

VISUALIZING URBAN SUSTAINABILITY USING ESDA
STUDY CASE (AL LAITH CITY - KINGDOM OF SAUDI ARABIA)

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I give all Glory, Honor to the Almighty ALLAH, the giver of life and all good things for his Faithfulness and his mercy over my life. Thanks fully for showing my way. Great is the ALLAH Faithfulness unto me.

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ABSTRACT

In our world the population increasing day after day and governments should be worried about this issue. They should take the necessary actions to address this steady increase and its impact on development processes which affects the universe in general. Thus sustainability is a core issue for today. However, sustainability entails more than green architecture or re-using building materials. A city should for example also be an attractive place to live with economic potential for its inhabitants. The practice of spatial planning greatly influences our environment. Given the importance of cities, we argue that sustainability is a necessary mindset of planners. In today's network society geographic information has an increasingly important role to support this mindset. In this study explores how spatial information may spur the discussion on planning sustainable cities. This is done by analyzing urban survey forms and environmental, socio-economic from the questionnaire. Yet, the careful interpretation of geographic data into spatial information is essential for the quality of the final result. By means of a case study area (city of Al Laith - Kingdom of Saudi Arabia), this study shows how GIS and ESDA can be used to describe the sustainability of the city. Six indicators (public space, educational level, average income, employment status, carbon dioxide emissions and building density) are used to visualize the sustainability of the study area. There are some aspects need to be considered in order to achieve a sustainable development of the city of Al Laith. We can conclude from this study there are some problems that a necessary solution to achieve sustainability of the city of Al Laith. This will be achieved through some strategies and policies to make this city more sustainable for current populations and for the next generations.

ABSTRAK

Isu peningkatan populasi dapat kian dirasakan setiap hari di seluruh dunia dan pemerintah harus mengambil perhatian tentang masalah ini. Penguasa perlu mengambil langkah yang sepatutnya dalam menangani peningkatan populasi dan kesan global dari proses pembangunan. Oleh itu, kelestarian merupakan isu hangat dibicarakan kini. Bagaimanapun, lestari bukan sekadar pembangunan berkonsepkan kehijauan semata-mata ataupun penggunaan bahan binaan yang dikitar semula. Lestari merangkumi keupayaan pembangunan seperti bandar yang mampu menarik kehadiran ramai penghuni menetap di situ akibat dari persekitaran yang selesa dan suasana ekonomi yang membina. Mengaplikasikan pengurusan spatial adalah sangat berkesan terhadap melestarikan persekitaran kita. Dalam pengurusan bandar-bandar besar, penguasa dan pemaju masih membahas tentang kelestarian dalam perancangan. Melalui perkembangan kepakaran dalam Sistem Maklumat Geografi (GIS) terkini, fungsi dan penerapan bandar lestari dapat direalisasikan dengan jayanya. Kajian ini menyelami bagaimana maklumat spatial berupaya membentuk sebuah bandar lestari. Analisa yang dilakukan dalam kajian ini adalah berdasarkan hasil soal selidik yang telah dilakukan berkenaan ukuran bandar, alam sekitar dan sosioekonomi. Pemerhatian terperinci dalam data GIS adalah penting bagi mengawal kualiti ketepatan hasil analisis. Dengan menggunakan kajian ke atas Bandar Al Laith, Kerajaan Arab Saudi, kajian ini mendalami bagaimana GIS dan ESDA boleh digunakan bagi kelestarian bandar. Sebanyak enam aspek dikaji (kawasan awam, tahap pendidikan, purata pendapatan, status pekerjaan, pelepasan gas karbon dioksida dan ketumpatan bangunan) dalam mengukur kelestarian bandar. Beberapa aspek yang harus diambil perhatian supaya Bandar Al Laith mencapai status bandar lestari. Sebagai kesimpulan kajian, terdapat beberapa kelemahan yang harus ditangani bagi menjadikan Bandar Al Laith sebagai satu bandar lestari. Ianya boleh diselesaikan melalui beberapa pendekatan strategi dan undang-undang bagi menjadikannya lebih mapan untuk menampung populasi sekarang mahupun masa depan.

TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
	STATUS VALIDATION	i
	SUPERVISOR'S DECLARATION	ii
	TITLE	iii
	DECLARATION	iv
	ACKNOWLEDGMENT	v
	ABSTRACT	vi
	ABSTRAK	vii
	TABLE OF CONTENTS	viii
	LIST OF TABLES	xiii
	LIST OF FIGURES	xv
	LIST OF ABBREVIATIONS	xvii
	LIST OF APPENDICES	xviii
1	INTRODUCTION	1
	1.1 Introduction	1
	1.2 The Background to the Study	1
	1.3 Research Problem	3

1.4	The Main Objective	4
1.5	The Objectives and Specific Research Questions	5
1.6	Conceptual Framework	5
1.7	Research design	7
1.8	The Structure of Thesis	8
2	MEASURING URBAN SUSTAINABILITY	10
2.1	Introduction	10
2.2	Sustainable Urban Development	10
2.2.1	Definition of Sustainability	11
2.2.2	Definition of Sustainable Development	12
2.2.3	Urban Sustainability	13
2.3	Components of sustainable urban development	15
2.3.1	The components of sustainable development	15
2.3.2	The dimension and the elements	16
2.4	Measuring urban sustainability	17
2.4.1	Spatial indicators	19
2.4.2	Non-spatial indicators	19
2.5	Urban sustainability indicators	20
2.5.1	The emergence of urban indicators	21
2.5.2	Characteristics for effective indicators	22
2.5.3	Criteria for choosing appropriate indicators	22
2.6	Exploratory spatial data analysis (ESDA)	23
2.6.1	ESDA tools	24
2.6.2	ESDA and GIS	25
2.6.3	Data Model for ESDA	25
	2.6.3.1 Data properties for a single variable identified through ESDA	26

2.6.3.2	Data properties for two variables identified through ESDA	27
2.6.4	ESDA for Describing Non-Spatial Properties of Attribute	27
2.6.5	ESDA for Describing Spatial Properties of an Attribute	28
3	CITY OF AL LAITH – THE STUDY AREA	29
3.1	Introduction	29
3.2	Description of the study area	29
3.3	The population of the city	33
3.3.1	The city's population pyramid	34
3.3.2	The population and population density	35
3.3.3	Population growth rates in Al Laith city	36
3.4	The economic activities of the city of Al Laith	37
4	RESEARCH METHODOLOGY	38
4.1	Introduction	38
4.2	The research method	38
4.3	The data for the study	40
4.3.1	The survey data	40
4.3.1.1	Data collected by questionnaire	40
4.3.1.2	Data collected by urban survey	41
4.3.2	The processing of the survey data	42
4.3.2.1	Questionnaire forms	42
4.3.2.2	Urban survey forms	44
4.3.3	The maps of Al Laith	45
4.3.4	The indicators	47
4.3.5	The study database	48

4.3.5.1	Division criteria of Al Laith city districts	49
4.4	Visualization of the data	50
4.4.1	The social sustainability of the city	50
4.4.1.1	Public space	50
4.4.1.2	Educational level	52
4.4.2	The economic sustainability of the city	54
4.4.2.1	Economic activity of the population	54
4.4.2.2	Current economic activities and economic resources in Al Leith city	55
4.4.2.3	Income	56
4.4.2.4	Employment status	60
4.4.3	Environmental sustainability of the city	62
4.4.3.1	Carbon dioxide emission	63
4.4.3.2	Building density	65
5	RESULTS AND DISCUSSION	67
5.1	Introduction	67
5.2	Exploring the sustainability of the city of Al Laith	68
5.3	Results and discussion	68
5.3.1	Social Dimension of Sustainable Development	70
5.3.1.1	The social dimension - Public space	70
5.3.1.2	The social dimension - Educational level	73
5.3.2	Economic Dimension of Sustainable Development	75
5.3.2.1	Economic dimension - Income average	75
5.3.2.2	Economic dimension- Employment status	77
5.3.3	Environmental Dimension of Sustainable Development	79
5.3.3.1	Environmental Dimension - Carbon Dioxide emissions	79

