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Title: Environment Dimensions of Quality of Life

(Assessment of Environmental Indicators that Influence the Quality of Life in Indonesia)

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Summary

The understanding and improvement of the human living environment have been major goals of individuals, researchers, communities and governments. The overall assessment of humans' living environment has been commonly expressed by the term quality of life across multiple disciplines. An understanding quality of life has tremendous potential implications because improving quality of life is a major policy and sustainability goal. In order to obtain the comprehensive understanding about quality of life and sustainable development aspect, recently, several global institutions used a number of standard tools to measure aspects of environmental quality in relation to quality of life.

The main purpose of the quality of life measurement is providing tangible information about what is needed for the accomplishment of a good life, value of humankind, how strong human bonds are and the relationship to the environment. As one of the prominent developing countries, Indonesia sought to expand the availability of data regarding regarding quality of life and environmental quality to support improvements on sustainable development.

Therefore, this research measure the relationship between environmental quality dimensions and quality of life in Indonesia during 2010 to 2013. There are three major environmental quality dimensions that have been used for this research, which are: environmentally responsible behaviour, physical environmental quality, and consumption of environmental services. The objective quality of life dimensions are established from good health condition and life expectancy at birth. Meanwhile, there are also several control variable derived from demographic and social dimensions.

The measurement result indicated that in some extent the environmental quality dimensions affect the quality of human's life in Indonesia. There are three major result regarding its relationship: Firstly, environmentally responsible behaviour, indicated by reforestation activity, has remained positively significant to the quality of life. It implies that higher awareness to the living environment can increase the responsible activities to the environment, thus having an impact on the quality of human life.

Secondly, physical environmental quality was indicated by air quality, which remains significant to the quality of life. It implies that higher air quality can reduce the water pollutants in the river, thus increasing the water quality that contributes to the improvement of the quality of life. Thirdly, consumption of environmental services was indicated by clean water consumption, which also remains significant to the quality of life. It implies that a higher consumption of clean water can contribute to the improvement of the quality of life.

In conclusion, the overall result implies that interrelationship variables of environmental quality, which are environmentally responsible behaviour, physical environmental quality, and consumptions of environmental services can improve quality of life. Towards the significant variable, it can be also concluded that reforestation activity can increase the air quality, which has a positive impact on the improvement of clean water consumption, and a higher consumption of clean water has a positive impact on increasing the quality of human life.

Keywords

Environmentally responsible behaviour, Physical Environmental Quality, Consumption of Environmental Services, Quality of Life

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This master thesis is reflected my greatest dream to be able to do something exceptional in my life. I always believe that failure will never overtake me if my determination to succeed is strong enough. I dedicated a greater praise for Allah SWT, my parents, my brother, my friends, my lectures, and NFP scholarship for an infinity support.

Foreword

Environmental Quality and Quality of Life Assessment in Indonesia is a master thesis that discussed regarding environmental quality and quality of life measurement in national level. This thesis utilizes the data related to indicators of environment, demography, health, and social aspects from government institutions. The result presents an analysis of the relationship between three environmental dimensions, which are: Environmental responsible behavior, Physical environmental quality, and consumption of environmental services influence quality of life.

This thesis is expected to be a basis data in order to support environmental policy development and also advocacy materials for national and regional development in planning or evaluating the policies and programs on environment and quality of life issues. It has been fully aware that this publication is not fully sufficient. One of the limitations is caused by the imperfect data collection system in the related institutions.

Finally, to all who had participated in preparing this thesis, I would like to convey my high appreciation and grateful. Constructive critics would be greatly appreciated.

Rotterdam, September 11th , 2015

Fitri Novitasari

Abbreviations

BOD	Biochemical Oxygen Demand
CO	Carbon Monoxide
CO2	Carbon Dioxide
COD	Chemical Oxygen Demand
EPA	Environmental Protection Agency
Eurofound	European Foundation for the Improvement of Living and Working Conditions
FE	Fixed Effects
ISQOLS	International Society for Quality of Life Studies
IV	Instrument Variables
IUCN	International Union for Conservation of Nature
GDP	Gross Domestic Product
HDI	Human Development Index
HRQOL	Health Related Quality of Life
NO	Nitrogen Dioxide
NWRM	Natural Water Retention Measure
OECD	Organization for Economic Co-operation and Development
QOL	Quality of Life
PPP	Private Public Pathnership
RE	Random Effects
RIVM	*Rijksinstituut voor Volksgezondheid en Milieu*
SO	Sulfur Dioxide
TSP	Total Suspended Particulates
UN-Water	United Nation - Water
UNESCO	United Nations Educational, Scientific and Cultural Organization
WHO	World Health Organization

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CHAPTER 1: Introduction

1.1 BACKGOUND

A brief history of sustainable development concept emerged in the last half of the twentieth century. There were four key elements from the collective concerns and aspirations of the people: peace, freedom, development, and environment (National Research Council, 1992; Kates et al., 2005). Peace and freedom appeared after World War II and was marked by attaining national independence from other countries. The success of national independence was followed by a focus on economic development to provide basic necessities of humankind.

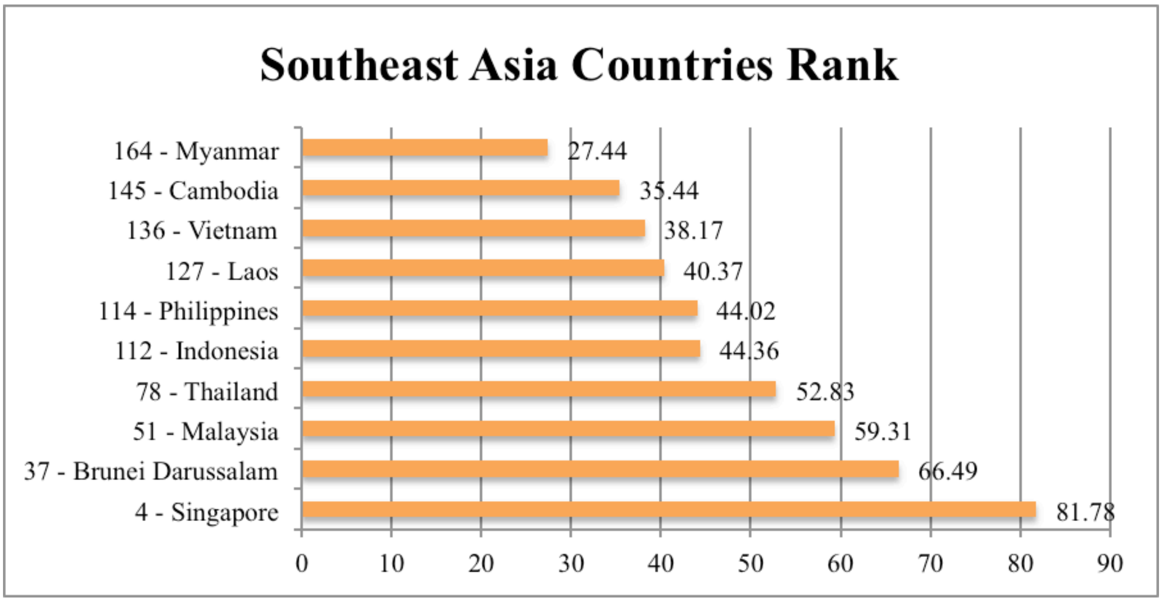
During the process of improved economic development, another problem arose about the balancing of environment. Many policymakers argued that an effort to satisfy human necessities caused huge effects to environment, such as: biodiversity loss, impaired ecosystem functions, pollution, and land degradation. Those effects contributed to a diminishing quality of life.

Although reinterpreted over time, concepts of sustainable development remain prominent issues among policymakers. In 2002, a World Summit on Sustainable Development meeting in Johannesburg, South Africa commited to set down those concepts as a central issue of sustainable development. The concept of sustainable development did not have an absolute limit, but rather limitations enforced by the technology and social organizations on environmental resources and by the ability of the biosphere to absorb the effects of human activities (World Commissions of Environmental Development - WCED, 1987; Kates et al., 2005). Humans ensure that they exploit resources to satisfy their needs by compromising the ability of future generations to accomplish their own needs (WECD, 1987; Kates et al., 2005). In this context, humanity has an ability to harmonize their role to satisfy their needs and also protect the environment.

A key to develop sustainable development policy and planning is how it is measured (Kates et al., 2005). One important method to measure sustainable development associated that concept with an effort to improve quality of life. The meaning of quality of life differs a good deal as it is variously used, but, in general, it is intended to refer to either the condition of the environment or to some attribute of people themselves (Paccione, 1982; Hills, 1995, Benzeval et al., 1995; Paccione, 2003:19). A recent literature review stated that a quality of life study that has been associated with environmental quality becomes a central issue in policy making and urban development (Leidelmidjer et al., 2002 and van Kamp et al., 2003).

The main purpose of the quality of life measurement is providing tangible information about what is needed for the accomplishment of a good life, value of humankind, how strong human bonds are and the relationship to the environment. Recently, several global institutions used a number of standard tools to measure aspects of environmental quality in relation to quality of life. For example, Yale University and Columbia University developed Environmental Performance Index (EPI) as a tool to rank how well countries perform on high-priority environmental issues in two broad policy areas: protection of human health from environmental damage and the protection of the ecosystem. In 2014, they released the rank of 178 countries, including Southeast Asia countries.

Figure 1. 1 Environmental Performance Index 2014 for Southeast Asia Conutries



Source: Environmental Performance Index 2014, http://epi.yale.edu/epi/country-rankings

According to the figure above, Singapore is in the highest position among Southeast Asian Countries (ranked number four in the world). Otherwise, another Southeast Asia countries are still struggling in middle and low ranks. It indicates that Southeast Asia countries still have a long way to go to improve their quality of life.

As planners, the notion of quality of life provides important opportunities to improve sustainable development policy making and planning. To achieve a better policy and planning, focus would largely need to be on human and environment elements of quality of life, such as: air and water quality, rehabilitation activities, health condition, environmental services, land coverage, and others. In conclusion, policymakers have come to realize that quality of life is not necessarily a simple function of material wealth. However, it is growing awareness of the integrated social, economic and environmental issues in the framework of sustainable development.

1.2 PROBLEM STATEMENT

In social and behavioural studies, environmental degradation, quality of life, human living conditions, and environmental behaviour have been prominent research topic for several decades (Redcliff and Woodgate, 1997; Bechtel and Churchman, 2002; Vlek and Steg, 2007). Meanwhile, Vleg and Steg (2007) stated that social, economic, and environmental research are important in conceiving sustainable development and its relation to human quality of life studies. In accordance with sustainable development, van Kamp et al., (2003) also explained that comprehensive multidisciplinary issues of environment and quality of life are required to improve the field of sustainable development.

As one of the developing countries, Indonesia sought to expand the availability of data to support improvements on sustainable policy and planning. In order to support that effort, several government institution established research based on actual issues, such as: environmental quality index, human development index, life satisfaction index, environmentally responsible behaviour index, and many others. For instance, Indonesia developed a life satisfaction index to measure how satisfied people are with their life based on the social relationship, health condition, education, employment status, household income, leisure time, housing and asset condition, living environment, and safety. Furthermore, Indonesia also has environmental quality index to measure air, water, and land condition.

Table 1. 1 Environmental Quality Index and Life Satisfaction Index 2014

Provinces	Life Satisfaction Index	Environmental Quality Index
Special Region of Aceh	67.48	72.89
North Sumatera	67.65	60.04
West Sumatera	66.79	65.68
South Sumatera	67.76	59.30
Riau	68.85	47.01
Riau Island	72.42	69.65
Bangka-Belitung Island	68.45	53.88
Jambi	71.10	57.91
Lampung	67.92	49.58
Bengkulu	67.43	67.87
West Java	67.66	47.02
Jakarta	69.21	36.26
East Java	68.70	55.90
Central Java	67.81	58.10
Jogjakarta	70.77	52.24
Banten	68.24	48.14
Bali	68.46	60.40
East Nusa Tenggara	66.22	60.70
West Nusa Tenggara	69.28	62.77
East Kalimantan	71.45	71.71
Central Kalimantan	70.01	72.85
West Kalimantan	67.97	69.88
South Kalimantan	70.11	55.08
Gorontalo	69.28	72.18
North Sulawesi	70.79	61.53
Central Sulawesi	67.92	81.30
Southeast Sulawesi	68.66	70.22
South Sulawesi	69.80	60.49
West Sulawesi	67.86	71.59
Maluku	67.86	70.47
North Maluku	70.55	80.87
Papua	60.87	83.13
West Papua	70.45	78.48
Indonesia	**68.28**	**62.57**

Source: Ministry of Environment Report, 2014 (Environmental Quality Index) and Central Bureau of Statistic 2014 (Life Satisfaction Index)

According to the table above, life satisfaction index indicates that several provinces have a value above an Indonesian average value (68.28), mainly for provinces which have tight social relationships, higher leisure time, and higher safety conditions. On the other hand, environmental quality index indicates that most provinces have a value below an Indonesian average value (62.57), mainly for provinces which have advanced industries and forest area. If those index are compared, it shows that the higher life satisfaction index does not lead to higher environmental quality index. For instance, life satisfaction value for Jakarta is 69.21, but environmental quality value is lowest among other provinces at 36.26. Furthermore, South Kalimantan has one of the highest life satisfaction values of 70.11 but a lower value for environmental quality at 55.08. Index results indicate that environmental condition does not have an ability to improve a human's life satisfaction in Indonesia yet.

Although life satisfaction and environmental quality index has been developed for several years, there is still an absence of measurement about how environment quality can influence the life satisfaction and also quality of life in Indonesia, particularly, quality of life study has rarely been done by government institution. This research focuses on assessing the relationship between environmental quality and quality of life in Indonesia.

1.3 RESEARCH QUESTION

In accordance with the problem statement above, the main question for this research is:

"To what extent does environmental quality influence the human quality of life in Indonesia?"

Furthermore, sub-research questions to support the main question are:

1. How does the environmental quality and quality of life conditions in Indonesia during 2010 to 2013?
2. Which are the factors of environmental quality that affect to human quality of life in Indonesia?
3. Does a control variable derive from demographic and social dimension affects the measurement of environmental quality and quality of life in Indonesia?

1.4 RESEARCH OBJECTIVES

1. This research has two objectives:
2. To test environmental dimensions that affect human quality of life in Indonesia;
3. To provide data about environment dimensions of quality of life as a mutual inspiration for policymakers in Indonesia.

1.5 SCOPE AND LIMITATION

In general, Indonesia has 34 provinces located on eight islands and each province has a provincial capital. For the research, it is focused on 33 provinces (names of the provinces were mentioned on Table 1.1), because the latest province – North Kalimantan – did not have any sufficient data yet.

This research uses secondary data from government institutions in Indonesia, such as: 1) Ministry of Environment and Forestry; 2) Ministry of Marine and Fisheries; 3) National Development Planning (Bappenas); 4) Central Statistic Bureau (BPS). Researchers derived data from the province level, but a few environmental quality data reflected urban condition. For instance, to measure an average of treated solid waste on province level, BPS used treated solid waste activity that had been done by the city's government. Therefore, the time span of the data was approximately between 2000 to 2013, but the time span for this research is 2010 to 2013. The limitations of this research are:

1. Researchers analyzed the environment quality and quality of life dimensions that are derived from prior government institutions' survey and research;
2. Researchers used objective indicators to develop quality of life variable, such as: good health condition and life expectancy rate at birth. Subjective indicators of quality of life are not included because of inadequacy of data.

