UNIVERSITI PUTRA MALAYSIA

ENVIRONMENTAL HEALTH, HEALTH OUTCOMES, POVERTY AND SUSTAINABLE DEVELOPMENT IN DEVELOPING COUNTRIES

SALISU IBRAHIM WAZIRI

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By

SALISU IBRAHIM WAZIRI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirement for the Degree of Doctor of Philosophy

January 2018

DEDICATION

With gratitude, appreciation and affection

I solely dedicate this work to my late Father Alhaji Maigari Ibrahim (Wazirin-Hardawa) of the blessed memory, and to entire family. May Allah grants us Paradise, amin.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment
of the requirement for the degree of Doctor of Philosophy

ENVIRONMENTAL HEALTH, HEALTH OUTCOMES, POVERTY, AND SUSTAINABLE DEVELOPMENT IN DEVELOPING COUNTRIES

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January 2018

Chairman : **Norashidah Mohamed Nor, PhD**
Faculty : **Economics and Management**

Safe drinking water and good sanitation are very important facilities to humanity
especially to improve health outcomes and achieving sustainable development.
There exists a large variation in accessibility of these facilities amongst the more
developed (higher- and upper-middle income) and less developed (low- and lower-
middle income) countries. Therefore, socioeconomic indicators such as health
outcomes, poverty and sustainable development could be largely affected as
population get access to safe drinking and good sanitation.

This study aims to estimate the impact of environmental health (access to safe
drinking water and good sanitation) on health outcomes (under-five mortality) in 81
low- and lower-middle income countries in the world. The second objective
examines the direct effect of environmental health on poverty in 81 low- and lower-
middle income countries. Also, it estimated the indirect effects of environmental
health on poverty through labour-force productivity. While the third objective aims
at to examine the impact of environmental health, under-five mortality, and poverty
on sustainable development in 47 developing countries. Generalized method of
moments (GMM) was employed to estimate the dynamic models in all the three
objectives. The period of nine years was used in all the three models from 2008 to
2016.

The results show that, access to safe drinking water and good sanitation are very
critical determinants for reducing the prevalence of under-five mortality in
developing countries (low- and lower-middle income countries). Interestingly, both
results of difference and system GMM have indicated a negative relationship
between access to safe drinking water and good sanitation and under-five mortality.

This implies that as population get access to safe drinking water and good sanitation facilities, the prevalence of water-related diseases such as malaria, cholera, diarrhea and dengue would be reduced, hence the prevalence of under-five mortality would also declined.

Regarding the second the objective, the result reveal that, access to safe drinking water and good sanitation also plays a significant role both direct and indirectly in poverty reduction in low- and lower-middle income countries. Both the direct and indirect links have indicated that access to safe drinking water and good sanitation is negatively related to poverty. The indirect relationship explained the conditional hypothesis, in which the marginal effect of the interaction term between labour-force productivity and access to safe drinking water and good sanitation. The result shows that reduction of poverty due to access to safe drinking water and good sanitation is conditional on the effectiveness of human capital (labour-force productivity).

Finally, the third objective discloses a contribution to sustainable development literature by providing empirical link between environmental health, under-five mortality and poverty with sustainable development using the Green Solow growth model. The estimated results revealed that, environmental health especially access to safe drinking water is an essential factor for achieving sustainable development, with a positive relationship amongst them. Carbon dioxide (CO_2) emission and under-five mortality were found to be negatively related to sustainable development in developing countries. This study has also utilised the three indicators of governors (control of corruption, regulatory qualities and governance effectiveness) in the analysis. The results of difference and system GMM suggested that governance indicators are important and crucial factors for achieving sustainable development in developing countries.

For policy implication, the study suggest that, governments in low- and lower-middle income countries should ensure the provision safe drinking water for all. Also enforcement of environmental sanitation laws should be maintained.

Secondly, to alleviate poverty, the study recommend Government policies especially fiscal policy should focused on provision of safe drinking water amongst households/communities as to overcome the suffering of people toward water-poverty nexus. Enhancing productivity of labour through human capital investment is also recommended to mitigate poverty in those countries.

Finally, Government of developing countries should enact policies that geared towards increasing economic growth and development alone side with ensuring quality of environment. Agreements signed by various governments during Rio-De Janerio (Rio- Summit) and beyond toward adopting sustainable practice in managing natural resources like water and reduction in green-house gasses globally should be implemented.

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Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

KESIHATAN PERSEKITARAN, MAMPAN KESIHATAN, KEMISKINAN, DAN PEMBANGUNAN MAPAN DI NEGARA MEMBANGUN

Oleh

SALISU IBRAHIM WAZIRI

Januari 2018

Pengerusi : **Norashidah Mohamed Nor, PhD**
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Air minuman yang selamat dan sanitasi yang baik adalah kemudahan yang sangat penting kepada manusia, terutama untuk meningkatkan hasil kesihatan dan mencapai pembangunan yang mampan. Terdapat banyak variasi aksesibiliti untuk kemudahan ini di kalangan negara maju (berpendapatan tinggi dan pertengahan) dan negara kurang maju (berpendapatan rendah dan sederhana). Oleh itu, petunjuk sosioekonomi seperti hasil kesihatan, kemiskinan dan pembangunan mampan boleh dipengaruhi secara berkesan apabila penduduk mendapat akses kepada air minuman yang selamat dan sanitasi yang baik.

Kajian ini bertujuan untuk menganggar kesan kesihatan persekitaran (akses kepada air minuman yang selamat dan sanitasi yang baik) terhadap hasil kesihatan (kematian di bawah lima tahun) di 81 buah negara berpendapatan rendah dan sederhana rendah. Objektif kedua mengkaji kesan langsung kesihatan alam sekitar terhadap kemiskinan di 81 buah negara berpendapatan rendah dan sederhana rendah. Juga, dianggarkan kesan secara tidak langsung kesihatan alam sekitar terhadap kemiskinan menerusi produktiviti tenaga buruh. Sementara matlamat ketiga bertujuan untuk mengkaji kesan kesihatan alam sekitar, kematian di bawah lima tahun, dan kemiskinan terhadap pembangunan mampan di 47 buah negara sedang membangun. Kaedah penganggar sistem GMM digunakan untuk menganggarkan model dinamik bagi ketiga-tiga objektif. Tempoh masa selama sembilan tahun diambil bagi kesemua tiga model bermula tahun 2008 sehingga 2016.

Penemuan hasil menunjukkan bahawa, akses kepada air minuman yang selamat dan sanitasi yang baik adalah faktor penentu yang sangat penting untuk mengurangkan prevalen kematian di Negara membangun (negara berpendapatan rendah dan sederhana). Yang menarik, kedua-dua hasil perbezaan dan penganggar sistem GMM

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menunjukkan hubungan negatif antara akses kepada air minuman yang selamat dan sanitasi yang baik dengan kematian di bawah lima tahun. Ini menunjukkan apabila penduduk mendapat kemudahan akses kepada air minuman yang selamat dan kemudahan sanitasi yang baik, maka prevalen penyakit berkaitan air seperti malaria, kolera, cirit-birit dan denggi akan berkurangan.

Untuk objektif kedua, keputusan kajian menunjukkan bahawa akses kepada air minum yang selamat dan sanitasi yang baik juga memainkan peranan penting samada secara langsung maupun tidak langsung dalam pengurangan kemiskinan di negara berpendapatan rendah dan sederhana rendah. Kedua-dua hubungan langsung dan tidak langsung telah menunjukkan bahawa akses kepada air minuman yang selamat dan sanitasi yang baik berkaitan secara negatif dengan kemiskinan. Hubungan tidak langsung telah menjelaskan hipotesis bersyarat, iaitu kesan marginal interaksi antara tenaga buruh dengan akses kepada air minum yang selamat dan sanitasi yang baik. Hasil kajian menunjukkan pengurangan kemiskinan akibat akses kepada air minum yang selamat dan sanitasi yang baik adalah bersyarat atas keberkesanan modal insan (produktiviti tenaga buruh).

Akhir sekali, objektif ketiga memberi sumbangan kepada kesusasteraan pembangunan mampan dengan mengkaji hubungan empirikal antara kesihatan persekitaran, kematian di bawah lima tahun dan kemiskinan dengan pembangunan mampan menggunakan model pertumbuhan Solow Hijau. Hasil kajian menganggarkan, kesihatan persekitaran terutamanya akses kepada air minum yang selamat merupakan faktor penting untuk mencapai pembangunan yang mampan, dengan menunjukkan hubungan positif di antara mereka. Walau bagaimana pun pelepasan karbon dioksida (CO_2) serta mortaliti di bawah lima tahun didapati berkaitan negatif dengan pembangunan mampan di negara membangun. Selanjutnya kajian ini telah menggunakan tiga petunjuk gabenor (kawalan rasuah, kualiti pengawalseliaan dan kecekapan tadbir urus) dalam analisisnya. Hasil perbezaan dan sistem GMM menunjukkan bahawa tadbir urus adalah faktor penting untuk mencapai pembangunan yang mampan di negara membangun.

Implikasi dasar kajian ini mancadangkan bahawa kerajaan dari negara berpendapatan rendah dan sederhana rendah seharusnya memastikan peruntukan air minuman yang selamat untuk semua.. Begitu juga, penguatkuasaan terhadap undang-undang kebersihan persekitaran harus dikekalkan.

Keduanya, untuk megurangkan kemiskinan, kajian ini mencadangkan agar polisi kerajaan terutama polisi fiskal seharusnya memberi penekanan terhadap peruntukan air minuman yang selamat kepada isi rumah atau komuniti bagi mengatasi masalah kesukaran terhadap nexus kemiskinan air. Peningkatan produktiviti pekerja melalui pelaburan tenaga buruh juga dicadangkan bertujuan untuk mengurangkan kemiskinan bagi negara terlibat.

Akhirnya, kerajaan dari negara membangun seharusnya mengubal polisi yang lebih menjurus ke arah peningkatan pertumbuhan dan pembangunan ekonomi, di samping memastikan kualiti persekitan dijaga. Perjanjian di antara pelbagai agensi kerajaan semasa Rio-De Janerio (Rio-Summit) terhadap pelaksanaan amalan yang mampan dalam pengurusan sumber semulajadi seperti air serta pengurangan dalam pengeluaran gas rumah hijau secara menyeluruh sepatutnya dilaksanakan.

