THE ROLE OF SAIs IN PROMOTING SUSTAINABLE DEVELOPMENT: ENVIRONMENTAL AUDITING

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ABSTRACT

THE ROLE OF SAIs IN PROMOTING SUSTAINABLE DEVELOPMENT: ENVIRONMENTAL AUDITING

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This thesis is based on cross-sectional data analyses by using Ordinary Least Squares (OLS) Method in order to determine the main drivers of the environmental performance and specifically the effects of environmental audits conducted by Supreme Audit Institutions (SAIs) on sustainable development. Two general models are employed throughout the study that have the Environmental Performance Index (EPI) as dependent variable and various sub-models for different income groups are produced to observe the individual and interactive effects of explanatory variables.

First model includes 150 countries regressing their EPI scores on income, population, literacy rate and indicators of the strength of institutional structure such as corruption perceptions index or government effectiveness score. Then, second model which comprises 52 countries introduces the number of environmental audit reports as a new explanatory variable. Principal Component Analysis (PCA) is also applied to highly correlated variables and the models are reestimated. The results indicate that

well functioning environmental management systems and resulting positive effects on the environmental performance can only be attained through strengthened governmental institutions with high transparency and accountability as well as rigid implementation of the related regulations. More specifically, environmental audit

reports generated by SAIs are of vital importance for especially improving the environmental management systems of the developing countries.

Keywords: Supreme Audit Institution, Environmental Audit, Sustainable Development, Environmental Performance, Cross-sectional Analysis

ÖZ

YÜKSEK DENETİM KURUMLARININ
SÜRDÜRÜLEBİLİR KALKINMADAKİ ROLÜ: ÇEVRE DENETİMİ

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Bu tez, çevresel performansın temel etmenlerinin ve özellikle Yüksek Denetim Kurumları (YDK) tarafından yürütülen çevre denetimlerinin sürdürülebilir kalkınma üzerindeki etkilerinin belirlenmesi için En Küçük Kareler (EKK) Yöntemi kullanılarak yapılan kesitler-arası veri analizine dayanır. Çalışma boyunca bağımlı değişken olarak Çevresel Performans Endeksini temel alan iki genel model kullanılmış ve açıklayıcı değişkenlerin bireysel ve etkileşimli etkilerini gözlemlemek amacıyla farklı gelir grupları için çeşitli alt modeller oluşturulmuştur. İlk model; EPI puanlarının gelir, nüfus, okur-yazarlık oranı ve yolsuzluk algılama endeksi ya da devletin etkinliği gibi kurumsal yapının gücüne yönelik göstergeler üzerine ilişkilendirildiği 150 ülke içermektedir. Daha sonra 52 ülkeyi kapsayan ikinci modele, yeni bir açıklayıcı değişken olarak çevre denetim raporlarının sayısı eklenmiştir. Ayrıca yüksek ilişkili değişkenlere Temel Bileşenler Analizi (TBA) uygulanmış ve modeller yeniden değerlendirilmiştir. Sonuçlar göstermiştir ki; iyi işleyen bir çevre yönetim sisteminin ve bunun çevresel performans üzerindeki olumlu etkileri ancak şeffaf ve hesap verebilir güçlü kurumsal yapıların ve ilgili düzenlemelerin sıkı bir şekilde uygulanmasıyla elde edilebilir. Özellikle Yüksek Denetim Kurumları tarafından

hazırlanan çevre denetim raporlarının gelişmekte olan ülkelerin çevresel yönetim sistemlerinin iyileştirilmesindeki önemi büyüktür.

Anahtar Kelimeler: Yüksek Denetim Kurumu, Çevre Denetimi, Sürdürülebilir Kalkınma, Çevresel Performans, Kesitler-arası Analiz

To My Family

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I owe special thanks to my father Hüseyin Durusu and my mother Ayşe Durusu for their belief and confidence in me not only during the preparation of this thesis but also at every stage of my life. Without their love and support, this thesis could not be completed.

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TABLE OF CONTENTS

LIST OF TABLES

TABLES

LIST OF FIGURES

FIGURES

CHAPTER 1

INTRODUCTION

Sustainability of economic development has been a controversial issue at global level since the time that humanity has recognized the cause-effect relationship between the level of development and the extent of environmental degradation. It is a real fact, which is not only experienced by every one on their daily lives but also proved by a wide range of scientific researches, that the earth has been going under dramatic changes due to the adverse effects of rising environmental challenges such as climate change, biodiversity loss, unsustainable management of water resources and health impacts of pollution and hazardous chemicals. And the level of seriousness of these adverse effects is closely related to the success of environmental management systems of the governments. Development of policies with an environmentally irresponsible manner and the lack of effective supervision on these policies would cause consequences to the detriment of the environmental outlook and therefore of the sustainability of the next generations.

With the emergence of sustainable development theory following the Brundtland Report (1987), 1980s witnessed that many governments had increased their environmental activities by committing themselves to sustainable development policies and by improving and expanding their environmental departments, agencies, laws, and regulations (INTOSAI WGEA, 2007a). Government expenditures on environment have begun to increase with the growing threats of environmental degradation, broadening the responsibility of governments for environmental management. Along with this, getting more aware of the environment, changing citizen expectations from the public financial management have brought along a need for an independent and objective oversighting on environment. This raising awareness about environmental protection has made the assessment of environmental performance essential as well. Therefore, Supreme Audit Institutions (SAIs), taking

this unique responsibility and becoming more aware of their responsibility towards the environment and environmental policy, have increased their audit coverage to assess the efficiency and effectiveness of their governments' environmental activities, exploring a new field of audit work: Environmental Auditing.

Integration of the environmental audits on the agenda of SAIs is an important step taken as a response to the environmental crisis and it has been popular since the early 1990s for both developed and developing countries since environment is perceived as global public fund. Most SAIs around the world have launched environmental audit programmes both at national and international levels and followed this increasing trend through strengthening both their human capacity and other capacities in environmental auditing such as budget, training, methodology[1]. Under the umbrella of the Working Group on Environmental Auditing of the International Organisation of Supreme Audit Institutions (INTOSAI WGEA), member SAIs, since 1992, have made great contributions to the development of the environmental auditing and used it as a major tool to enhance the environmental performance in line with their commitment *"..to use the power of public sector audit to leave a positive legacy for future generations, by improving the quality of the environment, the management of natural resources, and the health and prosperity of peoples around the world."*(INTOSAI WGEA, 2011).

SAIs assist the parliaments about pursuit of public interest and questioning the accountability by providing independent information and assurance level related to the use of public resources on environment. Environmental auditing, in this respect, has also a guiding role for decision makers in enhancement of the environmental management systems and development of sound environmental policies. Furthermore, about the reflections of environmental auditing on public in general, SAIs, being responsible of accountability of all activities conducted by auditees as well as by themselves, are supposed to provide public with accurate and reliable

[1] *The Sixth Survey on Environmental Auditing*. (INTOSAI WGEA, 2009).

information on the performance of environmental policies and therefore to pave the way for conscious decisions to be taken.

The literature on the linkage between various economic, social and institutional factors and the environmental performance is quite rich. However, literature on environmental auditing especially carried out in the public sector by SAIs is very limited. Bearing in mind that it is essential to examine the reflections of the environmental auditing in both qualitative and quantitative manner, this thesis is the first study in this area that we are aware of in terms of the empirical derivations made about the effects of the environmental auditing on improving environmental performance. In this manner, two groups of the analyses are followed throughout this thesis. In the first group of the analyses "without the audit variable", a general picture about the main determinants of the environmental performance of the countries are tried to be put forward. In fact, GDP per capita, population density, literacy rate, Corruption Perceptions Index (CPI) and Government Effectiveness Score (GES) are searched for their possible effects on the environmental performance. Then in the second group of the analyses "with the audit variable", the effects of the environmental audit reports on the environmental performance are analysed besides the other economic, social and institutional determinants and as expectedly, it is revealed that environmental auditing by the SAIs are of vital importance for the countries, especially for developing group of countries. It should be noted at this point that in case of the detection of high multicollinearity among certain variables such as GES, GDP per capita and CPI, GES is prefered in the analyses since it is an indicator which is easier to interpret and gives a more true and fair view about the development level of the countries while for instance GDP per capita is rather an aggregate indicator that encompasses most of the time multilateral aspects and ambiguous interpretations.

The outline of this thesis is as follows: In Chapter 2, a general overview of the concept of sustainable development and main environmental challenges facing new

millennium are presented while evolution of environmental auditing and the rising role of SAIs in this area constitute the main focus of Chapter 3. The scope and objectives of the environmental audits and the issues dealt with in the audit reports are also mentioned in Chapter 3. Chapter 4 focuses on the specific factors affecting the environmental performance of the countries and further examines the role of SAIs on environmental performance through audits.

The empirical analyses related to the effects of certain factors on environmental performance are explained in Chapter 5 through constructing several models of cross-sectional data and using OLS Method. First group of the analyses is carried out with 150 countries by not taking “audit related variable” which is the “number of audit reports” into account and as the basic formulation, EPI scores are regressed on GDP per capita, population density, literacy rate, Corruption Perceptions Index (CPI) and Government Effectiveness Score (GES). Due to the existence of high correlation among GDP per capita, CPI and GES, a reduced form of the basic formulation is designed to consist of GES, population density and literacy rate. On the other hand, to capture also the effects of other variables on EPI scores, Principal Component Analysis is applied to the high correlated three variables and reduced form of the model is repeated with the new extracted factor which is called “ Development Rate”. Then a new variable is introduced in the second group of the analyses which is the “number of audit reports” and a sample of 52 countries is taken. The same procedure with the first group of the analyses without the audit variable is followed also in the second group of the analyses with the audit variable. All the models formed in both the first and second groups of the analyses are run for different income groups to explore the main differentiating effects of defined factors on the environmental performance of developed and developing countries.

Finally, concluding remarks and a brief summary of the findings are included in the last chapter.

CHAPTER 2

SUSTAINABLE DEVELOPMENT IN FACE OF ENVIRONMENTAL CHALLENGES

Sustainable development is rather a new concept that has gained global acceptance and understanding due to extensive discussions about the environment and development. Most of the degradation facing the world is not a result of sudden and catastrophic events; rather, it is the result of an accumulation of less sudden events. Directly and indirectly, humanity has negative impacts on the environment, many of which are unfortunately irreversible and detrimental for the health of both current and future generations as well as environmental sustainability.

The literature on conflicts between environment and development dates back to the 1970s, leading to the rise of the term "sustainable development" in the 1980s. Since that time, sustainability of development has become a subject with a detailed and vast literature. In this context, the first section briefly describes the origin of the term "sustainable development" and its various interpretations in the literature. And the second section discusses the main environmental challenges the earth has been facing with for a long time and reveals the outstanding facts about the environmental outlook. Among these challenges, problems related to waste, water and climate change are dealt with in further detail in the context of this second section.

2.1 The Concept of Sustainable Development

People, over the course of human history, have recognized the need for harmony between the environment, society and economy. However, global progress on developing the concept of sustainable development has been rapid since the 1980s[2]. Having no unique definition, the term "sustainable development" was first

[2] Retrieved from http://www.iisd.org/pdf/2011/intro_to_sd.pdf

popularized by the Report of the World Commission on Environment and Development (in short Brundtland Commission), entitled “Our Common Future (1987)” which is also known as the “Brundtland Report”. The Report defines sustainable development as “the development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” (WCED, 1987). The respective report also points to the following two key concepts of sustainable development:

- The concept of 'needs', in particular the essential needs of the world's poor, to which overriding priority should be given; and
- The idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs (WCED, 1987).

By a different interpretation of this definition of the Brundtland Commission, it can be deduced that human economic actions should be in harmony with the environmental development rather than achieving development at the expense of environmental degradation through exhausting natural resources and polluting the environment.

The roots of the Brundtland Commission whose work was committed to the unity of environment and development were in the “1972 Stockholm Conference on the Human Environment” and in the “1980 World Conservation Strategy of the International Union for the Conservation of Nature” (Adams,1990). The first one revealed for the first time the conflicts between environment and development and the latter argued for conservation as a means to assist development and specifically for the sustainable development and utilization of species, ecosystems, and resources.

As stated in Global Environmental Outlook Report (UNEP, 2007);

> Before the Brundtland Commission, "development progress" was associated with industrialization, and measured solely by economic activity and increases in wealth. In fact, environmental protection was perceived by many as an obstacle to development. However, *Our Common Future* changed this understanding from the dichotomy of "environment or development" to "environment and development," and then to "environment for development (UNEP, 2007, p.10).

The Brundtland Report was followed by Declarations signed as a result of the World Environment Summits such as the United Nations Conference on Environment and Development (UNCED,1992) held in Rio de Janeiro in 1992 (the so-called "Earth Summit") and World Summit on Sustainable Development Conference in Johannesbourg, South Africa in 2002 (TCA, 2007, p.96). Earth Summit in 1992 issued certain resulting documents such as Agenda 21, the Rio Declaration on Environment and Development, the Statement of Forest Principles, the United Nations Framework Convention on Climate Change and the United Nations Convention on Biological Diversity[3]. "Agenda 21" called for all countries to develop national sustainable development strategies as mechanisms for translating a country's goals of sustainable development into concrete policies and actions (UN DESA, 2002a). This is also one of the targets stated in the *United Nations Millennium Declaration* (2000) by reaffirming the support for the principles of sustainable development including those set out in Agenda 21. Ten years later than the Rio Declaration, in 2002, at the World Summit in Johannesbourg, commitment to working towards sustainable development was reaffirmed by more than 180 leaders, and three key outcomes were issued (INTOSAI WGEA, 2007b):

[3] Retrieved from http://www.un.org/geninfo/bp/enviro.html

- The Declaration describes the essential requirements for sustainable development such as poverty eradication, changing consumption and production patterns, and protecting and managing the natural resource base for economic and social development.
- The Plan of Implementation describes the steps of achievement in sustainable development at international, national, and local levels.
- The partnerships bring together governments, businesses, and other non-governmental stakeholders. (INTOSAI WGEA, 2007b, p.3)

The Johannesbourg Declaration (2002) emphasized on "a collective responsibility to advance and strengthen the interdependent and mutually reinforcing pillars of sustainable development—economic development, social development and environmental protection—at local, national, regional and global levels." So that the well-known definition of sustainable development was expanded with the widely used three pillars: economic, social, and environmental as shown in Figure 1 below.

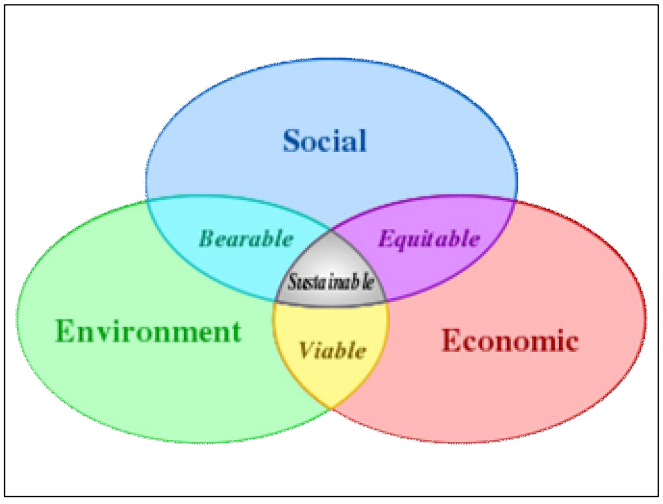


Figure 1: Three Pillars of Sustainable Development
Source: http://www.newworldencyclopedia.org/entry/Image:Sustainable_development.svg

The rapid growing population and economic development accompanied by high level of industrialization inevitably impose pressures on environment leading to an unbalanced interaction among these pillars, unfortunately to the detriment of environment. In the process of development, human beings cause high pollution levels resulting in irreparable damage to the environment. When nature's resources such as trees, habitat, earth, water and air are consumed faster than nature can replenish them, environmental degradation becomes unavoidable (ASOSAI, 2009, p.5). Environmental degradation may ocur in many forms such as overexploitation of natural resources which leads eventually to environmental issues such as water scarcity, deforestation, desertification and loss in biological diversity (ASOSAI, 2009, p.5).

In the summary of the Report "Environmental Outlook to 2030" (OECD, 2008a), the most urgent environmental challenges which are complex and mainly global in nature and the impacts of which are expected to be more apparent in the long run are stated as "climate change, biodiversity loss, the unsustainable management of water resources and the health impacts of pollution and hazardous chemicals". These environmental issues are referred in the Report as "red light issues" meaning that they are not well managed, are in a bad or worsening state, and require urgent attention (OECD, 2008a). One of the most important threat to humanity is the water scarcity that will worsen due to unsustainable use and management of the resource as well as climate change; the threat gets more clear when the projection that "the number of people living in areas affected by severe water stress is expected to increase by another 1 billion to over 3.9 billion by 2030" is considered[4]. Global emissions of greenhouse gases, as an another global threat, are projected to grow by a further 37% by 2030, and 52% by 2050 which will result in an increase in global temperature over pre-industrial levels in the range of 1.7-2.4° Celsius by 2050[5],

[4] Retrieved from the Summary of the Report "Environmental Outlook to 2030" (OECD,2008a)

[5] Retrieved from the Summary of the Report "Environmental Outlook to 2030" (OECD,2008a)

leading to increased heat waves, droughts, storms and floods, resulting in severe damage to key infrastructure and crops. Growing urbanization and uncontrolled increase in world population will require a 10% increase in farmland worldwide[6] with a further loss of wildlife habitat due to expanding infrastructure and agriculture, as well as climate change. This means that in the near future, a considerable number of today's known animal and plant species are likely to be extinct, deteriorating at the same time the improvements of the economic growth and human well-being. As an important red light issue, health impacts of air pollution are also projected to increase worldwide, with the number of premature deaths linked to ground-level ozone quadrupling (OECD,2008a).

These projections on the future status of the environment reveal that the environmental degradation will be increasingly irreversible within the next few decades. Without any new policy actions, pressures imposed on nature will result in gradually worsening living standards and in the long run, such degradation on a global scale, if not addressed, would mean extinction for humanity (ASOSAI, 2009, p.5).

As stated by Chai (2009), the observed change over time in focus of sustainable development approach from just environmental dimension to three-dimensional sustainability, integrating three pillars of development- economic, social and environmental has brought along the need for environmentally responsible use of all of society's scarce resources – natural, human, and capital. Since natural capital as distinct from man made capital is a scarce factor limiting the extent of economic growth, it deserves value assignment and fresh investment for its preservation, restoration and productivity[7]. That is why sustainable development is perceived as a

[6] Retrieved from the Summary of the Report "Environmental Outlook to 2030" (OECD,2008a)

[7] Retrieved from http://www.asosai.org/asosai_old/journal1999/enviroment_issues_in_audit.htm

development model based on the modification of the traditional economic development model and is an inevitable choice by the history[8].

The evaluation of regional sustainable development is a complex and multifaceted matter since it requires the understanding of multi-objective theory (Roberts, 2006) related to economic, environmental and social issues. So in making future development plans, governmental policies should be built upon it searching the paths of how to maintain the quality of the environment, human well-being and economic security at the same time. Only with this manner, current and future generations will have equal opportunities without leaving behind a damaged environment due to unsustainable development policies.

2.2 Main Environmental Challenges Facing New Millennium

The earth has been going under dramatic changes, some of which are directly human related disasters while some occur within the nature's own movements. As mentioned in Section 2.1, certain environmental issues need urgent attention due to their uncontrollable worsening state. These issues, also referred to as "red light issues", are stated as climate change, biodiversity loss, the unsustainable management of water resources and the health impacts of pollution and hazardous chemicals (OECD, 2008a).

Although different regions of the world have been experiencing more or less the similar environmental problems, there may occur challenges exclusive to each region with respect to their diverse geographical, economic and social features. These challenges are tried to be categorized in the Global Environmental Outlook Report (UNEP, 2007) as depicted in Table 1 below.

[8] Retrieved from http://www.asosai.org/journal2002/articles_2.htm#h1

Table 1: Key Regional Priority Issues
Source: Global Environmental Outlook Report (UNEP, 2007).

Africa	Land degradation and its cross-cutting impacts on forests, freshwater, marine and coastal resources, as well as pressures such as drought, climate variability and change, and urbanization
Asia and the Pacific	Transport and urban air quality, freshwater stress, valuable ecosystems, agricultural land use, and waste management
Europe	Climate change and energy, unsustainable production and consumption, air quality and transport, biodiversity loss and land-use change, and freshwater stress
Latin America and the Caribbean	Growing cities, biodiversity and ecosystems, degrading coasts and polluted seas, and regional vulnerability to climate change
North America	Energy and climate change, urban sprawl and freshwater stress
West Asia	Freshwater stress, land degradation, degrading coats and marine ecosystems, urban management, and peace and security
Polar Regions	Climate change, persistent pollutants, the ozone layer, and development and commercial activity

Among the environmental challenges stated in Table 1, it is apparent that issues related to climate change, water and waste are of vital importance for the regions; so that the following sub-sections focus on these priority issues due to their immediacy and far-reaching effects on the environment.

2.2.1 Dealing with Waste Issues

Waste, in general, is defined as a product no longer suited for its intended use (INTOSAI WGEA, 2004a). Definitions of waste are based on the notion of "discard", i.e., something which the holder intends to get rid of. In the Basel Convention[9], waste is defined as "substance or objects, which are disposed of or are

[9] Retrieved from www.basel.int

intended to be disposed of or are required to be disposed of by the provisions of national law".

There are several categories of waste such as hazardous and non-hazardous, radioactive, medical, municipal waste and industrial waste. They can be examined under two general categories, one of which is general waste, consisting of non-hazardous (solid) waste and municipal waste while the other is a cluster of hazardous, medical and radioactive waste[10]. Handling with waste issues of both categories necessitates great care since waste threatens the human well-being and the environmental conditions directly.

General waste, even though it is commonly known as trash or garbage of domestic and industrial activities, can cause considerable harm and damage, and may lead to diseases and air pollution and the poisoning of water sources that is for the use of people and animals. On the other hand, hazardous waste can be harmful to people or the environment even in small quantities due to its inherent chemical and physical characteristics, such as being toxic, explosive, corrosive, carcinogenic or infectious. What's more, medical waste and radioactive waste expose serious threats causing serious illness or even death. That is why many countries have strict regulations governing the storage, collection and treatment of this kind of wastes.

