

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

BY

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## 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 على 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. إلى 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 فرداً، 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 سلباً 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 السلي للتنمية الحضرية على جودة المياه الجوفية. في نفس الوقت، اتفق قرابة نصف المجيبين على 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 أيضاً من التأثير السلي للتنمية الحضرية على جودة المياه الجوفية.

## APPROVAL PAGE

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## 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

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# Table of Contents

Abstracts.....	ii
Abstract in Arabic.....	iii
Approval Page.....	v
Declaration.....	vi
Copyright.....	vii
Acknowledgments.....	viii
List of Tables.....	xiii
List of Figures.....	xvi
List of Abbreviations.....	xx
<b>CHAPTER ONE: INTRODUCTION .....</b>	<b>1</b>
1.1 Introduction.....	1
1.2 Background of The Study.....	2
1.3 Problem Statement.....	4
1.3.1 Degradation of Water Quality .....	4
1.3.2 Lacking of Proper Sanitation and Solid Waste Management System .....	5
1.4 Research Questions.....	6
1.5 Aims and Objectives of The Research.....	6
1.6 Significance of The Research .....	7
1.6.1 Significance Toward Urban Development.....	7
1.6.2 Significance Towards Water Quality .....	8
1.7 Scope of Study and Limitation .....	8
1.8 Research Structure .....	9
<b>CHAPTER TWO: LITRATURE REVIEW .....</b>	<b>10</b>
2.1 Introduction.....	10
2.2 Relevance of Urban Planning with Environmental Quality .....	10
2.2.1 Definition .....	10
2.2.2 The Importance of Urban Planning.....	11
2.2.3 The Effect of Urban Planning on Environmental Quality.....	12
2.2.3.1 The Effect of Urban Transportation on Environmental Quality .....	14
2.2.4 Environmental Consideration.....	15
2.2.5 Sustainable Urban Development.....	16
2.2.5.1 Environmental Sustainability.....	18
2.2.5.2 Economic Sustainability .....	19
2.2.5.3 Social Sustainability .....	20
2.3 Groundwater Quality .....	21
2.3.1 Environmental Pollution .....	23
2.3.2 Sources of Water Supply.....	23
2.3.3 Sources of Water Pollution .....	26
2.3.4 Properties of Water Quality.....	28

2.3.4.1 Physical Properties of Water .....	29
2.3.4.2 Chemical Properties of Water.....	31
2.3.4.3 Biological Properties of Water .....	34
2.4 The Relationship Between City and Environment .....	36
2.5 Benchmarking Studies about the Impact of Urban Development on the Water Quality.....	37
2.5.1 Iran .....	37
2.5.2 Nigeria.....	38
2.5.3 India.....	39
2.5.4 Brazil .....	39
2.5.5 China .....	39
2.5.6 Lessons Learned.....	40
2.6 Benchmarking Studies about the Residents Perception on Drinking Water Quality .....	41
2.6.1 Pakistan .....	41
2.6.2 Bangladesh .....	42
2.6.3 Lessons Learned.....	43
2.7 Conclusion .....	43

**CHAPTER THREE: OVERVIEW OF THE KABUL URBAN DEVELOPMENT .....46**

3.1 Geographical Information.....	46
3.1.1 Climate Condition .....	48
3.1.2 Geological Information .....	49
3.2 Population Growth.....	51
3.3 Economic Growth.....	53
3.4 Urban Governance .....	54
3.5 Water Governance .....	57
3.6 Kabul Urban Development Trend.....	58
3.6.1 Postwar Urban Development .....	62
3.6.2 The Challenges of Postwar Urban Development.....	65
3.7 Water Resources .....	67
3.7.1 Kabul Sub River Basin.....	68
3.7.2 Kabul Sub River Basin Ground Water Quantity.....	71
3.8 Infrastructure System.....	73
3.9 Conclusion .....	75

**CHAPTER FOUR: RESEARCH METHOD ..... 77**

4.1 Introduction.....	77
4.2 Research Design .....	77
4.2.1 Quantitative Research .....	78
4.2.2 Qualitative Research .....	79
4.3 Method Of Data Collection.....	80
4.3.1 Primary Data Collection .....	80
4.3.1.1 Survey Questionnaire Sampling, Design and Strategy.....	81
4.3.2 Secondary Data Collection.....	83
4.3.2.1 Water Quality Data.....	84
4.3.2.2 Post-war Urban Development.....	84
4.4 Case Study Method.....	85