CHAPTER 2: Literature Review

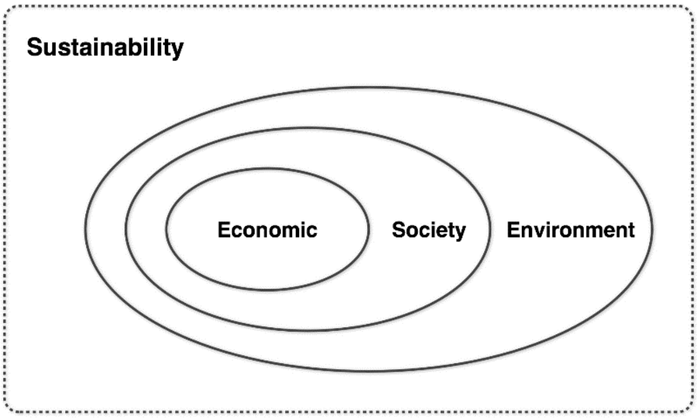
2.1 PURPOSE

This chapter explains concepts, theories, and perspectives that are used to understand the relationship between environmental quality and quality of life. There are several theories and perspectives which have been used by prior study or research, but this research emphasises the environmental sustainability concept to explain the importance of environment dimensions in order to improve the quality of human life. This research also emphasises the objective aspect of quality of life, such as: relation of good health condition and life expectancy as a determinant of quality of life dimensions. The end of this chapter explains the conceptual framework of this research.

2.2 ENVIRONMENTAL SUSTAINABILITY

The concept of sustainable development is comprised of three major aspects: economic, social, and environment (Brundtland 1987; Kates et al., 2005; and Tanguay et al., 2010), balancing interaction from these aspects could lead into livable human conditions where the relationship of the environment to social needs can refer to the improvement of quality of life. In one prominent theory about sustainable development explained with the **Russian doll model** created by Levett (1998), it is mentioned that environment sustainability was the most important aspect. If the environmental component becomes depleted, sustainable development could not be achieved because the ecosystem is endangered. The perception of this vision is represented as circles nested within each other.

Figure 2. 1 The Russian Doll Model



Source: Sustainability Indicators – Integrating Quality of Life and Environmental Protection, Levett, 1998

The Russian doll model assumes that sustainable development is achieved when natural capital could not be substituted by another type of capital, and sustaining the environment is key to secure both human needs and ecosystem (Levett, 1998).

The basic understanding of environmental sustainability emerged from common perception of human activity that was associated with concept of ecology (Goodland, 1995; Vlek and Steg, 2007; and Morelli, 2011). According to Morelli (2011:4), ecology could be considered as a concept of an interdependence of elements within a system, meanwhile he also explained that ecological sustainability is a congregation of human needs without compromising the health of ecosystem. It implied that ecology was a broader context of the human experiences. Morelli (2011:6) also argued that sustaining environmental components leads to balanced and resilient conditions that allow humans to satisfy their needs while neither exceeding the capacity of its supporting ecosystems to continue to regenerate the services necessary to meet those needs.

Several pieces of literature state that environmental sustainability is related to natural capital, where environment could be seen as a stock that provides assets to support human life, such as: soil and its microbes and fauna, forests, and water to provide a flow of useful services (Pimentelet al. 1992, Goodland and Daly, 1996). Citing from Goodland and Daly (1996:1005), sustainability could be achieve by maintaining environmental assets and services.

However, sustaining the utilization of natural capital caused a misunderstanding of the conception of exploiting the environment, for it disregards the infinitude of human needs and market forces which could cause environmental degradation. According to Goodland (1995) and Basiago (1999), an overlapping relationship was identified between economic and environmental components causes an inequality between human needs and the efforts to sustain the environment.

As the buffer system of humankind, environmental sustainability is fundamentally dependent on the flow of ecosystem services (Morelli, 2011:4). Such services include:

1. *Provisioning services* that are obtained from the ecosystem, including: genetic resources, fish resources, clean water, and energy resources;
2. *Regulating services* that benefit, obtained from regulating of ecosystem processes, including: clean water quality regulation, treated waste management, and natural hazard regulation;
3. *Supporting services*, including: photosynthesis, primary production, water cycling, and seed spreading;
4. *Cultural services* that are obtained from ecosystems through spiritual enrichment, cognitive development, and recreations.

It is fitting that attention has been given to environmental sustainability as the prerequisite to a sustainable socio-economic system, and it is also taken into account that there should be actions to prevent the environment from threats and sustaining the environment to contribute to an improvement of quality of life.

As a result, there should be an agreement ensuring that the provision of environmental services would not jeopardize the living environment, such as: how to utilize clean water without disturbing the availability and quality of fresh fish, how to maintain the quantity of trees in order to maintain air and water quality, and also how to sustain the vacant lands from hazardous components. According to Morelli (2011), it would be difficult to achieve environmental sustainability without balancing responsibility in social and economic systems. There needs to be more than good will and effective regulation, but also real action to provoke responsible awareness of environment.

According to Goodland (1995), Moffat (2010), and Morelli (2011), there are 15 guiding principles that were sorted into five categories in order to provide a greater perspective of environmental sustainability, which is explained on the table below.

Table 2. 1 Supporting Principles of Environmental Sustainability

Societal Needs	Preservation of Biodiversity	Regenerative Capacity	Reuse and Recycle	Constraints of Non-renewable Resources and Waste Generation
Produce nothing that will require humankind to maintain vigilance	Select raw materials that maintain biodiversity of natural resources	Keep harvest rate of renewable resources inputs within regenerative capacities of the natural system	Design for re-usability and recycle-ability	The scale of human economic subsystem should be limited to a level that, or within the carrying capacity and sustainable
Design and deliver products and services that contribute to a more sustainable economy	Use environmentally responsible and sustainable energy resources and invest in improving energy efficiency	Keep depletion rates of non-renewable resource inputs below the rate in which renewable substitutes are developed	Design manufacturing and business process as closed-loop system, reducing emissions and waste to zero	Keep waste emissions within assimilative capacity of receiving ecosystem without unacceptable degradations
Support local employment				
Review the environmental attributes of raw materials and make environmental sustainability as a key requirement of the selection of ingredients for new products and services				Develop transportation criteria that prioritize low-impact transportation modes
				Support all product management decision with full consideration of environmental impacts of the product throughout its life cycle
Support fair trade				

Source: The Concept of Environmental Sustainability, Goodland, 1995; The Ceres Roadmap to Sustainability, Moffat, 2010; Environmental Sustainability: Definition for Environmental Professionals, Morelli, 2011, 5-6

The choice between environmental sustainability principles explained the trade-offs between human-made capital and natural capital. Economic perspective requires humankind to invest in the limiting factor, which now is often natural, rather than manufactured, capital. Investing in natural capital is essentially an infrastructure investment on a grand scale which is the biophysical infrastructure of the entire humankind. Investment in such "infra-infrastructure" maintains the productivity of all previous economic investments in human-made capital, public or private, by rebuilding the natural capital stocks that have come to be limited. Operationally, this interprets into three concrete actions as explained by Goodland and Daly (1996:1006-1007):

1. Regeneration - encouraging the growth of natural capital by reducing the level of current exploitation of it;
2. Relief of pressure - investing in projects to relieve pressure on natural capital stocks by expanding cultivated natural capital, such as tree plantations to relieve pressure on natural forests;
3. Increase of efficiency - increasing the efficiency of products, infrastructure, and lifestyle.

In conclusions, the efforts to improve environmental sustainability are immense. It is important to understand how to manage human needs and the ability of the environment to provide services in both short and long terms (Pimenteletal, 1994; Goodland and Daly, 1996). Environmentally responsible behaviour must be considered to invest in renovating the damage and spreading an idea on how to sustain the environment in many parts. Environmental sustainability needs empowering conditions that are not themselves essential parts of environmental sustainability, it also needs not only economic and social sustainability, but also human resource development, empowerment of women, and much more investment in human capital than is common today in order to achieve a greater impact to improve quality of life.

2.3 THE OBJECTIVE QUALITY OF LIFE

The understanding and improvement of the human living environment have been major goals of individuals, researchers, communities and governments. The overall assessment of humans' living environment has been commonly expressed by the term quality of life across multiple disciplines including economics, environmental science, and sociology (Constanza et al., 2006). Utilization of the term quality of life spans a large range of academic disciplines; several worldwide institutions measured the quality of life at the national level, equal in number or higher are the studies developed by several organizations acting in the social sector, such as OECD, UNESCO, WHO, Eurofound (European Foundation for the Improvement of Living and Working Conditions), ISQOLS (International Society for Quality-of-Life Studies). Some institutes have even developed their own system of quality of life measurement: International Living (Quality of Life Index), Institute for Risk Research Canada (Life Quality Index), The Economist Intelligence Unit (Quality-of-Life Index), Mercer - Human Resource Consulting (Quality of Living survey).

Understanding QOL has tremendous potential implications because improving quality of life is a major policy and sustainability goal (Schuessler and Fisher, 1985). Recent research has focused on two basic methodologies of measurement. One method utilizes quantifiable social, economic, or environment indicators to reflect the extent to which human needs are met. The other looks to self-reported levels of happiness, pleasure, fulfillment, and the like, and has been termed "subjective well-being" (Diener and Lucas, 1999; Easterlin, 2003).

According to Suh and Diener (1997), the empirical findings emerge to support an understanding that in objective and subjective quality of life research have direct fundamental concerns of societies and individuals:

1. *The subjective quality of life*: how one evaluates whether they have a good life or not. Whether a human is content with life and happy are aspects that reflect the subjective quality of life;
2. *The objective quality of life*: how one is perceived by the outside world. It is related to the human ability to adapt to the values of a culture in which they live.

The objective quality of life generally centers on social, economic, environmental, and health indicators (Cummins et al., 2003), utilizing tools such as the UN's Human Development Index (HDI) and GDP/capita (Constanza et al., 2006). In the field of health discipline related to the quality of life (HRQOL) research has resulted in the development of numerous individual instruments, each intended to measure HRQOL for specific subsets of populations based, for example, on life expectancy, disease status, and condition. While these measurements may provide a snapshot of how well some physical and social needs are met, they are narrow, opportunity-biased, and cannot incorporate many issues that contribute to quality of life such as identity and psychological security.

Furthermore, Suh and Diener (1997) explained the strengths and weaknesses for the objective quality of life approach:

Table 2. 2 Strengths and Weaknesses of Objective Quality of Life

Strengths	Weaknesses
It allows valid comparisons both from the geographic perspective (comparisons between regions, countries or continents), and from the temporal one (evaluating how the objective indicators have evolved from period to period reflects the level of development of a region, country or continent)	Outlining general index for quality of life research depends largely on the statistical registration made by each country, a fact that can become an inconvenience because of the incomplete statistical data (there are countries in which the census did not have the same accuracy because of the impossibility to register some data, but also because of the people's reluctance to declare the real state of their life)
The objectivity of the used indicators leads to a full acceptance of their sense or value from the society; having a clear delimitation between the indicators with a negative connotation (such as infant mortality rate)	Different ways of measurement and interpretation for objective indicators might have different interpretations for indicators with a negative connotation, such as criminality, deforestations or gender equality
Objective quality of life used mostly quantitative indicators, a fact that offers precision to the measurement techniques; and the most mentioned strength for the objective quality of life analysis is the fact that did not depends on people's perception, therefore there is no subjectivity in evaluating quality of life	

Source: Measuring Quality of Life: Economic, Social and Subjective Indicators, Suh and Diener (1997)

Despite the fact that there were several weaknesses that occurred in the objective quality of life measurement, the objective approach has still lead to assessing the quality of human life for several decades, such as the United Nation's Human Development Index (Sen, 1985; UNDP, 1998).

Objective quality of life is also defined by the following spillover theory, which states that human satisfaction in one sphere of quality of life influences the level of satisfaction in other spheres (Susniene and Jurkauskas, 2009). There is a certain hierarchy of life sphere in the human awareness, the highest level is perceived as quality of life, then depending on the human itself, follows other parts of quality of life, such as: health, family, leisure, others (Sigry et al., 2003).

In the perspective of the objective quality of life, it is also strongly associated with good health conditions. A good example of an approach in which health is described is resultant of genetic factors, the nature and quality of health care, behaviour or lifestyle, and the quality of the physical and social-cultural environment (Blum, 1974 and van Kamp et al., 2003) In a model formulated by RIVM – *Rijksinstituut voor Volksgezondheid en Milieu* – (2000), health was a dimension of quality of life, and treated as an aspect of a dynamic (transactional) process. Clearly, RIVM (2002) and van Kamp et al. (2003) explained the relationship between quality of life and good health condition:

> “*Quality of life is the factual material and immaterial equipment of life and its perception characterized by health, living environment and legal and equity, work, family, and others*”

The use of quality of life as a measurement is predicated on the assumption that a consensus about how good health conditions and environmental conditions can be measured (Rogerson, 1995). Recent literature has mentioned the consensus about the measurement of quality of life. It has been argued that there was an agreement about the definition of quality of life related to and synonymous of individual or group well-being, satisfaction and happiness, or being concerned with environmental conditions in places or with health conditions (Rogerson, 1995:1374).

The concept of health covers biological functioning at large. Specific health concepts concern specific aspects of human functioning. Citing from Veenhoven (1996), the flourishing of humans could be judged by their bio-physiological functioning; in other words, by their 'health'. Veenhoven (1996:10) explained that the analogy of bio-physiological function was also called physical health, which could be defined in two ways:

1. *Negative health*: measured by the incidence and severity of impairments and disease. That sounds easier than it is. Medical statistics say more about medical consumption than about illness;
2. *Positive health*: measured by performance tests and by subjective reports about feelings of health. The latter indicators typically concern overall health.

Citing from Cummins (1997) and Haregty et al., (2001), health was one part of the quality of life core domain. In the health-related quality of life model, humankind was abstracted as an active part of its health status, and not only as a passive receptor of the negative input from their living environment (De Hollander, 1999). Therefore, Rogerson (1995) also explained that health-related quality of life research has been developed to assess quality of life through actual or potential human conditions.

However, good health conditions could not be defined as a single definition of quality of life. Some researchers consider quality of life to be concerned with evaluation of objective health and individual experiences. Meanwhile, in some research, quality of life could also be measured by longevity: higher longevity levels reflect good health conditions and higher quality of life levels. According to Veenhoven (1996:10), longevity could be referred to as life expectancy at birth. Generally, life expectancy is estimated on the basis of observed survival rates in age-cohorts and differs by age.

In accordance with good health conditions concept, objective quality of life research was also associated to promoting means for human within their environments, in order to live in the best way for them. Unsustainable resource use does not necessarily lead to decreases in local environmental quality, particularly in global economies where unsustainable resources used in one location are used to support a high quality of life in other locations (Moser, 2009:352).

The model that was developed by Blum (1974) examined a combination of measurable spatial, physical and social aspects of the environment and the perception of these. This perception was not only related to the objective characteristics of the environment but also personal and contextual aspects. The approach of objective quality of life consists of health, physical environment, natural resources, personal development, and security (van Kamp et al., 2003:9). Furthermore, van Kamp et al., (2003) also mentioned that it was fully independent of the physical environment and could be considered as an elaboration of the interplay of perceptions that lead to a sense of quality of life. According to recent research, one indicator that explains quality of life is a good health condition. If a human has a better health condition than others, it indicates that they have a higher value of quality of life.

The idea of sustainability perspective is ensuring a better human quality of life. It means achieving social, economic, and environment aspects at the same time, strong society bonding in which the benefits of improved economic prosperity are widely shared, with more efficient use of natural resources (Brundtland, 1997 and Kates et al., 1995). According to the effort, the concept of sustainability and quality of life are complementary to each other. If humankind wants to improve sustainability and quality of life simultaneously, the goal is to strengthen environmental sustainability to non-materialistic values (Chapelle and Shove, 2005).

According to Newman (1999), Interrelationship between quality of life and sustainability is explained in this statement:

> "*A global process of development that minimizes environmental resources and reduces the impact on environmental sinks using processes that simultaneously improve economy and the quality of life*"
>
> (Newman, 1999 in van Kamp et al., 2003)

Meanwhile, another definition derived from IUCN (International Union for Conservation of Nature) states that sustainability is associated with ecosystem:

> "*Development that improves the quality of human life while living within the carrying capacity of supporting ecosystems*"
>
> (IUCN, 1980 in van Kamp et al., 2003)

In conclusion, it is important that sustainability is integrated into efforts to increase the environmental quality and enhance the activities that present awareness to the environment. Empiric research indicates that the enhancement of awareness towards environmental activities can improve the quality of environment and services that are provided by environment in a long term (Goodland and Daly, 1996; Moser, 2009; Streimikiene, 2014). In conclusion, citing from Basiago (1999), the expected impacts of environmental sustainability increasingly play a role in improvement of the human quality of life and social acceptance of policy making and planning.