5.3.3.2	Environmental Dimension - Building density	81
5.4	Describe the sustainability of Al Laith	83
5.4.1	Educational level and employment status	83
5.4.2	Educational level and income average	84
5.4.3	Public space and building density	85
5.4.4	Carbon emission, building density and public space	86
5.4.5	The sustainability of Al Laith	86
6	CONCLUSION AND RECOMMENDATIONS	87
6.1	Introduction	87
6.2	The Conclusion	88
6.2.1	To review the concept of urban sustainability and develop indicators to measure the sustainability	88
6.2.2	To visualize the survey data of the study area in order to describe the sustainability of the city	89
6.2.3	To evaluate the result of this study to describe the sustainability of the city	90
6.2.4	The summary of the study	91
6.2.5	Recommendations	92
	REFERENCES	94
	APPENDICES A – B	99-108

LIST OF TABLES

TABLE NO.	TITLE	PAGE
1.1	The Research Design	7
2.1	Dimension of sustainable urban development	17
3.1	Population density and information about Al Laith districts	35
3.2	Describes the population growth rates in the Kingdom of Saudi Arabia	36
3.3	Population growth rates expected for Al Laith city	37
4.1	Distribution of the working-age according to Al Laith employment status (Do not include those who are under 18 years old)	55
4.2	Distribution of workers in Al Laith city according to the business sector	56
4.3	Households in Al Laith city according to the monthly income categories	57
4.4	Distribution of Households in Al Laith city according to the number of people receiving monthly income	58
4.5	Distribution of Households in Al Laith according to the source of income	58
4.6	Distribution of the working-age according to Al Laith employment status (Do not include those who are under 18 years old)	60

4.7	Car ownership rate in Al Laith city	63
4.8	Air conditioners ownership rate in Al Laith city	63
5.1	The three main aspects of sustainable development and the indicators we will use it to measure the sustainability	68

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE
1.1	The Research Conceptual Framework	6
2.1	Components of sustainable development	16
3.1	The location of the city of Al Laith	30
3.2	The administrative boundaries of the city of Al Laith	31
3.3	Distribution districts in Al Laith city	32
3.4	Development and non-development districts	32
3.5	The Population census	33
3.6	The city's population pyramid	34
3.7	Main Activities in Al Laith city	37
4.1	Shows the steps that have been taken to undertake the research	39
4.2	Sample of part from questionnaire form	41
4.3	Sample of part of urban survey form	42
4.4	Describes the data conversion process	43
4.5	Sample from the data after we convert it to access file	43
4.6	Sample from the data after we convert it to shape file	44
4.7	Al Laith city boundaries and flood channels	45
4.8	Sample of the layers in Al Laith city map	46
4.9	The indicators we use it to measure the sustainability of the city of Al Laith	47
4.10	The process of creating geodatabase	48
4.11	Districts divided into zones	49
4.12	The distribution of public spaces in Al Laith city	51
4.13	The distribution of educational level in Al Laith city	53

4.14	Monthly income categories in an Al Laith city restriction	59
4.15	Employment status of Al Laith city	61
4.16	Average environmental pollution caused by air conditioners and cars in Al Laith city	64
4.17	Houses density for each zone in an Al Laith city	66
5.1	Research methodology for the study area	69
5.2	The basic components of ESDA method	70
5.3	public space indicator in Al Laith city	72
5.4	Educational level indicator in Al Laith city	74
5.5	Average disposable income per person indicator in Al laith city	76
5.6	Employment status indicator in Al laith city	78
5.7	Average carbon dioxide emissions indicator in Al laith city	80
5.8	Building density indicator in Al Laith city	82
5.9	Comparison between social and economic results	84
5.10	Comparison between social and environmental results	85

LIST OF ABBREVIATIONS

EDA	-	Exploratory Data Analysis
ESDA	-	Exploratory Spatial Data Analysis
GIS	-	Geographic Information Systems
GUO	-	Global Urban Observatory
JUO	-	Jeddah Urban Observatory
KSA	-	The Kingdom of Saudi Arabia
LUO	-	Local Urban Observatories
NUO	-	National Urban Observatories
RUO	-	Regional Urban Observatory
SAR	-	Saudi Arabia Riyal
UN	-	United Nations
UNEP	-	United Nations Environment Program
UN-HBITAT	-	The United Nations Human Settlements Program
WCED	-	The World Commission on Environment and Development

LIST OF APPENDICES

APPENDIX	TITLE	PAGE
A	Economic, Social and Environmental questionnaire of Al Laith city	99
B	The urban survey of Al Laith city	108

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter presents the background information regarding sustainable urban development, indicators for measuring the sustainability of urban development, and a descriptive spatial statistical approach called the Exploratory Spatial Data Analysis (ESDA). From these, the problem statement, research formulation and justification were derived.

