ASSESSING THE SUSTAINABILITY OF GHANAIAN CITIES: THE CASE STUDY OF ACCRA METROPOLITAN AREA

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Thesis
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Moses Kweku Aryee

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ABSTRACT

The objectives of this research were to develop Accra Sustainability Indicators (ASI) to assess the sustainability status of Accra Metropolitan Area. In all, 41 indicators were selected and classified into Economic, Environment, Social and Institutional dimensions. Statistical data on all indicators were collected from Accra Metropolitan Assembly and its departments, other relevant central government institutions and publications for a period of 4 years, from 2012 to 2015. Statistical analysis using SPSS and Microsoft Excel was used to evaluate the city's sustainability performance. The results showed that Accra's economic and social dimensions were approaching sustainability while environmental and institutional dimensions were performing poorly. Economic sustainability rose from 0.84 in 2012 to 0.87 in 2015 so also was the social dimension which increased from 0.50 in 2012 to 0.52 in 2015. Meanwhile the environmental dimension remained at ~0.2 and the institutional dimension moved slightly from 0.35 in 2012 to 0.4 in 2015. The overall sustainability score of Accra however showed a little progression to sustainability over the last 4 years rising from 0.48 in 2012 to 0.51 in 2015.

KEY WORDS: SUSTAINABLE CITY/ SUSTAINABLE DEVELOPMENT INDICATORS/ CTY SUSTAINABILITY ASSESSMENT/ ACCRA

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CONTENTS

	Page
A**CKNOWLEDGEMENTS**	**iii**
ABSTRACT	**iv**
LIST OF TABLES	**viii**
LIST OF FIGURES	**ix**
LIST OF ACRONYMS	**x**
CHAPTER I INTRODUCTION	**1**
1.1 Background / Problem Statement	1
1.2 Conceptual Framework	3
1.3 Research Questions	4
1.4 Objective	4
1.5 Scope	5
1.6 Expected Result	5
1.7 Definition of Terms	6
CHAPTER II LITERATURE REVIEW	**7**
2.1 Introduction	7
2.2 Sustainability	7
2.2.1 Definition	7
2.2.2 Dimension of Sustainable Development	8
2.3 Sustainable City	10
2.3.1 Definition of City and Urbanization	10
2.3.2 Sustainable Cities	10
2.3.3 Goal of Sustainable City	12
2.3.4 Characteristics of Sustainable Cities	13
2.4 Sustainable Development Indicators	17
2.4.1 Definition of Indicators	17
2.4.2 City Sustainability Indices	17

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CONTENTS (cont.)

		Page
	2.4.3 Importance of Sustainable Development Indicators	22
	2.4.4 Selecting Sustainable Development Indicators	23
2.5	City Sustainability Assessment (CSA)	24
	2.5.1 CSA Methods	24
	2.5.2 CSA using Indicators	26
	2.5.3 Related Researches on City Sustainability Assessment	27
2.6	Ghanaian City/ Urban Area	29
	2.6.1 The major cities of Ghana	29
	2.6.2 Ghana Urban/City Management	30
	2.6.3 Urban/City Management Authorities	32
2.7	Profile of Accra Metropolitan Area (AMA)	33
	2.7.1 Land area and location	33
	2.7.2 Population	34
	2.7.3 Water and Sanitation	35
	2.7.4 Vegetation	36
	2.7.5 Education and Health	36
	2.7.6 Economic	37
	2.7.7 Transport	39
	2.7.8 Local Governance	39
CHAPTER III	**METHODOLOGY**	**40**
3.1	Selection of study area	40
3.2	Selection of Sustainable Development Indicators (Accra Sustainability Indicators)	40
3.3	Secondary Data Collection and Data Sources	41
3.4	Data Analysis	43
	3.4.1 Standardization and normalization of indicators values	43
	3.4.2 Estimation of Weight	44

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CONTENTS (cont.)

	Page
3.4.3 Score calculation	44
CHAPTER IV RESULTS AND DISCUSSION	**47**
4.1 Accra Sustainability Indicators (ASI)	47
4.2 Results of Accra Sustainability Indicators	50
4.2.1 Performance of economic indicators	50
4.2.2 Performance of environmental indicators	53
4.2.3 Performance of Social Indicators	56
4.2.4 Performance of institutional indicators	58
4.3 Discussion of Results	60
4.3.1 Economic Sustainability of Accra	60
4.3.2 Environmental Sustainability of Accra	61
4.3.3 Social Sustainability of Accra	62
4.3.4 Institutional Sustainability of Accra	64
4.3.5 Overall Sustainability Performance	65
4.3.6 Comparison between the four dimensions	67
CHAPTER V CONCLUSION AND RECOMMENDATION	**69**
5.1 Conclusion	69
5.2 Recommendations	70
5.2.1 Recommendations for economic sustainability	71
5.2.2 Recommendations for environment sustainability	71
5.2.3 Recommendations for social sustainability	72
5.2.4 Recommendations for institutional	73
5.2.5 Policy Recommendations	73
5.2.6 Recommendations for Future Research	74
REFERENCES	**75**
APPENDIX	**84**
BIOGRAPHY	**102**

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LIST OF TABLES

Table		Pages
2.1	Characteristics of Sustainable City	14
2.2	Features of top sustainable cities	16
2.3	Sustainable Cities Indicator	19
2.4	Sustainable Indicators of Egypt Green City	21
2.5	Ghana Urban Policies	32
3.1	Sources of Secondary Data	42
3.2	Indicator Weighting	44
3.3	Procedure for aggregate score calculation using assigned weights	45
3.4	Sustainability Index Scale	46
4.1	Accra Sustainability Indicators Aspects	49

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LIST OF FIGURES

Figure		Page
1.1	Conceptual Framework	4
2.1	The four pillars of Sustainable Development	9
2.2	The Map of Ghana	30
2.3	Map of Accra Metropolis in National Context	34
2.4	Informal settlement of Accra	35
2.5	Solid waste nuisance in Tema Station, Accra	35
2.6	Korle Lagoon narrowed by slums and wastes	36
2.7	Greater Accra Regional Hospital at Ridge	37
2.8	Makola Market, Accra	38
2.9	Accra Shopping Mall	38
2.10	Accra Financial Center	39
4.1	Performance of economic indicators	52
4.2	Performance of environmental indicators	55
4.3	Performance of social indicators	57
4.4	Performance of institutional indicators	59
4.5	Economic sustainability performance of Accra	61
4.6	Environmental sustainability performance of Accra	62
4.7	Social sustainability performance of Accra	64
4.8	Institutional sustainability performance of Accra	65
4.9	Overall sustainability performance	66
4.10	Radar analysis showing sustainability dimensions of Accra	68

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LIST OF ACRONYMS

AFD	Agence Française de Développement (French Development Agency)
AMA	Accra Metropolitan Area / Accra Metropolitan Assembly
ASI	Accra Sustainability Indicators
BRT	Bus Rapid Transit
CDI	City Development Index
CSA	City Sustainability Assessment
CSD	City Sustainable Development
DACF	District Assemblies Common Fund
DPSIR	Driving Force State Response
ECOWAS	Economic Community of West Africa States
EPA	Environmental Protection Agency
GDP	Gross Domestic Product
GHG	Green House Gas
GNUPAP	Ghana National Urban Policy Action Plan
GSGDA	Ghana Shared Growth and Development Agenda
GSS	Ghana Statistical Service
GoG	Government of Ghana
GCSI	Ghana City Sustainability Index
HDI	Human Development Index
HIV/AIDS	Human Immunodeficiency Virus/ Acquired Immunodeficiency Syndrome
ICSU	International Council of Scientific Unions
LEAP	Livelihood Empowerment Against Poverty
LSDI	Local Sustainable Development Index
MDAs	Ministries, Departments and Agencies
MLGRD	Ministry of Local Government and Rural Development

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LIST OF ACRONYMS (cont.)

MMDAs	Metropolitan, Municipal and District Assemblies
MWRWH	Ministry Water Resources, Works and Housing
NUP	National Urban Policy
NDPC	National Development Planning Commission
NGO	Non-Governmental Organization
PM	Particulate Matter
SD	Sustainable Development
SDG	Sustainable Development Goal
SDIs	Sustainable Development Indicators
SPSS	Statistical Package of the Social Sciences
UN	United Nations
UNCSD	United Nations Council for Sustainable Development
UNDP	United Nations Development Programme
UNSDG	United Nation Sustainable Development Goal
UNSTATS	United Nations Statistics Division

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CHAPTER I
INTRODUCTION

1.1 Background / Problem Statement

The world in the past two decades continues to experience urbanization with over 54% of the world population currently residing in cities (UN – Habitat, 2016). It is expected that by 2050, two-thirds of the world population would reside in urban centres with Africa and Asia experiencing about 90 percent growth in urbanization (World Bank, 2016). The world currently has about 250,000 cities. These accommodate the 54 percent of the global population, control 70 to 80 percent of economic output and consume 80 percent of global energy (Arcadis, 2015) in addition to emitting more than 70 percent of global carbon dioxide (UN-Habitat, 2016). Urban growth in Africa within the past two decades is unprecedented. Its urban growth rate is 11 times more than the growth in Europe (UN-Habitat, 2016). It is noted that over a quarter of the 100 fastest growing cities in the world are located in Africa (UN-Habitat, 2014). The urban growth has benefited the continent economically while at the same time pose some challenges to its environment and social life.

Ghana, one of the fastest growing economies in Africa, has experienced high urban growth in the past 20 years. Ghana's urbanization rose from 31 percent in 1984 to 54 percent in 2015. This, far outpace the West Africa average (40.4 percent in 2015) and even growing faster than the world growth rate (2.16 percent) (World Bank, 2015). By 2025, Ghana's urbanization is projected to reach 60 percent above Africa and the World projections of 44.9 and 58.2 percent respectively (UN-Habitat, 2016). Cities offer opportunities for economic growth, human development and beautification of a nation.

In Ghana, the rapid urbanization is associated with 5.7 percent annual contribution to GDP from 1984 to 2013, structural transformations and poverty reduction with Accra (the Capital of Ghana) experiencing a 20 percent drop from 1991

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to 2012 (World Bank, 2015) as well as rise in Ghana's Human Development Index (HDI) from 0.423 in 1980 to 0.579 in 2014 (UNDP, 2015).

Despite, the opportunities for growth, cities face major challenges including urban poverty, environmental degradation and destruction of social cohesion. Africa cities continue to face resource constraints; higher cost of energy, water and raw materials coupled with environmental and climate change variability (UN-Habitat, 2014). Ghana's urbanization has been characterized with problems such as weak urban economy, urban poverty, land use disorder, pollution, stressed on urban services such as water and electricity, growth of slums and squatter settlements, poor urban governance and weak institutional coordination, poor transport infrastructure and traffic management and insecurity amongst other negative aspects (MLGRD, 2012a). Global responses to the challenges of urbanization have called for inclusive, safe, resilient and sustainable cities (UN, 2015) that provide opportunities including energy, housing, employment, transport and water for all residents. Promoting city sustainability is so necessary especially in Africa due to its increasing urbanization, promising economic fortunes and high consumption patterns.

Realizing the dangers associated with unplanned and uncoordinated urbanization, and considering the great promises of urbanization to sustainable development, many governments around the globe have policy interventions aimed at minimizing the challenges while optimizing the gains. The government of Ghana over the years has implemented several urban development structures. Some of these strategies were outlined in the Ghana Vision 2020, the Ghana Poverty Reduction Strategy (2003 – 2005), Growth and Poverty Reduction Strategy (2006 – 2009), Ghana Shared Growth and Development Agenda (GSGDA I) (2010 – 2013) and currently GSGDA II (2014 – 2017). The GSGDA II seeks among others to promote green economy; sustainable, spatially integrated and orderly development of human settlements; resilient urban infrastructure, maintenance and provision of basic services; slum upgrading and development of institutions. Government of Ghana in May 2012 launched the National Urban Policy (NUP) which seeks "to promote a sustainable, spatially integrated and orderly development of urban settlements with adequate housing, infrastructure and services, efficient institutions, and a sound living and

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working environment for all people to support the rapid socioeconomic development of Ghana (MLGRD, 2012a).

An Action plan which was developed alongside the policy framework defined key activities to be implemented by Metropolitan/Municipal/District Assemblies (MMDAs) and Ministries and Departments (MDAs) within five years in order to achieve the twelve NUP policy objectives (MLGRD, 2012b). Several other interventions include the Ghana Urban Management Pilot Project (GUMPP), Urban Development Grant (UDG), and Participatory Slum Upgrading Project.

Almost five years (2012 – 2016) into the implementation of National Urban Policy and Action Plans as well as years of implementing government urban policies and strategies, what is the sustainability status of Accra? Has the implementation of these policies, strategies and action plans improved the city's economic, social and environmental dimensions?

This study developed Accra Sustainability Indicators (ASI) and assessed the sustainability performance of Accra Metropolitan Area, the largest and capital city of Ghana. It provided insights into the strong and weak sustainability indicators of the city.

1.2 Conceptual Framework

Based on a comprehensive literature review on sustainability, sustainable city and sustainable development indicators and a set of selection criteria, appropriate sustainability indicators were selected under four pillars namely economic, social, environment and institution.

Statistical data on the indicators were collected from public institutions and official documents on the study area and using quantitative analysis to evaluate the performance status of the city. Results were presented quantitatively and qualitatively using tables and charts to describe the sustainability status of the study area and make appropriate recommendations. This conceptual flow is shown in Figure 1.1 .

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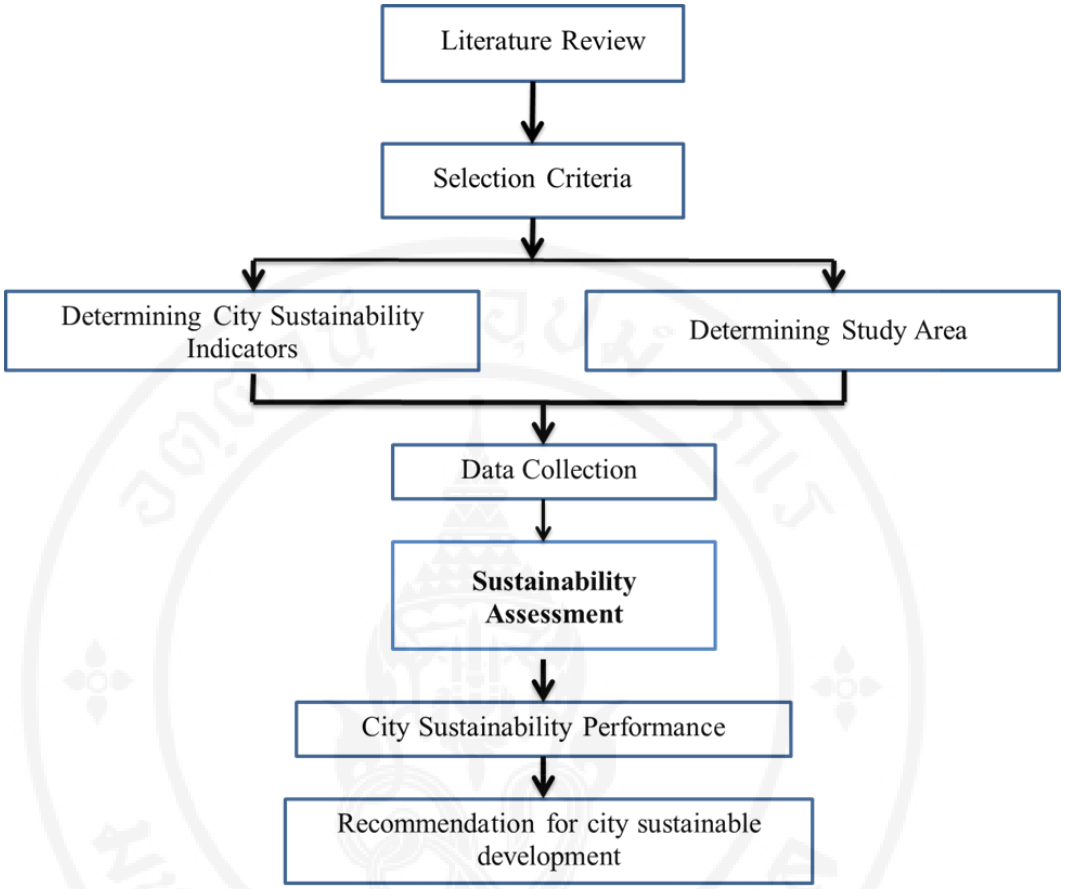

Figure 1.1: Conceptual Framework

1.3 Research Questions

1. What kinds of indicators can be used to evaluate the city's sustainability?
2. What is the sustainability status of Accra Metropolis?

1.4 Objective

1. To develop indicators for evaluating city sustainability in Accra
2. To comprehensively assess the sustainability status of Accra Metropolitan Area

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1.5 Scope

This research assessed the sustainability of the study area. The assessment was undertaken for the period of four years spanning 2012 to 2015. The main aspects of the research include developing sustainability indicators to evaluate the sustainability status of the study area. The four dimensions of sustainable development forming the pillars of the indicators are:

(A) Economic sustainability (economic growth) –this described the economic performance of the city in terms of access to energy, transport or mobility, level of unemployment, urban poverty and income inequality.

(B) Social Sustainability (quality of life) – this deals with living conditions and relationship among people. Key issues include housing, health, education, utility supply and incidence of crime

(C) Environmental Sustainability (environmental quality) – the environment dimension looked at issues of pollution, sanitation, waste management, and land use.

(D) Institutional Sustainability (good governance) – The role of the transparent and accountable local institutions is essential in achieving Sustainable Development. Indicators include among others financing environmental management and inclusive local administration.

1.6 Expected Result

1. Developed appropriate indicators for sustainable city planning, monitoring evaluation.

2. The sustainability performance of Accra Metropolitan Area, Ghana.

3. Results and recommendations on sustainable decisions and city plans that would ensure improved quality of life, economic growth and environmental quality.

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1.7 Definition of Terms

1. City Sustainability Assessment: The evaluation of the sustainability of a city / urban area using statistical methods

2. Economic sustainability: the ability of the economy of a state, nation, city to support the wellbeing of people

3. Environmental Sustainability: Environmental Sustainability is concerned with protection of natural resources from destruction to support the wellbeing of residents and future generations

4. Gini Co-efficient: it is the statistical measure of the level of disparity in the income of people in a particular locality.

5. Indicator / Index: Selected statistics or parameters related to key objectives that, when monitored over time, represents trends

6. Institutional sustainability: an efficient and effective governance that is capable of directing development in a sustainable manner

7. Social Sustainability: one of the dimensions of sustainable development that creates an enabling environment for easy coexistence of different social and cultural groups

8. Sustainable City: An urban area that satisfies the needs of both current and future generations

9. Sustainable Development: The development that meets the needs of the present without compromising the ability of the future generations to meet their own needs.