Increasing industrialization and urbanization has led to rapid changes in consumption patterns, the generation of large quantities of waste and changes in waste composition. Urbanization, especially on the coastal areas which is projected to reach 6 billion by 2025 (UNEP, 2007), exerts great pressures on the environment through municipal and industrial waste. In fact, the excessive nutrient load caused by the disposal of waste in the marine ecosystems is the main reason of eutrophication

[10] This categorization was followed in the EUROSAI WGEA Seminar on Auditing Waste held in Oslo,Norway in 2011. For further information, see http://www.eurosaiwgea.org/Activitiesandmeetings/OtherEUROSAIWGEAmeetings/waste2011/Pages/EUROSAIWGEAseminaronaudtingwaste,2011.aspx

which leads to depletion of dissolved oxygen in the water, therefore the emergence of dead zones in the marine ecosystems (UNEP, 2007). Inappropriate waste management in the populated urban areas has potential impacts on both the human health and ecosystems such as soil and water contamination and adverse effects on the air quality, land use or landscape. Waste that can not be treated as a part of other waste-processing methods such as composting, incineration and recycling is disposed at landfills, varying from open dumps to sanitary landfills, as the most common solution. The main differences among them are in the way they are operated and in the level of adverse environmental effects they produce such that sanitary landfills are a fully acceptable environmental solution while open dumping is an unfavourable one (INTOSAI WGEA, 2004a). As seen in Figure 2, incinerated or recycled waste volume is larger in OECD countries while disposal of waste in landfills is a common approach in non-OECD countries. This shows that sound waste management requires a high level of technology and a significant budget and most countries will have to wait a long time to afford it.

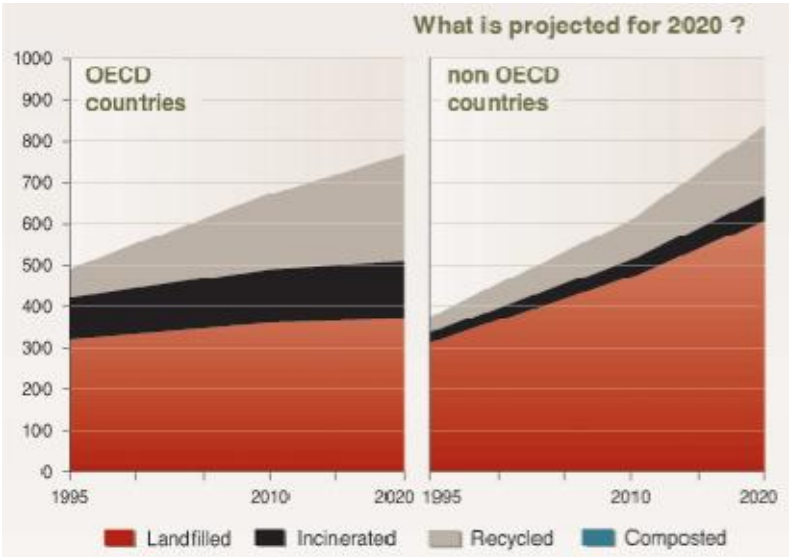


Figure 2: Projection for waste-processing methods

Source: http://www.grida.no/publications/vg/waste/page/2863.aspx

Some countries fail to operate landfills properly, and sometimes waste is illegally dumped leading to contaminated sites and contaminated waters. Although there are examples of policies and strategies to tackle with waste problems, effective waste management strategies and systems are still lacking or inadequate in many countries, posing a serious threat to human health and the environment. In addition to the risks embodied in the waste management systems, the illegal traffic in electronic and hazardous waste and their effects on human health and the environment pose new and growing challenges (UNEP,2007).

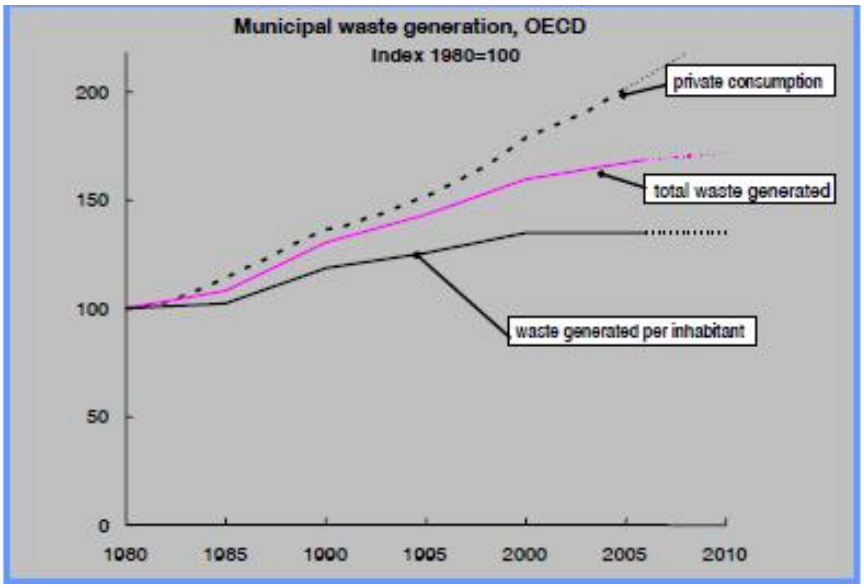


Figure 3: Municipal Waste Generation in the OECD Area
Source: Key Environmental Indicators (OECD, 2008b)

Figure 3 shows that the quantity of municipal waste, which is only one part of total waste generated but its management and treatment represents more than one third of the public sector's financial efforts to abate and control pollution, has risen since

1980 and exceeded 650 million tonnes in 2006 (560 kg per inhabitant) in the OECD area (OECD,2008b). This fact strengthens the need for financial oversight in the waste management system especially by SAIs, which are responsible of enhancing the use of public funds in an economic, efficient and effective manner.

2.2.2. Dealing with Water Issues

Water is an essential part of the global ecological system and a crucial resource for life and human existence. Economic and social development for most of the countries is highly interlinked to the availability and quality of water resources.

Water resources can be divided into two broad categories: saltwater and freshwater. Freshwater, which is a scarce resource, makes up only 2.5 % of the total volume of water in our planet and less than 1 % of all freshwater is directly accessible for human use. It encompasses freshwater lakes, rivers, fresh groundwater, glaciers, permanent snow cover, ground ice, soil moisture, atmospheric water vapour, marshes and wetlands while oceans, saline/brackish groundwater and saltwater lakes compose the saltwater supply which accounts for 97.5 % of global water resources[11].

70% of the global freshwater use arises from the use for agricultural purposes (mainly for irrigation) while 8% is used for domestic purposes (cooking, washing, drinking, watering gardens and lawns, flushing away waste, etc.) and the rest for industrial use (cooling water for hydroelectric power plants, etc.) (UNESCO WWAP, 2009a). At world level, water demand that is estimated to have risen by more than double the rate of population growth in the last century (OECD, 2008b) is further expected to increase by 50 % to 2025 in developing countries, and by 18 % in developed countries (UNESCO WWAP, 2006). This rising need for water will undoubtedly further impede socio-economic development and increase pressures on water ecosystems.

[11]Retrieved from *Vital Water Graphics 2: An Overview of the State of the World's Fresh and Marine Water* (UNEP, 2008).

Despite huge national and international efforts, problems of overexploitation and pollution of water continue to worsen in both freshwater and marine systems (UNEP 2005). Main concerns about the marine systems are pollution, overexploitation of living marine resources and coastal habitat loss. Sewage remains the largest source of contamination, by volume, of the marine and coastal environment while oil spills from ships and oil disasters and growing urbanization and increased population in coastal areas, with their implications for pollution and habitat destruction, also contribute to marine pollution. It should be noted that about half of all wetlands worldwide have been lost and more than 20 percent of the world's 10,000 known freshwater species are extinct, threatened or endangered (INTOSAI WGEA, 2004b).

On the other side of the water issue, the most important problem associated with the freshwater is the lack of access to safe drinking water and sanitation due to increasing depletion and contamination of freshwater, causing great threats for human health; illnesses and even death. The management issues related to safe drinking water and sanitation are main concerns especially in developing countries where governments have tighter budgets to finance satisfactory water and sanitation systems. Huge quantities of funds have been allocated for the purpose of maintaninig adequate supply of freshwater of suitable quality for human use and to support aquatic and other ecosystems. For instance in İstanbul, a megalopolis with close to 12 million inhabitants, US$3.6 billion was invested between 1994 and 2004 to improve the water supply and sanitation infrastructure (UNESCO WWAP, 2009b).

As shown in Figure 4, even though there have been improvements in urban and rural access to water resources and sanitation facilities, efforts still fall short of the required targets for sustainable development (UNEP, 2008).

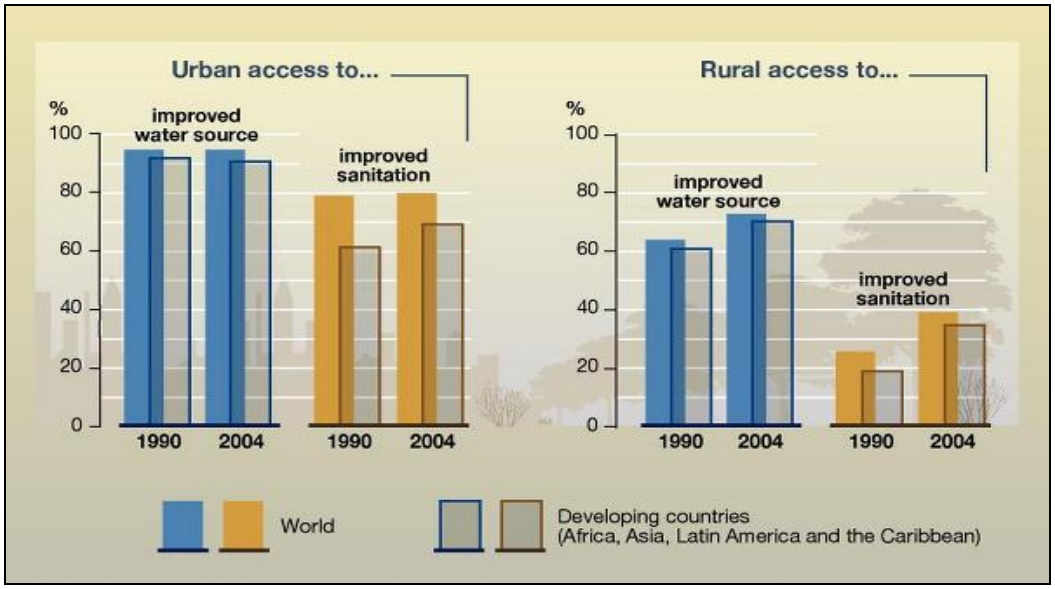


Figure 4: Inequity in access to clean water and sanitation
Source: *Vital Water Graphics 2: An Overview of the State of the World's Fresh and Marine Waters* (UNEP, 2008).

It is in fact a reality that water-related diseases, such as diarrhoea and cholera, kill an estimated 3 million people/year in developing countries, the majority of whom are children under the age of five (UNEP, 2007, p.11). Even though the percentage of wastewater treated grows, the total volume of untreated wastewater continues to increase rapidly (UNEP, 2007, p.407), threatening the human well-being along with the microbial pollution primarily from inadequate sanitation facilities. It is further estimated by the World Health Organization (WHO) that a rapidly changing climate, combined with declining socio-economic conditions in the poorest part of the population, will contribute to an increasing spread of the disease (UNEP, 2008), a fact of whose severity can be better perceived by examining the Figure 5 below.

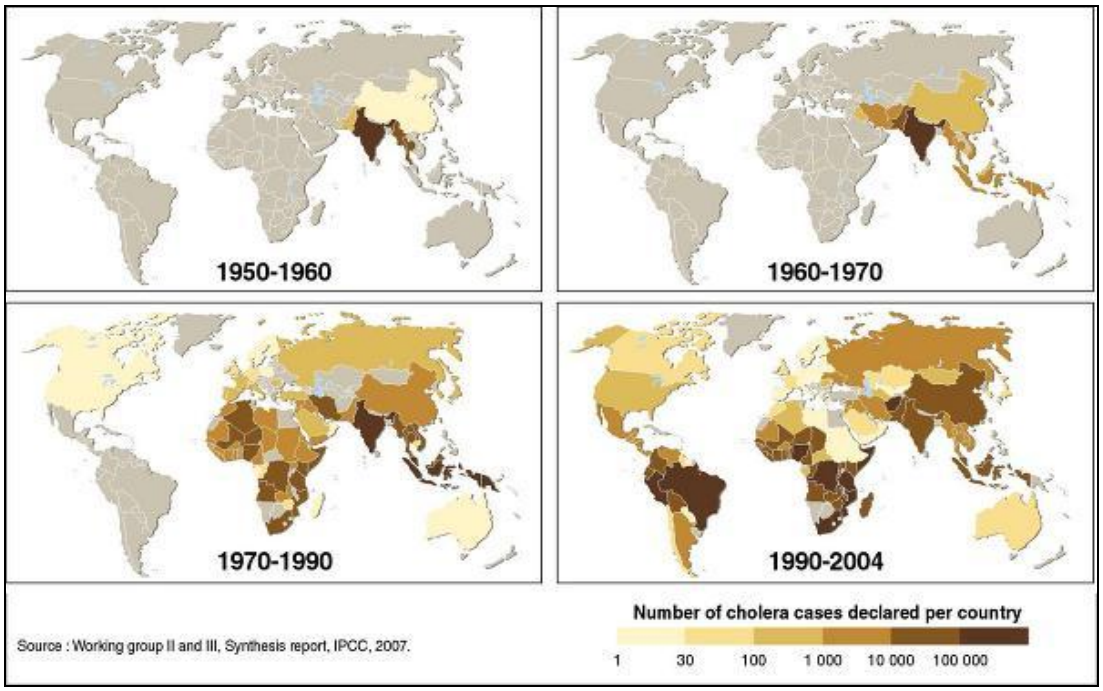


Figure 5: The spread of cholera 1950-2004
Source: *Vital Water Graphics 2: An Overview of the State of the World's Fresh and Marine Waters* (UNEP, 2008).

Uneven distribution of freshwater supply on earth is another aspect of water related issues such that about one third of the world's population lives in countries that do not have enough freshwater for their population. This lack of sufficient freshwater allocation is called "water stress". Putting it differently, severe water stress is defined as a situation where withdrawals exceed 40 per cent of renewable resources, making it more likely to face with chronic or acute water shortages (UNEP, 2007, p.421). Water scarcity is mentioned as one of the "red light issues" in the Environmental Outlook to 2030 Report (OECD, 2008a), meaning that the problem of water shortage is not well managed and requires urgent attention. Figure 6 shows that African and Asian countries will suffer the most due to the lack of water.

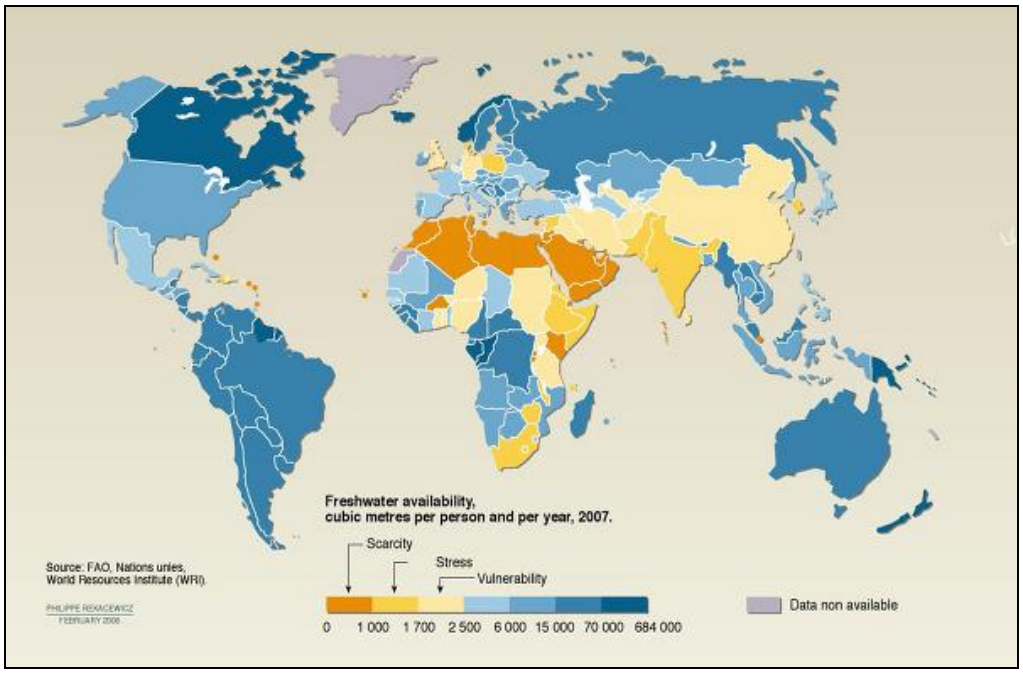


Figure 6: Freshwater availability
Source: *Vital Water Graphics 2: An Overview of the State of the World's Fresh and Marine Waters* (UNEP, 2008).

There are three main reasons for the water stress, the first two of which involve quantity and the third water quality issue:

- Water resources and population distribution do not match,
- Population and water use are growing too fast, and ecosystems cannot renew freshwater resources quickly enough and
- A lot of accessible freshwater is polluted and not usable.

If the habit of unsustainable use and management of the limited water resources and lack of sufficient mitigation efforts against the climate change continue without any change, the number of people living in countries or regions with absolute water scarcity is expected to increase over 1.8 billion by 2025; accompanied with the fact

that two-thirds of the world population will be under conditions of water stress. (UN Water, 2007).

Signaling to a strong rising public awareness of the importance of sustainable use of water resources, there have been many conferences and forums launched from 1972 to the present, proposing water-related goals and objectives (UNESCO WWAP, 2009a). As the first of them, the declaration of the Stockholm Conference on the Human Environment (1972) acknowledged that "a point has been reached in history when we must shape our actions throughout the world with a more prudent care for their environmental consequences.". Agenda 21, as an output of the Earth Summit held in Rio de Janeiro, Brazil (1992), put emphasis on the protection of the quality and supply of freshwater resources through application of integrated approaches to the development, management and use of water resources. Millennium Declaration (2000), additionally, set two water-related Millennium Development Goals as follows:

- Halving, by the year 2015, the proportion of the world's people whose income is less than one dolar a day and the proportion of people who suffer from hunger and, by the same date, to halve the proportion of people who are unable to reach or to afford safe drinking water.
- Stopping the unsustainable exploitation of water resources by developing water management strategies at the regional, national and local levels, which promote both equitable access and adequate supplies (UN 2000).

World Summit on Sustainable Development (2002) also dealt with freshwater-related issues such as integrated water resources management, regional challenges recognized and financial and economic mechanisms while Water for Life Decade (2005-15) which is a mechanism launched by the United Nations System, aimed to

promote efforts to fulfil international commitments made on water and water-related issues by 2015[12].

Having analyzed briefly the main problems about water resources at global level and possible solution offers, it is obvious that the main challenge on the water issue is to ensure effective management of scarce water resources, avoiding overexploitation and degradation, so as to attain the goal of sustainable socio-economic development. All countries around the world have the responsibility of providing improved water supplies and sanitation facilities for their citizens especially when the rising international community pressures and stimulus for the governmental acitons are considered. In the process of discharging this responsibility and establishing water management policies, governments should follow the ecosystem approach, which implies an integrated management of water resources, taking into account the water requirements of natural ecosystems in addition to the requirements of agriculture, industry and municipalities (UN DESA, 2002b). In this context, SAIs' role is of vital importance in assisting the governments to integrate the ecosystem approach into their policies.

2.2.3. Dealing with Climate Change Issues

Climate change, in United Nations Framework Convention on Climate Change (UNFCCC), is defined as the change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods[13]. With a different point of view, climate change, in Intergovernmental Panel on Climate Change (IPCC, 2007) definition, refers to a change in the state of the climate over time, whether due to natural variability or direct or indirect results of human activity.

[12] See for further details "UNESCO WWAP (2009). *The United Nations World Water Development Report 3.Water In a Changing World."*

[13] Retrieved from http://unfccc.int/essential_background/convention/background/items/1349.php

The general trend in the warming of the climate system especially in the last century is evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, rising global average sea level, changes in precipitation patterns and frequency of extreme event such as devastating floods, droughts or increasing tropical storms in some regions (IPCC 2007; WEC, 2010). As seen in Figure 7, it is of first priority to define the drivers of climate change, then analyze impacts of it and develop sound responses.

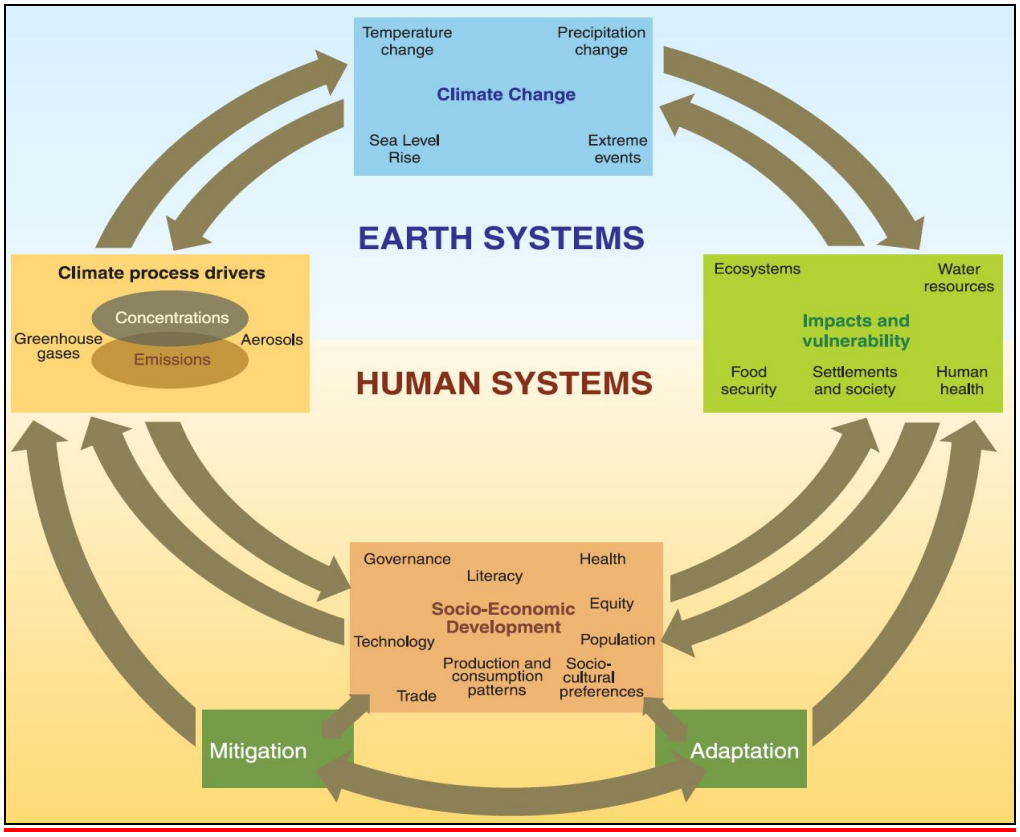


Figure 7: Schematic framework representing anthropogenic drivers, impacts of and responses to climate change and their linkages

Source: Climate Change 2007: AR4 Synthesis Report (IPCC, 2007)

The global mean temperature of the earth has risen by 0.7 ^{0}C in the 20th century, and continues to rise, a fact which is demonstrative by the global warming trend over the 50 years from 1956 to 2005 that is nearly twice that for the 100 years from 1906 to 2005 (IPCC, 2007, p.30). In line with the increasing trend of global warming, the temperature level of the oceans has also increased taking up over 80% of the heat being added to the climate system. Furthermore, satellite data since 1978 show that annual average Arctic sea ice extent has shrunk by 2.7 % per decade, with larger decreases in summer of 7.4% per decade. This shrinkage of mountain glaciers due to increasing global temperature inevitably lead to increases in sea level when accompanied by the other effects of the changing climate. It is asserted that global average sea level rose at an average rate of 1.8 mm per year over 1961 to 2003 and at an average rate of about 3.1 mm per year from 1993 to 2003. Change in precipitation patterns and the resulted drought events in some regions such as eastern parts of North and South America, northern Europe and northern and central Asia can also be accepted as the adverse effects of climate change; keeping in mind that the area affected by drought globally has increased since the 1970s[14].