1.2 The Background to the Study

Allah said in the Holy Quran "هُوَ أَنشَأَكُم مِّنَ الْأَرْضِ وَاسْتَعْمَرَكُمْ فِيهَا" (Surah Hud, Verse 61) that He created you from earth and He makes it prosperous for you. From this verse, Holy Prophet Muhammad explained that Allah has deposited in many human energies,

some of which is apparent, and some of which is hidden souls, for use in building land and upgrade life. Human carrying responsibility for this universe, that responsibility that is part of his nature, is on the whole maintenance of environmental balance on the planet. Prophet Muhammad said: “if the Final Day comes upon you while you were planting a seed, then continue on planting it.” This is the Islamic concept of sustainable development in that human being is maker of development and the first beneficiary of revenues, which is part of the universe, a creature from clay, and the whiff top of the Spirit of Allah, elements Built in an entity entirely, has held his succession on the ground to fill it and develop according to the method of Allah. Therefore, the main pillar of the concept of sustainable development is the unity of determination.

Sustainable urban development applications require spatial data in order to support for decision making. The use of indicators for urban monitoring and regulation is becoming more and more in demand (Repetti and Desthieux, 2006). Measuring sustainability means we are getting serious about sustainability. It's scary, as undoubtedly it will show we aren't doing well enough, although everyone suspects that anyway. The community wants us to be honest and to show we are trying. (Newman, 2006). In some cases the municipalities themselves launch the observatory when it is apparent that there are problems, in particular in terms of population growth, as was the case of JUO (Andreia, Lúgia and Rui, 2012). The use of indicators to simplify complex phenomena and present it in a communicable form has appealed to different organizations (Atkisson, 1999).

The concept of sustainable urban development seeks to establish a balance between human needs and environmental urban preservation. Urban planners consider maintaining sustainable development in expanding and renovating urban areas. When an urban area expands into wildlife regions, much care is taken to integrate the wilderness with the developing city (Litman, 2007). Sustainable development in urban expansion focuses on curtailing the city's production of pollution, increasing the

availability of recycling facilities, and focusing on the efficient usage of alternative energies.

The concept sustainable development soon spread widely after the United Nations Conference on Environment and Development in Rio in 1992 (UN, 1992), and it has proposed that cities act as a center to solve global environmental problems in the direction of sustainable urban development.

1.3 Research Problem

In 2003, the (UNHabitat) recommended to the Kingdom of Saudi Arabia (KSA) to establish urban observatories for the purpose of monitoring the development of major urban areas in the Kingdom. The secretariat of Al Madina Al Munawarah, therefore, took the initiative to establish the first local urban observatories in the Kingdom in cooperation with the Arab Institute for Urban Development. For the purpose of monitoring the development of urban Medina in order to meet the objective of Sustainable Urban Medina, a total of 68 indicators were identified – these include 53 international indicators and 15 local indicators which reflect Medina privacy and data elements. Those indicators are used to simplify the measurement of complex phenomena and to be able to present it in a communicable form (Atkisson, 1999). Soon after that, Jeddah Municipality also established the Jeddah Urban Observatory (JUO) with the similar purpose of monitoring the development of one the most rapidly expanding urban areas in the Kingdom of Saudi Arabia to become a Sustainable Jeddah Municipality.

The City of Al Laith which is located in the southwest of the kingdom of Saudi Arabia is a fast growing urban area. This city is on the road between Jeddah – Jizan but located within the region of Mecca. It is located about 220 km to the south of the city of Jeddah. The city started as fishermen village as well as a centre for pilgrims coming from the south and east of Africa and Ethiopia. Today, the city has grown up to become a commercial port for the Kingdom of Saudi Arabia that receives goods mainly from Jizan and Yemen to be transported to other parts of the kingdom. With the establishment of a number of urban observatories throughout the kingdom in particular the neighboring City of Jeddah, the City of Al Laith has taken a preliminary step toward determining the sustainability of the city against its planned urban development. Therefore, a consulting firm was commissioned to conduct a survey with respect to the existing social, economic and environmental conditions of the city for the purpose of determining the sustainability. What is the sustainability of the City of Al Laith in term of the social, economic and environmental dimensions? How to use ESDA approach to explore the survey data and how to use GIS to present the sustainability of the City of Al Laith?