2.4 CONDUCTING ENVIRONMENTAL QUALITY AND QUALITY OF LIFE

Recently the environment conditions face the accelerating pace of resource limitation, climate change, land degradation, and many other changes. Hence, it is important to develop integrated indicators towards environmental sustainability (Dahl, 2012:14). Designing indicators of sustainability has emerged from initiatives across the institutional spectrum (Dahl, 2012). At the highest level of intergovernmental organizations, such as South Pacific Applied Geosciences Commission launched the Environmental Vulnerability Index with 50 indicators. Initiatives also come from the academic community, such as Yale University, which released the Environmental Performance Index.

Although, there are some initiatives to develop environmental indicators, challenges are still facing the policymakers, including finding indicators that could change the dynamic system, establishing environmental sustainability targets toward real-life conditions, developing global level indicators, and developing indicators that reflect positive encouragement for further efforts (Dahl, 2012). Citing from Mascarenhas et al., (2010), attainment of sustainability was fundamentally an ethical challenge, a values-based indicators was required to measure the implementation of ethical principles as a guidance to the transitions towards environmental sustainability.

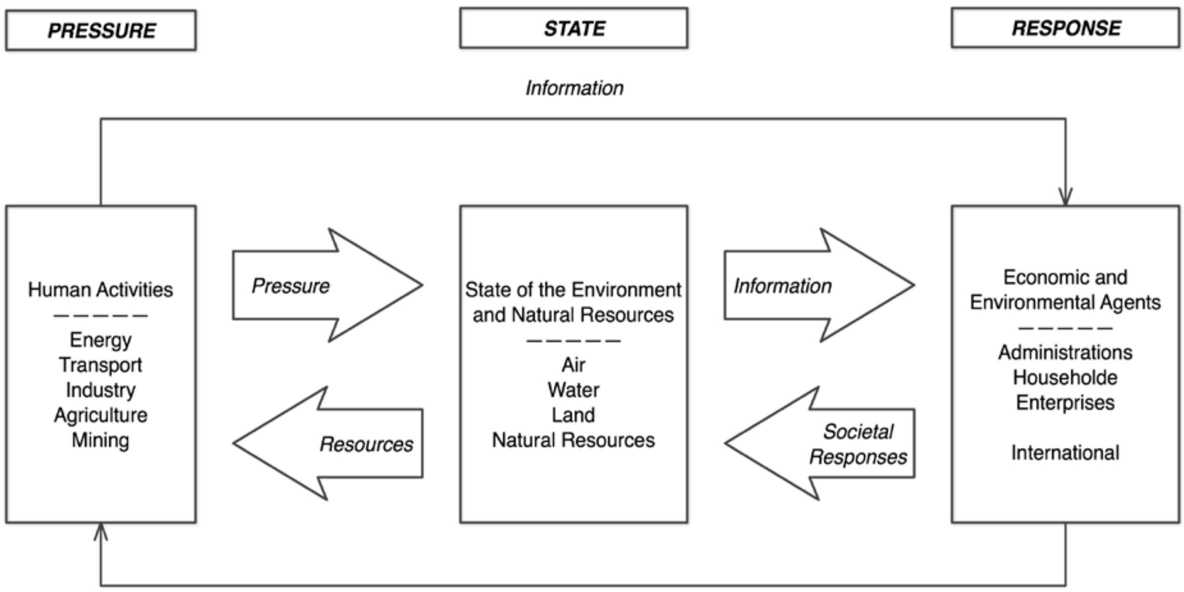
According to Zurlini and Girardin (2008), environmental indicators should be in accordance with phenomena across multiple scales of space, time, and organizational complexity in order to highlight cross-scale effects and reduce mismatching. Furthermore, they also emphasized that interaction among resources at multiple scales and dynamic ecosystems should be developed at national levels. Swanson et al., (2004) also explained that:

> "*To be considered strategic and effective, national action towards sustainability must catalyze sustainability action at sub national and local levels and manage the interdependency between levels of government*"
>
> (Swanson et al., 2004 in Mascarenhas et al., 2010)

Meanwhile an OECD report (1993) explained that an indicator was a parameter or a value derived from parameters, which identifies and provides information and describes the state process, environment or area, with a significance that extends beyond the value directly associated with the parameter. An indicator quantifies and simplifies phenomena, helping researchers to understand complex situations and changes in a system. Its usefulness depends greatly on the particular context, and will only be useful if they fit into the conceptual model and can interact with each other (Antequera 2005).

Generally, in order to develop environmental indicators a framework that describes an overview of the relation between environment and humans must be set. One of the simple frameworks is **PSR** (**Pressure – State – Response**).

Figure 2. 2 Pressure – State – Response Framework



Source: OECD Core Set of Indicator, 1993:10

The PSR framework was based on a concept of causality, a framework which merely states that human activities use pressures (such as pollution emissions or land use changes) on the environment, which can induce changes in the state of the environment (for instance, changes in ambient pollutant levels, habitat diversity, and water flow). Society, then, responds to changes in pressures or state with environmental and economic policies and programs intended to prevent, reduce or mitigate pressures and environmental damage (OECD, 1993; Pinter et al., 2005; Antequera, 2005).

Not only can designing environmental indicators on global scale be important for the global measurement, it can also be particularly useful to develop indicators based on interaction at a local scale (Holden, 2006; Wallis et al., 2007). Citing from Lafferty and Meadowcroft (2000), developing a conceptual framework for common local environmental indicators reflected the community values, concerns, and hopes. Local indicators are also mainly supported by strategic goals, objectives, targets, and resources (Mascarenhas et al., 2010:15).

In the research of sustainable development, several quality of life measures, including environmental indicators, have been developed at the global and local levels. For instance, Tarzia (2003) explained that the European Commission had the initiative to develop objective indicators called ‘European Common Indicators’ in order to monitor environmental sustainability at local levels. The initiative had seven indicators.

Table 2. 3 European Common Indicators

Objective Indicators
• Local contributions to global climate change • Availability of public areas and services • Quality of ambient air • Sustainable management of the local authority and business • Noise pollution • Sustainable land use • Ecological footprint

Source: Towards a Local Sustainable Profile, European common indicators, 2003: 212

In previous research, the quality of life had been associated with four areas of public policy, which are: health, individual life satisfaction, objective standards of living, and sustainable development (Uzzell and Moser, 2006). Recent research explained that the relationship between environmental sustainability and quality of life was based on the assumption that without the achievement of an objectively and subjectively sufficient environmental quality, a sustainable development of society cannot be attained (Moser, 2009:352).

Objective measures of quality of life focus on how to improve general standards of living environments. It is usually associated with availability of amenities, financial resources, and facilities in the neighbourhood, and health conditions (Jackson, 2002; Donovan and Halpern, 2002). Furthermore, WHO group (1998) also mentioned that the environmental aspects of common quality of life research include: home environment, opportunities for recreation/leisure activities, air pollution, noise, traffic density, climate, transport facilities, and opportunities for acquiring new information and skills.

In conclusion, indicators can be influential tools to developing important dimensions of the environment and also quality of life. Adequate indicators can help guide the major effort that is required for the environment issues to create a necessary transition in quality of life measurement (Dahl, 2012). However, it still remains that determination of environmental indicators regarding sustainability and quality of life should be done, both to develop indicators at the global level as well as indicators from national and local levels.

2.5 LESSON LEARNED

An effort to conduct quality of life and environmental quality become a specific study in this research, and as mentioned in the recent literature above that in the perspective of sustainable development, multidisciplinary issues of environment and quality of life are required to improve sustainable development policy and planning. Recent literature explained that higher environmental quality dimensions, such as environmental awareness behavior, consumption of environmental services, and improvement of water and air quality, have an impact on improving the quality of human life, particularly in increasing a human health condition and life expectancy (Rogerson, 1996; Hollander 2003; Lercher, 2003; and Srebotnjak, 2012). By measuring objective approach of quality of life, it could provide a more realistic picture of the important inputs and variables for improving quality of life.

A comprehensive set of environmental indicators would aspire to capture key factors from environmental capacity, quality, consumptions, and human behaviour as a complex, integrated system (Moldan, 2012:7). Therefore, in order to establish an integrated system, a meaningful reference value is needed as a threshold value of irreversibility and instability of a system (Rickard et al., 2007). The notion of a reference value has guided an indicator typology, comparing actual conditions with the current environmental situations and the desired situations or the target. Furthermore, in order to measure the quality of life indicators, it should be generally accepted to decay the concept, developing an understanding within quality of life indicators through empirical testing and evaluation about the relationship within indicators as a whole (Rogerson, 1995:1375).

In the perspective of policy role in creating and sustaining opportunities, environmental quality of life research can also play a role in social norm and preference formation. This mechanism may be responsible for generally accepted beliefs such as more money means a higher quality of life. When this belief is translated into national policy, its policies focus solely on increasing GDP despite research that shows that increases in individual income have no lasting effect on people's reported level of happiness (Easterlin, 2003).

Therefore, policy can create not only the opportunities for improving quality of life but also provide the information crucial to evaluating individual decisions. An integrated environmental quality of life measurement tool can aid in identifying apparent discrepancies between policies or lifestyle choices and strategies that actually improve quality of life. With this information, policies can be crafted to respond to changing social norms or the reevaluation strategies of individuals. Moreover, policy can actually aid in the evolution of these norms and strategies in a way similar to embedded policies now (Norton et al., 1998). For example, Easterlin (2003) suggests that if long term improvement in quality of life were the goal, policy would focus more on health and time available for humankind rather than economic production.

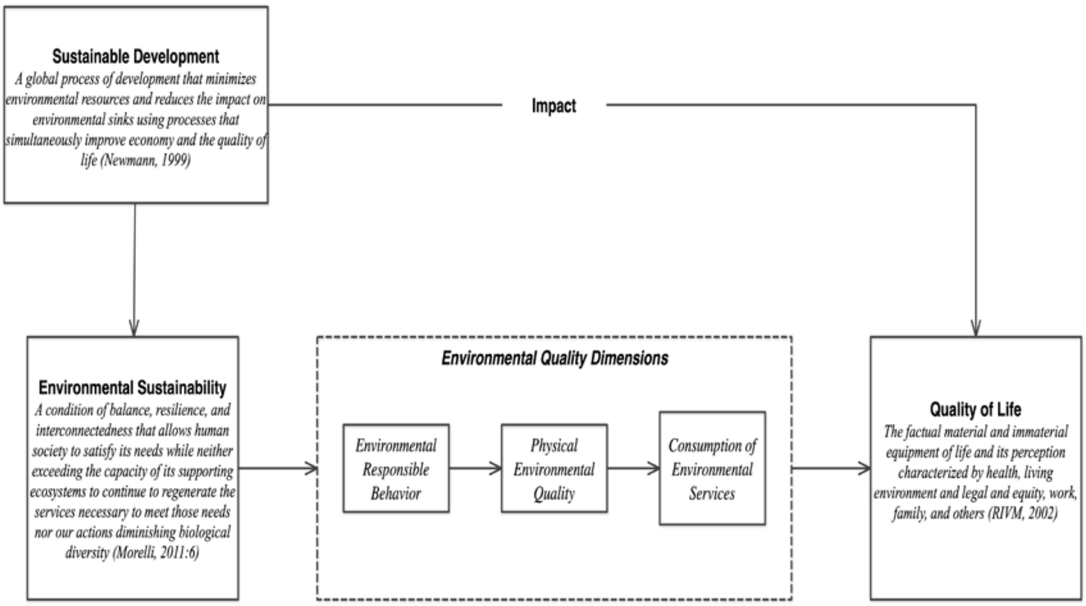
In order to obtain a well-defined insight about relationships between environmental quality and quality of life concepts for this research, researchers developed a conceptual framework that explained how concepts and theories are used to construct environmental quality of life research.

2.6 CONCEPTUAL FRAMEWORK

In Indonesia, sustainable development instruments also considered environmental quality as one of important aspect. It is clearly stated on law of the Republic of Indonesia Number 32 Year 2009 regarding ‘Environmental protection and management” article 1 that sustainable development shall be a conscious and planned effort, which integrates environmental, social, and economic aspects into a development strategy to ensure the totality of the environment as well as safety, capability, welfare, and quality of life. In accordance with that law, conducting environmental quality and quality of life research in Indonesia has an important role to offer comprehensive information about the ability of humans to preserve their environment, in order to sustain the capability of the environment to provide services in the short and long terms.

This research emphasizes the environmental quality dimensions that have impact on the quality of life measurement in Indonesia. The concept of environment is based on the concept of environmental sustainability, as well as the quality of life concept, is determined by the outcome of sustaining development. A figure below describes the conceptual framework for this research.

Figure 2. 3 Conceptual Framework



Source: Researcher Own Development (2015)

The grand concept of this research is sustainable development, citing definition from Newmann (1999) that sustainable development is a global process that minimalizes the utilization of environmental resources and reduces the impact of the environmental degradation in order to improve quality of life. As mentioned by Kates et al. (2005) and Tanguay et al. (2010), environment is one of the most important aspects of sustainable development alongside social and economic aspects, therefore Levett (1999) argued that environment is the most important aspect that could secure human needs as well as the ecosystem The diminishing of environmental quality leads to a deliberation of the economic and social system. Therefore, this research focuses on how environmental sustainability could sustain a balancing condition that allows human society to satisfy their need as well as diminishing environmental degradation.

Furthermore, environmental sustainability could be derived from improvement of natural and human-made environment. Environmental sustainability has three dimensions, which are:

1. *Environmentally responsible behaviour*: the human activities that relate to the efforts and behaviour to improve the physical environmental condition;
2. *Physical environmental quality*: the physical condition of air and water that is related to the quality of environmental services;
3. *Consumption of environmental services*: The services that are provided by the environment to satisfy human needs.

Those dimensions could improve of the quality of the human life, particularly improvement of health conditions. Citing the definition from RIVM (2002) that quality of life is related to the factual material and immaterial equipment of life characterized by health, living environment and legal and equity, family, and others.

CHAPTER 3: Research Design and Methods

3.1 PURPOSE

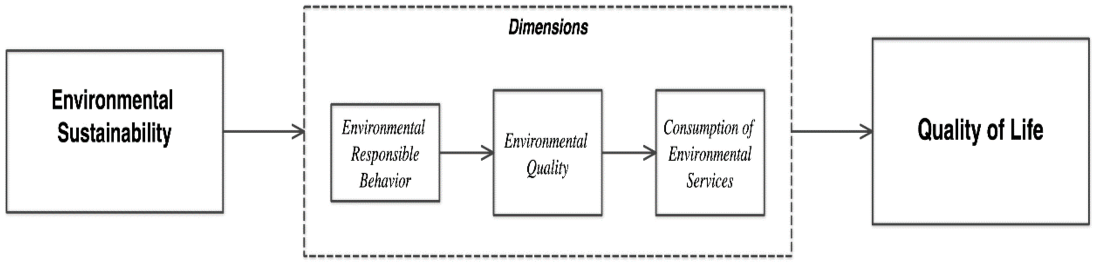
This chapter explains what kind of research strategy, methods, and design that are acquired by the researcher. This chapter also wants to describe the different types of knowledge, such as:

1. Determination of how the choice of research strategy reflects the research objectives and constrains the possible outcomes of this research;
2. Acquired appropriate methods and research instruments within a specific social context.