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

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LIST OF ABBREVIATIONS AND ACRONYMS

ARDL	Auto-Regressive Distributed Lags
BRIC	Brazil Russia Italy and China
BRICS	Brazil Russia Italy China and South Africa
EG	Engel Granger
CDC	Centre for Diseases Control and Prevention
CO_2	Carbon dioxide
DPT	Diphtheria Pertussis and Tetanus
DPD	Dynamic Panel Data
ETS	Emission Trading Scheme
EUTS	European Union's emission trading scheme
FDI	Foreign Direct Investment
GDP	Gross Domestic Products
GED	Generated Environmental Debt
GHE	Government Health Expenditure
GHG	Greenhouse Gas
GLASS	Global Analysis and Assessment of Sanitation and Drinking Water
Ghain	Global HIV/AIDS Initiatives Nigeria
GMM	Generalise Method of Moments
HDI	Human Development Index
HSD	Human Sustainable Development
HSDI	Human Sustainable Development Index
IEA	International Energy Agency
IHVN	Institute of Human Venereology of Nigeria
IPCC	Intergovernmental Panel on Climate Change
JMP	Join Monitoring Program
Kg	Kilogram
MDGs	Millenium Development Goals
MPI	Multi-dimensional Poverty Index
NASA	National Aeronautics and Space Administration
NPHCDA	National Primary Health Care Development Agency
NO_4	Nitrous Oxide

OECD	Organization of Economic Corporations and Development
OPHDI	Oxford Poverty and Human Development Initiative
PPP	Purchasing Power Parity (PPP)
RCH	Resource Curse Hypothesis
SDGs	Sustainable Development Goals
SSA	Sub-Saharan Africa
TShip	Targeted States High Impact Projects
UNCED	United Nations Conference on Environmental Development
UNCSD	United Nations Conference on Sustainable Development
UNDP	United Nations Development Program
UNEF	United Nations Emergency Force
UNHDI	United Nations Human Development Index
UNICEF	United Nations International Children and Emergency Fund
UK	United Kingdom
UKDE	United Kingdom Department of Environment
USAID	United States Agency for International Development
USD	United States Dollars
USEPA	United State Environmental Protection Agency
VIP	Ventilated Improved Pit
WBCSD	World Business Council for Sustainable Development
WCED	World Commission on Environment and Development
WDI	World Development Indicators
WEF	World Economic Forum
WGI	World Governance Index
WHO	World Health Organization
WSSD	World Summit on Sustainable Development
WSSC	Water Supply and Collaboration Council
WWI	World Watch Institute

CHAPTER 1

INTRODUCTION

1.1   Background of the Study

Poor environmental health due to inadequate basic necessities of life, such as access to safe drinking water and good sanitation facilities is associated with unfavorable health and economic conditions (United Nations, 2015). This situation may affect the people's health outcomes and can expose them more into bandage of poor, and poverty cycle that may take a longer time to recover (Bloom and Canning, 2000; Mkondiwa et al, 2014). The United Nations' sustainable development agenda had considered poverty, under-five mortality and safe drinking water and sanitation as among the major components of sustainable development (Kaldewei, 2010). The Sustainable Development Goals (SDGs)[1] has outlined eradication of poverty of all kinds as the first objective, reduce the global maternal and under-five mortality rates by 70 per 100,000 live births and 25 per 1,000 live births respectively as the third objective and the sixth objective is to ensure availability and sustainable management of water and sanitation for all (UNDP, 2015).

Therefore, to sustain development, access to water and good sanitation (as determinants of environmental health), health outcomes and poverty formed an integral part of sustainable development goals 1, 3 and 6. Thus, they are also very important ingredients for human development, especially in the lower-income countries. The majority of rural population in the lower income countries that do not have access to safe drinking water, good sanitation, and large proportion of global poor and under-five mortality are residents in these countries. Water scarcity could have adverse effects on health and sustainability limiting economic and regional development, and thus resulting to loss of biodiversity. It is an important measure of a country's vulnerability to water shortages (United Nations, 2007).

According to United Nations development program (UNDP), there are many factors that can improve the health outcomes and reduce poverty. This includes, government expenditure, remittances, good governance, education etc. as highlighted by some studies such as Odhiambo, (2009); Takeshi and Shigeyuki, (2010); Kamiya, (2010); Aloi and Tournemaine, (2011); PHIM, (2012); Ngoma, (2013); and Barenberg, (2015). Barenberg (2015) have found a positive and significant relationship between government expenditure and infant mortality reduction in Indian States, while

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[1] The United Nations 17 sustainable development goals (SDGs) include the following; 1. No poverty 2. Zero hunger 3. Good health and wellbeing 4. Quality education 5. Gender equality 6. Clean water and Sanitation 7. Affordable and clean energy 8. Decent work and economic growth 9. Industry, innovation and infrastructure 10. Reduce inequality 11. Sustainable cities and communities 12. Responsible consumption and productivity 13. Climate action 14. Life below water 15. Life on land 16. Peace and strong institution 17. Partnership for goals.

Adebayo and Ayodele (2013) reveals that, remittance from foreign workers also reduces poverty rate in Nigeria.

The importance of water and sanitation has been recognised by the UNDP, and emphasized that, every human has a right to water. This implies that, almost 100% of the global population should have access to safe water and good sanitation. However, about 58% of the global population do not have access to safe drinking water and good sanitation combine[2], and they are mostly are from low- and lower-middle income countries.
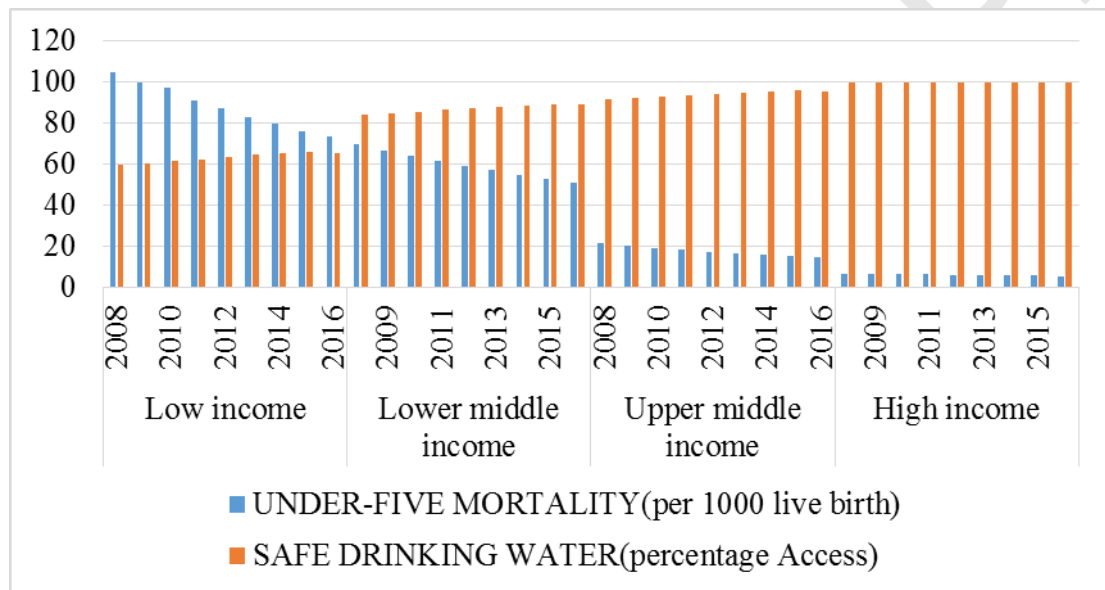
Figure 1.1 : Global Distribution of People Access to Safe Drinking Water and Under-Five Mortality based on Income Level
Source: Author's computation from WDI (2018)

Lack of access to safe drinking water, and good sanitation are amongst the major source of ill-health and poverty especially in developing countries (Health 2001; and Iii et al. 2016). World health organization (WHO) reported that, diseases relating to water and sanitation have continued to devastate the lives of millions of people globally (especially women and children) through the prevalence of communicable and water- borne diseases like diarrhea and malaria.

The primary occupation of rural communities is mostly farming and rearing of animals (Mukherjee and Benson, 2003; Barbier, 2010; PHIM, 2012). As such, water is very important for the livelihood of the lower-income communities. The availability and accessibility to water and good sanitation facilities can be used to

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[2] Global distribution of people access to safe drinking water and sanitation in percentage (%)
Source: USEPA (2015)

reduce the rate of water-related diseases especially amongst children below the age of five. It will also provide them with opportunity to participate in entrepreneurial and other developmental activities like farming, local trading and so on.

Even though poverty rate has reduced to 10% globally from 1.8 billion in 1990 to about 836 million in 2016 (World Bank, 2015; and Roser, 2016), but it remains a dominant issue for economic development, especially in developing countries. This is because the proportion of population in the developing countries lives in environments with poor access to improved water and sanitation facilities (United Nation, 2016).

Figure 1.2 illustrates the global distribution of poverty, and the percentage of people living in extreme poverty based on continents. Asia is on the top of the list with 52%, followed by Africa with 41%. The two continents constituted 93% of the globally poor. The remaining 7% is within Oceania, North and South America respectively.
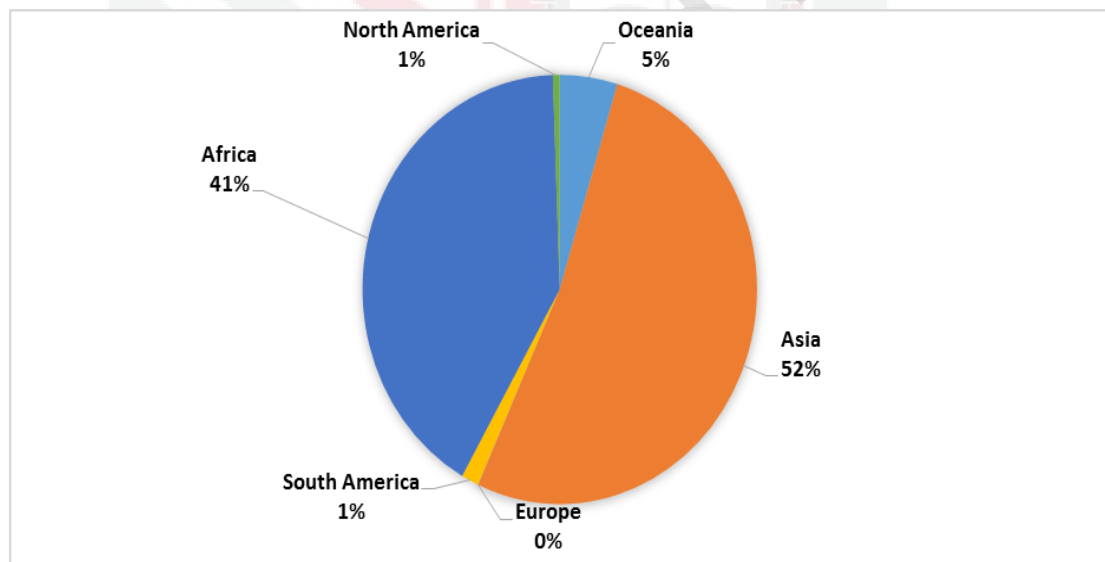
Figure 1.2 : Global percentage of people living in extreme poverty (those living below 1.9 USD per day) based on continents
Source: Authors computation from Max Roser - OurworldinData.org /WDI (2016).

Improving health outcomes and the quality of environment as it relates to environmental pollution, coupled with the eradication of poverty are of great concern among lower income countries. Eradicating poverty in these regions might not be feasible without tackling issues relating to water and sanitation (Mkondiwa et al., 2014; Ribeiro, 2015). This is due to the crucial role-played by safe drinking water and good sanitation in human development particularly toward achieving objectives one, three, and six of SDGs. One out of nine (1/9) people globally doesn't have

access to improved sources of drinking water and one out of three (1/3) lacks good sanitation[3].

In conjunction with this, the United Nations general assembly in 2010, categorized access to clean water and good sanitation as a human right.

Poverty have become developmental issues in many countries, especially low- and lower-middle income countries. There are about 780 million people globally used unimproved sources of water (Onda, Lobuglio, and Bartram, 2012). Out of 780 million people, almost 663 million people around the globe don't have access to safe drinking water. Beside that about 2.4 billion people doesn't have access to good sanitation facilities (1 out of 3 lack access to a toilet)[4]. This situation, exposed about 692 million people across the world practicing open defecation, and mostly from developing countries (Duraiappah 1996; Marmot and Bell, 2012; and Hammer 2013; Olinto et al. 2013).