The main reason underlying the observed increase in global average temperature since the mid-20th century is very likely due to the increase in global anthropogenic GHG emissions which have grown since pre-industrial times by 70% between 1970 and 2004 (IPCC, 2007, p.36). Global GHG emissions, mentioned as one of the "red light issues" in Environmental Outlook to 2030 (OECD, 2008a) is mainly arising from the energy sector, especially the density of fossil fuel use, which is asserted as responsible for 60% of global greenhouse gas emissions and much of regional and urban air pollution (WEC, 2010). It is further projected that the level of GHG emissions will grow by 37% to 2030, and 52% to 2050 without additional creative policies (OECD, 2008a). As it can be seen in the Figure 8, OECD countries are more likely to follow a rather stable path of GHG emissions in the projection to 2050 while

[14] See for further details IPCC (2007). *Climate Change 2007: AR4 Synthesis Report.*

the highest contribution to atmospheric concentration will come from the BRIC countries (Brazil, Russia, India, China) and rest of the world (ROW).

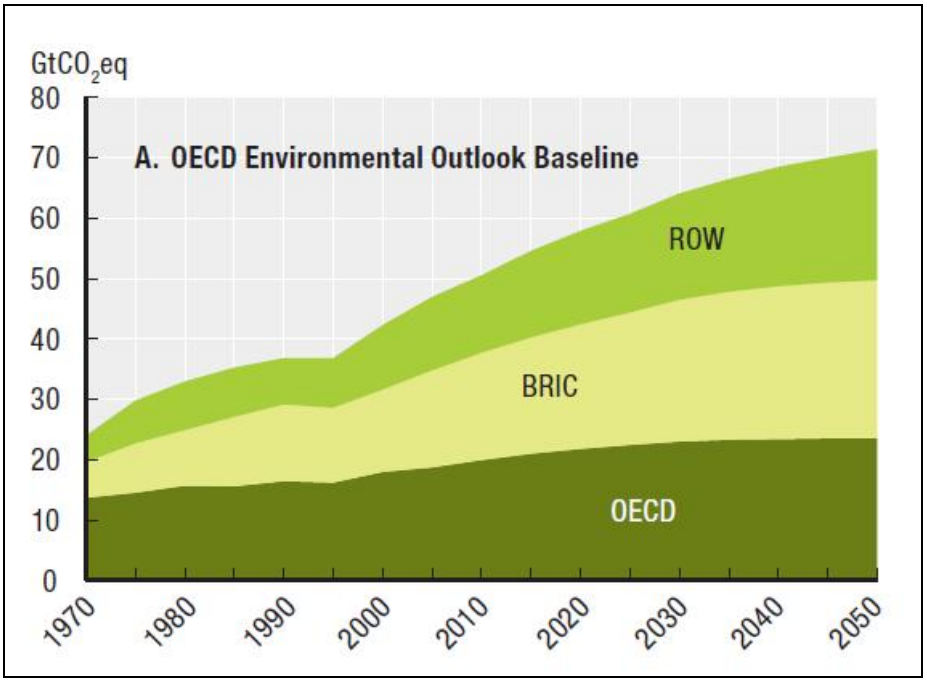


Figure 8: Total green house gas emissions (per region) (1970-2050)
Source: Environmental Outlook to 2030 (OECD, 2008)

It is unequivocal that climate change has many gradual adverse impacts on both human well-being and all kinds of ecosystems on earth. The vulnerability of ecosystems has risen largely due to climate change associated disturbances and other drivers such as expanding infrastructure and agriculture, pollution and overexploitation of resources. In fact, it is estimated that approximately 20 to 30% of plant and animal species assessed so far are likely to be at increased risk of extinction if increases in global average temperature exceed 1.5 to 2.5°C (IPCC, 2007).

Increasing global temperature and high precipitation levels are naturally expected to affect the physical, chemical and biological properties of water. With the increase in drought events and the rising risk of water stress due to global warming and high precipitation levels, agricultural activities have also worsened, causing crop productivity to fall and increasing eventually the risk of hunger (IPCC, 2007).

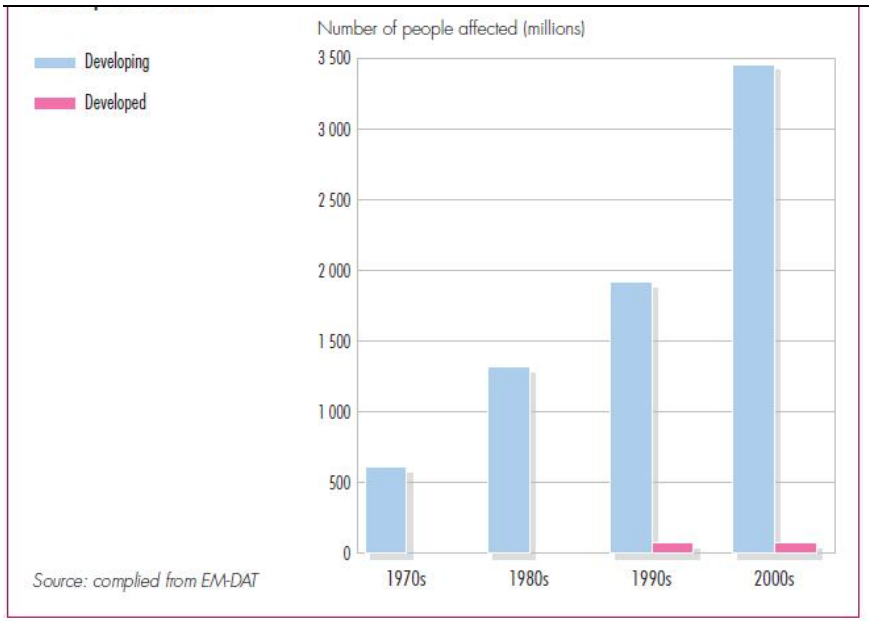


Figure 9: Number of people affected by climate-related disasters in developing and developed countries

Source: Global Environmental Outlook-GEO4 (UNEP,2007)

The impacts of climate change are somewhat evident in all parts of the world, leading to very different impacts in different countries, depending on regional environmental conditions and on differences in vulnerability to climate change. The region that is known to have significant contributions to climate change may not necessarily be the most affected and vulnerable region. As it is obvious in Figure 9,

climate change is expected to have the largest impacts on developing countries although the historical evidence shows that the majority of greenhouse gas emissions have come from developed countries (OECD, 2008a; UNEP, 2007).

In Africa, for instance, between 75 and 250 million of people are projected to be exposed to increased water stress by 2020 due to climate change (IPCC, 2007). Or due to large populations and high exposure to sea level rise, storm surges and river flooding, Asian and African megadeltas are widely accepted as the most vulnerable regions to climate change (IPCC, 2007). Last but not the least, human health is under significant threat of the impacts of the climate change mostly in Africa and some in Asian countries. It is estimated that there were 166.000 more deaths worldwide, mostly in these regions due to changes in climate by the year 2000, compared with the baseline climate of 1961–1990 (UNEP, 2007).

More frequent observation of climate change related impacts in developing countries is largely arising from the fact that developing countries in general lack the necessary financial and institutional adaptive capacity (OECD, 2008a; WEC, 2010). The weaknesses of their coping capacities, vulnerability of their social, institutional, and physical infrastructures and geographical locations make it indispensable for them to face with the worst impacts of climate change. This picture of unevenness makes the emergence of burden-sharing policies a key issue on the agendas of all countries to deal with the impacts of the climate change in a successful and promising manner.

Anlyzing the impacts of climate change on earth and humanity, there have been many initiatives launched at global level. Brundtland Report (1987), being the first international initiative to create awareness of sustainable development issue, called on the countries to take measures against the adverse effects of climate change and air pollution, and encouraged the relevant policy efforts. This report was followed by renewed commitments to solving these issues at the summits in Rio de Janeiro in 1992 and in Johannesburg in 2002. UNFCCC, as the main international agreement

on climate change that encourages countries to work together to stabilize GHG emissions "at a level that would prevent dangerous anthropogenic interference with the climate system"[15], was signed in 1992 at the Rio Summit, and has been ratified by 191 counties. Its Kyoto Protocol, prepared in 1997 and ratified by 177 parties, is in force since the 16th February 2005[16]. To achieve the GHG emission targets, Kyoto Protocol imposed differentiated national or regional emission reduction or limitation obligations for 2008-12 with 1990 as the reference year.

Depending on current climate change mitigation policies and related sustainable development practices without developing further policies would induce many changes in the global climate system during the 21st century that would very likely be larger than those observed during the 20th century (IPCC, 2007). It should be well understood that the more countries that participate in mitigation action against climate change, and the more sectors and greenhouse gases that are covered, the cheaper it will be to curb global GHG emissions (OECD, 2008a). For instance as a matter of urgency, greater energy efficiency and cleaner energy technologies, including advanced fossil fuel and renewable energy technologies should be enhanced to reduce air pollution and help to mitigate greenhouse gas emissions (UNEP, 2007). Extending the mitigation efforts, integrating the climate change concerns into the development plans covering all the vulnerable fields such as energy, transport, agriculture, forests, and infrastructural activities is urgent for both the developed and developing countries. This is an issue that will have broad impacts not just on the environment but also on economic and social development, and needs to be considered in the context of sustainable development. In this sense, since solutions to environmental crises, such as climate change, require greater globalization of governance (UNEP, 2007), SAIs' international audit initiatives and enhancing cooperation mean alot for the environmental improvement.

[15]Retrieved from http://unfccc.int/essential_background/convention/background/items/1349.php

[16] Retrieved from http://unfccc.int/kyoto_protocol/items/2830.php

CHAPTER 3

NEW TREND IN AUDITS OF SUPREME AUDIT INSTITUTIONS (SAIs): ENVIRONMENTAL APPROACH AND THE ADOPTION OF FOURTH "E" IN THE AUDITS

Changes of expectations of citizens who are getting more aware of the environment around them have brought along a need for an independent and objective oversighting on environment. This increased awareness about environmental protection has made the assessment of environmental performance essential as well. SAIs, taking this unique responsibility and developing a new approach to auditing, have launched environmental audit programmes both at national and international levels and begun to assist governments in internalizing the sustainability context in their policies.

First section of this chapter gives a brief insight on the evolution of environmental auditing while second section proposes further details on the environmental audits conducted by SAIs. After explaining the main drivers of environmental audits, audit approaches, mandate, audit process and the international reflections of environmental auditing as well as the experiences of the Turkish Court of Accounts in the second section, the third and last sections will focus on the scope of environmental audits in terms of their topics, main findings and recommendations.

3.1 Evolution of Environmental Auditing

Environmental auditing, being not a new discipline and having not a unique definition, has different implications for the public and private sectors. The first mandatory compliance audits were introduced in the U.S. chemical and steel

industries in the late 1970s as a major tool for the management of their environmental resources and checking compliance of their business activities with environmental legislation as well as defining the extent of their liabilities toward the environment (Cahill and Kane,1989; Harrison,1984; Desgagn´e and Gabel,1997). The need for the corporations and governments to be responsible for the impacts of their activities, processes and products on the environment and subsequently on human health paved the way for environmental audits to be perceived as a popular means of assessing environmental performance and remains it as an evolving discipline (Desgagn´e and Gabel,1997).

For the private sector, environmental auditing refers to an internal audit, for example, to assure corporate executives and investors that all relevant regulatory requirements are being satisfied (Quevedo, 1995 cited in Leeuwen, 2004, p.163). The United States Environmental Protection Agency (EPA) defined environmental audit as "a systematic, documented, periodic, and objective review by regulated entities of facility operations and practices related to meeting environmental requirements" [17]. Other well-known definition that was produced by the International Chamber of Commerce in its publication Environmental Auditing (ICC, 1989) is as follows:

> Environmental auditing is a management tool comprising a systematic, documented, periodic, and objective evaluation of how well environmental organisation, management and equipment are performing with the aim of helping to safeguard the environment by:
> (i) facilitating management and control of environmental practices; and
> (ii) assessing compliance with company policies, which include meeting regulatory requirement (ICC, 1989, p.117).

[17] Retrieved from http://www.epa.gov/compliance/resources/policies/incentives/auditing/auditpolicy51100.pdf

Humphrey and Hadley (2000), following the definition of ICC, systematized the features of audit and concluded that audits should be:

- systematic and comprehensive;
- fully documented and where possible, substantiated with physical evidence;
- periodic rather than "one off" procedure; and
- objective, providing a true and fair view of the situation at a site or within company.

Environmental audit reports may address various subject matters and they are not necessarily equivalent to an audit of an environmental performance report. According to International Federation of Accountants' (IFAC) statement, environmental auditing contains the following types:

1) evaluation on place contamination;
2) evaluation on environmental impacts of planned investment projects;
3) due concern audit of the environment;
4) audit of environmental performance report of companies;
5) audit of the conditions of organizing environmental laws and regulations (Rongbing, 2011, p.9).

With the introduction of Eco-Management and Audit Scheme (EMAS) in 1993, which is a European Standard designed to help an organization manage and improve its environmental performance through voluntary participation, and the publication of ISO 14001 in 1996 which is an international Standard for environmental management systems (EMS), the importance of environmental audits has increased dramatically. More and more companies have begun to find it valuable to audit their environmental impacts (Welford, 2002). As Hillary (1998) has put forward:

> The growth of environmental auditing may be seen as a response to a business need to be able to more effectively control environmental performance and its efforts to promote self-regulation as a more cost effective mechanism to achieve environmental improvements than traditional "command and control" environmental regulation (Hillary, 1998, p.71).

Within the context of SAIs' work, environmental auditing has a different understanding which extends the environmental performance efforts at organizational level to the system-based evaluation at governmental level and eventually at national and global level. The increasing concern that organisations affecting the environment should be accountable for their actions has led to growing expectations that the representations made in these environmental reports should be subject to independent audit (INTOSAI WGEA, 2001, p.5). As a result of the implications of this expectation for SAIs, the subject was taken up by INTOSAI and INTOSAI established the Working Group on Environmental Auditing (WGEA) in 1992, the same year with the UN Earth Summit that was held in Rio de Janeiro. In 1995, at the Fifteenth INTOSAI Congress, held in Cairo, whose one of the main themes was environmental auditing, a framework definition of environmental auditing was established reflecting the consensus among SAIs. According to this definition:

- Environmental auditing is not significantly different from normal auditing as practised by SAIs;
- Environmental auditing may be included in financial, compliance, or performance audits. Performance audits normally cover the three Es of Economy, Effectiveness, and Efficiency. The adoption of a fourth E - Environment – depends very much on an SAI's mandate and its government's environmental policy;

- The concept of sustainable development may be part of the definition, provided that it is part of government policy and/or the programme to be audited (INTOSAI WGEA, 1997, p.1).

Based on these underlying principles, environmental auditing of SAIs is widely accepted as a methodological, objective, impartial and technical process to evaluate the use, administration, protection and preservation of the environment and natural resources, considering the fundaments of sustainable development and observance of the principles on oversight by government institutions, as well as the activities of private parties that manage or exploit natural resources (OLACEFS, 2002 cited in Lima and Magrini, 2010, p.111). Not to allow environmental audits to degenerate into self-serving exercises in public relations, it should be ensured that environmental audits address the important issues of conservation and sustainability (Rika, 2009, p.305)

3.2 Environmental Auditing and SAIs

Environmental auditing, as it applies within the responsibility of SAIs, plays a significant role in promoting the environmental protection and the effectiveness of the environmental management systems. In this context, following sections will explain the main drivers of environmental audits conducted by SAIs and give a general insight about audit approaches, mandate, audit process and the international reflections of environmental auditing as well as the experiences of the Turkish Court of Accounts in this area.

3.2.1 Main Drivers of SAI Audits with Environmental Perspective

SAIs, as autonomous, independent, and non-political organizations, audit governments to help them improve performance, enhance transparency, ensure accountability and foster the efficient and effective receipt and use of public resources for the benefit of their populations (INTOSAI WGEA, 2007a). As stated in

the Lima Declaration of Guidelines on Auditing Precepts, adopted at the IXth INCOSAI, held in Lima (Peru) in 1977;

> Audit is not an end in itself but an indispensable part of a regulatory system whose aim is to reveal deviations from accepted standards and violations of the principles of legality, efficiency, effectiveness and economy of financial management early enough to make it possible to take corrective action in individual cases, to make those accountable accept responsibility, to obtain compensation, or to take steps to prevent-or at least render more difficult-such breaches[18].

SAIs carry out environmental audits in the context of the independent, external, public sector audit by which the auditors undertake a new responsibility due to the increasing interest of public opinion on the status of environmental issues. Addressing environmental matters in their audit activities falls within the mandate of SAIs and this view has gained increasing support for some sound reasons (Carisse et al., 2004). First of all, governments have to be held accountable for the public resources spent on environmental protection in terms of the prudency of their both financial and effective management. SAIs also need to hold governments accountable for compliance to signed international agreements and enacted domestic laws and regulations.

Auditors in SAIs, being aware of the main environmental problems threatening the world, can understand the complexities in international and domestic environmental governance and develop a great insight for tackling with the problems and weaknesses in the implementation process by proposing concrete recommendations. Since financial responsibility also covers environmental responsibility in the public

[18] Retrieved from http://www.intosai.org/blueline/upload/limadeklaren.pdf

sector stemming from “the right to environment”, SAIs serving for the responsibility relations between executive and legislature help fulfilment of the said responsibility in the best possible way through their environmental audits (TCA, 2007).

The disclosure of compliance of government policies with the legislation, and conventions at both national and international level as well as the measurement and promotion of the economic, efficient, and effective use of public funds for environment can be put forth as the basic targets and at the same time the most outstanding benefits of the environmental auditing. Moreover, environmental auditing initiatives are considered as a relatively inexpensive environmental protection tool by the governmental side by which severe consequences of environmental deterioration can be competed with cooperatively through the assessments and recommendations of SAIs on the environmental management systems. Auditors in SAIs should ensure that the actions of public agencies responsible for environmental goods and services and environmental protection are well coordinated. In fact, auditors are responsible in their environmental audit reports basicly for strategic evaluation of:

- legislation establishing national environmental management systems,
- government agendas that include actions needed to promote sustainable development, and
- government environmental policies, plans, and programs (Campelo, 2004, p.1).

As Rongbing (2011) puts forward, beside traditional regulatory tools such as imposing taxes, directions etc., carrying out environmental audits which has been an important part of government auditing has a unique role to overcome “government failure” in the field of environmental management. In many countries there are parliamentary committees or commissions linked to the SAI (TCA, 2007). The main purpose of those committees’ is to review the audit reports in detail by taking the

observations, findings and suggestions of SAIs into consideration and to present their own comments and suggestions to the parliamentarians on the audited management activities. Parliament committees are seen as important means for strengthening the role of SAIs and improving public accountability. For instance, the existence of a Commissioner of the Environment and Sustainable Development within the Office of the Auditor General of Canada makes it necessary for each of the administrative departments to submit a 'Green Report' on the environmental performance of their activities (Rubenstein, 2001 cited in Lima and Magrini, 2010) while in Colombia, the local SAI must report annually to Congress on the situation of the country's natural resources and environment (Colombia, 2007 cited in Lima and Magrini, 2010). In this sense, using environmental auditing as a monitoring tool contributes significantly to the high-end performance and regulation and therefore to the effective implementation of sustainable development strategy.

Measures of environmental audit quality have different aspects in a sense that quality is not only reflected in detecting violations of laws and regulations but also in rapid implementation of the audit decisions and recommendations by the responsible agencies. This is the most important factor that enhances the credibility of environmental auditing by turning environmental auditing accountability into legal accountability, personal accountability and consequences accountability (Rongbing, 2011).

The choice of topics for environmental audits of each individual SAI shows a great variety according to the national and regional circumstances and priorities of the country. Followings are the possible factors that could affect environmental audit decisions of SAIs:

- the natural geography of the country;
- influences of neighbouring countries;

• other national interests (for example, security, poverty eradication, economic development);
• the strong presence of specific industries, including natural resource extraction;
• urgent environmental problems, which may vary from basic needs such as sanitation and water supply to climate-change mitigation;
• the need in smaller developed and lower income countries to involve more external support to build governance and accountability;
• varying levels of capacity of the national government, including the role of an independent audit institution;
• a perception that environmental protection and management can only occur after a country becomes more prosperous; and,
• the various states of security or political stability (INTOSAI WGEA, 2007a).

Since the concept of sustainable development is differently interpreted by each country, the strategies and priorities identified are expectedly unique in national levels (INTOSAI WGEA, 2007a). By assessing the capacity of the country to create a strategy and adequacy of the existing sustainable development strategy in terms of its clarity and expected benefits, SAIs have an important role in enhancing the implementation of sustainable development initiatives. Through the support of the environmental audit, the deficiencies in the environmental protection measures could be reduced to a minimum level, and the effectiveness of the audited bodies and welfare of the society could be promoted to higher levels.

3.2.2 Different Audit Approaches in Environmental Auditing

There is not an obligatory methodology for environmental auditing that is accepted by the SAI community; environmental auditing can encompass all types of audits such as financial, compliance, and performance audits, the choice which is highly depending on SAI's mandate and government's environmental policy (Leeuwen, 2004).