3.2 RESEARCH OPERATIONALIZATION

As explained in Chapters 1 and 2, this research conducts environmental quality that influences quality of life. A diagram below describes the main concept of this research:

Figure 3. 1 Main Concept



Source: Researcher Own Development (2015)

This research determines three dimensions that were developed by Streimikiene (2014) in her research, '*Comparative assessment of environmental indicators of quality of life in Romania and Lithuania*', She introduced a system of indicators for assessing environmental issues of quality of life by divided environmental issues into three major dimensions (or variables in this research), which are:

Table 3. 1 Variable Definition Operational

Variable	Definitions
Independent Variables	
Environmentally Responsible Behaviour	The activity that have been done by humankind in order to preserve their living environment and correspond to improvement of environmental quality (Streimikiene, 2015)
Physical Environmental Quality	A number of environmental media (e.g., soil, water, air, and waste) that has been used to measure the quality of living environment and has a direct impact on human health (Holman and Coan, 2008; Kahn, 2002; Streimikiene, 2014)
Consumption of Environmental Services	The benefits that humankind directly or indirectly obtain from their living environment (Balestra and Dottori, 2011; Kahn and Matsusaka, 1997)
Dependent Variable	
Quality of Life	The factual material and immaterial equipment of life characterized by health, living environment and legal and equity, work, family, and others (RIVM, 2000 and van Kamp, 2013)

For this research, indicators are compiled from prior research from Ministry of Environment and Forestry, Ministry of Marine and Fisheries, and Central Statistic Bureau. The data types included survey and observation data. The environmental indicators utilize a cross-national data of environmental features in a systematic and quantitative approach. It assists the move toward a more analytically rigorous and data driven approach to environmental issues.

Table 3. 2 Environmental Quality Indicators

Variables	Indicators	Definition Operational
Environmentally Responsible behaviour	Critical land rehabilitation activities	Rehabilitation activity that prioritized the planting or re-greening on critical land, vacant lands, and degraded forest area
	Watershed area rehabilitation activities	Rehabilitation activity that prioritized an area of land which is an integral part of the river and its stream-banks that serves to accommodate and drain water from rainfall to the river or the ocean
	Reforestation activities	Planting forest trees species on critical lands, vacant lands, degraded forest area which is vacant land to restore forest functions. In Indonesia, those activities take priority on conservation and protected forest area
	Planting one billion trees activities	Planting forest trees implemented by communities in order to increase their awareness and skills to maintaining their living environment, this movement aims to increase land cover and to prevent landslides and floods, absorbing carbon dioxide (CO_2), and renewing a raw material wood product
	Treated urban solid waste activities	An activity to recycle urban solid waste in household level, usually treatment activity is done by the local government.
Physical Environmental Quality	Water Quality	The condition where water is measured by several factors, such as the concentration of dissolved oxygen, bacteria levels, the amount of salt (or salinity), or the amount of material suspended in the water (turbidity Water has two dimensions that are closely linked: quantity and quality. Water quality is commonly defined by its physical, chemical, biological and aesthetic (appearance and smell) characteristics. A healthy environment is one in which the water quality supports a rich and varied community of organisms and protects public health
	Air quality	The state of the air around human. Good air quality refers to clean, clear, unpolluted air. Clean air is essential to maintaining the delicate balance of life on this planet — not just for humans, but wildlife, vegetation, water and soil. Poor air quality is a result of a number of factors, including emissions from various sources, both natural and "human-caused." Poor air quality occurs when pollutants reach high enough concentrations to endanger human health and/or the environment
	Consumption of fresh fish	The consumption of fresh fish products in provinces, from inland open water and marine capture fisheries
	Consumption of clean water	An amount of households that consumes clean water, mainly for safe drinking water

Source: Ministry of Environment and Forestry, 2014; Ministry of Marine and Fisheries, 2014; Central Statistic Bureau, 2014.

Indicators can be powerful tools for making important dimensions of the environmental visible and enabling their capacity. Adequate environmental indicators that reflect the real time condition of Indonesia can help guide the major efforts for assessing the quality of life.

Quality of life dimensions are derived from good health conditions and life expectancy at birth. According to the National Environmental Statistic of Indonesia (2014) there are several indicators that are related to health development; however, this research focuses on two indicators, which are:

Table 3. 3 Quality of Life Indicators

Variables	Indicators	Definition Operational
Quality of Life	People who have good health condition within a year	An amount of people who did not experience health problems that interfered with daily activities. This indicator was measured through subjective questionnaire (asking respondents about their health condition within a year) and objective survey (collecting information from hospital regarding the amount of people who came to examine their health condition);
	Life expectancy at birth	Measuring how many years of a particular age group were expected to live, considering age-specific mortality risk

Source: Central Statistic Bureau, 2014

There are other factors that are not included in the main model, but could influence the quality of life. These factors are mentioned as control variables. The indicators are derived from demography dimension (area, density, and population), social dimension (accessibility to clean water and education), and economy dimension (Gross Regional Domestic Bruto). The adequacy of control variable can also influence the dynamic process of model.

Table 3. 4 Control Variables

Variables	Indicators	Definition Operational
Control Variable	Area	The extent or measurement of a province surface land
	Density	The quantity of people who occupy a certain area in the province
	Accessibility to clean water	The percentage of population using an improved drinking water source
	Education	Proportion of people who obtain highest education level

Source: Ministry of Environment and Forestry, 2014 and Central Statistic Bureau, 2014

In conclusion, research operasionalization provides a clear determination of concept and variables into tangible indicators. It suitable to developing an empirical measurement.

3.3 RESEARCH STRATEGY AND METHOD

This research develops the element of idea that considers conceptual framework (explained in Chapter 2.6), strategy, and methods. A strategy consists of a research approach and method that may have an influence on deicions made about the research design and the choice of specific data collection and analysis. A table below describes research strategy.

This research tends to be a more quantitative approach, because the researcher bases the inquiry on the hypotheses that collecting diverse types of secondary data best provides an understanding of the research objective. The research begins with an initial hypotheses (H0) as a basic statement of prediction of what is expected to happen in this research. The initial hypotheses is:

'Integrated variables of environmental quality, which are environmentally responsible behaviour, physical environmental quality, and consumptios of environmental services can improve quality of life'

Table 3. 5 Combination Approach, Strategy, Method

Approach	Strategy	Method
Quantitative	Survey strategy based on secondary data	1. Utilize secondary data based on survey activities: a. Survey instrument was close-ended questionnaire b. The result was based on numeric data analysis 2. Utilize secondary data based on observation activities: a. Observation activities focus on environmental entities, such as: air, river, and land; b. The results describe the level of quality of environmental entities 3. Utilize secondary data based on policy plan, monitoring and evaluation report, and regulation.

Source: Researcher Own Development (2015)

From the initial hypotheses above, researcher determines the collection of data to support the hypotheses, then analyzes the data using statistical procedures.

3.4 VALIDITY, RELIABILITY, AND DATA COLLECTION

In this research, reliability refers to the extent to which results are consistent over time. Validity refers to the extent to which an instrument measures and performs as it is designed, concerning the crucial relationship between variables and indicators.

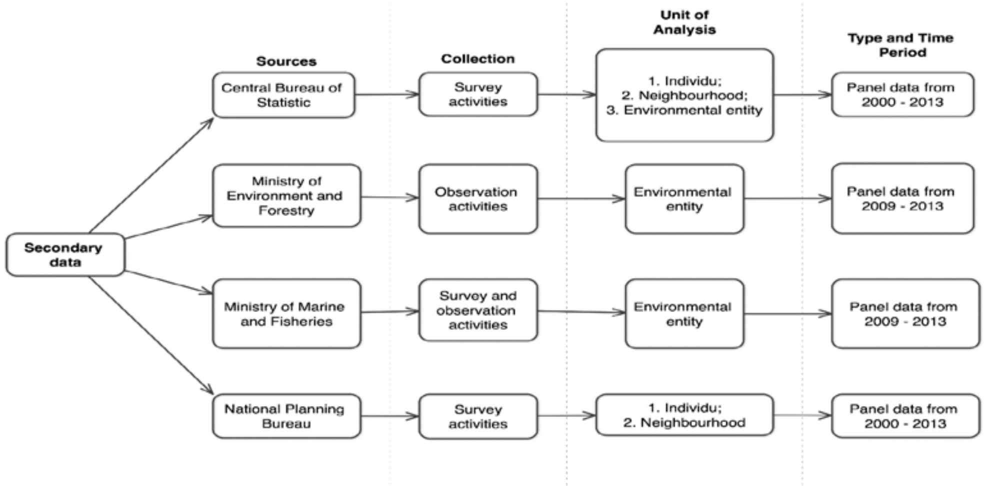
Table 3. 6 Validity and Reliability

Reliability	Validity
• Secondary data are based on survey and observation during 2000 to 2014, the instruments and methods remain consistent over time	• Secondary data used statistical analysis to obtain the result, and researcher also used statistical analysis to data analysis with asuitable adjustment reciprocal with research objective.
• There is no missing data during time span period 2000 to 2014	• Stage of measurement are consists of descriptive statistic and inferential analysis.

Source: Researcher Own Development (2015)

As mentioned above, this research uses secondary data from several government institutions in Indonesia. The data collection involves survey data and observation data from 33 provinces in Indonesia. The secondary data is generated into panel data because it is a dataset in which the behaviour of entities are observed across time, then it includes variables at different level analysis. A diagram below describes data collection flow.

Figure 3. 2 Data Collection Flow



Source: Researcher Own Development (2015)

Therefore, utilization of secondary data is based on three reasons:

1. The secondary data that was provided by government institutions was based on a representative sample and the result was used to support several policy developments in Indonesia.
2. Survey based on secondary data can generate a large amount of data in a short time for a fairly low cost.

3.5 RESEARCH ANALYSIS

This research uses panel data analysis to measure the relationship between environmental quality and quality of life with a time span from 2010 to 2013. A panel data analysis model is applied to estimates relationships. There are several types of analysis available with the panel dataset, such as: fixed effects (FE) model and random effects (RE). A fixed effects model is cast a regression problem by using fixed indicators to represent the heterogeneity, non-random quantities that account for the heterogeneity and do not change over time (Fress, 2004:18). A fixed effect model is also used to control the bias effects of time-invariant indicators in order to better measure the impact of changing indicators.

The random effects model differs from the fixed effects model, where identity is assumed to be random and uncorrelated rather than fixed. A random effects model was a cast in the mixed linear model framework where the heterogeneity is modelled using random quantities Fress (2004:72). The key difference in the equation of the random effects model is a single random intercept known as the error-components (Fress, 2004:72), and it is associated with the indicators within each individual such as: population and density.

In order to determine whether to use a fixed or random effects model for analysis, a **Hausman test** needs to be run. According to Fress (2004) and Baum (2006), a Hausman test was essentially a test of whether the loss of efficiency was worth removing the bias and inconsistency of the regression estimator. In statistical terms, fixed effects are always reasonable things to do with panel data because it always gives a consistent result, but for several cases it may not be the most efficient model to use. Otherwise, usually random effects provide better P-values, as they are more efficient estimators (Stock and Watson, 2007).

Therefore, to avoid the non-positive-definite result, this research uses **sigmamore** syntax. According to Hausman (1978) and Baltagi (2011), sigmamore was recommended when comparing fixed effects and random effects linear regression because it was more reliable to produce a non-positive-definite-differenced covariance matrix. This option also provides a proper estimate of the contrast variance for test of exogeneity and over-identification in regression (Hausman, 1978).

Panel data analysis also increases the possibility of violating the statistical assumptions needed to provide inferences (Hatz II, 2011). The most common violations are heteroskedasticity and auto correlations with the errors terms. Heteroskeasticity appears when the standard deviations of indicators vary over a specific amount of time. However, the error term appears uncorrelated over time and the standard deviations of the error terms will be consistent over time (Hatz II, 2011). In order to control the violations, it needs robust standard errors to calculate heteroskedasticity.

A basic model for this research describes as:

$$QoL_{it} = \beta + ERB_{it}\beta_1 + EQ_{it}\beta_2 + CSE_{it}\beta_3 + \varepsilon_{it}$$

Description:

QoL_{it}	: Quality of life as dependent variable
β	: Constanta
$ERB_{it}\beta_1$	: Environmentally Responsible Behaviour as independent variable
$EQ_{it}\beta_2$	: Physical Environmental Quality as independent variable
$CSE_{it}\beta_3$	: Consumption of Environmental Services as independent variable
ε_{it}	: Error term
it	: i = identity (province) and t = time (year)

This research uses four analysis stages, which are:

1. Testing the relationship among independent variables. It is related to the premise explained by Streimikiene (2014) that the dynamics of environmental dimensions are relevant to quality of life were environmentally responsible behaviour has a positive impact on environmental quality, and improved environmental quality provides for a higher consumption of services provided by the environment. Therefore, researcher runs two models:
    a. Testing the relationship between environmentally responsible behavior (x) and physical environmental quality (y);
    b. Testing the relationship between physical environmental quality (x) and consumption of environmental services (y);
2. Testing the relationship between environmental quality dimensions (x) and quality of life (y);
3. Testing the relationship between environmental quality dimensions and quality of life with several control variable;
4. Testing environmental quality dimensions that reflect urban condition with quality of life.

CHAPTER 4: Research Findings

4.1 PURPOSE

This chapter explains the results of the environmental quality and quality of life measurement. The results are also conducted with several theories, prior worldwide research, and Indonesia in order to support the result. The model measurement follows the analysis stages that are mentioned in Chapter Three.

4.2 DESCRIPTIVE FINDINGS

This research collected data from the provinces level and spans four periods of time, from 2010 to 2013. The size of the database is derived from environmental quality indicators, quality of life, and control variables (demographic, social, and economic dimension). A table below describes a summary statistic of the database.

Table 4. 1 Summary Statistic

Dataset : Panel data
Indices : Province x Year
Panel variable : Provinces (strongly balance)
Time span : 2010 to 2013
Observation : 33 province x 4 years (132)
Total data points : 3168

Source: Researcher Own Development, 2015

In general, there are 132 observations from 33 provinces in Indonesia in a four year time span, therefore the total data points is 3,168 points. The panel summary indicates the data is strongly balanced, and means that there is not a missing value in each point.

Descriptive statistic measurement indicates that every indicator has a dynamic value of mean, standard deviation, minimum, and maximum points (seen on Table 4.2). In general, data from an environmentally responsible behaviour variable indicates that there are three activities which have a minimum value of zero (0), such as: critical land rehabilitation, watershed area rehabilitation, and reforestation. It indicates that several provinces did not have any environmental responsible activities related to rehabilitate the land and forest in a certain year. For instance, DKI Jakarta province did not have critical land rehabilitation in 2010 and 2013, West Sumatera province did not have watershed area rehabilitation in 2010 and 2013, and West Sulawesi province did not have reforestation activity in 2011.

The planting one billion trees indicator indicates the measurement used for the quantity of trees that were planted on critical and vacant lands. Therefore, the maximum value is 264,056,794 trees in West Sumatera in 2014, and the lowest activity occurred at DKI Jakarta, with 710,144 trees in 2010. Meanwhile, other rehabilitation and reforestation activities used wide-scale areas (hectare – ha) to measure the activities. For instance, the maximum value of critical land rehabilitation activity is 80,021 ha in Central Java in 2013, and the lowest activity is zero (0) in DKI Jakarta in 2010 and 2013.