4.5 Data Analysis .....	88
4.5.1 Descriptive Analysis .....	89
4.5.2 Content Analysis .....	90
4.5.3 Spatial Analysis .....	91
4.5.4 Reliability Analysis .....	91
4.5.5 Correlation Analysis .....	92
4.5.6 Regression Analysis .....	92
4.6 Conclusion .....	93
<b>CHAPTER FIVE: DATA ANALYSIS.....</b>	<b>95</b>
5.1 Introduction.....	95
5.2 Water Quality Level of Kabul City.....	96
5.2.1 Physical Analysis of the Water Quality .....	97
5.2.1.1 Temperature .....	98
5.2.1.2 Electrical Conductivity (EC) .....	100
5.2.1.3 pH .....	100
5.2.1.4 Dissolved Oxygen (DO) .....	101
5.2.1.5 Total Dissolved Solid (TDS) .....	102
5.2.1.6 Salinity, Colour and Turbidity .....	104
5.2.1.7 Total Hardness (CaCo <sub>3</sub> ) .....	105
5.2.1.8 Conclusion of Physical Analysis .....	107
5.2.2 Chemical Analysis of the Water Quality.....	107
5.2.2.1 Calcium and Magnesium .....	108
5.2.2.2 Sodium.....	111
5.2.2.3 Total Alkalinity and Bicarbonate (HCO <sub>3</sub> ) .....	112
5.2.2.4 Chloride and Fluoride .....	114
5.2.2.5 Sulphate and Phosphate .....	115
5.2.2.6 Potassium.....	117
5.2.2.7 Nitrite, Nitrate and Ammonia.....	119
5.2.2.8 Iron and Manganese.....	122
5.2.2.9 Copper and Aluminium .....	124
5.2.2.10 Arsenic and Cyanide.....	126
5.2.2.11 Conclusion of the Chemical Analysis.....	128
5.2.3 Biological Analysis .....	128
5.3 The Sources of Water Pollution.....	130
5.4 Residents' Perception about the Water Quality and the Impact of Urban Development on the Water Quality .....	132
5.4.1 Demographic Information of the Respondents .....	133
5.4.1.1 Gender Composition of the Respondents .....	133
5.4.1.2 Age Group of the Respondents.....	134
5.4.1.3 Living Duration of the Respondents in Kabul City.....	134
5.4.1.4 Education Level of the Respondents .....	135
5.4.1.5 Income Level of the Respondents.....	136
5.4.1.6 Settlement Type of the Respondents .....	137
5.4.2 Residents' Perception on the Water Quality of Kabul City .....	137
5.4.2.1 Drinking-Water Sources .....	137
5.4.2.2 The Water Quality Level .....	138
5.4.2.3 Sources of Water Pollution.....	143

5.4.2.4 The Residents' Level of Awareness about the Water Quality .....	151
5.4.3 The Impact of Urban Development.....	158
5.4.3.1 The Impact of Urban Development on the Groundwater Quality .....	158
5.4.3.1.1 Rapid Urbanization Growth Impact on the Water Quality .....	160
5.4.3.1.2 Post-war Urban Development Impact on the Water Quality .....	164
5.4.3.2 How the Urban Development can give Impact on the Water Quality .....	168
5.4.3.3 Sustainable Urban Development Measures .....	168
5.5 Summary Of Key Findings .....	171
5.6 Conclusion .....	174
<b>CHAPTER SIX: FINDINGS AND CONCLUSION.....</b>	<b>175</b>
6.1 Introduction.....	175
6.2 Revisiting the Research Objectives .....	175
6.2.1 Groundwater Quality Impact of the Urban Development .....	176
6.2.2 Residents' Perception about the Water Quality .....	177
6.2.3 Recommendations .....	177
6.2.3.1 Intervention Measures .....	178
6.2.3.2 Policy Recommendations .....	178
6.2.3.3 Research Gap .....	179
6.3 Conclusion .....	179
<b>REFERENCES.....</b>	<b>181</b>
<b>APPENDIX I: SURVEY QUESTIONNAIRE FORM.....</b>	<b>195</b>