In its paper *Guidance on Conducting Audits of Activities with an Environmental Perspective* (INTOSAI WGEA, 2001), WGEA identifies three types of audits in which environmental issues can be addressed. First of all, "*compliance audit"* of environmental issues deals with providing assurance that governmental activities are conducted according to relevant environmental laws, standards, and policies, both at national and (where relevant) international levels. Through providing this assurance, compliance audit can help the governmental agencies close the gap between commitments and the actual results attained by its policies and programs (INTOSAI WGEA, 2004c, p. 14). This type of environmental audit, as stated in the WGEA guidance paper "*Environmental Audit and Regularity Auditing*" can;

- promote compliance or provide increased assurance about compliance with existing and impending environmental policy and legislation;
- reduce the risks and costs associated with non-compliance with regulations;
- save costs by minimizing waste and preventing pollution; and
- identify liabilities and risks (INTOSAI WGEA, 2004c, p.14).

Environmental auditing can also be carried out by means of "*financial audits"* through which auditors inspect the environmental costs and liabilities that are reflected in financial statements. Financial audits consider whether funding provided multilaterally and bilaterally has been used for its intended purpose, and properly documented (INTOSAI WGEA, 2007b, p.5). For this kind of audit to be performed, the existence of financial statements in the field of environment is a necessity. During an audit of financial statements with an environmental approach, initiatives to prevent, abate, or remedy damage to the environment; the conservation of renewable and non-renewable resources; the consequences of violating environmental laws and regulations; and the consequences of vicarious liability imposed by the state (INTOSAI WGEA, 2004c) form the main focus points for the auditors' evaluation.

Another and maybe the most widely used type of audit on environmental issues is "*performance audit"* which includes the three Es of *Economy, Effectiveness* and *Efficiency* and with the adoption of fourth E, *Environment*. Performance audit of environmental activities includes ensuring that environmental programs are conducted in an economical, efficient, and effective manner as well as they contribute to integrated objectives of sustainable development, especially to the environmental outlook. As Chai (2009) puts forward, the change of evaluation standard from "do things right" to "do right things" with an environmental perspective constitutes the four dimensions of performance audit: the economy of administrative practices; the efficiency of utilisation of human, financial and other resources employed on the programme or activity; the effectiveness of the programme or activity in achieving its objectives and its intended impact; and environmental effectiveness. Within this context, performance audit for the public sector implies the independent assessment of the degree of effectiveness and efficiency of a specific activity, program or institution while paying regard to the principles of cost effectiveness at the same time[19].

The classification of a particular audit about environmental issues as a compliance, financial or performance audit depends on the primary purpose of that audit and most of the time, the environmental audit reports can be presented as a combination of different audit types, such as carrying the principles of both performance and compliance audit.

The SAIs of some countries (such as SAIs of Bulgaria, Czech Republic, Estonia, Hungary etc.) strictly prefer following financial audit approach along with the compliance methodology in their environmental audits although they have also performance audit mandate. These kind of reports generally focus on auditing of the efficiency of the utilization of funds, subsidies or grants allocated to the means of environmental management or of the success of the implementation of specific

[19]Retrieved from http://steconomice.uoradea.ro/anale/volume/2008/v3-finances-banks-accountancy/279.pdf

environmental projects. On the other hand, most of the SAIs apply performance audit approach along with the compliance methodology in order to focus on the challenges, gaps or opportunities in the environmental management system rather than investigating the utilization of environmental funds. In other words, SAIs that prefer mainly the performance audit methodology try to grasp the big picture in the environmental management system and help governmental agencies take measures for current or possible deficiencies rather than punishing them. Shortly, performance audit is looking at management, effectiveness, and efficiency (TCA, 2007). Because, focusing only on the legal compliance and financial accountability of the transactions within the environmental legislation and the tendency of responsible bodies toward avoiding penalties rather than improving processes may fail to enhance environmental accountability. This may lead to a danger that legal requirements will be perceived as an acceptable standard rather than a minimum standard (Rika, 2009, p.306). And audits conducted against a mimimum standard may not encourage organizations to take proactive measures in order to improve management systems within the scope of sustainable development strategy (Rika, 2009, p.312).

There are opposing views among the environmental auditors on the issue of environmental audit type that should be followed. Some argue that including financial means in an environmental audit strengthens the impacts of the audit results due to their higher sanction power. Knowing that execution of the transactions within the environmental management system could result in judicial process or imposing sanctions, the attitudes of the managers of the audited agencies are expected to be more responsive to the environmental audits according to financial approach promoters. Conversely, some group of environmental auditors believe that environmental auditing is naturally within the performance audit (TCA, 2007) and the managers of the audited entity substantially appreciate the positive and constructive contributions of the performance audit to their entities. The main tool to help the responsible entities develop an understanding of the positive contributions of the environmental auditing with performance audit approach is obviously extending the number, scope and field of the environmental audit projects and promoting

relations with the actors of the environmental management system. There is also an urgent need for capacity building in the field of environmental auditing. As previous studies suggest (Rika, 2009, p.314), enforcement of environmental management systems necessitates an increase in the number of annual audits and this depends to a large extent on the adequacy of the capacity in terms of budgetary resources and number and ability of human resources.

The type of an environmental audit may not necessarily conform strictly to either financial audit or performance audit types. An audit report may be built on a performance approach including at the same time financial evaluations. Taking as an example of the performance audits of the National Audit Office of China (the CNAO) on the phase-out projects for ozone-depleting substances financed by the grants of Montreal Ozone Projects Multilateral Trust Funds[20], the CNAO's performance audit over the implementation of Environmental Protection Projects as well as revenues and expenditures on an annual basis during the period of project execution put forward a combination of both the performance and financial approaches. In case the audit results revealed that the implementation effects fell short of the requirements, further actions could be stated to certify the audit findings, and sanctions such as decreasing or stopping payment of grants could be applied.

U.S. General Accountability Office (GAO) is one of the examples that has changed its route in the environmental working plan from financial audit in the early 20th century to performance audit in the 1970s and the 1980s (Rongbing, 2011, p.9). As a result of its new route, it has been in a close relationship with the Congress about the generation of the environmental policies in order to better achieve the anticipated targets. Similar to this relationship, exchanging ideas among the auditors and audited entities, as the main pillar of the performance audit methodology, has a very significant contribution to the implementation process. Chinese future environmental auditing on the basis of a specific issue, namely carbon emission evaluation index system, is

[20] Retrieved from http://www.asosai.org/asosai_old/journal2004_April/articles_3.htm

expected to gradually remove its focus from the lawfulness of the usage of funds to the political and governance performance (Rongbing, 2011, p12). On this wise, the development of environmental auditing will be facilitated toward the performance auditing approach, paying more attention on the effectiveness of the functioning of the systems, mechanisms and institutions.

The level of development and income of a country significantly affects the extent of the environmental audits. Although environmental issues are major concerns in all countries, small developing countries have lower ability to manage environmental issues and conduct environmental audits when compared to developed or larger developing countries due to their financial constraints (Rika, 2009, p.305). The evolution of environmental auditing from legal compliance to review of environmental management systems and focus on sustainability since 1990 has been a great feature of especially higher income countries. This evolution has hardly been experienced by low income countries; many of small developing countries have hardly achieved to go beyond the level of legal compliance since environmental audits with a performance approach are rather costly (Bae and Seol, 2006 cited in Rika, 2009) to implement than the execution of traditional regulatory audit tools such as financial and compliance audits. Therefore, it is unambigously expected that SAIs of developed countries and larger developing countries prefer to carry out environmental audits with an approach measuring the performance of environmental management system and as income increases, shift from legal compliance and financial inspection to performance evaluation becomes a more common application.

It can further be argued that audits with financial approach have rather short-term effects on the environmental performance of a country since their scopes are generally restricted to utilization of certain funds or projects carried out. So it is highly probable that the effects of such environmental audits will be limited. However, in performance methodology, since challenges and opportunities of the systems of the environmental management are explored during the audits process,

such audits may be accepted to have more permanent impacts on the environmental performance of the countries since the management system becomes on the eve of essential reforms.

As the 6th Survey on Environmental Auditing (INTOSAI WGEA, 2009) reveals, %78 of respondent SAIs which corresponds to a number of 106 has experience in conducting environmental audit and the number of audits of more than half of the SAIs (59%) has increased since 2006 although the number of environmental audit reports display a great variability among different regions. It is further mentioned in the 6th Survey that compared to the 5th Survey, there has been a significant increase in all types of conducted audits related to environmental matters such that the number of financial audits which is recorded as 49 in 2006 has increased to 383 in 2009, the number of compliance audits which is 242 in 2006 has increased to 622 in 2009 while the number of performance audits has increased from 296 in 2006 to 640 in 2009 (see Table 2). As shown in Table 2, we see a trend of environmental audit focused on performance auditing while the tendency to incorporate financial means in the reports dealing with environmental issues seems weaker in general especially due to lack of environmental financial statements and environmental accounting.

Table 2: Number of reports with respect to audit type
Source: 6th Survey on Environmental Auditing (INTOSAI WGEA, 2009).

Audit type		**Number of reports**				
		1994–96	**1997–99**	**2000–02**	**2003-05**	**2006-08**
Financial audits	**Regularity audits**	117	87	74	49	383
Compliance audits					242	622
Performance audits		257	304	181	296	640

3.2.3 Mandate of SAIs for Environmental Auditing

It has been a debatable issue from the launch of environmental auditing whether a special mandate is necessary for conducting environmental audits. Although there are different opinions on this controversial question among SAIs, official statement of the WGEA is that a specific mandate is not needed (INTOSAI WGEA, 2007c). As the tasks and mandate of SAIs are defined in the Constitutions or Audit Law, their legislative mandate can, but does not necessarily need to refer specifically to environmental auditing (INTOSAI WGEA, 2007a). SAIs, differing in type of their mandate on environmental auditing, may conduct environmental audits through a general mandate that can be applied to all sectors of the government including the environmental sector or may have a specific mandate for environmental auditing, which gives them an extra responsibility (Leeuwen, 2004).

It is well accepted that environmental audit can encompass all types of audits such as financial, compliance, and performance audits (with a rather more emphasis) depending of the mandate of SAIs and their institutional structure. However, the emerging idea that performance audit mandate is more suitable for conducting audits with environmental perspective has again led to debates over the type of environmental audits. In fact, at the 6th INTOSAI WGEA Meeting in Cape Town, South Africa (2000), the difficulties in carrying out environmental audits within a regularity mandate (that encompasses both financial and compliance audit mandates) were first raised by especially the SAIs that do not have a specific performance or environmental audit mandates. WGEA Guidance Paper "*Environmental Audit and Regularity Auditing*", relying on the idea that SAIs do not require a performance audit mandate or a specific environmental mandate to be able to conduct audit work with an environmental focus, provides guidance on how to conduct environmental audits using regularity auditing practices (INTOSAI WGEA, 2004c, p.3). As a Chief Auditor in the Supreme Court of Audit of Iran put forward:

> The Supreme Court of Audit of Iran, like many SAIs, faces the challenge of working within a restricted mandate when performing environmental audits. What paved the way for us to begin these audits was the belief, expressed in earlier WGEA publications, that environmental auditing is not that different from the other types of audits that SAIs perform. So we started environmental auditing in a regularity contex and operated under the assumption that we did not need a new mandate… Our participation in the WGEA showed us that other SAIs have been able to audit environmental issues with a restricted mandate (Momeni, 2004).

Specific mandate, even though it is not a common issue for SAIs, is regarded by several groups as a mechanism that enhances SAIs' initiatives to conduct environmental audits. Some SAIs view that a special mandate can facilitate the approach and effectiveness of the messages of SAIs' to the government emphasizing that environmental audits are important (INTOSAI WGEA, 2007c, p.23).

According to the 6th Survey on Environmental Auditing, progressively more SAIs are specifying their mandate to audit environmental issues such that the percentage of SAIs with specific mandate stated as 17% in 2006 has increased to 23% in 2009. Besides, it is still a fact that environmental audit mandate for most of the SAIs (73%) has not been changed since 2006 (INTOSAI WGEA, 2009, p.6). As can be seen in Table 3, the list of SAIs with specific environmental audit mandate is not a long list[21]:

[21] Retrieved from http://www.environmental-auditing.org/tabid/127/RegionId/226/Default.aspx

Table 3: SAIs with specific environmental audit mandate
Source: Retrieved from http://www.environmental-auditing.org/tabid/127/RegionId/226/Default.aspx

Region	SAI
Africa Region	SAIs of Egypt, Libyan Arab Jamahiriya, Tanzania (United Republic of), Tunisia, Cameroon and Uganda
Asia Region	SAIs of Armenia, China and Sri Lanka
Central America Region	SAIs of Belize, El Salvador, Honduras, Nicaragua and Panama
European Region	SAIs of Belarus, Norway, Iceland, Romania and Russian Federation
Middle East Region	SAIs of Jordan and Yemen
North America Region	SAI of Canada
South America Region	SAIs of Colombia, Ecuador and Peru

Aside this limited list of the SAIs with specific environmental audit mandate, most SAIs within the body of INTOSAI WGEA have been carrying out environmental audits depending on their full mandate of regularity (financial and compliance) as well as performance audit frameworks. So it can be concluded that no matter what the scope of the mandate is, all SAIs can build suitable audit approaches and methodologies in order to conduct audits of the implementation of environmental commitments (INTOSAI WGEA, 2007b, p.ix).

Specific reference to environmental auditing in Audit Law is not the only differentiating issue for SAIs. The level of access that SAIs' mandate gives to undertake environmental auditing in both the governmental and non-governmental organizations shows also a great variety among them. An SAI may have full or partial access, or in some cases no access to the organizations below:

- The national government
- Provincial, regional, or state governments
- Local, municipal, or community governing bodies
- State-owned enterprises or state-owned companies
- Semi-governmental organisations
- Non-governmental public enterprises or organisations
- Private sector enterprises or organisations (INTOSAI WGEA, 2009)

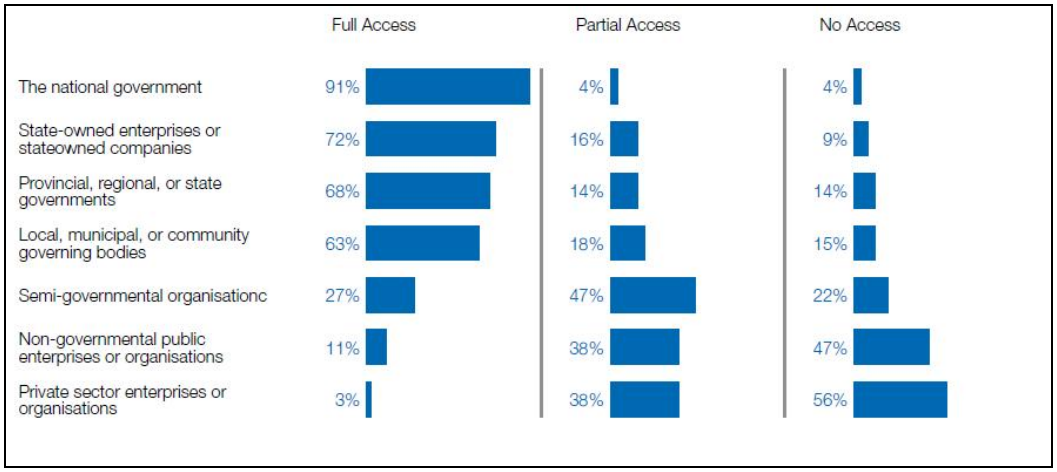


Figure 10: Level of access given by the mandate of SAIs
Source: 6th Survey in Environmental Auditing (INTOSAI WGEA, 2009)

According to the 6th Survey results on Environmental Auditing (2009), most of the SAIs have full access to national government, state owned enterprises or companies and provincial, regional or state governments (see Figure 10). However, most SAIs have either partial access or do not have access to non-governmental public enterprises or organisations and to private sector enterprises or organisations. As it is shown in Figure 10, of 106 respondent SAIs, only 11% of them have full access to non-governmental public enterprises or organisations while 3% to private sector

enterprises or organisations. This lacking in extending the auditing scope and mandate over the entities may be frustrated mostly by capacity constraints such as human resource capacity, specific environmental audit department structure, budget constraints and the existence of environmental management systems.

Since the legislative mandate can give different level of access for auditing entities, auditors sometimes have to get in touch with and get information from the authorities outside their mandate on a voluntary basis (Leeuwen, 2004). But it should be noted that the auditors have to be careful while deriving audit results and enforcing responsibilites when such authorities are involved in the auditing. Because the restriction of access mandate always has to be beared in mind.

3.2.4 Audit Process with Environmental Perspective

Audit process is more or less the same for all audit projects in terms of the steps followed, being independent of audit topic, either environmental issues or any other topic, and audit type, whether it is a financial, compliance or performance audit. Auditors should define an audit strategy prior to the audit to implement during the whole process since the success of this strategy will affect to a large extent the audit efficiency and effectiveness (Wanga et al., 2011, p.2110).

Following the determination of the audit topic and respective assignment to the auditors, an audit process normally consists of four steps[22] (ASOSAI, 2009) which are:

- Planning for the audit
- Conducting audit
- Audit reporting
- Follow up review

[22] Explained in detail in *"8th ASOSAI Research Project: Guidance on Conducting Environmental Audit."* ASOSAI (2009).

In the planning step, auditors should make necessary preparations for the next implementation stage of the audit. These preparations consist of in the first instance collecting the background information about the topic and setting the audit scope in terms of the aspects of the subject matter and responsible bodies. Then audit objectives and audit criteria as well as the audit methodology are decided. The decisions on these issues depend to a large extent on the possible approaches followed in environmental auditing which are shown in Figure 11 below.

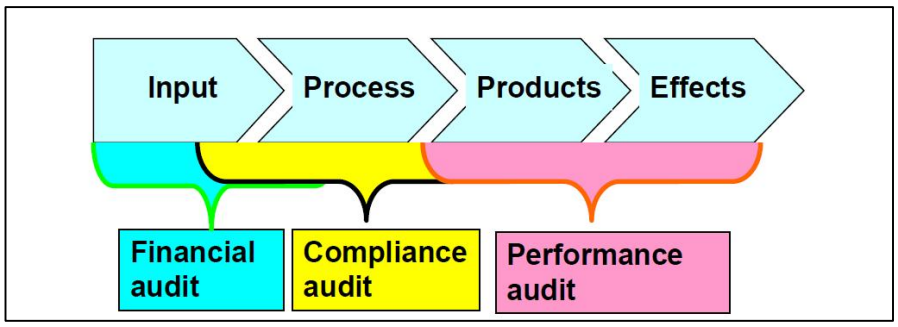


Figure 11: Possible approaches in environmental auditing
Source: Retrieved from the presentation titled as "Introduction to best practice in auditing and the ISSAIs", in EUROSAI WGEA Seminar (2011), available at www.eurosaiwgea.org

Financial audit dealing with environmental issues generally focus on the "Input" stage by correcting the financial statements prepared for environmental purposes while compliance audit stresses on the "Process" stage and aims to reveal the compliance of policy implementation with environmental requirements and all related national or international legislations and conventions. On the other hand, performance audit rather deals with the products and effects of environmental measures in place. In environmental audits, three pillars of the sustainable development may be looked for in the policies to declare that whether they are:

•**economic**; meaning that all the resources are used in appropriate time, in right quantity and quality and at the most convenient prices;

•**efficient;** meaning that the best ratio between inputs used and outputs achieved is attained and

•**effective**; meaning that set goals and expected results are achieved[23].

In the framework of these principles, evaluation of programmes to see whether they worked as intended, of outcomes to examine whether the goals are attained and of impacts to realize the contribution of the policies to intended goals may constitute the main objectives of the audit.

Audit criteria, which are also to be defined in the planning phase, are the benchmarks against which the subject matter will be compared[24]. As shown in Figure 12, narrowing down the scope of the audit to define the best related criteria without deviating from the essence of the subject matter is one of the important rules of the planning step.

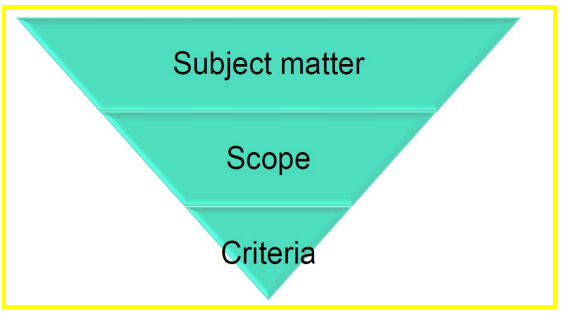


Figure 12: Defining Audit Criteria
Source: Retrieved from the presentation titled as"Introduction to audit criteria in environmental auditing: Audit approaches based on ISSAIs" in EUROSAI WGEA Seminar (2011), available at www.eurosaiwgea.org

[23] The definitions are retrieved from the presentation titled as "Examples of evaluating the 3Es in waste and water management audits in Slovenia" in EUROSAI WGEA Seminar (2011), available at www.eurosaiwgea.org

[24] Retrieved from the presentation titled as"Introduction to audit criteria in environmental auditing: Audit approaches based on ISSAIs" in EUROSAI WGEA Seminar (2011), available at www.eurosaiwgea.org

For the environmental audits, existence of the environmental policies of the government is of vital importance since SAIs derive audit criteria from policy documents of the government, such as laws and regulations, action plans, strategies, programmes, international agreements that are ratified by their country, or any other formal government documents (TCA, 2007). Without the clear formulation of these policies and the availability of the necessary information, the audit could not be carried out.

Defining audit methodology comprising the procedures to obtain audit evidence is another important aspect of the planning phase. Among these procedures[25], some are perceived as traditional while some emerge as new auditing methods. Inspection in terms of examining records or documents in paper or electronic form, reviewing the activities of related executive bodies such as committees, working groups, task forces, or similar groups, interviews with the representatives of the auditees and other stakeholders and field visits can be stated as examples for traditional methods. In addition to these, using questionnaires to seek information from knowledgeable people within and outside the entity, using external consultants, receiving external confirmation from a third party, such as a bank or debtor, comparative analysis to establish benchmarks and best practice and carrying out analytical procedures have been recently used commonly by the auditors in defining their audit methodology.

Following the planning step, *implementation phase of the audit* begins during which the auditors collect sufficient, competent and reliable audit evidence in order to form audit opinion. This is in line with the essence of auditing[26] that corresponds to the

[25] Retrieved from "Guidance on Conducting Audits of Activities with an Environmental Perspective (INTOSAI WGEA, 2001)" and "The World Summit on Sustainable Development (INTOSAI WGEA, 2007b)"

[26] Retrieved from the presentation titled as "Introduction to best practice in auditing and the ISSAIs", in EUROSAI WGEA Seminar (2011), available at www.eurosaiwgea.org

measurement of a subject matter against a set of criteria by obtaining sufficient, appropriate audit evidence.

