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Title: Environmental assessment of Human Well-being in South Asian and Southeast Asian Countries

Name: Ayesha Noor

Supervisor: Spiros Stavropoulos

Specialization: Urban Environment Sustainability and Climate Change

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Name: Ayesha Noor

Bangladesh

Supervisor: Spiros Stavropoulos

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Summary

Human relationship with their living environment has been major focus of several researchers, government institutions, and individuals. Different disciplines have expressed their solidarity in assessing this relationship through the notion of human well-being. An understanding of well-being of human life has numerous benefits and it is important for developing sustainable environmental policy as ''ensuring well-being at all ages'' is the third goal of sustainable development. Many global institutions developed standard measurement approach to comprehend the well-being-environment relation in context of sustainable development.

The main objective of well-being measurement is to provide objective information about requirements of having satisfied life and how it is affected by availability of financial resources, human-environment congruence, and evaluation of humankind. Therefore, this study measures the relationship among environmental quality indicators, and well-being in SA and SEA for 10 years, from 2006 to 2016. Four major dimensions of environmental quality have been used for this study, which are: environmentally responsible behaviour, rebuilt natural capital, quality of physical environment, and environmental services consumption. The subjective perception of human well-being is developed from satisfaction to life surveyed by GALLUP. Moreover, this research also includes some control variable derived from demographic, economic and social dimensions.

The results showed that dimensions of environmental quality affect well-being only to some extent; being the major outcomes concerning its association are fish consumption and well-being depending on rebuilt natural capital, environmentally responsible human behaviour, and air quality. In particular, the indicator "rebuilt natural capital" (described by the reforested amount of lands), has remained positively significant to the well-being. It infers that if people are aware of their living environment, the responsible human actions towards environment will increase. Also, environmentally responsible human behaviour (described by the use of clean cooking fuel) remained significant with well-being since it contributes to good quality of air. The quality of physical environment was also indicated by air quality, which remains significant to well-being because of the potential reduction of pollutant intake to river water, consequently improving quality of water that contributes to well-being. This air-water quality nexus is explained by acid rain which causes absorption of toxic air pollutant into the soil which then finally drain into the water bodies.

Finally, environmental services consumption was indicated by consumption of fresh fish, was significant as higher consumption of fresh fish can increase human well-being, although it can contribute to ecosystems degradation. However, some adaptive measures and policies taken to protect fish species in several countries of SA and SEA are found to be effective towards minimizing the adverse effect on ecosystem. These adaptation actions including increase in terrestrial protected area, mangrove reforestation, aquaculture are protecting fish species and ensure sustainable consumption of fish and thereby contribute to human well-being.

In summary, the overall findings indicate that interrelationship among environmental quality indicators can improve well-being of human life. In terms of significance, the relationship is well expressed within the nexus linking reforested area, improving quality of air, which significantly impact the accessibility of clean water eventually contributing to human well-being.

The research proposed collaboration among governments of the respective countries of the study area to increase reforested area as well as to encourage use of clean cooking fuel, municipal waste recycling activities, and rooftop rain water harvesting. Furthermore, the study also recommended to mainstreaming the concept of well-being into the national development strategy for achieving ecologically sustainable development since it proved to have impact on countries well-being.

Keywords

Environmentally responsible human behaviour, Environmental Quality, Environmental Services Consumption, Human Well-being, atmospheric teleconnection;

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Foreword

Environmental Assessment of Human Well-being in SA and SEA is a master thesis that discoursed about quality of physical environment and well-being measurement. This thesis uses the data related to indicators of environmental quality, and environmental services from different ministries and government institutions. Additionally, it also utilizes information collected from relevant international organization. The findings of research analysis present the relationship among dimensions of environment, which are: Environmentally Responsible Human Behaviour, quality of environment, and environmental services consumption and how it impacts human well-being.

This thesis is likely to be a source of advocacy information towards evaluation of environmental policy and programs focusing on relationship between environmental quality and well-being.

Finally, constructive criticism would be highly appreciated.

Rotterdam, September 7th, 2017

Ayesha Noor

Abbreviations

IHS	Institute for Housing and Urban Development
WHO	World Health Organization
PM2.5	Particulate matter
PM10	Particulate matter
CO2	Carbon dioxide
PSR	Pressure State Response
DPSIR	Driver pressure state impact response
IPCC	Inter-governmental panel on climate change
WB	World Bank
FAO	Food and Agricultural organization of the United States
BOD	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
DO	Dissolved Oxygen
CO	Carbon Monoxide
GDP	GDP
WB	Well-being
GEMStat	Global Environmental Monitoring of fresh water
SA	South Asia
SEA	Southeast Asia
ULT	Urban land teleconnection
AT	Atmospheric teleconnection

Table of Contents

List of Figures

List of Tables

Chapter 1: Introduction

1.1 Background

Urbanization is a fundamental outcome of economic growth which is also responsible for increased energy demand (Annez and Buckley, 2009, McGranahan and Satterthwaite, 2014). Achieving higher economic growth requires more exploitation of both natural and physical capital (Sinha Babu and Datta, 2013) and thereby contributes to environmental degradation (McGranahan and Satterthwaite, 2014). The complex process of urbanization leads to increased energy demand which then causes environmental degradation(Wang, Zhang, et al., 2015) through pollution of air, soil, and water, mixed land use, changes in terrestrial protected areas, and depletion of natural resources (Grafton and Knowles, 2004).

Due to consequences of rapid economic growth and associated urbanization, countries especially developing ones are following the path of extreme risk of climate change in terms of health problems although these countries are contributing the least to global risk of greenhouse gas emission (Kjellstrom, Friel, et al., 2007). This is because major portion of developing world experienced shift from agriculture focused economy to industry focused and consequently to service focused economy. This resource reorganization brings in unprecedented growth(Sinha Babu and Datta, 2013) and associated urbanization (Annez and Buckley, 2009, McGranahan and Satterthwaite, 2014) in economy, causing environment concerns and associated health hazards (Kjellstrom, Friel, et al., 2007, Sinha Babu and Datta, 2013).

History of pre-industrial economies revealed the fact that urbanization accompanied by economic growth resulted in amplified concentration of Nitrous oxide(N2O), Methane(CH4), and Carbon dioxide (CO2)(Fifth Assessment Report, 2014). These further worsen the global warming thereby causing severe impact of climate change which is expected to be observed at serious scale in coastal area, where approximately 13 percent of total urban population lives(UN Habitat, 2011). Moreover, change in climate is likely to intensify risk in urban centres of developing nations; in the form of sea level rise, storm surges, air pollution, drought, water scarcity, landslides, extreme precipitation, urban flooding, and heat stress(Fifth Assessment Report, 2014). This is because these countries are diffident to invest in improving environmental quality and often put more emphasize on boosting economic growth as it is a key which can bring these countries out of poverty(Annez and Buckley, 2009, Habitat, 2016).

Population being added to urban from rural could imply denser urban pattern of living while transfer from rural to urban land use could result in less densified urban living pattern(McGranahan and Satterthwaite, 2014). Level of densification of settlements govern the amount of energy to be consumed, which put pressure on global environment(McGranahan and Satterthwaite, 2014). According to Kleiber law, energy consumption rate of a larger creature is less compared to smaller ones(Fragkias, 2013). So, lower density urban settlement could consume more energy(Azam and Khan, 2015, Habitat, 2016) and thereby more emission but, higher density urban settlement posits less energy consumption per person thereby less emission (Azam and Khan, 2015). Higher density urban settlement with less energy consumption and less pollution can provide decent quality of life (Habitat, 2016). However, demand for better life, drive people to demand more energy, which

cause rapid urbanization(Liddle, 2014, Liddle and Lung, 2014). So, there is a possibility of causal relation between human well-being, and urbanization.

Urbanization, economic growth, environment, and well-being has an intricate relationship and well-being is often synonymously used with economic growth i.e. Gross Domestic Product (Costanza, Hart, et al., 2009, Lawrence, 2011). However, economic growth indicator does not consider environmental dimension of well-being(Costanza, Hart, et al., 2009). Considering this fact (OECD, 2015) has formulated new index for determining well-being.

Human welfare or Quality of life comprises three aspects; social, environment, and economic (Shafer, Lee, et al., 2000) and growing urban population put further pressure on these three systems(Beck and Stave, 2011). If the danger associated with this pressure is not appropriately managed the long-lasting sustainability of urban areas is likely to be impossible (McGranahan and Satterthwaite, 2014). Urban sustainability depends on the relationship between environment and urban areas by linking domains of economic, social and environmental development(Vemuri and Costanza, 2006, Beck and Stave, 2011, Khansari, Mostashari, et al., 2014, Habitat, 2016). This linkage can potentially lead to decrease the pressures on ecosystem stemming from fast urbanization(Basiago, 1998, Beck and Stave, 2011, Khansari, Mostashari, et al., 2014). Furthermore, identification of driving forces, its burdens on the environment should be examined and the resulting impacts should be recognized with possible responses(Collados and Duane, 1999, Marans, 2003, Niemeijer and de Groot, 2008, Jago-on, Kaneko, et al., 2009, Moldan, Janoušková, et al., 2012, Sekovski, Newton, et al., 2012).

It is important to comprehend the proper association among urbanization, economic growth, city planning, natural resource, technology, and human well-being. Balance between urbanization and environmental concerns can harness the positivity of urbanization without compromising well-being of people (Basiago, 1998, Beck and Stave, 2011, Annez and Buckley, 2009, McGranahan and Satterthwaite, 2014, Khansari, Mostashari, et al., 2014).

1.2 Problem statement

Urbanization lead to environmental hazards in ancient cities having limited local resource(McGranahan and Satterthwaite, 2014). In 19^{th} century, most economically successful cities of Europe and North America face the curse of poor environmental quality in terms of polluted air and lack of proper sanitation(McGranahan and Satterthwaite, 2014). Overtime, this environmental burden has been shifted to other locations i.e. developing countries, where livelihood of the people is more dependent on local resources and environmental issues are more prominent(McGranahan and Satterthwaite, 2014).

For the very first time in human history more than 50 percent of people is residing in urban areas(UN-Habitat, 2011, UN-Habitat, 2016). So, urban areas will face risk of environmental degradation, scarcity of basic services provision, and social conflict(Basiago, 1998). As a solution to these problems several countries such as India, Mexico, Brazil have embedded concept of urban sustainability in their economic, environmental, and social development practices (Basiago, 1998).

The field of economics has already acknowledged the uncertainty of limited environmental resources to offer basic provisioning services for increasing population(Basiago, 1998). Well-

being of human kind depend on whether they are endowed with a bundle of services which will meet their preferences or not(Beck and Stave, 2011).

Hence, to ensure well-being of humankind, urban areas should be sustainable and natural resources should be consumed within its carrying capacity so that it is not exhausted faster than its replenishment(Beck and Stave, 2011).

It is evident from several studies (Basiago, 1998, Osbaldiston and Sheldon, 2003, Walter, 2005, Uzzell and Moser, 2006, Moser, 2009, Beck and Stave, 2011, Felix and Garcia-Vega, 2012, Streimikiene, 2015) that different types of capital have linkage with both sustainability and well-being (Beck and Stave, 2011) i.e. natural, human, economic, and social. So, quality of both human beings and urban areas will depend on how people use different forms of capital, lessen it, replace it, and recycle it(Beck and Stave, 2011).

As cited by (Pacione, 2003, van Kamp, Leidelmeijer, et al., 2003, Lawrence, 2003, Olewiler, 2006) quality of environment has significant contribution to explain human well-being. Moreover, both terms are pre-requisite for sustainable urban development and policy making(Basiago, 1998, van Kamp, Leidelmeijer, et al., 2003, Beck and Stave, 2011), so it is important to embody concept of urban sustainability in the strategy domains of social, environmental, and economic development to improve well-being.

Urbanization is on rise in world scale, but predominantly in developing countries, having 3.6% urban growth rate on yearly basis between period of 1950 and 2005 while developed countries had 1.4% only (Aubry, Ramamonjisoa, et al., 2012, p.1). Asia is the fastest urbanizing region, however decline in urbanization rate is faster in Asia compared to Africa (McGranahan and Satterthwaite, 2014). Yet, the number of settlers being added to urban population is higher in Asia(McGranahan and Satterthwaite, 2014).

It is expected that by 2050, urban areas will have to accommodate almost 70 percent of the total global population (Shen, Ochoa, et al., 2011a). Reason behind this increase could be, urban areas have more services and employment, better education facilities, hospitals and amusement facilities although, urban environment has less nature than rural environment (Pretty, Peacock, et al., 2005). Increased population put pressure on natural green environments and consequently could affect human well-being and life quality as-a-whole (Pretty, Peacock, et al., 2005).

Population density has influence on different facets of sustainability such as urbanization, social, environment, and human well-being (Pretty, Peacock, et al., 2005, Prado-Lorenzo, García-Sánchez, et al., 2012) as majority of people concentrating in a small area carry threat to social, economic and environmental well-being(Beck and Stave, 2011, p.2). If this risk is not addressed properly environmental quality could degrade continuously. The risk is becoming intense due to global warming, disposal of industry waste to rivers, less available land to biodiversity, and ozone layer depletion (Sinha Babu and Datta, 2013). These are eventually altering the state of ecosystem, limiting urban sustainability (Beck and Stave, 2011, Shen, Ochoa, et al., 2011) and affecting quality of human life (Beck and Stave, 2011).

The Rio Declaration acknowledged people should be provided with healthy and prolific life in accord with environmental resources (Beck and Stave, 2011). Therefore, it is important to comprehend the patterns of societal influence on environment and people' association with environmental resources, economic growth, and each other (Beck and Stave, 2011).

Urbanization and facets of environmental degradation are triggering health problems globally (Pimentel, Cooperstein, et al., 2007, McGranahan and Satterthwaite, 2014). Prime reason behind health problems is worst urban air quality. Almost fifty percent of respiratory illness in world is due to air pollution(Pimentel, Cooperstein, et al., 2007). Conditions are more intense in coastal megacities of developing countries(Sekovski, Newton, et al., 2012).

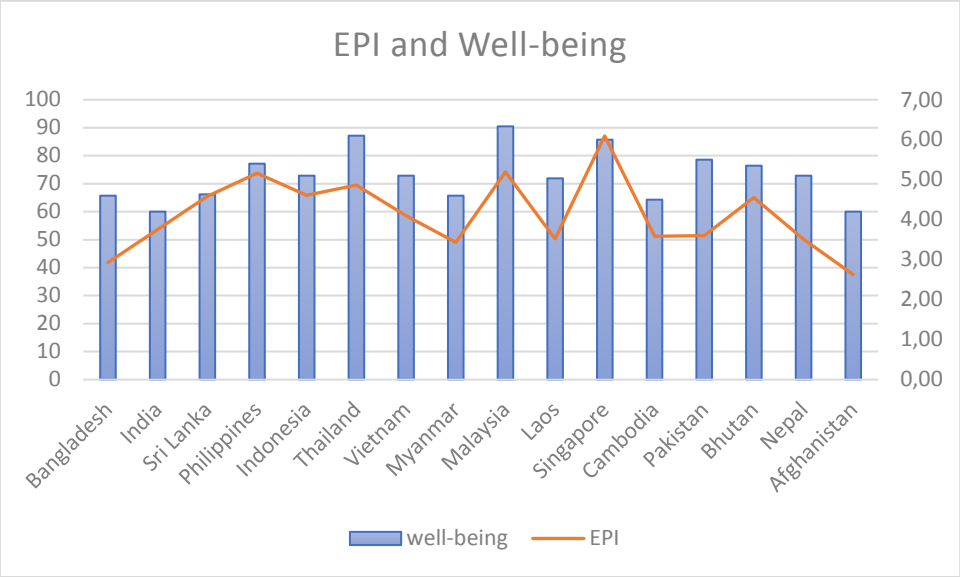
For the last few decades, developing countries especially South Asian and Southeast Asian countries are experiencing air pollution because of rapid urbanization, and industrial development (Khwaja, Umer, et al., 2012). In South Asia and Southeast Asia, GHG gas emissions i.e. nitrogen oxides, carbon dioxide, Sulphur dioxides, and particulate matter (PM) is on rise due to economic growth and growing demand for energy (Khwaja, Umer, et al., 2012). Cities in Bangladesh, India, and Pakistan are ahead in the list of worst urban air quality (World Health Organization, 2015). Absence of proper air quality management is worsening the air quality more in Pakistan (Colbeck, 2009). Air pollution is being identified as severe problem of several cities of India stemming from urbanization, and industrialization (Chauhan, 2010).

Air quality in urban areas is getting worse due to indoor cooking fuel use as well as energy use in vehicle (Pimentel, Cooperstein, et al., 2007). The primary source of outdoor pollution in both developed and developing economies is vehicle and power plant whereas in developing economies the reason behind indoor pollution is mostly due to use of cooking fuel(Pimentel, Cooperstein, et al., 2007). Worse quality air increase death due to respiratory and heart diseases (World Health Organization, 2006).Highest level of air pollution is observed in developing economies(Pimentel, Cooperstein, et al., 2007).

Another environmental problem is clean water accessibility, and safe sanitation. Urban dwellers in developing nations especially countries of South and Southeast Asia, are suffering from serious environmental health challenges due to absence of access to safe drinking water to all, ill management of solid waste disposal, and sanitation. Water and sanitation report of United Nations mentioned that distribution system of water in developing countries especially South Asia is not serving whole urban periphery(Cohen, 2006).

To measure the association between well-being of human life and environmental quality(Paul, Sandrine, et al., 2003, Dolan and White, 2007); University of Yale, and University of Columbia formed Environmental Performance Index (EPI). They considered two broad themes i.e. protection of people's healthiness from environmental degradation and the safety measure of the environment. Following graphical presentation is showing the index for some Southeast Asian countries.

Figure 1. 1:EPI and Well-being status,2016



Source: Environmental Performance Index Report 2016 and GALLUP database

According to the above graphical illustration, among Southeast Asian countries only Malaysia and Thailand are ranking high in EPI ranking while among South Asian countries Pakistan and Sri Lanka remained ahead in ranking. Most other South Asian and Southeast Asian countries are yet to improve environmental quality to improve well-being. From the above figure, it can be concluded that the well-being statistics is lower in countries with lower ranking in EPI. However, it is possible that with better technology, rebuilding natural capital, conservation-oriented or environmentally responsible behaviour, environment friendly policies and national institution will deploy the economic potential of these countries to improve environmental quality and improve well-being.

It is important to know whether all these positive attributes will improve wellbeing of people given the levels of poverty, and environment conditions which challenges sustainable development.

1.3 Research objective

This research is aimed to assess the relationship and influence of environmental quality indictors on human well-being for period 2006 to 2016 in selected South Asian and Southeast Asian countries.

1.4 Research question

Which are the factors of environmental quality that affect the most human well-being in South Asia and Southeast Asia?

Sub questions

Do socio-economic factors affect the measurement of quality of environment and human well-being in South Asia and Southeast Asia?

1.5 Significance

Countries in South Asia and Southeast Asia are experiencing rising economic growth along with urbanization accompanied by serious environmental degradation. Several authors explored urbanization and environmental degradation nexus considering only Carbon dioxide (CO_2) whereas very few(Stern and van Dijk, 2016) considered particulate matter pollution (Azam and Khan, 2015, Ibrahim and Law, 2014, Sharma, 2011, Al-mulali, 2015, Wang, Zhang, et al., 2015).

Additionally, few studies (Collados and Duane, 1999, Vemuri and Costanza, 2006, Silva, De Keulenaer, et al., 2012, Streimikiene, 2015) explore the relation between environmental quality and well-being in context of sustainable use of environment.

This study contributes to the prevailing knowledge by looking at the connection among increasing urban population, different environmental conditions, particulate matter emission, and human well-being for the period of 2006 to 2016 in South Asian and Southeast Asian countries which is missing in the existing literatures (van Kamp, Leidelmeijer, et al., 2003, Rahman, Mittelhammer, et al., 2005b, Zheng, 2009, Rogerson, 1995, Pacione, 2003, Dietz, Rosa, et al., 2009, Sekovski, Newton, et al., 2012, Winters and Li, 2015, Shaker, 2015).

Therefore, this analysis identifies the factors of environmental quality which affect human well-being, and how conservation-oriented or environmentally responsible human behaviour can improve the environmental quality. The findings of the research are also significant for policy perspective since it identifies the significance of environment friendly behaviour to ensure sustainable development.

1.6 Scope of the study

The scope of the study includes three main aspects of the problem, relationship between indicators of environmental quality, influence of environmental quality on well-being and how congruity between environment and people can contribute to sustainable development.

1.7 Limitations

The focus of this research is on testing the relationship between well-being with environmental quality and environment friendly human response at city scale. Due to unavailability of city scale information over long time horizon and time constraint, the study area covers only country scale information.

The study will use objective indicators of environmental quality from reports of government institutions of selected South Asian and Southeast Asian countries, concerned personnel, and world development indicators. Data constraint has restricted this research up to selected South Asian and Southeast Asian countries only. Subjective indicators of environmental quality and well-being data will be collected from GALLUP database.

Chapter 2: Literature Review / Theory

In this chapter, the theories that examine the relationship between environmental quality and wellbeing are reviewed. For this purpose, literature on Environmental sustainability, environmental quality, conservation-oriented or environmentally responsible behaviour, sustainable consumption of environmental services and other issues such as per capita GDP, energy or electricity consumption, political stability, perception of air quality, demographic structure, environment friendly policies and institutions were discussed. The relationship between environmental quality and wellbeing is discussed at country levels.