10.Sustainable Development (SD) Dimensions: these include economic, environment, social and institutional aspects of development

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CHAPTER II
LITERATURE REVIEW

2.1 Introduction

The chapter placed the study into perspective by defining relevant terms and concepts, and described some previous works done by others on sustainability assessment and thereby justifying the methodology adopted. The key concepts addressed in this chapter were (1) Sustainability (2) Sustainable Development Indicators, (3) Sustainable Cities and (4) City Sustainability Assessment and (5) Accra Metropolitan Area (AMA).

2.2 Sustainability

2.2.1 Definition

Sustainability is an integral part of human development. It is even more an issue with the current generation considering the level of our population, resource consumption and environmental degradation. During the 1970s, the term sustainability was used to describe the balance between economy and basic ecology (Csaba et al., 2008). The Meadows (1972) co-authored the Limits to Growth which warn of the dangers of population over shot and its consequences of over consumption of natural resources. It applied the exponential growth scenarios to predict a limit to the carrying capacity of the earth, a level where the earth cannot accommodate the overpopulation. Sustainability is therefore the ability to endure (Ibrahim et al., 2015).

The increasing global population and its activities have and continue to put stressed on the earth's natural resources thereby leading to environmental degradation. There is however increasing knowledge of environmental degradation posed by overpopulation and resource exploitation. This led to the discussions on sustainability.

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In the year 1980, the World Conservation Strategy (WCS) used the term Sustainable Development as a way of addressing challenges of population growth and ecosystem damage. This was instrumental in the formation of the Brundtland Commission by the United Nation's World Council on Environment and Development which focused on long term environmental strategies as a means to achieving global sustainability.

The Brundtland Commission made the term Sustainable Development very popular since 1987. In the Commission's report on Our Common Future in 1987, it defined sustainable development as development that meets the needs of the present without compromising the ability of the future generations to meet their own needs.

Shaker & Sirodoev (2016) used the term Sustainable Development to mean equilibrium in the use of natural resources to satisfy human's present and infinite socioeconomic needs of future generation. Sustainable Development aims at enhancing quality of life of current population while using of the earth's natural resources within its carrying capacity (El Ghorab and Shalaby, 2016). In this way, consumption of natural resources does not reduce the ability of the earth to contain population and activities of its current and future habitats.

2.2.2 Dimension of Sustainable Development

The concept of sustainable development connotes equilibrium between social and economic growth and protection of the environment. This aimed at ensuring that natural resources are utilized wisely in a manner that the future generation can comfortably meet their needs. This gives rise to the three pillars (dimensions) of Sustainable Development namely Environment, Social and Economic (World Bank, 2001).

Another key dimension of Sustainable Development that was recognized by many researchers and institutions is the role of institutions. UNCSD (2001) and ICSU (2015) mentioned that institutions play critical role in Sustainable Development.

Specially mentioned was local government and financial management capacity. Institution or governance plays interlocking or supporting function to the other dimensions. Explaining further the importance of institutions as the fourth dimension of sustainable development, the UN-Habitat (2016) noted that for

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sustainability there be must strong leadership, land use planning, jurisdiction coordination, inclusive citizen participation as well as efficient financing. The four pillars of Sustainable Development as shown in Figure 2.1 depict their interconnection and the coordinating role of Institutions.

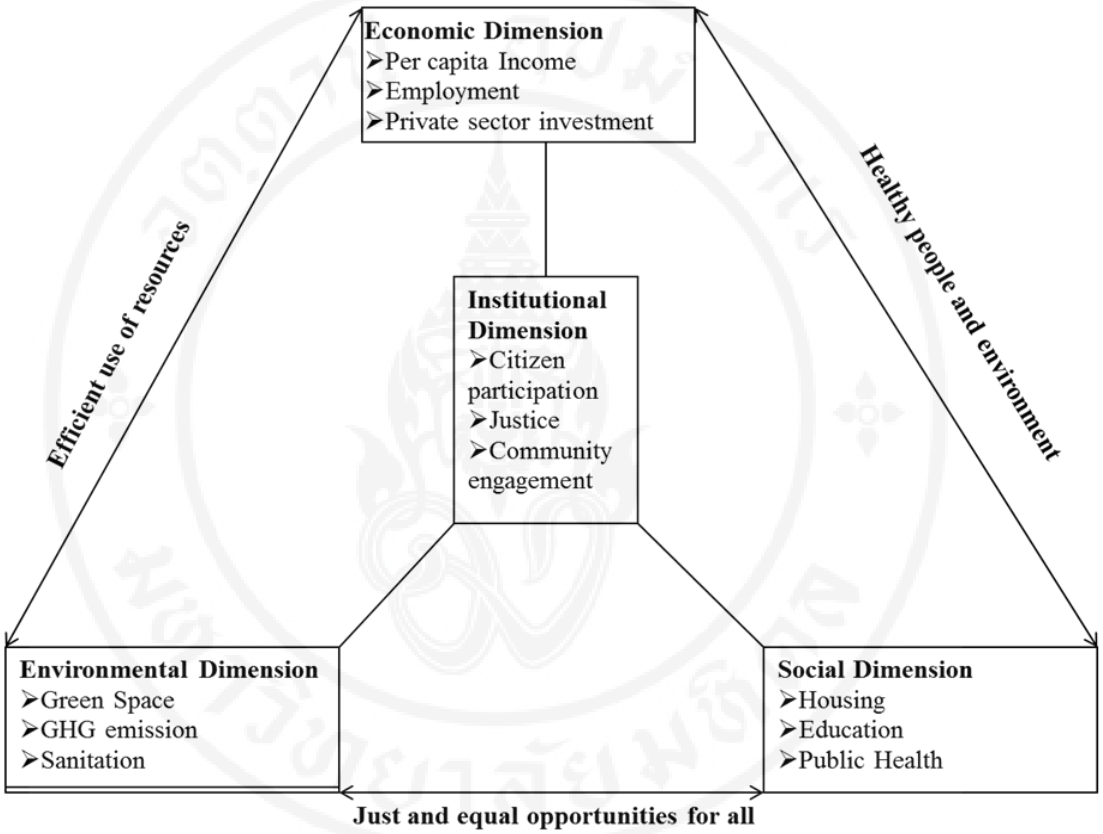

Figure 2.1: The four pillars of Sustainable Development

A sustained development can therefore be defined as the coordination of socio-economic and environmental management goals by the system of government (institutions) to bring long term growth and progress characterized by efficient use of resources, clean environment, healthy people, justice and equal opportunities for all.

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2.3 Sustainable City

2.3.1 Definition of City and Urbanization

A city is an intensively developed area of high population density characterized by high resources and human activities (Wei et al., 2016). Every city is located within a geographical space with limited resources which can accommodate only certain number of habitants and activities. Cities turn to grow more rapidly due to the fact that most of these areas are capital towns, resources dominance, vibrant in economic and social activities.

According to the World Bank (2016), the world is experiencing increasing rate of urbanization with over a half of the global population already residing in urban areas. As a centre, a city offers education and knowledge, infrastructure, socio-cultural networks, trade avenues, and economic opportunities for citizens to grow (United Nations, 2015). The development of cities and town increases opportunities for its people, in addition to the beauty the urban built environment gives the area.

However, many cities especially in developing countries are held back by several challenges. The problem with urbanization in many countries is poor management. Urban areas in developing countries are faced with water shortages, waste management, overcrowding, traffic congestion, air pollution, poor infrastructure, housing deficit and slum growth. There is increasing degradation of the urban environment. Most urban growths have resulted in the breakdown of traditional and community safety nets or social alienation and criminality (Bithas et al., 2006). Economically, poorly developed urban cities experience income inequality, low income and high unemployment as well as hard macro-economic and financial shocks (World Bank, 2000). It is in regards to these urban challenges that the call for a sustainable cities to enhance continuous and improved economic, environmental and social growth is in the right direction.

2.3.2 Sustainable Cities

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Cities and other human settlements are the main focus of efforts aimed at reducing poverty and promoting sustained growth because these settlements provide the living and working environment of almost everybody in the world (UN-Habitat,

2016). Making cities sustainable is very important to promoting the health and well being of its residents. It is in light of this that the idea of sustainable cities has emerged. Sustainable cities can address global environmental challenges associated with urban growth, middle income status, and population increases (Global Environment Facility, 2015).

In this study, a sustainable city is defined as an urban area that satisfies the needs (in terms of infrastructure, education, safety, health and medical care, housing, utilities, greenery and good governance) of both current and future generations. The sustainability of a city has a direct correlation with quality of life. A city that is more sustainable offers good quality of life and wealth for its residents with lower per capita environmental degradation (Arcadis, 2015).

Sustainable cities are resilient and are capable of adapting to, mitigating, and promoting economic, social, and environmental change (World Bank, 2013). In addition to mitigating the effect on the environment, a sustainable city is also a region that promotes active citizen participation in its development agenda (Martos et al., 2016).

According to Naoko Ishii, "If planned and managed well, compact, resilient, inclusive, and resource-efficient cities can drive development, growth, and the creation of jobs, while also contributing to a healthier, better quality of life for residents and the long-term protection of the global environment" (World Bank, 2016). Sustainable city therefore works well for the citizens in the present and at the same time preserving a better world for the future (Arcadis, 2015).

Highlighting the ecological aspect of sustainable city, Martos (2016) noted that a "sustainable, resource efficient city is significantly decoupled from resource exploitation and ecological impacts and is socio-economically and ecologically sustainable in the long term". City sustainability comprises a wide range of issues including management of the environment, economic growth and social welfare. The bedrock for city sustainability is promoting a livable environment where social stability is maintained. Providing sustainable, integrated basic service (energy, water, transport, education, health and waste management) is essential to enhancing the resilience of urban household's livability.

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Due to the importance of cities in human development, the United Nations adopted the goal (UNSDG11) which seeks to make cities and human settlements inclusive, safe, resilient and sustainable. The targets of this goals aim at addressing issues regarding provision of houses and essential needs, transports, participatory human settlement decision making and development, protection of cultural and natural heritages, disaster reduction as well as lowering of cities' per capita environmental impact (United Nations, 2015).

The issue of urbanization and the call for sustainable city development is gaining root by governments all over the world. Multilevel governance strategies are being developed worldwide to promote livable urban cities. Development of sustainable cities depends on governments' ability to significantly decouple economic growth from inefficient usage of natural resource and environmental degradation.

2.3.3 Goal of Sustainable City

The aim of every sustainable development agenda is a balance between the economy, environment and social aspects back by strong institution to deliver quality of life, economic growth and clean environment as well as good and participatory governance. Sustainable city aims at creating value, eliminating waste and improve access to renewable energy and overall quality of life for its citizens.

World Bank (2000) in its document, Cities in Transition defined the following goals and objectives for sustainable cities.

1. Decent quality of life for all, including basic living standards for the poor
2. Reduced poverty and inequality
3. Healthy environment including clean air and water and safe waste disposal
4. Safety and security including low levels of crime, violence and natural disasters
5. Integration of women and vulnerable groups in urban society
6. Preservation of cultural heritage of urban areas, for enjoyment by all residents including public green spaces

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7. Growth and increased productivity of city output, broad based employment, investment and trade opportunities

8. Accountable and transparent local government

9. Strong institutions which are responsive to the demands of the disadvantage

10. Sound financial management system

As part of the 2030 Agenda for Sustainable Development, the United Nations in Goal 11asked governments to make cities and human settlements inclusive, safe, resilient and sustainable. According to Goal 11, sustainable cities seek to:

1. provide adequate, safe and affordable housing and basic services and upgrade slums

2. provide safe, affordable, accessible and sustainable transport system and improved road safety for women, children, persons with disabilities and older persons

3. promote participatory, integrated and sustainable human settlement planning and management

4. protect and safeguard the world's cultural and natural heritage

5. reduce the number of deaths and people affected and decrease the direct economic losses caused by disasters

6. reduce the adverse per capita environmental impact of cities

7. increase access to safe, inclusive and accessible, green and public spaces

8. ensure resource efficiency, mitigation and adaptation to climate change and resilience to disasters and

2.3.4 Characteristics of Sustainable Cities

The characteristics of a sustainable city include but not limited to the livability of the area which results to the social wellbeing of people, environmental quality, the economic output and good governance. Farmer et al. (2006), Goode (2011) and Martos et al. (2016) have provided some characteristics of a sustainable/green/livable/eco city as shown in Table 2.1 .

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Table 2.1: Characteristics of Sustainable City

Pillars (Index)	Characteristics (Indicator)	Definition (Parameter)
Economic	Accessibility/Mobility	▪ Public transport (mass transit) system ▪ Bikes and pedestrian lanes
	Attract and retains investments	▪ Investment opportunities ▪ Business ownership by investors (environment for private sector growth)
	Green economy	▪ Low carbon emission ▪ Eco Industrial Parks ▪ Employment
Social	Educated people	▪ Adult literacy ▪ School enrolment ▪ Educated working class ▪ Environmental awareness education
	Healthy population	▪ Public health including malaria, HIV/AIDS ▪ Infant mortality ▪ Maternal health
	Local ownership	▪ Strong communities ▪ Affordable and easy access to resources

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Table 2.1: Characteristics of Sustainable City (cont.)

Pillars (Index)	Characteristics (Indicator)	Definition (Parameter)
Environment	Green space	➢ Community parks and gardens ➢ Forest reserves
	Resource Efficiency	➢ Efficient utilization of resource including water and energy ➢ Low GHG emission
	Green Building	➢ Environmentally sustainable building design, construction and operation ➢ Limited resource use especially energy
	Municipal solid waste Management	➢ Source reduction of waste (generation) ➢ Technologies for Recycle and Reuse and composting
	Renewable Energy	➢ Solar, wind, geothermal and biomass energy sources
Institutional	Leadership	➢ Local governance system ➢ Citizens participation
	Safe and secure	➢ Crime and accident reduction ➢ Disaster management ➢ Community engagement
	Accountable governance	➢ City assessment mechanisms

Based on studies by Tamanini et al. (2014) and Arcadis (2015) Frankfurt, Copenhagen, Amsterdam, London, Rotterdam, Berlin and Singapore among others were ranked as top ten sustainable cities in the world. The rankings (Global Green Economy Index, 2014 and Sustainable Cities Index, 2015) were based on issues such as quality of life of people, environmental quality and resource efficiency, economic performance and leadership. Table 2 is a summary of the sustainability features of top five sustainable cities of the world.

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Table 2.2: Features of top sustainable cities

City	GGEI 2014	SCI 2015	Characteristics
Frankfurt	-	1	- Decreased CO_2 emission per capita by 15 % - Increased economic growth by 50 % in 2015 - Energy efficient economy - Green buildings, technologies, industries - Green area with every tree numbered and published online - Protected vegetative cover (Germany's largest city forest with 8,000 hectares) - Recreation area - 15% of all commutes done by bicycle
Copenhagen	No. 1	No. 3	- Holistic long term environmental Planning and policies - Working on carbon neutrality by 2025 - Largest wind turbine industries in the world - Generates large amount of wind energy - Efficient public transit - More people on bikes
Amsterdam	No. 2	No. 4	- Reducing carbon emission to 40 percent by 2025 - Energy saving mechanism - Sustainable and efficiency in use of fossil fuel - Maximize renewable energy uses
London	No. 5	No. 2	- Reducing GHG emissions by 60% in 20 years - Offer incentives for energy efficiency in homes - Increasing urban green spaces - Reduce traffic congestion in the city through stiff taxes - Promoting electric vehicles and hybrids
Berlin	no. 6	No. 6	- Vehicle emission standards - High density of environmental technology companies - Clean technology

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2.4 Sustainable Development Indicators

2.4.1 Definition of Indicators

Indicators are defined as selected statistics or parameters related to key objectives that, when monitored over time, represents trends (Dekker et al., 2011). Indicators are either qualitative or quantitative. They are useful tools for monitoring goals and objectives and for important decision making.

Indicators have been realized to be important in making informed policy decision by the UN General Assembly. In 1992, the Agenda 21 approved indicators as key aspects of sustainable development. Agenda 21, Chapter 40, called for the development of sound indicators for measuring sustainable development by countries and the international community. The indicators, according to the UN, would amplify the goal on sustainable development also help in decision-making at all levels governance.

The next agenda was the Johannesburg Plan of Implementation & CSD-11, CSD-13 in the years 2001, 2003 and 2005 respectively. In Chapter X of the Johannesburg Plan of Implementation the CSD encouraged participating countries to do develop additional and better quality indicators for sustainable development which would be in tune with country specific policies (United Nations, 2016).

2.4.2 City Sustainability Indices

Due to growing recognition of the environmental challenges of the world, more than 190 countries have engaged in sustainable development to promote environmental quality, social equity, and economic welfare (UNCSD, 2012 and Shaker & Sirodoev, 2016). As a result various indices have been developed for assessing the sustainability of societies by researches and institutions.

Sustainable Development indicators and indices are generally acceptable tools for evaluating performance, decision making and communication within the three dimensions of social, economic and environment (Shaker & Sirodoev, 2016). Some known sustainable development indices include:

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2.4.2.1 Local Sustainable Development Index (LSDI)

Shaker & Sirodoev (2016) developed the local sustainable development index (LSDI) using household and property composition indicators from demographic and health. The LSDI include: number of household members; residence type and number of rooms used for sleeping; main roof, wall, and floor material; amount of land owned by household; amount livestock, herds, or farm animals; has vehicle(s) (truck/car; motorcycle/scooter), distance to nearest city and capital; type of cooking fuel; water heat, refrigerator, TV, and washing machine; wealth index; computer, mobile phone, microwave, and DVD/VCR; access to improved water source; access and type of sanitation facility; number of household members outside country and head of household education level.

2.4.2.2 United Nations Council for Sustainable Development Indicators

The United Nations in 2007 adopted the third edition of the CSD indicators which incorporated the Millennium Development Goals and other followed up agenda. 96 indicators, including a 50 sub core indicators were approved. The revised indicators as summarized under four pillars of social, environment, economic and institutional included Equity, Health, Education, Population, Housing, Security, Natural hazards, Atmosphere, Land, Oceans, seas and coasts, Freshwater, Biodiversity, Economic development, Governance and Global economic partnership(UN, 2007). These have become useful source of SD indicators for governments.

2.4.2.3 City Development Index

The City Development Index (CDI) was proposed by the United Nations Centre for Human Settlements (UN-Habitat) in 2002. According to Singh et al. (2009), the CDI consist of two areas

1. Infrastructure index - made up of indicators on households' access to clean and affordable water, canalization, electric power, telecommunication networks.

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2. Waste index – made up of indicators on sewage treatment, waste water treatment and solid wastes disposal.