In the third *"Audit reporting"* step, a draft report is prepared in first place and audit findings along with the proposed recommendations are elaborated on with the representatives of audited entities. Regarding the results of these meetings and incorporating the replies received from the auditees, audit report is finalized, approved by the senior management of SAIs and sent to the senior management of the audited entities with the recommendations.

In the *follow-up review phase,* it is examined whether the proposed recommendations are regarded by the auditees in their subsequent policies and necessary measures are taken in response to the audit opinion.

3.2.5 International Aspect of Environmental Auditing

Most environmental problems are perceived as transboundary in nature. That is why it is very usual for countries to come together and put their efforts collectively on the emerging environmental problems through many international aggrements and conventions. In this respect, this transboundary nature of the environmental problems and the environmental policies of the governments bring along with the necessity of a strong coordination and cooperation among the SAIs from different regions (Köse, 2007, p.275)

The International Organisation of Supreme Audit Institutions (INTOSAI), founded as a result of this necessity in 1953 with 34 original member countries, is today perceived as the leader of the external government audit community with 189 full members and 4 associated members all around the world. As an autonomous, independent and non-political organisation, it has provided an institutionalised framework for SAIs to apply internationally accepted audit standards, improve public sector auditing within the framework of these standards, promote development and

transfer of knowledge and experience among SAIs and enhance professional capacities and influence of them in their countries[27].

The principle bodies of INTOSAI are Congress (which is the supreme organ of INTOSAI and is composed of all members), Governing Board, General Secretariat and Regional Working Groups (See Table 4).

INTOSAI has established several mechanisms to encourage SAIs to share the experience, results from participation in national and international environmental audits and ideas on harmonization of methodology, audit documents, enhancement of qualification in performing sustainable development audits. In this context, mechanisms[28] established by INTOSAI are as follows:

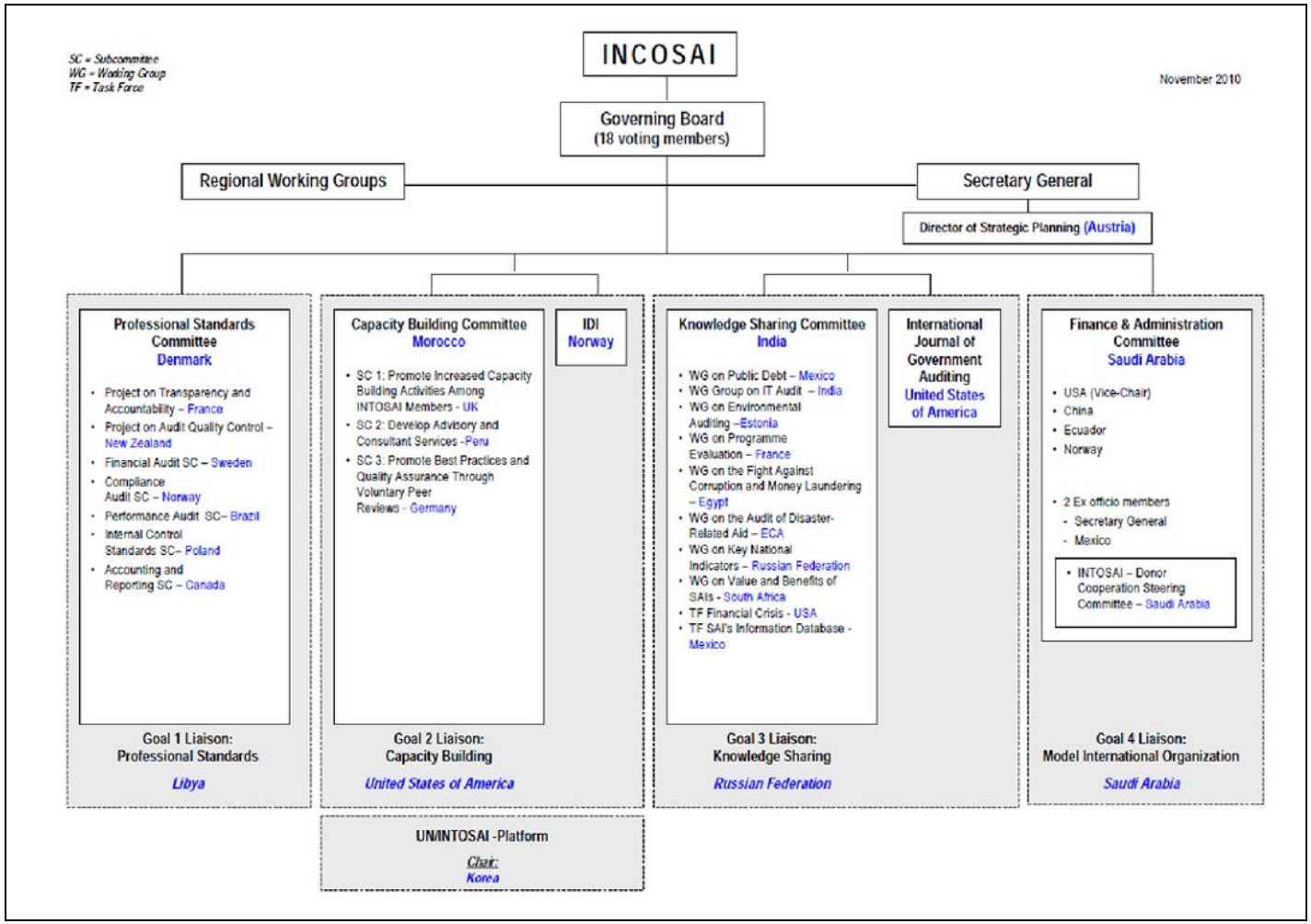
- *Committees on special subjects*: Professional Standards Committee (PSC), Capacity Building Committee (CBC), Committee on Knowledge Sharing and Knowledge Services, Finance & Administration Committee (FAC).
- *Working groups on SAIs' interests in specific technical issues*: Working Group on Public Debt, Working Group on IT Audit, Working Group on Environmental Auditing, Working Group on Programme Evaluation, Working Group on the Fight Against Corruption and Money Laundering, Working Group on Accountability for and Audit of Disaster-related aid, Working Group on Key National Indicators, Working Group on Value and Benefits of SAIs.
- *Task forces on issues of significant interest of members:* INTOSAI Communications Strategy Task Force, INTOSAI Task Force Global Financial Crisis - Challenges to SAIs.

[27]Retrieved from *INTOSAI Strategic Plan 2011-2016* (INTOSAI, 2010), available at www.intosai.org

[28] Retrieved from http://www.intosai.org/en/portal

Table 4: INTOSAI Goals Organisational Chart (as of November 2010)

Source: http://www.intosai.org/blueline/upload/chairs0211.pdf



INTOSAI has also established collaboration mechanisms such as meetings, training workshops and knowledge sharing through case studies and detailed audit reports for perpetuating best practices.

Within INTOSAI, there are seven Regional Working Groups established in order to promote INTOSAI's goals regionally:

- Latin American and Caribbean (OLACEFS-1965),
- Caribbean (CAROSAI-1988),
- Europe (EUROSAI-1990),
- Africa (AFROSAI-1976),
- Arabic countries (ARABOSAI-1976),
- Asia (ASOSAI-1978) and
- South Pacific (PASAI-1987).

These Regional Working Groups provide members with opportunities of professional and technical cooperation on a regional basis. Working Group on Environmental Auditing (WGEA), one of the most active Regional Working Groups, was created in 1992. This is the same year that the UN Earth Summit was held in Rio de Janeiro, with 12 member countries as a result of this strong interest in the roles and activities of SAIs in issues of environmental auditing and now it has grown to a membership of 72, making it the largest INTOSAI Working Group[29]. The WGEA aims to improve the use of audit mandate and audit instruments in the field of environmental protection policies by;

- Assisting SAIs in acquiring a better understanding of the specific issues involved in environmental auditing,
- Facilitating exchange of information and experience among SAIs and
- Publishing guidelines and other informative material for their use.

[29] Retrieved from http://www.environmental-auditing.org/Home/AboutWGEA/Background/tabid/103/Default.aspx

The WGEA has developed numerous guidance documents[30] to support auditing specific environmental topics and to improve audit methodology such as Guidances for Supreme Audit Institutions on Auditing Forests (INTOSAI WGEA, 2010), Mining (INTOSAI WGEA, 2010), Sustainable Energy (INTOSAI WGEA, 2010), Sustainable Fisheries Management (INTOSAI WGEA, 2010), Government Response to Climate Change (INTOSAI WGEA, 2010), Biodiversity (INTOSAI WGEA, 2007), Water Issues (INTOSAI WGEA, 2004), Waste Management (INTOSAI WGEA, 2004) etc. There are also guidances published to enhance the mutual cooperation among SAIs such as Auditing the Implementation of Multilateral Environmental Agreements (MEAs): A Primer for Auditors (INTOSAI WGEA, 2010), Cooperation Between SAIs: Tips and Examples for Cooperative Audits (INTOSAI WGEA, 2007) and How SAIs May Co-operate on the Audit of International Environmental Accords (INTOSAI WGEA, 1998).

SAIs are increasingly using international networks to share information about environmental auditing among themselves. Emphasizing the importance of these communication channels, a Chief Auditor in the Supreme Court of Audit of Iran[31] states that;

> If there is one lesson our experience has taught us, it is that SAIs interested in undertaking environmental auditing should join the international community of environmental auditors. In doing so, they will see whether they are on the right track and will come to understand what they need to do to improve (Momeni,2004).

So, these audit guidances, with other tools developed by WGEA such as meetings and workshops, provide a unique opportunity to improve audit practices and share

[30] Retrieved from http://www.environmental-auditing.org/Home/WGEAPublications/StudiesGuidelines/tabid/128/Default.aspx

[31] Retrieved from http://www.intosaijournal.org/technicalarticles/technicalapr04c.html

audit findings, challenges and best practices experienced by different countries on different environmental topics.

3.2.6 Environmental Auditing Experience of the Turkish Court of Accounts

Under the Constitution and the Law on the Turkish Court of Accounts (Law No 832 as the former Law; Law No 6085 as the current Law with date of enactment 03.12.2010), TCA is responsible for performing audit activities on behalf of the Turkish Grand National Assembly of all accounts related to revenues, expenditures and properties of the government departments financed by general and subsidiary budgets (1982 Constitution, Article 160; Law No 6085, Article 1).

Following the upstream trend in environmental auditing as a result of the increasing interest of SAIs in environmental problems, Turkish Court of Accounts (TCA) has also started to conduct environmental audits since the early 2000s. Before mentioning the TCA Law with respect to environmental audit mandate scope, it should be noted that the Article 56 of the Constitution of the Republic of Turkey (1982) states:

> Everyone has the right to live in a healthy, balanced environment. It is the duty of the state and citizens to improve the natural environment, and to prevent environmental pollution (1982 Constitution, Article 56).

With the Annex Article 10 added by the Law No 4149 to the previous TCA Law No. 832 in 1996, the TCA was given performance audit mandate which is used to deal with environmental issues throughout the audits without referring to any specific environmental audit mandate. With the 1996 amendment to the Law, TCA, that has been confined within the financial and compliance audit frameworks until then, was entitled with the authority to examine whether the public institutions and

organizations within its audit mandate are using their resources effectively, efficiently and economically.

The recent enactment of the new TCA Law No 6085 in 2010 displacing the TCA Law No 832, has explicitly introduced the following principles within the context of performance audit mandate which can implicitly be accepted as applicable to the environmental audit activities:

- The performance audits performed by the Turkish Court of Accounts shall not result in financial and legal responsibility (TCA Law No 6085, 6th paragraph of Article 7).
- Audit shall be the examination of the accounts, financial transactions and activities and the internal control systems of the public administrations, and the evaluation of the effective, economic, efficient and legal usage of the public resources (TCA Law No 6085, point (a) of Article 35).
- Performance audit shall be carried out within the framework of accountability through measuring the activity results related to the objectives and indicators determined by the administrations (TCA Law No 6085, 3rd paragraph of Article 36).

The TCA, as an institution that gives great significance to improving international relations, has been following an assertive approach for taking place at the international arena with respect to environmental auditing initiatives[32]. In this context, the TCA is a member of INTOSAI and two of its Regional Working Groups; European Organisation of Supreme Audit Institutions (EUROSAI) and Asian Organisation of Supreme Audit Institutions (ASOSAI). It has also been a member of the INTOSAI WGEA since 2002. In addition, the TCA is one of the founding members of the Economic Cooperation Organisation Supreme Audit Institutions

[32] Retrieved from http://www.sayistay.gov.tr/english_tca/about/145_Yil_Brosur_ENG.pdf

(ECOSAI) which comprises SAIs of Azerbaijan, Iran, Kazakhstan, Kyrgyzstan, Pakistan, Tajikistan, Turkmenistan, Turkey and Uzbekistan.

Although it is a fact that TCA has started to conduct environmental audit since the early 2000s, it was decided in 1995 (just before the 1996 amendment to the abolished TCA Law) to make necessary preparations for giving the start signal to acquire sufficient knowledge and assurance for the development of performance audit activities and as a result, broadening the environmental audit perspective. For this purpose, pioneering work on performance auditing was launched with the close collaboration between the TCA and National Audit Office of the United Kingdom (NAO) which generously provided its assistance for the TCA staff on performance audit methodologies and techniques, with a view to developing rules and procedures to use in carrying out performance audits[33].

In the framework of this cooperation, the TCA received technical assistance under three different headings. The first gave the opportunity to the TCA auditors to attend the "Audit Training Course(s) for Staff from Overseas Supreme Audit Institutions" held at NAO annually. Under the second heading, a training course by the NAO lecturers to the TCA staff was presented in Turkey. After enhancing the TCA staff's competency about the performance audit methodology, as the third item, NAO-TCA cooperation continued with two collaborative audit projects, namely:

(i) The Examination of the Activites of Museums Affiliated to the Ministry of Culture (1998).

(ii) Management of Road Maintenance, Repair and Construction Activities of General Directorate of Highways (1998).

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[33] For further details, see TCA Country paper "On The Threshold Of Performance Auditing" printed in the 4th issue of EUROSAI Magazine and available at http://sayistay.gov.tr/english_tca/comp/papers.asp

The reason underlying the choice of these topics was the desire to select similar topics or areas to those that had already been examined by the NAO. So that, within the context of these two pilot projects, the TCA was able to receive advice and guidance from the NAO staff on planning, execution and reporting phases of the audit tasks. It can be undoubtedly stated that it was this close cooperation with the NAO that encouraged the TCA management to start the work on performance auditing.

The legal process of issuing an environmental audit report begins with the establishment of audit teams with members of sufficient environmental audit experience and skills; and continues with conduction of audit according to priorly agreed upon scope, objectives, methodology and auditees. Then, the report is generated builded upon the audit findings. Following the approval of the report by the General Assembly of the TCA, the process ends with the submission of the report to the Turkish Grand National Assembly.

In addition to the aforementioned pilot reports which were regarded as environmental audit due to their content and published at the INTOSAI WGEA website, TCA has conducted many other performance audit projects with environmental perspective which can be stated as follows[34]:

- Preventing and Dealing with Pollution From Ships at Sea and in Ports (2002)
- How Well is Istanbul Getting Prepared For The Earthquake (2002)
- Activities of the Ministry of Public Works and Settlement in the Aftermath of Marmara and Düzce Earthquakes (2002)
- Report on Protection of Forests (2004)
- Performance Audit Report on the Conservation of Historical Artifacts Under the Responsibility Area of General Directorate of Foundations (2004)

[34] For further details, see http://www.environmental-auditing.org/tabid/126/CountryId/401/Default.aspx

- The Planning and Audit of the Costal Utilization (2006)
- Waste Management in Turkey. Assessing National Arrangements and Results of Implementation (2007)
- Coordination of Infrastructure Works By Metropolitan Municipalities (2008)
- Joint Report on the Results of the Coordinated Parallel Audit on Protection of the Black Sea against Pollution (2011)

When the evolution of the contents of the TCA's environmental audit reports is considered from the initial pilot works up to the recent publications, it can observed that the TCA has changed its understanding of environmental audit from traditional compliance audit whose main concern is to see whether the environmental expenditures are made in accordance with the relevant laws and regulation to performance evaluation of governmental environmental management systems. In other words, "quality" has been perceived as important as "legality" in the environmental audit acitivities.

3.3 The Scope of Environmental Audits: What are their objectives and what do they audit?

SAIs differ in terms of their audit subjects as well as audit objectives since the scope of their environmental audit mandate is different from each other. Also the main challenges countries face with show great variety, necessitating common measures as well as specific environmental approaches. That is why SAIs may have differentiated orientations while they conduct environmental audits. Main audit objectives that are mostly followed and aimed to be evaluated by the SAIs are stated in the 6th Survey as follows:

- Fair presentation of financial statements and expenditures,
- Compliance with international environmental agreements,
- Compliance with domestic environmental legislation,
- Compliance with domestic environmental policies,

- Performance of government environmental programs,
- Environmental impacts of non-environmental government programs,
- Evaluations of environmental impacts of proposed environmental policies and programs (INTOSAI WGEA, 2009).

An SAI may determine only one or a group of them as its audit objective, or it may follow all of these audit objectives during the conduction of the audit. This choice totally depends on the mandate of the SAI and the nature of the environmental issue that will be focused on.

Table 5: % of SAIs who consider the corresponding objective to be in top three

Source: *The Sixth Survey on Environmental Auditing* (INTOSAI WGEA, 2009)

	Region								
	EUROSAI (n=38)	ASOSAI (n=33)	AFROSAI (n=11)	OLACEFS (n=14)	ARABOSAI (n=15)	CAROSAI (n=5)	PASAI (n=7)	Other (n=2)	TOTAL (n=106)
	%	%	%	%	%	%	%	%	%
Compliance with domestic environmental legislation	68%	79%	55%	71%	73%	40%	43%	100%	**67%**
Performance of government environmental programs	66%	70%	45%	57%	53%	20%	43%	50%	**57%**
Compliance with domestic environmental policies	55%	55%	73%	57%	60%	20%	43%	50%	**54%**
Fair presentation of financial statements and expenditures	42%	30%	18%	29%	27%	40%	29%		**34%**
Compliance with international environmental agreements and treaties	58%	18%	9%	29%	20%		14%	50%	**31%**
Evaluations of environmental impacts of proposed environmental policies and programs	13%	18%	27%	36%	20%			50%	**17%**
Environmental impacts of non-environmental government programs	8%	9%		14%	7%				**6%**
TOTAL	**310%**	**279%**	**227%**	**293%**	**260%**	**120%**	**172%**	**300%**	**266%**

Table 5 displays the general attitudes of the Regional Working Groups as well as total respondent SAIs to the selection of audit objectives. The compliance with domestic environmental legislation (with a percentage of 67%), the performance of government environmental programs (with a percentage of 57%) and compliance with domestic environmental policies (with a percentage of 54%) are the three most important audit objectives determined by the SAIs. These audit objectives show similarity to those stated in the previous survey-5th Survey (INTOSAI WGEA, 2007c).

Audit objectives, determined by SAIs in the design of audit, more or less define the framework of the possible audit conclusions and recommendations that are proposed for the audited entities. The task of SAIs, in a sense, is to offer as good as possible a basis for decision making so that the government and other decision makers would be able to achieve the governance targets (Pollitt and Summa, 1997). To help gaining an insight about the main messages of environmental audits, Table 39 in the Appendix A presents main findings and recommendations of some selected reports with different audit objectives.

Environmental auditing is a management tool to improve the environmental performance through assessing the environmental management systems and minimizing the risks and challenges. Common goal of SAIs that conduct environmental audits is to ensure that audit findings have an impact since audit is not an end; it is rather the path to attain the end.[35] That is why the regarding of audit findings and implementation of recommendations in an effective manner by the related agencies are the most important outputs of the audit process.

There are varios ways for SAIs to measure the impacts of their environmental audits on the government policies and programmes. Of these ways, observing the government's responses to audit recommendations and conducting follow-up audits

[35] Retrieved from http://www.intosai.org/blueline/upload/limadeklaren.pdf

are the main activities that are prefered. According to the 6th Survey results (INTOSAI WGEA, 2009), 66% of respondent SAIs measure the impact of their environmental audits by observing government responses to audit recommendations and 64% of them conduct follow-up audits. SAIs use especially follow-up audits as a tool to verify whether the audited bodies fulfil the promises or obligations with reference to the audit report and adopt the audit recommendations (INTOSAI WGEA, 1997). So, conducting follow-up audits is an effective way to evaluate the influence of the work of SAIs and the extent of the improvements on the governmental activities in the field of environment. Also, they have an enforcing power on the organizations that reject to fulfil their responsibility. This is of course possible with a proper follow-up system put in place by SAIs to track the efforts of the audited entities inducing from the audit recommendations (Wanga et al., 2011, p.2113; INTOSAI WGEA, 2007a, p.71).

The impacts of environmental audit results may be observed as improvements in environmental performance indicators as well as government programmes and strategies. Followings are some of the expected impacts of audits on the environmental management systems:

- Laws, legislation, and regulations are revised or new ones are introduced to protect the environment.
- The environmental impact assessment process is strengthened.
- Changes are made to funding environmental plans, programs, and projects.
- Improvements are made to disaster management and preparedness.
- Improvements are made for more environmentally sound program delivery.
- Compliance with national laws, regulations, and international agreements is strengthened.
- Systems of accountability related to governing the environment are installed or increased.

- Increased emphasis is placed on performance measurement and reporting on environmental objectives.
- More environment-related training for public servants is made available.
- Improvements are made to gathering and monitoring of environmental data (INTOSAI WGEA, 2007a, p.8).

The results of the 6th Survey on Environmental Auditing reveal that governmental agencies mostly make use of SAIs' outputs on environmental auditing;

- to evaluate their capacity to develop and implement environmental policies or programs (67% of SAIs claim that their conducted audits had such impact, either partial or full),
- to develop environmental management systems (63% of SAIs claim that their conducted audits had such impact, either partial or full) and
- to formulate environmental legislation or environmental policy and/or programs (62% of SAIs claim that their conducted audits had such impact, either partial or full) (INTOSAI WGEA, 2009).

The impacts of environmental audits, especially those conducted by performance audit approach, can not be measured in general in monetary terms. Since the main aim is to help audited bodies to improve their performance, impacts of reports are generally measured by assessing the "reaction rate" of the governmental agencies (Pollitt and Summa, 1997, p.321). In other words, the higher the acceptance level of the auditees of those proposed recommendations is, the more effective the environmental reports are. The reflection of SAIs' recommendations as outputs of their audits to the governments' environmental policies and programmes can be further analyzed through Table 40 in the Appendix B.