1.1.1 Environmental Health

Environmental health is defined by WHO as an aspect of human health that is affected by factors in the environment, which include; physical, chemical, biological, economic and social factors. According to Gnanakan (2000) determinants of environmental health are categorises into 3 factors which influences the quality of life. These include domestic determinants that relates with issues as drinking water, sanitation, home pests, food contamination, and other pollutants that influences human health. They also have a direct link to poor economic conditions, like poverty, deprivation and the prevalence of diseases. Secondly is the local determinants, which is related to the person's exposure with hazardous substances beyond the threshold level. These include the air and water pollution, and the influence of hazardous wastes on health. For example urbanization and industrialization are some contributing factors of environmental pollution, and eventually causing increases of environmental health-related diseases.

Lastly, is the global factors, and might result from negligence and the spillover effect from first and second (domestic and local determinants) and its impact worldwide at large. For example, the ozone layer depletion, global warming, acid rain, and the health hazards that have resulted from these major disruptions to the environment. Escalating human activities are resulting in new forms of pollution, threatening human survival.

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[3]Available@http://www.unwater.org/fileadmin/user_upload/watercooperation2013/doc/Factsheets/sanitation.pdf

[4] http://water.org/water-crisis/water-sanitation-facts/

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Determinants of environmental health such as air pollution, the food we eat, water we drink, the air we breathe, or the type of place we live has been utilised by the literature (Corvalán et al., 1999; Gangadharan & Valenzuela, 2001; Hambling et al. 2011) that can affect our health either positively or negatively. WHO (2010) concluded that air pollution was found to be one of the environmental health factors that claims lives of millions of people globally.

Social determinant of environmental health according to Gnanakan (2000);Schulz and Northridge (2004) include deforestation also contributed to the prevalence of communicable diseases such as HIV/AIDS and Tuberculosis and so on.

Amongst the numerous determinants of environmental health, this study will focus on the access to safe water, good sanitation and carbon dioxide (CO_2) emission as proxy of environmental health, as well as determinant of health outcomes and poverty in developing countries. This approach is slightly different from other studies such as Coulombe and Mckay (1996); PHIM, (2012); Chandy and Gertz, (2011); Takeshi and Shigeyuki, (2010); Gradín, (2009) that focused on income, expenditure, GDP, FDI, remittance as determinants of poverty. It also differs from studies on health outcomes (Liu et al., 2012; Kamiya, 2010; Phil, 1997; Hansen, 2013) that employed used indoor air pollution, CO_2 emission, as determinants of health outcomes.

The justification of selecting water and sanitation as a proxy to environmental health and determinant of health outcomes and poverty is that, other determinants of environmental health such as air pollution are more concern with urban centers, which has high concentration of industries with dense population density, and predominantly found in the higher income countries (Zhang et al. 2014; Gill, Viswanathan, & Hassan, 2017). Unlike rural area, particularly in lower income countries, air pollution is not the major environmental concern (Mubasher Usman, 2009; Marwah & Marwah, 2013; Reardon et al. 1995). However, access to water and good sanitation are amongst the major problems associated to lower income group. For example many rural communities in India and Malawi are lacking access to water and good sanitation leading to abundant the other economic routines to search for water on daily basis (Sutherland et al. 2014; Mkondiwa et al., 2014; Das, 2015).

 Access to water and sanitation especially in lower income countries may directly and indirectly link with health status and standard of living. Therefore, theoretically the link between lacks of access to safe drinking water and good sanitation facility may directly affect the health outcomes, more especially children under the age of five years. This is because, children within this age are more vulnerable to environment (Bampoky, 2013; Moezzi et al. 2015). However, on the other hand, lack of access to safe water may be indirectly link with poverty. For example, many households abandoning other economic routine on daily basis to search for water. While those that can affords are buying it at an exorbitant amount. Therefore, this might reduce their per capita income as well (Barker, 2000; Mkondiwa et al., 2014).

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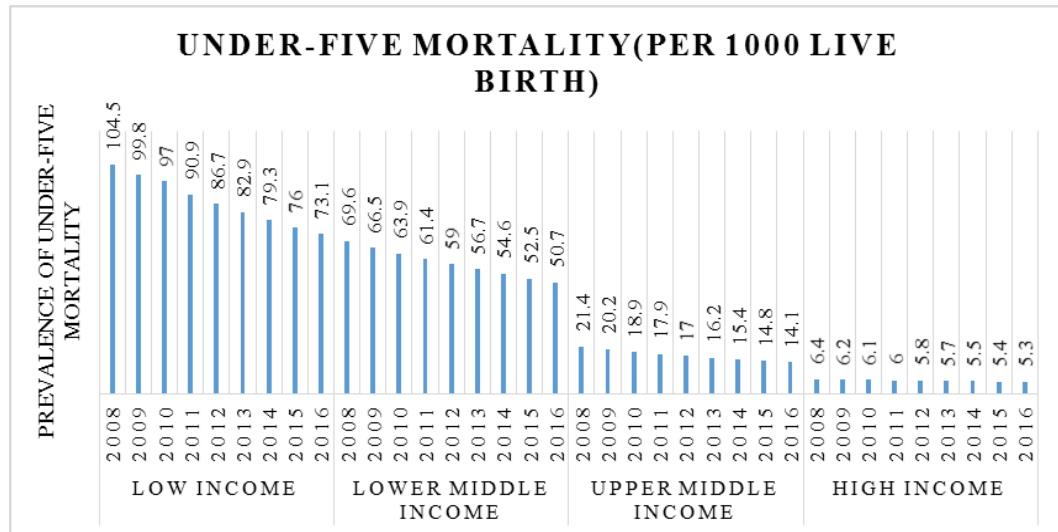
Figure 1.3 : Prevalence of Under-Five Mortality per 1000 Live Birth across Income Level.
Sources: Authors Computation from WDI (2018)

1.1.2 Safe Drinking Water

Safe drinking water measures the percentage of people having access to safe water for drinking from good source that is not contaminated. World Health Organisation (WHO) has categorized the sources of safe water from tape, deep boreholes, dug well separated from contaminants, water from rainfall harvest, and natural spring water that is not contaminated. Therefore, this study will used access to safe drinking water as a proxy to one of the indicators of environmental health, to conduct an empirical investigation between under-five mortality rate, poverty and sustainable development respectively. It is expected to have a negative relationship between access to safe drinking water and under-five mortality rate.

1.1.3 Good Sanitation

According to the World Health Organisation (WHO), access to safe drinking water is used to measure the quality of sanitation in a particular community or country at large. It shows the total number of population having access to toilet facilities, good drainage system, or percentage of people practicing open defecation; it is also consider how waste is being discharge. Access to good sanitation as an indicator, is defined by the WDI as protection of human excretes from the body contact. It is also measured by the proportion of population using functional toilets with water system, or digging of protected fit latrine with through/cross ventilation system. It is also defines as a percentage of people access to safe sanitation facilities, such as good toilets (flush to septic tank, or good ventilated pit) that safeguard hygienic separation of human excreta from contact. This study used access to good sanitation as another

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proxy to the environmental health indicators. We also expect a negative relationship between accesses to good sanitation, with under-five mortality rate.

1.1.4   Health Outcomes

Health outcomes has been defined as a component of health in terms of diseases, morbidity, mortality or life expectancy, for example see (Anyanwu, 2007; Kamiya, 2010; Sartorius and Sartorius, 2014). It is also defined as the influence of healthcare activities have on people and it measures the quality of life in terms of live or death. This measurement of health outcomes can be in terms of morbidity, mortality or life expectancy. Morbidity according to World Health Organisation (2016), refers to how frequent diseases focus on death occurs in a specific community or country. It is measured in terms of number of sick persons with chronic disease like cancer. While mortality is the other form of health outcomes that is expressed in terms of death, and is usually measured in number of death per 1,000 live birth. Mortality rate is further divided into child mortality, adult mortality or combine. Child mortality include; neonatal, infant and under-five mortality. Neonatal mortality refers to number of death before reaching 28 days of age, and is calculated in terms per 1,000 birth. Infant mortality meanwhile, is the death per 1000 population below the age of two years, and under-five mortality is the probability of death per 1,000 before celebrating fifth year anniversary.

However, adult mortality is normally calculated in terms of probability of number death in person ages from 15 years and above. Then crude death is calculated in terms of overall or total number of deaths recorded per 1,000 population in a given country normally in a year.

Health outcomes is also measured in terms of life expectancy; which according to WHO refers to the expected number of days an individual would live from date of his/her birth until the date he/she would die. Life expectancy differs from country to country or region to region. For example higher income countries are associated with higher life expectancy compared with lower income countries (Cervellati, Sunde, & Cervellati, 2009; Cervellati & Sunde, 2011).

 In 2015 the top-five countries with highest life expectancy are Monaco with 89.52 years, Japan 84.74 years, Singapore with 84.68 years, Macau with 84.51 years, and San Marino with 83.24 years, respectively, and all are from the higher income or developed countries[5]. On the other hand, the last five countries with least life expectancy on global ranking which include; Namibia with 51.62 years, Swaziland with 51.05 years, Afghanistan with 50.05 years, Guinea-Bissau with 50.23 and the last but not the least is Chad Republic with life expectancy of 49.81 years, are from low-income developing countries.

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[5] Life expectancy for countries; Health and social statistics.
http://www.infoplease.com/world/statistics/life-expectancy-country.html

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This study will use under-five mortality as a proxy to health outcomes. The justification is that, studies such as Romani and Anderson, (2002); Fuentes, Pfütze, and Seck, (2006); De la Porte, (2011); and Bampoky, (2013) have suggested that, child age appears to be an essential variable when studying the impact of environmental health (physical environment) on child health. Lower-income countries accounted for more than 85% global under-five mortality rate, and almost 90% of the death is due to water and sanitation associated diseases such as diarrhea, malaria and others.
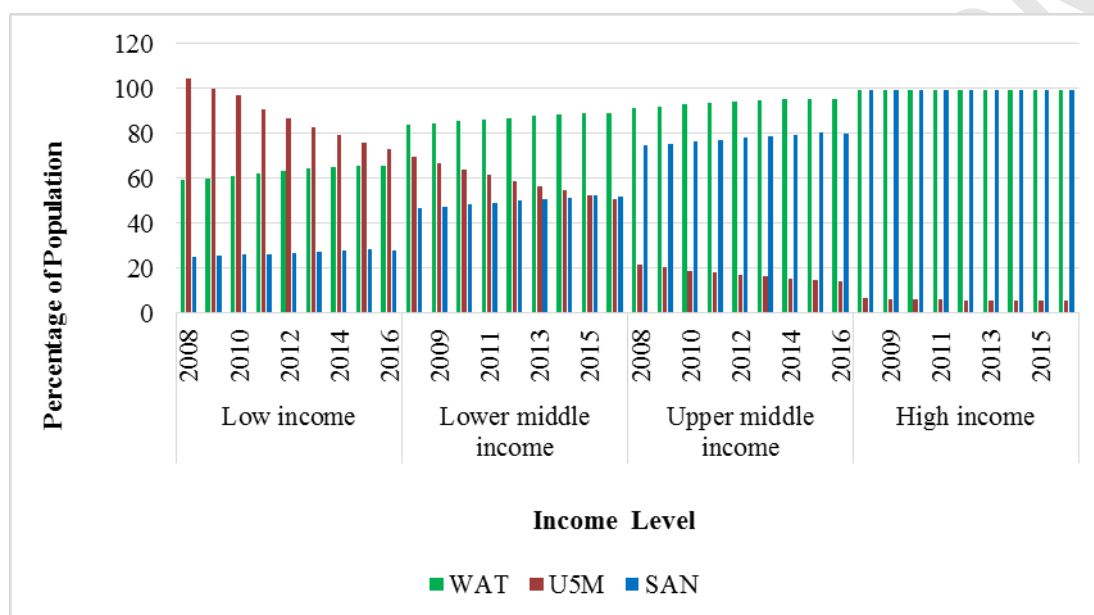
Figure 1.4 : Proportion of Population access to Good Sanitation, Safe Drinking Water and Under-Five Mortality amongst Low- Middle- and Higher Income Countries.
Sources: Author's computation from World development Indicators (2018)