2.4.2.4 Sustainable Cities Index 2015

Arcadis (2015) also developed sustainable cities index for measuring the cities sustainability. The aim was to promote a balance between economic growth, social development and environmental management of 50 cities from 31 countries in the world. The indices developed were categorized into three dimensions as shown in Table 2.3. The indicators seek to measure the quality of life,

Table 2.3: Sustainable Cities Indicator

Pillars	Description	Sub- Index/ Indicators
People	Measures social performance including quality of life	- Transport infrastructure (public transport, rail, airport, commuting time) - Health - Literacy - Education - Income inequality - Work-life balance - Dependency ratio - Green spaces
Planet	Captures environmental factors like energy, emissions and pollution	- City energy consumption and renewable energy share - Recycling rate - Green House Gas emission - Natural catastrophe exposure - Drinking water - Sanitation - Solid waste management - Air pollution
Profit	Assesses business environment and economic performance	- Ease of doing business - Importance to global economic networks - Property and living costs - GDP per capita - Energy efficiency

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2.4.2.5 UN Sustainable Development Goal 11

The aim of making cities safe and livable, the United in August 2015 outdoor Goal 11, sustainable cities, as one of the 17 Global Goals that seeks to achieve the 2030 Agenda for Sustainable Development. The following indicators were developed to aid implementation and performance measurement by implementing countries (UNSTATS, 2016).

1. Proportion of urban population living in slums, informal settlements or inadequate housing
2. Proportion of the population that has convenient access to public transport, disaggregated by age group, sex and persons with disabilities
3. Ratio of land consumption rate to population growth rate
4. Percentage of cities with a direct participation structure of civil society in urban planning and management which operate regularly and democratically
5. Share of national (or municipal) budget which is dedicated to the preservation, protection and conservation of national cultural natural heritage, including World Heritage sites
6. Number of deaths, missing people, injured, relocated or evacuated due to disasters per 100,000 people
7. Percentage of urban solid waste regularly collected and with adequate final discharge with regard to the total waste generated by the city
8. Annual mean levels of fine particulate matter (PM2.5 and PM10) in cities (population weighted)
9. the average share of the built-up area of cities that is open space for public use for all, disaggregated by age group, sex and persons with disabilities
10. Proportion of women subjected to physical or sexual harassment, by perpetrator and place of occurrence (last 12 months)
11. Cities with more than 100,000 inhabitants that implement urban and regional development plans integrating population projections and resource needs

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12. Percentage of cities that are implementing risk reduction and resilience strategies aligned with accepted international frameworks (such as the successor to the Hyogo Framework for Action 2005-2015 on disaster risk reduction) that include vulnerable and marginalized groups in their design, implementation and monitoring

13. Percentage of financial support that is allocated to the construction and retrofitting of sustainable, resilient and resource-efficient buildings

2.4.2.6 Green and Eco City in Eastern Desert, Sohaj governorate, Egypt

In developing the new city, El Ghorab & Shalaby (2015) identified the following sustainability indicators (Table 2.4) as part of the master plan of the city which aimed to create a unique and new centre where urgent needed urban services including Recreation, Health, Education, Tourism, Business and Trade Services (wholesales, commercial centres, Malls and exhibition for agric and industrial productions).

Table 2.4: Sustainable Indicators of Egypt Green City (Modified from El Ghorab & Shalaby, 2015)

1. Urban, Land Use and Architecture Sustainability Indicators - Demand on housing and services - Land use distribution - Urban landform that is compact, integrated and reduces travel distances - Green, open spaces and recreation - Green building	2. Infrastructure and Public facilities sustainability - Transport system incorporating choices for private cars, mass transit, bikes lanes and pedestrians walkways - Energy efficient – LED bulbs - Waste management system including recycling technologies for waste water

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Table 2.4: Sustainable Indicators of Egypt Green City (Modified from El Ghorab & Shalaby, 2015) (cont.)

3. Social Sustainability Indicators - Equal access to housing and basic urban services by all residents regardless of age, income, gender, race, ethnicity and disability - Social inclusion	4. Economic Sustainability Indicators - Economic base and employment - Private sector development
5. Environmental Sustainability Indicators - Air quality and Noise	6. Management and Governance Sustainability Indicators - Citizen participation defined by membership of local government - Environmentally Preferably Purchasing (EPP) - Green Procurement

2.4.3 Importance of Sustainable Development Indicators

As compare with monetary aggregation methods for assessing sustainability, the use of indicators are best yardsticks of measuring the well of city's development (Ibrahim et al., 2015). Researches; Searcy (2009), Agency (2012), Ibrahim et al. (2015) and King (2016) have shown that Indicators are useful for sustainable development in the following ways:

- Indicators are practical, cost-effective means of assessing performance and measuring progress
- They are useful tools communicating sustainability performance and decisions
- Indicators are useful in problem identification and awareness by city authorities
- Indicators help city authorities to explain, predict and justify development actions taken to address a problem in the city
- They aid sustainable urban planning by providing data for easy decision making

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- Improve stakeholder participation in city planning, monitoring and evaluation. Published indicators assist citizens to contribute effectively to their development
- Indicators serve as useful tools for re-directing performance towards sustainability targets
- At the local governance level, Sustainability Indicators can help to improve service delivery to the public
- Indicators can serve as a means of comparison between metropolis/municipalities/districts
- Help to promote good and accountable governance

2.4.4 Selecting Sustainable Development Indicators

For a comprehensive sustainability assessment, indicators must quantify all economic, social, environmental and institutional aspects of cities. Indicators must reflect the positive and negative impacts (Valenzuela-Venegas et al., 2016) of city development. Selecting indicators for sustainability assessment must be specific to the type and scale of assessment.

Driving Force State Response (DPSIR) is method used in defining sustainability indicators. According to Agency (2012), this approached is based on

✓ Driving forces of environmental change such as mining activities and industrial production

✓ Pressures on the environment from activities such as disposal of municipal waste

✓ State of the environment (such as quality of water in rivers and lakes)

✓ Impacts on population, economy and ecosystem (such as flooding, climate change)

✓ Response to the society (example: watershed protection)

The DPSIR provides a causal loop for assessing the relationship between environment and society. The framework explains that human activities and natural conditions put pressure on the environment. The effect of this is change in the environmental condition. As a consequence, human health, ecosystems and economic resources are negatively impacted. This invariably calls for responses from

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institutions. Societal responses feed into all other elements to close the loop. This framework helps in assessing the causes and effects environmental challenges. Analysis of a city using this approach would help in deriving indicators for monitoring and measuring environmental sustainability.

Another credible and widely used means of developing good indicator for sustainability assessment is based on characterization. Characterization was the foundation of selecting indicators (King, 2016). As expressed in criteria UNCSD (2007), Arcadis, (2015), Shaker & Sirodoev (2016) and Valenzuela-Venegas et al. (2016), the following characteristics must be checked in selecting indicators

a) Comprehensive – indicators consider various factors affecting the sustainability of the city including availability and use of natural resource, environmental degradation, social equity and good governance

b) Relevant – useful for local decision making and city planning, monitoring and evaluation of city's sustainability. Also useful to long term development strategies of the city.

c) Available – should be easily measurable and based on easy accessibility and collection of information.

d) National in scope – the national interest must fit into indicators. Indicators must be seen as contributing to policies, goals and objectives of national long and medium term plans

e) Simple – indicators must be clear, easy to understand and interpret and open to use by all

f) Conceptually sound – measurement and monitoring of indicators must be practical and systematic within the available data.

2.5 City Sustainability Assessment (CSA)

2.5.1 CSA Methods

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There are different approaches to sustainability assessment. Singh et al. (2009) identified two branches of methodologies of assessing the sustainability of an

industry, state or a nation. These are monetary aggregation methods and the use of physical indicators.

1. Monetary Aggregation Methods

Monetary aggregation methods also called monetary valuation methods are usually adopted by economists. In this analysis, all Sustainable Development Indicators are translated into monetary units and economic methods such as Cost Benefit Analysis (CBA), Green Domestic Product accounting, Resource Accounting and Sustainable Growth Modeling are used to assess the level of sustainability. Monetary Aggregation Methods for sustainability assessment are noted for their inherent limitations. According to Munda (2000), the use of precise, quantitative data based on market prices can be very misleading. These methods therefore do not provide a comprehensive approach to addressing the complex nature of sustainability assessment.

2. Use of Physical Indicators

The use of physical indicators became widely used approach to assessing sustainable development after the United Nations in 1992 approved, as part of Agenda 21, indicators as key aspects of sustainable development. This method measures the closeness of an indicator to a desired sustainability target (Olsson et al., 2004). The indicators summarize and simplify the complex nature of the environment into a handful number of useful information for decision making (Godfrey et al., 2001 and Singh et al., 2009). In sustainability assessment, indicators are used to assess current sustainability conditions and trends or anticipate future conditions.

The challenge with the use of indicators as expressed by Olsson et al. (2004) include

1. Difficulty in choosing specific and appropriate indicators by researchers/planners

2. Possibility of researchers concentrating more on the method of assessment and its outcome rather than the ultimate goal of sustainability

3. Difficulty in creating a linkage between national and local indicators where differences exist.

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2.5.2 CSA using Indicators

Singh et al. (2009) provided extensive framework for evaluating sustainability using of sustainable indicators. The following approached was defined from data collection through to final evaluation.

1. Data

Availability of high quality data must be considered in data selection. Where data gaps exists, appropriate methods such as mean substitution, correlation results or times series can be used to fill the missing data.

2. Constructing composite indices

Since, there are many indicators for the sustainability analysis, a composite index need to be determined for easy analysis and comparison. This can be done based on empirical analysis or intuitive appeal or combination. Bivariate (correlation matrices) and multivariate statistical techniques can be employed in the empirical analysis. The multivariate which is composite indexing uses methods such as factor analysis.

3. Normalizing/Standardizing/Scaling composite index

There are four options to undertaking composite scaling. The researcher can decide not to scale variables and the second option is the use of standard scores (z and t values). In this case, raw data is adjusted by multiplying with either +1 or -1.

To transform the raw data into standard scores, the formula z = (actual score – mean) divided by standard deviation is applied. Where the calculations result in discomfited figures, they are adjusted by multiplying with 10 in order to obtain a visually manageable score. The other two options include transforming variables into ordinal response scale or using conventional linear scaling transformation (LST) method where variable are scaled from 0 to 100.

4. Weighting

A weighting scheme is then adopted and applied on the standardized composite index. Multivariate techniques are useful options of weight selection when explicit weights are not employed. However, principal component analysis method where various components are weighted with proportion of variance in the original set of variables can be also used.

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5. Aggregation

Each component score such as economic, social and environment is aggregated either through addition or functional nature to produce one composite sustainability score of the city. Some aggregation methods include multiple linear regression, principal component analysis, factor analysis and analytical hierarchy process.

6. Validation

Finally, to improve the quality of results, the composite indices are validated by going over the selection, scaling, weighting and aggregation process. Two methods useful for validation are item analysis and external validation.

2.5.3 Related Researches on City Sustainability Assessment

1) Sustainability index for Taipei (Lee et al., 2007)

In assessing the sustainability of Taipei in Taiwan, 51 indicators were developed by the researchers. The sources of the indicators included the Taipei Sustainable Development Strategic Plan (2004), the United Nations Center for Human Settlement (1997), United Nations Council for Sustainable Development (2001) and the Organization for Economic Co-operation and Development (1998). Statistical data was collected from government agencies to analyse the sustainable development trends of the city from 1994 to 2004.

For the purpose of easy analysis, the 51 Indicators were classified into four dimensions of economic, environment, social and institutional. Composite Indicators Values were then calculated for these four dimensions. Finally, the composite values were summed up into single value to form the Sustainability Index of Taipei. The method used in calculating the Sustainability Index was **Standard Deviation**. The following steps were adopted by the researchers:

a) Indicator simplification – this involves making indicators easily understandable by using numbers. It also involves unifying the indicators with different characteristics and units into one unit.

b) Standardized values of indicators were calculated over the period of 11 years spanning 1994 to 2004

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c) The Indicators standardization was done such that standardized values fall within 0 to 1 in order to facilitate the weighting of the indicators

d) Overall sustainability index for each year was calculated by assigning equal weights to all four dimensions. The calculated Sustainability index of the dimensions were summed up to form the Sustainability Index of Taipei

2) The Urban Sustainability Index for measuring China's cities (Xiao et al., 2010)

In this research, 18 relevant indicators were developed to assess cities with respect to five aspects of sustainable development namely basic need, resource efficiency, environmental health, built environment and commitment to sustainability. Data was collected from 112 Chinese cities from the year 2004 to 2008.

Colours (green and red) and signs (↑→↓) were used to show the performance trends of the cities. For analysis, the indicators were aggregated across indexes in order to identify common characteristics among the cities. The aggregated score was derived from the average of the indicators. Correlation analysis was also done between the wealth (GDP growth) of the city and sustainability using a series of f-tests. The study limited its statistical analysis to ANOVA, Regression and Factor analysis.

3) The China Urban Sustainability Index 2013 (Li et al., 2014).

This study was a further expansion of the USI by Xiao et al. (2010). This research evaluated 185 cities for the period of 7 years spanning 2005 to 2011. For the purpose of calculating scores, all indicators were standardized for easy comparison with each other. Secondly, where data gaps existed in some years, calculated mean of the years before and after or the average growth rate of nearby years were used. Four dimensions were used and different weights were assigned to each. Society and environment were each worth 1/3 of the whole while economic and resources were each worth 1/6 of the whole. The analysis of data included:

a) Growth analysis - compound annual growth rates of each indicator was calculated in order to deduce the fastest growing cities and the drivers of the growth

b) Benchmarking – the study benchmarked Chinese cities with eleven international cities including London, Berlin, Paris and Copenhagen in order to compare case cities to these developed cities

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c) Quantitative analysis – the research conducted statistical analysis such as correlation to summarize city growth strategies and relationship between and among the drivers of sustainability.

2.6 Ghanaian City/ Urban Area

2.6.1 The major cities of Ghana

Based on a 2010 population census of Ghana, the major cities in Ghana (Figure 2.2) include Accra, which serves as the seat of government and hub for transport, business, education and health; Kumasi, a historical, commercial and cultural city; Tamale the most important urban centre in the northern half of Ghana; and Tema and Sekondi-Takoradi as port cities, (Laryea-Adjei, 2000). Others include Ashiaman, a commercial city; Obuasi, noted for gold mining and Cape Coast, former capital of Ghana, a historical and tourism city. With a population of more than 20, 000 other cities in Ghana are Wa, Bolgatanga, Ho, Koforidua, Obuasi, Teshie and Sunyani among others.

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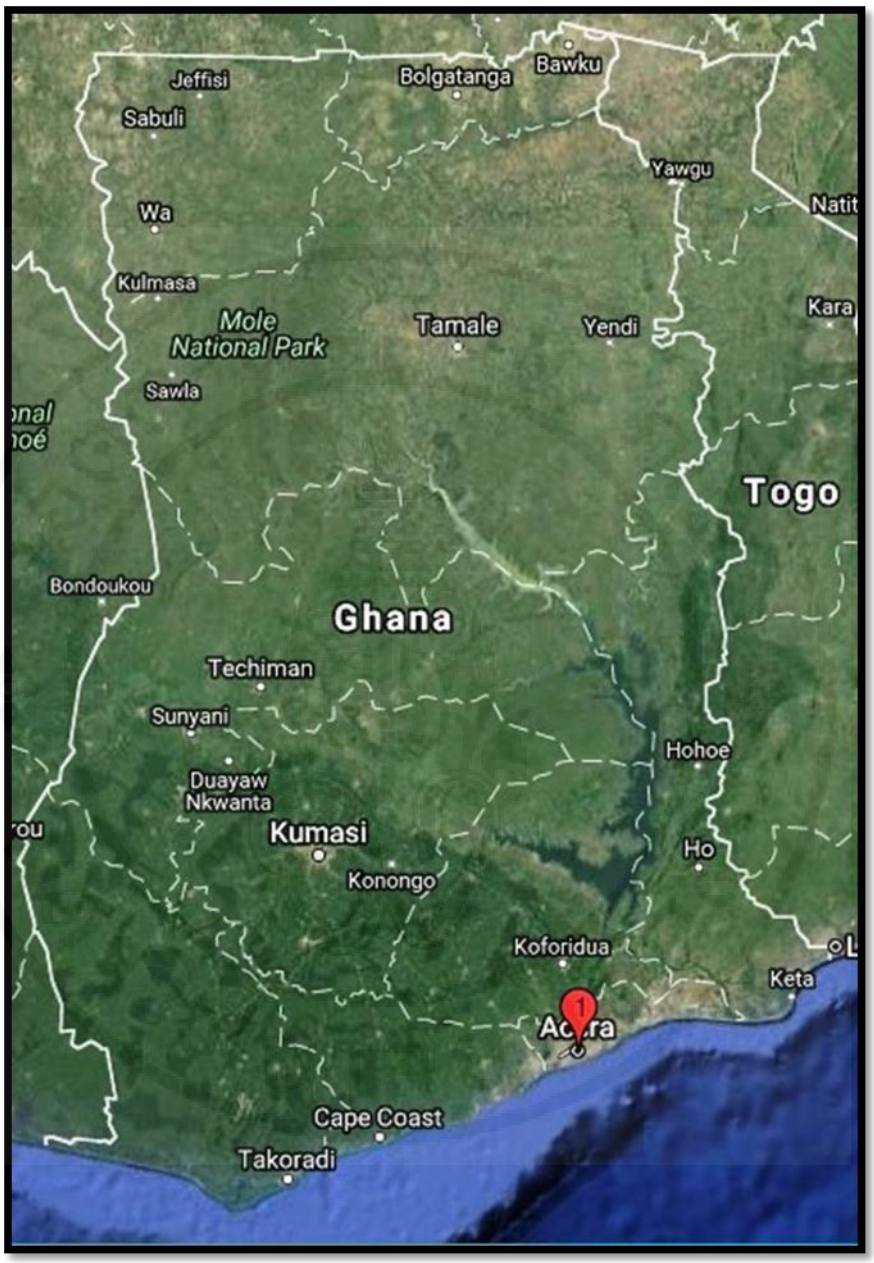

Figure 2.2: The Map of Ghana (EarthExplorer, 2017)

2.6.2 Ghana Urban/City Management

Ghana has witnessed an unprecedented urban growth in the past 20 years. Its level of urbanization (54 percent) is said to outpace the West Africa average (40.4 percent) and even growing faster than the world (54 percent) (World Bank, 2015 & UN-Habitat, 2016). The country is ranked among the top four urban countries in West Africa (Fuseini & Kemp, 2016). This urban transition has faced several challenges including weak urban economy, urban poverty, land use disorder, pollution, stressed

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on urban services such as water and electricity, growth of slums and squatter settlements, poor urban governance and weak institutional coordination, poor transport infrastructure and traffic management and insecurity among others (GoG/MLGRD, 2012a). To harness its benefits and reduce the challenges of urbanization, the government of Ghana initiated several urban management policies and projects.

