Sarah Aziz Abdul Ghani Aziz
External Examiner

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

……..
Syafiee Shuid
Head, Department of Urban and Regional Planning

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

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

DECLARATION

I hereby declare that this thesis is the result of my own 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.

Safiullah Zahid

Signature ..... Date .....

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

DECLARATION OF COPYRIGHT AND AFFIRMATION OF FAIR USE OF UNPUBLISHED RESEARCH

THE IMPACT OF POSTWAR URBAN DEVELOPMENT ON THE GROUNDWATER QUALITY IN KABUL CITY, AFGHANISTAN

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

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

Affirmed by Safiullah Zahid

……..…….. ……..

Signature Date

ACKNOWLEDGMENTS

بسم الله الرحمن الرحيم

In the name of Allah, The most compassionate, The most merciful. I would like to gratitude to Almighty Allah for his blessing, mercy, and giving me the patience and strength during this master program and to complete this thesis successfully.

I would like to express my heartiest thanks to my supervisor, Assoc. Prof. Dr. M. Zainora Asmawi for her guidance, continues support, and encouragement, which made it possible for me to complete this thesis successfully. I also would like to express my deepest gratitude to my Co-supervisor, Asst. Prof. Dr. Muhammad Faris Abdullah for his continued guidance and support.

This is my pleasure to dedicate this work to my dear parents and family, who always remember me on their prayers and provided me the endless support to complete this journey. Thanks for your support and patience.

Table of Contents

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ANDS	Afghanistan National Development Strategy
ANOVA	Analysis of Variance
ANSA	Afghanistan National Standards Authority
AS	Afghan Standard
AUWSSC	Afghanistan Urban Water Supply and Sewerage Corporation
CDC	Community Development Council
CRIDA	Capital Region Independent Development Authority
CSO	Central Statistic Organization
DCDA	Dehsabaze City Development Authority
DO	Dissolved Oxygen
EC	Electrical Conductivity
GDP	Gross Domestic Products
GIS	Geographic Information System
GRDP	Gross Regional Domestic Products
IDLG	Independent Directorate of Local Governance
IDP	Internal Displacement People
JICA	Japan International Cooperation Agency
KM	Kabul Municipality

Km	Kilometre
M	Meter
MEW	Ministry of Energy and Water
MORR	Ministry of Refugees and Repatriations
MPW	Ministry of Public Works
MUDL	Ministry of Urban Development and Land
NA	Not Applicable
NEPA	National Environmental Protection Agency
NGVS	No Guideline Value Set
NTU	Nephelometric Turbidity Units
PAMA	Building Project Central Institute
SDG	Sustainable Development Goals
SHTAPA	The Institute of Urban Planning and Building Construction
SPSS	Statistical Package for the Social Science
TCU	True Colour Units
TDS	Total Dissolved Solid
UN	United Nation
UNESCO	United Nation Education, Scientific and Cultural Organization
UNHCR	United Nation High Commissioner for Refugees

WHO	World Health Organization
WMO	World Metrological Organization

CHAPTER ONE

INTRODUCTION

1.1 INTRODUCTION

Afghanistan had faced new political, social and economic challenges when it emerged from the past few decades of war in 2001. The civil war in the country had made Afghanistan become one of the poorest countries in the world, more than five million people migrated to the neighbouring countries and had severely affected the overall livelihood (Beall & Schütte, 2006). After 2001, major cities of Afghanistan had experienced rapid population growth due to the returning of emigrant and internal displacement (Majidi, 2011). Kabul as one of the biggest cities and the capital of Afghanistan is counted as the fifth rapidly growing city in the world. Kabul city population has significantly increased from 1.5million in 2001 to about 4.9million people in 2015, which shows the rapid urbanization growth according to the first Kabul city master plan (1962 – 1964), designed for about 800,000 people(Ahmadi & Kajita, 2017).

As a result of the fastest population and urbanization growth, the residents of the city are suffering from different types of environmental challenges such as air pollution, weak solid waste management, absence of water sanitation, safe drinking water and green areas (Afghanistan's environment, 2008). Hence, only 27.5% of Kabul city population has access to the water supply network, and the city does not have any proper wastewater treatment system (Zaryab, Noori, Wegerich & Kløve, 2017). Therefore, Kabul city drinking water is mainly being supplied by either privately or community-owned shallow wells of groundwater, whith depth of normally less than 30m (Mack,

Chornack & Taher, 2013). Meanwhile, the solid waste producing rate of the Kabul city is about 0.31 Kg to 0.43 Kg/Capita/Day, which is in line with the lowest income south Asian countries (Forouhar & Hristovski, 2012).

Accordingly, the main objective of this research is to identify the post-war urban development impact on groundwater quality, to analyse the residents' perceptions about water quality, and to determine the specific recommendations for further protecting the groundwater quality of Kabul city.

1.2 BACKGROUND OF THE STUDY

Afghanistan has an old history of urban settlement, which dates back to 3000BC and counting as one of the oldest civilization centres of central Asia (see Figure 1.1). The contemporary urban planning organization was founded in the early 20th century during the ruling of Amanullah Khan (1919-1929). However, two departments of urban planning and building constructions were formed within the Ministry of Public Works in 1961. These departments were mainly responsible for designing and implementing all projects of Afghanistan cities (Habib & Kidokoro, 2015).

Besides that, in 1964 one additional specialized organization which was called *Sharwali* and that had the same meaning as Municipality had been added in the constitution and organizational system of the country during the reign of Mohammad Zahir Shah (1933 – 1973). This institution was specifically responsible for implementing the urban planning services. With the passage of time, the form of the existing urban planning organization had been changed when finally in 1992 the Government established a separate ministry under the name of Ministry of Urban Development Affairs which had a leading role in the development of Policies and