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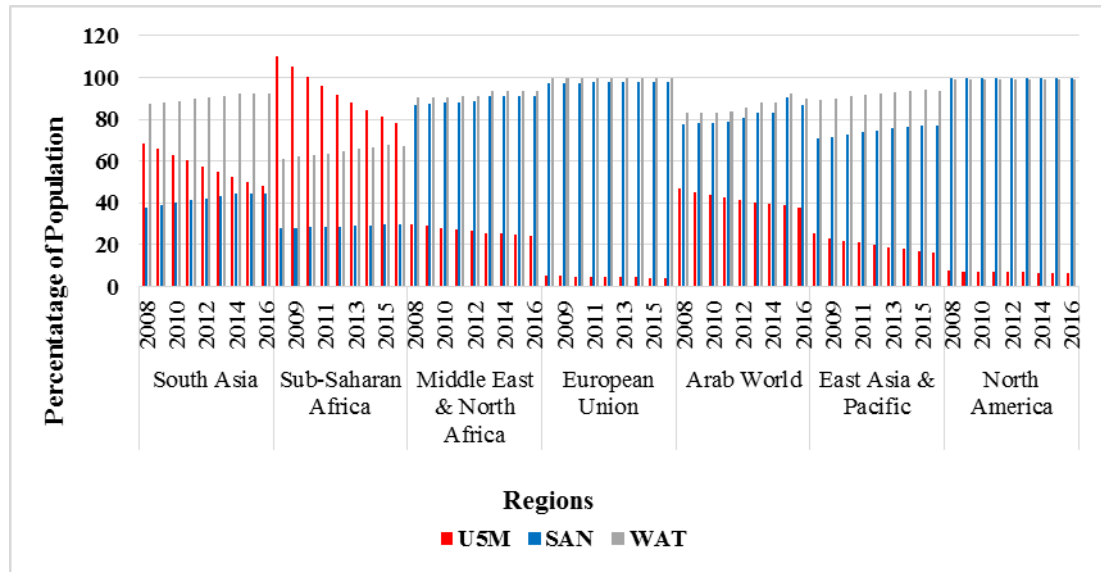
Figure 1.5 : Proportion of Population access to Good Sanitation, Safe Drinking Water and Under-Five Mortality amongst different Regions of the World.
Sources: Author's computation from World development Indicators (2018)

1.1.5 Poverty

Poverty has several meanings and measures. Literature on poverty (Reardon and Vosti, 1995; Gutierrez, 2007; Schulz and Northridge, 2004;Reardon, Lansing, Vosti, and Food, 1995;United Nations, 2015; Azam, 2016; PHIM,2012) have utilised two economic indicators; (income and expenditure), which is a poverty line approach in monetary terms. According to this indicator, a person is poor when he/she is living on or below Poverty line of 1.25USD per day. Other non-monetary measures in terms of unsatisfied basic human need (UBN) are also used to measure poverty. They include shelter, education, health services, safe water (Nunan, Grant, and Bahiigwa, 2002; Al-Hmoud and Edwards, 2005; Usman, 2009; Barbier, 2010; and Mkondiwa et al., 2014).

World development indicators have also defined poverty based on household income level using poverty index. Poverty measures based on income and expenditure were also used at both national and international level respectively (United Nations Development Programme,2006). For instant, the Millennium Development Goals (MDGs) and the recent Sustainable Development Goals (SDGs)'s poverty indicators are scale based on income measures. The income and consumptions are very important criteria in measuring poverty, they are also useful in critical areas like measures of human wellbeing such as mortality or access to basic infrastructures like good sanitation, safe water and hygiene (Sullivan et al., 2003; Mkondiwa et al., 2014).

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Therefore, poverty is defined as a situation in which an individual cannot afford or acquire basic things of life due to factors such as economic, political, social, or natural. Literature such as (Leipziger, 2001; Gupta and Mitra, 2004; Nindi and Odhiambo, 2015) amongst others, associated poverty with economic factors like individual's income and purchasing power (consumption) while other determinants include political factors such as quality of institutions in terms of rule of law, control of corruption, government effectiveness; or sometimes poverty is associated with natural factors such as flooding, drought and so on.

According to United Nations Development Programme (UNDP), poverty has 3 dimensions which includes: education; health and standard of livings. These dimensions are further subdivided into 10 indicators. For education, poverty is viewed from average years of schooling amongst population and child school enrolment.

Then health indicators includes nutrition and mortality in children. Finally standard of living is sub divided into access to safe water, good sanitation, source of cooking fuel, electricity, flooring and asset ownership (Alkire et al., 2011). According Oxford Poverty and Human Development Initiative (OPHDI), using multi-dimensional poverty index (MPI), close to 1.5 billion people from 101 developing and lower income countries or 29% of their population live in multidimensional poverty. 33% of the indicators reflecting acute deprivation in health, education and standard of living. And close to 900 million people are vulnerable to fall into poverty if setbacks occur due to financial, natural or otherwise (Alkire, Seth, and Roche, 2013).

Poverty is also measured based on lack of access to good health, education, shelter, insufficient total income to sustain life, and the quality of environment that have emotional impact people's welfare (Gerth, H. and Mills, 1974; Coulombe and McKay, 1996; A. Markandya, 2001; Nunan, Grant, and Bahiigwa, 2002; Gordon, 2006; and Mkondiwa et al., 2014). James Foster (1984) categorized measurements of poverty into poverty head count index, which is measured by the proportion of the population that live in the household with a consumption per capita less than the poverty line. The poverty gap index measures as the distance or gap between the incomes of the average poor man from poverty line. These indicators are widely used as measures of poverty by World Bank and poverty literature such as (Ali, 2003; Gradín, 2009; Shandra et al. 2011; WHO, 2013).

Vicious Cycle of Poverty Cycle

Poverty is multidimensional, sometimes it is beyond the household income level. The intricacy of the cycle of poverty means that resolutions need to be equally complex. Poverty is caused by many factors, and therefore, the solution should also be multidimensional one. According to Klugman (2002) there are some factors responsible for exposing a poor person into poorer condition, which is poverty cycle. These include lack of opportunity to participate fully in the society which may

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affects income and consumption level of an individual, relative to national poverty line. Inadequate or no improvement and access to development indicators, such as education, safe drinking water and health facilities are amongst the reasons for a poor society.

1.1.6 Poverty Measurements

This study utilised household final consumption expenditure per capita as measurements of poverty. The proxy is amongst the multidimensional poverty index. It is commonly used by researches such as (Coulombe & McKay 1996 ; Alkire & Santos, 2014). Based on data from the World Bank development indicator and the world average poverty bench mark is 30, and according income level, the higher income countries is 35, which is above the world average. Whereas that of low income countries is 25. Below the world poverty bench mark individual fall below the poverty threshold are thus considered to be poor, relatively speaking. Although it may be justified to use more absolute approaches to poverty measurement. Relative income thresholds (poverty-threshold) used in this study provide poverty measurement that is relevant in a global assessment of policy impacts in both low, lower-middle- and high-income countries[6]. The measurement is also consistent with the poverty reduction strategy, especially in the era of millennium development goals [MDGs] and SDGs as well.

Figure 1.5 below illustrates the poverty line and cut off point indicating consumption gap based on the data from world development indicators from low- and higher-income countries. The world average consumption expenditure is regarded as threshold beyond which the household is not regarded as poor. Whereas below the world average spending is regarded as poverty line (consumption gap).

Therefore, this indicator-house hold final consumption per capita(consumption gap) has been utilised by poverty literature such as Coulombe & McKay (1996) ; and Alkire & Santos (2014).

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[6] see Vijaya, Lahoti, & Swaminathan (2014).

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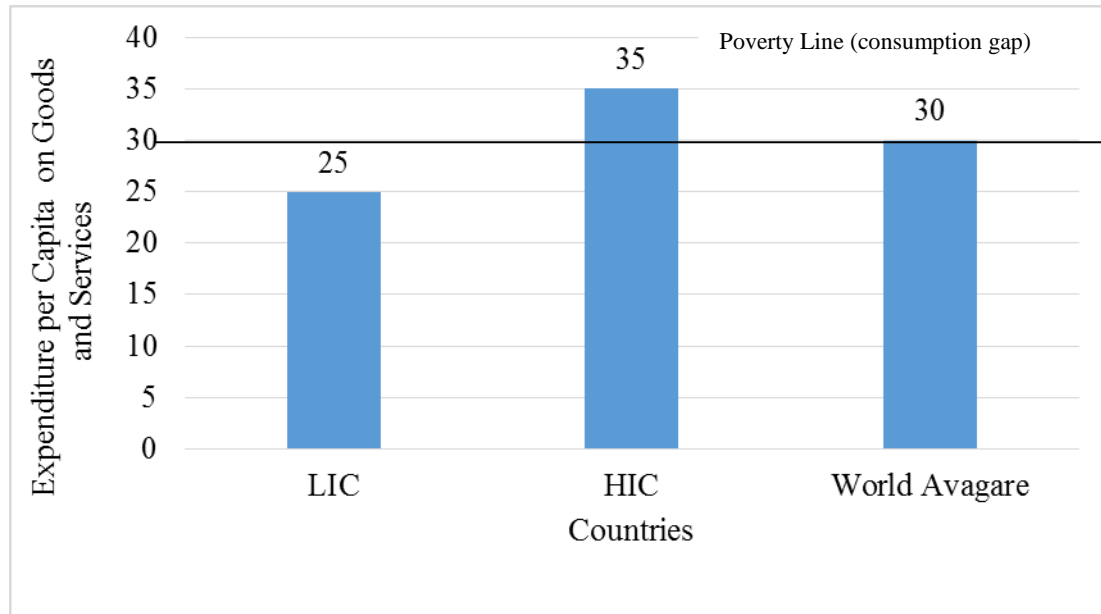
Figure 1.6 : Poverty Line based on Household Final Consumption Expenditure per Capita
Sources: Author's computation from World development Indicators (2018)

Therefore, from the above scenario, we can deficits that, an increase in the access to safe drinking water is expected to reduce consumption gap (poverty). Because according to data from WDI consumption gap is tag as household final consumption expenditure, the poverty line is tag below the world average. Therefore increase in access to safe drinking water is expected to increase the household final consumption expenditure, hence it impliedly reduces consumption gap (poverty).

1.1.7   Environmental Health and its Determinants

Environmental health as defined by WHO is an aspect of human health that is determined by factors in the environment. This includes: physical, chemical, biological, economic and social factors that affect health outcomes (CSD, 2005).