Table 4. 2 Descriptive Statistic

Variable	Indicator	Mean	Standard Deviation	Minimum	Maximum
Environmentally responsible behaviour	Critical land rehabilitation	14370.26	15756.34	0	80,021
	Watershed area rehabilitation	10538.55	14614.44	0	79,165
	Reforestation	3091.84	2849.22	0	15,000
	Planting one billion trees	47,980,400	56.20	710,144	26,405,694
	Treated urban solid waste	67.34	19.85	3.70	100
Physical Environmental Quality	Air quality	86.34	12.35	37.59	99.76
	Water quality	51.77	20.74	0	100
Consumption of Environmental Service	Average fish consumption per capita	34.28	9.85	9.92	50.67
	Clean water consumption	59.11	14.20	22.90	93.50
Quality of Life	Quality of life	76.32	2.69	68.27	82.15
Control Variable	Area	58481.36	64803.39	664.01	319,036
	Density	694.22	2495.19	8.00	15,015
	Accessibility to clean water	46.37	14.75	17.80	92.49
	Education	66.50	4.90	51.38	81.00
	Estimation CO2 emission	1792.36	2086.75	0	9093.80

Source: Researcher Own Development, 2015

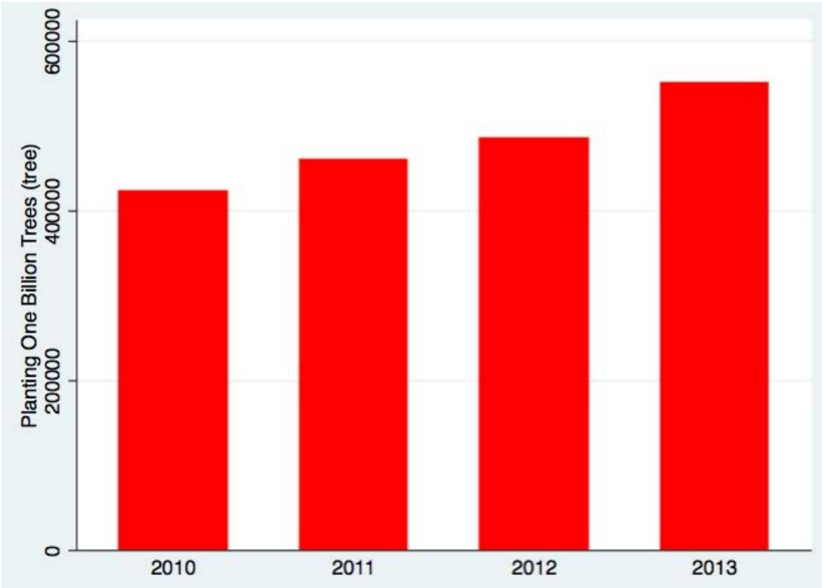
The physical environmental quality variable is divided into two major indicators, such as: air quality and water quality. Air quality measurement used four major parameters, which are: TSP (Total Suspended Particulates), SO2 (Sulfur Dioxide), NO2 (Nitrogen Dioxide), and CO (Carbon Monoxide). Therefor, water quality measurement used two major parameters, which are: BOD (Biochemical Oxygen Demand) and COD (Chemical Oxygen Demand) on the river in major cities. For estimation, the air quality indicator indicates the minimum value is 37.59% in Riau in 2013. Thus, the maximum value is 99.76% in 2010. Therefore, the water quality indicator indicates the minimum value is zero (0) in several provinces, such as: East Nusa Tenggara and Papua in 2010, and the maximum value is 100% in several province, such as: North Sumatera, Bengkulu, and Central Sulawesi in 2010

The consumption of environmental services refers to the efforts of humankind to consume the products that are produced by the environment. The main premise is that higher physical environmental quality can increase the quality of environmental services. The average fish consumption per capita indicates that the minimum value is 9.92% while the maximum value is 50.67%. Otherwise, the clean water consumption indicator also indicates a high discrepancy between minimum value 22.90% and maximum value 93.50%.

The quality of life variable was derived from two indicators, such as: good health condition and life expectancy at birth. The average value for quality of life is 76.32%. The highest level is 82.15% in East Kalimantan in 2013, and the lowest level is 68.27% in East Nusa Tenggara in 2010. Therefore, the control variable indicates that the indicator may have a relationship with quality of life but is not included as an environmental quality variable. An interesting finding indicated in demographic dimensions that the maximum value of a provincial area is Papua with 319,036.05 km2, but the density is 10/km2, while West Java has a provincial area of 35,377.76 km2, but the density is the highest with 15,015/km2. Those values indicate that the provincial area is inversely proportional with the density.

To obtain specific understanding about environmental quality and quality of life condition in Indonesia, this research also measures the frequency value for each indicator from 2010 to 2013. Firstly, the environmentally responsible behaviour activities indicate that planting one billion trees activity tended to increase from 2010 to 2013 (seen on Figure 4.1). For instance, East Java province indicated that there was an increasing quantity of trees that were planted in critical and vacant lands, from 115,369,160 trees to 206,961,617 trees. It occurred because the Ministry of Environment and Forestry increased the quantity of trees that were distributed to provinces every year. The total for the national level was 1,398,552,467 trees in 2010 and 1,815,180,535 trees in 2013 (Ministry of Forestry, 2013).

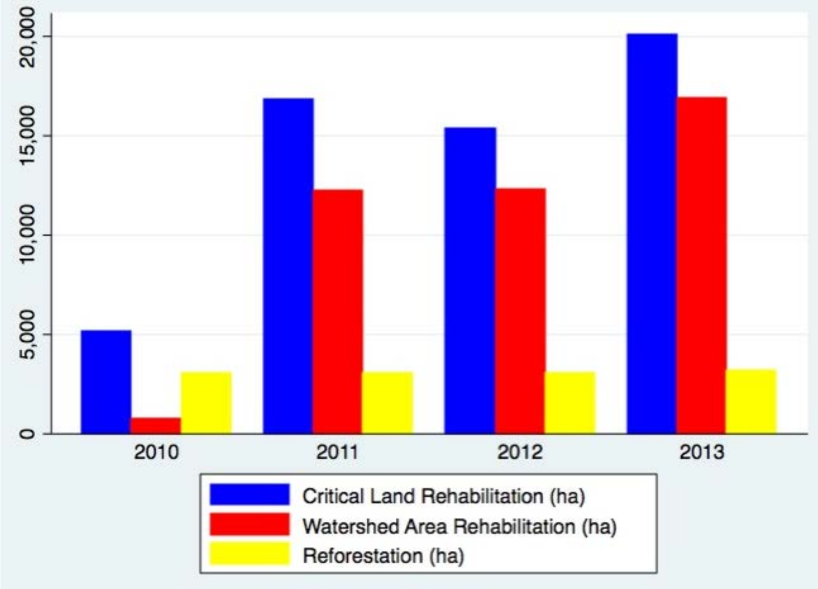
Figure 4. 1 Planting One Billion Trees Activity



Source: National Forestry Statistic of Indonesia Report, 2014

Critical land rehabilitation activity indicates that there was a decrease of activity from 2011 to 2012 (seen on Figure 4.2). For instance, South Sumatera indicated that critical land rehabilitation activity was accomplished in 16,540 ha critical lands, but decreased to 11,360 ha. Watershed area rehabilitation tended to increase from 56.951 ha in 2010 to 557,376 ha in 2013. Therefore reforestation activity tended to increase from 100,738 ha in 2010 to 105,656 ha (Ministry of Forestry, 2013).

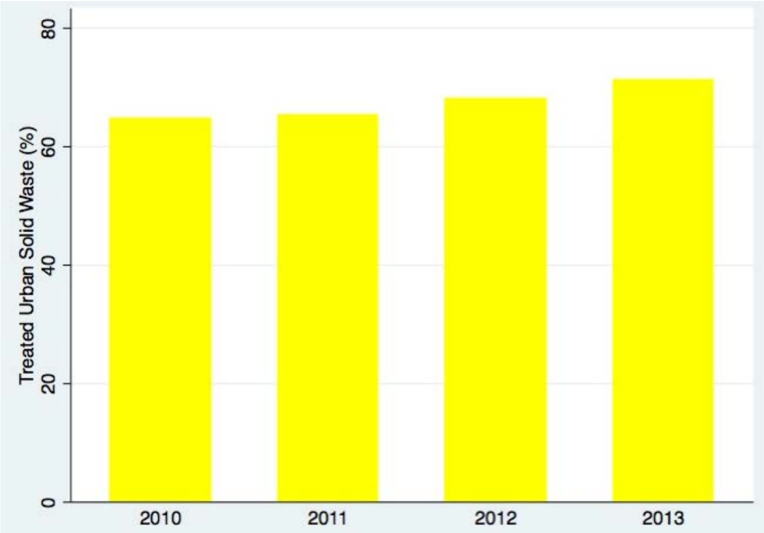
Figure 4. 2 Rehabilitation and Reforestation Activities



Source: National Forestry Statistic of Indonesia Report, 2014

The treated urban solid waste tends to increase from 2010 to 2013 (seen on Figure 4.3), the average activity increases from 64.82% to 71.22%.

Figure 4. 3 Treated Urban Solid Waste

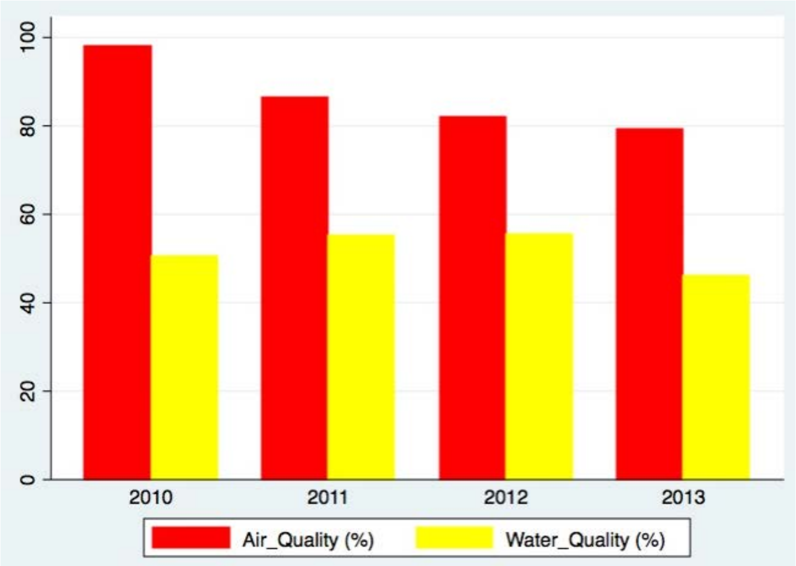


Source: Environmental Statistic of Indonesia, 2011 to 2014

The average national level of treated solid waste was captured from urban activities because urban levels have better technology and regulation to manage their solid waste, as well as a community movement that helped the regional government in treating solid waste in urban levels since 2008 (Ministry of Environment, 2012). For instance, South Kalimantan province indicated that treated urban solid waste activity increased during 2010 to 2013 from 33% to 57.80%. This occurred because the quantity of community movement that was involved in solid waste treatment activities was increasing in Banjarmasin (the provincial city of South Kalimantan) from 30 communities in 2010 to 71 communities in 2014.

Secondly, physical environmental quality variables indicate air and water quality conditions in Indonesia (Seen on Figure 4.4). Air quality tended to decrease from 97.91% in 2010 to 79.31% in 2013. One of the reason was an increasing of CO2 emission from gasoline and solar during 2010 to 2013. Estimation of CO2 emission from gasoline tends to be higher than CO2 emission from solar, because it was measured from industrial, household, and buses emission; however, CO2 emission was measured only from motorized vehicles, particularly private vehicles. These conditions indicate that higher CO2 emission is parallel with the increasing number of industrial areas and motorized vehicles. For instance, DKI Jakarta has the highest value of CO2 emission from gasoline and solar, with the highest quantity of motorized vehicles being 17,990,200 in 2013 as well as 1,140 industrial area in 2012 (Central Statistic Bureau, 2014a).

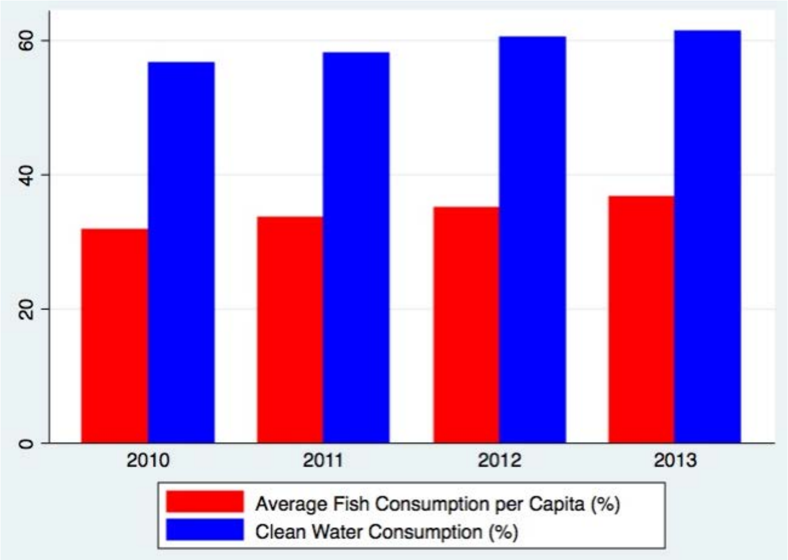
Figure 4. 4 Air and Water Quality Conditions



Source: Environmental Statistic of Indonesia Report, 2010 to 2014

Thirdly, consumption of environmental services is indicated through average fish consumption per capita and clean water consumption (seen on Figure 4.5).

Figure 4. 5 Fish and Clean Water Consumption



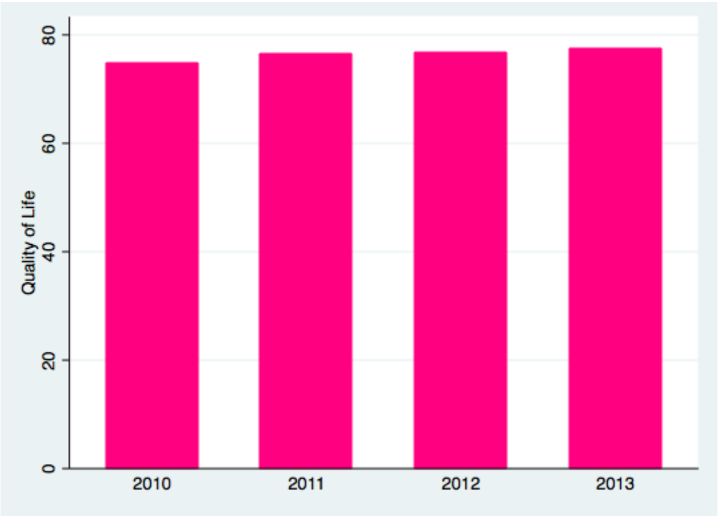
Source: National Forestry Statistic of Indonesia Report, 2014 and Environmental Statistic of Indonesia Report, 2010 to 2014

Fresh fish consumption tends to increase each year, and the average fresh fish consumption per capita increased 31.76% to 36.62% from 2010 to 2013. In general, fresh fish was captured from inland open water and marine fisheries production. The quantity of marine fisheries production tends to be higher than inland open water fisheries production; for instance, the marine fisheries production was 5,330,458 tons, while the inland open water fisheries production was only 393,561 tons in 2012. However, fresh fish consumption is parallel to the fisheries production, with several provinces having high fresh fish consumption as well as having high fisheries production. For instance, Maluku has 48.16% average fresh fish consumption and the highest marine fisheries production with 537,262 ton in 2012 (Ministry of Marine and Fisheries, 2014).

The clean water consumption is indicated with safe drinking water in household levels, and people who consume safe drinking water have better health. From 2010 to 2013, the clean water consumption tended to increase from 56.54% to 61.39%. The increasing percentage of clean water consumption occurred because the BOD and COD levels on rivers tended to decrease, and lower levels of water pollution increases water quality level.

Fourth, the quality of life condition is indicated with good health conditions and life expectancy at birth (seen on Figure 4.6).

Figure 4. 6 Quality of Life Condition



Source: Environmental Statistic of Indonesia Report, 2010 to 2014

Higher good health conditions and higher life expectancy at birth indicate higher quality of human life. In general, quality of life tends to increase from 2010 to 2013 (seen on Figure 4.6), from 74.67% to 77.51%. The highest average good health condition is 90.81% in East Kalimantan in 2013, and the highest average life expectancy at birth is 74.50% in D.I Jogjakarta in 2013. It indicates that health conditions and life expectancy at birth were increasing during that time period.

In conclusion, descriptive findings provide an insight to environment and quality of life conditions in Indonesia from 2010 to 2013. The findings indicate dynamic conditions every year without extreme difference values for each indicator. Furthermore, this research measures the relationship between environmental quality and quality of life. It started by measuring the relationship among environmental quality variables, and followed by measuring the relationship between environmental quality and quality of life (the analysis stage was explained in Subchapter 3.5).

4.3 MODEL 1 – Measuring Environmentally responsible behaviour and Physical Environmental Quality

This model measures the relationship between environmentally responsible behaviour and physical environmental quality indicators. The premise is that higher environmentally responsible behaviour can increase the quality of the physical environment (Streimikiene, 2014). This model is divided into two measurements: 1) measuring environmentally responsible behaviour and air quality; 2) measuring environmentally responsible behaviour and water quality. As mentioned above, the air quality variable is developed based on calculation of four major parameters, which are: TSP (Total Suspended Particulates), SO2 (Sulfur Dioxide), NO2 (Nitrogen Dioxide), and CO (Carbon Monoxide), and the water quality variable is developed based on calculation between BOD and COD levels in rivers of major cities. A table below describes the measurement result.