2.1 Environmental sustainability

Basis of sustainability is that natural resources ought to be preserved for current cohort's necessity but should not be consumed quicker than they can naturally revive and be accessible for upcoming cohort(Beck and Stave, 2011). Sustainability concept is built upon three development pillars i.e. societal, fiscal and environmental(Beck and Stave, 2011, Moldan, Janoušková, et al., 2012). A framework which is used widespread in sustainability studies is the Russian Doll framework(Beck and Stave, 2011). (Levett, 1998) described this framework using set theory. He viewed society and economy as embedded into environment as both will not exist without the provisioning services of environment. Limitation of resources cause environment to become the boundary of set of society and economy(Levett, 1998). Economy is inside the society set, as behavior of both institutions and people is influenced by social preferences. He also defined sustainability as a resolution of life quality and limits to environmental resources(Beck and Stave, 2011).

For an urban area to be sustainable it is important to have harmony among human capital, environmental resource or natural capital, social capital, economic capital i.e. per capita GDP(Beck and Stave, 2011, Khansari, Mostashari, et al., 2014). So, it is better to view urban areas as a place of inter-relationships among these different forms of capital which drive economic growth, and protection of environmental system (Beck and Stave, 2011) to understand the connotation of human well-being in context of sustainability.

Urban sustainability comprise of economic sustainability(Khansari, Mostashari, et al., 2014), social sustainability(Khansari, Mostashari, et al., 2014), individual well-being(Maclaren, 1996), and Environmental sustainability(Khansari, Mostashari, et al., 2014).

Achieving urban sustainability requires congruity among natural, human, social, and economic capital(Khansari, Mostashari, et al., 2014). Connotation among these variables drives economic growth, human well-being, as well as environmental protection (Beck and Stave, 2011). Concept of urban sustainability requires the understanding of how urbanization is linked with economic, environment, and social context(Alberti, 1996, Maclaren, 1996, Beck and Stave, 2011, Khansari, Mostashari, et al., 2014).

Economic sustainability refers to higher economic growth, which often translates into higher life expectancy, better education, and good health status and these variables also enhances social capital, which results in further increase in economic growth (Khansari, Mostashari, et al., 2014).

Social sustainability, refers to fulfilling basic human requirements of urban population such as healthy diet, dwelling place, clothing, education safe drinking water, sanitation, pollution-free environment, social cohesion, and life satisfaction(Khansari, Mostashari, et al., 2014).

Environmental sustainability denotes use of natural environment within its carrying capacity by ensuring less consumption of non-renewable natural capitals (Choguill, 1996, Alberti, 1996, Maclaren, 1996). By definition the term is stated as the "maintenance of natural capital" referred to balanced use of exhaustible and non-exhaustible natural resources, and natural pollutant absorbing capacity on sink side(Goodland, 1995, p.15).

Environmental sustainability includes the decline in rate of current depletion of environmental resources, conservation, regeneration, and transforming it to something else(Goodland, 1995, Basiago, 1998, Collados and Duane, 1999, Beck and Stave, 2011).

Environmental Sustainability refers to maintenance of natural assets, or not exhausting them irrationally(Goodland, 1995), which explain the compromises to be made between capital which is manufactured and capital which is natural. From economic point of view, it is important to invest more in natural capital as its reserve is on decline. Vesting effort in natural capital refers to investment in the biophysical infrastructure of the whole humanity maintains the yield of all prior monetary investments in manufactured capital through rebuilding natural capital reserve that now is found to be scarce. Rebuilding of natural capital is explained by (Goodland, 1995)in following three ways,

1. Regeneration - Reassure the evolution of natural capital by dropping present level of consumption(Goodland, 1995, p.17).

2. Relief of pressure – Devoting in projects to relieve pressure on natural reserves of forest by planting trees (Goodland, 1995, p.17);

3. Efficiency increase - developing the end use efficiency of goods, infrastructure, and living pattern such as use of solar technology in daily needs and recyclability of products (Goodland, 1995, p.17).

These three aspects can contribute to better quality life or human well-being(Goodland, 1995). OECD has defined four specific criteria for Environmental sustainability(Moldan, Janoušková, et al., 2012)

- Regeneration which means consumption of non-replaceable(exhaustible) natural resources must not be quicker than its natural replenishment rate
- Substitutability which means efficient use of non-replaceable(exhaustible) natural reserve in place of its renewable substitutes.
- Assimilation which means waste generation per capita should not be beyond natural treatment capacity
- Avoiding irreversibility

The relationship between human well-being and natural resources can be described in terms of four types of services (Walter, 2005).

1. Provisioning services: Crop, clean water, fiber, timber and gaseous fuel.
2. Regulating services: regulation of climate induced disaster, disease, and purification of water.
3. Supporting Services: Include nutrition cycle, soil formation, photosynthesis, and primary production.
4. Cultural Services: Aesthetic, spiritual, educational, and recreational.

The natural flow of the above-mentioned services is crucial factor to attain environmental sustainability, which is also a precondition for sustainability(Basiago, 1998, Osbaldiston and Sheldon, 2003, Beck and Stave, 2011). Environmentally responsible behaviour is critical to protect natural capital and have sustainable human well-being. For instance, ground water should not be consumed at a higher rate in comparison of rain capacity to make natural replenishment. Withdrawal fresh water should follow the way so that it does not disturb available fish stock, forest cover should not be cut at faster rate than its natural regeneration rate, and current cohort should not practice farming in such a way which could take away all nutrients from soil (Beck and Stave, 2011). Having balance among responsibilities of society, economic and institutional systems, provides incentives for following the habit of environmentally responsible behaviour(Basiago, 1998, Osbaldiston and Sheldon, 2003).

''Sustainability is non-declining human well-being over time''(Hinterberger, Luks, et al., 1997, p.3-13, Neumayer, 2007, Pearce, Barbier, et al., 2013, Morelli, 2013) and environmental sustainability is a criterion towards socioeconomic sustainability. So, the actions to foster sustainability of environment; had better contribute to the socioeconomic system as well(Morelli, 2013, p.5).

Ecosystem consists of the forest cover, landscape driven by anthropogenic actions, agricultural land and urban areas, which intensively used and altered by beings(Chu and Karr, 2013, Morelli, 2013). Concept of environmental quality stresses on the portion of the ecosystem where there exist significant patterns of human use. So, definition of environmental sustainability should be defined in recognition of these linkages between human well-being and ecosystems(Morelli, 2013, p.5).

Human activities to attain well-being, has gone beyond the capacity of nature to serve them. So, human well-being should be ensured by maintaining the sustainable use of natural capital (Goodland, 1995). To comprehend the relationship between these three aspect and human well-being, indicators of environmental quality must be grouped(Streimikiene, 2015) together to measure quality of human life.

Conservation-oriented consumption behaviour can improve quality of environment which allow technologically advanced use of environmental services and contributes to human well-being(Osbaldiston and Sheldon, 2003). Environmental sustainability also needs economic and social sustainability, and human capital to realize a greater effect to improve human well-being.

Well-being of people or country or region depends on natural capital in two ways(Collados and Duane, 1999). First, natural capital allows human beings to consume environmental services directly from nature which cannot be trade in and second is provision of environmental resources by a man-made production process to make the resources valuable to society and beings(Collados and Duane, 1999). Synthesis of these two constituents of of life quality governs the pathway of sustainable development a country or region takes(Collados and Duane, 1999). The regeneration capacity of natural capital rely on environmental services(Collados and Duane, 1999), which supply human beings basic materials for good life(Walter, 2005) that is prerequisite for reproduction of natural capital as well(Collados and Duane, 1999). The core sources of improvement of human quality of life is often hindered due to the loss of critical natural capital(Collados and Duane, 1999).

Economists of environmental discipline outlined natural capital as a significant contributor to well-being in terms of provisioning services, natural process of waste assimilation, and provision of other amenities(Collados and Duane, 1999, Walter, 2005). Strong sustainability is based on the premise that, the natural reserve should remain constant overtime and waste assimilative capacity must not decay over time. Weak sustainability denotes attenuation of exhaustible capitals should be substituted by increase in renewables or man-made capital(Collados and Duane, 1999, p.6).

The above-mentioned functions of natural capital have highlighted the fact that services drawn from nature are principal element of human welfare(Collados and Duane, 1999).

2.2 Well-being

Well-being and ''Quality of'' human ''life'' are often used interchangeably (Veenhoven, 2009, Antonella, D.,Fave, 2013), which depends on the physical environmental quality, where individual reside, individual's health, educational achievement (Pacione, 2003), per capita GDP(Welsch, 2002, Welsch, 2006, Lucas, 2014), urbanization(Liddle, 2014, Lucas, 2014), and energy or electricity consumption(Liddle, 2014). The level of analogy or discord between urban settlers and their built-up settings also influence quality of life(Pacione, 2003).

Wellbeing and happiness is often used to define quality of life as-a-whole(Veenhoven, 2013, p.1), and to assess dwelling conditions or employment likelihoods however, quality of life not only refer to the quality of an individual life but also to aggregate human life and entire environment. Quality of life consists of health, social relation, hedonic wellbeing, environmental quality, individual safety, happiness of people and quality of society (Rahman, Mittelhammer, et al., 2005a, Veenhoven, 2009, Veenhoven, 2013). Wellbeing is being synonymously used with economic welfare (Veenhoven, 2013).

Due to this connotation, definitions of quality of life, wellbeing, and happiness are often unequivocal. For example,(Terhune, 1973) defines quality-of-life as subjective satisfaction, (Hajiran, 2006) explained quality of life as an outcome of happiness, and (Kesebir and Diener, 2008) defined wellbeing in terms of happiness which refer to satisfaction with life as-a-whole(FELDMAN, 2008) or adaptive capacity of individual to face problems. However, (Tatarkiewicz, 1966) defined happiness as momentary satisfaction of life or individual perception of pleasure (Veenhoven, 2013).

Well-being can be explained better by distinguishing objective requirements of having a standard life, and self-reported satisfaction (Patrick and Michael, 2003, p.13), for instance, subjective perception of being in good health condition. If indicators of good life score satisfactory in both objective indicators and individual perception of life then it means well-being is attained(Veenhoven, 2013).

Quality of life and well-being differs depending on two concepts such as life chances and life results (Veenhoven, 2013). Life chances include livability of environment, and life ability of the person while life results refer to utility of life, and appreciation of life(Veenhoven, 2013). ''Livability of environment'', and ''utility of life'' are outer quality of life while ''life ability'', and ''appreciation of life'' are inner quality of life(Valenkamp and Walt, 2009, Veenhoven, 2013)''.

Livability is defined by the interaction between environment and human(Veenhoven, 2013) or individual perception of the dwelling environment(Doherty, Wise, et al., 2013). Livability of the environment denotes the decent living standard, which is often used as an indicator of

wellbeing as well as quality of life(Veenhoven, 2013). Increase in global temperature, Climate change, pollution, deterioration of nature, are often used by ecologist to measure the quality or livability of environment(Veenhoven, 2013). In social view, the term denotes quality of societal environment or quality of life in country and its capacity to meet its citizen need(Veenhoven, 2013).

Life-ability of the person is defined by capability of human to adapt with of different stressors, which is also synonymously used to indicate both wellbeing and quality of life(Veenhoven, 2013).

Utility of life is defined by the contributions of individual for society and environment, while appreciation of life indicates "subjective well-being" or life satisfaction or happiness(Veenhoven, 2013).

Quality of life and well-being are often used synonymously to describe attributes of quality of life such as livabiity, life-ability, and appreciation of life(Veenhoven, 2009).

Well-being referred to what extent the subjective perceptions of individuals' objective state of life, and their necessities, ambitions (Andrews and Withey, 2012) while (Peter and Hoekstra, 2011) defined human well-being as an overarching concept representing all those features which raise quality of life of people.

As cited by (Szalai, 1980) life quality denotes the level of satisfactory state of life. Besides, an individual's well-being and life satisfaction determined by both objective realities and features of life and subjective assessment that an individual has of these realities and features, of life and of himself (Szalai, 1980, van Kamp, Leidelmeijer, et al., 2003). So, both quality of life and well-being are used to define overall worth of human life and to measure the goodness of life comprehensively (Veenhoven, 2013, p,24).

Quality of physical environment and social activities play a significant role in human satisfaction to their quality of life (van Kamp, Leidelmeijer, et al., 2003, Veenhoven, 2013). Quality of life will be less in value for a potential polluter in comparison with a non-polluter. Environmental quality especially air pollution significantly affects human well-being which reflects in life satisfaction or happiness (Welsch, 2002, Welsch, 2006, Ferrer-i-Carbonell and Gowdy, 2007, Rehdanz and Maddison, 2008).

However, harmony between human and environment can hardly be quantified, it can only be inferred from consequential enjoyment of human life(Veenhoven, 2013, p,24). Individual often evaluate their life in comparison with ideal situation of life and happiness(Veenhoven, 2013). Mostly, happiness depends on subjective evaluation of information and emotional experience. Hence, individual appraisal of life is the appropriate indicator of human well-being(Veenhoven, 2013).

In the view of psychological and social perspective, human well-being includes income, health, housing condition, education, political environment, social cohesion, and life satisfaction(Moser, 2009, Veenhoven, 2013, Veenhoven, 2009). Life satisfaction is defined in terms of the happiness sign of fulfilling basic needs(Veenhoven, 2013).

So, in a nutshell it can be said that well-being refers to the satisfactory state of life(van Kamp, Leidelmeijer, et al., 2003). In this research author used human well-being as an indicator to measure people's satisfaction with life as-a-whole.

2.3 How well-being is measured

Understanding the significance of environmental sustainability on well-being has tremendous potentials as ensuring well-being of all is a key policy and sustainability agenda (Schuessler and Fisher, 1985, Easterlin, 2003, Costanza, Fisher, et al., 2007, p.1). As cited by (Schuessler and Fisher, 1985, Diener and Suh, 1997, Easterlin, 2003) there are two ways of measuring quality of life. One quantifies the environmental, social and economic indicators and the other one measures the subjective well-being or self-reported life satisfaction.

Objective measurement of well-being quantifies the indicator of societal, fiscal, and environmental scale to show the extent of human desires being met(Veenhoven, 2013). Subjective well-being means self-experiencing of happiness which is measured in terms of life satisfaction(Veenhoven, 2013).

Subjective indicators are the sense of being well or satisfaction of an individual, and contribute to the environmentally responsible human behaviour(van Kamp, Leidelmeijer, et al., 2003) . Objective indicators are important to evaluate facets of environment that are difficult to measure, which validate subjective measures(van Kamp, Leidelmeijer, et al., 2003).

The objective measurement of well-being includes economic, health, social, and environmental indicators(Cummins, Eckersley, et al., 2003), Human Development Index (HDI) and earnings or per capita GDP(Costanza, Fisher, et al., 2007), amount of pollutants in environment, life expectancy, job, and education (Rahman, Mittelhammer, et al., 2005b, Felix and Garcia-Vega, 2012).

Well-being measurement is the way that one evaluates the overall lifespan and all that evolves with it. It is often measured in quantitative method such as surveys, to gauge self-reported satisfaction level life quality as-a-whole. Several authors rank well-being on a measurement scale of 1-10(Veenhoven, 2010, Forgeard, Jayawickreme, et al., 2011, Ballas and Tranmer, 2012). GALLUP database measure well-being of people on a scale of 1 to 10, using life ladder approach. Gallup measure well-being by surveying on human satisfaction to life which refer to how they perceive the quality of their life.

(OECD, 2015) developed a comprehensive wellbeing index considering eleven dimensions i.e. job and income, dwelling conditions, health, education, wealth, good governance and participation in social activities, balance in life and job, skills, secured life, quality of environment, and individual satisfaction of life.

2.4 Subjective well-being

Subjective well-being research deal with central concerns of society and individuals and objective measures of well-being are basically the proxies for subjective perception(Vemuri and Costanza, 2006).

Subjective well-being: How people assess life or whether they satisfied with life are features that present the subjective evaluation of life.

Objective indicators of well-being: How people feel about the world and their living environment.

In this research, the dependent variable is human well-being which is indicated by life satisfaction(Veenhoven, 2013).

Strength and weaknesses of subjective well-being in measuring human well-being.

Table 2. 1 Strength and weaknesses of Subjective Well-being

Strength	Weakness
It complements indicators of social, monetary, and well-being i.e. the extent to which a perceived necessity is being fulfilled and the significance of 'perceived necessity' to well-being(Costanza, Fisher, et al., 2007, p.1).	Subjective well-being may note reflect actual well-being as it may internalize cultural or social norms, psychological illness, and sometimes people do not acknowledge some factors which may have influence on well-being.
It reflects real state of human life.	

Human well-being can be evaluated through objective or with subjective indicators of (Felix and Garcia-Vega, 2012). But it cannot be generalised that objective indicators can essentially improve individual well-being. It is rational to assume that better job, and education, high per capita GDP, pollution free environment, and life expectancy will ensure well-being. However, it is possible that these indicators will not always reflect individual's perception of well-being. Despite improvement in objective indicators, perception of well-being may remain unchanged (Felix and Garcia-Vega, 2012, Veenhoven, 2013). For instance, despite increase in income people may perceive no increase in their well-being (Diener and Seligman, 2004) and despite polluted air, people may perceive quality of their living environment is satisfactory because of having social cohesion with their neighbours (Moser, 2009, Veenhoven, 2013). Hence, instead of asking people's income if the question involves the capacity of income to cover individual basic requirements, it may symbolize an effective measurement of the individual's perceived well-being (Felix and Garcia-Vega, 2012). However, what comprises a basic requirement is very subjective and may vary across individuals (Felix and Garcia-Vega, 2012). Despite the complexity of using subjective indicators, (Kahneman and Krueger, 2006) concluded that subjective indicators are better device to define human well-being. So, combined use of objective and subjective indicators of quality of physical environment can better explain well-being (Marans, 2003, Roberts and Clement, 2007, Santos, Martins, et al., 2007)

Conditions of health reflects satisfaction to life(Diener and Chan, 2011). Hence, people with a higher life satisfaction index spent less for health care (Kim, Park, et al., 2014). Health is a prerequisite of people's productivity and well-being (van Kamp, Leidelmeijer, et al., 2003). Health is the state of physical well-being so higher well-being means people are healthier, more productive and able to handle challenges in daily life(Leedle, 2014)

Human well-being is grounded on individual or collective well-being, happiness and, satisfaction or being affected by conditions of living environment or sense of being in good health (Rogerson, 1995, van Kamp, Leidelmeijer, et al., 2003). Human well-being means bio-physiological functioning or health, which could be defined in two ways such as negative health and positive health(Veenhoven, 2009). Negative health is determined through the medical report of disease and positive health is measured through self-reported perception of health. Positive health reflects the state of overall health.

Health is an indicator of human well-being, which is a passive receptor of the negative input from their living environment(Rogerson, 1995, Cummins, Eckersley, et al., 2003). However, only health cannot describe the definition of well-being. Some researchers consider well-being to be concerned with evaluation of objective health and individual experiences. Some authors also linked longevity, good health, and well-being all together, for instance (Veenhoven, 2009) life expectancy at birth as an indicator or longevity, good health, and well-being. In line with concept of good health conditions, (Moser, 2009) found health is also associated with living environment. Blum (1974) studied a quantifiable social, physical, and

spatial issues of environment and perception as well. Perception includes both the explicit features of the environment and individual aspects. Life quality or human well-being comprise of built environment, natural resources, health, and safety (van Kamp, Leidelmeijer, et al., 2003). Health condition represent objective sense of being well. Basic agenda of sustainability is to includes ensuring well-being to all and at the same time ensuring efficient use of natural capital(Basiago, 1998, Beck and Stave, 2011).

Several authors (Pearce, Atkinson, et al., 1994, Hinterberger, Luks, et al., 1997, Pearce, Barbier, et al., 2013), *have explained* interlinkage between sustainability and well-being which is further strengthen by (Pearce, Atkinson, et al., 1994, p.14) in the statement, *''Sustainability is non-declining human well-being overtime''.*

According to Newman (1999) sustainable development is *"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"* (van Kamp, Leidelmeijer, et al., 2003, p.7)

So, sustainability and human well-being are two integral concepts. (van Kamp, Leidelmeijer, et al., 2003) concluded that the intersection set between environment, and human is called person-environment fit and the current benefit of sustainability is perceived by individual in terms of sense of being well. Therefore, environmental sustainability is the pre-condition to have sustainable development and to improve human well-being at the same time(Beck and Stave, 2011). Sustainable human welfare is achieved when individual behave responsibly towards environment and in turn environment will provide individual more environmental services to consume (Uzzell and Moser, 2006).

2.5 What is environmental quality

Concepts as environmental quality, livability, quality of life, life satisfaction, and sustainability, are often used as synonyms, since all denotes the association between individual and environment (van Kamp, Leidelmeijer, et al., 2003). Application of these concepts like livability, quality of environment, and quality of life is also not clear. Often, concept of environmental quality is multidimensional(van Kamp, Leidelmeijer, et al., 2003).

Livability and quality of dwelling place is linked to environmental quality, whereas well-being is more about human(van Kamp, Leidelmeijer, et al., 2003). Besides, perception of quality of environment depends on geographic position of region or country(van Kamp, Leidelmeijer, et al., 2003, Pacione, 2003), which is one component of quality of life(van Kamp, Leidelmeijer, et al., 2003, Pacione, 2003). Interactions between physical environment and human response define the quality of environment(van Kamp, Leidelmeijer, et al., 2003) while (Pacione, 2003, Moser, 2009) concluded that environmental quality is the proportion of similarity or discord between urban dwellers and their urban settings .