As Dr Toepfer, Former Executive Director of United Nations Environment Programme (UNEP), stated in the Foreword to the GEO2000 Report:

> *There is a need for more comprehensive, integrated policy making……. It is usually impossible to determine which policy contributes to what change in the state of the environment, and furthermore there are few mechanisms, concepts, methodologies or criteria for making these policy assessments*[36].

SAIs play an outstanding role in providing environmental policy assessments as being maybe the most important of those few mechanisms. It is a fact that policymakers need to define policy targets clearly and shift toward more rigorous environmental protection efforts at the global, regional, national, state/provincial, local, and corporate scales (Emerson et al., 2010). But what makes SAIs' environmental audits more valuable is moving beyond compliance and begin auditing Environmental Management Systems (Rika, 2009, p.316). In this sense, SAIs may make both technical and political contributions in their reports such that adoption of related regulations, plans and programs as well as more effective monitoring of projects can be the focus subjects of their recommendations.

[36] Retrieved from http://www.stakeholderforum.org/publications/reports/IEG-SFpaper.pdf

CHAPTER 4

FACTORS AFFECTING THE ENVIRONMENTAL PERFORMANCE OF COUNTRIES AND THE ROLE OF SAIs THROUGH ENVIRONMENTAL AUDITING

The relationship between population, wealth and environment has received considerable attention in the 1960s and 1970s (Cole, 1999). The observation of the general upward trend in environmental performance in mostly developed countries has caused the idea that countries with higher income levels and lower population density become more successful in environmental management. Beside these factors, there are also many institutional factors that play significant roles in attaining sustainable development path such as educational level of the population, awareness about the environmental issues at both the governmental and citizen level, transparency and accountability of the public sector management and institutions and the perception level of corruption etc.

The literature about the effects of these factors on environmental performance is explained in detail in the following sections. Section 4.1 deals with the interaction between the income level and environment while Section 4.2 puts forward the ideas that search for the effects of population and Section 4.3 for the effects of educational level of social capital. Then, Section 4.4 analyses that to what extent the government effectiveness has a determining role in environmental performance and Section 4.5 focuses on the effectiveness of the oversight institutions, especially of the SAIs on enhancing the environmental management systems. Finally, Section 4.6 presents a brief information about the Environmental Performance Index (EPI).

4.1 Income (Wealth) and the Environment

The conflict between economic development and environmental improvement has been for a long time a controversial issue, especially since the 1970s, the decade in which the 1972 Stockholm Conference was held. As a result of the growing concerns and therefore importance attached to the relationship between economic development and the environment, two opposing opinions have emerged: “Economic development is the solution to the environmental degradation” vs “Economic development is one of the reasons of environmental degradation” (Aslan, 2010, p.55). Following the broad literature developed on the arguments between these optimistic and pessimistic views, the beginnings of the 1990s have witnessed a great interest on the concept of “sustainable development” which was first popularized by the 1987 Brundtland Report. The emergence of the “Environmental Kuznets Curve (EKC)” coincides exactly with the rising of this concept as a result of the serious warnings of the scientific environments on the future of the world with respect to the unsustainable interaction between the development and the environment. Therefore, in 1990s, the literature that sorts the direction of the relationship between income and economic degradation has grown paving the way for many empirical researches.

EKC hypothesis asserts that in the initial phases of economic development, scale effect which is the negative effect of production increase on environmental quality (Andreoni and Levinson, 2001) dominates the structural effect meaning the rise of light industries with less pollutive effect (Stern, 2004); and technique effect meaning the rise in R&D expenditures on cleaner Technologies (Stokey, 1998). This causes a rise in the level of economic degradation but the sum of the structural and technique effects gradually exceeds the scale effect, leading to a improvement in environmental quality with the continuning rise in per capita income. EKC is infact a reinterpretation of the study of Simon Kuznets (1955) that investigated the impacts of economic growth on income equality. His study resulted in an inverted U-shaped curve, meaning that income inequality increases first with the increases in per capita

income, reaching a peak, then decreases as the per capita income continues to rise. Grossman and Krueger (1991), in their study of the possible environmental impacts of a North American Free Trade Agreement (NAFTA), found a similar inverted U-shaped curve, this time between the environmental quality and per capita income; creating a pioneering work in the economic growth-environment relation literature. In detail, they carried out a panel data analysis for 42 countries to sort out the possible relationship between the air pollution indicators, namely sulphur dioxide (SO2), dark matter (fine smoke) and suspended particles, and per capita income, reaching an inverted U-shaped curve.

The study of Grossman ve Krueger was followed by Shafik and Bandyopadhyay (1992) with the World Development Report (1992) as a part of the study for the relationship between growth and environment, and Panayotou (1993) with his Development Discussion Paper as a part of the study for International Labour Organisation (ILO). Shafik and Bandyopadhyay (1992) investigated the EKC relationship between ten different indicators; they found that carbon dioxide emissions increase with the per capita income while water pollution follows a monotone decreasing function. According to the definition of EKC, given in the mentioned report:

> The view more economic activities mean more environmental pollution bases on the assumption that technology, preference and environmental investment are constant, but people will pay more attention to environment issues and resolve it with increasing income, consequently, environmental pollution level will decrease (Shafik and Bandyopadhyay, 1992).

In his study for ILO, Panayotou (1993), who for the first time called this inverted U-shaped curve as “Environmental Kuznets Curve” due to its resemblance to the

Kuznets hypothesis, reached some evidences of EKC relationship relating per capita income to several air pollution indicators and forest lands.

There have been many evidences in favor of the notion that as countries get wealthier, they can afford to use more environmentally-friendly production techniques. Of those evidences, Pizer and Popp (2008) emphasize on the key role of technological progress in the long run to reduce GHG emissions or Johansson and Kristrom (2007) point out that technological progress is an important driver of movements along an EKC for sulphur dioxide in Sweden. However, it is also worth noting that Lantz and Feng (2006) find an evidence against technological progress in such a way that there exists a U shaped curve relationship between CO2 and technology for Canada during the period 1970-2000.

Song et al. (2008) investigates the relationship between economic growth and environmental pollution in 29 provinces of China over 1985–2005 based on the EKC hypothesis, defining dependent variables as per capita waste gas, per capita waste water, and per capita solid wastes. According to comparisons with the dynamic OLS estimator and the Within OLS estimator, panel cointegration estimation is found preferable for all pollutants except for solid wastes; and the results show that all three pollutants reflect an inverse U-shaped relationship, having water pollution improved earlier than gas pollution and solid pollution. On the other hand, Shafik and Bandyopadhyay (1992) reach the conclusion that both municipal waste and carbon emissions per capita increased unambiguously with rising income.

Regarding these research findings contrary to EKC hypothesis, it can be stated that in terms of the conclusions reached in the broad literature of EKC relationships, an inverted-U shape is not the only way (See Figure 13) to characterise the relationship between income and environmental stress (Canas et al., 2003, p.219). Some studies reveal that an N shaped curve (a in Figure 13) can also be found, pointing to the fact that environmental degradation again worsens with the rise in income, following the

improvement observed in the inverted U-shape (d in Figure 13) (Torras and Boyce, 1998; Akbostancı et al., 2009). Furthermore, relations may be represented by a monotonic decreasing (f in Figure 13) or monotonic increasing (e in Figure 13) functions, showing no EKC relationship found between the selected environmental pollution indicator and income at all (Holtz-Eakin and Selden, 1995; Akbostancı et al., 2009). Relying on the evidences of no relationship findings, fragility of the EKC models has also been a matter of debate since the chance of finding evidence for EKC relationship between real income and pollution indicators highly depends on the sample selection and empirical specification (Harbaugh et al., 2002 cited in Lee et al., 2010).

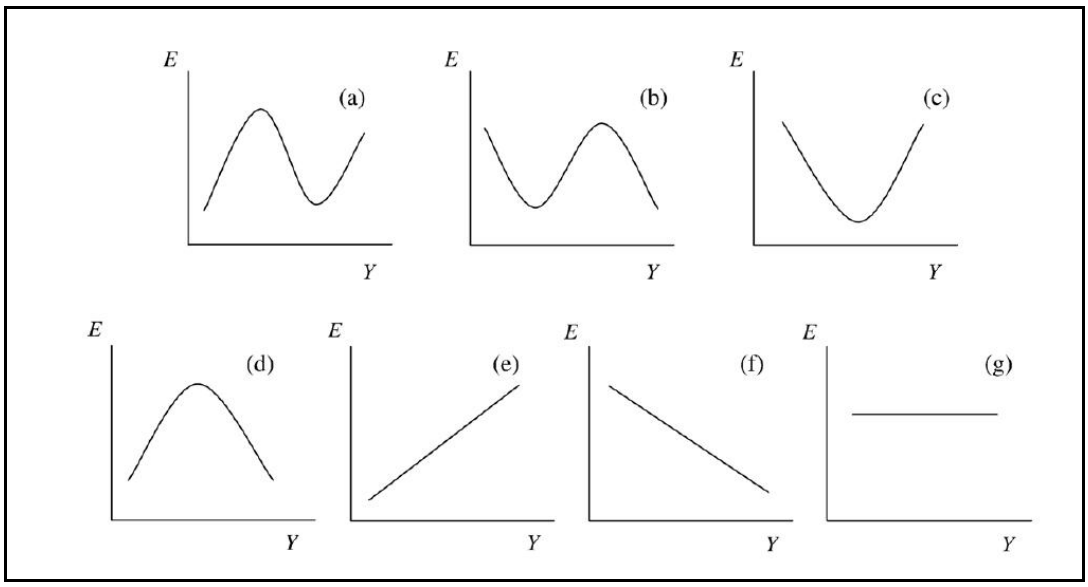

Figure 13: Various relationships between environmental degradation and per capita income
Source: Song et al. (2008)

Akbostancı et al. (2009) constructs two models, one of which relies on time series data of Turkey relating CO_2 emissions to GDP per capita while the other bases on the panel data, defining SO_2 and PM_{10} as pollutant factors and GDP per capita and population density as explanatory variables. Results of both models reveal no

evidence supporting EKC relationship since a monotically increasing relationship between CO_2 and income is found while an N-shaped relationship exists between SO_2, PM_{10} and income. Even though not all the literature provides evidence in favor of the EKC relationship, important policy implications may be derived from the analysis carried out. For instance, the projected two regime model of Aslanidis and Iranzo (2009) asserts that pollution increases in both low-income and medium-high income countries with economic growth but at a diminished rate at the second group. This supports the idea that there occurs a deceleration of emissions as low-income countries grow.

Following the literature survey on EKC hypothesis which reveals contrary findings on the effect of income level on environment, Environmental Performance Index Report (Emerson et al., 2010) should be analysed as well. In this Report, it is found that wealth is highly correlated with the environmental performance scores of the countries, in particular with the environmental health results which represents the level of environmental stress to human health (Emerson et al., 2010, p.6). In this sense, poverty is often cited as a social-economic factor that constrains conservation efforts in the tropics (Peh, 2008 cited in Peh and Drori, 2010). Countries with different income and therefore development levels experience environmental challenges in different forms such that pollution impacts of industrialization largely affect developed countries while safe drinking water and basic sanitation issues have adverse affects for primarily developing nations (Emerson et al., 2010, p.7). In fact, poor undeveloped countries have, as expected, poor health infrastructure and limited fosil fuel-based development. Therefore environmental health poses the main problems in undeveloped countries while they are not in so much trouble with the climate change indicators like developed countries.

Although the correlation between the wealth and the environmental performance is found to be high, it should be stated that is not a valid statement for all countries in the same country-groups. For instance, a developed and high-income country (such

as U.S with EPI score 63.5 and rank 61, among 163 countries) may underperform with respect to its environmental management while a middle or low-income country (Costa Rica with EPI score 86.4 and rank 3, as well as Cuba with EPI score 78.1 and rank 9 among 163 countries) may have higher environmental performance score. This is certainly due to the existence of other factors than the income level of the countries such as "good governance" that shape the results (Emerson et al., 2010, p.19) as it is stated that good governance contributes to better environmental outcomes according to the statistical analysis. In other words, a host of other important factors, including government policies, institutional structures, and the specific characteristics of the environmental and natural resources involved may show great variability from case to case (WB, 1997, p.114).

4.2 Population and the Environment

Global changes such as tremendous industrial and technological developments lead to a general trend toward high levels of urbanization. Putting it differently, the share of population moving to the urban areas has shown an unprecented increase following the changes in search for better living conditions and therefore, population density in the urban areas of most regions has been a striking fact for the sustainability of economic, environmental and human development. Ehrlich (1968), in his book "Population Bomb", blames human population as the ultimate enemy of the environment. Because high population brings with it more use of energy sources, greater consumption patterns and therefore more human-induced pressure on the environment.

There are various studies showing that population and affluence are the primary drivers of various types of environmental stress (York *et al.*, 2001; Rosa and York, 2002; Madu, 2009; Ajaero, 2011). Ajaero (2011), in his study of countries in West Africa, puts forward that there exist a positive correlation between population size increase and environmental stress on one hand and also a positive correlation

between increase in affluence and increase in environmental stress on the other hand although the level of environmental stress may show differences across countries. However, as a general statement, it can be declared that the populations of developing countries are the most vulnerable to the consequences of environmental stress due to dependence of the majority of the population on primary economic activities such as fishing, agriculture, forestry, and hunting as their livelihoods. (Ajaero, 2011, p.64; WB, 1997)

As handled with in the literature, population growth has major environmental implications such that the joint pressures of great population increase, urbanization and industrialization lead to inadequacy in the availability of water sources, more importantly in the fresh water supply to the people in different regions of the world. As it is depicted in Table 6, the world population increases by 4 billion people between 1995 and 2150 according to the medium scenario (which assumes that fertility in all major areas will stabilize at replacement level-at slightly over 2 children per woman-by 2050 or after). It is known that provision of the safe water to every citizen is one of the most important priorities of every government in the framework of provision of public health since fresh water is the only natural resource for which shortage causes significant concern for humanity (McNeill, 2006, p.188). However, regarding the rise in population projected in Table 6, as population and by the way cities enlarge, water demand consequently increases due to need for irrigation for food production, domestic and industrial use leading to surely the problem of water shortage. As stated in the EPI Report (Emerson et al., 2010), any country that does not actively increase infrastructural coverage, will inevitably score lower on the "Access to Drinking Water indicator" as population grows.

Table 6: World Population by Major Area, Medium Scenario, 1995-2150
Source:Retrieved from
http://www.un.org/esa/population/publications/longrange/longrangeExecSum.pdf

		Major area							
Year	Total	Africa	Europe	Latin America and the Caribbean	Northern America	Oceania	Asia excluding China and India	China	India
				Population (millions)					
1995	5 666	697	728	480	297	28	1 282	1 221	934
2000	6 055	784	729	519	310	30	1 391	1 278	1 014
2025	7 824	1 298	702	697	364	40	1 912	1 480	1 330
2050	8 909	1 766	628	809	392	46	2 262	1 478	1 529
2075	9 319	2 077	549	857	390	48	2 423	1 386	1 589
2100	9 459	2 215	515	877	388	49	2 476	1 340	1 600
2125	9 573	2 264	508	894	390	50	2 512	1 338	1 617
2150	9 746	2 308	517	912	398	51	2 558	1 361	1 642

Similarly to water issue, urbanization and industrialization result also in wastes (Wolman, 1965), some of which go into the waters, some into the soil, and some into the air. Collection and disposal of human and industrial waste as well as intensive air pollution are also problematic issues in higly populated areas since infrastructural and regulatory capacity will undoubtedly be lacking. The main concern related to air pollution is the greenhouse emissions which is accepted as the main driver of the climate change phenomenon and may show great disparities among regions. In fact, it is more burdensome for developed countries than the developing or least developed countries since the economic development and energy intensive practices are more common in those developed countries. However due to the fall in energy intensiveness as a result of development of regulatory systems, it can be stated that the link between the population levels and air pollution have always been weaker than those between population and water (McNeill, 2006, p.188).

The projection that the population growth will take place to a large extent in poor countries such as African or Asian countries (see Table 6) will probably increase the risk of environmental degradation since environmental management in these countries carries a low priority (McNeill, 2006, p.190) and they have been already experiencing the adverse effects of this lacking in environmental management. With this respect, it should be noted that although increase in population emerges as the main factor threatening both the environmental and human health, no hardship upon the countries would ensue if the resources owned are intelligently managed (Wolman, 1965).

Rising global population means rising requirements for more food and fiber. This leads inevitably to changes in the land use such as conversion of grasslands and especially after 1950, of tropical forests into new croplands (McNeill, 2006, p.186). One of the implications of this conversion driven by population growth is unfortunately the loss of biodiversity. In fact, mounting human numbers in the American, African, and (less clearly) Asian tropics are the main causes of the reduction in species diversity (McNeill, 2006, p.186). In the EPI Report, it is also noted that the countries whose land areas are experiencing the greatest declines in greenness fall mostly in Africa, Western Asia, and South Asia, many of which are densely populated or have experienced significant deforestation (Emerson et al., 2010, p.57).

The environmental problems of the countries such as the BRIC countries – Brazil, Russia, India, and China- that struggle with the pressures of large populations along with the growing industrialization and bias for resource mismanagement are more diverse to cope with successfully (Emerson et al., 2010, p.19). They need comprehensive strategies for environmental protection and more effective enforcement of environmental laws and regulations. On the other hand, some other nations such as those in Scandinavia use the advantage of having large land areas and low population densities for better environmental performance (Emerson et al., 2010,

p.24). However it should not be forgotten that "population density is not an insurmountable barrier to good environmental quality" (Emerson et al., 2010, p.25). Which is more important in attaining better environmental quality largely depends on concerted policy effort and deep commitment to environmental values across their public and business communities.

4.3 Educational Level, Social Awareness and the Environment

The effect of literacy rate of a country on its environmental performance is expected to be in close relationship with its income level. Because a well educated population along with a well−functioning set of government institutions are important determinants of successful development. In fact, it can be declared that it is nearly impossible for a country to achieve sustained economic growth without high levels of education (WB, 1997, p.101).

Poor nations are naturally composed of less educated people than the developed nations since they are exposed to lower living standards and environment is in no circumstances their priority. For instance, an analysis (Pargal and Wheeler, 1995 cited in WB, 2007, p.116) about the water pollution emissions in Indonesia, based on a large sample of data from Indonesian factories, revealed that pollution intensity was substantially higher in poorer, less−educated communities. Besides the suggestions of such statistical analyses, the concept of "*informal regulation*" is also of vital importance in terms of assessing the dynamics of the environmental performance of the countries. Informal regulation is the pressure of the public for better environmental protection policies and its effectiveness depends to a large extent on the income and educational levels of the communities (WB, 1997, p.116). Based on this definition, it can be deduced that the power of the public opinion on the environmental issues and the compliance of the government's environmental policies with this opinion surely relies on the education level of the citizens and thereon the power of their responsiveness. The World Bank Report titled "Expanding

the Measure of Wealth (1997)" mentions about the lack of effective responsiveness of the poor people to environmental problems and the reasons behind this lacking are attributed to the following factors:

- Less awareness of poor communities of environmental risks due to their lack of access to various channels of information and their lower levels of education,
- More willing to trade off environmental quality for increased employment, and
- Less ability to impose effective measures on polluters because of the factors such as illiteracy, lack of resources, or lack of influence over government officials (Hettige et al., 1995 cited in World Bank, 1997, p.117).

In addition, as Welsch (2004) states in his study;

> Even if *optimal* environmental standards become stricter as income rises, the desire for stricter environmental regulation will translate into *actual* environmental policy only if citizens are able to express their preferences for environmental quality and if governments have an incentive to satisfy these preferences by changing policy (Welsch, 2004, p.666).

Based on these ideas, it is no surprise that poorer communities are less successful than the developed countries in exhibiting community pressure for abatement and mitigation of pollution. Because polluters can more easily find illegal ways such as corruption or abusement to get rid of their responsibilites about compliance to environmental regulations in less developed countries due to weakness of formal as well as informal regulatory systems.

4.4 Government Effectiveness and the Environment

The common belief on the direction of the relationship between economic growth and environmental quality, particularly within developing countries, is that strengthened environmental governance could hinder the progress in national economic and trade policies[37]. However, as delivered by the broad EKC studies, promoting economic growth does not have to be regarded as being in conflict with a cleaner environment as long as suitable policies are put in place by the government (Turner and Hanley, 2011, p.1). In fact, as Cole (2003) points out, " Growth does not reduce pollution. Rather, the evidence suggests that growth can facilitate the required legislation and investment to help reduce per capita emissions of some pollutants." (Cole, 2003, p.575). That is why, following Stockholm Conference on the Human Environment (1972), many governments have taken action to create and strengthen the institutional mechanisms to protect the environment regarding the balance between the environment and the economic concerns.

It can be stated that government's support for institutional factors such as political liberties, civil rights and effective implementation of environmental policies has a significant role in facilitating the harmonization between economic growth and environmental quality (Torras and Boyce, 1998; Panayotou, 1997). And within this context, competence of the bureaucracy, quality of policymaking and public service delivery are the main measures to evaluate the government effectiveness (Bhattarai and Hammig, 2001). Natural resources, for instance, have an important meaning for the lives of the people in especially low-income countries since their source of income largely depends on them. So the sound management of natural resources is vital for these countries underlining the need for effective governmental interventions. As Peh and Drori (2010) point out, one of the striking features of low developed countries in regions such as sub-Saharan Africa is the weak ability of states to impose their legislation, even though the need for environmental protection

[37] Retrieved from http://www.stakeholderforum.org/publications/reports/IEG-SFpaper.pdf

is perceived as an urgent issue by the governments. Furthermore, Bhattarai and Hammig (2001) examined the relationship between the rate of deforestation and income in 66 countries from the tropical regions of Latin America, Africa and Asia for 1972-91. And they concluded that institutional factors are claimed to have more important effect on tropical deforestation process than other frequently cited factors like population and macroeconomic factors.