Table 4. 3 Model 1 - Measurement Result 1

VARIABLES	(1) Air Quality	(2) Water Quality
Critical land rehabilitation	-0.074	0.385
	(0.114)	(0.247)
Watershed area rehabilitation	0.332**	-0.435
	(0.133)	(0.273)
Reforestation	-0.739*	-0.989
	(0.445)	(0.682)
Planting one billion tress	0.062***	0.041
	(0.018)	(0.027)
Treated urban solid waste	0.140**	0.045
	(0.066)	(0.111)
Observations	132	132
R-Squared	0.2	0.02
Number of Province	33	33

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: Researcher Own Development, 2015

The first measurement indicates that an increase of one hectare point of watershed area rehabilitation can increase 33% air quality (seen on Table 4.3). It implies that higher rehabilitation activity in watershed area can reduce the air pollution and has an impact on increasing air quality. The significant relationship is as expected because prior results indicated that that many rehabilitation actions, particularly in watershed areas, are an effort to prevent and control air pollution(Tripathi, Chaturvedi, et al., 1996).

It also indicates that an increase of one point of planting one billion trees activity can increase 6.2% air quality. Meanwhile, an increase of one point of reforestation activity can increase 70% air quality. Those results imply that planting a higher number of trees and reforestation activities can also reduce the air pollution and increase air quality. This significant relationship is as expected because prior research explained that planting trees removed gaseous air pollution, and also removed air pollution by intercepting airborne particles (Nowak and Crane, 2002). In Indonesia, the initiative of planting one billion trees is one of the most important programs to reduce the impact of negative concentration in the air, and is highlighted as one potential benefit to improving quality of life. Furthermore, reducing the quantity of CO_2 emissions can decrease the incidence of respiratory illness(Central Statistic Bureau, 2014b).

The measurement between treated urban solid waste and air quality indicates that an increase of one percentage point of treated urban solid waste activity can reduce 13% CO_2 emissions from gasoline and solar. It implies that with more treated urban solid waste activity, air pollution can be reduced which in turn has an impact on the air quality. This significant relationship is also as expected because prior research explained that the consequences of the solid waste treatment in landfill areas can reduce potential health hazards, as well as reduce unpleasant odour (El-fadel, Shazbak, et al., 1999).

In general, air pollution could harm land and water, the pollution that had been released into the air—by cars, trucks, gas-powered lawn tools, power plants and other sources— produce nitrogen and chemical contaminants that dangerous for air and also water quality. With maintaining the forests that absorb airborne pollutants and enacting regulations to reduce emissions from our vehicles and power plants are two ways that can reduce air pollution (OECD, 1993).

Therefore, air pollution is gaining increasing prominence as a public health hazard in developing countries. According to World Health Report (2002), air pollution is responsible for 2.7% of the global burden of disease. Exposure to air pollution is responsible for a high degree of respiratory morbidity and mortality in Indonesia. I it has been found that people typically spend more than 90% of their time indoors in an enclosed environment where air circulation may be restricted. For this reason experts feel that Air quality impacts health to a greater extent than outdoor pollution due to higher concentration and exposure (Central Statistic Bureau, 2014b).

The second measurement indicates that the environmentally responsible behaviour activities do not influence the water quality. It can be explained from prior research done by UNESCO (2006), sedimentation was a major contributor in increasing a negative impact of water quality in the river. Moreover, the UNESCO report also stated that sedimentation occurred in watershed areas of semi-arid climates following a high intensity rainfall, land use changes, and agricultural practices (UNESCO, 2006). According to the report, it concludes that although there is a low or high rehabilitation, reforestation, and solid waste treatment activity, it cannot influence the water quality level as long as sedimentation always occurs in watershed areas.

In conclusion, the main finding indicates that environmentally responsible behaviour could influence air quality, but not the water quality. It can be explained that watershed area rehabilitation, reforestation, planting one billion trees, and treating urban solid waste have positively significant relationships to air quality. Furthermore, the second model measures the relationship between physical environmental quality and consumption of environmental services.

4.4 MODEL 2 – Measuring Consumption of Environmental Service and Physical Environmental Quality

This model measures the relationship between consumption of environmental services and physical environmental quality indicators. The premise is that higher physical environmental quality can lead to a higher consumption of environmental services (Streimikiene, 2014). This model is divided into three measurements: 1) measuring physical environmental quality and fresh fish consumption; 2) measuring physical environmental quality and clean water consumption.

The environmental services performed by environment to provide products such as: food crops, water, fuels, water, oxygen and others in parallel with ensuring the proper functioning of natural systems such as: water purification, rainfall cycles, climate balance, soil fertility and the recycling of the nutrients essential to agriculture. For instance, environmental services are: the production of oxygen and the purification of the air by plants; the stabilization of climatic conditions, including the moderation of temperatures, rainfall, winds and tides; and the capacity to produce water and the equilibrium of the hydrological cycle with the control of floods and droughts. Environmental services also are related to the flow of materials, energy and information from the stocks of natural capital (Basiago, 1998, Collados and Duane, 1999).

The first measurement indicates that an increase of one percentage of water quality can have an increase of 2% consumption of fish (seen on Table 4.4). Therefore, an increase of one percentage of air quality can have an increase of 16% consumption of fish. It implies that lower water and air pollutions can increase the quality of fish products and has an impact on consumption of fish. The second measurement also indicates a similar result with a first measurement, one percentage point of water quality can have an increase of 3% consumption of clean water, and also an increase one percentage point of air quality can increase the consumption of clean water by 19%. It implies that lower water and air pollutions can increase the quality of fish products and has an impact on consumption of clean water.

This model indicates that the relationship between air quality and fish and clean water consumption tends to be strongly significant and convenient with the prior research. According to Drivsholm and Nielsen (1992) the major problem of the consumption services provided by environment was the discharge of odour emission. Odour emission releases particles such as: sulphur dioxide (SO_2), nitrogen dioxide (NO_2), and CO_2 (carbon dioxide) into the air and causes a decreasing air quality level. Therefore, Shafik (1994) argued that in the case of environmental indicators where flow measures were used within water air pollution parameters, much of the damage is relatively recent and flows over the past 20-30 years are likely correlated with the quality environmental services.

Table 4. 4 Model 2 - Measurement Result 2

VARIABLES	(1) Average fish Consumption per Capita	(2) Clean Water Consumption
Water Quality	0.020*	0.030**
	(0.011)	(0.014)
Air Quality	0.168***	0.195***
	(0.029)	(0.033)
Observations	132	132
R-squared	0.49	0.45
Number of Province	33	33

Robust standard errors in parentheses

*** p<0.01, **p<0.05, * p<0.1

Source: Researcher Own Development, 2015

Access to clean drinking water is important as a health and development issue at a national and regional level. In some province, it has been shown that investments in water supply and sanitation can yield a net economic benefit, since the reductions in adverse health effects and health care costs outweigh the costs of undertaking the interventions. This is true for major water supply infrastructure investments through to water treatment in the home. Experience has also shown that interventions in improving access to safe water favor the poor in particular, whether in rural or urban areas, and can be an effective part of poverty alleviation strategies (Hespanhol and Prost, 1994).

In conclusion, the relationship among physical environmental quality and consumption of environmental services indicators tend to convenient with premises. It can be explained that an increasing of water and air quality which has an impact on higher quality of fish and clean water productions, and leads to an increase of average fish per capita and clean water consumption in Indonesia between 2010 to 2013. Furthermore, the model is used to measure the relationship between environmental quality and quality of life. Third model reflects the measurement without any control variable.

4.5 MODEL 3 – Measuring Quality of Life in National Level

The prior research from Streimikiene (2014) explained that the environmental dimensions reflecting the quality of life can be grouped based on their relationships with quality of life: dimensions for assessing environmentally responsible behavior, dimensions of environmental quality, and dimensions of consumption of environmental services. In accordance with prior theory and research hypothesis (seen in Subchapter 3.3) that interrelationship between environmentally responsible behaviour, physical environmental quality, and consumption of environmental services can influence human quality of life in Indonesia.

As mentioned above (seen in Subchapter 4.1 and 4.2) environmentally responsible behaviour affects the quality of the physical environment; therefore, a better quality of physical environment affects the consumption of that which is provided by the environment. This model explains a further measurement used to conduct the interrelated environmental quality variables with the quality of life in Indonesia from 2010 to 2013. Measuring environmental quality dimensions with quality of life is important because environment plays a crucial role in a human's physical and social quality of life, and a higher quality of living environment has a positive impact on the human's health condition.

There are four models in this sub-chapter. Firstly, this research wants to measure the relationship between environmental quality dimensions with quality of life partially. Secondly, all variables are combined to measure the relationship with quality of life. The table below describes the measurement result.

A Hausman test result indicated that this model is using random effects (prob>chi2 = 0.16) for regression. First model measures the environmentally responsible behaviour with quality of life. The result indicates (seen on Table 4.5) that an increase one hectare point of watershed area rehabilitation can increase 3.9% quality of life. Therefore an increase one point of planting one billion trees can increase 0.8% quality of life. It implies that higher watershed area rehabilitation and planting trees can increase the quality of life.

The increasing number of planting trees can modify air temperature, increase air humidity, reduce wind speed, and reduce air pollutants (de Abreu-Harbich, Labaki, et al., 2015). Several researches explained, like structure and density of the treetop, size, shape and color of leaves, tree age and growth, can influence the performance of solar radiation attenuated by canopy, air temperature and air humidity (de Abreu-Harbich, Labaki, et al., 2015). Furthermore, the increasing of air temperature can contribute to reduce quality of human life (Akbari, Pomerantz, et al., 2001).

Table 4. 5 Model 3 – Measurement Result 3

	(1)	(2)	(3)	(4)
VARIABLES	Model 1	Model 2	Model 3	Model 4
	Quality of Life	Quality of Life	Quality of Life	Quality of Life
Critical land rehabilitation	0.006			0.008
	(0.014)			(0.012)
Watershed area rehabilitation	0.039*			0.016
	(0.020)			(0.017)
Reforestation	0.083			0.142**
	(0.063)			(0.058)
Planting one billion tress	0.008***			0.004
	(0.003)			(0.002)
Treated urban solid waste	0.023			0.005
	(0.015)			(0.014)
Air quality		0.076***		0.044***
		(0.017)		(0.017)
Water quality		0.011		0.010
		(0.008)		(0.007)
Average fish consumption			0.087***	0.019
			(0.032)	(0.029)
Clean water consumption			0.130***	0.077***
			(0.030)	(0.029)
Observations	132	132	132	132
R-squared	0.38	0.31	0.22	0.42
Number of Province	33	33	33	132

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: Researcher Own Development, 2015

Second model measures the physical environmental quality with quality of life. The result indicates that an increase one percentage point of air quality can increase 7.6% quality of life. However, a low or high water quality would not influence the quality of life. The positively relationship between air quality and quality of life is in accordance the several researches that explained air pollution now takes a greater toll on human life, health effects from air pollution can last for a short while (e.g., coughing) or become chronic (e.g., heart and lung disease). Health problems are increasing when human exposed to air pollution for a long time (exposure).

Therefore, a recent research from United Nation (2013), it stated that missions of air pollutants continue to play an important role in a number of air quality issues. In 2013, about 94 million tons of pollution were emitted into the atmosphere in the developing countries. These emissions mostly contribute to the formation of ozone and particles, the deposition of acids, and visibility impairment. According several theories above, it can be explained that higher air pollutant can contribute to reduce air quality and has an impact to the human's health condition. Lower health condition indicates lower human's quality of life.

Third model measures the consumption of environmental services with quality of life. The result indicates both fish and clean water consumption can influence the quality of life. An increase one percentage point of average fish consumption per capita can increase 8.7% quality of life. Therefore, an increase one percentage point of clean water consumption can increase 13% quality of life. It implies that a higher clean fresh fish and clean water consumption can contribute to higher health condition. Because dirty water and toxic fish can cause several disease that has an impact to quality of human's life.

Forth model measures overall environmental quality dimensions with quality of life. The result indicates that an increase one hectare point of reforestation activities can increase 14% quality of life, thus an increase one percentage point of air quality can increase 4% quality of life. Meanwhile, an increase one percentage point of clean water consumption can increase 7% quality of life. When the model measures all variables, it changes several things, such as: watershed area rehabilitation and planting one billion trees remain insignificant with quality of life, but reforestation appears as significant variable. The average fish consumption per capita is also insignificant with quality of life. Therefore the coefficient value is likely smaller than the prior model.

For two decades, reforestation has played an important role in repairing critical land and improving the vacant lands that used to be used as industrial areas or hazardous landfill areas. The efforts to rebuild damaged forest or land can restore the biochemical cycling of carbon, oxygen, and nutrients in the atmosphere and hydrosphere (Arneth et al., 2010 and Cunningham et al., 2015). Gilbert-Norton et al. (2010) argued that reforestation might improve links between existing relic forest patches, increasing movement, gene flow and effective population sizes of many species in the river, sea, land, and hinterland. Reforestation can reduce severe impacts of land and forest degradation by providing secure access for humankind in order to preserve hydrological and nutrient cycling, providing a better quality water and supporting a higher biological diversity (Maginnis and Jackson, 2002). The impacts of these activities not only increased water quality, but could also substantially change the accumulation of clean water.

Air quality is key to human and ecosystem health. Good air quality sustains healthy ecosystems and hence leads to an improved quality of human life. Many air pollutants have long-term negative impacts on air quality, and as a result clean water is severely reduced. Available clean water resources are evolving as a limiting factor not only in quantity but also in quality for human and ecological stability (Srebotnjak, Carr, et al., 2012). Water quality is a significant criteria in matching water and demand supply, and securing adequate clean water quality for both human and ecological needs is an important aspect of integrated environmental management and sustainable development(Srebotnjak, Carr, et al., 2012). However, poor air quality affects the human health condition. For instance, waterborne diseases cause the death of more than 1.5 million children each year. There are numerous benefits to improving air quality, among them being improved ecosystem and environment services, improved health, and improved livelihoods.

Since 2010, national governments have collaborated with regional governments to cultivate trees in the critical lands, degraded lands in watershed area, critical forests, and vacant lands in order to protect land as well as rivers from major pollutant sources, such as: chemicals, oxygen depleting nutrients, metals, and biological pollution. Higher reforestation activity has contributed to preserving air resources (Ministry of Environment, 2012). From 2010 to 2013, there was an increased quantity of seed provision that was provided by the government, from

1,398,552,467 seeds to 1,815,180,535 seeds for planting one billion trees, and 206,887,700 seeds to 803,321,420 seeds for reforestation activity (Ministry of Forestry, 2013). Furthermore, an effort to preserve water resources plays an important role in increasing clean water provisions. An increasing quantity of clean water has an impact in increasing the volume of clean water that is distributed by water supply establishment companies from 2,410,901,000 m3 in 2008 to 2,968,646 m3 in 2012 (Central Statistic Bureau, 2014b).

According to Millennium Development Goals (MDGs) Report (2013), providing and maintaining safe drinking water is central to improving the quality of life and alleviating poverty. On an international level, communities are still far from achieving the target of reducing by half the quantity of people without access to safe water by 2015. Recently, the human population still remaining unreached is 1.1 billion people around the world who still lack access to improved water supply. In Indonesia's case, the human population that has access to improved clean water is increasing from 63.48% to 67.73% from 2009 to 2013(Central Statistic Bureau, 2014a). Prior research explained that clean, safe, and adequate freshwater is vital to the survival of all living organisms, and increasing environmental quality has become a global action in order to improve quality of life (Rogerson, 1995).

In the perspective of environmental services, Krutilla et al. (2002) identified a trade-off between values associated with preservation and consumption. They agree that the environment and natural capital provide utility in the natural state as well as through consumption, then attempt to broaden the traditional quality of life function to include a wider role for natural capital beyond consumption alone. The model indicates water quality improvement as a natural capital stock that influences a clean water production. It implies that higher quantity and quality of water can increase the consumption flows. Therefore, the accessibility of clean water locations could exhibit differences in quality of life.