Pollution of urban settings has influence on well-being of people (van Kamp, Leidelmeijer, et al., 2003, Veenhoven, 2013). From the view of human ecology, (Lawrence, 2003) mentioned that people share close tie with ecosystem. Fast growing urban population put pressure on this natural relation through increases in energy consumption at a higher rate which cause decline in environmental quality(Lawrence, 2003).

2.6 How environmental quality is measured

Environmental quality is evaluated by measuring the quality of air, water, soil, and waste (Diener,Wolfgang,Torbjorn,Mirjam,Joachim,Veenhoven, 2011). Environmental quality is also determined by grouping indicators of conservation-oriented human actions and consumption of environmental services (Osbaldiston and Sheldon, 2003, Streimikiene, 2015).

(Goodland, 1995, Collados and Duane, 1999, Olewiler, 2006) mentioned the significance of considering rebuilding natural capital stock as an indicator of environmental quality.

2.7 Conducting well-being and environmental quality

Human well-being is defined by standards of living (Uzzell and Moser, 2006), economic solvency, access to specific services in residential area, sustainable use of natural resources(Uzzell and Moser, 2006), satisfaction to family and social relation(Donovan, Halpern, et al., 2002), health, income, job, education, and access to better quality environment (Poortinga, Steg, et al., 2004, Veenhoven, 2009, Veenhoven, 2013).

However, concentration of pollutants prevailing in the environment is also a key factor of well-being (Jackson, 2002, Uzzell and Moser, 2006, Moser, 2009). These multiple facets of well-being can be compiled as an index by considering objective conditions in which people live, their perception of those circumstances and significance of natural capital in human life

(OECD, 2015). Satisfaction to life has the potential to represent people's well-being by putting light on the relationship between explicit circumstances where people live in and their evaluation of those circumstances(van Kamp, Leidelmeijer, et al., 2003, OECD, 2015).

Individual's perception of their objective conditions refers to life satisfaction which is influenced by population density, green space, type of building, social cohesion, ambient environmental stressors i.e. air, soil, and water pollution, and the individual adaptive capacity to confront pollution associated health hazard(Pacione, 2003, Moser, 2009).

There is a noteworthy association with environmental problems and life satisfaction(Ferrer-i-Carbonell and Gowdy, 2007) as individual perception of being well depends on their living environment i.e. air quality(Day, 2007). Several authors (Welsch, 2002, Welsch, 2006, Ferrer-i-Carbonell and Gowdy, 2007, Rehdanz and Maddison, 2008) provided evidence that environmental quality adds to life satisfaction whereas inferior quality environment make people less satisfied with life, however satisfaction to environmental quality differs across people(Donovan, Halpern, et al., 2002).

Despite this opposite relation, increase in human well-being is often accompanied by depletion of environmental quality through unsustainable use of environmental services(Moser, 2009).

Across countries, lack of environmental quality such as polluted air and water, traffic congestion, poor sewer system, use of non-renewable energy and solid fuel, are affecting human-health negatively.

Environmental pollution associated health problems reduces human well-being however, people often are not aware of causal association between well-being and environmental quality (Welsch, 2006, MacKerron and Mourato, 2009). Besides, consciousness of environmental problems can affect well-being irrespective of health problems(Welsch, 2006, MacKerron and Mourato, 2009). This is reflected by human satisfaction with life.

Several authors (Welsch, 2002, Dolan and White, 2007, Ferrer-i-Carbonell and Gowdy, 2007, Menz and Welsch, 2010, Silva, De Keulenaer, et al., 2012, Winters and Li, 2015) concluded that people are now more concerned about environmental quality and they consider environmental degradation as a risk to their well-being.

Therefore, it is important to acknowledge the significance of human-environment relationship to recognize environmental concerns in people's wellbeing(Moser, 2009). This relationship determines the individual capacity of meeting necessities from environment, which is crucial factor of individual well-being (Walter, 2005, Moser, 2009). This necessitates the fact that if human deals with environment in a humble manner, only then human well-being will follow a sustainable pathway(Uzzell and Moser, 2006). Harmonious relation between individual and environment could be ensured by connotation with human perception towards the environment and objective indicators of environmental quality i.e. concentration of pollutants in air(Moser, 2009).

Environmental quality is continuously facing the issues such as urbanization, climate change, resource depletion, land degradation, and degraded environment also threatening human well-being(Moser, 2009). Therefore, many institutions developed integrated indicators towards environmental sustainability(Dahl, 2012). For instance, University of Yale developed Environmental Performance Index.

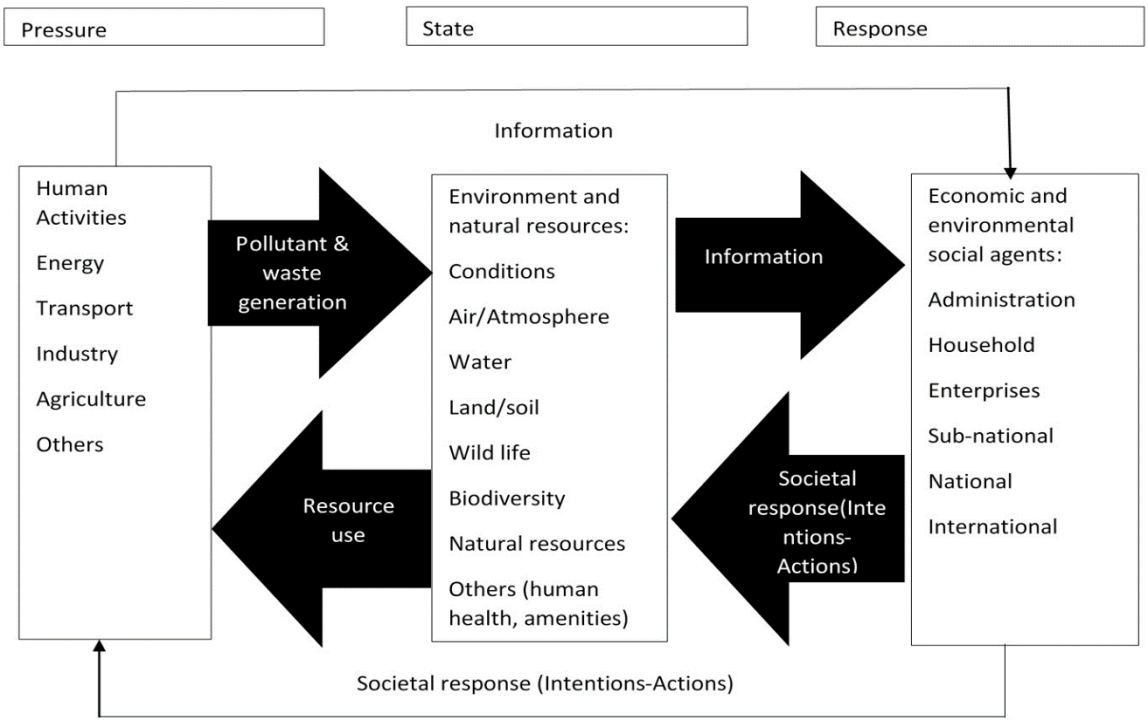
However, policymakers are still find it difficult to get environmental indicators which will include actual conditions of human life and for implementing environmental sustainability actions objective indicators are necessary to defined properly(Dahl, 2012). Also, an environmental sustainability indicator to be effective on national scale, it is important to have integrated actions among all tiers of government as well as time scale(Mascarenhas, Coelho, et al., 2010, Dahl, 2012, Mascarenhas, Nunes, et al., 2014).

In the meantime, (OECD, 2003) clarified that an indicator is basically a parameter to define the condition of a fact or event or environment or space with an implication ranging beyond that directly accompanying with value of a parameter.

As cited by (OECD, 2003, Niemeijer and de Groot, 2008) environmental indicators quantify the state of the natural environment i.e. environmental pressures, state and human responses. Pressure State Response(PSR) is a simple framework for setting environmental indicators showing the relation between environment and humans response(OECD, 2003). And the modified versions of PSR models are driver state response (DSR), and driver pressure state impact response (DPSIR)(Niemeijer, 2002, Niemeijer and de Groot, 2008).

Each of the framework, consider a causal chain where division is made between driving forces that affect environment, the pressure that the driving force put in environment, the condition of environment due to that pressure, the impact on creatures who are consuming environmental services, and the reactions of human and society to those changes(Niemeijer, 2002, OECD, 2003, Niemeijer and de Groot, 2008). The difference in the framework is in the subdivision of the phases in the causal chain(Niemeijer, 2002, OECD, 2003, Niemeijer and de Groot, 2008). PSR is one of the basic framework which is explained below.

Figure 2. 1: PSR framework (OECD 2003)



PSR framework states that human/anthropogenic activities put pressure in terms of emitting pollutants to environment or changes in land use pattern. These consequences cause changes in environmental condition i.e. concentration of pollutants, water, and nutrition cycle(Niemeijer, 2002, OECD, 2003, Olewiler, 2006, Niemeijer and de Groot, 2008). Confronting the effect of the environmental condition, society and human show response in terms of policies or behavior(OECD, 2003, Niemeijer, 2002, Olewiler, 2006, Niemeijer and de Groot, 2008).

Environmental indicators are important not only for global measurement of environmental quality but also for local level(Mascarenhas, Coelho, et al., 2010, Mascarenhas, Nunes, et al., 2014). Often local indicators for environmental sustainability reflect local concerns, priorities, which are also reinforced by strategic vision, and financial capitals(Mascarenhas, Coelho, et al., 2010).

Several measures of human well-being incorporating indicators for environmental quality, have been advanced at both the global and local levels. For example, human well-being is interrelated with four areas of national policy i.e. health, subjective and objective conditions of living, individual life satisfaction, and sustainable development(Uzzell and Moser, 2006, Moser, 2009). Hence, without considering both objective and subjective indicator of environmental quality simultaneously, society cannot attain sustainable development(Uzzell and Moser, 2006, Moser, 2009).

Objective indicators are of major concern in well-being studies as subjective indicators are influenced by objective indicators, for example good health is sign of being well. As cited by

(Malkina-Pykh and Pykh, 2008) well-being is often influenced by environmental conditions but not all types of environmental conditions influence well-being. For instance, protection of natural resources and biodiversity may not have direct relation with individual well-being but can be observed in terms of health conditions of individual. Objective indicators of environmental quality i.e. amount of pollutants in air can directly affect individual well-being (Malkina-Pykh and Pykh, 2008) through health problems.

Subjective measures of human well-being refer to the individual satisfaction with life. Objective measures of human well-being refer to standards of living environments i.e. income, amenities in the vicinity, and health status(Donovan, Halpern, et al., 2002, Jackson, 2002). Besides, (OECD, 2015) revealed a framework of well-being emphasizing on natural capital including environmental quality i.e. air pollution, traffic congestion, climate change, and noise level.

(Mascarenhas, Coelho, et al., 2010, Dahl, 2012, Mascarenhas, Nunes, et al., 2014) concluded that use of right indicator is prerequisite to deal with environment issues to make evolution in human welfare measurement in both global and local scale.

2.8 Lessons learned so far

This research has been focused on conducting human well-being and environmental quality as specific study. From the literature review, it is being found that multiple facets of environment and well-being are necessary to have better policies and planning for sustainable development.

Environmentally responsible behaviour, rebuilding natural capital, environmental services consumption, and better quality air and water have an impact on human well-being in terms of life expectancy and health (Rogerson, 1995, Collados and Duane, 1999, Osbaldiston and Sheldon, 2003, Peter and Hoekstra, 2011, Streimikiene, 2015). Subjective well-being is better device to represent the important variables of the conditions where people live in and their evaluation of those conditions(van Kamp, Leidelmeijer, et al., 2003, Kahneman and Krueger, 2006). However, both objective and subjective indicators of environmental quality can contribute to improve human well-being (Marans, 2003, Roberts and Clement, 2007, Santos, Martins, et al., 2007).

Human relationship with consumption of environmental services, and environmental quality is a complex process. To indicate the effect of quality of physical environment on human, an indicator is required to compare the actual state with the present threshold value of environmental conditions and the target. Moreover, to measure the human well-being indicators, an understanding within indicators through testing in practice and assessing the relationship among indicators as-a-whole is required(Rogerson, 1995).

Environmental assessment of human well-being research can contribute to formation of social norm and preference. For instance, it is generally believed that more per person income increases human well-being however after a certain tipping point it has negligible change(Lawrence, 2011) or no lasting change(Easterlin, 2003) in people's reported well-being.

Preferences too are an important concern in development of policy. If individuals do not acknowledge some of the factors influencing their choices then their well-being will not be

maximised successfully(Easterlin, 2003, p.7). Therefore, policies should be developed in a way that may contribute to more informed preferences(Easterlin, 2003, p.7).

A cohesive environmental assessment of well-being measurement device can support in recognising seeming incongruities between policies and choices that people make in their daily life and approaches that improve human satisfaction with life.

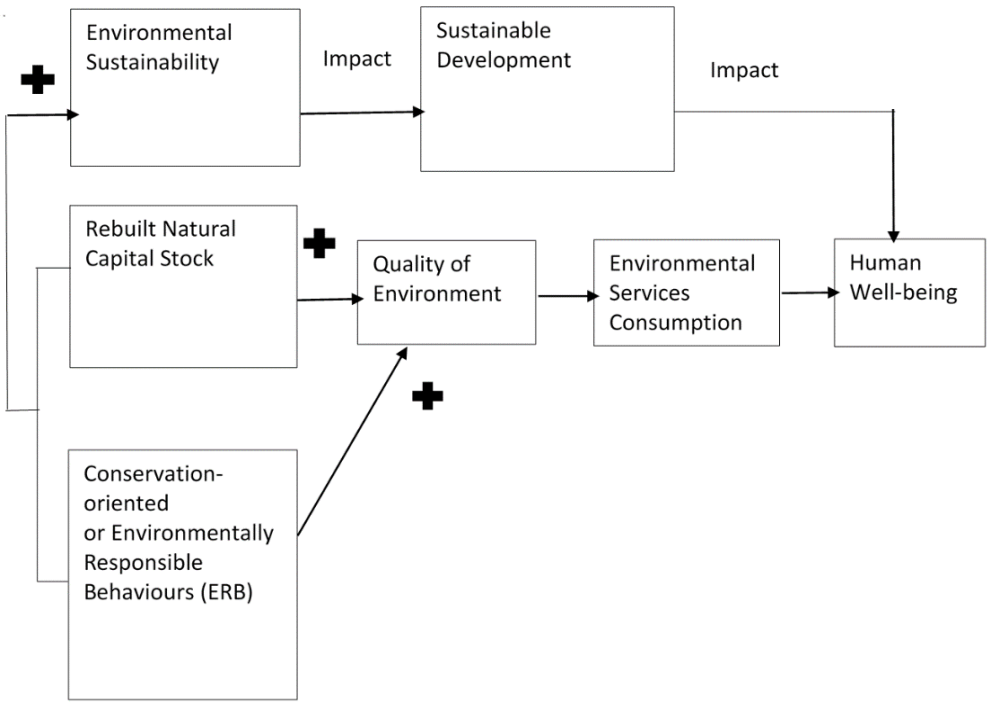
Information derived from the integrated device, can be used develop policy focusing more on people's satisfaction with life rather than the economic growth.

Aiming at precise insight on relation between human well-being and environmental quality, researcher advanced a conceptual framework to explain in what way concepts and theories are considered to measure environmental dimensions of well-being.

2.9 Conceptual Framework

Theory has shown that there is an association among environmental quality, human well-being, and environmental sustainability. The conceptual framework shows the interrelationship between environmental sustainability, and human well-being as an outcome of sustainable development. This research intends to assess the importance of environment on well-being in South Asian and Southeast Asian countries.

Figure 2. 2: Conceptual framework of Environmental assessment of Human Well-being



Source: (author,2017) based on (Collados and Duane, 1999, Osbaldiston and Sheldon, 2003)

The grand concept of this research is sustainable development citing definition from (Pearce, Atkinson, et al., 1994, Hinterberger, Luks, et al., 1997, Pearce, Barbier, et al., 2013) that development is sustainable if ensures that human well-being is not diminishing. Degraded environmental quality affect both society and economy and thereby sustainable development(Beck and Stave, 2011). Therefore, this research focus on how rebuilding natural capital and environmentally responsible behaviour can ensure sustainability of environment by enabling balance between human actions that let on them to fulfil their necessities as well as protecting environmental quality.

Besides, environmental sustainability can be seized through the rebuilding natural capital stock and conservation-oriented or environmentally responsible behaviour(Osbaldiston and Sheldon, 2003, Streimikiene, 2015).

Along with demographic, social and economic indicators, environmental indicators have significant impacts in sustainable development of urban grid(Basiago, 1998, Beck and Stave, 2011, Pissourios, 2013, Khansari, Mostashari, et al., 2014). Therefore, this research is aimed for testing the relationship with quality of environment and well-being by controlling the effect of socio-economic and demographic variables.

There are four environmental conditions which are pre-requisite Human Well-being.

1. Environmental quality: State of air, water and soil which represent quality of environmental services.
2. Rebuilding natural capital stock: Investing in natural growth of environmental resources by controlling over-exploitaition.
3. Conservation-oriented Human behaviour: Human actions to improve quality of environment.
4. Environmental services consumption: Services enjoyed by human either directly or indirectly from environment.

The above four conditions have the potential to improve health status of people and thereby can contribute to human well-being. Citing from (Leedle, 2014) health is the state of physical well-being.

Chapter 3: Research Design and Methods

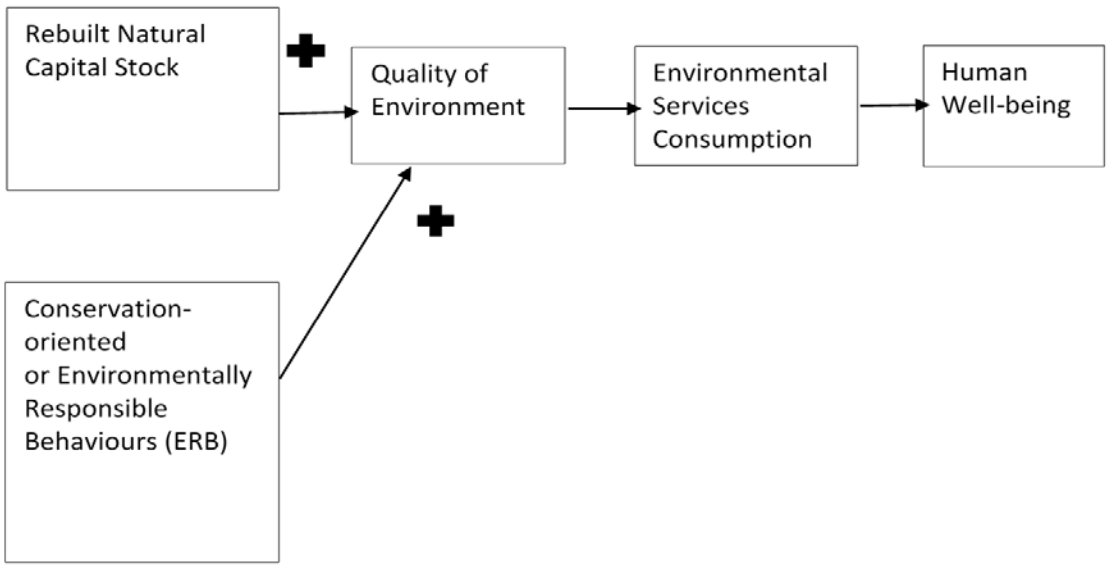
This chapter describes the research strategy, and methodology that researcher is going to apply to get the answers of the research questions. This chapter also wants to explain how the choice of research strategy reflects the research objectives. It will also mention the limitation of the study as per use of the research strategy.

3.1 Research Operationalization

This research will test the relation between environmental quality and human wellbeing.

A figure below indicates the main concept of this study:

Figure 3. 1: Main Concept



Source: (author,2017) based on (Osbaldiston and Sheldon, 2003, Peter and Hoekstra, 2011, Streimikiene, 2015)

The study will determine the environmental issues of well-being by dividing them into four major aspects or variables, which are:

Table 3. 1: Variable Definition Operational

Variable	Definition
Independent variable	
Rebuilt Natural Capital	‘’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’'(Goodland, 1995, Wouter, 1995).
	Increasing the end-use efficiency of products i.e. improved cook stoves, solar heaters and cookers, wind pumps, solar pumps, manure rather than chemical fertilizer, use of clean fuel(Goodland, 1995).
Conservation-oriented or environmentally responsible behaviours (ERB)	Alteration in human habits to offset current environmental degradation and to improve environmental quality(Osbaldiston and Sheldon, 2003).
Quality of Environment	Environmental media such as water, air, soil, and waste which are the key determinants of the quality of environment where people live in and has a direct consequence on health of beings(Streimikiene, 2015)
Environmental Services Consumption	Benefits enjoyed either directly or indirectly from environment (Walter, 2005, Pretty, Peacock, et al., 2005, Streimikiene, 2015)
Dependent Variable	
Well-being	A measure of subjective appreciation of life (Veenhoven, 2013, p.3)

For the research, indicators are compiled from Ministry of Water Resources, Ministry of Health and Family Planning, Ministry of Environment and Forest, Department of Environment, Statistic Bureau, Ministry of Fisheries and Livestock, Food and Agricultural organization of the United States(FAO), World bank indicators, Global Environment Monitoring System for freshwater(GEMS/Water), and GALLUP database. For environmental indicators, quantitative environmental features were collected.