In contrary to the less developed countries, expectations of better environmental performance are more frequent for the developed countries simply due to their consideration of environmental conservation as a priority for their life expectations. In addition to their perception of a better environment as a priority, states exhibiting high rates of economic growth are also more likely to gradually adopt and enforce anti-corruption laws as long as the effectiveness of government institutions evolve with per capita income (Lopez and Mitra, 2000). In order to clarify this relation between the corruption and the environmental performance, it is stated in the EPI Report that countries with high levels of perceived corruption tend to have low levels of environmental performance, whereas countries with low levels perform better on the EPI scores (Emerson et al., 2010, p.35). This is because of the adverse effects of corruption not only in the provision of accountability and transparency of government policies but also in their environmental protection and conservation efforts (Peh and Drori, 2010, p.336). It is well known that government institutions in developing countries are often weaker, less effective, and generally more corrupt than those in developed countries (Lopez and Mitra, 2000). And high levels of corruption not only affect the formation of environmental regulations but also eventually reduce the stringency of them. For instance, least developed and many developing countries receive funds from donor organisations to spend for the environmental conservation efforts. However, it must be articulated that provision of relatively large sums of money into poor societies usually invites corruption (Peh and Drori, 2010, p.338). The lack of appropriate governance of these funds and halting of projects' execution due to nontransparent use of those funds pose consequently

serious problems in attaining the sustainable development path. At this point, it should be beared in mind that even though deviation from the sustainable development path is generally perceived as a common issue for low income and less developed countries, some high income and developed countries may also experience degeneration in their social capital through weakened social and institutional relationships leading to rising crime rates, falling trust in government, and participation in the political process (WB, 1997). Therefore, enhancing transparency is vital for strengthening governance and accountability in both developed and developing countries; and this necessitates a strong desire of government and relevant agencies via effective regulations and audit.

In the literature, there is a number of studies showing the link between the corruption and environmental degradation (Fredriksson et al., 2004; Lopez and Mitra, 2000; Peh and Driori, 2010; Cole, 2007). Apart from this direct link, there are also studies that further analysed the indirect effects of corruption on the pollution level. To clarify, corruption may reduce the stringency of environmental regulation, thus leading to higher pollution (Lopez and Mitra, 2000) on the one hand while it may affect prosperity thus leading to ambiguous results for countries with different levels of income on the other hand (Welsch, 2004; Cole, 2007).

In the paper by Fredriksson et al. (2004), it is stated that greater corruptibility reduces the stringency of energy policy by shifting the government's relative weight away from welfare towards bribes, making it cheaper to purchase government influence. In another search for the interaction between the corruption and environmental performance, Peh and Drori (2010) analysed 66 tropical developing countries based on the data of Transparency International's Corruption Perceptions Index (CPI), which evaluates corruption levels in both government and private sector, and Environmental Performance Index (EPI). They found a high and significant correlation between these indicators. Lopez and Mitra (2000) also derived the conclusion that for any given level of per capita income, corruption will

raise pollution levels above the socially optimal level. They further show that corruption does not remove the EKC relationship. However, corruption causes the turning point of any EKC to take place at income and pollution levels above those corresponding to the social optimum. These examples from the literature focus on the direct and positive effect of corruption on pollution.

As mentioned above, there are other studies that regard also the indirect effect of corruption on environment (Welsch, 2004; Cole, 2007). This indirect effect can be analysed when income is regressed on the pollution level while corruption is instrumented as a determinant of income. So that the effects of corruption-induced reduction in income on the pollution level can be found. Welsch (2004), using six indicators of ambient air and water pollution for 106 countries, distinguishes two partial efffects of corruption on pollution via "corruption-pollution" relationship as direct effect and "corruption-income" then "income-pollution" relationships as indirect effect. The direct effect of corruption on pollution is found to be unambiguously positive, in other words pollution enhancing, while the indirect effect via income, whether positive or negative depending on the income level, is found to be dominated by the direct effect, thus the total effect of corruption is to enhance pollution. As a political message, he states that fighting corruption in low income countries could substantially reduce pollution just by raising the income level since the positive indirect effect of corruption on certain air pollution indicators is stronger in low income countries. The results estimated in the paper of Cole (2007) have some differences with those of Welsch (2004). Cole (2007) analyses both direct and indirect impacts of corruption on air pollution emissions using data for 94 countries covering the period 1987–2000. In all models, corruption is found to be a negative and statistically significant determinant of income along with its direct positive and statistically significant impact on pollution. However, the absolute value of the indirect effect of corruption on pollution is found to be larger in magnitude than the direct effect and it is increasing (approaching zero and becoming positive) with the level of per capita income in contrast to the findings of Welsch (2004). In other

words, there exists a negative total effect (meaning that pollution decreases as corruption level increases) which becomes positive (meaning that pollution increases as corruption level increases) only towards the upper end of the sample income range. That is why Cole (2007) concludes a policy implication for high income countries such that the biggest gain from tackling corruption would appear to occur in high income countries since the total effect of corruption on pollution is positive for them.

4.5 Effectiveness of Oversight Institutions: Environmental Audit Reports of SAIs

The strength of formal as well as informal regulatory systems within the government and the society play the key role in attainment of a better environmental performance as emphasized in the previous sections of this thesis. Existence of regulatory systems does not count for much without the effective oversight of the implementation of these systems. As one of the main oversight institutions of a country, the SAI provides various potential benefits to the audited entities such as the detection of compliance problems before the problems can pose serious threats, cost savings through increases in operating efficiency and reduced environmental risks (Stafford, 2006, p.173).

It is well accepted that there is a close relationship between the environmental audit works of SAIs and the level of environmental performance of the countries. This relationship highly depends on the fact that the work of environmental auditors provides an invaluable source of independent, legitimate, and credible information that assesses the efficiency and effectiveness of environmental policy at the national level. As Dr. Toepfer, former Executive Director of the UNEP, declares, recommendations and information provided by the SAIs can make an important contribution to UNEP's overall mandate of keeping the global environmental situation under review. In his own words:

> Simply put, sustainable development can not be achieved without good governance, and good governance, in turn, is greatly furthered by the valuable work of SAIs. Therefore, SAIs can play a vital role in informing and supporting efforts to achieve sustainable development[38].

UNEP's "Driving forces-Pressure-State-Impact-Response approach (DPSIR approach)[39]" puts forward the following questions:

- What is happening to the environment and why?
- What is the impact on the environment?
- What are the policy responses and their impact?

SAIs, being independent in carrying out financial, compliance, and performance or value-for-money audits, are in a unique position to contribute to the answers of these questions. Independent audit, providing assurance on the reliability of environmental matters, has a significant role in making corporations and governments sensitive to the environmental results of their actions (Sylph, 2005, p.1 as cited in Chiang, 2010, p.914). Legitimately and credibly evaluating the efficiency and effectiveness of government policy and obligations, environmental auditors help exploring the general situation of the environment and defining the relevant policy measures.

4.6 Environmental Performance Index (EPI)

The Environmental Performance Index (EPI) is a score that provides a strong basis for making sound comparisons across the overall environmental performances of the countries. EPI and its predecessor Environmental Sustainability Index (ESI) were both developed by Yale University (Yale Center for Environmental Law and Policy)

[38] Retrieved from http://www.intosaijournal.org/pdf/april2004.pdf

[39] Retrieved from http://www.intosaijournal.org/pdf/april2004.pdf

and Colombia University (Center for International Earth Science Information Network) in collaboration with the World Economic Forum and the Joint Research Center of the European Commission.

ESI that stresses on preserving environmental resources was published between 1999 and 2005. Later, due to an increasing focus on outcome-oriented indicators, EPI that rather measures environmental stress has been developed. In fact, EPI is perceived as a supplementary tool for tracking on the environmental targets set forth in the U.N. Millennium Development Goals and providing a ground for governments to assess their paths in environmental policymaking. In this sense, its "proximity to target approach" reveals unique interpretations for the enhancement of the environmental management systems of the countries.

As of January 2010, three reports have been published related to the EPI scores: Pilot 2006 EPI Report, 2008 and 2010 EPI Reports. 2010 EPI scores which will be used as a dependent variable in this study draws upon ten years of research and reports ranging from the pilot Environmental Sustainability Index in the year 2000 to the 2008 EPI. 2010 EPI scores rank 163 countries with regard to their effectiveness in national environmental protection efforts based on two main objectives: "Environmental Health", which measures environmental stresses to human health; and "Ecosystem Vitality", which measures ecosystem health and natural resource management. Both objectives have a weight of 50% in the EPI score and they are further based on ten policy categories which are tried to be represented by various indicators, total of which is 25 (see Table 41 in Appendix C for further details). Air pollution and water with their effects on human and ecosystems, environmental burden of disease, biodiversity&habitat, fisheries, forestry, agriculture and climate change are the policy categories included in the EPI score calculation. This broad scope makes the EPI score a strong composite index with which sound cross-country analyses could be made.

As can be understood from the brief explanation on EPI given above, it provides a more macro basis for evaluating the environmental management systems of countries. Although the literature that seeks for the characterization of relationships between EPI and its possible drivers is not deemed rich, there are sevaral studies that are to be mentioned. One of these outstanding studies is that of Mukherjee and Chakraborty (2010) who examine the relationships among Environmental Quality (EQ), Human Development (HD) and political and governance regime in a cross-country framework with 168 countries. Using the available 2007-08 data of the variables EPI (2008), GDP per capita (2007), Human Development Index (2007), Human Poverty Index (2006), Democracy Index (2008) and its sub-indices and Corruption Perceptions Index (2008), they attempted to understand the possible interactions of environment with corruption, human development, democracy and income; of corruption with human development, democracy and income and of human development with democracy. According to their results, greater political freedom and higher human development level as well as income growth are confirmed to have significant effects on enhancing environmental performance. They also found that environmental performance of a country is positively related to its ability to control corruption owing to the linear relationship between the two series.

Holmberg and Rothstein (2011), unlike the study of Mukherjee and Chakraborty (2010), focus on one of the specific policy categories of the EPI score which is the water quality. They investigated to what extent this water quality problem is related to the quality of government (QoG) institutions based on models that include water quality measures, one related to ecosystem health and the other to human health, as dependent variables and government effectiveness, GDP per capita and level of democracy as explanatory variables. Their results revealed no obvious proof for the assumption that good government is good for ecosystem water quality. However, they managed to put forth that human related water quality can not only be improved by income growth but also by better quality of government.

Pellegrini and Gerlagh (2006), on the other hand, used environmental regulatory regime index and environmental protection stringency index as dependent variables instead of the EPI. But the method and objective are the same with the aforementioned literature in the sense that they analyzed the relative importance of income, corruption and democracy along with the control variables such as urbanization and schooling on environmental policy through diversified models. And one of their important inferences is that democracy and corruption are found significant when they are considered individually as explanatory variables for environmental policy stringency. But when used together, robust evidence is found for a substantial effect of corruption on the stringency of environmental policy while there exists no evidence of a direct sizeable and significant positive effect of democracy on environmental policy. They explained this unexpected result with the fact that there is a high correlation between democracy and corruption which may have decreased the statistical significance of the coefficient on democracy. Their results also stated that urbanization and schooling are significant determinants of environmental policy stringency, and have negative and positive effects, respectively.

CHAPTER 5

THE EMPIRICAL ANALYSES

In the previous chapter, factors affecting the environmental performance of the countries are explained in detail. Income of a country, its population, literacy rate, institutional structure and effectiveness of its government as well as effectiveness of its oversight institutions such as Supreme Audit Institutions have somewhat direct or indirect effects on its environmental outlook. Although the individul effects of these factors can not be perfectly captured by the variables they will be represented in this thesis, an insight about the general relationships will surely be gained by the results of the estimations.

In this chapter, the effects of certain factors on environmental performance are explained through constructing several models of cross-sectional data and using OLS Method. After giving brief information on data in Section 5.1 and on methodology and main models in Section 5.2, the first sub-section of 5.3 deals with the first group of the analyses which is carried out with 150 countries by not taking “audit related variable (number of audit reports)” into account. As the basic formulation of the first group, EPI scores are regressed on GDP per capita, population density, literacy rate, Corruption Perceptions Index (CPI) and Government Effectiveness Score (GES). Due to the existence of high correlation among GDP per capita, CPI and GES, a reduced form of the basic formulation is designed to consist of GES, population density and literacy rate since GES is found to have the most statistically significant effects on EPI scores. On the other hand, to capture also the effects of other variables on EPI scores, Principal Component Analysis is applied to the high correlated three variables and reduced form of the model is repeated with the new extracted factor which is called “ Development Rate”. After presenting a general picture on the main drivers of the environmental performance in the analyses without the audit variable, in the following sub-section 5.3.2, a new variable is introduced which is the “number

of audit reports" and a sample of 52 countries is taken for the second group of the analyses. The same procedure with the first group of the analyses is followed also in the second group. To explore the main differentiating effects of defined factors on the environmental performance of developed and developing countries, all the models formed in both the first and second groups of the analyses are run for different income groups and comparisons are made within the models of each analyses.

5.1 Data

In these empirical analyses, several models of cross-sectional data are employed to explore the main drivers of the environmental performance of the countries. Since data availability plays a vital role in setting up of the models, we progress by two analyses and the models that are formulated under these analyses. The dependent variable is defined as the EPI score of the countries and the explanatory variables that will be used in these models and their symbols as well as their expected signs are shown in Table 7 below.

Table 7: Expected Signs of the Variables in the Models

Independent Variable	Symbol	Expected Sign
Per capita GDP	GDPC	+,-
Population density (people per sq km of land area)	POP_DEN	-
Corruption Perceptions Index (ranges from 0 to 10)	CORRUP	+
Literacy rate (%)	LITER	+
Government effectiveness (ranges from -2.5 to 2.5)	GOV_EFF	+
Number of audit reports (Total of 1993-2007 period)	REPORTS	+

In the present cross-sectional analyses, data are extracted from the databases of World Bank, UNESCO, Transparency International and INTOSAI WGEA. We, on the other hand, derive the values of our dependent variable from the Report "2010 Environmental Performance Index" published by Yale University.

EPI score ranks 163 countries on 25 performance indicators tracked across ten well-established policy categories covering both environmental public health and ecosystem vitality. These indicators provide a gauge at a national government scale of how close countries are to established environmental policy goals (Emerson et al., 2010). Scores change on a scale from 32.1 which leads Sierra Leone to be ranked at the end of the list as the least successful country to 93.5 which puts Iceland at the top of the list as a country with the highest environmental performance.

"Per capita GDP" belongs to the year of 2007 and is in terms of constant 2000 US$[40] and "population density" represents the number of people in per sq km of land area while "literacy rate" is presented in percentage. "Transparency International's Corruption Perceptions Index (2007)" is calculated using data from 14 sources originated from 12 independent institutions and all sources measure the overall extent of corruption (frequency and/or size of bribes) in the public and political sectors. The CPI gathers data from sources that span the last two years; so CPI 2007 includes the surveys from 2007 and 2006. This indicator takes the values on a scale from 10 (highly clean) to 0 (highly corrupt). The values of the indicator "Government effectiveness" which is one of the six aggregate governance indicators published by the World Bank ranges from -2.5 to 2.5, with higher values corresponding to better governance outcomes.

[40] The estimations are also repeated with the Per capita GDP with "current" international dolars to check whether the results will change. However, almost the same results are obtained with both the constant 2000 dolars and current international dolars. So Per capita GDP in terms of the constant 2000 dolars is preserved in the analyses.

Independent variables except literacy rate and number of audit reports take 2007 values since EPI score, as stated in the EPI Report (2010), has been calculated by regarding 25 indicators and the most up-to-date value that has been used in this calculation is that of year 2007. Furthermore, the explanatory variables of the present analyses are rather stable ones which do not show dramatic changes within short periods of time such as 2 or 3 years. That is why 2007 values of these variables are considered. On the other hand, all countries do not have their literacy rate declared exactly in 2007. So we take the value of the year that is the closest to 2007 with respect to literacy rate. Since, as mentioned earlier, the literacy rate is not a variable that is expected to show great varieties within 2-3 years, this approach is assumed not to have an adverse effect that will harm the equality between countries. About the variable related to environmental audits, "number of audit reports" represents the total number of environmental audit reports of a country that have been produced between the period 1993-2007. In the website of INTOSAI WGEA, the records of reports date back to 1993, so we regard this date as the beginning of environmental audits. Since this kind of reports does not provide immediate and direct impacts on the environmental performance and they deal rather with the positive evolution of the environmental mananagement systems, we assume the existence of long-term effects. Due to their such contribution to instititutional accumulation, we regard all the reports produced between the period 1993-2007.

5.2 Methodology and the Analyses

As an estimation method, Ordinary Least Squares (OLS) regressions on a cross section of countries are produced. Based on two general analyses that are explained below in detail, straightforward formulation such that dependent variable is a linear combination of the relevant independent variables is employed.

In the first group of the analyses depicted below, we use cross-country data of 150 countries which are selected among the 163 countries ranked in the EPI Report

(2010) regarding the available data for the determined variables. In this framework, following model is formulated:

$$EPI = \beta_0 + \beta_1 (GDPC) + \beta_2 (POP\_DEN) + \beta_3 (GOV\_EFF) + \beta_4 (CORRUP) + \beta_5 (LITER) + u \quad (1)$$

Revealing the directions and size of the effects of the variables presented in the first group of the analyses, we introduce a new variable in the second group of the analyses related to environmental audits of SAIs in order to find out the extent they influence the environmental performance of a country. In this respect, we add the varible "number of audit reports" and take the sample of 52 countries of whose audit related data can be reached from the INTOSAI WGEA website. The model is formulated as follows:

$$EPI = \beta_0 + \beta_1 (GDPC) + \beta_2 (POP\_DEN) + \beta_3 (GOV\_EFF) + \beta_4 (CORRUP) + \beta_5 (LITER) + \beta_6 (REPORTS) + u \quad (2)$$

When running regressions with the OLS method, the problem of the existence of heteroscedasticity should be taken into consideration since testing hypotheses in the presence of heteroscedasticity will probably lead to faulty inferences. As a correction for heteroscedasticity, White (1980) has derived a heteroscedasticity consistent covariance matrix estimator which provides correct estimates of the coefficient covariances in the presence of heteroscedasticity of unknown form. The White covariance matrix $\hat{\Sigma}_W$ is given by:

$$\hat{\Sigma}_W = \frac{T}{T - k}(X'X)^{-1} \sum_{t=1}^{T} u_t^2 x_t x_t' (X'X)^{-1}$$

where T is the number of observations, k is the number of regressors, and u_t is the least squares residuals.

In the regression estimations, standard errors of the coefficient estimators are White's heteroscedasticity-corrected standard errors, which are also known as robust standard errors.

Furthermore, for testing the null hypothesis that the data is from a normal distribution, we use **Jarque–Bera test** which is a goodness-of-fit measure of departure from normality, based on the sample kurtosis and skewness. The test statistic *JB* is defined as (Jarque and Bera, 1987):

$$JB = \frac{n}{6}\left(S^2 + \frac{1}{4}K^2\right)$$

where *n* is the number of observations (or degrees of freedom in general); *S* is the sample skewness, and *K* is the sample kurtosis. The statistic *JB* has an asymptotic chi-square distribution with two degrees of freedom and the bigger test statistics value means the strong rejection of the null hypothesis of a normal distribution.

For our purpose, the important point is whether there is heteroscedasticity in the data. Since the data are cross-sectional involving a heterogeneity of countries, a priori one would expect heteroscedasticity in the error variance. Therefore we should apply **White's heteroscedasticity test** to the residuals obtained from regressions (Gujarati, 2004). As an illustration of the basic idea, suppose we estimate the following regression:

$Y_i = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + u_i$

Obtaining the residuals, $\hat{u}_i$, we then run the following (*auxiliary*) regression:

$\hat{u}_{2i} = \alpha_1 + \alpha_2 X_{2i} + \alpha_3 X_{3i} + \alpha_4 X^2_{2i} + \alpha_5 X^2_{3i} + \alpha_6 X_{2i} X_{3i} + v_i$

We obtain the R^2 from this (auxiliary) regression and under the null hypothesis that there is no heteroscedasticity, it can be shown that sample size (*n*) times the R^2

obtained from the auxiliary regression *asymptotically* follows the chi-square distribution with df equal to the number of regressors (excluding the constant term) in the auxiliary regression. That is,

$$n \cdot R^2 \underset{\text{asy}}{\sim} \chi^2_{\text{df}}$$

In the models throughout this thesis, there observed high collinearity among several independent variables namely GOV_EFF, GDPC and CORRUP which is an anticipated relation. Since this relation may cause multicollinearity problem in the models if they are used together, each variable is included in different versions of models seperately and the most meaningful results are presented. But this situation also paves the way for using the Principal Component Analysis (PCA) to analyze whether we will have still sound and maybe more significant results if PCA is applied to correlated variables to produce one representative end variable. PCA is a variable reduction procedure which linearly transforms large group of variables into a smaller group of variables that contain large portion of the information contained in the original group of variables (Dunteman, 1989). Analyzing the correlations among variables and determine those which will be subject to PCA is the most important step. However, to observe high collinearity among variables is not sufficient to guarantee relevance among factors (Hair et al., 2006) since these variables must also be theoretically relevant. Ensuring this theoretical relevance, sampling adequacy for set of variables must be considered through analyzing two measures: Barlett's test of sphericity and Kaiser-Meyer-Olkin measure of sampling adequacy (Hair et al., 2006). PCA requires that the probability associated with Barlett's test of sphericity be less than the level of significance and also Kaiser-Meyer-Olkin measure to exceed the minimum requirement of the value, 0.50. Establishing the confidence in the appropriateness of the PCA, factors that constitute a larger portion of total variance, compared to a single variable, are extracted according to the "latent root criterion". In the models with PCA application in this study, factors with eigenvalues over 1 are extracted which corresponds to "one" due to the low number of correlated variables

which is three (GOV_EFF, GDPC and CORRUP). Naming the extracted factor as Development Rate (DEV_RATE) since high levels of Government effectiveness and Corruption Perceptions Index scores as well as GDP per capita are significant indicators of the development level of a country, we will use this new representative explanatory variable in the different versions of models.

5.3 Empirical Results

5.3.1 Empirical Results of the Analyses without the Audit Variable

In the previous section, main model formulated for the analyses without the audit variable is stated as follows:

$$EPI = \beta_0 + \beta_1 (GDPC) + \beta_2 (POP\_DEN) + \beta_3 (GOV\_EFF) + \beta_4 (CORRUP) + \beta_5 (LITER) + u \quad (1)$$

The descriptive statistics of the variables included in (1) are shown in the Table 8 below:

Table 8: Descriptive statistics of the variables in (1)

	EPI	GDPC	POP_DEN	LITER	CORRUP	GOV_EFF
Mean	58.57	7529.09	144.01	83.30	4.02	-0.04
Median	59.45	2148.00	66.07	91.90	3.25	-0.25
Maximum	93.50	56389.21	6650.14	99.80	9.40	2.26
Minimum	32.10	93.55	1.68	26.20	1.50	-1.77
Std. Dev.	12.53	11330.35	546.42	19.17	2.14	0.98
Skewness	0.07	1.92	11.37	-1.23	1.17	0.54
Kurtosis	2.56	6.01	135.80	3.57	3.28	2.41
Jarque-Bera	1.33	149.30	113464.9	40.15	34.97	9.62
Probability	0.5125	0.0000	0.0000	0.0000	0.0000	0.0081
Observations	150	150	150	150	150	150

Considering the mean values of the variables of 150 countries that are depicted in Table 8, we see that average EPI score is 58.57 while average GDPC is about US$7,529 and average POP_DEN is 144 people per sq km of land area. The average percentage value of LITER is 83.3 %. Furthermore it can be observed that the mean value of GOV_EFF is very close to 0 and of CORRUP is about 4.