A lack of access to clean safe drinking water can diminish a clean water consumption, hence a negative impact to human health, particularly for vulnerable population groups, such as: children, the elderly, and pregnant woman. For instance, consuming low water quality during pregnancy can influence the infant mortality rate because dirty water can cause increasingly harmful particles to infiltrate the body. A medical review also stated that consuming safe drinking water has a positive impact on longevity, and a higher consumption of clean water can increase the life expectancy rate (Wilson, 2010).

The consumption of a lower quality of water has a negative impact on gastrointestinal and stomach illnesses, such as: nausea, vomiting, cramps, and diarrhea. For the long term, these variants of illnesses can increase bodily function limitation, for instance, vision loss, mobility difficulty, and intellectual disability. Reduced bodily function conditions can reduce the ability to achieve a long and productive life and the opportunity to enjoy a good quality of life (Albrecht and Devlieger, 1999). Quality of life encompasses more than activities of daily living, illnesses categories, and functional ability, but also focuses on a more complete social participation (Albrecht and Devlieger, 1999; Krahn et al., 2009). It implies that if a human has an experience barrier because of their poorer quality of living environment, it can reduce their quality of life and has a negative impact to the capability of participation in social interaction.

In conclusion, there are three variables of environmental quality that influence the quality of life, which are: reforestation, air quality, and clean water consumption. However, an interpretation of the objective indicators of environmental quality suggests that there is an expectation that environmental quality should be higher in order to influence the quality of human life. It does, indeed, appear to be regarded as being higher overall, but this expectation does not preclude an awareness of those aspects of environmental quality that are not as high as would be expected. Therefore, it is necessary to measure other dimensions that could likely be a determinant of quality of life. Further models explain the relationship between environmental quality and quality of life with an addition of control variables. Control variables derive from demographic dimensions, such as provincial area and density as well as social dimensions, such as education and accessibility to clean water.

4.6 MODEL 4 – Measuring Quality of Life with Control Variables

This model measures the relationship between environmental quality and quality of life with control variables. The main premise being that the control variables are not the primary interest in the main model but have the possibility to affect environmental quality and quality of life measurement, or the possibility to affect the quality of life directly.

It describes four models used to measure control variables in the environmental quality and quality of life measurement. The first model includes only one control variable in the measurement, the second to forth model adds another control variable in the measurement. Therefore, a Hausman test result indicates that this model uses random effects (prob>chi2 = 0.14) for regression.

When the model is using ‘area’ as a control variable (seen on Table 4.6), it implies overall land in a provincial area. Therefore, the premise is higher that the provincial area is likely to provide higher land for environmentally responsible behaviour activities, such as: rehabilitation, reforestation, and treated urban solid waste. The result indicates that higher provincial area is likely to increase the environmentally responsible behaviour activity. The area usually was used as a spatial factor to measure the wide-scale in order to determine reforestation and rehabilitation program. Higher rehabilitation and reforestation could be used as a buffer zone to protect environment and human itself from natural disaster.

Therefore, ‘density’ is used as control variables, with the premise that the higher density is likely to increase environmentally responsible behaviour activities, which has an impact on reducing the physical environmental quality. As a result, the density remains insignificant with the model. The result is not as expected because, the density should be one of important factor to measure the human’s contribution of air and water pollutions. In general, province which has a high density area having a poorer environmental quality and become potential as man-made disaster area.

The ‘accessibility to clean water’ is used as a control variable, with the premise that close access to clean water is expected to increase clean water consumption. As a result, access to clean water has an affect on the clean water consumption. It implies that people who live closely to clean water are likely to have a higher consumption of clean water, while people who tend to have limited access to clean water are expected to consume less clean water. The result indicates that accessibility can be likely to affect clean water consumption.

When ‘education’ is used as a control variable, the premise is that education is expected to affect environmentally responsible behaviour and consumption of environmental services. People who have a higher education level tend to have a higher awareness level of the environment. The result indicates that higher education is likely to increase the awareness to consume high quality of water. However, the education does not affect the environmentally responsible behaviour. This implies that having a higher or lower education level is unlikely to influence awareness of the environment.

Table 4. 6 Model 4 – Measurement Result 4

VARIABLES	(1) Model 5 Quality of Life	(2) Model 6 Quality of Life	(3) Model 7 Quality of Life	(4) Model 8 Quality of Life
Critical land rehabilitation	0.009	0.009	0.009	0.006
	(0.013)	(0.013)	(0.014)	(0.012)
Watershed area rehabilitation	0.014	0.014	0.013	0.007
	(0.017)	(0.017)	(0.018)	(0.016)
Reforestation	0.133**	0.132**	0.129**	0.092
	(0.060)	(0.061)	(0.062)	(0.060)
Planting one billion tress	0.004	0.003	0.003	0.001
	(0.003)	(0.003)	(0.002)	(0.003)
Treated urban solid waste	0.005	0.005	0.003	-0.002
	(0.013)	(0.013)	(0.014)	(0.012)
Air quality	0.042**	0.042***	0.040**	0.033**
	(0.016)	(0.016)	(0.016)	(0.014)
Water quality	0.008	0.009	0.007	0.006
	(0.007)	(0.007)	(0.008)	(0.007)
Average fish consumption	0.011	0.008	0.004	-0.017
	(0.029)	(0.031)	(0.032)	(0.036)
Clean water consumption	0.099***	0.102***	0.099***	0.070*
	(0.028)	(0.031)	(0.032)	(0.037)
Area	0.133***	0.134***	0.136***	0.114**
	(0.040)	(0.040)	(0.041)	(0.045)
Density		0.548	0.451	0.409
		(0.075)	(0.077)	(0.081)
Accessibility to clean water			0.010*	0.001
			(0.005)	(0.007)
Education				0.199***
				(0.075)
Observations	132	132	132	132
R-squared	0.52	0.42	0.43	0.53
Number of Province	33	33	33	33

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: Researcher Own Development, 2015

In conclusion, the model explains that area, accessibility to clean water, and education tend to affect the environmental quality and quality of life measurement. However, when the model includes control variables, the coefficient value of the main model tends to lower than the coefficient value in main model (seen on Table 4.5, model 4) and likely to be bias. For instance, when education is included as a control for environmentally responsible behaviour indicators, it indicates that environmentally responsible behaviour indicators remain insignificant and bias with the quality of life measurement.

4.7 INSTRUMENT VARIABLES

This research also measures the instrument variables in order to understand the possibility of variable that suspected to be endogen. In general, the problem of 'endogeneity' refers to anytime there is a violation of the third assumption. In other words, an empirical model for is tended to suffer with an endogeneity problem (Wooldridge, 2010). There are two variables that suspected to be endogen. Firstly, the clean water consumption is likely to be endogen. A table below describes the measurement result.

Table 4. 7 Model 5 – Instrument Variable

IV estimate result for Clean Water Consumption Variable		**IV estimates result for reforestation Variable**	
VARIABLES	(1) Model 9 Quality of Life	VARIABLES	(2) Model 10 Quality of Life
Clean water consumption	0.181* (0.093)	Reforestation	0.489 (3.988)
Critical land rehabilitation	0.019 (0.021)	Land Rehabilitation	-0.013 (0.207)
Watershed area rehabilitation	-0.005 (0.024)	Watershed area rehabilitation	0.032 (0.261)
Planting one billion trees	0.007* (0.004)	Planting one billion trees	0.001 (0.009)
Reforestation	0.136** (0.065)	Treated urban solid waste	-0.009 (0.079)
Treated urban solid waste	0.005 (0.010)	Air quality	0.043 (0.114)
Water quality	0.004** (0.002)	Water quality	0.011 (0.050)
Air quality	0.035** (0.017)	Average fish consumption	-0.024 (0.083)
Average fish consumption	-0.017 (0.025)	Clean water consumption	0.072 (0.045)
Area	0.186** (0.073)	Area	0.793 (0.036)
Density	0.943 (0.018)	Density	0.466 (0.055)
Accessibility to clean water	0.013 (0.010)	Accessibility to clean water	-0.299 (0.021)
Education	0.054* (0.196)	Education	0.182 (0.240)
Observations	132	Observations	132
R-squared	0.45	R-squared	0.38
Number of Province	33	Number of Province	33

Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Source: Researcher Own Development, 2015

The method of instrumental variables is applied in first case in order to override reverse causation. An instrumental variable (IV) requires the following properties: 1) it has to be uncorrelated with the error term and thus it has to be exogenous; 2) it has to be partially correlated with the endogenous variable. Therefore, the potential variable is correlated with clean water consumption variable but remain exogenous from model, such us: a quantity of water supply establishment costumer. The water supply establishment is a state-owned company that has responsibility to manage the clean water provision in Indonesia (Central Statistic Bureau, 2014b).

The result (seen on Table 4.7, column 1) of IV estimates the coefficient of clean water consumption is higher than the original model (seen on Table 4.6 – Model 8). This could be due to several reasons. Firstly, two-way causation is presented the relationship between quality of life and clean water consumption is not purely from the quality of life to the clean water consumption. It can be suspected that changes in the quality of life may cause changes in clean water consumption, so it is likely a causality relationship. Secondly, the coefficients in original model might be possible to be underestimate rather than the coefficient in IV model. Therefore, IV model is likely to perform a better measurement.

Secondly, the reforestation variable is also suspected to be endogen due to the possibility of variable bias. It can be indicated when overall control variables was included into measurement, the reforestation variable remained bias, whereas in prior model have shown to be quite stable (seen on Table 4.5, model 4 and Table 4.6, model 8). The potential candidate in second case is correlated with reforestation variable but remain exogenous from model, such us: a quantity of seed that distributed by national government. Since 2010, national government increased a quantity of seed in order to accelerate the reforestation and rehabilitation programs and also to reduce forest degradation level (Ministry of Forestry, 2013).

The result (seen on Table 4.7, column 2) of IV estimates the coefficient of reforestation is insignificant with the quality of life, and another variables also indicate to be bias. It implies that IV instrument is likely to be weak and could not perform a better measurement rather than the original model. Therefore, it needs a further research to determine a suitable IV measurement for reforestation or another environmental responsible behavior variables.

In conclusion, the IV measurement indicates two different results. The clean water consumption that suspected as endogen has a likely perform better IV estimator result rather than OLS estimators with a quantity of water supply establishment costumer as an instrument. However, the reforestation variable tend to have a week instrument that could not perform better IV estimator result with a quantity of seed that distributed by national government as an instrument.

Chapter 5: Conclusions and recommendations

5.1 PURPOSE

This chapter explains the major conclusions of environmental quality and quality of life measurement. The conclusions are also conducted with several theories, prior worldwide research, and in cooperation with Indonesia. This chapter also develops the recommendations and also discussions in order to have an insight for future research development.

5.2 RESEACRH CONCLUSIONS

Main Conclusion

The major finding from this research indicates that to some extent the environmental quality dimensions affect the quality of human life in Indonesia from 2010 to 2013. The result indicated that there are three dimensions of environmental quality that are used to measure the quality of life: environmentally responsible behaviour, physical environmental quality, and consumption of environmental service. These three dimensions could affect the quality of life. Firstly, environmentally responsible behaviour, indicated by reforestation activity, has remained positively significant to the quality of life. It implies that higher awareness to the living environment can increase the responsible activities to the environment, thus having an impact on the quality of human life.

Secondly, physical environmental quality was indicated by air quality, which remains significant to the quality of life. It implies that higher air quality can reduce the water pollutants in the river, thus increasing the water quality that contributes to the improvement of the quality of life. Thirdly, consumption of environmental services was indicated by clean water consumption, which also remains significant to the quality of life. It implies that a higher consumption of clean water can contribute to the improvement of the quality of life.

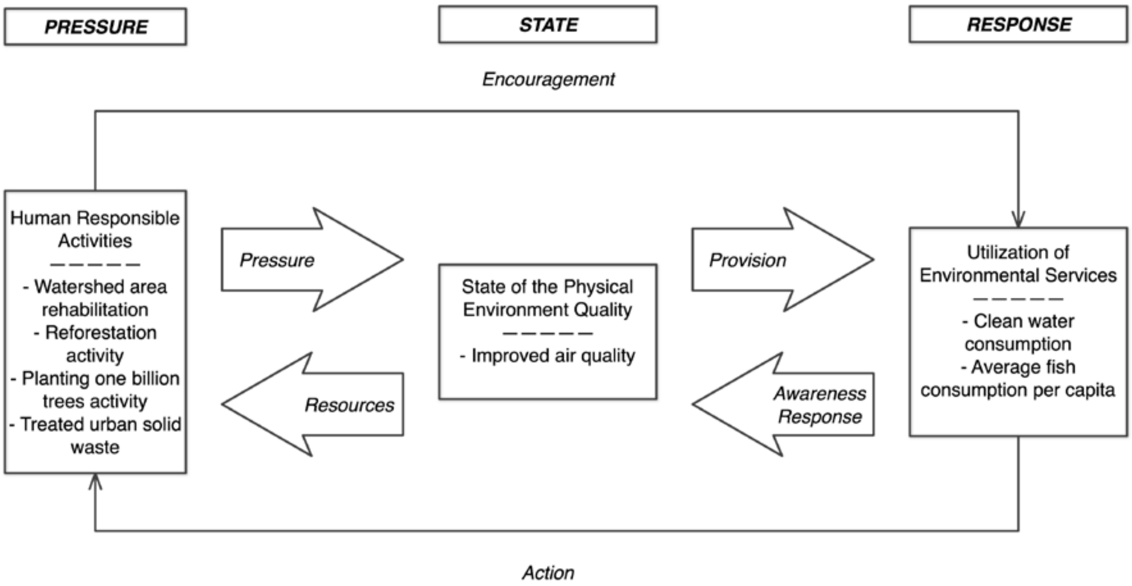
Several variables from these three dimensions have been shown to have a positive significant relationship with the quality of life. The result is still in accordance with the null hypothesis (h0) that 'interrelationship variables of environmental quality, which are environmentally responsible behaviour, physical environmental quality, and consumptions of environmental services can improve quality of life'. It can be explained through the result that reforestation activity can increase the air quality, which has a positive impact on the improvement of clean water consumption, and a higher consumption of clean water has a positive impact on increasing the quality of human life.

According to the notion that the quality of life means a good life, a good life is the same as living a life with a high quality (Ventegodt et al., 2003). The notion of a good life in this research is related to the objective dimension of quality of life that implies to the external factor of life, which is environmental quality. It can be explained that if people live in a high quality environment, it means that they live a good life. Therefore, Vlek (2005) and Moser (2009) argued that people's relationship to their environment is a crucial issue for understanding their personal quality of life. This is also an important issue for sustainable development. There is evidence to demonstrate that the lack of environmental quality is perceived as an important threat to quality of life. Environmental pollution and insufficient neighborhood environmental services are repeatedly mentioned by dwellers as threatening the quality of life (Marans, 2003).

This research also measured the interrelationship between environmental quality dimensions. To some extent, these groups of variables are tightly related as environmentally responsible behavior has a positive impact on environmental quality, and improved environmental quality provides for a higher consumption of services provided by the environment. It can be explained thusly: watershed area rehabilitation, reforestation, planting one billion trees, and treating urban solid waste has a positive impact on higher air quality, higher air quality can contribute to increasing the quality of environmental services, and higher quality of services has an impact on higher consumption of clean water.

The interrelationship between environmental quality dimensions that are indicated as significant in the model can be explained through the insight of the PSR (Pressure, State, Response) framework from OECD (1993). Pressure describes environmentally responsible behavior that puts pressure on natural environments, which has an impact on the increase of environmental quality. State was the influence of the environmental condition, which contributes to the increase of environmental services. Response is an effort to utilize the services that are provided from the environment.

Figure 5. 1 Interrelationship Between Environmental Quality Dimensions



Source: Researcher Own Development, 2015

According to the pressure – state – response (PSR) framework above, the responsible activities can influence the improvement of air quality. The improved air quality provides better resources such as: prolific land and healthy air ambient for planting trees. Hence, the improvement of air quality can result in better provisions for environmental services, for instance, higher air quality which reduces the toxic concentration in the rivers and preserves the quality of the water. Consequently, a higher water quality can increase the clean water consumption. Meanwhile, if people have better services from the environment, it could increase their awareness to maintain their environment.