Ghana Urban management dated back in history. One major progress towards the management of cities in the country was contained in the Seven-Year Development Plan for Reconstruction and Development (1963/64 – 1968/70) under the Nkrumah government. The National Physical Development Plan which came along with the Seven-Year Plan underscored the emergence of urbanization in the country and how it was to be managed (Amazon S3, 2015).

Over the years, many short and medium term plans were prepared and implemented by several governments which had components of urban management. In 1995, the Ghana Vision 2020 was prepared under the Rawlings administration. This, among others, set up the Ghana Free Zones Board in 1997 to oversee the creation of free zones enclaves in major cities to attract direct foreign investment in those areas (Laryea-Adjei, 2000). Other national policy and plans such as the Ghana Poverty Reduction Strategy (2002 – 2005), the Growth and Poverty Reduction Strategy (2006 – 2009) and the Ghana Shared Growth and Development Agenda (I and II from 2010 – 2013 and 2014 – 2017 respectively) give various policy directives aimed at promoting sustainable cities in Ghana. Many other policies and projects including the first integrated National Urban Policy of Ghana (2012) are summarized in Table 2.5.

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Table 2.5: Ghana Urban Policies (UN-Habitat, 2012, MLGRD, 2012 and AFD, 2015

National Policy and Projects	**Objectives**
Ghana Shared Growth and Development Agenda II (2014 – 2017).	promote green economy; Promote resilient urban infrastructure, maintenance and provision of basic services; slum upgrading and development of institutions
National Urban Policy (NUP) and Ghana National Urban Policy Action Plan (2012)	promote a sustainable, spatially integrated and orderly development of urban settlements with adequate housing, infrastructure and services, efficient institutions
Ghana Urban Management Pilot Project (2012-2016)	improve the living conditions in urban areas for the inhabitants of the four selected cities of Kumasi, Sekondi-Takoradi, Tamale and Ho leading to sustainable development
Urban Development Grant (2011)	improve the social life of people in some Municipal and Metropolitan Assemblies in the fields of health, sanitation and water
Participatory Slum Upgrading Project (2008 – 2015)	strengthen the capacity of institutions and key stakeholders in settlement and slum improvement through the use of good governance and management approaches and pilot projects

2.6.3 Urban/City Management Authorities

The main institutions responsible for the management of cities in Ghana is the Metropolitan/Municipal/District Assemblies (MMDAs) set up under the Chapter 20 of the 1992 Constitution and Local Government Act 1993 Act 462. There are 216 MMDAs currently in Ghana charged with the responsibility of planning, initiating, coordinating, managing and executing policies to the growth and development of their respective areas of jurisdiction.

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The MMDAs are coordinated under the Local Government Service (LGS) and the Ministry of Local Government and Rural Development (MLGRD) who

formulates urban policies such as the NUP and the Ghana National Urban Policy Action Plan (2012) for implementation by the MMDAs.

In the discharge of its mandates, the MMDAs are guided by the Ghana National Development Planning Commission (NDPC) in planning and Ministry of Finance in financial budgeting. Other Ministries, Departments and Agencies (MDA) also play several oversight roles in the areas of environmental management by the EPA, land use management by the Lands Commission and Town and Country Planning, natural resources management by Forestry Commission and Mineral Resources, agriculture by the Ministry of Agric, trade and investment by the Ministry of Trade and Industry and a host of others depending on jurisdiction.

The challenges to these MMDAs in ensuring sustained growth of cities in Ghana are inadequate funding, inadequate staff, bureaucracy and undue politicization of policies, programmes and projects (Laryea-Adjei, 2000).

2.7 Profile of Accra Metropolitan Area (AMA)

2.7.1 Land area and location

Geographically, Accra Metropolitan Area (Figure 2.3) located on longitude 05 35’ and latitude 00 06’ and shares boundary with La-Dadekotopon Municipality to the east, the Gulf of Guinea to the south, on the West by Ga South and Central Municipal Assemblies, and Ga West and La-Nkwatanang Municipalities to north. It has total land area of 139.674 Km^2 (GSS, 2014). The area has a long coast and consists of ten (10) sub-metropolitan areas.

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Figure 2.3: Map of Accra Metropolis in National Context (Google, 2017)

2.7.2 Population

AMA is the large metropolis in Ghana with a 2015 population of 2,277,000 and which is expected to grow to 2,870,000 by 2025 (UN-Habitat, 2016). The Metropolis is entirely urban (100%) and it is the largest city in Ghana and the 6th in West Africa (UN Habitat, 2014). It is estimated that the city's growth rate is 3.1 percent per annum (AMA, 2014) typically is a result of rural migration. It is also estimated that more than a million commuters move in to the city daily to work in administrative, educational, industrial and commercial sectors (AMA, 2016).

Housing

Accra Metropolis has over 450, 794 households living in 149,689 houses making the population per house estimated at 11.1 percent and an average household size of 3.7 (GSS, 2014). According to the AMA (2014), only 21.4 percent of the annual estimated housing needs of the city are produced creating a backlog of 300,000 units resulting in the development of over 29 squatters and slum (Figure 2.4).

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Figure 2.4: Informal settlement of Accra (Author's fieldwork, 2016)

2.7.3 Water and Sanitation

Two water sources, namely Weija and Kpong waterworks, supply on daily basis 401,800m3 of water to meet a daily demand of 532,570m3 resulting in a shortfall of 130,000m3 (AMA, 2014). Sanitation is a major concern of the Accra Metropolitan Assembly. The city generates between 1,800 and 2,000 tonnes of solid waste on daily basis. However, daily collection of waste is between 1,500 and 1,800 tonnes at an average daily expenditure of GH¢18,000.00. This means that between 300 and 500 tonnes of waste remain uncollected daily, resulting in poor environments (Figure 2.5).

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Figure 2.5: Solid waste nuisance in Tema Station, Accra (Author's fieldwork, 2016)

2.7.4 Vegetation

AMA is made up of three vegetation regions namely shrub, grass and coastal lands. The area dominated by shrubs and a number of small trees with mean height of 5m is in the west and northern parts of the city. The grasses are however short with height less than 1m found in forests. Accra has a long stretch of coastal area comprising wetland and dunes as vegetation zones. Mangroves are common forest types that can be found along the coasts. The vegetation cover of the city has however been destroyed over the years. Accra has wetlands and lagoons that generate micro climates in parts of the Metropolis (GSS, 2014). Most of these have been destroyed by residential property developers, slum dwellers and solid wastes (Figure 2.6).

Figure2.6: Korle Lagoon narrowed by slums and wastes (Author's fieldwork, 2016)

2.7.5 Education and Health

There are over a hundred and thirty-two (132) health facilities in Accra comprising 31 government (Figure 2.7), 7 quasi government, 1 mission, 93 private/NGOs (AMA, 2016 cited from BRT Action Plan, 2010). These provide out and in-patient services as well us public health services including reproductive and child health, nutrition, pharmacy, laboratory and X-rays.

In terms of education, the city has many high ranking private and public institutions from pre-school to tertiary level. There are also various non-formal institutions that provide technical and vocational skills.

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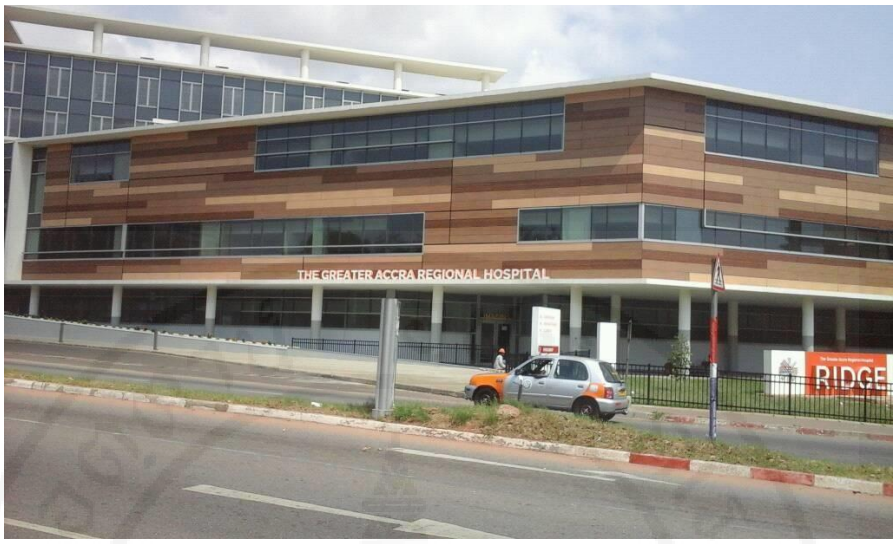

Figure2.7: Greater Accra Regional Hospital at Ridge (Author's Fieldwork, 2016)

2.7.6 Economic

The city of Accra is a major contributor to economic growth of Ghana. Contributing about one-third of Ghana's total manufacturing output and 10 percent of national Gross Domestic Product; Accra is an emerging economic hub in the ECOWAS sub-region. It is hub of major manufacturing industries, oil companies, market (Figure 2.8) and shopping malls (Figure 2.9), financial institutions (Figure 2.10), telecommunication, tourism, education, health institutions, transport and other important establishments which provide job prospects for citizens of Ghanaians and the West Africa sub-region.

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Figure 2.8: Makola Market, Accra (Author's fieldwork, 2016)

Figure 2.9: Accra Shopping Mall (Author's fieldwork, 2016)

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Figure 2.10: Accra Financial Center (Author's fieldwork, 2016)

2.7.7 Transport

The road network in the city is 1,800km (AMA, 2014) serving road users who are private and commercial users. Traffic congestion resulting in long waiting times, long driving times and long walking distances characterize the transport system in Accra.

2.7.8 Local Governance

The Accra Metropolitan Assembly is the local administrative government of the city. Established under Article 241 of the 1992 Constitution and the Local Government Act 462, AMA comprised the General Assembly and 10 Sub-Metropolitan District Councils namely Ayawaso West and East, Osu Klottey, Ashiedu Keteku, Ablekumah Central, Ablekumah North, Okaikoi South and Okaikoi North. The General Assembly is composed of 116 Assembly members (76 elected and 40 government appointees) thirteen Parliamentarians and the Mayor who are responsible for decision making (AMA, 2014).

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CHAPTER III
METHODOLOGY

3.1 Selection of study area

For the purpose of this study, selection of the case study area was based on the following criteria (MLGRD, 2012a and Tamanini et al., 2014):

- The city with the largest population size,
- The city's contribution to national economy,
- It's administrative function,
- The geographic representation,
- The city's comparability with other cities in Ghana and the world
- Data availability

3.2 Selection of Sustainable Development Indicators (Accra Sustainability Indicators)

A thorough literature review was conducted to compile a comprehensive list of city sustainable indicators to be called Accra Sustainability Indicators (ASI). These relevant worldwide indices were included the United Nations Sustainable Development Goal 11, Sustainable Cities Index 2015, City Development Index, Sustainability Cities Index and LSDI among others. National Policy documents such as the Ghana Shared Growth and Development Agenda II (2014 – 2017) and National Urban Policy provided a hub for the definition of indicators.

The Accra Sustainability Indicators were selected using the criteria based on Arcadis, (2015), Shaker & Sirodoev (2016) and Valenzuela-Venegas et al. (2016). These include:

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1) Usefulness for local decision making and city planning, monitoring and evaluation.

2) Relevance to National Policies – the conformity of selected indicators to GSGDA II (2014-2017) and National Urban Policy (2012) among others.

3) The selection also took into consideration very basic needs such as water, housing, health care and electricity.

4) Data availability and ease of data collection and analysis were considered

5) Simplicity – indicators must be clear, easy to understand and interpret and open to use

6) Conceptually sound – measurement and monitoring of indicators must be practical and systematic within the available data

In all, indicators were developed under the four pillars of City Sustainability namely economic sustainability, environmental sustainability, social sustainability and institutional sustainability. Each indicator was seriously evaluated to determine their significance to Ghana's sustainability agenda as expressed in the GSGDA II (2014-2017), the National Urban Policy and United Nations Sustainable Development Goal 11. An analysis to link the indicators to these policy documents was undertaken and shown in Appendix A.

3.3 Secondary Data Collection and Data Sources

Statistical data of the Metropolitan Area were collected for the period of four years starting from the year of the National Urban Policy and its implementation Action 2012 to 2015. The data sources included local and central government institutions operating in city in addition to government and international reports and publications on the indicators selected for this research. Table 3.1 show the data sources and data needs.

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Table 3.1: Sources of Secondary Data

DATA SOURCE	SECONDARY DATA
Accra Metropolitan Assembly - General Administration - Waste Department - National Disaster Management Organization - Town and Country Planning Department - International reports and publications	- 2012 – 2015 Composite Budgets - Annual Progress Reports on Waste management Local governance and finance Access to electricity and water Disaster rate and reduction Urban land uses Housing
Environmental Protection Agency	Air quality indicators
Ghana Statistical Service - Ghana Living Standard Survey 6 - 2010 Population Census Report (2014)	Poverty, income inequality, access to services, adult literacy, education
Metropolitan Agriculture Department	Agric land use and production
Ghana Police Service	Safety and security indicators
Metropolitan Directorate of Education	School enrolment
Metropolitan Directorate of Health Services	Health indices
Metropolitan Sanitation Department	Access to approved sanitation facilities

Data Collection and defining missing values

A set of data collection designed to collect statistical data on various aspects of city sustainability indicators selected were used during the data collection. In cases where indicator values were not available for some years, the study used simple average to calculate the score for year that is lacking. The average or mean values were calculated between the first two values on each side using the formula (Year A + Year B)/ 2. The instance where this is done was when data was available for three out of the four years. Where only one or two years' data was available, the indicator was abandoned. This led to the final 41 indicators from the initial 51.

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3.4 Data Analysis

This study employed both quantitative and qualitative analysis skills to measure the sustainability trend of the study area over the period of four years. The analytical tools used include descriptive statistics, graphical methods, standardization, and Spider Web Analysis.

3.4.1 Standardization and normalization of indicators values

Based on Singh et al. (2009), Xiao et al. (2010) and Li et al. (2014), this research used statistical analysis to standardize and normalize indicator values using the following formula and steps:

a) Indicator simplification – this involves making indicators easily understandable by using numbers. This study quantified all indicators for easy statistical analysis.

b) In order to normalize all Indicators to same units and scale, standardized values of were calculated over the period of 4 years using the formula:

Standard Value Z = $(\boldsymbol{Xi} - \mu)/\boldsymbol{\sigma}$

Where Z = standardized value,

Xi = Indicator value,

μ = mean value, and

σ = standard deviation.

c) The next step was to normalize the standardized indicator values such that standardized values fall within 0 to 1 in order to facilitate the weighting of the indicators. The Standardized Indicator Value is therefore

Y = $(\boldsymbol{Zi} - \boldsymbol{a})/(\boldsymbol{e} - \boldsymbol{a})$

Where Zi lies between a to e, and Zi = standard score

a = minimum value and

e = maximum value

Y ranges from 0 and 1.

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d) Reverse indicators were standardized using the formula (1 - Y) so that all values nearer or equal to 1 means approaching sustainability whiles those approaching zero (0) means unsustainable development.

3.4.2 Estimation of Weight

This research applied the concept of Kirkwood (1997) which stated that indicator weights were assigned to each value based on the degree of importance. Equal weights were assigned to each indicator values of the four dimensions of City Sustainability because the study assumes that all indicators share equal importance towards the sustainability of the study area. The weights were assigned equally to indicators under the four dimensions. Economic indicators were assigned the weight of 0.167 while environment indicators were assigned 0.077. In addition, social and institutional indicators were weighted 0.063 and 0.167 respectively (Table 3.2). In calculating the overall score, a weight of ¼ (0.25) is assigned each sustainability dimension.

Table 3.2: Indicator Weighting

Indicator	Weight (Wi)
Economic	0.167
Environment	0.077
Social	0.063
Institutional	0.167

3.4.3 Score calculation

Three levels of calculations were done in this research. These include:

I. Calculating Aggregate scores of each sustainability dimension namely economic, environment, social and institutions.

II. Calculating overall city sustainability for each year

II. Radar analysis to compare sustainability of the study period (2012 – 2015)

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(a) Calculating Aggregate Scores

This method employed additive averaging technique. This is advantageous because of its methodological transparency. In this case, the standardized values (R) were multiplied (X) with the weighted values (W) of each indicator. The individual indicator values (RW) were then be aggregated using additive method and divide (/) by the sum of weights to give the total score for each SD Dimension is shown in Table 3.3 below:

Table3.3: Procedure for aggregate score calculation using assigned weights

Indicator	Score (Ri)				Weight (Wi)	RiWi
	2012	2013	2014	2015		
Indicator 1						
Indicator 2						
Indicator ……						
	ΣR_1	ΣR_2	ΣR_3	ΣR_4	ΣWi	$\Sigma RiWi$

W = weighting of each indicator

Y = normalized value of each indicator

n = number of indicator

i = year of assessment

Composite Dimension Score = $(\sum_{i=1}^{n}(\boldsymbol{YixWi}) / (\sum_{i=1}^{n} \boldsymbol{wi})$

(b) Overall Sustainability index

In the second analysis, Composite Indicators Values were calculated for the four dimensions of SD. A weight of 0.25 was assigned each dimension in this research such that the contribution of each SD dimension to local sustainability was treated as equal. Therefore, the total weight is 1. The overall sustainability score of Accra was calculated by summing the sustainability of each dimension score in each year divided by the total weight.

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$$\text{Accra Sustainability Index} = \frac{\sum_{i=1}^{n}(ES\ x\ W)(SS\ x\ W)(EnS\ x\ W)(IS\ x\ W)}{\Sigma W}$$

Where

W = Weight

i = year of assessment

The result of the overall assessment was match against the sustainability index scale (Table 3.4) to indicate the level of the city's sustainability. The scale showed that a score of less than 0.4 is poor performance; between 0.4 and 0.5 is a moderate; a good sustainability performance ranged from 0.51 to 0.7 while an excellent sustainability performance is from 0.71 to 1.0.

Table3.4: Sustainability Index Scale

SCALE	**Level of performance**
Less than 0.4	Poor
0.4 - 0.5	Moderate
0.51 - 7.0	Good
0.71 – 1.0	Excellent

(c) Radar Chart/Spider Web Analysis

The Spider Web Analysis was used to compare composite indicators between the various years of assessment and among the four dimensions of SD. The spider web chart otherwise known as Radar chart, Web chart, Spider chart, or Star chart is a method that graphically presents multivariate data, in a manner that many quantitative variables start from the origin with different angles (Zhang et al., 2015). It provided a better view for understanding the overall sustainability index of the city (Science for Environment Policy, 2015) as against the direction of each SD dimension.