Table 3. 2: Environmental quality indicators

Variables	Indicators	Operational Definition
Rebuilt Natural capital stock	Reforestation activities	Natural regeneration or re-establishment of forest through planting and/or deliberate seeding on land already in forest land use
Environmentally Responsible behaviour	Access to clean cooking fuel	Percentage of total population who use clean fuel for cooking
	Treated municipal waste activities	An activity to recycle municipal waste.
Quality of Environment	Water Quality Objective indicator	Water quality is measured by several factors, such as the concentration of Biochemical Oxygen Demand(BOD), Dissolved Oxygen, electrical conductivity, total oxidised Nitrogen, Orthophosphate (OP), pH, and Faecal Coliforms (FC).
	Water Quality Subjective indicator	Individual perception of quality of water.
	Air quality Objective indicator	The concentration of pollutants in air. If pollutants are less in concentration then air quality is good otherwise air quality is poor. Quality air is important for humans, flora and fauna, water and soil quality. Quality of air can be polluted due to emissions from both natural and anthropogenic, which can threaten health of both environment and human beings.
	Air quality Subjective indicator	Individual perception of quality of air.
	Waste	Municipal waste generated per capita
Consumption of environmental services	Consumption of clean water	Percentage of the people who use an improved source for water.
	Consumption of fresh fish	Fish consumption products in cities, from both fresh water and marine resources

Source: Ministry of Water Resources, Ministry of Environment, Forest and Climate change, Ministry of Fisheries and Livestock, Food and Agricultural organization of the United States(FAO), Global Environment Monitoring System for freshwater(GEMS/Water).

These indicators can be influential to make environmental conditions noticeable and enhancing capacity of environmental services, which will eventually provide direction to assess human well-being.

Human well-being data is collected from Gallup database. Gallup measured well-being in terms of life satisfaction on a scale of 0 to 10.

Table 3. 3: Human well-being indicator

Variable	Indicator	Definition
Well-being	Life satisfaction	Satisfaction with life as a whole

Source: Gallup database

There are other factors which can affect human well-being which are mentioned in this research as control variables. Control variables are per capita GDP, life expectancy at birth, access to safe sanitation, and Educational attainment.

Table 3. 4: Control Variables

Variable	Indicators	Definition
	Healthy People	Subjective perception of people who do not have any health problem
	Per capita GDP	Measurement of Income
	Life expectancy at birth	Male and female life expectancy at birth
	Access to safe sanitation	Percentage of population with access to Improved sanitation facilities
	Educational attainment	At least secondary education, population 25+, total (%)

Source: World development indicators 2016

3.2 Research strategy and method

This research analysis is based on collecting secondary data to test influence of environmental indicators on human well-being for Southeast Asian countries and show a trend between the two terms from the year 2006 to 2016. The hypothesis of the research is:

''Rebuilding of natural capital, Conservation-oriented or Environmentally Responsible Behaviour, quality of Environment, and consumption of environmental services will increase human well-being''

Table 3. 5: Approach, Strategy, and Method

Approach	Strategy	Method
Quantitative	Survey based secondary data	Secondary data collected by GALLUP, Food and Agricultural organization of the United States(FAO) and World bank using survey method. Survey result was based on numeric data analysis. Secondary data on quality of environmental media such as air, water, and land from different ministries. Secondary data from ministry annual reports, policy plan, monitoring and evaluation report and concerned personnel.
	Projection	Waste projection by waste projection formula used by government institutions and researchers.

Waste Projection:
The municipal waste per capita was found only for Singapore, India, and Thailand. So, this research made projection for per capita waste generation for countries in the study area by taking actual per capita waste for the base year 2006 . Municipal waste generation was projected for different countries by considering Compound annual growth rate (CAGR), gross annual product (GAP), and income spending approach(K.M.Nazmul Islam, 2016). For calculating the waste generation growth factor, household final consumption expenditure and gross national income (current US$) were collected from world bank indicators. For gross annual product (GAP), annual GDP growth rate was considered as both indicators are similar.

As, population of each year is available from ministry statistical yearbook and from world bank indicators. So, for waste projection actual population was considered instead of population growth rate. PCWB is per capita wastes generation in baseline year (kg/cap/day) of base year 2006 was collected from ministry of Environment and forest resources report of different countries. For validity of projected waste generation rate were cross-checked with actual per capita waste generation.

Projected waste generation was calculated using
PWG = (Each year population × (PCWB + PCWB × WGG) × 365 × 1)/1000 (K.M.Nazmul Islam, 2016)

Projected waste recycled per capita:
Waste recycling rate for base year 2006 was collected from ministry reports, and for remaining years the rate was considered same. However, as each year projected waste generation per capita was different for different countries so the recycled amount of waste was different in each year for each country as well.

3.3 Validity, reliability, and data collection

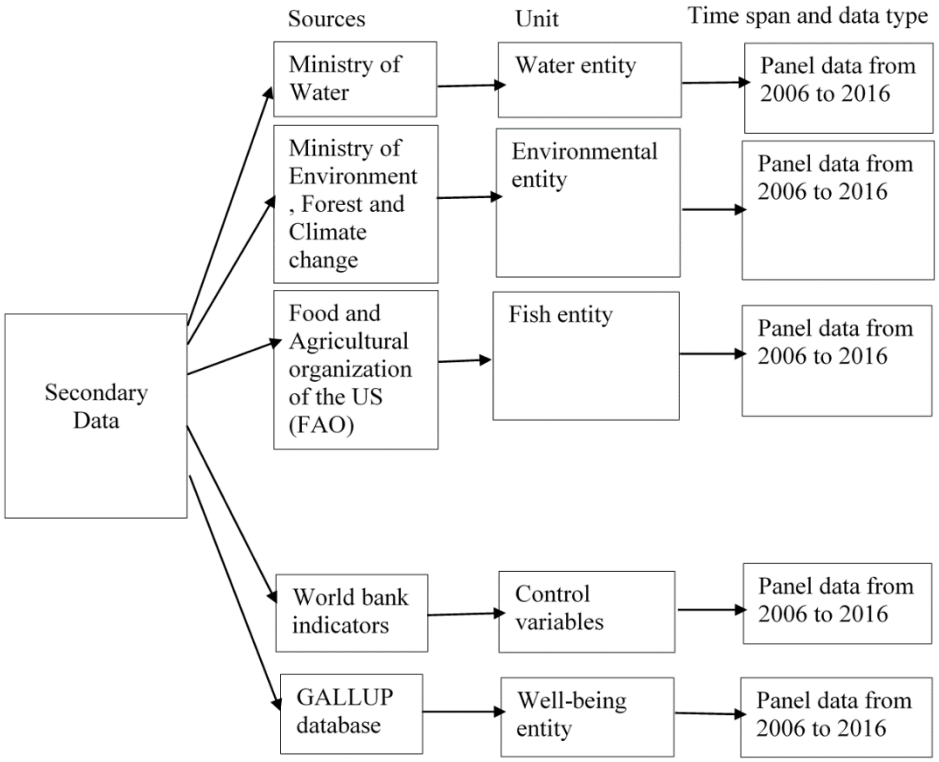
Table 3. 6: Validity and reliability

Reliability	Validity
Some data on forest is not available on annual basis but considering trend of previous years estimation of missing years has been done. So, there will be no missing data for period 2006 to 2016. Projected recycled amount of waste per capita was cross checked with the countries having actual data so the projected figures are reliable being approximately same as actual figures.	Although secondary data will be used for the research analysis but other influential variables will be considered as control variables.

This research will collect secondary data from several government institutions in South Asia and Southeast Asian countries for the time 2006 to 2016. The research area requires the dataset to be considered as panel dataset. As the secondary data will be collected from government institutions, and ministry reports, it will provide a large amount of data in zero cost however it will cost a lot of time.

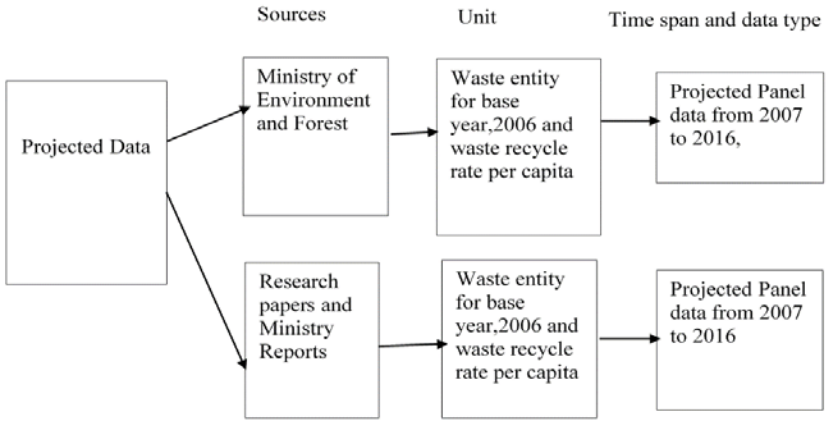
Data Collection flow:

Figure 3. 2: Data source, unit, time span, and data type



Source: Author (2017)

Figure 3. 3: Projected data source, unit, time span, and data type



Source: Author (2017)

3.4 Research analysis

This study will use panel data analysis to test the association between human well-being and quality of environment for period of 2006 to 2016. Since, the dependent variable well-being data is measured by GALLUP database as aggregate for countries which makes the dependent variable in continuous form, so the research will perform regression analysis.

A panel data analysis model allows considerable number of data points and reduces collinearity among regressors. This type of model allows to explain more important economic questions which cannot be explained using time series or cross-sectional data. Panel data has two types of model i.e. Fixed effect model, and Random effect model. A fixed effect model is used determine the relationship between regressors and regressand within a country or city (Oscar Torres-Reyna,2007). Each city or country has its own individual characteristics may or may not impact the regressand i.e. being a delta country may or may not influence the water quality of a country or city. Fixed effect model can be used to remove the effect of the individual characteristics which are not time varying which can correlate with explanatory variables and sometimes can correlate with other distinct features. If the error term of each entity is correlated with the distinct features of each entity, then Fixed effect model is no longer applicable.

In contrast with the fixed effect model random effect model assumes the variation among the countries or cities is random and uncorrelated with the regressand and regressors (Oscar Torres-Reyna,2007). Random effect analysis allows researcher to infer something concerning the population from which the sample is taken. Heterogeneity is exhibited by means of random measures (Oscar Torres-Reyna,2007). In random effects analysis, error term is used as single random intercept which is related with the indicators within each entity i.e. population or density of countries or cities.

Hausman (1978) test is used to determine whether the analysis should use fixed or random effect model. And the null hypothesis assumes that the differences in the coefficients of predictor variable for different entity is not systematic which means the errors are uncorrelated with predictor variables (Green,2008).

Following is the simple random effects model, $Yit = \beta Xit + \alpha + uit + \varepsilon it$ ……. (1)

Here, εit: Within-entity error

uit: Between-entity error

α: constant

β: coefficient of Predictor variable

Xit: Predictor variable

Yit: Outcome variable

Here, the β include both the within-entity and between-entity effects and represents the average consequence of independent variable(X) over dependent variable (Y) in presence of one unit variation in X across time and between countries.

Using the Wald test statistics of the difference between the estimated vector coefficients, the Hausman test compares an estimator that is known to be fixed with an estimator that is random (Green,2012 p.421: Woolridge 2002). This study used sigmamore syntax to compare consistent effects(FE) and non-systematic effects(RE) simple linear regression. Sigmamore produces non-positive difference between covariance matrix of consistent estimator(FE) and efficient estimator(RE) (Baltagi,2011).

Another important note for panel data analysis is the probability of not fulfilling some assumption tests which are necessary to make inference. Sometimes, panel data show autocorrelations while performing test for independence which is known as Woolridge test. To control violations, robust command is used to calculate heteroscedasticity.

Econometric model: $\mathbf{WB_{it} = \beta_0 + \beta_1 RNC_{it} + \beta_2 ERB_{it} + \beta_3 EQ_{it} + \beta_4 CES_{it} + \beta_5 Controls + \varepsilon_{it}}$

where,

$\mathbf{WB_{it}}$: Human well-being as dependent variable

$\boldsymbol{\beta_0}$: constant

$\mathbf{RNC_{it}}$: Rebuilt Natural Capital as an independent variable

$\mathbf{ERB_{it}}$: Conservation-oriented or Environmentally Responsible Behavior as an independent variable

$\mathbf{EQ_{it}}$: Quality of Environment as an independent variable

$\mathbf{CES_{it}}$: Environmental services consumption as an independent variable

$\boldsymbol{\varepsilon_{it}}$: error term

i: country

t: year

The above econometric model is developed to test the following:

1. testing the inter-relationship between Rebuilt natural capital, Environmentally Responsible Human Behavior and quality of environment.
2. testing the relationship between testing the relationship between quality of environment and consumption of services produced by it.
3. testing the inter-relationship between all environmental quality indicators and human well-being.

4. testing the relationship between all environmental quality indicators and human well-being using several control variables.
5. Testing the relationship between interaction effect of environmentally responsible human behavior and environmental quality on Environmental services consumption and well-being by comparing two regions,
6. Testing the relationship between consumption of environmental services and air quality by comparing two regions,
7. Testing the relationship between environmentally responsible human behavior and air quality by comparing two regions,
8. testing the relationship between all environmental quality indicators and human well-being using several control variables by comparing two regions.

Chapter 4: Research Findings

4.1 PURPOSE

This chapter describes the findings of the analysis of human well-being and dimensions of environment. The outcomes are also explained with theories, previous study findings to support the outcome. The analysis follows the analysis steps mentioned in previous chapter.

4.2 DESCRIPTIVE FINDINGS

This study collected data from the country scale from 2006 to 2016. The size of the dataset is drawn from well-being, indicators of environmental quality, environmentally responsible behaviours, rebuilt natural capital indicator and control variables from three dimension which are demographic, social, and economic dimension. A table below describes a summary statistic of the database.

Table 4. 1: Summary statistics

Dataset: Panel data
Indices: Country x Year
Panel variable: Country ID (strongly balanced)
Time span: 2006 to 2016
Observation: 12 countries x 11 years (132)
Total data points: 132

In general, there are 132 observations from 12 countries in eleven-year time, so the total data points are 132. The panel summary indicates the data is strongly balanced.

Table 4. 2: Descriptive statistics

Variable	Indicator	Mean	Std. Dev.	Min	Max
Environmental Quality	AirQ	39.11076	21.02477	13.77328	90.8251
	WaterQ	7.020974	1.164685	2.77	10.5
Rebuilt Natural Capital	Ref	1820.444	2940.789	0	12209.4
Environmentally Responsible Behaviour	MCWR	3.73422	3.013818	0.3431	12.73225
	cleancooki~l	39.57364	29.97046	3.565395	100
Environmnetal Services Consumption	Cleanwater	82.4589	17.60799	31.5	100
	Fish	14.31385	13.27663	0.06	54.89
Subjective Perception of Environmental Quality	satisfiedWQ	78.61932	9.836229	55	99
	satisfiedA~Q	83.21591	8.392444	55	97
Subjective Perception of health	healthyPop	73.41225	9.646237	0	95
Well-being	wellbeing	5.007873	0.767984	3.1	7.1
Control Variable	sanitation	66.80259	22.54556	26.6	100
	Lifeexpe	69.5575	5.262152	57.43256	82.86775
	PrimaryEduc	56.80114	20.6597	13	92
	PcGDPCurre~S	5066.603	11329.27	280.2456	56007.29

Descriptive statistics shows that each indicator has a dynamic value of mean, standard deviation, minimum, and maximum points. In general, data from rebuilt natural capital variable indicates that minimum reforestation activities are zero as Singapore did not have any reforestation activities from the last 11 years and the highest amount of reforestation activities is found in India in year 2016.

Data from an environmentally responsible behaviour variable specifies two activities such as: municipal waste recycled per capita, and access to clean cooking fuel. It indicates that some countries have less responsible actions related to improving air quality in a certain year. For instance, Afghanistan did not have any waste recycling activities from year 2006 to 2016 and Myanmar have minimum amount of recycled amount of waste in 2006. Singapore shares least amount of Renewable energy consumption of total energy consumption whereas Lao PDR shares the highest. Maximum percentage of People in Malaysia and Singapore has access to clean cooking fuel. Almost 99 percentage of people in Singapore are satisfied with quality of water and 97 percentage of people for air quality.

Quality of environment is indicated by waste, and quality of air and water. Air quality is indicated by Particulate Matter(PM2.5). Water quality measurement used one major parameter, dissolved oxygen in the major rivers in different countries. Dissolved oxygen is important for both drinking water quality as well as for aquatic resources(Tanja.Srebotnjaka, Genevieve.Carrb, et al., 2011). For estimation, the air quality indicator indicates the minimum

value is of PM2.5 is 13.77 in Indonesia in 2006. Thus, the maximum value is 90.8251 in Bangladesh in 2016. The water quality indicator indicates the minimum value is 2.77 in Philippines in 2011 and the maximum value is 10.5 in Bangladesh in 2016.

The environmental services consumption denotes the measures taken by human beings to consume the goods provided by the environment. This research hypothesized is higher environmental quality can increase the quality of environmental services. Data from consumption of environmental services variable indicates that there are three activities such as: Fish consumption per capita, percentage people using improved water source, and terrestrial protected areas. The average fish consumption per capita indicates that the minimum value is 0.06 in Afghanistan in kg per capita in 2006 while the maximum value is 54.89 kg per capita in Myanmar in 2011. Significant difference is observed in the value indicated by access to clean water consumption indicator (minimum value 31.5 and maximum value 100). Terrestrial protected areas refer to area comprising of National Parks and Wildlife Sanctuary. The Terrestrial protected areas indicate that minimum value is 3.35 in Singapore which is constant over the eleven-year time span and maximum value is 32,211.2 in Indonesia in 2014.

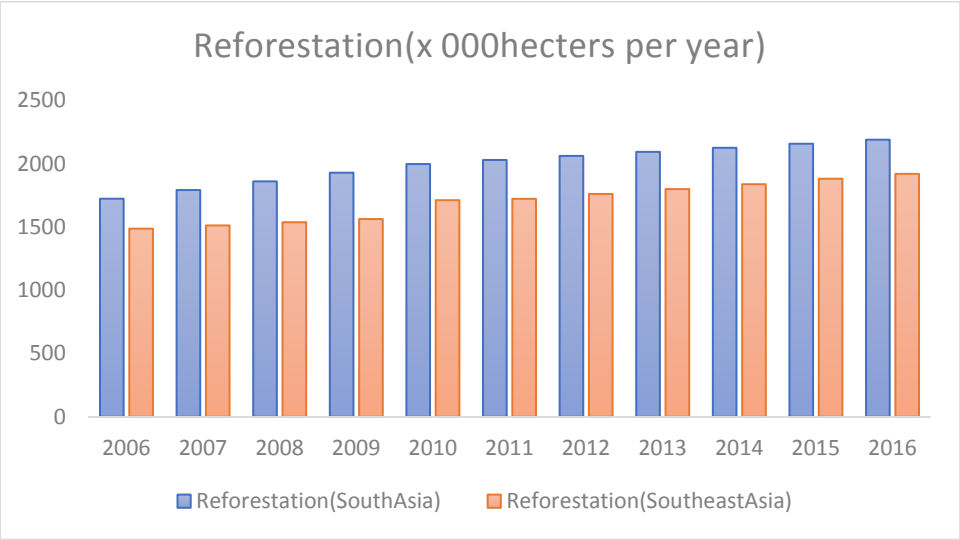
The human well-being variable was collected from GALLUP database which used survey strategy to get the overall life satisfaction of people using life ladder approach in a scale of 1 to 10. The average value for well-being is 5.

The highest level is 7.1 in Singapore in 2014, and the lowest level is 3.1 in Afghanistan in 2014.

Hence, the control variable shows that the indicator may have a relationship with well-being but is not contained within model as an environmental quality variable.

To get precise understanding about prevailing state of environmental quality and well-being in SA and SEA, this study also considered the frequency value for respective indicators started from 2006 to 2016. First, indicator of rebuilt natural capital activities (reforested forest area) was on increase from 2006 to 2016 for both region (seen on Figure 4.1 and Figure 4.2). However, the amount of reforestation was much higher for South Asian countries compared to Southeast Asian countries. It occurred because the Ministry of Environment and Forestry of the countries of both region increased the number of seeds that were disseminated nationwide in each year. The total for the national level in South Asian countries was 2030 hecters reforestation area in 2011 and 2190 in 2016 (Ministry of Environment and Forestry; and Global Forest Report 2015). And for Southeast Asian countries the corresponding values were 1723 hecters in 2011 and 1920 in 2016(Ministry of Environment and Forestry; and Global Forest Report 2015).