Many other factors affect environmental health, such as air pollution, war, natural disasters etch, are amongst the worrying environmental health factors, which is responsible for children death include both indoor and outdoor pollution. The sources of indoor pollution is mostly associated with smoke from burning of coal, charcoal, firewood and so on. "A polluted environment is a deadly one – particularly for young children," says Dr. Margaret Chan, WHO Director-General. "Their developing organs and immune systems, and smaller bodies and airways, make them especially vulnerable to dirty air and water."

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Exposure to harmful substances by the pregnant woman also increases the danger of premature birth. In the same vein, the risk of prevalence of chronic respiratory diseases such as asthma, heart diseases, cancer and stroke also increased amongst children due to their exposure to indoor, outdoor pollution and second-hand tobacco smoke (WHO, 2017). Also frequent use of unhygienic fuels for cooking and heating, such as charcoal and animal dung increases the risk of pneumonia incidence amongst children.

Environmental public health indicators according to Hambling, Weinstein, & Slaney, (2011a) can be used as a tool to assess the health status or risk as they relate to the environment. Amongst the best indicators are those that consistently predict the connection between human health and the immediate environment.

Another environmental health hazard is associated with the exposure to chemical substances such as lead. For example, CDC (2016) reveals that, center for preventive diseases and control, reported a lead poisoning outbreak in Zamfara state northern Nigeria in 2010. The incident was the largest ever known to occur in the history of mankind. Due to high concentration and dangerous level of lead substances in blood, it claims the lives of thousands and hundreds of adult, children and even animals that are exposed to lead dust from gold mining in their communities.

In relation to that, WHO (2017) have highlighted that, children are more vulnerable to the risk of environmental health hazards because their organs and immune systems are not yet developed. This make them more vulnerable to dirty air and water. Lead caused serious damage to their body system, such as the central nervous system, and particularly the brain, borne, and kidney. Many children who has been exposed to lead will have developmental problems of growth and low IQ scores says (WHO, 2011).

Other environmental determinants affecting children health include the quality of water, sanitation and hygiene. These factors are associated with children health outcomes which affects the quality of their lives. For example, lack of access to safe drinking water, good sanitation and hygiene increases the risk of the prevalence of diarrhea, malaria, dengue and other water, sanitation and hygiene (WASH) related disease. Many families in low and lower-income countries are without access to basic amenities, such as safe water and sanitation, which increase the incidence and risk of diarrhoea amongst children (UN Inter-agency Group, 2015).

Figure 1.4 below shows the WHO News release of *6 March 2017,* highlighting the global cost of environmental pollution on children below the age years. It is reveals that, polluted environment accounted for 1.7 million death amongst children below the age of five annually. Poor states of drinking water and sanitation facilities is reported to be the highest killer of children below the age of five due to their exposure to environmental pollution. Neonatal conditions, diarrhea and malaria are

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responsible for about 52% of under-fiver mortality annually. This is equivalent to 830,000 children died annually before celebrating their 5 years anniversary.

Air pollution causing respiratory infection such as pneumonia is the second killer of children under-five amongst the environmental health factor. This is a result of exposure of children to indoor, outdoor and second-hand smoke. Respiratory infection accounted for 35% of the death, which is equivalent to 570,000 under-five child death globally per annum.
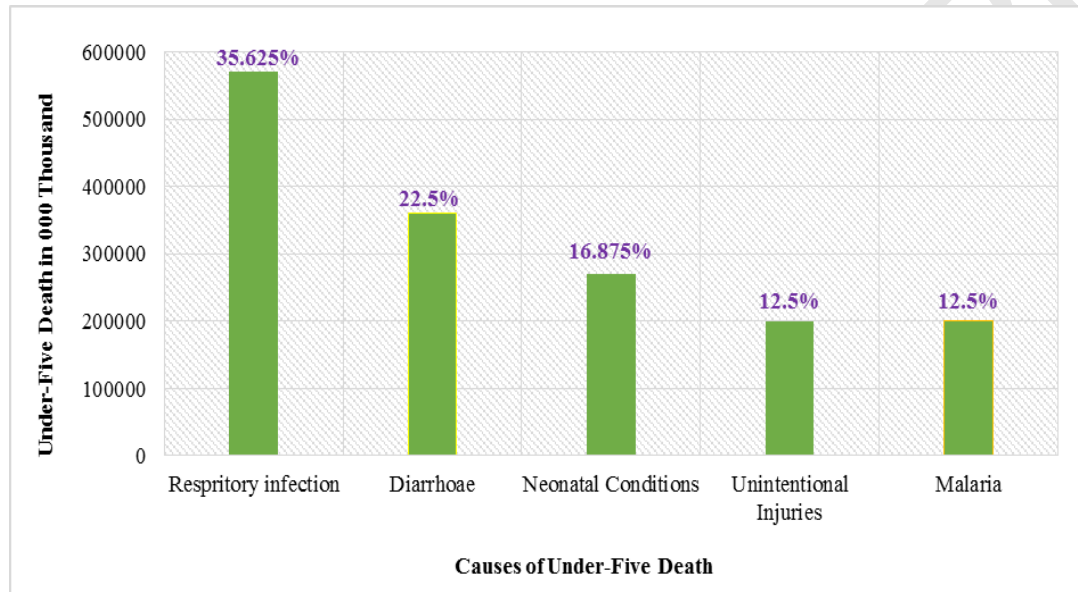
Figure 1.7 : Global Under-Five Death Related to Environmental Pollution
(Sources: Authors' computation from WHO News release 6 March 2017[7]).

Safe drinking water is one of the major determinants of environmental health. According to WDI (2016), safe drinking water, is the water from improved sources, such as piped water on premises, tube wells or boreholes, protected dug wells, protected springs, and rainwater collection. Due to the importance of water to life, the United Nations general assembly urged that, its supply should be available to every household, educational institutes, offices, health centers and so on, and should be accessible within the radius of 1000 meters and not exceeding 30 minutes of trekking. Minimum of 50 to 100 liters is required per person in order to meet his/her daily private and domestic needs. Meanwhile, the cost of water should not also be

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[7]The cost of a polluted environment on annual under-Five children deaths. http://who.int/mediacentre/news/releases/2017/pollution-child-death/en/?utm_source=WHO+List&utm_campaign=a5120e56a1-EMAIL_CAMPAIGN_2017_03_06&utm_medium=email&utm_term=0_823e9e35c1-a5120e56a1-266512529)

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greater than 3% of the household disposable income (Wall, 1997; UNDP, 2006; WHO, 2009; UNDP, 2010 and Marwah and Marwah, 2013).

Other determinants of environmental health comprises good sanitation. It is measured in terms of access to better-quality sanitation facilities, and referring to the percentage of the population using improved sanitation facilities. Good sanitation is required to safeguard the hygienic separation of human body waste from human touch. This research focuses more on water and sanitation, which are amongst the environmental health concern in the life of rural population of the lower income countries (Al-Hmoud & Edwards, 2005; PHIM, 2012; Sutherland et al., 2014).

Figure 1.5, present the Global distribution of people who have access to water and sanitation in percentage. Only 42% of the global population have access to safe water and clean sanitation and it is mostly in higher income countries. This pointed out that, poor environmental health may closely be linked to ill-health, and further related to poverty.
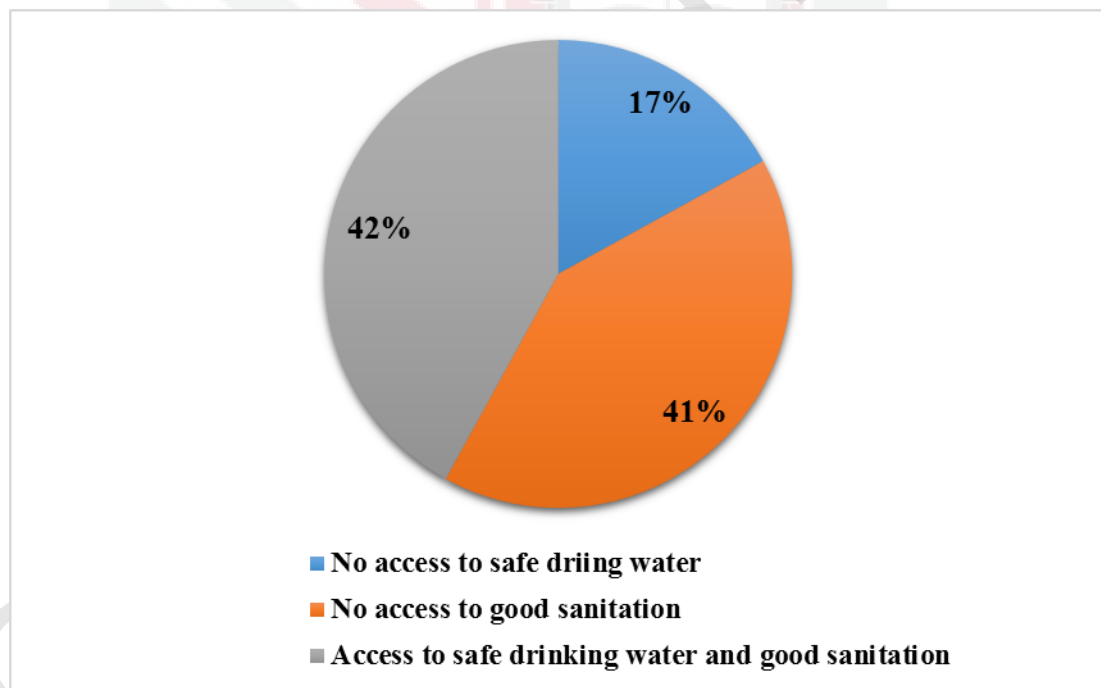
Figure 1.8 : Global distribution of people access to water and sanitation in percentage (%)
(Source: Authors computation from USEPA (2015).)

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Thus, a need for empirical investigation on the relationship or impact of water and sanitation on health outcomes and poverty, particularly in the lower-income countries.

1.1.8 Health Outcomes and Environmental Health

Health outcomes is a component of health in terms of diseases, morbidity, mortality or life expectancy. It shows how frequent diseases occurs in a specific community or country and it refers to an incidence of ill health in a given population (Anyanwu, 2007; Kamiya, 2010; Sartorius and Sartorius, 2014). The measurement of health outcomes can be in terms of morbidity, mortality or life expectancy according to World Health Organisation (2016).

The World Health Organization (WHO) have categorized diseases associated to water as; water-borne, water-wash, water-based, and water-related to insect vectors. Diseases like diarrhea, malaria, dengue and other water related communicable diseases also lead to premature death, and are associated with poverty especially in low income countries (Romani and Anderson, 2002; Kaldewei, 2010; Michael Marmot and Alpbach, 2013). Almost 4% of the global death was attributed to diarrhea. This is approximately translated to about 2.2 million people annually, and mostly affected children under the age of five in developing countries.

World Health Organization (2015); and Ribeiro (2015) reveals that, the majority of under-five mortality in developing and lower income countries are mostly associated to water and sanitation communicable diseases like diarrhea, malaria, dengue, and the rest. Regions that are mostly affected are South Asia and Africa, which accounted for 8.5% and 7.7% of all deaths respectively[8].

In this regard, child age appears to be an essential variable when studying the impact of environmental health on child health. Romani and Anderson (2002); Fuentes, Pfütze, and Seck (2006); De la Porte, 2011; and Bampoky (2013) have emphasized that, influence of household environment on child health is limited during their first 28 days of life. It is more extensive between 28 days to 11 months but the effect of environmental health is more influenced in age above one year and below five years.