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CHAPTER IV
RESULTS AND DISCUSSION

4.1 Accra Sustainability Indicators (ASI)

This study initially selected 51 indicators to assess the city's sustainability. However, due to lack of adequate data, the researched finally settled on 41 sustainable development indicators and categorized them under the four dimensions of sustainability as shown in Table 10. The remaining 10 indicators included total number of jobs created by all sectors; residents' saving power; noise level of residential areas; proportion of renewable energy in total energy mix; annual concentration Sox and Nox; total land designated as public space; daily per capita electricity consumption; volume of industrial waste generated; mortality from road traffic accidents; deaths, missing people or injured due to disaster; and police-civilian rate. These were equally important sustainability indicators.

The indicators were adopted primary based on data availability, simplicity and relevance to sustainability and national policies. A study was carried out to link the relevance of these indicators to the Ghana Shared Growth and Development Agenda (2014 – 2017), National Urban Policy and the UNSDG 11 (Appendix A). The research showed that all indicators of this study found their root in the national development policies revealed in the goals and objectives of these documents. The definition and sources of Accra Sustainability Indicators are shown in Appendix B. In defining the indicators, the national context was highly considered so as to ensure relevance to national development agenda.

Out of the 41approved, 6 indicators are defined under economic and institutional dimensions, 16 indicators under the social dimension and 13 under the environment. The economic dimension was concerned with basic economic parameters such as poverty rate and income inequality among rich and poor using the Gini co-effiecient

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Others included unemployment rate and access to energy and transport. The environment dimension defined indicators that were related to waste management including daily collection, treatment, recycle and reuse; access to sanitation facilities; pollution; land uses and water efficiency.

The social dimension on the other hand had indicators in the areas of health, education and security while institutional dimension was concerned with local governance especially women representation in local assembly and financial management of the local administration, the Assembly's management of waste and disaster and natural resource conservation as evident in its annual financial budget and expenditure records.

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Table 4.1: Accra Sustainability Indicators Aspects

Economic	**Social**	**Environment**	**Institution**
1. Incidence of Poverty 2. Incidence of extreme poverty 3. Income Inequality (Gini Index) 4. Unemployment 5. Access to energy 6. Transport/Mobility	1. Urban population living in Slums 2. Water Access 3. Infant mortality rate 4. Under 5 mortality rate 5. Maternal mortality rate 6. Prevalence of HIV 7. Prevalence of cholera 8. Net school enrolment in Kindergarten 9. Net school enrolment in Primary 10. Net school enrolment in JHS 11. Net school enrolment in Senior High School 12. Special education for People With Disabilities 13. Adult literacy 14. Crime Rate 15. Domestic Violence 16. Child abuse	1. concentration of PM10 in mg/ms at roadside 2. concentration of PM10 in mg/ms in residential area 3. concentration of PM10 in mg/ms in commercial area 4. concentration of PM10 in mg/ms in industrial area 5. Sanitation 6. Waste collection 7. municipal waste recycled, reused and composed (plastic) 8. metal wastes recycled and reused 9. Waste water treatment 10. Water efficiency 11. Land under agriculture cultivation 12. Land classified as built environment 13. Land covered by vegetation	1. Women participation in local governance 2. Sanitation management 3. Disaster Risk Reduction 4. Natural Resource conservation 5. Revenue Performance 6. Financial Management

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4.2 Results of Accra Sustainability Indicators

The calculation of the scores of the indicators involved SPSS standardization of indicator values. These standardized values were normalized to fall within 0 to 1 so that values equal or nearer to 1 means sustainable and those nearer to 0 means unsustainable development. Reverse values were calculated for all negative indicators. For example, a crime rate with high indicator and therefore a high normalize score does not mean it is sustainable. Those indicators were reversed to fall into sustainability. An indicator with zero sustainability index means that it had very low data values during the data collection. For the example proportion of budget allocated natural resource conservation under institutional dimension was 0%. When subjected to the analysis, it produced a sustainability index of 0. In another case, reverse indicator such as mean annual PM10 concentration in roadside had very high data values and so got normalized score of 1. When subjected to the reverse formula it became zero. This means that the PM10 emission along road side is unsustainable. Finally, the normalized scores were assigned weights (Appendix C) to show the level of importance attach to each indicator and dimension.

The indices were rated as either approaching sustainability or not sustainable. An indicator that is said to be approaching sustainability had a sustainability index of 0.5 and above while indicators below the performance index of 0.5 means not sustainable. The performances of the city's 41 indicators were classified under the four sustainability dimensions as follows.

4.2.1 Performance of economic indicators

The six indicators evaluated in the economic dimension show improvement towards sustainability as the indices approached one (Figure 4.1). The city's population living below the poverty line of GH₵1,314 (about US$300) per annum ranges between 3.5 to 4.4 percent and those in extreme poverty (GH₵ 792) is 0.5 percent.

The indicators of this dimension maintained positive scores throughout the period of assessment. These achievements could be attributed to the numerous economic activities that exist in the formal and informal sector which offers employment to over 90 percent of the working population and resulting in the

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reduction in the city's Gini index from 0.5 in 2012 to 0.346 in 2015. A major achievement in the economic dimension is the access to electricity in the metropolis which recorded almost 100% throughout the period. This study concentrated only on the access to electricity by households without looking at power availability all year round due to lack of adequate data on per capita daily consumption of power in the city.

As shown in Figure 13, the indicator with the lowest performance was income inequality indicating an imbalance economy with wide gap between the rich and poor. Between 2012 and 2015, the gap appeared to be closed a bit as shown in the Figure 13. Another low indexed indicator was access to public transport. This indicator has also inched during period from an index of 0.645 in 2012 to 0.698 in 2015 revealing the need for massive investment in the transport sector.

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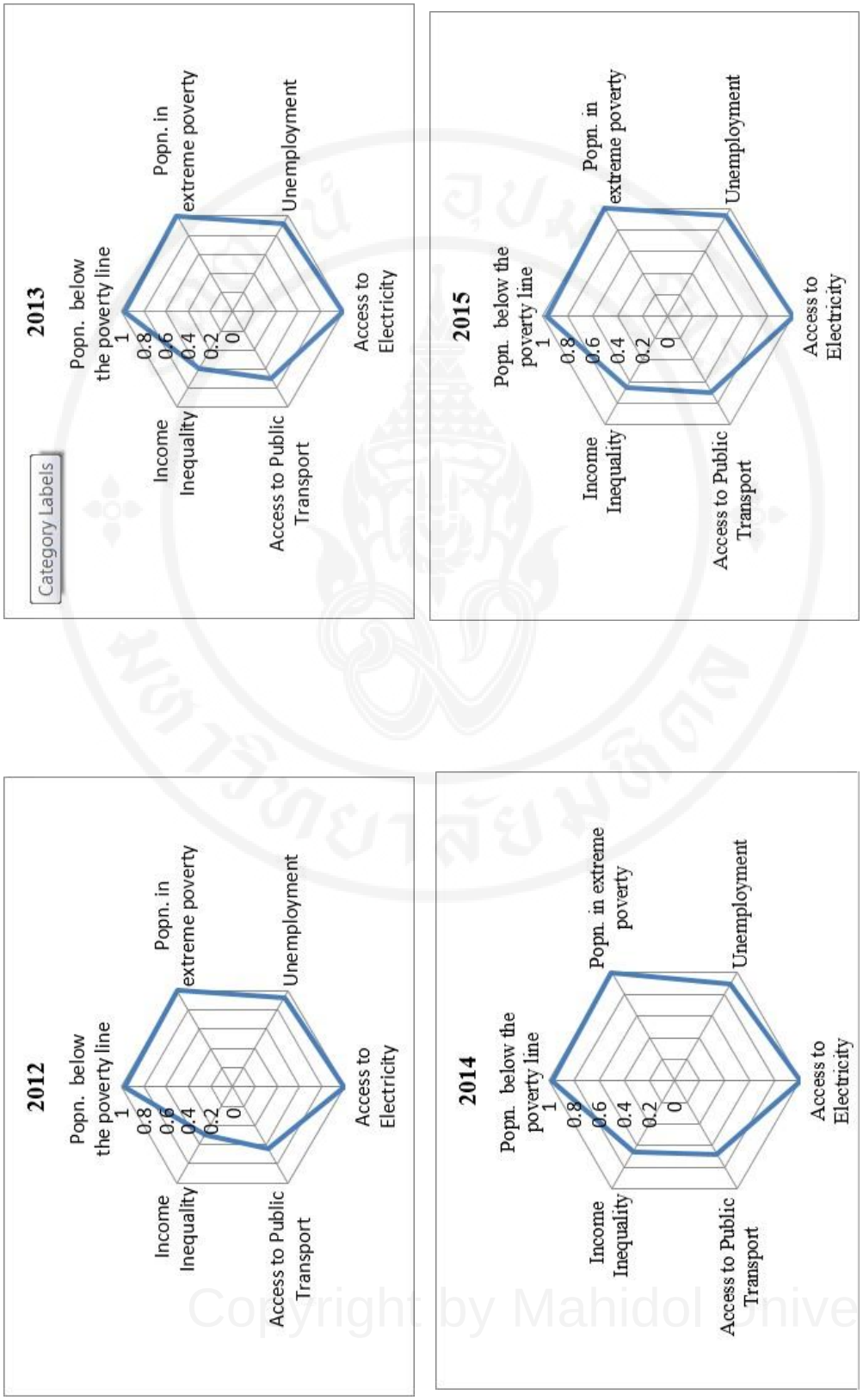

Figure 4.1: Performance of economic indicators

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4.2.2 Performance of environmental indicators

For ease of constructing the radar analysis (Figure 4.2), the PM10 concentrations were recalculated using simple averaging to form an overall annual mean concentration in the city. As shown in Appendix C2, the environmental indicators of the city have shown lower scores as compared to indicators in the economic dimension. The least performing areas include annual mean concentration of PM10 along roadside and proportion of total land covered by vegetation. PM10 along roadside recorded annual mean concentrations of 175.75 mg/ms in 2012, 197.48 mg/ms in 2013 and improved a little to 183.75 mg/ms in 2015. The vegetative cover of the city continuously decreased from 0.00046% in 2012 to 0.0003% in 2015 thereby producing a sustainability index of 0. These portions of total land were cleared to make way for built-up area which has increased from 64% in 2012 to 72% in 2015 and thereby recording a sustainability index of 0.36 in 2012 to 0.39 in 2015. Agric land also saw depreciation in proportion during the period from 0.068% in 2012 to 0.0079% in 2015.

Treatment of waste water, a key aspect of waste management, has also produced very low score indicating little percentage of waste water was treated (0.05% in 2012 to 0.5 in 2015). Its sustainability index rose from 0 in 2012 to 0.001 in 2015. It is an area has not been developed even though it is essential to addressing the perennial water problem in Accra. Other challenging environmental concerns include poor access to approved sanitation facilities which recorded as low as 30% in 2012 but increased to 55% in 2015. Though, AMA has tried to remove municipal wastes collection from the streets of Accra, some amount, about 20%, were still left uncollected daily. There was also low treatment, composting, recycling of waste. Plastic waste recycle stood at 0.22 in 2012 and increased to 3% of total plastic wastes in 2015 as a result of emerging small scale recycle industries. Water efficiency also recorded poor performance recoding a sustainability index of ~0.001. The average per capita daily water consumption (M^3 per capita) during the assessment period stood ~0.2. This exceeded the World Health Organization (2013) maximum standard of between 15 to 20 litres (0.015 to 0.02M^3) per day.

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Figure 4.2 show improvements in some indicators such as PM concentration in 2012 to 2014 but decreased in 2015. Even though PM10

concentration in commercial, industrial and residential areas recorded moderate AQI (51 – 100), according to the EPA standard the atmosphere in these areas is not fit for unusually sensitive members of the city. That is those with lung diseases at risk of dwelling in those areas. The proportion of metal wastes recycled was an improving indicator with sustainability index which rose from 0.398 in 2012 to 0.435 in 2015. This is attributed mainly to the existence of local metal workers and the scrap dealers who purchase metal scraps and transform them into other metal products such as cooking and coal pots among others.

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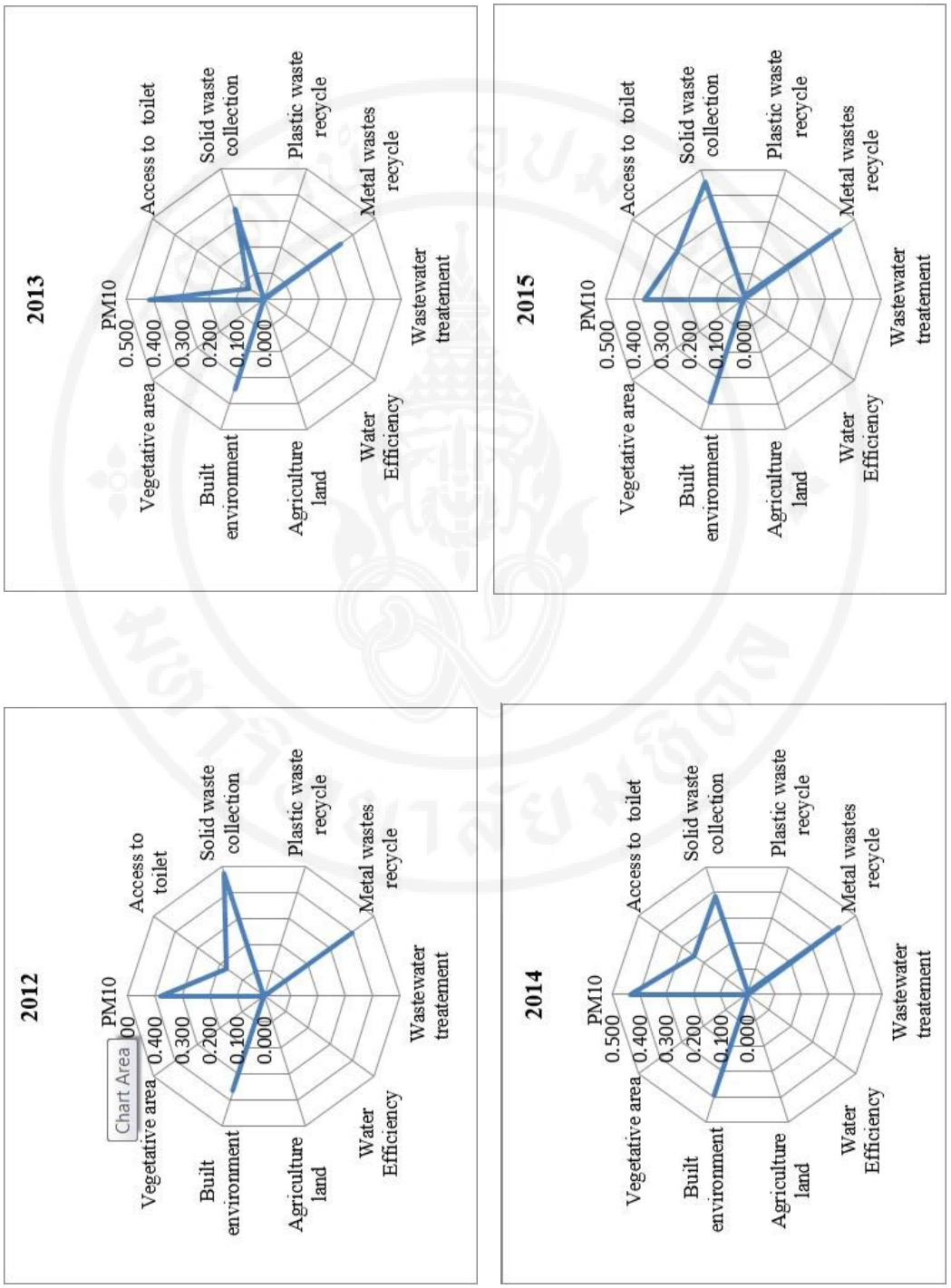

Figure 4.2: Performance of environmental indicators

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4.2.3 Performance of Social Indicators

For ease of this dimension's radar analysis (Figure 4.3), net school enrolments in kindergarten, primary, junior high, senior high and tertiary were averaged to form one an overall net school enrolment. Appendix C3 show that the social dimension of Accra revealed both strong and weak sustainability indicator scores. Being the national as well as regional capital, the city boasts of major health facilities and services that have stimulated the growth of health care. This accounted for some positive scores in the health sector. For example, child mortality decreased from 25 per 1000 live births in 2012 to 15 per 1000 live births in 2014. This performance compared with UNSDG 3 target on reducing child morality (to 25 deaths per 1000 live births) was remarkable. In addition, Cholera and HIV/AIDS have also experienced decrease incidence with cholera recording zero incidence in 2013.

Other positive indicators included over 90% adult literacy rate (the percentage of people age 15+ who can read and write English/French and a Ghanaian language). Incidence of child abuse and domestic violence reduced from 300 cases in 2012 to 135 and 247 in 2015 respectively. These produced a sustainability index of 0.691 in 2012 and increase to 0.841 and 0.710 respectively for child abuse and domestic violence in 2015.

The weakest social indicator was number of reported crime. Reported crime included incidence of rape, armed robbery and murder in the metropolis. This produced a sustainability score of zero throughout the assessment period. Other weak indicators were mainly recorded in the educational sector where school enrolment at all levels was low despite low incidence of poverty, the availability of most and best schools in Accra coupled with the government implementation of the Free Compulsory Universal Basic Education (FCUBE) which required all children in school going age to attend basic schools in the country without paying school fees. The Net School Enrolment recorded the sustainability of 0.031 in 2012 and inched to 0.037 in 2015. In addition, access to quality pipe water was as low as 54.6% in 2012 recording a sustainability index of 0.054. There seemed to be little improvement in the water situation as water is still rationed to the extent that some parts of the city receive pipe water once a week.

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Figure 4.3: Performance of social indicators

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4.2.4 Performance of institutional indicators

The performance of the institutional indicators (Figure 4.4) of the city showed that the Accra Metropolitan Assembly has a relatively effective revenue generation (for example generating 109.13% in 2012) and efficient financial expenditure management. These two indicators were the strength of this dimension with sustainability index around 0.9 to 1.0 confirming the growing economic sector as evident in the analysis of the economic dimension. Figure 16 revealed that 2014 saw a reduction in revenue performance to the lowest index of 0.582 as a result of poor release by the central government of Ghana, of District Assemblies Common Fund (DACF) which constitutes about 60% of revenue of Ghana's local governments.

However, the weak indicators were shown in low number of women represented in the local government (10% in 2012 and increased to 17.8% in 2014 and 2015). This research considered the 0% budget allocation to natural resources conservation throughout the period of assessment as the weakest sustainability indicator of this dimension. Natural resource conservation is a critical aspect of the UNSDG as shown in SDGs 13, 14 and 15 which deal with climate change, conservation and sustainable use of oceans and marine resources as well as the protection and restoration of ecosystems. Other low points include the city authority's low budget allocation for disaster risk reduction (0.30% of total budget in 2012) in a city where flood and fire are common occurrences. This indicator recorded a sustainability index of 0.003 in 2012 to 2014 but increased marginally to 0.17 in 2015 due to need to manage for the June 2015 flood in Accra.