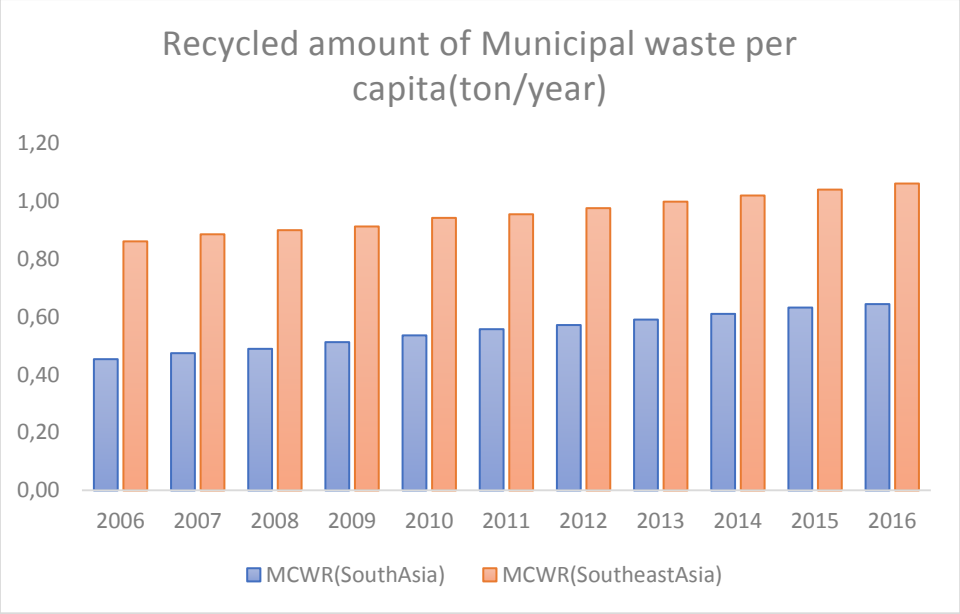
Figure 4. 1: Average Reforestation amount in South Asian & Southeast Asian countries



Reforestation activity indicates that there was a decrease of activity from 2007 to 2010 for Bangladesh however from 2011 the activity was again increased due to the reforestation activities along the roads, embankment and railway lines Global Forest Report Bnagladesh,2015). For Cambodia from 2007 to 2010 there was a slight decrease in reforestation activities but from 2010 the activity was constant (Global Forest Report Cambodia,2015). Therefore, reforestation activity tended to increase for rest of the countries accept Singapore and Afghanistan among which Singapore has zero reforestation activity and Afghanistan data was missing in the report (Ministry of Environment and Forestry; and Global Forest Resource Assessment,2015).

The projected treated municipal waste increased during time span of 2006 to 2016 (Figure 4.2), the figure increases from 0.45 to 0.69 tons per year for South Asian countries. For Southeast Asian countries, the figure rises from 0.86 to 1.06 tons per year. Singapore and Thailand are the performing recycling municipal waste activities at the highest rate compared to other Southeast Asian countries. Among South Asian Countries, the recycling rate is highest for Bhutan and India.

Figure 4. 2: Average recycled amount of municipal waste per capita per year in South Asian &Southeast Asian countries



The average national level of recycled municipal waste was projected considering both rural and urban areas. However, urban levels have improved waste recycling technology, along with a non-formal sector work along with government in treating municipal waste in urban levels for countries especially Bangladesh (Department of Environment, 2015). For instance, Bangladesh has introduced National 3R strategy for waste management in 2010 and data indicated that recycled amount of municipal waste increased during 2010 to 2016 from 3.01 to 3.93. This happened due to the enormous number of waste pickers from informal sector and NGO movement that was involved in municipal solid waste treatment activities. Among other South Asian countries recycling rate of Indian cities is also very high compared to other South Asian countries however there was fall in recycled amount of waste in year 2008, 2010, 2012, 2014.

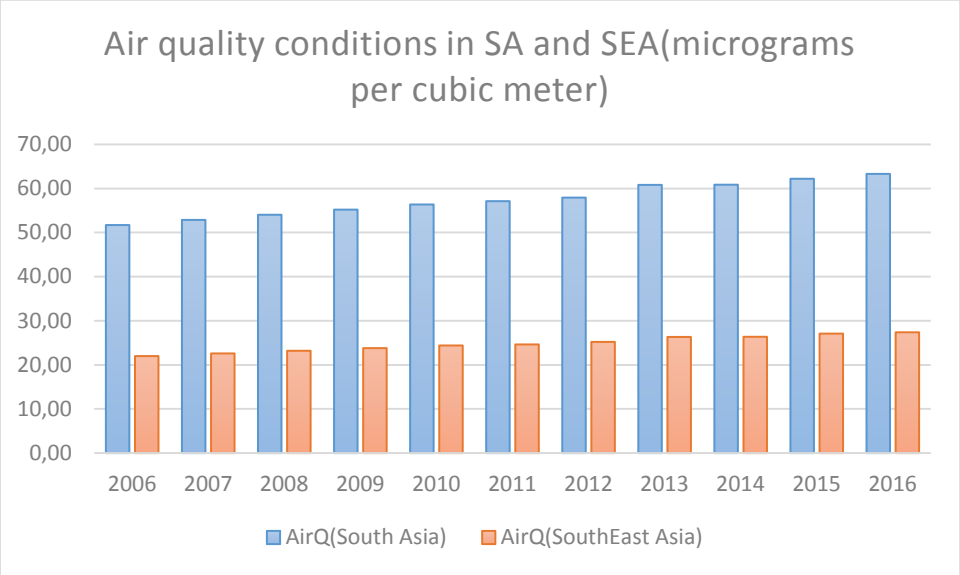
Secondly, environmental quality variables indicate air, water quality conditions and waste generation per capita in South Asian and Southeast Asian countries (Seen on Figure 4.4). Concentration of PM2.5 tended to increase from 21.99 micrograms per cubic meter in 2006 to 27.38 in 2016 in Southeast Asian countries. And concentration of PM2.5 tended to increase from 51.7 in 2006 to 63.30 in 2016 in South Asian countries. One of the reason was an increasing of CO2 emission from transport sector for these countries, however for southeast Asian countries co2 emission from transport sector is increasing at a slower rate compared to the South Asian countries which might be the reason behind the greater rate of increase in particulate matter emission as well. These circumstances indicate that carbon emission is corresponds with the increasing number of industries and motorized vehicles. For example, in Bangladesh the peak PM2.5 concentration (90.82) is observed in 2016 with the highest number of motorized vehicles being 2,879,708 in 2016 as well as private vehicles being

308,541(Statistical pocket book, 2016). Moreover, the carbon emission from residential sector is also highest in Bangladesh in 2016(Statistical pocket book, 2016).

In general, the air quality is getting worse in South Asian countries compared to the Southeast Asian countries (Seen on Figure 4.4) however, water quality is decreasing for both region.

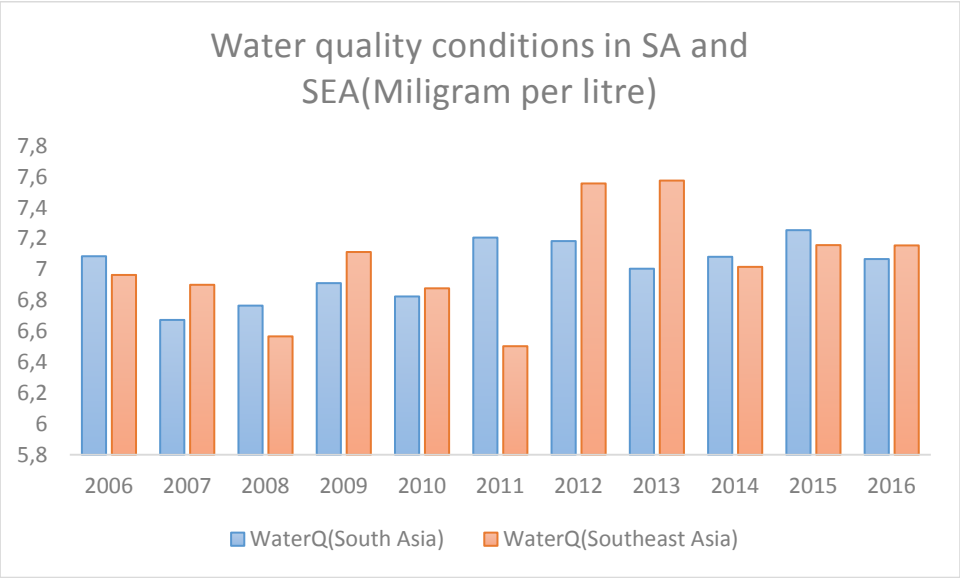
This can be explained using notion of atmospheric teleconnection. The remote effect of black carbon(aerosol) in SA on summer monsoon of SEA is responsible for 5–10% of the total rainfalls in SEA. Outcome of this remote effect is observed in decline in supply of moisture from Bay of Bengal towards SEA (Rashed, 2014). Atmospheric moisture content or humidity has negative correlation with PM2.5 concentration(Jianhua, 2015). In presence of higher moisture content concentration of particles in atmosphere is reduced as particles fall to ground(Jianhua, 2015). Above mentioned information explains the increase in PM2.5 concentration in South Asian countries compared to countries in Southeast Asia. Furthermore, it draws attention towards thinking beyond rural-urban dichotomy by focusing on the fact that climatic events have broad impact beyond geographic boundaries.

Figure 4. 3: Air quality conditions in South Asia and Southeast Asia



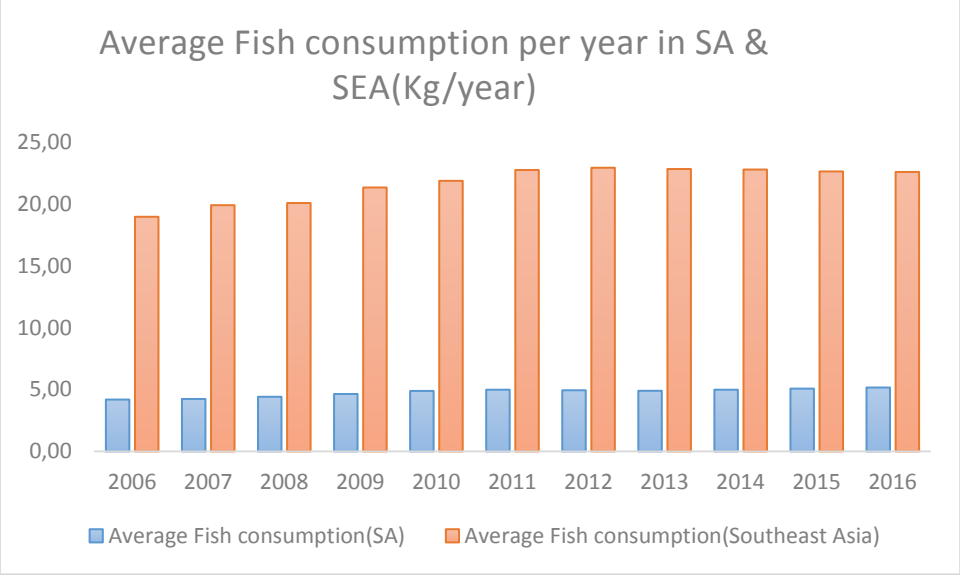
PM2.5 being an vital element of aerosols has adverse impact on health and environment(Daji, Gebreab,Xun, Anne, David, 2017). Additionally, presence of some pollutants in air cause more acidic decomposition in atmosphere which eventually drains into river and lake water through acid rain. Water quality of river has seen fluctuations during the time span of 2006 to 2016. Water quality is affected by several factors such as level of pH, temperature, industrial pollutants etc. Hence, it is difficult to identify the reason behind this change. But, it is worth to mention here, few countries are taking adaptive actions towards mangrove reforestation. And, planting more forestry in area adjacent to river has potential to improve quality of water (Zanata, Pissarra, et al., 2015). This could possible answer the slight increase in level of dissolved oxygen in year 2016 in comparison with year 2006.

Figure 4. 2: Water quality conditions in South Asia and Southeast Asia



Per capita consumption of fish, accessibility of clean water and terrestrial protected areas are the indicators of environmental services consumption variable (seen on Figure 4.5, 4.6, and 4.7).

Figure 4. 5: Average Fish consumption per year in South Asian & Southeast Asian countries



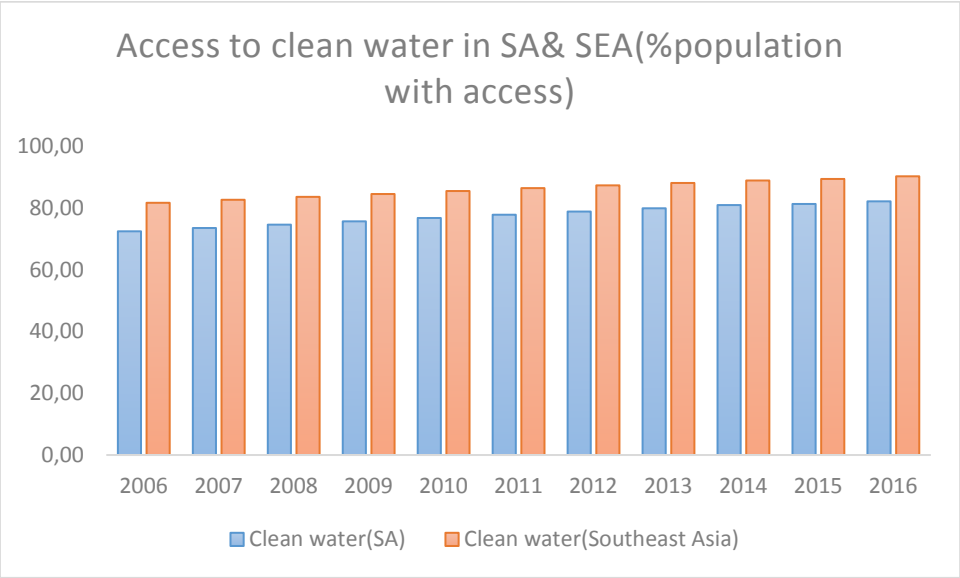
Fish consumption per capita tends to rise every year, and the average per capita consumption of fish rose 5.17Kg per capita in 2016 from 4.2 in 2006 in South Asian countries and in Southeast Asian countries the figures were 18.99 to 22.62 correspondingly. Fresh fish was captured from both fresh water and marine water resources. The amount of fresh water fisheries production found to be higher compared to marine water fisheries production; for example, in Bangladesh the marine fisheries production was 118,432.93 tons, while the freshwater fisheries production was 2,816,952.583 tons in 2016 however for Cambodia the situation was vice versa. For all countries, freshwater fisheries production is higher than

marine water except Myanmar, Malaysia, and Cambodia. However, consumption of fresh fish consumption per capita moves parallelly with fisheries production, with several countries producing higher number of fisheries. For instance, Cambodia has 41.72 kg per capita fish intake and the produced fisheries from marine water sources was 102,802.4 ton in 2016 (FAO).

Hence, it is worth to mention here that countries in SA experienced less increase in fish consumption per capita as well as less increase in captured number of fish both from fresh and marine water. This can be explained by the migration of fish from warm water and melting of ice caps.

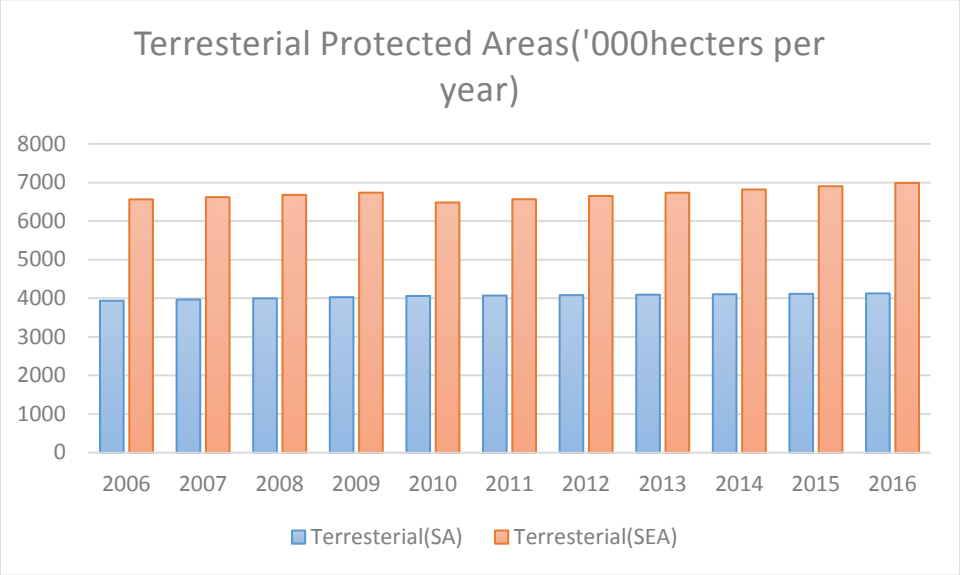
Moreover, these countries in the study area did not experience decline in captured fish rate as flood water brings new fish species into these countries with simultaneous migration of some species(Clare, 2014). Furthermore, some policy initiatives as well as fish aquaculture practices prevent the decline fish catch potential.

Figure 4. 6: Access to clean water in South Asian & Southeast Asian countries



The accessibility of clean water denotes safe drinking water in household levels, and it is expected that households living close to safe water source are likely to have good health. From 2006 to 2016, the clean water accessibility percentage rose from 72.44 to 82.14 in South Asian countries while for Southeast Asian countries the figure increase from 81.67 to 90.25. The increasing percentage of clean water consumption occurred because the dissolved oxygen levels on rivers tended to increase, and higher levels of dissolved oxygen is important both for drinking water and aquatic resources.

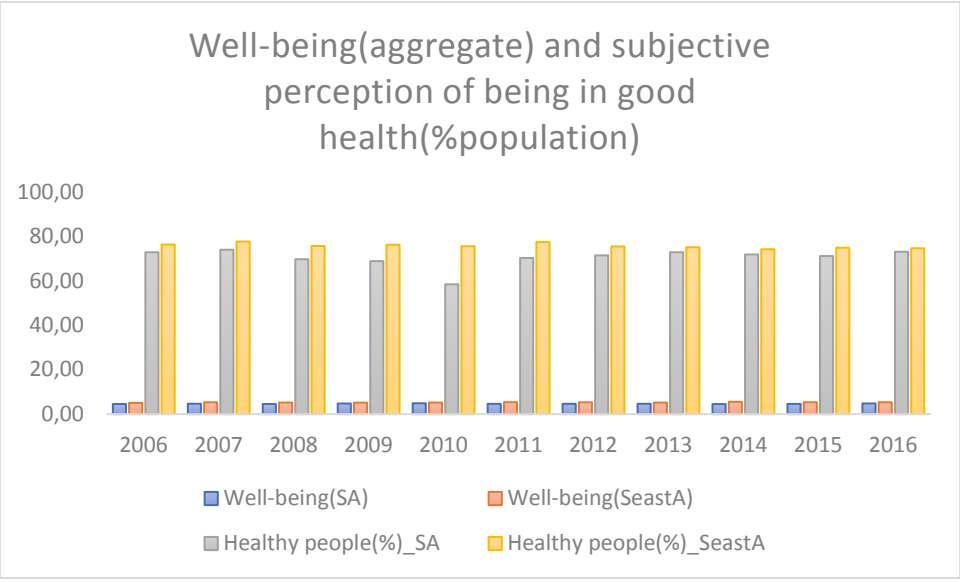
Figure 4. 3: Terrestrial Protected Areas in South Asian & Southeast Asian countries



The terrestrial protected areas were decreased in year 2010 for Southeast Asian countries, however from 2011 the area again increased from 6,482.572 to 6,988.441 in 2016. Growing concern towards the adverse effect of over fishing on ecosystem has motivated governments of countries in the study area to put more emphasis on protecting terrestrial protected areas.

According to (Walter, 2005) terrestrial ecosystems is net source of carbon sink and offset the warming effect of associated carbon emissions from land cover change. According to the statistics it can be mention that the countries having higher terrestrial protected areas were found to have less PM2.5 concentration in air as well as less carbon emission.

Figure 4. 4: Well-being and subjective perception of being in good health in SA & SEA



Higher good health conditions indicate higher human well-being. In general, well-being tends to increase from 2006 to 2016 except year 2008, 2011, and 2014(seen on Figure 4.6), from 4.54 to 4.79 for South Asian countries. For Southeast Asian countries, the figure dropped in year 2008, 2013, and 2015. The highest average number of people who perceive good health condition is 73% in SA in 2016, and in SEA the percentage is 77 in 2011. It indicates that health conditions and well-being were increasing throughout that time.

To conclude it can be mentioned that descriptive findings presented the conditions of environment and human well-being in countries of SA and SEA from 2006 to 2016. The findings show dynamic settings in each year without extreme variance values for all indicator. Besides, this study measures the relation between quality of living environment and well-being. It began from the step of measuring the inter-relationships among variables to indicate quality of environment, followed by analysing the inter-relationships of quality of living environment with well-being (the analysis stage was explained in Subchapter 3.5).

4.3 MODEL 1 – Measuring Rebuilt Natural Capital, Environmentally responsible behaviour and Environmental Quality

This model measures the inter-relationships among indicators of Rebuilt Natural Capital, environmentally responsible human behaviour and quality of living environment. The hypothesis is that activities to rebuilt natural capital and higher environmentally responsible human activities can improve the quality of living environment (Streimikiene, 2014). Two models were used for this measurement: 1) measuring Rebuilt Natural Capital indicator, environmentally responsible human behaviour and quality of air; 2) measuring Rebuilt Natural Capital indicator environmentally responsible behaviour and quality of water.

As previously mentioned, the air quality variable indicated by PM2.5 concentration, and the water quality variable is indicated by Dissolved oxygen levels in major rivers of different countries. A table underneath shows the result.