## LIST OF TABLES

Table 2.1	Sources of Water Pollution .....	27
Table 2.2	Physical Parameters of drinking water quality .....	30
Table 2.3	General parameters of drinking water quality concerning the necessary and non-organic chemical substance .....	32
Table 2.4	Drinking water quality parameters concerning the non-organic toxic chemical substance .....	33
Table 2.5	Bacteriological Parameters of drinking water quality .....	35
Table 3.1	Climatological Data for Kabul City for the period of 1956 to 1983.....	48
Table 3.2	Water Governance in Afghanistan.....	57
Table 4.1	List of Secondary Data of Water Quality in Kabul City.....	84
Table 4.2	Case Studies Methodology Comparison with Current Study .....	86
Table 5.1	Physical Analysis of the Groundwater Quality in Kabul City.....	98
Table 5.2	Chemical Analysis of the Groundwater Quality in Kabul City .....	108
Table 5.3	Biological Analysis of the Groundwater in Kabul City.....	129
Table 5.4	Status of Water Wells .....	130
Table 5.5	Water Pollution Sources in Kabul City.....	131
Table 5.6	Gender Composition .....	134
Table 5.7	Resident Perception in regards to the water quality.....	138
Table 5.8	Correlation between Residents satisfaction level and resident's perception about physical attributes of water.....	140
Table 5.9	Reliability statistic test result for water quality data.....	141
Table 5.10	Regression Model for the resident's satisfaction level and resident's perception about physical characteristics of water .....	142
Table 5.11	Regression Model ANOVA table for the resident's satisfaction level and resident's perception about physical characteristics of water ....	142

Table 5.12	Regression Model Coefficients for the resident’s satisfaction level and resident’s perception about physical attributes of water .....	142
Table 5.13	Crosstabulation between Drinking Water Contamination and Drinking Water Sources .....	145
Table 5.14	Residents Perception about the common water supply issues associated with drinking water quality .....	145
Table 5.15	Reliability Statistic test result of the common water supply issues associated with water quality .....	147
Table 5.16	Residents perception in regards to the sources of water pollution ....	147
Table 5.17	Reliability statistic test result of the main sources of water pollution.	148
Table 5.18	Correlation between water pollution and sources of water pollution	148
Table 5.19	Regression Model for the resident’s perception on water pollution, common water supply issues and sources of water pollution .....	150
Table 5.20	Regression Model ANOVA table for the resident’s perception on water pollution, common water supply issues and sources of water pollution.....	150
Table 5.21	Regression Model coefficients for the resident’s perception on water pollution, common water supply issues and sources of water pollution.....	150
Table 5.22	Reliability statistic test result for the residents’ level of awareness and public announcements .....	155
Table 5.23	Correlation between residents’ level of awareness and public announcements .....	155
Table 5.24	Regression model of residents’ level of awareness with the public announcement, water quality, common water supply issues and sources of water pollution .....	156
Table 5.25	Regression model ANOVA table of residents’ level of awareness with the public announcement, water quality, common water supply issues and sources of water pollution .....	156
Table 5.26	Regression model coefficients for residents’ level of awareness with the public announcement, water quality, common water supply issues and sources of water pollution .....	157
Table 5.27	Residents perception about the negative impact of urban development factors on the water quality.....	159

Table 5.28	Correlation between Rapid urbanization growth and resident's perception on water quality attributes .....	161
Table 5.29	Correlation between rapid urbanization growth and resident's perception about common water supply issues related to the water quality .....	161
Table 5.30	Correlation between rapid urbanization growth and resident's perception on sources of water pollution .....	162
Table 5.31	Regression model of urban development impact.....	162
Table 5.32	Regression model ANOVA table for urban development impact .....	163
Table 5.33	Regression model coefficients for urban development impact.....	163
Table 5.34	Reliability test result for the factors related to the impact of urban development on the water quality .....	165
Table 5.35	Correlation between the mean value of the urban development impact factors with water quality, common water supply issues, resident's level of awareness and sources of water pollution .....	165
Table 5.36	Regression model for post-war urban development impact on the water quality .....	166
Table 5.37	Regression model ANOVA table for the post-war urban development impact on the water quality.....	166
Table 5.38	Regression model coefficient for the post-war urban development impact on the water quality .....	166
Table 5.39	Sustainable urban development measures .....	169
Table 5.40	Sustainable urban development measures model .....	169
Table 5.41	Sustainable urban development measure ANOVA table.....	169
Table 5.42	Sustainable urban development measure coefficients .....	170
Table 5.43	Reliability test result for the urban development measures .....	171