Health outcomes are also measured in terms of life expectancy; which according to WHO refers to the expected number of days an individual would live from the date of his/her birth until the date he/she would die. Life expectancy differs from country to country or regions. For example, higher income countries are associated with higher life expectancy compared with lower-income countries.

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[8] Water Aids 2015

Figure 1.6 shows the relationship among the percentage of population with access to safe drinking water and sanitation and the percentage of under-five mortality rate in high and lower income countries globally. More than 95% of population in high income countries have access to safe drinking water and good sanitation. This is in line with the achievement in human development as recorded in the MDGs. and also consistent with SDGs.

Conversely, lower-income countries lagged behind only 47.8% and 23.6% of the population that have access to safe drinking water and good sanitation. Similarly, the prevalence of under-five mortality rate in lower income countries is double digit (11.6%) as against a single digit (8.9%) in higher income countries. The Figure reveals a negative relationship between access to safe drinking water and sanitation with the prevalence of under-five mortality rate.
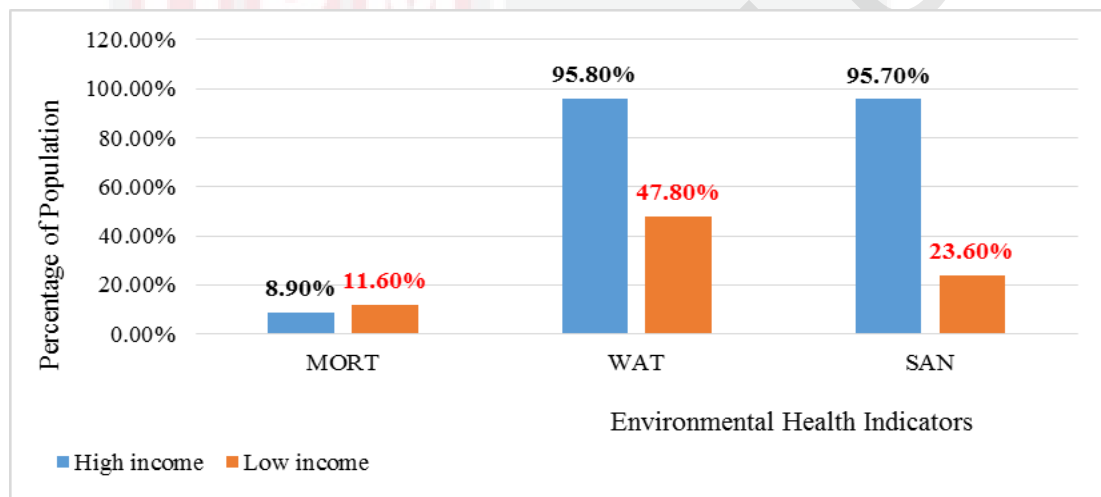
Figure 1.9 : Percentage (%) of Global population access to improved water, sanitation and under-five mortality rate by region from 1995 and 2011
(Source: WDI (2016).)

Sub-Saharan Africa and South Asia are regions with a high prevalence of under-five mortality. Diseases such as diarrhea, malaria and dengue fever are claiming the lives of million children in these regions over a decade. Literature such as Ribeiro, (2015) and Deribew, (2015) have suggested that, access to safe water, good sanitation and good hygiene reduce disease prevalence and mortality among children.

The proportion of population lacking access to good sanitation globally have reached 2.5 billion in 2015, resulting in serious health problems. This study is consistent with SDGs 3, which aims at reducing under- five-mortality rate to the dearest level through safeguarding healthy lives and uphold well-being for all at all ages. Thus, estimating the effect of environmental health on under-five mortality, through access to safe drinking water and good sanitation is very important, especially in

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developing countries. It is also distinct from other studies that focus only on country basis for the link between water, sanitation and health outcomes (Gleick 2002; Bampoky 2013; and Bello and Joseph 2014).

1.1.9 Poverty and Environmental Health

Pioneering work on poverty had defined it from deprivation point of view. For instance, to Gerth and Mills (1974) people are consider poor, if there is lack of resources in the community or society. Resources such as food, shelter, health care, and security that enable people to obtain basic needs (Bradshaw, 2007), while Veit-Wilson (2009) view poverty as lack of minimum income required for physical survival of an individual. Therefore, impliedly poverty can be define as lack of productive resources to fulfil basic needs, which include food, water, shelter, education and health. It also means deprivation in the well-being of people in terms of basic needs, economic growth and quality of life.

World Bank has recently revised and adjusted the poverty indicators of head[9] count and poverty gap from 1.9 USD to 3.10 USD PPP respectively. But based on Millennium Development Goals (MDG) and Sustainable Development Goals scales, they utilized poverty headcount comprising the proportion of the population living on or less than 1.90 USD per day. However, some literature have argued that, in addition to income and expenditure, poverty is multidimensional, it can be viewed from different angles such as health, education, and possession of assets etc.

For example, Figure 1.7 reveals the relationship between environmental health and poverty. South Asia, and sub-Saharan Africa are regions with highest number of poor, with 51% and 28% respectively. According to WHO (2013) multidimensional poverty index (MPI), regions like Arab states, East Asia and pacific, Central and Latin America have lower proportion of poor population. Many previous studies suggested that, access to safe drinking water and good sanitation services lead to improvement in living standard of the people (Bosch et al., 2001; Al-Hmoud and Edwards, 2005; Commission on Sustainable Development, 2005; Cohen and Sullivan, 2010; Tignino, 2011; PHIM 2012; WHO, 2013; Musa, 2015).

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[4]. Poverty headcount ratio and Poverty gap has recently revised by WDI from $1.90 and $1.25 to at $3.10 a day (2011 PPP) PPP exchange rates in 2015.

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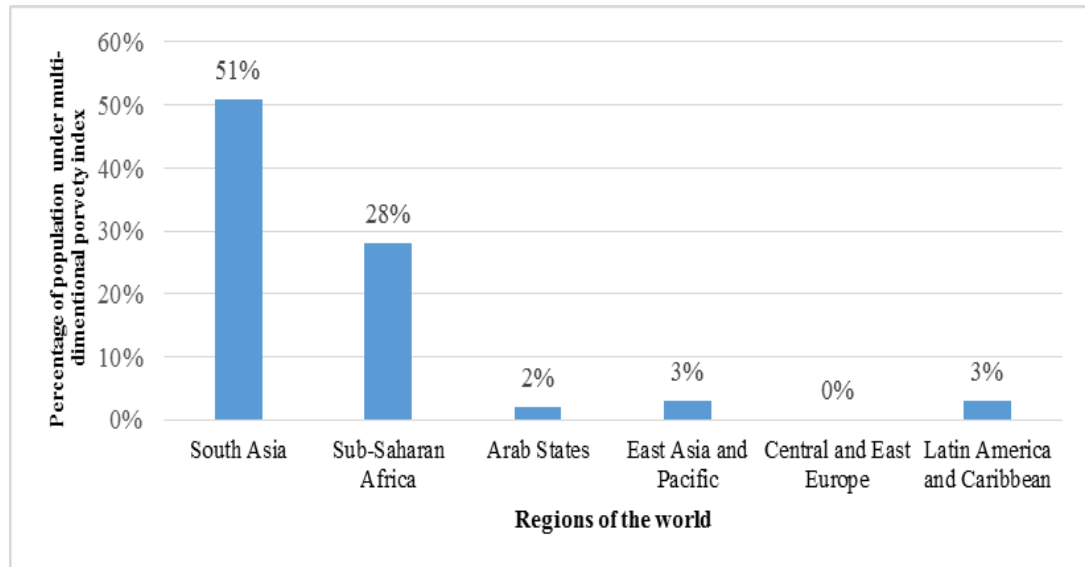
Figure 1.10 : Multidimensional Poverty Index: A New Approach to Global Poverty 2015 of Developing Countries by regions
(Source: Authors computation from (www.ophi.org.uk).)

Similarly, Figure 1.8 reveals the percentage of population access to safe drinking water (WAT) and access to good sanitation (SAN) from higher income, lower income countries and world aggregate for the period of 1997 to 2015. The world benchmark is 86% and 62% percentage of population access to safe drinking water (WAT) and access to good sanitation. For higher income countries (mostly developed countries), 98.5% and 95.6% of their population have access to safe drinking water and good sanitation facilities. However, in lower-income countries (developing countries), only 57.2% and 23.2% of their population have access to safe drinking water and good sanitation, which is below the World threshold for the two indicators. This situation is also link with other indicators for human development (from dimension of poverty) such as access to infrastructural facilities (GFC), individual income in terms of gross national income per capita (GNIpc), and household final consumption expenditure per capita (HCE).

The average household final consumption expenditure per capita in higher income countries is 37.5% as against 25.6% in lower income countries. This is an indication the difference in the standard of living in both countries. On the other hand, GNI per capita of higher income countries is 32.5% and 25.8% which is above lower income (developing countries) and global average respectively. Finally, the gross fixed capital formation explains the availability and accessibility of infrastructural facilities such as access to water in a given country. Higher income countries on the average have more access to these facilities with 31.7% than developing countries with only 24.6%.

Therefore, based on the measurement of poverty, (household final consumption expenditure per capita). The lower income countries is lagged behind. Since the world bench mark is 30. Higher income countries is 35 whereas for the lower income countries is 25 which is below the poverty line based on MPI using house hold final consumption expenditure.
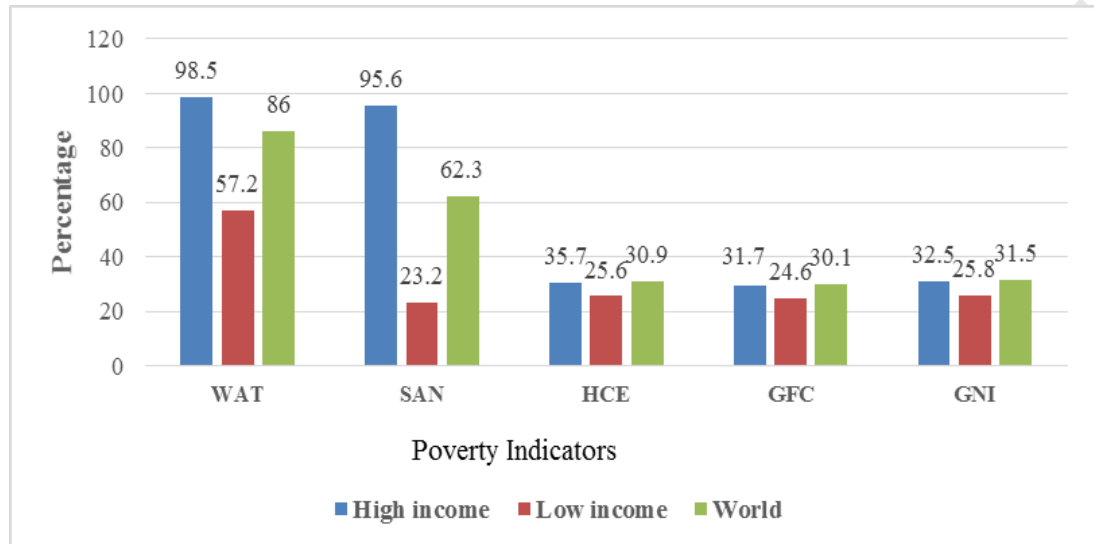
Figure 1.11 : Aggregate GNIpc, Household final consumption, and Population access to water and sanitation 1997-2015
(Source: Authors computation from WDI 2016.)