Finally, the low budgets allocation to waste management by the city (between 4.7 in 2012 to 6.5% in 2015) gives credence to the poor sanitation situation shown in the environmental dimension of this study. This explained why about 20% municipal solid waste was still left uncollected daily in the city. This indicator recorded a sustainability index of 0.047 in 2014 and increased to 0.65 possibly because of increased expenditure needed to clear the debris left by the flood of June 2015.

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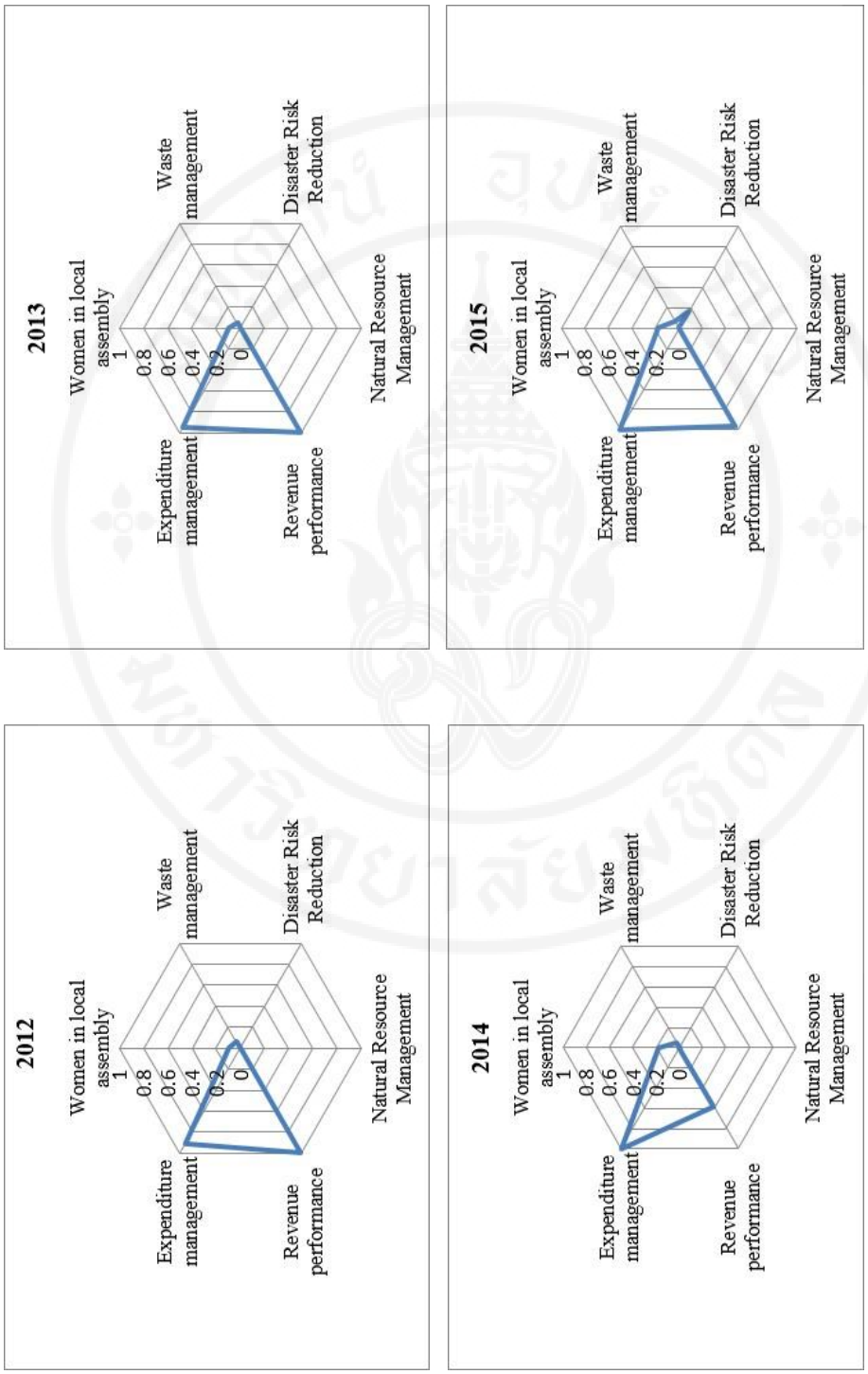

Figure 4.4: Performance of institutional indicators

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4.3 Discussion of Results

4.3.1 Economic Sustainability of Accra

The economic dimension was greatest contributor to the city's sustainability performance. The economy of Accra had the highest sustainability scores ranging from 0.84 in 2012 to 0.87 in 2015 as shown in Figure 16. All indicators assessed under the economic dimension produced sustainability indices above 0.5 indicating a city with vibrant economic activities for all and confirming that Accra is an emerging economic hub in the West Africa sub-region (Earth Institute/Columbia University, 2015). The findings confirmed Accra as a centre offering opportunities to both formal and informal sector workers, residents and other Ghanaians to enhance their economic and social welfare (Tufuor et al., 2015).

The performance of the poverty and income inequality indicators could also be attributed to government's social intervention programmes such as the Livelihood Empowerment Against Poverty (LEAP) which has helped to cushion the core poor of the society (Abebrese, 2011). The LEAP is government programme meant to assist vulnerable members of the society with regular stipend for their livelihood. This is evident in reducing income inequality figures from 0.5 in 2012 to 0.346 in 2015.

This has also contributed to reduction in the city's population in extreme poverty to 0.5 and those below the poverty line of GH¢1,314 (US$300) per annum to 3.5 in 2012 and 2013. Though the incidence of poverty increased to 4.4 in 2015, it remained the lowest in the country (GSS, 2014).

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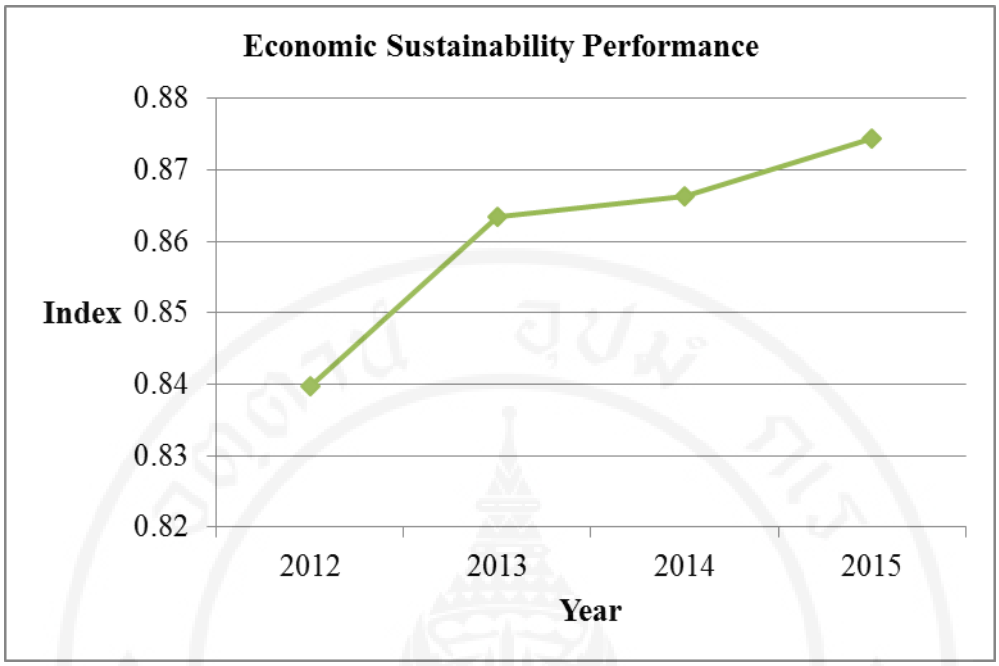

Figure 4.5: Economic sustainability performance of Accra

This study examined access electricity, as one of the major contributors to the success of the economic sustainability. Available data from the field showed that the city is 100% connected to electricity over the years. However, the main concern of the people of which data was not readily available for inclusion in this study was daily available power for residents and industries. Ghana has been faced with major power crisis over the past two decades. The supply of electricity has been adequate enough to meet the growing demand from industry, residential and non-residential. According to Eshun and Amoako-Tuffuor (2016), the speedy population and industrial growth of Accra, Kumasi, Takoradi and Tema have increased the residential demand for electric power leading to shortage in supply. With this shortage in the country, Accra and many other towns and cities in Ghana faced power rationing or load shedding exercises where residents get power at some times and at other times do not have.

4.3.2 Environmental Sustainability of Accra

Based on the indicator sustainability indices (Appendix C2) and expressed in Figure17, the sustainability performance of Accra showed a poor environmental dimension. This is the worst contributor to the city's performance. The annual sustainability score for 2012 stood low at 0.23 and decreased further to 0.21 in 2013.

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The result of the third year showed a little increase to 0.25 but decreased again to 0.24 in 2015. The decrease in the year 2013 was because this year recorded

1. the lowest proportion of agriculture and vegetation land
2. lowest number of population with access to approved household toilet facilities due to increase in population in slum
3. poor water efficiency expressed by per capita daily water consumption

However these indicators have seen improvement during subsequent years except in 2015 when the worst concentration of particulate matter along roadside and in residential and industrial areas were recorded.

In general, poor performance of the environment dimension is negatively affected by poor sanitation, pollution, inadequate access to approved sanitation facilities and inefficient use of natural resources as confirmed in Grant and Yankson (2003), UN-Habitat (2014) and EPA (2014).

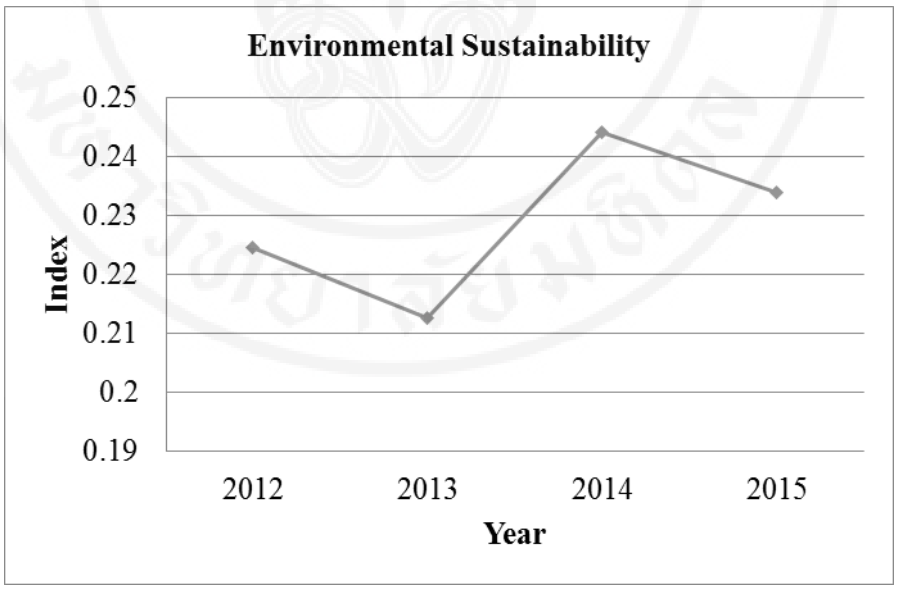

Figure 4.6: Environmental sustainability performance of Accra

4.3.3 Social Sustainability of Accra

The combination of the high and low scores of the social indicators of the city produced the second well performing sustainability dimensions. Its sustainability scores rose a little from 0.50 in 2012 to 0.52 in year 2015 (Figure 4.7). The low scores in the social dimension score of Accra could be attributed to difficulty of the AMA to

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significantly provide social services and infrastructure for the increasing population (Songsore, 2008 and Owusu, 2010). For example, residents have to queue for long hours to access some basic services such as water and some communities are fed with pipe water on rationed basis, sometimes once a week (MWRWH, 2007).

The educational indicators of the city also produced poor sustainability indices. Despite the existence of many public and private schools at all levels, school attendance (Net School Enrolment) in most indigenous communities is low (Arguello et al., 2013). According to the National Development Planning Commission (2012), the Greater Accra region as a whole recorded the lowest Net Enrolment and is least on the full cycle of primary schooling even though Accra has the lowest poverty incidence.

The high scores of the city were produced mainly by health indicators. With improvement in the health sector, some level of general safety and security and government's provision of more educational, the social dimension has experienced improvement over the years and its heading towards sustainability.

As seen in the Figure 18, there was a decrease in sustainability index of 2013 to 0.496. This performance was because that year recorded the highest incidence of maternal death (338 per 100,000 live births) and had the highest number of population living in slum. In subsequent years (2014 and 2015), as a result of government programmes such as maternal health education, provision of health facilities and services, and the decongestion of major slums and squatters by the AMA (McTernan, 2014 and Gadugah, 2015) the social performance increased in the ensuing years.

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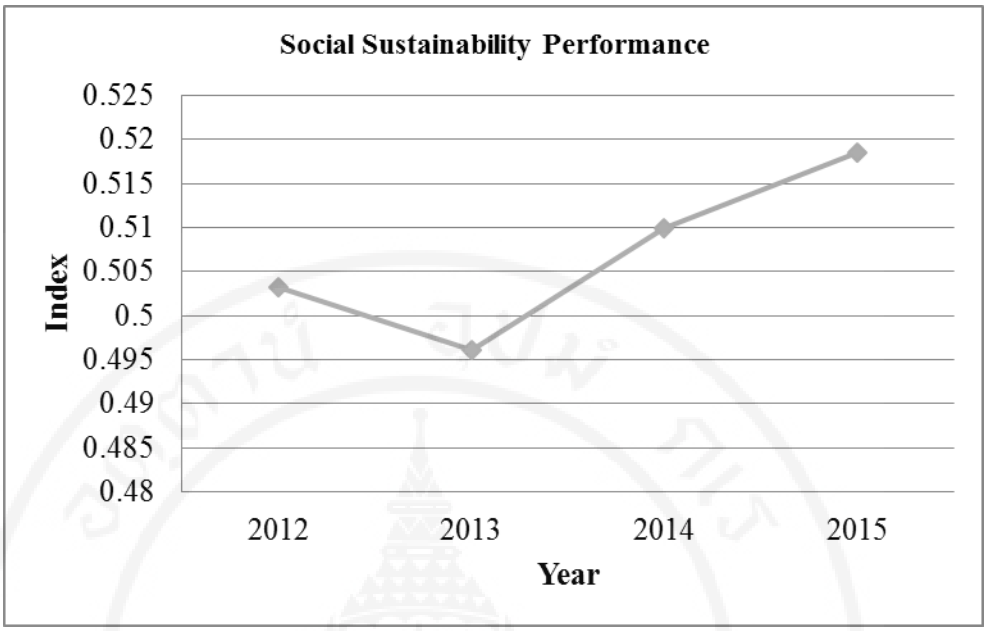

Figure 4.7: Social sustainability performance of Accra

4.3.4 Institutional Sustainability of Accra

Accra's weak governance resulted in the poor institutional sustainability performance of the city. Figure 19 show the institutional sustainability performance of the study area over the four assessment years. Its performance is increased from 0.35 in 2012 to 0.4 in 2015. The weak indicators (waste management, disaster risk reduction and natural resource conservation) in this dimension consistently maintained very low values some 0%. Fobil et al. (2008), Oteng-Ababio et al. (2015) and Amoako (2016) accentuated the weak urban governance of the AMA in separate studies on urban waste collection systems and disaster management in Accra. This research's findings vividly established the city authority's unpreparedness in disaster risk reduction and poor waste and sanitation management. These are shown by the low budgets allocated annually to these sensitive areas of the city.

The years 2012 and 2013 recorded almost same indicator values and therefore produced similar sustainability scores. There was a decrease in 2014 performance because this year recorded the lowest revenue performance (58.23 %) which affected other expenditure items such as allocation to disaster risk reduction. This revenue performance was attributed to the challenges in the release of the District

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Assemblies Common Fund (The Common Fund Newsletter, 2014) which form about 60% of the local governments' revenue.

However, 2015 witnessed an increase which is attributed to post flood financial support from central government and private sector increasing its revenue generation to 96%. As result expenditure for other indicators increase such as allocation for disaster management increased to 17% from ~0.3 and waste increased allocation on waste management to 6.5% from 4.7% in 2014.

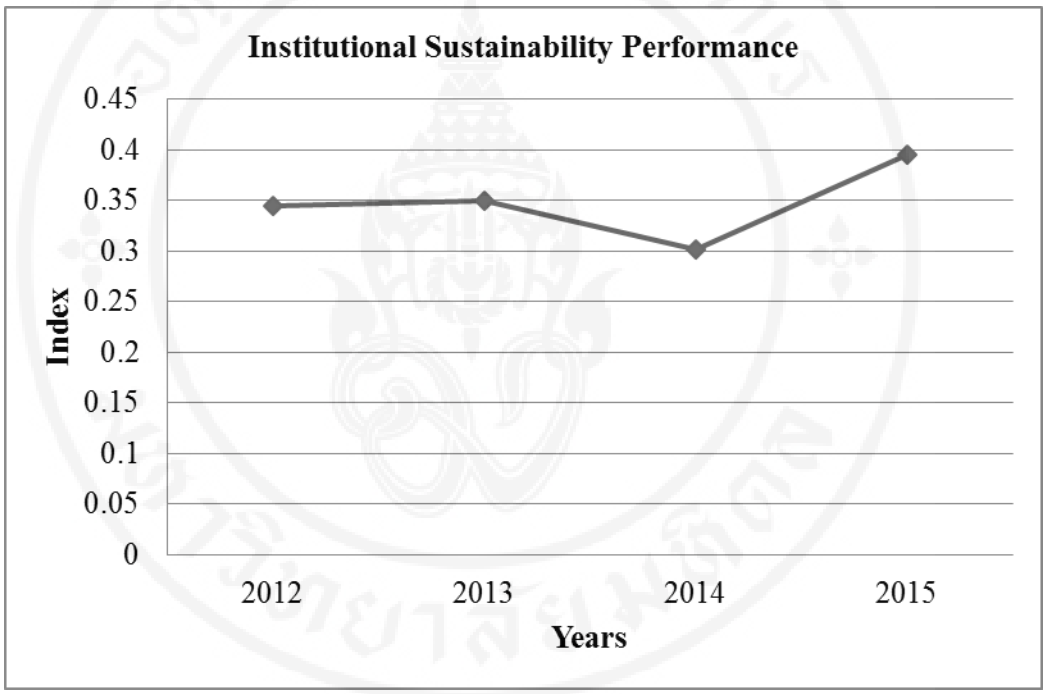

Figure 4.8: Institutional sustainability performance of Accra

4.3.5 Overall Sustainability Performance

The composite of all four dimensions in each year of assessment produced an overall sustainability score of the city of Accra as shown in Appendix C5. The result showed Accra as an area where the economic and social dimensions are approaching sustainability (scored above 0.5) while its environmental dimension and institutional dimensions are performing poorly. It is noteworthy however that some indicators have shown positive changes over the period of assessment. The overall sustainability score of Accra showed a slight progression to sustainability over the last four years rising from 0.48 in 2012 to 0.51 in 2015.