Relationship with Control Variable

Furthermore, this research also measured the relationship between environmental quality and quality of life with control variables. There are two main dimensions of control variables, such as: demography dimension (area and density), and social dimension (accessibility to clean water and education). Area is an important part of the living environment, as it reflects the space where humans and their living environment interact (Pacione, 2003). A higher area contributes to an effort to preserve the environment, otherwise, it can be become a major problem of environmental degradation. In this research, area tended to be described as an available space where people can perform their awareness to the environment. The result indicated that the availability of an area is likely to affect the environmentally responsible behaviour, mainly the reforestation activity. It implies that a larger area, particularly in critical and vacant lands, can expose the opportunity to implement the reforestation activity. Higher reforestation activity in critical and vacant lands can increase the air and also water quality, which has an impact to the higher quality of life.

Therefore, accessibility to clean water is an important part in obtaining clean water consumption. The result indicated that accessibility to clean water is likely to affect the clean water consumption. It can occurr because there are increasing demands on the water supply. Population growth and water-intensive agriculture are using water faster than it can be replenished. In addition, clean water resources are in jeopardy due to increasing pollution (Gleick and Ajami, 2014) Drinking unclean water causes millions of deaths each year from diseases such as diarrhea, hepatitis, cholera and typhoid. According to this research, accessibility to clean water is an intermediate aspect to improving the health and quality of human life.

Density is also referred to as the availability of human's space. If people stay in lower density areas, that could cause an increase of the quality of life. Lower density could open the opportunity to increase the environmentally responsible activity, such as: planting trees in the middle of housing areas in order to create green space. However, in this research, density tends to be insignificant with the environmentally responsible behavior and also quality of life.

The accessibility to clean water can be also obtained by the clean water provision. In Indonesia, water supply establishments supplied the clean water to household levels, people who have access to water provision implies that they consume the clean water. From 2010 to 2013, it is indicated that there is an increasing quantity of clean water provision provided by state-owned companies from 9,565,778 households to 10,633,265 households. However, the accessibility of clean water is a crucial issue that raises concerns about inequitable service provisions. In several developing countries, water accessibility systems are plagued by leakages, illegal connections and vandalism, while precious water resources are squandered through greed and mismanagement (UNEP, 2008).

Education plays an important part in the quality of life measurement. In this research, education was used as a control for environmentally responsible behavior, with the higher education tending to affect the awareness to the environment. The result indicated that a high and low education level was not likely to affect the people's awareness to their environment. However, education is indicated to affect the quality of life directly. It can be explained that education, in general, is an important determinant of quality of life (Basiago, 1998). So, it has remained positively significant to quality of life.

Since 2006, Indonesia has been developing environmental education for formal schools. The main purpose was to increase the environmental knowledge and awareness within students, teachers, and also neighborhood (Ministry of Environment, 2012). However, according to the result, this program has not been able to increase the awareness of the people yet. It might be because of the limited scope of this program, which is only for formal school. Therefore, environmental education should be studied in daily life and embedded within the daily human's behavior.

The control variables, which are area, accessibility to clean water, and education tend to affect the environmental quality and quality of life measurement. It implies that the exogenous variable should be considered as a control in the model because they are likely to change the dynamic of the model.

Endogeneity

Furthermore, this research indicated that there are two variables likely to be endogen, and are supposed to measure the instrument variable (IV) in order to discover the endogeneity. The first variable is clean water consumption, used to measure the possibility of endogeneity, using a quantity of water supply establishment costumers as instrument variable. The result indicated that this variable was suspected as endogen because the two-way causation is presented in the relationship between clean water consumption and quality of life is could be suspected as the changes in the quality of life may cause changes in clean water consumption.

The reason implies that the important function of clean water consumption is a willingness to pay for the water provision (Carson and Mitchell, 1993). If people have a high quality of life, it indicates that they are able to pay for the clean water provision in order to maintain their health conditions. However, people who have a low quality of life tend to use a low quality drinking water because they are not able to pay for the provision. This premise implies that to some extent, quality of life possibly affects clean water consumption. Meanwhile, the coefficients in the original model might possibly be underestimated, unlike the coefficient in the IV model. Therefore, the IV model is likely to show a better measurement.

The second variable is reforestation. In order to measure the possibility of endogeneity, it used a quantity of seed that was distributed by the national government. However, the result indicated that the IV estimates that the coefficient of reforestation is insignificant with the quality of life, and other variables are also indicated to be bias. It implies that the IV instrument is likely to be weak and could not perform a better measurement.

Limitation

In this research, there were several limitations, such as: 1) the quality of life dimensions was developed based on the objective aspect, which are good health conditions and life expectancy at birth. To some extent, this variable could have a direct and significant relationship with environmental quality. However, it also increases the possibility of endogeneity. For instance, a possibility of causality relationship between quality of life and clean water consumption, 2) this research did not consider the social environment and economic aspect as part of the main model, and including those aspects as control variables did not produce a better measurement.

Environment Dimensions of Quality of Life

This research is in accordance with the Russian Doll theory that was developed by Levett (1998) which states that environment sustainability was the most important aspect among other pillars of sustainable development. If the environmental component becomes more depleted, it can reduce the quality of human life, thus, sustainable development could not be achieved because the ecosystem is endangered.

In the perspective of sustainable development, development is sustainable if it provides a good quality of life and stays within environmental limits. It implies that humankind should be balanced in order to satisfy their needs and the capability of environment. Therefore, the purpose of sustainable development should lead to ensuring environmental sustainability, which could be parallel to improving quality of life. The overall policy goal certainly must be to reverse the trend of gradual environmental degradation, locally as well as globally. Some key aspirations are: 1) preserving the availability of basic resources, 2) protecting human health from environmentally risky conditions, 3) ensuring sufficient quality of human living environments, and 4) promoting greater harmony between quality of life and the environment.

5.3 RECOMMENDATION

A General Recommendation

The concept of sustainable development has evolved into definitions of the environmental sustainability is defined by focusing on its biophysical aspects. This means maintaining or improving the integrity of the Earth's life supporting systems. The concept of sustainable development and environmental quality has evolved from a rather vague and mostly quantitative notion to more precise specifications defined many times. Hence the need for a wide array of indicators is very clear.

This research analyses the different approaches and types of indicators developed which are used for the assessment of environmental quality dimensions of quality of life. One important aspect here is setting targets and then "measuring" the distance to a target to get the appropriate information on the current state or trend. Environmental quality is a concept based on a notion of ecosystem services, environmental responsible behavior, and physical environmental quality that provide benefits to humans and thus improve their quality of life. In order to enjoy and use the services throughout the ages, humanity must learn to live within the limitations of the biophysical environment. The discussion of environmental limits leads us to the edge of what traditional science may provide.

The study highlighted several issues that have implications for environmental and quality of life dimensions in Indonesia. The major highlight is associated with the awareness and services of ecosystem are already causing significant improvement as well as harmful to some people, particularly the poor, and unless addressed will substantially diminish the long-term benefits we obtain from ecosystems. The environmental condition in Indonesia during 2010 to 2013 indicated that:

1. The environmental responsible behaviors that are reflected by rehabilitation, reforestation, and treated urban solid waste have been shown the dynamic conditions but tend to be increase. For instance, planting one billion trees activities tented to increase during 2010 to 2013;
2. The consumption of environmental services examined is being improved, including clean water and fish consumption. However, the air and water quality indicated are being degraded or used unsustainably. If this condition is allowed, it can cause that many environmental services would be degraded as a consequence of actions taken to increase the supply of other services. These trade-offs often shift the costs of degradation from one group of people to another or defer costs to future generations;
3. The harmful effects of the degradation of environmental services are being borne disproportionately by the poor, are contributing to growing inequities and disparities

across groups of people, and are sometimes the principal factor causing an decrease of quality of human's life.

According to the findings environmental quality dimension seems to be open for developing and using targets that are firmly rooted in the biophysical properties of the environmental system. At the national level, Indonesia is facing the challenge to maintain the necessary quantity and quality of environmental resources that the community depends on. At the regional level, the variety and diversity of local situations means that some additional factors relevant to sustainability must be considered. It is usually at the national level that some solidarity is expressed between areas well endowed with resources and those that have more limited resources, face difficult conditions, or suffer calamities or disasters.

Therefore, in order to achieve a greater improvement of quality of life, this research suggested a subset notion of integrated environmental quality dimensions. It implies that environmental responsible behavior, physical environmental quality, and consumption of environmental services should be seen as one of unity. Several findings for this research can be addresses as supporting information for environmental policy development, such as:

1. To reduce the adverse impacts of water and air pollution on quality of human life, environmental planning should take into account the benefits of environmental responsible activities, such as: rehabilitation, reforestation, and treating an urban solid waste. National and regional government require collaboration in order to improve the environmental awareness. Higher environmental awareness can diminish the possibility of environmental pollution and in addition to receives the direct benefits for human health;
2. The regional government is essential in order to manage the environmental awareness, such as: an improvement of urban forest can diminish the air and water pollutions, that has an impact to provide a better quality of clean water production. On the other hand, regional government should take into account to preserve the quality of river, because the river is essential to provide water for people. Higher water quality can increase the provision of clean water;
3. The improvement of environmental education system through the lesson learned from the environment condition in Indonesia, such as: rainwater harvesting that means catching and using rainwater where it falls. A Indonesia has a high potential of rainfalls, it can be possible to educate people to build cisterns or wells in order to help capture the rainwater.
4. Enhance the PPP (Private Public Partnership) program in order to increase the quantity of seed that distributed to implement the rehabilitation and reforestation activity. And also, PPP program in clean water provision. Government should be able to update water systems, making the water supply establishment company more efficient and more accountable to consumers. In addition, many people believe that water is a public resource, and should not be owned by individuals or corporations.

In conclusions, human's relationship to their own living environment is a crucial issue for understanding their quality of life. This is also an important issue for sustainable development in Indonesia. An effective policy should deal with the multidimensional quality of living environments. There is much evidence to demonstrate that lack of environmental quality is perceived as an important threat to quality of human life. Environmental pollution, accessibility problems of environmental services, lack of environmental responsible activities are repeatedly mentioned by city dwellers as threatening their quality of life.

Future Research Discussion

In order to enhance the impact of environmental quality dimensions towards quality of life of a national level may be assessed by looking into the relation between the objective facilities and services, on the other, as these two factors may substantially differ according to personal factors like age, gender and cultural background. Identifying the environmental conditions of human wellbeing requires inventories of the specific physical and social conditions that may be threatening individuals' quality of life.

For the future research, it is suggested establish the environmental dimensions from three major groups, such as: natural environment, man-made environment, and social environment. The social environment dimensions can be extended the knowledge regarding the social aspect of quality of human life. It is important to emphasize that any attempt proposing a set of objectives and strategies to be applied indistinctly in all communities can be arguable. On the other hand, sharing experiences generated from different practices can eliminate the barriers that lead to the maturity of environment dimensions and quality of life as a common practice.

Environment dimensions are usually linked to such strategies and, accordingly, are also most frequently observed at local and national scales (and less at regional scale). The dimensions of scale play a significant role in the move towards to quality of life and sustainable development measurement. The regional scale is also a highly relevant level of governance for planning, coordinating and assessing action for sustainable development, which, in fact, are mainly taken at local level.

Therefore, it is also suggested to appreciated that the use of indicators for assessing urban environment quality of quality of life performance as an important tool and has been widely adopted. A short list of indicators at the beginning of application is recommended, and during later revisions more indicators can be added or eliminated according to the emerging needs. As mentioned before, this research tended to have an endogeneity, in order to have a better model, it may be useful to search another instrument variable that has relationship with the environmental responsible behavior variable.

In conclusion, indicators can be used to alert policy-makers to problem areas. They are also management tools, and can be used to measure progress.

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Annex 1

Do File:

VIF test

reg Quality_of_Life Area Density Accessibility_clean_water Education Forest_land_rehabilitation Degraded_lands_priority_watershe Reforestation Planting_1000000_trees Treated_urban_solid_waste new_waterquality new_airquality Average_fish_Consumption Household_use_clean_water

Hausman test

- xtreg Quality_of_Life newrehab newwatershed newreforest newplanting new_airquality new_waterquality Average_fish_Consumption Household_use_clean_water Area Density Accessibility_clean_water Education, fe
- estimates store fixed
- xtreg Quality_of_Life newrehab newwatershed newreforest newplanting new_airquality new_waterquality Average_fish_Consumption Household_use_clean_water Area Density Accessibility_clean_water Education, re
- estimates store random
- hausman fixed random, sigmamore
- Prob>chi2 = 0.0846

Model 1 - Environmentally responsible behaviour (ERB) and Physical Environmental Quality

- ERB and Air Quality
  xtreg new_airquality newrehab newwatershed newreforest newplanting Treated_urban_solid_waste, re robust level(90)
- ERB and Water Quality
  xtreg new_waterquality newrehab newwatershed newreforest newplanting Treated_urban_solid_waste , re robust level(90)

Model 2 - Consumption of Environmental Services (CES) and Physical Environmental Quality (PEQ)

- Average fish consumption per capita and PEQ
  xtreg Average_fish_Consumption newwater new_airquality, re robust level(90)
- Clean water consumption and PEQ
  xtreg Household_use_clean_water newwater new_airquality, re robust level(90)

Model 3 - Quality of life and environmental quality dimensions (partially)

- QoL and ERB
  xtreg Quality_of_Life newrehab newwatershed newreforest newplanting Treated_urban_solid_waste , re robust level(90)
- QoL and PEQ
  xtreg Quality_of_Life new_airquality newwater , re robust level(90)
- QOL and CES
  xtreg Quality_of_Life Average_fish_Consumption Household_use_clean_water , re robust level(90)

Model 4 - with control variables

- xtreg Quality_of_Life newrehab newwatershed newreforest newplanting Treated_urban_solid_waste new_airquality newwater Average_fish_Consumption Household_use_clean_water Area, re robust level(90)
- xtreg Quality_of_Life newrehab newwatershed newreforest newplanting Treated_urban_solid_waste new_airquality newwater Average_fish_Consumption Household_use_clean_water Area Density , re robust level(90)
- xtreg Quality_of_Life newrehab newwatershed newreforest newplanting Treated_urban_solid_waste new_airquality newwater Average_fish_Consumption Household_use_clean_water Area Density Accessibility_clean_water , re robust level(90)
- xtreg Quality_of_Life newrehab newwatershed newreforest newplanting Treated_urban_solid_waste new_airquality newwater Average_fish_Consumption Household_use_clean_water Area Density Accessibility_clean_water Education , re robust level(90)

Model 5 - IV clean water consumption

xtivreg Quality_of_Life newrehab newwatershed newplanting newreforest Treated_urban_solid_waste new_waterquality new_airquality Average_fish_Consumption Area Density Accessibility_clean_water neweducation (Household_use_clean_water = Volume_Clean_Water_Distributed_W Number_Water_Supply_Establishmen) , re first level(90)

Model 5 - IV reforestation

xtivreg Quality_of_Life newrehab newwatershed newplanting Treated_urban_solid_waste new_airquality newwater Average_fish_Consumption Household_use_clean_water Area Density Accessibility_clean_water Education (newreforest = Total_Seed_Distributed_Governmen) , re first level(90)

Annex 2

Multicollinearity test

Indicators	VIF test Result	1/VIF
Critical land rehabilitation	8.06	0.124116
Degraded watershed area rehabilitation	7.88	0.126879
Clean water consumption	2.01	0.496463
Density	1.82	0548676
Air quality	1.71	0.583332
Reforestation	1.60	0.632084
Planting one billion trees	1.58	0.634913
Area	1.58	0.634913
Education	1.40	0.716671
Average fish consumption per capita	1.33	0.753225
Water quality	1.31	0.762702
Treated urban solid waste	1.28	0.780269
Accesibility to clean water	1.22	0.819650
Mean VIF	**2.52**	