Table 4. 3:Model 1 Measurement Result 1

VARIABLES	logAirQ	logWq
logRef	-0.0182	0.0155
	(0.02)	(0.02)
cleancookingfuel	0.00541**	0.00144
	(0.00)	(0.00)
logMCWR	0.270**	0.0511
	(0.11)	(0.05)
Rsquared	0.0662	0.1708
Observations	132	132
Number of CountryID	12	12
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1		

The first measurement shows that an additional one-hectare reforested area can improve quality of air by reducing particulate matter by 0.01 percent (seen on Table 4.3). This relationship is in accord with prior study findings which explained that reforestation activities

can remove air pollution by intercepting airborne particles (Cavanagh, Zawar-Reza, et al., 2009, David. J. Nowak and Gordon. M. Heisler, 2010). The meaningful relation between municipal waste recycled per capita and air quality implies that waste recycling activities can improve air quality by 27 percent. This result implies that reforested area can also contribute to air pollution reduction and thereby can increase quality of air. Moreover, forest areas perform waste assimilation activities which may also enhance waste recycling activities as trees are also responsible for nutrient cycling in environment(Walter, 2005).

Furthermore, reducing the quantity of PM2.5 can decrease the incidence of respiratory illness in South Asian countries(Khwaja, Umer, et al., 2012).

Treated municipal waste and quality of air found to have positive significant association implying 0.27 percent improvement of quality of air with a one percentage increase in per capita treated municipal waste. It can be explained that in general activities to recycle municipal waste could reduce released amount of pollutants to air and as a result quality of air is improved. This relationship is in line with the findings of (El-fadel, Shazbak, et al., 1999, Crowley, Staines, et al., 2003) which explained the potential of waste landfill mechanism in attenuating health risk.

Use of clean cooking fuel can improve quality of air by 0.57 percent which is as expected as prior study (Khwaja, Umer, et al., 2012, William.Martin, John.Hollingsworth, et al., 2014, Komalkirti.Apte and Sundeep.Salvi, 2016) findings. According to (Komalkirti.Apte and Sundeep.Salvi, 2016) in Southeast Asian countries the third major determinants if disability adjusted life years is household air pollution which is true for South Asian countries as well(Khwaja, Umer, et al., 2012). Exposures to indoor air pollutants in early childhood tend to have the highest impact on the respiratory system, particularly pregnant women exposed to smokes from the burning of biomass or solid fuel were found to have a twofold danger of having eclampsia in comparison with those who used clean fuels for cooking(Khwaja, Umer, et al., 2012, William.Martin, John.Hollingsworth, et al., 2014, Komalkirti.Apte and Sundeep.Salvi, 2016). Also, according to (Anita Shankar,2015), it is important to engage women in using clean cooking fuel to reduce air pollution as well to increase women well-being.

Over-all, pollutants released by private cars, trucks, power plants and other sources—produce nitrogen, particulates, suspended particulate matter, and chemical contaminants that are hazardous for quality of air, soil and water air pollution. Tree species which has ability to absorb pollutants released in air can reduce air pollution (OECD, 2016).

Therefore, (Pimentel, Cooperstein, et al., 2007) found that in developing countries air pollution is perceived as an important concern especially in South Asian and Southeast Asian countries. In developing economies, use of cooking fuel is the basic reason behind indoor air pollution (Pimentel, Cooperstein, et al., 2007). As per (World Health Organization, 2006) report worse quality air increase death in form of respiratory and heart diseases. Air pollution is responsible for 2.7 percent of the global disease burden(World Health Organization, 2006, Pimentel, Cooperstein, et al., 2007). (Pimentel, Cooperstein, et al., 2007, Khwaja, Umer, et al., 2012, William.Martin, John.Hollingsworth, et al., 2014, Komalkirti.Apte and Sundeep.Salvi, 2016) found that people typically spend maximum time at indoors where air circulation is somehow restricted.

Second measurement model designates that the indicators of rebuilt natural capital and environmentally responsible behaviour do not affect the quality of water which is expected

because prior research done by (The USGS water science school, 2016) found that sedimentation as a key determinant of ongoing adverse impact of river water quality. Sedimentation in watershed zones of developing countries is occurring due to extreme rainfall, agricultural activities, and land use pattern (UNESCO, 2006). The report concludes that whether there is low or greater amount of reforestation or tree plantation activities, and municipal waste recycling activity, it cannot impact quality of water if sedimentation occurs.

So, in a nutshell, finding shows that rebuilt natural capital and environmentally responsible behaviour possibly impact quality of air but not quality of water. It can be explained that use of clean cooking fuel and municipal waste recycling activities have positive significant association with quality of air.

Besides, the second model deals with the inter-relationship between quality of environment indicators and environmental services consumption.

4.4 MODEL 2 – Measuring Environmental Service Consumption and Environmental Quality

This measurement is about the association between environmental services consumption and indicators of environmental quality. The hypothesis is that better environmental quality can produce greater amount of environmental services to consume (Streimikiene, 2015).

This model has two measurements: 1) measuring consumption of fresh fish, access to clean water and quality of environment and; 2) comparative measurement of environmental quality, consumption of fresh fish, and clean water consumption among South Asian and Southeast Asian countries;

Environment provides human provisioning services which includes providing crops, water, oxygen, fiber, fuel, biochemicals, natural medicines, and pharmaceuticals(Walter, 2005). Along with these services it also serves for regulating quality of air by cleansing itself of pollutants such as ammonia, NOX, SO2, particulates, methane(CH4) etc, water purification, waste treatment, natural hazard regulation, pollination, maintaining balance in climate, and recycling essential of the nutrients for agricultural products(Walter, 2005). For example, trees provide oxygen and purifies air by absorbing pollutants; control natural hazard maintaining balance of the hydrological cycle and temperatures(Walter, 2005).

According to (Basiago, 1998, Collados and Duane, 1999) services drawn from nature are also related to materials flow, and information from natural capital stock.

Results of measurement one shows that an increase of 0.68% fish consumption is possible with one percentage improvement of air quality (Table 4.4). It implies that less air pollutions can increase the quality of fish. Similar result is found with the next measurement, indicating increase of 71.2% of clean water consumption due to one percentage increase in quality of air. So, it can be summarized that less concentration of pollutions in air can improve the state of fish health leading to a meaningful effect on consumption of clean water.

Convenience of the meaningful relationship between quality of air, consumption of fish and accessibility of clean water is observed in study of (Shimshack, Michael, et al., 2007) which also stated that for quality of fish products mercury is a hazardous pollutant which is released to from industrial activities. According to ((Jedrychowski, Perera, et al., 2007)) air pollution is responsible for damage of fish in 200 lakes and ponds in U.S in year 1983. (B. Austin,1999)

mentioned that release of massive quantities of pollutants to environment may cause immediate effect on aquatic organisms i.e. fish mortality due to use of agricultural pesticides.

Discharge of sulphur dioxide (SO2), nitrogen dioxide (NO2), CO2 (carbon dioxide), particulates is a major problem of the consumption of environmental services(Shafik and Bandyopadhyay, 1992). Consequently, Shafik (1994) argued that much of the concentration of the pollutants in air and water is quite recent and is likely to correlate with the quality of services provided by environment.

Table 4. 4 Model 2 - Measurement Result 2

VARIABLES	(1) logFish	(2) Cleanwater
AirQ	0.0068*	0.712***
	(0.004)	(0.14)
logWq	0.0407	-0.3734
	(0.09)	(1.79)
Rsqaured	0.17	0.03
Observations	132	132
Number of CountryID	12	12
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1		

Access to clean water and sanitation are key factors for developing healthy life. Provision of incentive for collective sanitation generated greater public health and economic gains by reducing adverse health effects and health care costs in countries of Southeast and South Asia. It also promotes empowerment of communities and equity among women. Furthermore, the access to improved water source also alleviate poverty in rural or urban areas(Juliet, James, et al., 2008).

Table 4. 5:Model 2 - Measurement Result 3(Regional analysis)

VARIABLES	logFish(SA)	logFish(Southeast Asia)	Cleanwater(SA)	Cleanwater(Southeast)
AirQ	0.00476	0.0212***	0.616***	0.964**
	0	-0.01	-0.06	-0.44
logWq	-0.00834	0.0676	-2.457	2.403
	-0.12	-0.09	-1.51	-1.89
Rsqaured	0.12	0.39	0.01	0.23
Observations	66	66	66	66
Number of CountryID	6	6	6	6
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1				

This model describes the meaningful association between quality of air and fish in Southeast Asian countries which is supportive to prior researchers' (B. Austin 1999) findings. Results

indicated that 1 percentage increase in air quality is associated with 0.47 percent increase in fish consumption in South Asia while for Southeast Asia the increase is 2.12percentage. Similar result is found with the clean water, indicating increase of 61.6% of clean water consumption due to one percentage increase in quality of air in South Asia. In case Southeast Asia, one percentage increase in quality of air is associated with 96.4 percentage increase in clean water accessibility.

This model could also establish the meaningful relationship between air quality and accessibility of clean water consumption in both South Asian and Southeast Asian countries which is supportive to prior findings which stated that air pollution and quality of water are closely related and better-quality air can improve quality of water (Louis, McCabe, et al., 1952, Tord, Madhumita, et al., 2006). It can be explained that in substantial number of cases waste released to atmosphere also pollute river water (Louis, McCabe, et al., 1952). This can be observed in terms of acid rain causing pollution of river flowing near the coal industries(McCabe, Pond, et al., 1952). In general, air-borne particles are suspended particulate matter (PM) including mineral and metal dusts, coal fly ash, fumes, acid hazes i.e. sulphuric acid, and nitrogen dioxide, wood smokes, gases, odour, PM10, and the most harmful, PM2.5(Tord, Madhumita, Tony, Geetha, Rupendra, Sally, 2006). Much of PM2.5 comprises of Pollutants such as sulphuric acid(SO_2) and Nitrogen dioxide (NO_2) which are the main cause of acid rain resulting in acidification and sedimentation in river and lake water(Tord, Madhumita, Tony, Geetha, Rupendra, Sally, 2006). So, result of this measurement model is linked with prior studies explaining the relationship between quality of air and water. Findings of prior research explained the importance good quality which may contribute to quality of river water.

To conclude, it can be stated that association between indicators of environmental quality and environmental service consumption tends to convenient with the hypothesis. Also, better quality air has an influence on fish health, and water purification which implies in clean water productions. These effects altogether explain the increase in average fish consumption per capita in Southeast Asia i.e. particularly in Cambodia from 2009 to 2016.

Furthermore, the linkage between quality of environmental and well-being is also measured in the model. Next model measures the relation without any control variable.

4.6 MODEL 3 – Measuring Well-being in country scale

(Streimikiene, 2015) mentioned quality of environment as a crucial aspect of human well-being since human health is directly impacted by better quality environment. Author considered grouped indicators of environmentally responsible behaviour, environmental services consumption, and quality of environment. In harmony with previously mentioned theoretical background (seen in Subchapter 3.3) this research hypothesis is environmentally responsible behaviour, environmental services consumption, and quality of environment are inter-related, and can influence human well-being in the study area.

From previously mentioned measurement it can be concluded that environmentally responsible behaviour such as clean cooking fuel, municipal waste recycled per capita and combined effect of reforestation and municipal waste recycling activities affects quality of air and consequently better quality air affects the consumption of fish and clean water which is provided by the environment.

This model describes an in-detail measurement to find the inter-relationship among indicators of environmental quality with well-being in countries of Southeast Asia and South Asia from year 2006 to 2016. The significance of this measurement lies in the leading role played by environment on human physical and mental health(Walter, 2005).

This sub-chapter has four models. Firstly, this study aims to determine the association between human well-being and dimensions of environmental quality i.e. air and water quality partially. Secondly, combined effect of all indicators of environmental quality, rebuilt natural capital, environmentally responsible behaviour and all control variables on human well-being is being measured. Thirdly, the comparative measurement is being performed between the two regions. Fourthly, the interaction effect between ERB and EQ has been performed to test the hypothesis that combinedly they improved quality of environmental services for human consumption.

The results of the measurement are being presented in the following table.

A Hausman test result indicated the model to be random effects model (prob>chi2 = 0.8802) in regression. First model deals with indicators of rebuilt natural capital and environmentally responsible behaviour with human well-being. Result shows that an increase of one-hectare reforested area can contribute to 7% of human well-being. One percentage point increase in clean cooking fuel use can increase 1.36 % of human well-being. One percent increase in municipal waste recycling activities can contribute to human well-being by 7.5%. (Cavanagh, Zawar-Reza, et al., 2009)

These results imply that higher amount of reforestation activities and environment friendly human activities can improve human well-being.

(Khwaja, Umer, et al., 2012, William.Martin, John.Hollingsworth, et al., 2014, Komalkirti.Apte and Sundeep.Salvi, 2016) found that use of cleaner fuel can reduce the chances of pre-or post-eclampsia among pregnant women. Prior studies done by (Streiling.S.A.Matzarakis, 2003, Dennis, Jeanie, et al., 2011, Loyde.Vieira.de.Abreu-Harbicha, Lucila.Chebel.Labaki, et al., 2015) found that reforestation or tree plantation can control temperature of air by increasing humidity and can also absorb pollutants on tree leaves. Moreover, authors also mentioned the function of trees on carbon sink and radiation from sun. In addition, (Dennis, Jeanie, et al., 2011) mentioned that air temperature can impact well-being in form of heat-island effect.

Table 4. 6:Model 3 – Measurement Result 4

VARIABLES	wellbeing	wellbeing	wellbeing	wellbeing
logRef	0.0735*			0.0828*
	(0.04)			(0.05)
logMCWR	0.0128			0.242
	(0.14)			(0.24)
cleancookingfuel	0.0128**			0.0105**
	(0.01)			(0.00)
AirQ		0.0148		0.00081
		(0.012)		(0.01)
logWq		0.0019		-0.230
		(0.315)		(0.34)
c.AirQ#c.logWq		-0.0078		-0.0049
		(0.006)		(0.01)
logFish			-0.1080	-0.198
			(0.14)	(0.15)
Cleanwater			0.0104	0.0016
			(0.008)	(0.01)
Rsquared	0.61	0.10	0.19	0.58
Observations	132	132	132	132
Number of CountryID	12	12	12	12
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1				

Second model measures human well-being with quality of environment. The result shows that one percentage improvement of quality of air can contribute to 1.4% increase of well-being. However, lower or higher quality water is found non-influential to the well-being. The significant linkage between well-being and good quality air is in line with prior studies that described being exposed to air pollution could harm human life for a short while in form of coughing and for longer period in form of malfunctioning of heart and lung (Khwaja, Umer, et al., 2012, William.Martin, John.Hollingsworth, et al., 2014, Komalkirti.Apte and Sundeep.Salvi, 2016).

According to (Cavanagh, Zawar-Reza, et al., 2009) air pollution is responsible for about 8,00,000 premature death on global scale. Statistics mentioned in report of United Nation (2013) revealed that in developing economies, 94 million tons of pollutants were released in form of particulate matter and ozone gas in the environment. These pollutants could cause damage to eyesight(Khwaja, Umer, et al., 2012). Form previously mentioned theories, it can be concluded that higher concentration of pollutants in air reduce quality of air and thereby human well-being in form of poor health.

Third model measures the environmental services consumption and well-being. The result indicates access to clean water can impact the human well-being. A one percentage increase in access to clean water can lead to 1.01% increase in well-being. It implies that a higher accessibility to clean water can result in better health since dirty water can cause waterborne diseases that has health-impact to human well-being.

Forth model measures overall quality of environment with well-being. The result shows that 8.28% increase in well-being is associated with one hectare increase in reforested area, therefore one percentage improvement in quality of air can increase 0.8% well-being. Meanwhile, one percent increase in clean water accessibility can increase 0.16% well-being. Model combined with all variables, changes few things, such as clean water remains insignificant with well-being but reforestation and use of clean cooking fuel remain significant as in prior models. Therefore, the coefficient of clean water is found to be smaller than previous case.

Reforestation activities play central role in restoring critical land and the empty lands that were previously used for industrial purpose or perilous landfill areas(EDWARD.GILMAN, LEONE, et al., 1976, V. Alaric and Patrick.Bixler, 2014, Smith, Cotrufo, et al., 2015). Moreover, composting could be useful for increasing the regulating and supporting services of degraded lands as well as rebuilding natural capital activities have the capacity to restore the biochemical cycling of carbon, nutrients and oxygen, in the air (Smith, Cotrufo, et al., 2015, S.C.Cunninghama, R.Mac.Nally, et al., 2015).

Reforestation allow movement of species between patches of forest as well as ensure balanced population of species existing in the river, ocean, soil, and hinterland(Heidi, E., Robinson, 2015). As the water purification mechanism and maintaining nutrient cycle are the basic regulating services provided by the trees, the severe impacts of degraded forest area can be minimized by reforestation activities(Smith, Cotrufo, et al., 2015, S.C.Cunninghama, R.Mac.Nally, et al., 2015, Jennifer and Maginnis, 2016). As a consequence of the above-mentioned functions of trees, quality of water is improved and consequently have considerable effect on supply of clean water.

Quality of air is important for health of ecosystem as well as human beings(Walter, 2005). Air with less pollutants concentration sustains health of ecosystem leading to an improved human well-being. Several airborne particles leave negative effects on air quality in the long-run which can be substantial source of pollutant intake to water (United States Environmental Protection Agency report,1977). In a study conducted on influence of air quality on water quality of lake 'Tahoe' it is mentioned that air borne pollutants such as nitrogen, and phosphorous has potential to have chemical reaction with nutrition of water bodies. This can occur through acid rain which run-off the land and ended up in water bodies. Environmental resources such as aquatic resources and water bodies are the worse victims of acid rain after forests, fields, buildings, and roads. Furthermore, it also results in extinction of fish, vegetation, and animals which are sensitive to acidic water. Moreover, pollutants concentration of air has the potential to increase proportion of algae's in water bodies (Reuter,John, Allen, Brant,Goldman,Charles,Jassby,Alan, 2000).

Quality of water is important for health of ecosystem and human beings however, the growing demand for accessibility to clean water is responsible for extensive changes of inland water resources(Tanja.Srebotnjaka, Genevieve.Carrb, et al., 2011). It is essential to maintain

sufficient quantity and quality of water for human as well as aquatic and terrestrial resources which is a goal of sustainable development(Tanja.Srebotnjaka, Genevieve.Carrb, et al., 2011). Environmental quality leave impact on people's day to day life and directly influence perception of well-being (Paul, Melanie, et al., 2007).

Hence, inferior quality of air and water is the reason behind the death of more than 1.5 million children from water borne diseases each year. Healthy ecosystem, improved human well-being, and environmental services are among the several positive impacts of refined quality of air.

Healthy ecosystem, improved health, adequate environmental services provision and improved livelihoods are some of the enormous benefits associated with improved quality air.

Since 2005, governments of the countries of the study area prioritized reforestation activities in the critical lands, vacant lands and watershed area to safeguard rivers from metals, chemicals, biological pollution, and oxygen depleting nutrients. For instance, from year 2005 national government of Bangladesh took strip plantation activities specially to protect degraded watershed areas in coastal belt (Global forest report Bangladesh, FAO,2015), Ministry of Forestry Indonesia also have activities, such as rehabilitation and afforestation along river and road (Global forest report Indonesia, FAO,2015), Ministry of Environment and Forests India put more emphasis on protecting mangrove forest cover in coastal or inter-tidal region since year 2000(Global forest report India, FAO,2015), and Department of Forestry Vietnam has increased the proportion reforestation of ''forest area for protection of soil and water'' since 2005(Global forest report Vietnam, FAO,2015).

Furthermore, effective steps to preserve natural resources of water; plays a significant part in accelerating fresh water withdrawal and thereby ensuring more accessibility to clean water sources. According to Sustainable Development Goals (SDGs) Report (2016), providing clean water and sanitation are essential to ensure healthy lives and promote human well-being at all ages. According to WHO REPORT,2015 globally communities are yet to achieve the target of reducing number of household without access to safe water by 2015. In case of South Asia, the human population having access to improved sources of water is rising from 72.44 % to 82.15% from 2006 to 2016 while in Southeast Asian countries the figure rose from 81.67% to 90.25%. (Rogerson, 1995) mentioned the meaningful relationship among quality of environment, clean and sufficient withdrawal of freshwater, and existence of biological diversity. Therefore, concern about quality of environment to ensure human well-being has become an issue not only at national but also at global scale(Rogerson, 1995).

A trade-off exists between market price of preserving and consuming environment services(Erik, Rudolf, et al., 2009). Authors referred to the model used by Krutilla et al. (2002) and simultaneously stated that well-being function evolve around a broader role for environmental resources rather than consumption of environmental services. This model indicates that improved quality of air influences accessibility of clean water implying that greater water supply can increase consumption amount. Consequently, accessibility to clean water sources could impact human well-being. However, the accessibility of clean water in several developing countries, found to create inequitable service provision in form of illegal connections and leakages(Mafuta, 2011).

Additionally, less access to clean water sources could reduce consumption of clean water and thereby have impact on human health especially elderly, children, and pregnant women.

Unsafe water may contain toxic particles which could cause premature death of children. clean water and sanitation have impact on life expectancy at birth(Nicola.Bulled and Richard.Sosis, 2010, Dr.Jay.Rajapakse, 2015). Moreover, increasing concentration of pollutants in water causing danger to clean water resources as well(Gleick, 2014).