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Figure 4.9 revealed a major increase in the overall sustainability performance to 0.51 in 2015. This is because, apart from environmental dimension which decreased in 2015, economic, social and institutional dimensions increased in sustainability score. Since the overall score is the summation of all four sustainability dimension scores, 2015 witnessed this increase. The previous years 2012 and 2013 maintained an average score of 0.48 because of the low performances of social and institutional dimensions which had their lowest indices of 0.496 and 0.301 respectively in 2013 and 2014 (Appendix C5). In effect, the determining dimensions for the increase were social and institutional because economic and environment dimensions were constant at high and low performances respectively.

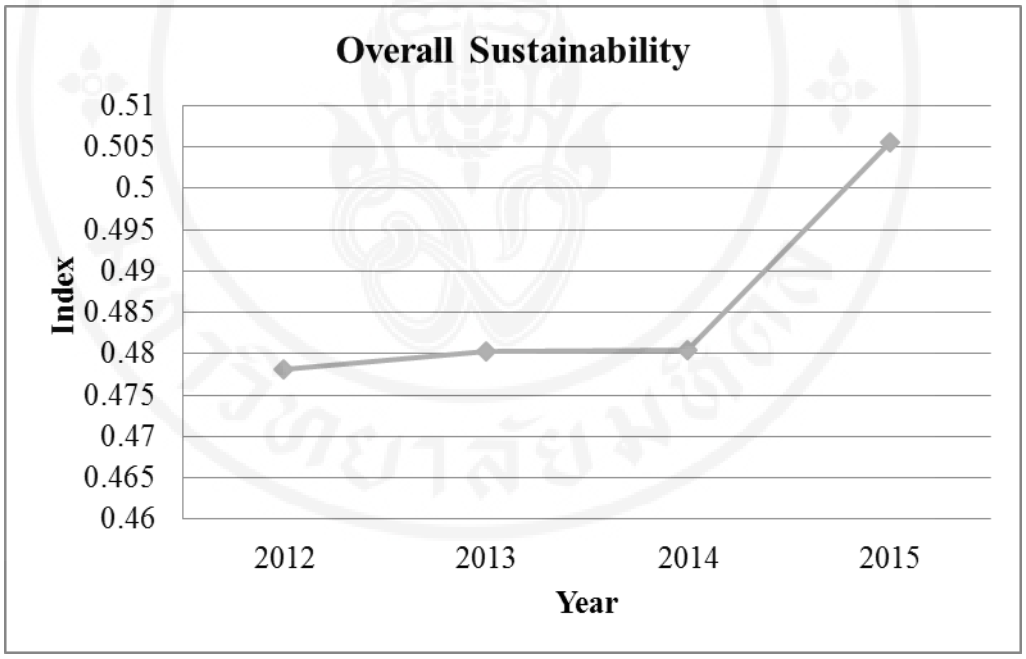

Figure 4.9: Overall sustainability performance

This research finding compared with Tamanini et al. (2014) which produced a sustainability score of 44.5% (0.45) for Ghana (Accra) among other 60 countries. This result is closer to the 2014 results (0.49) of this study. It also affirmed this research's findings on the growing economy of Accra Metropolis and the worrying environmental performance of the city where it called on Ghana to direct its fast-growing economy to greener growth path.

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4.3.6 Comparison between the four dimensions

A sustainable city is one that provides a balance between its sustainability dimensions (Farmer et al., 2006; Goode, 2011; and Martos et al., 2016). The livability of a city must be seen in social wellbeing of people, environmental quality, the economic output and good governance. This study revealed an imbalance in Accra's development. Comparing between the four sustainable development dimensions, the radar chart (Figure 4.10) graphically shows the difference between the economic and the other dimensions of the city's sustainable development. Characterized by growing economic opportunities, low poverty, decreasing unemployment and income inequality (Tamanini et al., 2014; GSS, 2014; Tufuor et al., 2015); the economic dimension becomes closer to sustainability.

Meanwhile the environmental dimension moves closer to zero. This dimension is typified by air pollution, poor sanitation, destruction of natural vegetation as seen in Grant & Yankson (2003), Arguello et al. (2013), EPA (2014) and UN-Habitat (2014). The economic and environmental dimensions of Accra suggest a reverse relationship where an increase in the economic dimension worsens the environmental indicators. For instance, more economic opportunities attract rural-to-urban migration from other parts of the country to the city's informal settlements such as Nima and Old Fadama (Awumbila et al., 2014) resulting in increased population, demand and consumption. For example, the increased population's demand for housing results in the encroachment on wetlands such as the Korle lagoon and influences construction of residential and commercial buildings on water ways which sometimes lead to flooding (the June 9, 2015 flood, as example) in the city. An increasing population's effect on poor sanitation (Owusu, 2010) is also evident in Makola, Kantamanto, Agbogbloshie markets and major slums. The environment is continuously sacrificed for economic growth. According to Grant and Yankson (20013), open spaces and the ecosystems are destroyed to make way for commercial and residential areas.

Social dimension showing a reasonably good performance maintained an average score (0.50 to 0.52) throughout the four years as a result of improvements in health infrastructure, services (Arguello et al., 2013), health education and economic conditions in Accra which make average residents to afford some decent social services. The social sustainability is linked to the environment and the economics of

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the city. Sanitation related diseases such as cholera and malaria are common annual phenomena in the Accra. Flood, a negative environmental issue resulting from waste choked gutters and blocked water-ways by informal structures has a major impact on social indicators such as low school attendance which produced poor indices throughout the period.

Accra's institutional performance (0.34 to 0.4) and the available literatures (Fobil et al., 2008; Oteng-Ababio et al.,2015; and Amoako, 2016) signaled a weak urban governance which is not providing a balanced socio-economic development in an environmentally-sustainable direction. It is expected that with a boost in the environmental and institutional dimensions, the city may attain high sustainability in the near future.

Sustainable city should address environmental challenges associated with urban growth (Global Environment Facility, 2015). Where this is lacking, there is no absolute sustainability. Accra's sustainability based on this analysis shows a moderate performance lying within the range of 0.4 to 0.5.

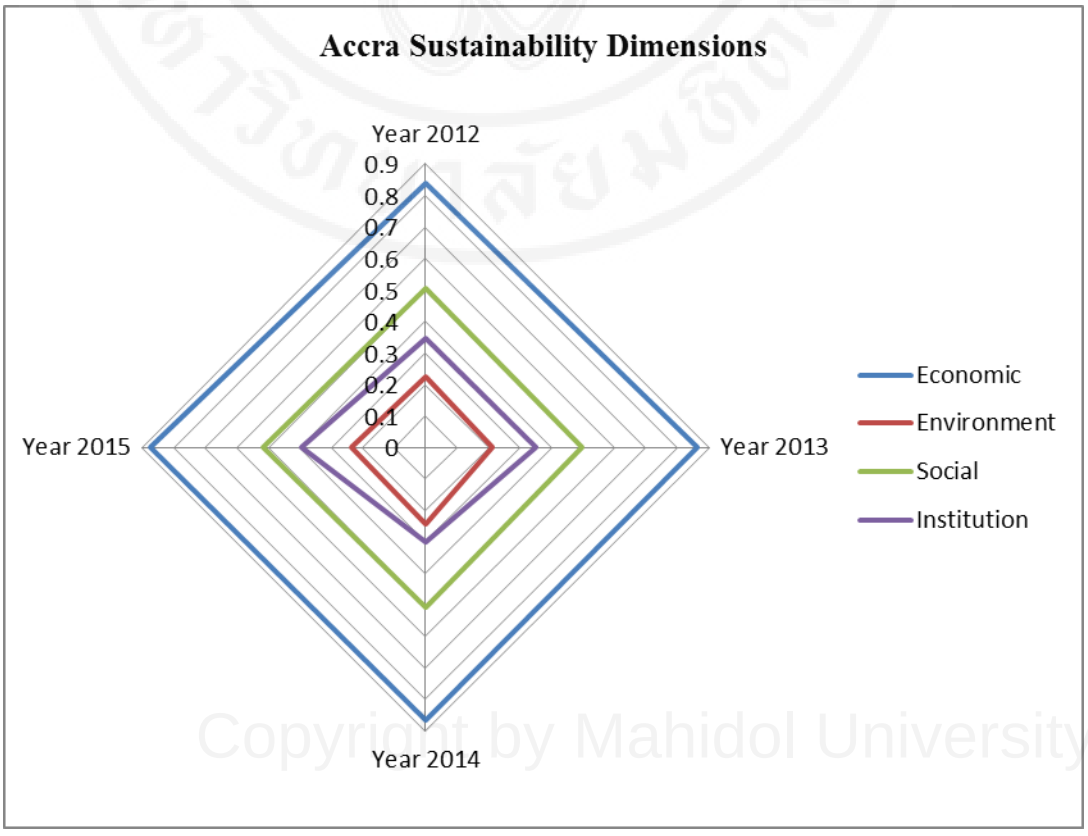

Figure 4.10: Radar analysis showing sustainability dimensions of Accra

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CHAPTER V
CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The results, discussions and recommendations presented in this research fulfilled the study objectives and the expected results which included defining appropriate indicators for sustainability assessment, sustainability assessment of Accra Metropolitan Area and recommendations for city sustainable development. The study has developed 41 sustainable development indicators characterized into economic, social, environment and institutional dimensions named Accra Sustainability Indicators (ASI). These were used to assess the sustainability of capital city of Ghana, Accra. Using secondary data collected from government sources, the study used SPSS, standardization and Microsoft Excel and Spider Web analysis to depict the sustainability performance of the city. The sustainability trend of the city showed some indicators progressing towards sustainable development whiles others though experience some positive changes are far from sustainability. In spite of some data constrains on all indicators, this study captured most relevant aspect of Accra's sustainable development. It gave an idea of the city's sustainability identifying strong and weak points of the city's development over the past four years (2012-2015). The following section showed the fulfillment of the research questions and objectives of this study.

Objective 1: To develop indicators for evaluating city sustainability in Accra

This objective sought to address the first research question about the kinds of indicators that can be used to evaluate city's sustainability. In addressing this objective, an extensive literature was reviewed on sustainable development indicators and sustainable cities. Based on these, a set of 51 indicators and finally 41 indicators were selected and defined to fall in line with national and international policies such as

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the Ghana Shared Growth and Development Agenda (2014-2017), Ghana's National Urban Policy and the United Nation Sustainable Development Goal 11 which required the making of cities and human settlements inclusive, safe, resilient and sustainable. The final 41 indicators were adopted based on some criteria including data availability, relevance to local decision making and simplicity.

Objective 2: To comprehensively assess the sustainability status of Accra Metropolitan Area

The study evaluated the performance of the 41 Accra sustainability indicators which were categorized under economic, environment, social and institutional dimensions. Based on data analyzed, this study was able to reveal the strong and weak sustainability dimensions and indicators of the city. The results showed that economic indicators were approaching sustainability while environmental indicators were unsustainable during the four years period of assessment. The indicators under social and institutional dimensions shared both strong and weak sustainability scores.

According to the composite analysis of the overall performance of the city's sustainability, there was a little progression towards sustainability. The analysis showed environment dimension closer to un-sustainability while economic and social dimensions were closer to the sustainability. This study therefore concluded that the environment of Accra which is characterized by pollution, poor sanitation and waste management, destruction of vegetative and agric lands was the worst performing dimension of the city's development. It was followed by the institutional dimension as the second weak dimension of the city.

5.2 Recommendations

The weak areas of Accra's sustainability shown in this study called for some drastic measures. It is expected that Accra Metropolitan Assembly and other relevant government and private institutions would adopt these in the quest to making Accra sustainable. For strong sustainability, Accra Metropolitan Assembly needs to

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direct its fast-growing economy to a greener–growth path by addressing the environmental challenges, including air pollution, municipal waste management and conservation of ecosystems. Improving social dimension requires the provision of uninterrupted urban services such as water, electricity and housing. The following recommendations were structured under the four dimensions of sustainable development with emphasis on the weakest indicators of the city.

5.2.1 Recommendations for economic sustainability

The weakest indicator in this dimension is access to transport. There is the need for massive investment in public transport. Government needs to provide the infrastructure in terms of roads and rails as well as buses and trains. Partnership with private transport businesses would improve the situation.

In terms of further reducing the city's poverty incidence, income inequality and level of unemployment, the government should to create a more conducive business environment that would bring green businesses to the city in order to create more employment opportunities. These investments should however be climate and environmentally friendly.

5.2.2 Recommendations for environment sustainability

A major challenge identified from this research is particulate matter pollution. Pollution emission from vehicles and factories should be controlled. The AMA and the Environmental Protection Agency need work on ensuring that companies and vehicles obey the country's emission standards.

In addition, introducing sustainable transport is a focus area in most sustainable cities in the world. The government through legislation should encourage cycling, use of mass transit (BRT) and trains to help reduce emissions from vehicles in the city.

Another critical issue in this dimension was the destruction of vegetative cover. It is recommended that the AMA reintroduce nature into the city by engaging in massive tree planting and restoration of the city's lost biodiversity. All green areas that have been converted into waste dumps and residential areas should be reclaimed. The

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AMA should devote part of its budget to the protection and conservation of natural resources and cultural heritage.

Participatory urban agriculture contributes to quality of life and food security in the city. It is recommended that the AMA restores all agric lands that were converted to unapproved residential areas and take steps to protect agric lands. It also needs to provide incentives to farmers in the metropolis.

Sanitation management continues to be a major challenge to the AMA. There is the need for a bye-law to control plastic waste in the city. Government's encouraging paper bags producers would discourage plastic bag production in the city and the country at large. In addition, the government should engage with more private companies to set-up waste recycling and composting centres.

The study revealed little effort in management of waste as shown in the performance of waste treatment, recycle and reuse. Most major sustainable cities recognize that waste is wealth. A positive partnership and creating a market for private sector in this regard would improve the waste management effort of the local government.

5.2.3 Recommendations for social sustainability

The weakest indicator in this dimension is incidence of reported crimes. More effort by the Ghana Police service in reducing crimes is needed. Community policing exercises by the Police Service should be enhanced. Also, government should provide livelihood opportunities for the unemployed people in the country through skills training.

Net School Enrolment at all levels was a major concern identified in this research. Therefore the need for proper enforcement of government legislations especially on the implementation of Free Compulsory Universal Basic Education program which requires every child in school going age to attend basic school. Also, secondary and tertiary education should be made progressively free as stated in the 1992 constitution of Ghana. This would encourage more enrolment.

Provision of improved water supply is a concern to residents of Accra. It is recommended that residents are encouraged to construct water harvesting tanks. For new constructions, provision of water harvesting technologies in the house should be

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made requirement for acquiring permits from the Assembly. Furthermore, citizens should be sensitized on the need to be water efficient in their homes and workplaces.

AMA and the central government should partner with the private sector to put up adequate but sustainable affordable houses to meet the increasing population. This way, slums and informal structures would be minimized. High rise condominiums or apartments are recommended to be rented to low income earners.

5.2.4 Recommendations for institutional

Sustainable city thrives in an atmosphere of effective and inclusive urban governance. It is important that very section of the society is represented in the local assembly including people with disabilities and women. Government and NGOs should encourage the participation of these groups in the local assembly.

There is the need for strategic sustainable development plan and land-use planning accompanied with effective and efficient implementation to conserve natural resources, reduce disaster and properly manage wastes. The plan, detailing the path to sustainability, with strong leadership would go a long way to improve the smartness of the city.

This study recommended an institutional change towards the election of city mayors as is the case in many sustainable cities in the world would support the realization of the sustainability goal. It is also important for central government to give full financial autonomy to the cities to manage serious issues regarding waste, disaster and natural resource conservation.

5.2.5 Policy Recommendations

This study recommends a sustainable city policy for Accra. This concept requires sustainable economy which focuses on green investments and offers employment opportunities to the working class in order to reduce to the barest minimum poverty and income inequality. This policy must focus attention on sustainable environment where pollution is reduced completely through the introduction of renewable energy and sustainable transport. Greening the environment, conservation of biodiversity, provision of adequate sanitation and effective waste management form critical aspects of green city policies. The policy should focus on

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social sustainability which ensures the provision of uninterrupted urban services including water, security and sustainable houses. And finally, the need to pursue and promote sustainable governance that is inclusive, incorruptible, effective and efficient.

5.2.6 Recommendations for Future Research

The recommendations for future study on the sustainability of cities and human settlements in Ghana are as follows:

1. Data collection

It is recommended that government ensure data storage and management in all local government offices. This should ensure collection and effective documentation district data on policy and plan implementations. The 2030 Agenda for sustainable development called for removing data gaps so as to timely review and evaluation progress on the goals and targets.

2. Further Studies

A further study to analyze the sustainability performance of other major Ghanaian cities including Kumasi, Tema, Tamale and Takoradi would help to know the status of implementation urban policies and the UNSDG 11 in the country. This would better shape the urban policy of Ghana and put her on the path to achieving UNSDG 11.

3. Data collection period

An extended data collection period such as 10 years would provide longer trend on the city's development. An expanded timeframe also give a broader view of the city's strength and weaknesses.

4. Indicator selection and weighting

This should be done through wider consultation with stakeholders. Stakeholders can assign weights to each indicator and dimension to indicate the importance of an indicator or dimension to residents.

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APPENDIX

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Appendix A: Linkage between ASI and GSGDA, NUP AND UNSDG 11 (MLGRD, 2012a; NDPC, 2014 and UN, 2015)

	GSGDA II	NUP	UNSDG 11
Economic	**Theme 6** ✓ Objective 13.2. Develop targeted economic and social interventions for vulnerable and marginalized groups ✓ 13.3. Reduce poverty among food crop farmers and fisher folks ✓ Objective 2.2. Create opportunities for accelerated job creation across all sectors ✓ Objective 13.4: Reduce income disparities among socio-economic groups and between geographical areas	✓ Objective 3: Promoting urban economic development ✓ Objective 6: Ensuring efficient urban Infrastructure and service delivery	✓ Target 2: provide access to safe, affordable, accessible and sustainable transport systems for all ✓ Target 5: decrease the direct economic losses with a focus on protecting the poor and people in vulnerable situations

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Appendix A: Linkage between ASI and GSGDA, NUP AND UNSDG 11 (MLGRD, 2012a; NDPC, 2014 and UN, 2015) (cont.)