## LIST OF FIGURES

Figure 1.1	Geographical Map of the Afghanistan.....	3
Figure 1.2	Research Structure .....	9
Figure 2.1	Three common sustainable development elements .....	16
Figure 2.2	United Nation Sustainable Development Goals (SDG) .....	17
Figure 2.3	Hydrological Cycle of Water.....	24
Figure 2.4	Earth Water Distribution .....	25
Figure 3.1	Location of Afghanistan in Asia.....	46
Figure 3.2	Kabul City Municipality Area .....	47
Figure 3.3	Annual Precipitation of Kabul.....	49
Figure 3.4	Population growth of Kabul City .....	51
Figure 3.5	Annual Voluntary Repatriation to Afghanistan.....	52
Figure 3.6	Trend of Urban Governance .....	55
Figure 3.7	Kabul City districts developed between 1923 to 1963 .....	59
Figure 3.8	Third Master Plan of Kabul City 1978.....	61
Figure 3.9	Trend of Kabul Urban Development .....	62
Figure 3.10	Fourth Master Plan of the Kabul City .....	64
Figure 3.11	Map of the Kabul Sub River Basin.....	69
Figure 3.12	Water Level decline from 2007 to 2017 .....	72
Figure 4.1	Research Structure .....	78
Figure 4.2	Data Analysis Framework .....	88
Figure 5.1	Sampling Point Location .....	97
Figure 5.2	Variation of Groundwater Temperature in Kabul City .....	99
Figure 5.3	Electrical Conductivity of Water in Kabul City .....	100
Figure 5.4	pH of groundwater in Kabul City.....	101



Figure 5.5	Dissolved Oxygen in the groundwater of Kabul city .....	102
Figure 5.6	Total Dissolved Solid in groundwater of Kabul City.....	103
Figure 5.7	Frequency of TDS in Kabul City.....	103
Figure 5.8	Salinity in Groundwater of Kabul City .....	104
Figure 5.9	Turbidity in Groundwater of Kabul City.....	105
Figure 5.10	Total Hardness of the groundwater in Kabul City.....	106
Figure 5.11	Total Hardness Frequency in groundwater of Kabul City.....	107
Figure 5.12	Calcium in groundwater of Kabul City .....	109
Figure 5.13	Magnesium in groundwater of Kabul City.....	110
Figure 5.14	Magnesium Frequency .....	110
Figure 5.15	Calcium Frequency.....	110
Figure 5.16	Sodium in groundwater of Kabul City .....	111
Figure 5.17	Sodium Frequency .....	112
Figure 5.18	Total alkalinity in groundwater of Kabul city .....	113
Figure 5.19	Bicarbonate in groundwater of Kabul city .....	113
Figure 5.20	Chloride in groundwater of Kabul city.....	114
Figure 5.21	Fluoride in groundwater of Kabul city .....	115
Figure 5.22	Sulphate in Ground Water of Kabul City.....	116
Figure 5.23	Phosphate in groundwater of Kabul City .....	116
Figure 5.24	Sulphate Frequency .....	117
Figure 5.25	Potassium in groundwater of Kabul City .....	118
Figure 5.26	Potassium Frequency .....	118
Figure 5.27	Nitrite in groundwater of Kabul city .....	120
Figure 5.28	Nitrate in groundwater of Kabul City.....	120
Figure 5.29	Ammonia in groundwater of Kabul City.....	121
Figure 5.30	Ammonia Frequency .....	121
Figure 5.31	Iron in groundwater of Kabul city .....	123

Figure 5.32	Iron and Manganese Frequency.....	123
Figure 5.33	Manganese in groundwater of Kabul city .....	124
Figure 5.34	Copper in groundwater of Kabul city .....	125
Figure 5.35	Aluminum in groundwater of Kabul city .....	125
Figure 5.36	Aluminum Frequency .....	126
Figure 5.37	Copper Frequency.....	126
Figure 5.38	Cyanide in groundwater of Kabul city .....	127
Figure 5.39	Cyanide Frequency .....	127
Figure 5.40	Biological attributes frequency.....	130
Figure 5.41	Gender Composition.....	133
Figure 5.42	Age group of the respondents.....	134
Figure 5.43	Living duration of the respondent in the Kabul city.....	135
Figure 5.44	Education level of the respondents.....	136
Figure 5.45	Income level of the respondents .....	136
Figure 5.46	Settlement type of the respondents.....	137
Figure 5.47	Drinking water sources in the Kabul city .....	138
Figure 5.48	Residents Perception in Regards to the Water quality .....	139
Figure 5.49	Water Quality Improvement Method using by the Respondents .....	140
Figure 5.50	Residents Perception on their Home Drinking Water Contamination	144
Figure 5.51	Residents perception about the common water supply issues associated with drinking water quality .....	146
Figure 5.52	Residents Perception in regards to the sources of water pollution.....	148
Figure 5.53	Residents perception in regards to the importance of water quality ..	152
Figure 5.54	Residents perception about the responsible organization for ensuring drinking water quality.....	153
Figure 5.55	Negative impacts of the poor quality of water on human health.....	154
Figure 5.56	Respondents level of awareness in regards to the poor-quality water	154

Figure 5.57	Residents perception in regards to the public announcements about water quality .....	155
Figure 5.58	Residents perception about the negative impact of the urban development factors on the water quality.....	160

## 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 20<sup>th</sup> 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