This study found fish consumption per capita to have an intermediate aspect to improving well-being and fish health is directly related with amount of dissolved oxygen in river water(Steven.Craig, 2009). Water consumption form unsafe sources may result in stomach illnesses, for example cholera, hepatitis, typhoid, dysentery, and diarrhea. These diseases could leave long term impact in body functioning in form of loss of eyesight, reduced productivity and disability to walk. (Albrechts, 1999) argued that if people have disability they do not have higher level of satisfaction to life as they possess poor health condition and disability distorts the social world of individual as well as community. Human well-being not only includes good health but also participation in social life(Albrechts, 1999, Paul, Melanie, et al., 2007). It implies that local environment can directly affect people's sense of being and it could affect the ability to interact in society.

To summarize, three indicators that influence the human well-being which are: reforested amount of area, air quality, and consumption of fresh fish. However, from explanation of the objective status of environment it is expected that human well-being would be influenced mostly by quality of environment. However, this expectation does not preclude the environment friendly actions leading to better quality environment which are not as significant dimensions of environmental quality as would be anticipated but could influence well-being. Therefore, it is essential to measure other dimensions of environment that could be a key factor of human well-being. Further models in this research clarify the inter-relationship between human well-being and quality of environment in presence of control variables. Control variables derive from demographic dimensions, such as subjective perception of being well (percentage population), per capita GDP, as well as social dimensions, such as life expectancy at birth, sanitation, and percentage people who completed primary education.

4.6 Model 4: with Controls and subjective perception of environmental quality

This model combines the relationship between well-being and indicators of environmental quality in presence of control variables. The reason behind this model is to check the possibility of subjective perception of sense being in good health, subjective perception of environmental quality, and control variables to affect environmental quality and well-being measurement, or the possibility to affect human well-being directly.

It describes six models used to measure association of subjective perception of being in good health, and environmental quality with human wellbeing in presence of the control variables. The measurement starts with first model including one control variable, the second to sixth model adds more control variables and subjective perception in the measurement. Therefore, a Hausman test result shows that this model uses random effects (prob>chi2 = 0.5176) for regression.

When the model used several control variables, reforestation activities remained significant in each model. In general, higher reforested area can work as a buffer zone for safeguarding

human and environment from natural adversities. The relationship remained same with subjective perception of environmental quality.

Using subjective perception of being in good health is as a control variable, with the hypothesis that subjective perception of health status influences well-being, each model showed significant effect.

Life expectancy at birth is taken as a control variable assuming the positive relationship between life expectancy and well-being. The result shows positive but no significant relationship between them. This result is not expected because higher life expectancy at birth reflect good health condition which should be an important determinant of well-being. In the measurement, the interaction effect between life expectancy at birth and water quality is used, on ground of the inter-relationship of life expectancy and clean water consumption. However, no significant impact is found from the interaction term.

The 'accessibility to improved sanitation' is used as a control variable, with the premise that sanitation facility at nearest possible distance is expected to reduce the possibility of waterborne diseases. Moreover, access to clean water influences the clean water consumption. People living close to sources of clean water will likely use more safe water than those living distantly. The latter are more likely to use unsafe water. The outcome indicates that clean water accessibility has higher chances to affect human well-being.

Level of education is presumed to affect environmentally responsible human behaviour and environmental services consumption. Individuals who have education are likely to be environmentally literate however, the result indicates that having a higher or lower level of education has no impact on developing environmental awareness.

Income and education are one of the major determinants of life evaluation. The findings of this research show that per capita GDP becomes significant with education and subjective perception of environmental quality. It can be explained form the prior study (Kahneman and Krueger, 2006, Kahneman and Deaton, 2010) who found the significant positive relationship between income and life evaluation which means satisfaction to life.

Table 4. 7: Model 4 – Measurement Result 5

VARIABLES	(1) wellbeing	(2) wellbeing	(3) wellbeing	(4) wellbeing	(5) wellbeing	(6) wellbeing
logRef	0.0925*	0.0801*	0.0810***	0.0789***	0.0813***	0.0540**
	(0.05)	(0.04)	(0.02)	(0.02)	(0.02)	(0.02)
AirQ	-0.0063	-0.0019	0.0043*	0.00530**	0.0053**	0.0067***
	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
logWq	27.08	14.33	23.08	31.16	33.75	38.53
	(28.63)	(30.76)	(36.03)	(40.48)	(43.22)	(43.31)
loglife	14.43	6.616	4.202	7.499	8.509	11.40
	(12.24)	(13.14)	(15.50)	(17.94)	(19.14)	(19.28)
c.logWq#c.loglife	-6.510	-3.510	-5.557	-7.500	-8.111	-9.226
	(6.75)	(7.25)	(8.49)	(9.55)	(10.20)	(10.21)
Cleanwater	-0.0012	-0.0014	0.0032	0.0020	0.0023	0.0005
	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
Fish	-0.0173	-0.0041	0.0246**	0.0210**	0.0228**	0.0205*
	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
MCWR	0.0066	-0.0043	-0.0133	0.0284	0.0179	0.0052
	(0.09)	(0.06)	(0.06)	(0.05)	(0.07)	(0.07)
cleancookingfuel	0.0115***	0.0145**	0.0199***	0.0157***	0.0160***	0.0144***
	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)
healthyPop		0.0078**	0.0112**	0.0116**	0.0121**	0.0133**
		(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
logSan			1.019***	0.919***	0.972***	0.803***
			(0.21)	(0.12)	(0.18)	(0.23)
PcGDPCurrentUS				0.0001	0.0001	0.0002**
				(0.00)	(0.00)	(0.00)
PrimaryEduc					0.00133	0.000841
					(0.00)	(0.00)
satisfiedWQ						-0.00306
						(0.00)
satisfiedAirQ						-0.0108
						(0.01)
Rsquared	0.50	0.68	0.92	0.95	0.96	0.95
Observations	132	132	132	132	132	132
Number of CountryID	12	12	12	12	12	12

Robust standard errors in parentheses

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

In conclusion, access to safe sanitation remained significant in each model. Per capita GDP became significant only when measured with education and subjective perception of environmental quality. Environmental quality especially, the air quality remained significant in each model except when measured against life expectancy and perception of good health as control variables. When the model includes subjective perception of environment, it is found to have no significant impact on well-being (seen on Table 4.7, model 6). Among the environmentally responsible behaviours and rebuilt natural capital indicators; reforestation activities and use of clean cooking fuel remained significant in each measurement model.

4.7 Model 5 Measuring Environmental dimensions of Well-being on regional scale

This model measures the association between environmental services consumption, environmentally responsible activities and environmental quality indicators using regional comparison. The hypothesis is that better environmental quality can produce greater amount of environmental services to consume (Streimikiene, 2015).

For this model, this research used software R to calculate index of environmentally responsible behaviour including Rebuilt natural capital indicator named as ''ERB'', index of environmental services consumption named as ''ES'', and index of environmental quality indicators named as "EQ".

This model is divided into four measurements: 1) measuring interaction effect of EQ and ERB on ES, and on Well-being in two regions individually; 2) measuring ERB and air quality; 3) measuring relationship between environmental quality particularly air quality, ERB, and ES in two regions individually; 4) measuring Well-being at regional scale;

Table 4. 8: Model 5 – Measurement Result 1

VARIABLES	ES(SA)	ES (Southeast Asia)	wellbeing(SA)	wellbeing(Southeast)
EQ	0.0683	0.22	0.0214	0.0894
	-0.05	-0.2	-0.02	-0.09
ERB	0.600**	0.645***	0.569***	0.327**
	-0.24	-0.12	-0.15	-0.16
c.EQ#c.ERB	-0.0173	-0.0549	-0.0661***	-0.0293
	-0.01	-0.04	-0.01	-0.04
Rsquared	0.11	0.04	0.46	0.70
Observations	66	66	66	66
Number of CountryID	6	6	6	6
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1				

The result showed that when the model used the combined effect of ERB and EQ, significant relationship among ERB, ES, and Well-being could be established. ERB could improve quality

of environment which will make more ES available for humankind and consequently increase Well-being. Interestingly, ERB remained significant at both national and regional scale.

Table 4. 9: Model 5 – Measurement Result 2

VARIABLES	AirQ(SA)	AirQ(Southeast)
ERB	13.86***	1.489**
	-2.95	-0.66
Rsquared	0.09	0.43
Observations	66	66
Number of CountryID	6	6
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1		

Results indicated that for both the regions, ERB and ES have meaningful relationship with air quality which is in accord with the previous findings of overall measurement.

Table 4. 10: Model 5 – Measurement Result 3

VARIABLES	ES(SA)	ES(Southeast)
AirQ	0.0382***	0.105***
	(0.00)	(0.03)
Rsquared	0.01	0.19
Observations	66	66
Number of CountryID	6	6
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1		

In this research, Environmental services are indicated by consumption of fresh fish and accessibility of clean water. It was found that the air quality has significant relationship with environmental services consumption. This can be explained by the fact that good quality air can result in less pollutant intake in river water and thereby improve fish health allow greater withdrawal of fresh water.

Table 4. 11:Model 5 – Measurement Result 3

VARIABLES	Wellbeing (SA)	Wellbeing (Souteast)	Wellbeing (SA)	Wellbeing (Souteast)	Wellbeing (SA)	Wellbeing (Souteast)	Wellbeing (SA)	Wellbeing (Souteast)
ERB	0.104	0.2355**					0.0772	0.298**
	0.147	0.113					-0.12	-0.13
AirQ			0.0026	0.007			-0.00358	0.0202
			-0.009	-0.009			-0.01	-0.02
ES					0.1557*	0.019	0.133*	-0.197
					-0.08	-0.055	-0.07	-0.13
Rsquared	0.26	0.70	0.14	0.36	0.33	0.02	0.34	0.74
Observations	66	66	66	66	66	66	66	66
Number of CountryID	6	6	6	6	6	6	6	6
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1								

Results indicated that for Southeast Asian countries ERB has meaningful relationship with well-being while for South Asian countries it is opposite. This could be explained by the fact that the amount of reforested area was the least in South Asian countries and these countries were found to have the highest particulate matter concentration in air.

The next model measures the relationship between indicators of environmental quality and well-being on different regions in presence of control variables. A Hausman test result indicated the model to be random effects model (prob>chi2 = 0.3230) in regression.

First model deals with ERB and human well-being in the context of South Asian countries. Result shows that one percent increase in ERB can increase well-being by 0.31 percent. However, the significant positive relationship between ERB and well-being could be established when model includes sanitation as a control for ERB. Insignificant but positive relationship was found among well-being, ES, and EQ. Interestingly, it is found that sanitation and primary education have significant positive relationship with well-being throughout the model. This can be explained by lack of access to safe sanitation and water (Cohen, 2006) in these countries. Additionally, primary education has significant influence on wellbeing. Since 2005 India has initiated environmental education textbooks in schools and universities of Madras to make people environmentally literate and similar initiatives were taken by Sri Lanka and Bangladesh partially. Thus the significant positive relationship between primary education and well-being created insight to develop awareness among people towards their living environment.

Table 4. 12:Model 5 – Measurement Result 4(South Asia)

VARIABLES	wellbeing(SA)	wellbeing(SA)	wellbeing(SA)	wellbeing(SA)	wellbeing(SA)	wellbeing(SA)
ERB	0.0031 (-0.09)	0.0034 (-0.09)	0.114* (-0.07)	0.0887 (-0.09)	0.0627 (-0.05)	0.0866 (-0.07)
AirQ	-0.0009 (0.00)	-0.0011 (0.00)	0.0015 (0.00)	0.0040 (0.00)	0.0048 (0.00)	0.0058 (0.00)
logWq	197.3 (-322.35)	0.659 (-434.09)	127.1 (-231.15)	201.7 (-188.68)	381.7 (-267.73)	397.2 (-285.68)
loglife	98.51 (-150.57)	7.672 (-202.15)	53.02 (-108.56)	89.24 (-90.18)	173.8 (-124)	179.9 (-135.3)
c.logWq#c.loglife	-46.73 (-75.95)	-0.357 (-102.3)	-30.29 (-54.46)	-47.81 (-44.43)	-89.9 (-63.03)	-93.58 (-67.16)
ES	135.9 (-174.87)	42.93 (-219.29)	81.18 (-105.22)	125.5 (-102.87)	214.6 (-134.42)	219.1 (-143.44)
healthyPop		0.0093 (-0.01)	0.0113 (-0.01)	0.0105 (-0.01)	0.0088 (-0.01)	0.0087 (-0.01)
logSan			1.479*** (-0.35)	1.288** (-0.59)	1.244*** (-0.4)	1.410** (-0.57)
PcGDPCurrentUS				0.0001 (0.00)	3.09E-05 (0.00)	3.28E-05 (0.00)
PrimaryEduc					0.0163** (-0.01)	0.0163** (-0.01)
satisfiedWQ						0.0089 (-0.01)
satisfiedAirQ						-0.0115 (-0.02)
Rsquared	0.86	0.89	0.92	0.94	0.97	0.97
Observations	66	66	66	66	66	66
Number of CountryID	6	6	6	6	6	6
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1						

Second model deals with ERB and human well-being in context of Southeast Asian countries. Results show that one percent increase in ERB can increase well-being by 8.2 percent although insignificant but positive relationship was found among well-being, ES, and EQ. Sanitation and subjective perception of being in good health proportion were found to have significant positive relationship with well-being throughout the model. As countries in SEA face lack of sanitation that is why it remained positively significant with well-being (Cohen, 2006).

Additionally, results showed insignificant relationship between primary education and wellbeing. As discussed earlier, Indonesia initiated environmental education program in schools since 2006, however the results found from report of Ministry of Environment the program found to be ineffective still. The reason behind this could be the scope of the program which was only within formal schools. Philippines also undertook environmental education action plan (2014-2018). Thus, the insignificant positive relationship between primary education and well-being reflect the failure of the environmental education awareness program in playing role in increasing well-being.

Table 4. 13:Model 5 – Measurement Result 4(Southeast Asia)

VARIABLES	Wellbeing (Southeast)	Wellbeing (Southeast)	Wellbeing (Southeast)	Wellbeing (Southeast)	Wellbeing (Southeast)	Wellbeing (Southeast)
ERB	0.082	-0.113	0.0419	0.0349	0.025	0.0267
	-0.19	-0.18	-0.13	-0.13	-0.11	-0.12
AirQ	0.0242	0.0182	0.00912	0.0098	0.0083	0.0078
	-0.03	-0.02	-0.01	-0.02	-0.01	-0.01
logWq	-22.18	37.97	245	236.9	252	259.7
	-192.87	-189.98	-163.04	-172.01	-207.14	-193.26
loglife	1.119	42.24	123.4	122.1	128.4	131.3
	-89.9	-89.68	-75.61	-79.3	-94.44	-88.42
c.logWq#c.loglife	6.42	-8.564	-57.87	-56.02	-59.63	-61.45
	-46.07	-45.34	-38.9	-41	-49.38	-46.08
ES	-6.293	15.52	87.01	83.73	88.44	91.45
	-64.68	-66.58	-58.61	-61.92	-72.65	-68.13
healthyPop		0.0388***	0.0149***	0.0158***	0.0168***	0.0165***
		-0.01	-0.01	-0.01	-0.01	-0.01
logSan		-177.3	1.146***	1.127***	1.176***	1.209***
		-376.21	-0.16	-0.16	-0.1	-0.08
PcGDPCurrentUS				5.25E-06	5.07E-06	5.95E-06
				0	0	0
PrimaryEduc					0.0012	0.0012
					0	0
satisfiedWQ						-0.0026
						-0.01
satisfiedAirQ						0.0004
						-0.01
Rsquared	0.91	0.95	0.98	0.99	0.99	0.99
Observations	66	66	66	66	66	66
Number of CountryID	6	6	6	6	6	6

Robust standard errors in parentheses

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

Chapter 5: Conclusions and recommendations

This chapter describes key inferences of human well-being and quality of environment measurement. Inferences have been drawn based on several theories, prior studies, and in context of South Asia and Southeast Asia. This chapter also proposes the recommendations which are likely to aid in further development.

5.1 RESEACRH CONCLUSIONS

Main Conclusion

The main outcome from this study is that indicators of environmental quality particularly, air quality affects the human well-being to some extent in countries of SA and SEA Asia from 2006 to 2016. The findings specified four aspects of environmental quality which have been taken to measure human well-being: rebuilt natural capital, environmentally responsible behaviour, consumption of environmental service and quality of environment. These aspects could impact human well-being.

Firstly, positive and meaningful relationship could be established between rebuilt natural capital, indicated by reforested area and well-being. It implies that higher awareness towards the environment where individual live in can result in more environmentally responsible human actions, thereby contributing to human well-being. In the tropical countries significance of reforestation on human well-being results from poverty alleviation and food security (De los Santos-Montero and Bravo-Ureta, 2017, Liz , John, Steve, Nestor, Engel, 2017). For example, after perceiving the contribution of agro-forestry in meeting increased food demand, the Government of Sri Lanka has included it as key component to address food security issues (Mattsson, 2017). However, in tropical countries (SA& SEA), the success of reforestation activity in raising well-being depends solely on its capacity in improving livelihood of people and how livelihood strategies are addressed in reforestation program (Liz , John, Steve, Nestor, Engel, 2017).

In face of ongoing urbanization trend in the countries of the study area, potential of reforestation in improving well-being can be jeopardized by tropical teleconnections of deforestation. Another outcome of urbanization is atmospheric teleconnection which is contributing to degradation of air quality(larger particulates in air) in these countries. Most of these countries are agrarian economies. Hence, the demand for agricultural land results in deforestation, loss of distinct species habitat as well as loss of vegetation biomass. This change in land use has negative impacts on the quality of environment(Karen, Setoa, Anette, Christopher, 2012). Understanding of the impact of environmental quality on wellbeing, has led some of the countries to come up with adaptive policies. For example, Vietnam (SA), and Bangladesh, Bhutan and India (SEA) achieved a transition in use of land with simultaneous progress in production growth of crop and forest cover (Eric, 2010). This transition in land use in these countries has been implemented by means of agricultural intensification, actions to protect forest, donor driven investments, and land zoning (Eric, 2010).

Similar to the finding of this research, it has been found in several studies that people are now more concerned about the environment they live in (Welsch, 2002, Ferrer-i-Carbonell and Gowdy, 2007, Silva, De Keulenaer, et al., 2012, Winters and Li, 2015). People being more

responsible towards environment particularly regarding uncontrolled use of land has inspired to establish National Sustainable Development Strategy and National policy for sustainable use of land in countries in SA and SEA. For instance, Bangladesh, Bhutan, and Philippines have developed National Sustainable development strategy to lessen the adverse effect of urbanization and economic growth on nature with simultaneous increase in socio-economic human welfare (Shuqing, Changhui, Hong, Xiangdong, 2006).

People residing in urban areas are getting far away from nature through process of urbanization(Karen, Setoa, Anette, Christopher, 2012). Rooftop gardening could be a possible solution to bring people closer to nature. Acknowledging the human-nature relationship, government of Bangladesh are in process of undertaking a policy of 10 percent holding tax rebate and free gardening services to encourage rooftop gardening in support of Dhaka City Corporation and Sher-E-Bangla Agricultural University of Dhaka (Department of Agricultural extension Bangladesh, 2017). Also in year 2016, the Davao city local government in the Philippines has launched a project titled ''Urban edible landscape'' to encourage organic container gardening of organic vegetables and herbs and spices in homes or offices and other small or limited spaces with possible minimal contribution to food security.

This research findings also says that pollutant concentration in people's living environment is directly related to the perceived well-being in terms of health condition and the same conclusion has been drawn by (van Kamp, Leidelmeijer, et al., 2003, Jackson, 2002, Uzzell and Moser, 2006, Moser, 2009). In this research air quality being measured by PM2.5 is found to have significant impact on well-being. PM2.5 is recognized as the reason behind the death of 4.2 million people worldwide. Exposure to particulate matter could cause respiratory illness, diabetes, and mental disorder (Esposito, Bellastella, et al., 2017). Reforestation and simultaneous use of clean fuel while cooking can contribute to lesser concentration of particulate matter in atmosphere and improve quality of air. This will then reduce 50% risk of cardiovascular diseases (Esposito, Bellastella, et al., 2017). It also contributes to improve life expectancy at birth since conditions of environment play a key role in life events such as birth, death, reproductivity etc (Nicola.Bulled and Richard.Sosis, 2010). Quality of air has a direct impact on well-being through health condition which has been recognised by several prior research findings (Donovan, Halpern, et al., 2002, Pacione, 2003, Welsch, 2006, Ferrer-i-Carbonell and Gowdy, 2007, Rehdanz and Maddison, 2008, Moser, 2009).

Results of this research also indicate the inter-relationship between quality of water and air. Nexus between these two environmental quality indicators can be explained by acid rain in critical watershed areas. Presence of some pollutants cause increase in acidic compound deposition in air which is responsible for loss in ecosystem services i.e. supply of fresh water, fish etc (O'Dea, Anderson, et al., 2017). Influence of air quality in improving quality of water can be explained by mangrove forest research. Mangrove forest area in coastal belt improves the quality of water in both urban and rural area by its natural discharge mechanism before flowing towards adjacent sea(Zanata, Pissarra, et al., 2015). However, during acid rain air borne pollutants reacts with molecules of water thereby deteriorates quality of water (MacDonnell, Zhang, et al., 2017). Nutrient base of the mangroves can also be affected by flood water and acid rain(MacDonnell, Zhang, et al., 2017).