According to Oxford Poverty and Human Development Initiative (OPHDI), using multidimensional poverty index (MPI) globally, there is close to 1.5 billion people from 101 developing and low-income countries that are poor. About 29% of their population live in multidimensional poverty[10]. 33% of the indicators reflecting acute deprivation in health, education and standard of living. While close to 900 million people are vulnerable to fall into poverty if setbacks occur to financial, natural or disaster or otherwise (Alkire, Seth, and Roche, 2013; Alkire and Robles, 2015; Bank, 2014; Fritzell, Rehnberg, Bacchus Hertzman, and Blomgren, 2015; Roser, 2016).

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[10] Multidimensional poverty is describing how poor people that lacks money and are suffering from multiple disadvantages at the same time. Take for example they may have poor health or malnutrition, and also lacks clean water, electricity, poor quality of work or lacks schooling. Focusing on one factor alone e.g. income, is not enough to capture the true reality of poverty. However, their combine effect on poor is regarded as multidimensional poverty. See http://www.ophi.org.uk/research/multidimensional-poverty/

1.1.10 Sustainable Development and Environmental Health

The concept of sustainable development lacks clear definition. Nonetheless different scholars (Ekins, 2003; Redclift, 2005) have defined it as sustainability of natural capital concept, which implies the management of natural capital stock (resources) in the interest of the humanity. Neumayer (2001) proposes green Human Development Indicators (green-HDI) in addition to the traditional HDI index such as income, longevity and education, given consideration to natural capital that are renewable resources like forest, water, fish, soil and biodiversity in general.

Brundtland, defines sustainable development as "any development that meets the needs of the present generation without comprising the ability of future generations to meet their own needs" (WCED, 1987). This definition according to Jordan (2008), was an eye opener to the concept of sustainable development.

Therefore, sustainable development as goal rejects any policies and practices that support current living standards by depleting the productive base, including natural resources, and that leaves future generations with poorer prospects and greater risks than our own generation.

Recently, Brock & Taylor (2010) have modified and developed a neoclassical Solow growth model into green Solow model. The model modified the United Nations human development index and captured sustainability of environment.

Therefore, the concept of environmental health proxy to access to safe drinking water and good sanitation, which can then be expressed in terms of not only quality, but also the availability, accessibility and sustainability of the resources amongst generations. For example, lack of access to safe drinking water have exposed millions of people into poverty trap. Prevalence of water-related diseases like cholera and dengue, especially in developing countries have claimed the lives of millions people which have a spill-over effect on future generations.

Figure 1.12 presents the global distribution of salt and fresh water in percentage. Even though, about 71% of the earth's surface is covered by water, however, almost 96% of the waters are not drinkable due to high concentration of salt. Only 4% of the global water is drinkable and 17% of the global population don't have access to safe drinking water. This implies that, they are using untreated water for their daily consumptions and mostly occur in developing countries. Thus, studies (Commission on Sustainable Development, 2005; Guzovic and Yan, 2013; United Nations, 2015) have suggested that, water is very crucial to development, and its scarcity may have an adverse effect on productivity as well as health condition.

GLOBAL DISTRIBUTION OF WATER
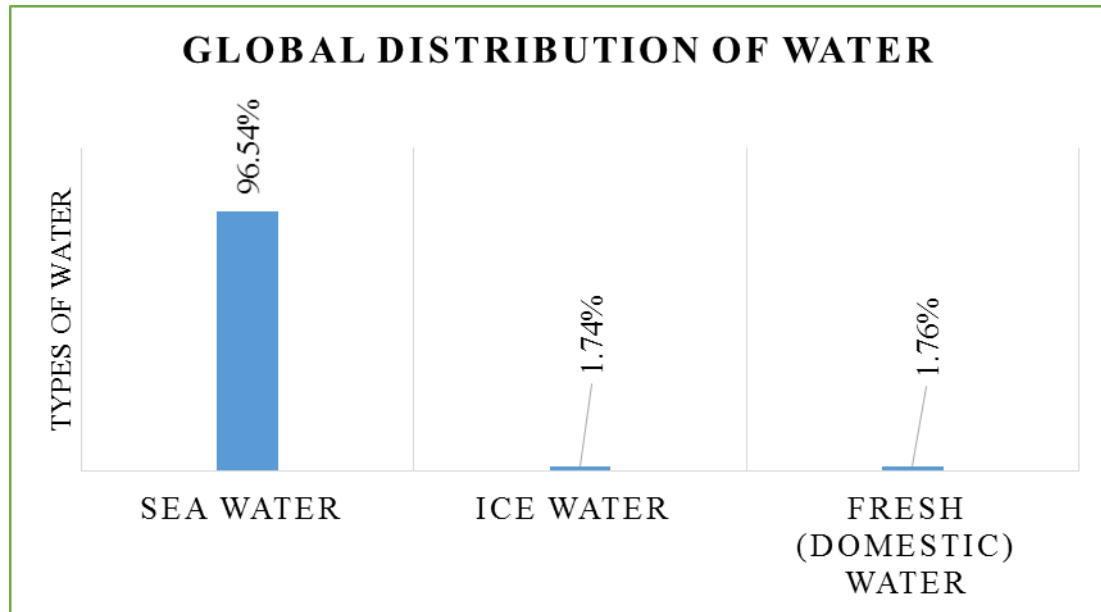
Figure 1.12 : Global distribution of salt and fresh water in percentage (%)
(Source: http://water.usgs.gov/edu/earthhowmuch.html (2016).)

Fresh water is one of the significant basic necessity to quality of lives. Apart from domestic uses, it is also important for productive activities such as agricultural practices, business operations, and industrial uses for achieving economic growth and development (Appleton, 2002; Brock & Taylor, 2010).

However, intensive agricultural practices coupled with rapid industrialization as recorded by many countries around the world, have contributed positively toward achieving intensive economic growth and development. Developing countries such as China, India, Nigeria, Indonesia, Pakistan and many other, have recorded remarkable increase in their GDPs over decades, due inflow and outflow of foreign direct investment (Akinlo, 2004; Alguacil, Cuadros, and Orts, 2002; Ang, 2009; Asiedu, 2002; Baharumshah and Law, 2010; Gao, 2010; Klasra, 2009; Kolstad and Villanger, 2008; Mah, 2010; Narayan, 2005; Omankhanlen, 2011; Routledge, 2011; Salim and Bloch, 2009; Vu Le and Suruga, 2005). Nonetheless, the regions accounted for the largest population that lack access to safe drinking water and sanitation, due to largely contamination and withdrawal of fresh water.

One of the challenges connected to sustainability of water is increasing trend in the volume of agricultural products losses and wastes. According to Silva (2017) affirmed that, food and agriculture organization (FAO) of the United Nations reported that, food losses and waste happen across the whole at all stages of the agricultural value chain (from the farm to the final consumer stage), which is also linked with the factors responsible for global withdrawal of limited fresh water, hence amongst the concern of sustainable development. For example, it is estimated that about 1.3 billion tons of food are lost and wasted annually. This wastes is

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equivalent to about 30% of agricultural products produced globally. Food losses and waste add to existing pressures on land, water, and biodiversity and are the cause of additional Greenhouse Gas (GHG) mostly emitted from households, agricultural and industrial wastes are affecting the global environment and hence local resources such as water body like rivers, lakes etc., hence are amongst the source of fresh waters.

For example, Figure 1.13 below presented the quantity required to produce 1 kilogram of agricultural product per litres. In order to produce 1 kilogram of Olives, a famer need about 3,025 litres of fresh water. According the statistics, Cabbage and unit of Egg are the agricultural products that requires less quantity of water in their production process. To produce a kilogram of each of these products, about 237 and 214 litres of fresh water are required respectively. One can imagine the quantity of water (fresh water) is needed in the production of food to feed the entire global population of more than 7 billion people.

As mentioned earlier, Agricultural sector alone, is responsible for the consumption of about 70% of global fresh water, which is followed by industrial sector with 22% and the remaining 8% is used for domestic consumption (mainly for drinking, cooking washing amongst others). More ever, the United Nations recommend about 50-100 litres of water for domestic consumption per day such as drinking, washing, cooking etc. per individual.
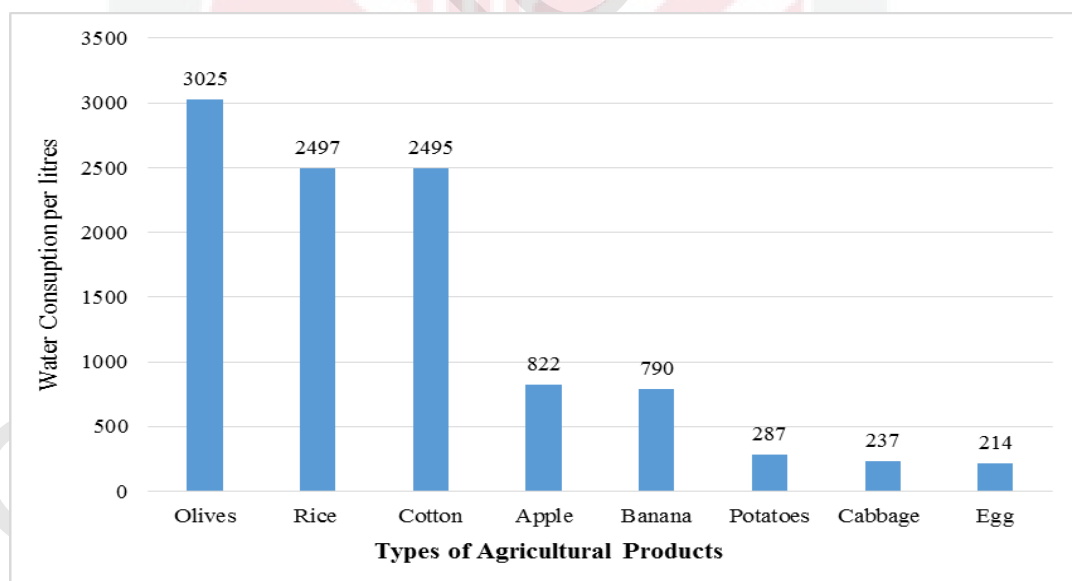
Figure 1.13 : Volume of Water required for the production of 1kg of Agricultural Products
Sources: Authors computation from IME food waste report (2017).

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The rate of water pollution is also one of the major developmental issues for the entire regions. This

is due to high rate dumping of agricultural, household, and industrial wastes into main sources of fresh water, such as rivers, lakes etc. For example, Zhang et al. (2014) reveal that many communities do not have access to safe drinking water in rural communities in China, thus it is amongst the major causes of under-five mortality.

Countries like Nigeria, Niger Republic, Chad and Cameroun Republic are also faced with similar problem of withdrawal of fresh water due to shrinking of Lake Chad[11]. Commission on Sustainable Development (2005) has reported that, in addition to the major source of their drinking water to those confluents, Lake Chad generates almost 100,000 tons of fish and generate $20 to 25 million income per annum to the region. Indonesia is also facing with the problem of contaminations of its five biggest Rivers due excessive dumping of refuse, making these waters undrinkable (A. Markandya, 2001; Bosch et al., 2001; and López, 2010).

It is worthy explanation that, if greater proportion of people living in a decent environment with accessibility to portable drinking water, good sanitation and hygiene, then, this can be translated into better income, schooling and better health due to low prevalence of water communicable diseases (Commission on Sustainable Development, 2005).