	GSGDA II	NUP	UNSDG 11
	Theme 5 ✓ Objective 5.1. Provide adequate, reliable and affordable energy to meet the national needs and for export ✓ Objective 1.2. create and sustain an efficient and effective transport system that meets user needs		
Environment	**Theme 3** ✓ objective 12.5 Reduce pollution and poor sanitation in the coastal areas ✓ objective 14.1: Promote effective waste management and reduce noise pollution ✓ objective 11.2 Promote efficient land use and management systems	✓ Objective 4: Improving environmental quality of urban life ✓ Objective 5: Ensuring effective planning and management of urban growth and sprawl, especially of the primate cities and large urban centres. ✓ Objective 10: Promoting climate change adaptation and mitigation mechanisms	✓ Target 6: Reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management ✓ Target 9: resource efficiency

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Appendix A: Linkage between ASI and GSGDA, NUP AND UNSDG 11 (MLGRD, 2012a; NDPC, 2014 and UN, 2015) (cont.)

	GSGDA II	NUP	UNSDG 11
Environment	**Theme 5**, ✓ objective 13.3 Accelerate the provision of improved environmental sanitation facilities ✓ objective 13.1 Improve management of water resources	✓	✓
Social	**Theme 5** ✓ objective 10.3 Upgrade existing slums and prevent the occurrence of new ones objective 13.2 Accelerate the provision of adequate, safe and affordable water **Theme 6** ✓ Objective 1.1. Increase inclusive and equitable access to, and participation in education at all levels objective 4.4 Improve quality of health services delivery including mental health	✓ Objective 6: Ensuring efficient urban Infrastructure and service delivery ✓ Objective 7: Improving access to adequate and affordable low-income housing Objective 8: Promoting urban safety and security	✓ Target 1: ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums

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Appendix A: Linkage between ASI and GSGDA, NUP AND UNSDG 11 (MLGRD, 2012a; NDPC, 2014 and UN, 2015) (cont.)

	GSGDA II	NUP	UNSDG 11
Social	services ✓ Objective 5.1. Ensure the reduction of new HIV and AIDS/STIs infections, especially among the vulnerable groups objective 10.2: Protect children against violence, abuse and exploitation **Theme 7** ✓ Objective 10.1. Improve internal security for protection of life and property ✓ objective 7.2 Safeguard the security, safety and protection of the rights of the vulnerable in society, especially women and the girl -Child		

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Appendix A: Linkage between ASI and GSGDA, NUP AND UNSDG 11 (MLGRD, 2012a; NDPC, 2014 and UN, 2015) (cont.)

	GSGDA II	NUP	UNSDG 11
Institutional	**Theme 3** ✓ Objective 4.3 Promote sustainable environment, land and water management ✓ Objective 17.1 Enhance capacity to mitigate and reduce the impact of natural disasters, risks and Vulnerability ✓ Objective 15.1 Enhance natural resources management through community participation **Theme 7** ✓ Objective 7.1 Promote gender equity in political, social and economic development systems and Outcomes	✓ Objective 9: Strengthening urban governance ✓ Objective 12: Expanding sources of funding urban development and strengthening financial management	✓ Target 4: Strengthen efforts to protect and safeguard the world's cultural and natural heritage ✓ Target 6: By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management ✓ Target 9: Holistic disaster risk management at all levels

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Appendix A: Linkage between ASI and GSGDA, NUP AND UNSDG 11 (MLGRD, 2012a; NDPC, 2014 and UN, 2015) (cont.)

	GSGDA II	NUP	UNSDG 11
	✓ Objective 2.2: Ensure effective and efficient resource mobilization, internal revenue generation and resource management		

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Appendix B: Description of Accra Sustainability Indicators

Economic Sustainability Indicators (n = 6)

Indicator	**Source**	**Description**	**Direction**
Incidence of Poverty	GSS/ AMA	Percentage of population below the poverty line of GH¢1,314 per annum	Less is better
Incidence of extreme poverty	GSS/ AMA	Percentage of population in extreme poverty (living below GH¢ 792.05 per annum who cannot afford basic nutritional requirements)	Less is better
Income Inequality (Gini Index)	GSS / AMA	Gini Index (A Gini Index of 0 represents perfect equality, while an index of 1 implies perfect inequality)	Less is better
Unemployment	GSS / AMA	Unemployment rate (persons aged 15+ available to work but not working as a percentage of total labour force)	Less is better
Access to energy	GSS / AMA	Percentage of households with access to electricity	More is better
Transport/Mobility	AMA	Percentage of population with convenient access to public transport (Public Mass Transit)	More is better

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Environmental Sustainability Indicators (n = 13)

Indicator	**Source**	**Definition of indicators**	**Direction**
Concentration of Particulate Matter	EPA	Annual mean concentration of particulate matter (PM10)	Less is better
Sanitation	AMA Sanitation Dept	Percentage of population with access to improved household toilet facilities	More is better
Waste management	AMA	Proportion of municipal solid waste left uncollected daily to final disposal site as a percentage of total waste generated	Less is better
Waste recycle	AMA	Percentage of municipal waste recycled, reused and composed	More is better
Waste water treatment	AMA	Proportion of wastewater treated	More is better
Water efficiency	AMA	Per capita daily water consumption (Liters per capita)	Less is better
Urban Land use distribution	Metro Agric Department	Proportion of land area under agriculture cultivation	More is better
	AMA	Proportion of total land classified under built environment	Less is better
	AMA	Proportion of land covered by Vegetation	More is better

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Social Sustainability Indicators (n = 16)

Indicator	Source	Definition	Direction
Slums	AMA / GSS	Urban population living in slums, informal settlements or inadequate housing	Less is better
Water Access	AMA	Population with access to quality drinking water	More is better
Under 5 mortality rate	Metro Public Health Directorate	Number of deaths occurring in children under-5 years per 1,000 live births	Less is better
Maternal mortality rate	Metro Public Health Directorate	Maternal deaths recorded per 100,000 live births	Less is better
Disease Prevalence rate	Metro Public Health Directorate	Prevalence of HIV	Less is better
	Metro Public Health Directorate	Prevalence of cholera	
Education: Net school enrolment	Metro Directorate of Education	Net enrolment ratio in Primary	More is better
	Metro Directorate of Education	Net enrolment ratio in JHS	
	Metro Directorate of Education	Net enrolment ratio in SHS	
Special education	GSS	Total enrolment in special schools by children with severe and profound disabilities	More is better

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Social Sustainability Indicators (n = 16) (cont.)

Indicator	**Source**	**Definition**	**Direction**
Adult literacy	GSS (GLSS 6)	Percentage of people age 15+ who can read and write	More is better
Crime Rate	Ghana Police Service Report	Total annual number of reported crimes (including rape, armed robbery and murder), in the Metropolis	Less is better
Domestic Violence	Ghana Police Service Report	Annual number of domestic violence against women and children	Less is better
Child abuse	Ghana Police Service Report	Annual incidence of child abuse (Number of children who become victims of violence and abuse (defilement, assault)	Less is better

Institutional Sustainability Indicators (n = 6)

Indicator	Source	Definition	Direction
Participatory governance	AMA	Proportion of citizens, women groups, PWDs and CSOs represented in local assembly	More is better
Sanitation management	AMA	Percentage of Metropolitan expenditure devoted to sanitation/ waste mgt	More is better
Disaster Risk Reduction	AMA	Percentage of annual Metropolitan Budget devoted to disaster risk reduction	More is better
Natural Resource Conservation	AMA	Percentage of expenditure devoted to natural resource conservation	More is better
Revenue Performance	AMA	Ratio of budget to actual generation	More is better
Financial management	AMA	Ratio of revenue to expenditure	

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Appendix C: Sustainability Weighted Scores

C1: Economic

Indicator	**2012**			**2013**			**2014**			**2015**		
	R_1	W_1	$\mathbf{R_1W_1}$	R_2	W_2	$\mathbf{R_2W_2}$	R_3	W_3	$\mathbf{R_3W_3}$	R_4	W_4	$\mathbf{R_4W_4}$
Percentage of population below the poverty line	0.967	0.167	**0.161**	0.967	0.167	**0.161**	0.967	0.167	**0.161**	0.961	0.167	**0.160**
Percentage of population in extreme poverty	1.000	0.167	**0.167**	0.999	0.167	**0.166**	1.000	0.167	**0.167**	1.000	0.167	**0.167**
Unemployment rate	0.925	0.167	**0.154**	0.925	0.167	**0.154**	0.898	0.167	**0.150**	0.933	0.167	**0.155**
Percentage of households with access to Electricity	1.000	0.167	**0.167**	1.000	0.167	**0.167**	1.000	0.167	**0.167**	1.000	0.167	**0.167**
Percentage of population with access to Public Transport	0.645	0.167	**0.108**	0.697	0.167	**0.116**	0.678	0.167	**0.113**	0.698	0.167	**0.116**
Gini Index (Income Inequality)	0.500	0.167	**0.083**	0.593	0.167	**0.099**	0.654	0.167	**0.109**	0.654	0.167	**0.109**
ΣR_iW_i			**0.84**			**0.863**			**0.866**			**0.874**

Legend: Ri = normalized standard score Wi = Indicator weight RiWi = Sustainability score

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C2: Environment

Indicator	**2012**			**2013**			**2014**			**2015**		
	R_1	W_1	$\mathbf{R_1W_1}$	R_2	W_2	$\mathbf{R_2W_2}$	R_3	W_3	$\mathbf{R_3W_3}$	R_4	W_4	$\mathbf{R_4W_4}$
Annual mean concentration of PM10 in mg/ms at roadside	0.000	0.077	**0.000**	0.000	0.077	**0.000**	0.000	0.077	**0.000**	0.000	0.077	**0.000**
Annual mean concentration of PM10 in mg/ms in residential area	0.590	0.077	**0.045**	0.559	0.077	**0.043**	0.680	0.077	**0.052**	0.364	0.077	**0.028**
Annual mean concentration of PM10 in mg/ms in commercial area	0.384	0.077	**0.030**	0.532	0.077	**0.041**	0.483	0.077	**0.037**	0.581	0.077	**0.045**
Annual mean concentration of PM10 in mg/ms in industrial area	0.537	0.077	**0.041**	0.570	0.077	**0.044**	0.562	0.077	**0.043**	0.500	0.077	**0.038**
Population with access to approved household toilet facilities	0.171	0.077	**0.013**	0.066	0.077	**0.005**	0.242	0.077	**0.019**	0.299	0.077	**0.023**
Proportion of solid waste left uncollected daily	0.472	0.077	**0.036**	0.344	0.077	**0.026**	0.382	0.077	**0.029**	0.452	0.077	**0.035**
Percentage of municipal waste recycled, reused and composed (plastic)	0.001	0.077	**0.000**	0.001	0.077	**0.000**	0.008	0.077	**0.001**	0.016	0.077	**0.001**

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C2: Environment

Indicator	**2012**			**2013**			**2014**			**2015**		
	R_1	W_1	$\mathbf{R_1W_1}$	R_2	W_2	$\mathbf{R_2W_2}$	R_3	W_3	$\mathbf{R_3W_3}$	R_4	W_4	$\mathbf{R_4W_4}$
Percentage of metal wastes recycled and reused	0.398	0.077	**0.031**	0.344	0.077	**0.026**	0.421	0.077	**0.032**	0.435	0.077	**0.033**
Proportion of wastewater treated	0.000	0.077	**0.000**	0.000	0.077	**0.000**	0.001	0.077	**0.000**	0.001	0.077	**0.000**
Water Efficiency – per capita daily water consumption	0.001	0.077	**0.000**	0.001	0.077	**0.000**	0.001	0.077	**0.000**	0.001	0.077	**0.000**
Total land area under agriculture cultivation	0.000	0.077	**0.000**	0.000	0.077	**0.000**	0.000	0.077	**0.000**	0.000	0.077	**0.000**
Total land classified under built environment	0.364	0.077	**0.028**	0.344	0.077	**0.026**	0.393	0.077	**0.030**	0.392	0.077	**0.030**
Total land covered by vegetative (green area)	0.000	0.077	**0.000**	0.00	0.077	**0.000**	0.000	0.077	**0.000**	0.000	0.077	**0.000**
ΣR_iW_i			**0.225**			**0.213**			**0.244**			**0.234**

Legend: Ri = normalized standard score Wi = Indicator weight RiWi = Sustainability score

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C3: Social Score

Indicator	**2012**			**2013**			**2014**			**2015**		
	R_1	W_1	$\mathbf{R_1W_1}$	R_2	W_2	$\mathbf{R_2W_2}$	R_3	W_3	$\mathbf{R_3W_3}$	R_4	W_4	$\mathbf{R_4W_4}$
Urban population living in slums	0.963	0.063	**0.060**	0.947	0.063	**0.059**	0.943	0.063	**0.059**	0.943	0.063	**0.059**
Access to quality drinking water	0.054	0.063	**0.003**	0.056	0.063	**0.003**	0.084	0.063	**0.005**	0.108	0.063	**0.007**
Under 5 mortality per 1,000 live births	0.977	0.063	**0.061**	0.982	0.063	**0.061**	0.986	0.063	**0.062**	0.979	0.063	**0.061**
Maternal mortality per 100,000 live births	0.702	0.063	**0.044**	0.688	0.063	**0.043**	0.669	0.063	**0.042**	0.739	0.063	**0.046**
Prevalence of HIV	0.999	0.063	**0.062**	0.997	0.063	**0.062**	1.000	0.063	**0.063**	0.996	0.063	**0.062**
Prevalence of cholera	1.000	0.063	**0.063**	1.000	0.063	**0.063**	0.996	0.063	**0.062**	1.000	0.063	**0.063**
Net enrolment ratio in kindergarten	0.026	0.063	**0.002**	0.025	0.063	**0.002**	0.023	0.063	**0.001**	0.024	0.063	**0.001**
Net enrolment ratio in primary	0.061	0.063	**0.004**	0.056	0.063	**0.004**	0.066	0.063	**0.004**	0.070	0.063	**0.004**
Net enrolment ratio in JHS	0.044	0.063	**0.003**	0.042	0.063	**0.003**	0.035	0.063	**0.002**	0.048	0.063	**0.003**
Net enrolment ratio in SHS	0.012	0.063	**0.001**	0.014	0.063	**0.001**	0.016	0.063	**0.001**	0.024	0.063	**0.001**
Net enrolment in tertiary institutions	0.010	0.063	**0.001**	0.013	0.063	**0.001**	0.015	0.063	**0.001**	0.020	0.063	**0.001**
Total enrolment in special schools by children with severe and profound disabilities	0.918	0.063	**0.057**	0.925	0.063	**0.058**	0.906	0.063	**0.057**	0.904	0.063	**0.056**

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C3: Social Score (cont.)

Indicator	**2012**			**2013**			**2014**			**2015**		
	R_1	W_1	$\mathbf{R_1W_1}$	R_2	W_2	$\mathbf{R_2W_2}$	R_3	W_3	$\mathbf{R_3W_3}$	R_4	W_4	$\mathbf{R_4W_4}$
Adult Literacy rate	0.906	0.063	**0.057**	0.914	0.063	**0.057**	0.892	0.063	**0.056**	0.890	0.063	**0.056**
Incidence of reported Crime	0.000	0.063	**0.000**	0.000	0.063	**0.000**	0.000	0.063	**0.000**	0.000	0.063	**0.000**
Domestic Violence against women and children	0.691	0.063	**0.043**	0.750	0.063	**0.047**	0.693	0.063	**0.043**	0.710	0.063	**0.044**
Incidence of Child abuse	0.691	0.063	**0.043**	0.526	0.063	**0.033**	0.835	0.063	**0.052**	0.841	0.063	**0.053**
ΣR_iW_i			**0.503**			**0.496**			**0.510**			**0.518**

Legend: Ri = normalized standard score Wi = Indicator weight RiWi = Sustainability index

C4: Institutional

Indicator	**2012**			**2013**			**2014**			**2015**		
	R_1	W_1	$\mathbf{R_1W_1}$	R_2	W_2	$\mathbf{R_2W_2}$	R_3	W_3	$\mathbf{R_3W_3}$	R_4	W_4	R_4W_4
Proportion of women represented in local assembly	0.092	0.167	**0.015**	0.095	0.167	**0.016**	0.178	0.167	**0.030**	0.178	0.167	**0.030**
Percentage of Metropolitan expenditure devoted to sanitation/ waste mgt	0.060	0.167	**0.010**	0.048	0.167	**0.008**	0.047	0.167	**0.008**	0.065	0.167	**0.011**

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C4: Institutional

Indicator	**2012**			**2013**			**2014**			**2015**		
	R_1	W_1	$\mathbf{R_1W_1}$	R_2	W_2	$\mathbf{R_2W_2}$	R_3	W_3	$\mathbf{R_3W_3}$	R_4	W_4	R_4W_4
Percentage of annual Metropolitan Budget devoted to disaster risk reduction	0.003	0.167	**0.000**	0.003	0.167	**0.000**	0.003	0.167	**0.001**	0.170	0.167	**0.028**
Percentage of expenditure devoted to natural resource conservation	0.000	0.167	**0.000**	0.000	0.167	**0.000**	0.000	0.167	**0.000**	0.000	0.167	**0.000**
Revenue generation performance (budget to actual)	1.000	0.167	**0.167**	1.000	0.167	**0.167**	0.582	0.167	**0.097**	0.960	0.167	**0.160**
Financial management (revenue to expenditure)	0.916	0.167	**0.153**	0.951	0.167	**0.158**	1.000	0.167	**0.167**	1.000	0.167	**0.167**
$\mathbf{\Sigma R_iW_i}$			**0.345**			**0.349**			**0.302**			**0.396**

Legend: R = normalized standard score W = Indicator weight RiWi = Sustainability index

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C5: Overall Score

Indicator	**2012**			**2013**			**2014**			**2015**		
	R_1	W_1	R_1W_1	R_2	W_2	R_2W_2	R_3	W_3	R_3W_3	R_4	W_4	R_4W_4
Economic sustainability (ES)	0.840	0.250	0.210	0.863	0.250	0.216	0.866	0.250	0.217	0.874	0.250	0.219
Environment sustainability (EnS)	0.225	0.250	0.056	**0.213**	0.250	0.053	**0.244**	0.250	0.061	**0.234**	0.250	0.058
Social sustainability (SS)	0.503	0.250	0.126	0.496	0.250	0.124	0.510	0.250	0.127	0.518	0.250	0.130
Institutional sustainability (IS)	0.345	0.250	0.086	0.349	0.250	0.087	0.302	0.250	0.075	0.396	0.250	0.099
ΣR_iW_i			0.478			0.480			0.481			0.506

Legend: R = normalized standard score W = Indicator weight RiWi = Sustainability score

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