1.4 The Main Objective

Based on the research questions above, the main objective of this research is to visualize the survey data of the City of Al Laith using ESDA approach and GIS to describe the sustainability of the City of Al Laith development.

1.5 The Objectives and Specific Research Questions

In order to support the main objective above, three specific objectives were developed together with their respective research questions:

1. To review the concept of urban sustainability and to develop indicators to measure the sustainability.
 - 1.1 What is urban sustainability?
 - 1.2 What is component of urban sustainability?
 - 1.3 How to measure the sustainability?
 - 1.4 How to select appropriate indicators?
2. To visualize the survey data of Al Laith city in order to describe the sustainability of the city.
 - 2.1 What is ESDA?
 - 2.2 How to visualize the survey data?
 - 2.3 How to describe the sustainability using the survey data and ESDA
3. To evaluate the results of the study and to describe the sustainability of Al Laith city.
 - 3.1 How to evaluate the result?

1.6 Conceptual Framework

Figure 1.1 shows the conceptual framework of the study. The survey data contain the social, economic and environmental information of the City of Al Laith.

This data represents the major input besides maps and identified indicators. The ESDA technique will be used to explore the survey data and GIS will be employed to present the sustainability of the City of Al Laith.

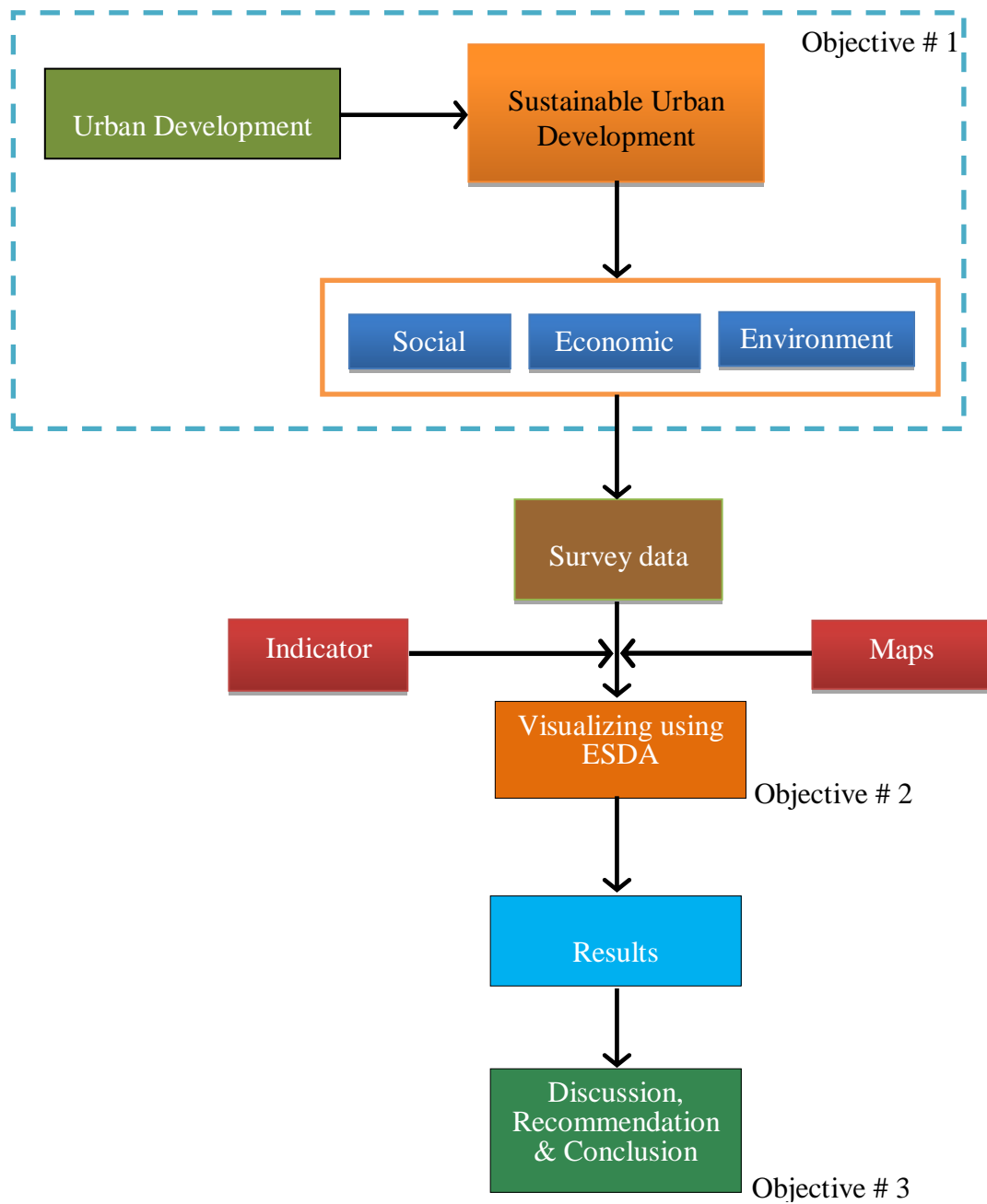


Figure 1.1: The Research Conceptual Framework

1.7 Research Design

The table below shows the research design for this study.

Table 1.1: The Research Design

Aim	Objectives	Research Question	Data	Method	Expected Output
Visualize the survey data of Al laith city in order to describe the sustainability of the city using ESDA	1) Review the concept of urban sustainability and develop indicators to measure the sustainability.	1) What is urban sustainability? 2) What is component of urban sustainability? 3) How to measure the sustainability? 4) How to select appropriate indicators?	Literature, papers, thesis	Literature Review	Research Framework
	2) To visualize the survey data of Al laith city in order to describe the sustainability of the city.	1) What is ESDA? 2) How to visualize the survey data? 3) How to describe the sustainability using the survey data and ESDA?	Secondary data, survey data, maps, documents	ESDA	Map of sustainability of Al Laith city
	3) To analyze the result for descriptive sustainability of Al-laith city.	1) How to evaluate the result?		Analyzing the result	Sustainability of Al Laith city