Hence, interrelationship between quality of air and water impacts well-being in terms of supply of clean water and accessibility of safe sanitation. In developing countries around 3.5 million people die due to lack of safe sanitation and clean water (Report of world health organization, 2008).

Thirdly, consumption of services provided by nature indicated by per capita consumption of fresh fish, remained significant to the well-being. It infers that a greater amount of fresh fish consumption per capita can increase human well-being. As many people in rural centres of SA and SEA regions are dependent on fishing as a source of earning, fish sector plays an important role in well-being of people in the study area. Furthermore, people share socio-cultural bonding with this sector. So, in terms of psychological well-being fish also play an important part(Clare, 2014). Fisheries also contributes substantial portion of gross domestic product in these two regions (Clare, 2014). This could be the plausible reason behind the significant relationship between well-being and fish consumption per capita established from the measurement result.

It is recognised worldwide that ongoing urbanization pose threat to fish species of both freshwater and marine water in terms of loss of habitat, overfishing or unsustainable fish farming techniques which could result in dangerous decline in some specific fish species(Clare, 2014). Additionally, impact of climate change will put additional risk towards fish stock. However, protection of terrestrial protected areas, mangrove reforestation, rehabilitation of critical land, and sustainable use of land can reduce the above-mentioned risks towards biodiversity(Clare, 2014). This research analysed reports from ministry of environment and forest of different countries of the study area and it is worth mentioning here that some countries such as Bangladesh, India, Indonesia, and Philippines are putting more emphasis on mangrove reforestation, coastal plantation, aquaculture and critical land rehabilitation activities(FAO,2015). These activities can have positive affect on environment; as mangrove plantation contributes to increase in environmental services production i.e. fresh water resources, biodiversity, and aquatic resources (Clare, 2014).

Furthermore, Bangladesh has seen a substantial amount of increase in the catch rate of Hilsa fish in year 2015 due to establishment of fish sanctuaries as well as the successful implementation of ban on all types of fishing activities in the Hilsa habitats during breeding season over the last couple of years (Department of fisheries Bangladesh, 2016). Learning from the experience of Bangladesh, in the year 2013, India declared three Hilsa sanctuaries in West Bengal to allow the mature fish to breed as well as to refrain fishermen from fishing (Ministry of fisheries, India, 2013). This could potentially improve the fish stock in the Bay of Bengal water (Ministry of fisheries, India, 2013).

Some variables from four environmental quality dimensions were found to share meaningful association with well-being. The outcome is in harmony with presumed hypothesis which is

''Rebuilding of natural capital, Conservation-oriented or Environmentally Responsible Behaviour, quality of Environment, and consumption of environmental services will increase human well-being''

In accordance with hypothesis, research findings support that reforested area can refine air, which positively affect the quality of water as well as fish, and greater amount of per capita fish consumption which have major influence in human well-being.

Referring to the notion of well-being, subjective well-being denotes the sense of being well, happy, satisfied with life etc. Hence, well-being of an individual is directly related to the environment he is living in (Paul, Melanie, et al., 2007) as polluted environment affects supply of environmental service(Marans, 2003, Marans, 2015).

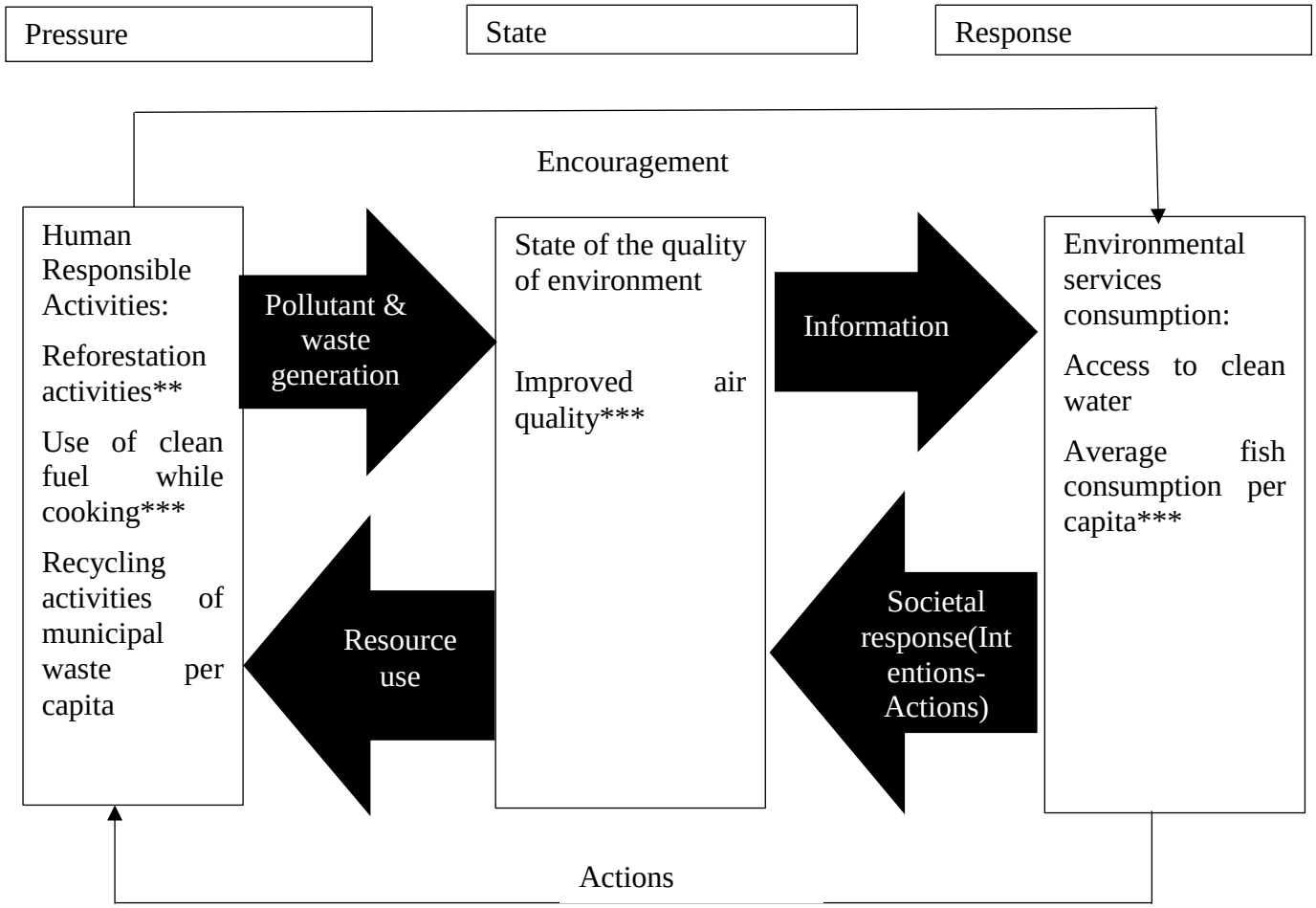
Rapid urbanization can negatively impact the environment and thereby the outer quality of life. The concept of walkable and compact city could possibly hold a solution in a highly urbanized world especially cities in SA and SEA. People in developing countries are happier in urban centres living close to available modern amenities and better employment opportunities(Berry and Okulicz-Kozaryn, 2011). To accommodate ongoing increase in urban population in countries in SA and SEA, the concept of compact city is reasonable enough. This concept allows denser residential area with multifunctional use of land as well as urban dwellers get chance to reside closer to work place and modern amenities. Compact city structure also promotes nature within walkable distance which address the human-environment congruence in measuring sense of personal well-being.

The growing concern towards human-nature relationship has motivated few countries to address importance of ecosystem in human well-being and sustainable development. For instance, Bhutan being the first ever country in South Asia has introduced draft economic development policy 2015 by putting emphasis on Gross National Happiness in promoting development which is ecologically sustainable.

This study also tested the inter-linkage between dimensions of environmental quality. To some extent, environmentally responsible behaviour was found to impact the quality of environment positively, and better environmental quality make more environmental services available to consume. It can be explained that reforestation, use of clean fuel while cooking, and recycled amount of municipal waste per capita ensure less pollutant concentration in air which consequently increases the quality of services produced by environment. Higher quality of services is indicated by availability of more fish to consume.

The interlinkage between dimensions of environmental quality and human well-being are found as meaningful in the measurements used in this research which can be described by using Pressure, State, Response framework(OECD, 2003). Pressure denotes responsible human behaviour which input pressure on environment, resulting in increased quality of environment. The increased quality of environment conditions represent state, which promotes growth of environmental services. Response indicates actions to consume services produced by the environment.

Figure 5. 1 Interrelationship Between Environmental Quality Dimensions



In the pressure – state – response (PSR) framework mentioned above, the activities to rebuilt natural capital can absorb 0.01 percent particulate matter and eventually improve quality of air. Similarly, environmentally responsible behaviour indicated by treated municipal waste and use of clean cooking fuel can improve quality of air by 0.27 percent and 0.57 percent correspondingly. Findings of this research indicate that one percentage improvement in quality of air is associated with 0.68 percentage increase in fish supply and 71.2 percent increase in clean water supply percent.

Relationship with subjective perception of environmental quality:

This research was not able to establish any significant relationship of subjective perception of environmental quality to wellbeing. Although environmental pollution associated health problems reduce human well-being, people often cannot perceive this causal association(Welsch, 2006, MacKerron and Mourato, 2009). This could explain the research finding.

Relationship with Control Variable

This study also measured the relationship between quality of environment and human well-being in presence of control variables. Control variables have three dimensions such as demographic, economic and social; however, this research only included economic dimension indicated by per capita GDP, and social dimension indicated by improved sanitation facilities, number of healthy people, life expectancy at birth and people who completed primary education. Area and density are essential elements of people's living environment (Pacione, 2003). However, in this study these two variables were found to have collinearity with other variables included in the panel model.

Education has an important part in measuring determinants of well-being(Basiago, 1998). This study, considered education as a control for responsible human behaviour, with the concept that education makes people environmentally literate as well. Results showed that education has positive correlation with well-being. However, it does not have significant effect on awareness to environment of an individual.

Since 2008, Ministry of Environment and Forests India in alliance with C.P. Ramaswami Ayer Foundation formed a centre which made environmental studies a compulsory subject at all levels of education in Madras. Introduction of environmental education in schools was initiated in Indonesia in year 2006. The above mentioned two examples was driven to grow environmental literacy among all. In 2013, Philippines as a member of Association of Southeast Asian Nations(ASEAN), adopted ASEAN Environmental Education Action Plan (2014-2018) to ensure environmental literacy among its citizens. Another example is found in Sri Lanka, in 2001 Environment Education and awareness Division was established to make Sri Lankan people aware of environmental concerns. In Bangladesh in school textbooks on environment are found poorly organized however in nine Universities environmental science is being taught. So, it is recommended to revise curriculum and include climate change impact and human adaptation. Recently reading on renewable energy and savings of energy is included in the National school level curriculum in Bangladesh (Ministry of Power, Energy and Mineral Resources, Government of the People's Republic of Bangladesh,2017).

However, according to the result, the relationship of education with well-being is not significant. Despite that people should be aware of their inter-relationship with environment. Thus, environmental literacy must be embedded in everyday life.

Sanitation is necessary to improve human health and consequently contributes to well-being which is in accord with the findings of this study (Travis, Daniele, et al., 2015).

This research found a positive impact of life expectancy at birth on well-being. It can be explained that in general sanitation and clean water are the major determinants of higher life expectancy at birth (Nicola.Bulled and Richard.Sosis, 2010). Higher life expectancy denotes healthy life which directly contributes to well-being.

This study could establish a significant association between per capita GDP and well-being which correlates with prior research suggesting the positive significant relationship between earnings and well-being (Kahneman and Krueger, 2006, Kahneman and Deaton, 2010). However, authors also concluded the presence of a tipping point income beyond which no further change is found on well-being. Additionally, they also mentioned income and education share close tie with life evaluation which is in line with the findings of the research.

Among the control variables, which are subjective perception of being well, improved sanitation, per capita GDP, life expectancy at birth, and people who completed primary education; the first three remained significant throughout the model. So, it can be mentioned that variables which are exogenous had better to be taken as a control in the regression since they possibly can modify the dynamic of the regression.

Limitation

This study has some limitations, such as: 1) the well-being indicator is based on the life satisfaction. Somehow, this subjective perception could be interlinked with quality of environment. Nevertheless, endogenous relationship can be present in this model. For example, well-being and clean water consumption or well-being and sanitation could possess causal relation, 2) social capital was not considered as part of the main model however it includes economic dimension i.e. per capita GDP. However, including social dimension i.e. education as a control variable did not produce a better result. 3) determining water quality is very difficult as it is influenced by many factors such as precipitation, temperature, waste water flow etc. This research used Dissolved oxygen as a water quality parameter, however the Biochemical oxygen demand and chemical oxygen demand could produce significant relationship with well-being. As limitation to access all water quality parameter for several countries, this research used dissolved oxygen parameter for all countries.

Environment Dimensions of Human Well-being:

This research is based on the Russian Doll framework, advanced by (Levett, 1998) which mentioned environment sustainability as the central among three pillars of sustainable development. Health of both ecosystem and human are inter-linked so, if the stock of natural capital is depleted beyond threshold, it can attenuate human well-being. Therefore, sustainable development is not possible in the cost of endangering ecosystem. If development deploy natural environment within its regenerating capacity to ensure human well-being then it becomes sustainable development. It indicates that individual should keep balance between to mechanism to satisfy their necessities and the regenerative capacity of environment.

Overall, human well-being and environmental sustainability should be the outcome of sustainable development. Policies both in national and global scale must reverse the ongoing degradation of environmental quality. This could be done keeping the following benefits in mind,

1) conservation of basic natural capital, 2) saving health of humankind from risk of endangered environment, 3) guaranteeing adequate quality of local environment where individual lives, and 4) encouraging more accord between well-being and environmental quality.

5.2 RECOMMENDATION

A General Recommendation

The concept of sustainable development has evolved focusing only on life supporting services of environment. Therefore, environmental sustainability indicator should be more widespread.

This study analyses the different indicators to assess dimensions of environmental quality and well-being. One important aspect here is the concept of environmental quality based on services consumed from goods produced by ecosystem. Environmentally responsible behaviour, and quality of environment that aids humans to improve their well-being. To ensure the non-declining human well-being throughout next generations, people have to exploit natural capital within its regenerative capacity.

The research highlighted some important concerns that have consequences on environmental quality and dimensions of well-being in the study area. The research found that responsible actions towards environment are already resulting in significant improvement in quality of air in some countries i.e. Indonesia and Philippines. However, if status of air quality in some countries i.e. Bangladesh, India and Pakistan is not addressed in earliest possible time, the long-term welfares stemming from ecosystems will substantially lessen. Additionally, atmospheric teleconnection is causing decline in humidity from Bay of Bengal towards East Asia. Less humidity contributes greater concentration of particulate matter in air. So, a need has been felt of having collaborative efforts among the governments of the respective countries in the study area.

The environmental condition in the study area during 2006 to 2016 showed that:

1. The environmental responsible behaviours that are reflected by use of clean cooking fuel, and recycled amount of municipal waste per capita have been shown the dynamic conditions but tend to be increase.

2. The activities to rebuilt natural capital for instance, reforestation activities tented to increase during 2006 to 2016 however some countries experienced less activities in between the time span;

3. The services provided by environment such as clean water accessibility and fish intake per capita were found to be improved. However, quality of air found to be degraded in some countries i.e. Bangladesh, Pakistan, India; implying that human activities to intensify the supply of other services may degrade both the quantity and quality of environmental services. These effects could eventually reduce the capacity of future cohort to fulfil their necessities.

4. The share of environmental burdens is hold disproportionately among rich and poor people which can be the root cause of inequality. Therefore, it can reduce well-being.

According to the results of testing environmental quality dimension it seems that environmental quality is limited to only bio-physical state of environment.

At the national level, countries under the study area is confronting difficulties to preserve the essential amount of ecological resources that the civic rely on. Concerning two regions of the study area have diversity in their local conditions clearly implying the need of considering additional issues related to sustainability. At the international level, some cohesion is observed among countries with more natural resources with those that have resource scarcity, suffer from natural disasters for instance, among the countries of the study area Bangladesh is flood-prone and Nepal is Earthquake-prone country.

Hence, to achieve a greater improvement of well-being, this study advised a subset concept of cohesive environmental quality dimensions. This means activities to rebuilt natural capital, environmentally responsible human behaviour, environmental quality, and environmental

services consumption had better be one entity. Results of this research can be useful to support developing environment friendly policies, such as:

1. To put an end to the negative impacts of air pollution on human well-being Environmental policies should focus more on the positive effects of reforestation and environmentally responsible human actions such as use of clean cooking fuel, municipal waste recycling activities. A regional co-operation among countries of South Asia and Southeast Asia can make citizens environmentally literate which will attenuate the possibility of environmental degradation. Environmentally literate citizens will also learn the direct benefits derived from nature for health condition of humankind.

2. This research findings showed that there is a relation with air quality and clean water supply so governments of the study area should combinedly take responsibility to increase reforested area which will intercept airborne particles on its leaves and prohibit pollutants intake to both air and water.

3. Government in collaboration with Non-government organization should supply seeds to perform more reforestation activities at the inter-tidal region. Furthermore, importance of collaborative efforts in reforestation programmes among tropical countries (SA & SEA) has also been recognized as an important factor in well-being research (Liz , John, Steve, Nestor, Engel, 2017).

4.The improvement of environmental education system in countries of the study area through the lesson learned from the examples of India, Indonesia, Sri Lanka. For example, Dhaka the capital of Bangladesh (Sabina, Ferdousour,2013) as well as Indonesia are two potential place of rain water harvesting means storing rain water where it sprays. Another good practice is observed in the island named “Alor” (Indonesia) and ‘’Mongla’’(Bangladesh) where, families use rainwater reservoir to solve the availability of clean drinking water problem. A collaborative effort among countries in SA and SEA to encourage rain water harvesting to meet ongoing demand for water supply in urban areas is necessary.

5. Mainstreaming concept of well-being into the national development strategy for achieving ecologically sustainable development since it proved to have impact on countries well-being.

To summarize, the connection between individual and their living environment is a critical issue for indicating their sense of well-being which is also a principal issue for sustainable development in Asian countries(Moser, 2009). The results showed that in the countries of the study area, along with environmental quality and environmentally responsible human behaviour; sanitation, health status and income play a very significant role in determining well-being. This implies the clear need of an effective policy to cover multidimensional aspects of living environments. It can be also concluded that lack of air quality is perceived as an important threat to human well-being. Interestingly, no meaningful relationship could be established between subjective perception environmental quality and well-being which is unlikely compared to previous researches(Silva, de Keulenaer, et al., 2012, Iddisah.Sulemana, Laura.McCann, et al., 2016). However, lack of access to environmental services, insignificant amount of environmentally responsible actions is repeatedly mentioned by city dwellers as threatening their well-being(Uzzell and Moser, 2006).

To establish the significant relationship between dimensions of environmental quality and well-being in countries of South Asia and Southeast Asia can be evaluated by looking into the association between the objective indicators of well-being i.e. health condition which can differ according to cultural, gender, age etc. Identifying the environmental conditions of human wellbeing necessitates specific social and physical condition that possibly will pose risk towards human well-being.

It is advised for further research to develop indicators of environmental quality dimensions from all three pillars of sustainable development i.e. natural capital, man-made capital, and social capital. This development can add further attributes to socio-environmental facet of human well-being. Proposing same set of indicators for all context could be debatable however, experienced gathered from the findings in different context can lead to efficient indicators of environment dimensions and well-being as a joint exercise globally.

Environment dimensions are typically allied to strategies practiced at locally and nationally in comparison to regional scale. According to (Khwaja, Umer, et al., 2012) to reduce pollutants concentration in atmosphere, a regional motivation and approach is indispensable, in which all participant countries of the South Asia will have responsibilities to protect health of ecosystem as well as humankind. Regional accord could be important for planning, implementing and evaluating activities towards sustainable development, which, are basically performed at root level(local).

It is being suggested by this research to use of indicators used in this study, to measure human well-being as an important device in a broader horizon. Before the well-being measurement a list of indicators should be assessed in terms of the baseline need and in case emergency need amendment of indicators should be allowed. For this purpose, climate-Prio tool developed by institute of housing and urban studies could be used. As previously mentioned, use of instrument variable that has relationship with the environmental responsible behaviour variable could be interesting to add in this model.

To summarize, it can be stated that indicators used in this research is to draw attention of policy makers to the environmental concerns of the study area. However, these indicators could be also being useful to calculate the score achieved with regard to the third goal of sustainable development which says to ensure well-being at all ages.

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Annex 1:

Multicollinearity Test:

Indicator Name	VIF	1/VIF
Reforested area	2.4	0.41662
Access to clean cooking fuel	6.1	0.16386
Recycled municipal waste	8.15	0.122657
Fish consumption	8.47	0.118096
Access to Clean water	3.28	0.304832
Air quality	2.91	0.343752
Water quality	1.49	0.672705
Per capita GDP	6.91	0.144686
Access to improved sanitation	5.89	0.169797
Subjective perception of water quality	3.99	0.25049
Life expectancy at birth	3.87	0.258383
Subjective perception of air quality	3.5	0.285703
Percentage people who completed Primary Education	3.3	0.30289
Percentage people who perceive good health condition	1.49	0.669994
Mean VIF	4.41	

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