1.2   Statement of Research Problem

Access to safe drinking water and good sanitation are critical facilities to mankind. World over, about 17% of the global population have no access to safe drinking water and 41% have lacks of good sanitation[12]. This situation have triggered the prevalence of under-five mortality rate caused by water-related diseases such as diarrhea, dengue and malaria, and which could be avoided through providing access to safe drinking water and good sanitation. Water-sanitation related cases have been largely eliminated in developed countries (Sartorius & Sartorius, 2014a). However, it remains a major environmental health-challenge in most developing countries, especially low- and lower-middle income countries. It makes up about 98.5% of the global under-five mortality, where the prevalence still remains very high[13].

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[11] See Appendix 1 (Aerial/remote sensing photograph captured by NASA/BBC Africa showing the percentage withdrawal of Lake Chad between 1980 to 2016).
[12] Source: USEPA (2015) on the Global distribution of people access to safe drinking water and Sanitation in percentage (%)

[13] Global Under-Five Death Related to Environmental Pollution *WHO News release 6 March 2017).

Asia and Africa are the most affected regions. Asia has the largest share of under-five deaths with about 50%, followed by Africa with about 45%, Latin America and Oceania 3.3%, while Europe constitutes the remaining 1.7%. Therefore, conducting an empirical study on how under-five mortality rate is influenced by lack of access to safe drinking water and good sanitation in low- and lower-middle income countries is therefore imperative.

The availability of safe drinking water and good sanitation services are amongst the basic amenities required to improve the living standard of millions of people globally particularly in the low- and lower-middle income countries. Poverty rate can be reduced when people have access to safe water and sanitation when they utilize the opportunity cost of time for fetching water and hence engaging themselves in productive activities. Therefore, improving their incomes through labour-force productivity, level of education and other economic activities. Globally the poverty rate have been reduced by about 10% from 1990 - 2015. This reduction in poverty within the last 25 years is from 1.8 billion to about 836 million. Based on the poverty line of 1.90 USD per day, there are about 836 million people living on less than 1.25 USD per day, and mostly are coming from developing countries. However, based on the multidimensional poverty index (MPI) [non-monetary index], globally, there are about 1.5 billion poor people and they come from 101 developing countries. Majority of population from these countries live in environments with poor access to safe drinking water and sanitation facilities.

The poorest regions include sub-Saharan Africa and South Asia which accounted for more than 80% of the global poor[14]. Majority of population in these countries live in environments with poor access to safe drinking water and sanitation facilities. In Africa and South Asia, millions of women and children spend an average of 5 hours trekking, or trekking for an average of 3 to 6 kilometers to fetch water from un-improved source, while abandoning other important economic routines. They spent up to 210 hours annually fetching drinking water. This contributes to loss of wages for 27 days to the household annually. In addition, it reduces children's access to education, which again contributing to poverty cycle.

Investment in human capital improves the living standard, and will aid in ensuring access to safe drinking water and good sanitation which is very important, as it remains one of the key challenges of development. As such, this can reduce poverty globally, especially in developing countries. Improved access to safe drinking water and good sanitation facilities enhances countries' economic growth and plays a significant role towards poverty eradication, especially in low- and lower-middle income countries.

For example, according to Commission on Sustainable Development, (2005) lower income countries with improved access to safe drinking water and good sanitation

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[14] Max Roser - OurworldinData.org /WDI (2016).

services enjoyed an average annual GDP of 3.7% higher than its contemporary with the same per capita income, but without improved access to these facilities had an average annual growth of only 0.1%. Therefore, the need for empirical study to explore how poverty rate can be reduced through improvement in the environmental health determinants such as water and sanitation in developing countries is very essential.

Achieving sustainable development (SD) globally is one of the major fundamentals of the United Nation's 2030 agenda for sustainable development. Sustainable development is any development that meet the needs of current generation without compromising the ability of upcoming generations to meet their own needs. Eradicating poverty of all kind, reducing the under-five mortality rates by 25 per 1,000 live births and achieving access to safe drinking water and good sanitation are 3 out of 17 cardinal targets of SDGs. They are also among the key determinants of environmental health.

Globally, statistics has shown that, about 2 million tons of industrial sewage and agricultural waste found their way into world fresh waters annually. This practices triggers water scarcity, poverty and other sanitations and hygiene related diseases, hence affect sustainable development. Countries like China, India, Indonesia, Pakistan, and Bangladesh and many African countries are more affected. UNEP/UNIHABITAT (2012) affirmed that, contamination of fresh water claims the lives of about 1.8 million children under the age of five every year, which is equivalent to death of a child in every 20 second (UNECE, 2014).

Similarly, rising demand for water universally, due to factors like expansion of towns/cities, population growth and other, have put an increasing pressure on its accessibility, sustainability, and quality of water globally. This may result in a potential threat to sustainable development. Besides that the excessive withdrawal of global surface waters, which are the main sources of drinking water to millions of people. For example, one of the world biggest lake and main source of fresh water to most of West African countries is Lake Chad. It links Nigeria, Niger, Chad and Cameroun republics. Between 1960-2015 excessive irrigation and fishing activities by these four communities had shrunk down the lake which lost about 95% of its size within 55 years. This is one of the main reasons, why millions of people still lack access to safe drinking water within these confluences. Therefore, this can also serve as an alarming warning, and threat on the future availability and sustainability of safe drinking water in the entire region. Similarly increase in green-house gases especially CO2 emission affect sustainable development by triggering global warming, which causes drought, melting of ice berg, rise in sea level and is becoming a global phenomenon.

Therefore, SDG[15]s 1, 3 and 6 may not be easier to achieve as greater proportion of population from developing countries are poor. Hundreds of thousands do not have access to safe drinking water and good sanitation, and about 90% of the global diarrheal death cases are children under the age of five.

The number of population that lacks access to safe drinking water and sanitation is increasing globally as the total population increases. Poverty rate in developing countries remains high and the prevalence of water-related diseases is igniting under-five mortality to increase. This situation, resulted to a large proportion of global population being denied access to quality education and health care services. This can affect sustainable development in terms of reduction in the supply of future labour force, total productivity that hinders sustainable development. Thus, the need for empirical investigation on the impact of health outcomes, poverty and environmental health on sustainable development will be imperative, especially in this era of SDGs.

1.3   Objective of the study

The main objective of this study is to determine the impact of Environmental Health on Health outcomes, Poverty and Sustainable Development in Developing Countries.

The specific objectives of the study are as follows:

   i.   To analyse the effects of Environmental Health on Health Outcomes in Developing Countries;
   ii. To examine the direct and indirect effects of Environmental Health on Poverty in Developing Countries and,
   iii. To investigate the impact of Environmental Health, Health Outcomes and Poverty on Sustainable Development in Developing Countries.

1.4   Significance of the Study

Conducting an empirical study on the impact of environmental health on poverty in developing countries will contribute to knowledge, especially environmental health economics. The findings and recommendations would be useful and serve as policy guidelines in handling poverty. Equally, the findings of this study and the subsequent

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[15] The United Nations 17 SDGs are as follows; 1. No poverty 2. Zero hunger 3. Good health and wellbeing 4. Quality education 5. Gender equality 6. Clean water and Sanitation 7. Affordable and clean energy 8. Decent work and economic growth 9. Industry, innovation and infrastructure 10. Reduce inequality 11. Sustainable cities and communities 12. Responsible consumption and productivity 13. Climate action 14. Life below water 15. Life on land 16. Peace and strong institution 17. Partnership for goals.

recommendations may be useful for the United Nations Development Program (UNDP) policy guidelines, particularly in relating to developing a new sustainable development index, in addition to its traditional human development index (HDI) that is not compliant with environmental quality.

Similarly, the proportion of global population having access to safe drinking water and good sanitation over the two centuries has been increased in terms of coverage. Nevertheless, considering the number of lives lost due to water and sanitation related diseases such as malaria, dengue, diarrhea, Zika to mention but a few warrant further investigation.

Most literatures [16] skewed to research on energy consumption and CO_2 emission and economic growth relationship while neglecting the environmental health, poverty, governance and sustainable development nexus. This research will contribute to the stream of growing literature particularly by focusing more on how environmental health relates with poverty, health outcomes, and sustainable development indicators.

Neumayer (2001); Brock & Taylor (2010) and Bravo (2015) have conceptualized the modified human sustainable development indicators, which is an improved version of the United Nations Development Program (UNDP) HDI. It comprises life expectancy at birth, mean years of schooling (education) and income (per capita) plus the environmental pollution indicator (CO_2 emission per capita) that takes care of environmental aspect for sustainable development. Therefore, the primary benefit of this study is the contribution to knowledge in the area of specialization in health and environmental economics and it will contribute to the relatively limited number of empirical studies conducted on sustainable development indicators (SDIs).

This study will set and provide valuable intuitions into what remains to be done, especially it will be important for policymakers and government funding agencies concerned with water, sanitation and health outcome. Specifically, the findings of this study shall serve as a guide and reference point to other various governments, regions, researchers, policy makers, international environmental health protection agencies and development partners, and also to students in their quest for additional knowledge.

It would also help policy makers in formulating policies and programs toward focusing much on the provision and management of basic needs of lives such as providing teaming population with safe and drinking water; and sanitation using

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[16] Times series studies like; Fatai, Oxley, and Scrimgeour (2004), Aktaş and Yilmaz, (2008) Bhusal, (2010),(Zhu & Peng, 2012) Chindo et al. (2014) etch, or on cross country studies such as Apergis and Payne (2009), Ozturk, Aslan, and Kalyoncu (2010), Soytas and Sari (2009), Jaunky (2011).

modern technology, research and development in their quest to end poverty and achieving sustainable development goals (SDGs).

However, this study as part of its novelty contribution to stream of research would be amongst the pioneer empirical research that uses sustainable development indicator to examine the relationship between environmental health, health outcomes, poverty, and sustainable development. Finally, the findings of this study is also expected to be useful to researchers and students as a reference point in their quest for seeking knowledge. It will also contributes to the limited and growing literature particularly in the area of environmental health and development economics.

1.5 Organisation of Chapters

Chapter one is organized to provide background concerning the major issues such as environmental health, poverty, water and sanitation, health outcomes, and sustainable development which are designed to be discussed in the study. The statement of the research problem is follows by the objectives that are set to achieve by the study. This is followed by the significance of the study and finally concludes with the organization of the chapters. On the other hand, chapter two is design to deliver the related theoretical and empirical literatures that are reviewed in the study, and concludes with literature gap.

Chapter 3 offered the methodology comprising the theoretical and empirical models used in achieving the stated objectives of the study. Chapter four presents and analysis discussion of the result. Chapter five provides the summary, conclusion and policy recommendation as well as suggested research gap for future research. Finally, the list of bibliography and reference were acknowledge as well as appendices and list of Tables and Figures used in the study were presented.

1.6 Concluding Remark

Water is one of the most important necessities of life. Its accessibility and supply is becoming less globally. Large proportion of world population especially from developing countries lack access to safe drinking water and good sanitation facilities. This situation led millions of people into hash economic and health conditions such as poverty and exposure to diseases relating to water, sanitation and hygiene like diarrhea, malaria, dengue and other disease outbreaks. These eventually claim the lives of millions of children across regions of the world. Hence, if this trend continued, achieving sustainable development (SD) may not be realistic.

The present study attempt to investigate the impact of environmental health on health outcomes, poverty and sustainable development in developing countries.

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