1.8 The Structure of Thesis

This dissertation contains six (6) chapters as follow:

Chapter 1, presents the background information regarding sustainable urban development, indicators for measuring the sustainability of urban development, and a descriptive spatial statistical approach called the ESDA. From these, the problem statement, research formulation and justification were derived.

Chapter 2, the main objective of this research is to visualize the survey data of Al Laith city in order to assess the sustainability of the city using ESDA approach. This chapter answers four research questions from objective 1 and one of the questions from objective 2. The research questions are: (1) What is urban sustainability?, (2) What is the component of urban sustainability?, (3) How to measure the sustainability?, (4) How to select appropriate indicators? and (5) The ESDA approach.

Chapter 3, the main objective of this research is to visualize the survey data of the city of Al Laith in order to describe the sustainability of the city using ESDA approach. Therefore, chapter 3 describes the study area in term of its location, population structure and economic activities.

Chapter 4, this chapter describes the methodology of the research that consists of the data used for the study, the development of the study geodatabase and the method for visualizing the data using GIS and ESDA. In addition, the main purpose of this chapter is to discuss about objective (2) and answer the research questions on: (1) how

to visualize the sustainability of the city using the survey data, maps and indicators? and (2) how to describe sustainability using GIS and ESDA?

Chapter 5, a total of six (6) research questions was answered in chapter (4). Chapter (3) describes the study area while chapter (4) explains the survey data of the city and the approach on how the survey was explored to describe the sustainability of the city of Al Laith. Three (3) research questions were answered in this chapter.

Chapter 6, this chapter concludes the research that has been conducted. The city of Al Laith, the kingdom of Saudi Arabia, uses selected as the study area for this thesis. The main research questions for this study is “what is the sustainability of the city of Al Laith in term of the social, economic and environmental dimension?” based on this main research question, the main objective of the research was to visualize data on the city of Al Laith in order to describe the sustainability of the city using ESDA approach. To operationalize the study, three specific objectives were developed.

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