Observing the Jarque-Bera statistics of the variables and the probabilities shown in Table 8, it can be concluded that none of the explanatory variables has normal distribution. This situation can be attributed to the large sample size which includes extreme individual country data. But this result does not lead to any disturbance on the analyses since "normal distribution of the variables" is not among the assumptions of OLS method (Ramanathan, 2002).

Before applying the OLS method, we should look into the variables whether they have perfect multicollinearity problem to preserve unbiasedness and consistency of the estimator. The correlations between the independent variables that will be used in the estimation are shown in the Table 9 below:

Table 9: Correlations among the independent variables in (1)

	GDPC	**POP_DEN**	**LITER**	**CORRUP**	**GOV_EFF**
GDPC	1	0.20	0.43	*0.85*	*0.77*
POP_DEN	0.20	1	0.06	0.22	0.23
LITER	0.43	0.06	1	0.47	0.54
CORRUP	*0.85*	0.22	0.47	1	*0.93*
GOV_EFF	*0.77*	0.23	0.54	*0.93*	1

According to the Table 9, GDPC, GOV_EFF and CORRUP variables are highly correlated (LITER is also correlated with GDPC, GOV_EFF and CORRUP variables

but its correlation is comparably weaker, so we ignore this correlation for the moment). These three variables are respectively preserved in the regressions with the variables LITER and POP_DEN in order to explore which of these highly correlated variables has more explanatory power for environmental performance. The regressions are run at first place for the whole group of 150 countries (Model 1.1). Then a sub-group constituting of low and middle income countries (called "developing countries" by World Bank) is formed which corresponds to 112 countries (Model 1.2). Since the most statistically significant results are obtained with the trials in which GOV_EFF is preserved, we present the regressions with GOV_EFF.

$$EPI = \beta_0 + \beta_1 (LITER) + \beta_2 (GOV\_EFF) + \beta_3 (POP\_DEN) + u \quad (1.1)$$

Table 10: Estimation Results of Model (1.1)

Dependent Variable: EPI
Method: Least Squares
Included observations: *150 (Whole Group)*
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	39.42***	3.418539	11.53168	0.0000
LITER	0.23***	0.039964	5.864225	0.0000
GOV_EFF	5.89***	0.932640	6.317010	0.0000
POP_DEN	-0.00078*	0.000453	-1.731117	0.0855
R-squared	0.51	Durbin-Watson stat		2.03
Adjusted R-squared	0.50	Akaike info criterion		7.22
F-statistic	51.08	Schwarz criterion		7.30
Prob(F-statistic)	0.0000			

Note: *** indicates level of significance at 1% level.
*indicates level of significance at 10% level.

Table 11: White Heteroskedasticity Test Result for Model (1.1)

F-statistic	0.89	Probability	0.5345
Obs*R-squared	8.13	Probability	0.5209

In Model (1.1), LITER and GOV_EFF are found significant at 1% level while POP_DEN is found significant at 10% level and all coefficients carry the expected signs. Adjusted R^2 of the model is 50% and F statistic of the regression which is found to be statistically significant at %1 level leads us to reject the null hypothesis that "The coefficients of all explanatory variables are zero" (see Table 10).

Furthermore, there is no heteroskedasticity problem as can be observed in Table 11 and the error terms, as shown in the Figure 14 below, have normal distribution with a mean zero and standard deviation 8.75.

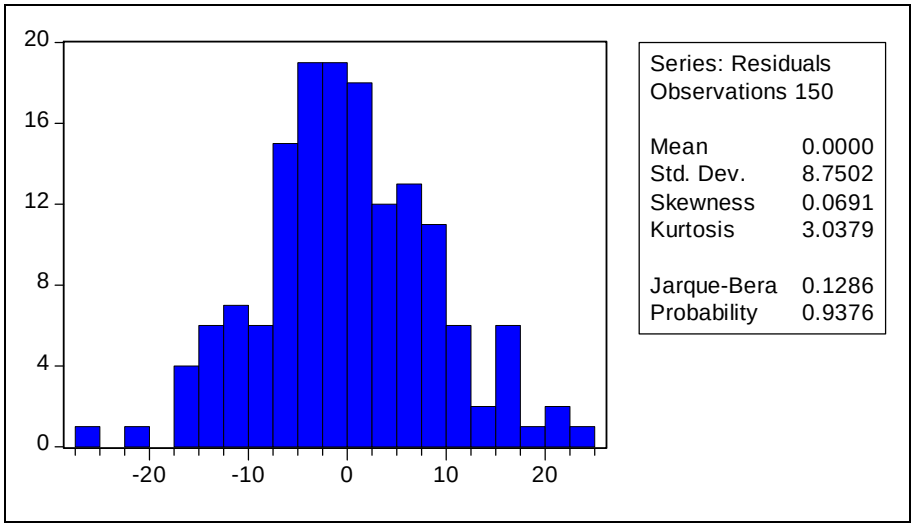

Figure 14: Jarque-Bera Results for Model (1.1)

Model (1.2) below is now run for the developing countries group:

$$EPI = \beta_0 + \beta_1(LITER) + \beta_2 (GOV\_EFF) + \beta_3 (POP\_DEN) + u \quad (1.2)$$

Table 12: Estimation Results of Model (1.2)

Dependent Variable: EPI
Method: Least Squares
Included observations: *112 (Developing Countries)*
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	38.67***	3.837724	10.07642	0.0000
GOV_EFF	6.30***	1.558956	4.041265	0.0001
POP_DEN	0.00513	0.008760	0.586564	0.5587
LITER	0.25***	0.041337	6.000039	0.0000

R-squared	0.44	Durbin-Watson stat	1.87
Adjusted R-squared	0.43	Akaike info criterion	7.18
F-statistic	28.58	Schwarz criterion	7.28
Prob(F-statistic)	0.0000		

Note: *** indicates level of significance at 1% level.

Table 13: White Heteroskedasticity Test Result for Model (1.2)

F-statistic	1.06	Probability	0.3968
Obs*R-squared	9.60	Probability	0.3837

In Model (1.2) which has the same structure with the Model (1.1), GOV_EFF and LITER are found significant at 1% level while POP_DEN is found insignificant with an unexpected positive sign. Adjusted R^2 of this model is about 43% and F statistic of the regression is found to be statistically significant at %1 level (see Table 12). There exist no heteroskedasticity problem in the present version as can be seen in Table 13. Furthermore, the error terms have normal distribution with a mean zero and standard deviation 8.51 (see Figure 15).

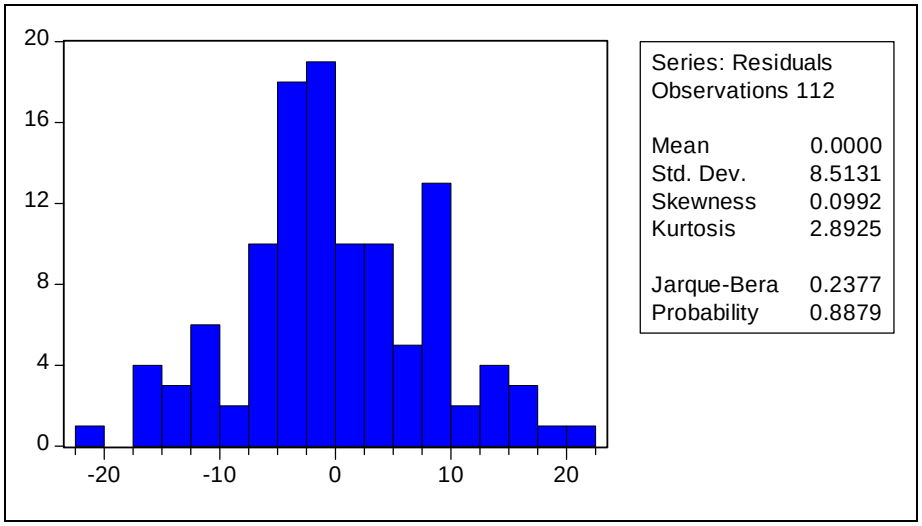

Figure 15: Jarque-Bera Results for Model (1.2)

Since Model (1.1) and Model (1.2) have the same formulation, there can be derived some comparable conclusions. First of all, In Model (1.1) for the whole group, GOV_EFF is found significant at 1% level with a coefficient 5.89 which means in case of 1 unit increase in Government effectiveness, EPI score will increase by 5.89 units. On the other hand, in Model (1.2) for developing countries group, GOV_EFF is significant at 1 % level with a coefficient of 6.30 which means in case of 1 unit

increase in Government effectiveness, EPI score will increase by 6.3 units. So it can be stated that for developing countries, GOV_EFF has a higher impact on EPI score than the whole group which encourages further the improvement in the effectiveness of government in these highly corrupt and less effective countries (see also Figure 16).

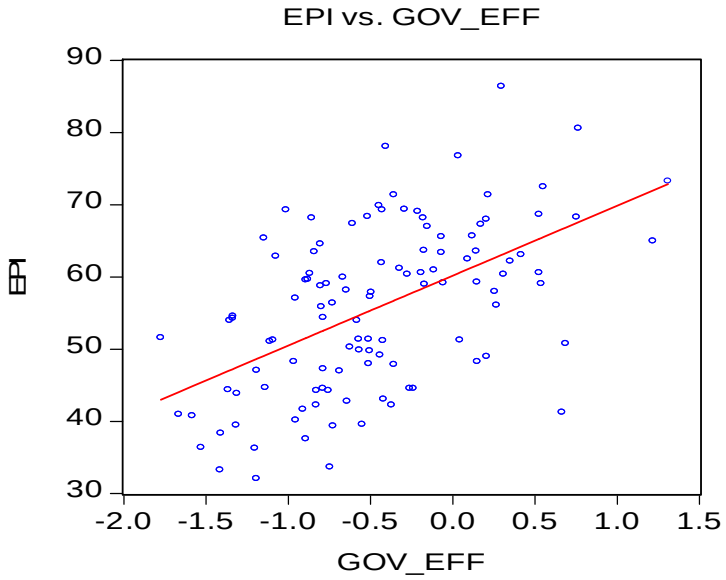

Figure 16: Scatter Plot for Developing Countries Group (EPI vs GOV_EFF)

Secondly, in Model (1.1), POP_DEN is found significant at 10% level and 1000 people increase in per sq km of land area will lead to 0.8 units decrease in the EPI score. In Model (1.2) for for developing countries group, POP_DEN is insignificant at 10 % level and it carries a positive sign unexpectedly. This result leads to an implication that change in the population density will lead to insignificant changes for the less developed and developing countries, meaning that population is not an

important determining factor on environmental performance of those countries since there exist more important governance problems to be resolved in the first place.

Furthermore, in Model (1.1), LITER is found significant at 1% level with a coefficient of 0.23 which means in case of 5% increase in literacy rate, EPI score will increase by about 1.15 units. On the other hand, in Model (1.2) for developing countries group, LITER is significant at 1% level with a coefficient of 0.25 which means that 5% increase in literacy rate will cause EPI score to increase by about 1.25 units. So it can be stated that for developing countries, literacy rate means more with respect to environmental performance than the whole group (see also Figure 17).

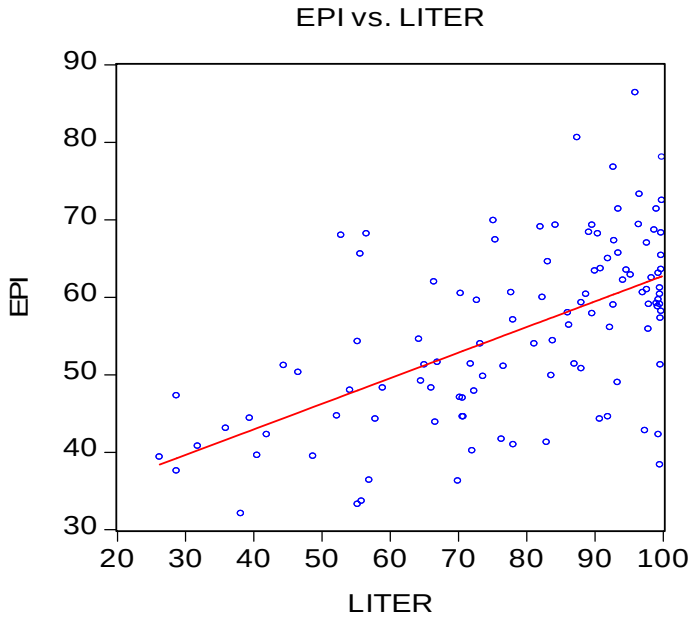

Figure 17: Scatter Plot for Developing Countries Group (EPI vs LITER)

Now, we apply Principal Component Analysis (PCA) to highly correlated GDPC, CORRUP and GOV_EFF variables. Results of the measures for sampling adequacy are found satisfactory such that KMO measure which is 0.69 exceeds the minimum

requirement of 0.50 and Bartlett's Test give significance level of 1%. One component is extracted with a total variance explained 90.2%[41] and it is called as "Development Rate (DEV_RATE)". Then the regressions including DEV_RATE as a new explanatory variable are run for the whole and developing countries groups, respectively.

$$EPI = \beta_0 + \beta_1(LITER) + \beta_2 (POP\_DEN) + \beta_3 (DEV\_RATE) + u \quad (1.3)$$

Table 14: Estimation Results of Model (1.3)

Dependent Variable: EPI
Method: Least Squares
Included observations: *150 (Whole Group)*
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	37.40***	3.353719	11.15148	0.0000
LITER	0.25***	0.039439	6.470754	0.0000
POP_DEN	-0.00064	0.000491	-1.298161	0.1963
DEV_RATE	5.32***	0.927013	5.739403	0.0000

R-squared	0.49	Durbin-Watson stat	2.04
Adjusted R-squared	0.48	Akaike info criterion	7.26
F-statistic	47.78	Schwarz criterion	7.34
Prob(F-statistic)	0.0000		

Note: *** indicates level of significance at 1% level.

[41] For the relevant SPSS 11.0 Outputs, see Tables in Appendix D.

Table 15: White Heteroskedasticity Test Result for Model (1.3)

F-statistic	1.49	Probability	0.1586
Obs*R-squared	13.08	Probability	0.1590

In Model (1.3), LITER and DEV_RATE are found significant at 1% level while POP_DEN is found significant only at 20% level and all coefficients carry the expected signs. Adjusted R^2 of the model is 48% and and F statistic of the regression is found to be statistically significant at %1 level. There is no heteroskedasticity problem as can be seen in Table 15. Furthermore, the error terms have normal distribution with a mean zero and standard deviation 8.89 (see Figure 18).

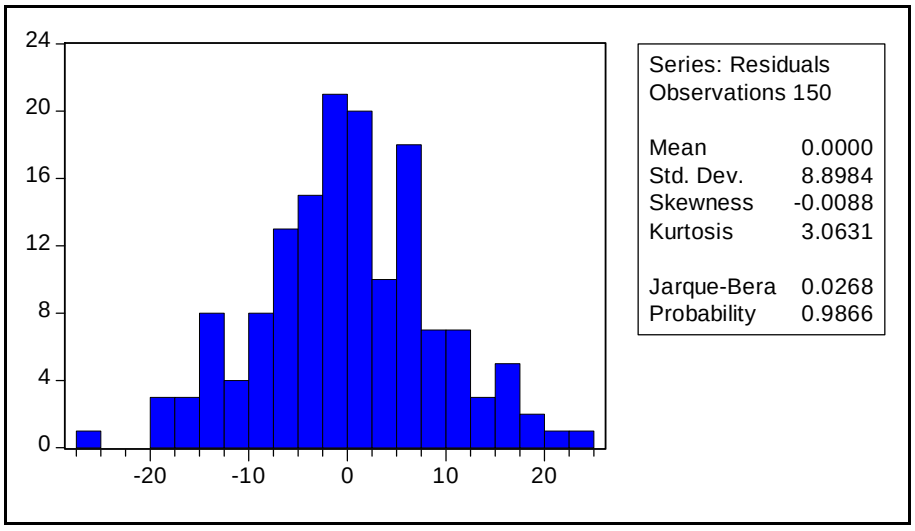

Figure 18: Jarque-Bera Results for Model (1.3)

$$EPI = \beta_0 + \beta_1(LITER) + \beta_2 (POP\_DEN) + \beta_3 (DEV\_RATE) + u \quad (1.4)$$

Table 16: Estimation Results of Model (1.4)

Dependent Variable: EPI
Method: Least Squares
Included observations: *112 (Developing Countries)*
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	37.28***	3.397997	10.97275	0.0000
POP_DEN	0.00787	0.008047	0.978262	0.3301
LITER	0.22***	0.041127	5.480325	0.0000
DEV_RATE	4.60***	1.081593	4.251290	0.0000

R-squared	0.47	Durbin-Watson stat	1.94
Adjusted R-squared	0.46	Akaike info criterion	7.12
F-statistic	32.30	Schwarz criterion	7.22
Prob(F-statistic)	0.0000		

Note: *** indicates level of significance at 1% level.

Table 17: White Heteroskedasticity Test Result for Model (1.4)

F-statistic	1.77	Probability	0.0822
Obs*R-squared	15.16	Probability	0.0867

In Model (1.4), LITER and DEV_RATE are found significant at 1% level while POP_DEN is found insignificant with an unexpected positive sign. Adjusted R^2 of the model is about 46% and and F statistic of the regression is found to be statistically significant at %1 level. Table 17 shows that heteroskedasticity problem does not exist at 5% significance level but at 10% significance level, it emerges. Furthermore, the error terms have normal distribution with a mean zero and standard deviation 8.27 (see Figure 19).

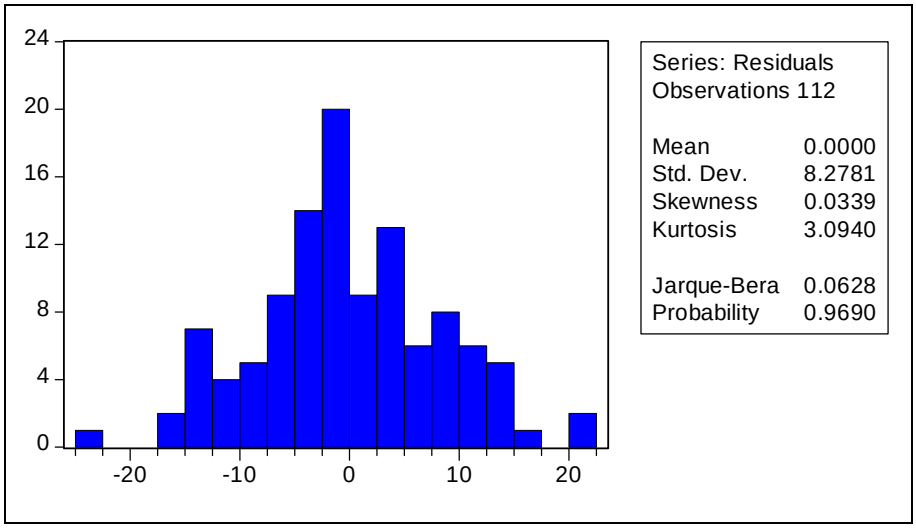

Figure 19: Jarque-Bera Results for Model (1.4)

The comparison between Table 14 and Table 16 reveals that the value of coefficients and Adjusted R^2 is lower in Model (1.4) for developing countries than those of the Model (1.3) for the whole group. But the significance levels for LITER and DEV_RATE are the same, both at 1% level. This can be attributed to the inclusion of a composite variable DEV_RATE in the models which carry the effects of GDPC, GOV_EFF and CORRUP, together. To interpret, DEV_RATE has more explanatory power in the EPI score in the whole group. Furthermore, POP_DEN is again found

insignificant with a positive sign for developing countries in line with the previous results of Model (1.2).

What has gained with the PCA application can be summarized by the fact that Adjusted R^2 of the developing group has improved while Adjusted R^2 of the whole group has decreased as can be observed in the Table 18 below.

Table 18: Comparison between the estimations with and without PCA in the analyses without the audit variable

Indep.Variables	(1.1) for the whole group	(1.3) for the whole group	(1.2) for the developing group	(1.4) for the developing group
C	39.42***	37.40***	38.67***	37.28***
LITER	0.23***	0.25***	0.25***	0.22***
GOV_EFF	5.89***	---	6.30***	---
POP_DEN	-0.0008*	-0.0006	0.0051	0.0078
DEV_RATE	---	5.32***	---	4.60***
Adjusted R^2	**0.50**	**0.48**	**0.43**	**0.46**
White stat.	8.13	13.08	9.60	15.16*
F stat.	51.08***	47.78***	28.58***	32.30***
# of countries	150	150	112	112

5.3.2 Empirical Results of the Analyses with the Audit Variable

In Section 5.2, main model formulated for the analyses with the audit variable is stated as follows:

$$EPI = \beta_0 + \beta_1 (GDPC) + \beta_2 (POP\_DEN) + \beta_3 (GOV\_EFF) + \beta_4 (CORRUP) + \beta_5 (LITER) + \beta_6 (REPORTS) + u \quad (2)$$

The descriptive statistics of the variables included in (2) are shown in the Table 19 below:

Table 19: Descriptive statistics of variables in (2)

	EPI	REPORTS	GDPC	POP_DEN	LITER	CORRUP	GOV_EFF
Mean	62.36	23.57	8671.95	107.55	87.82	4.62	0.30
Median	62.95	20.00	2985.73	64.96	93.75	4.10	0.18
Maximum	86.40	59.00	41900.79	499.95	99.80	9.40	1.97
Minimum	41.00	3.00	260.25	3.33	28.70	1.50	-1.66
Std. Dev.	11.61	14.56	10505.03	120.96	15.73	2.13	0.90
Skewness	-0.10	0.55	1.35	1.83	-1.90	0.85	0.10
Kurtosis	2.27	2.31	3.82	5.56	6.49	2.83	2.25
Jarque-Bera	1.22	3.71	17.29	43.46	57.95	6.35	1.30
Probability	0.5427	0.1563	0.0001	0.0000	0.0000	0.0417	0.5219
Observations	52	52	52	52	52	52	52

Considering the mean values of the variables of 52 countries that are depicted in Table 19, we see that average EPI score is 62.36 while average GDPC is about US$8,672 and average POP_DEN is 107 people per sq km of land area. The average

percentage value of LITER is 87.82 %. Furthermore it can be observed that the mean value of GOV_EFF is 0.3 and of CORRUP is about 4.6.

Observing the Jarque-Bera statistics of the variables shown in Table 19, REPORTS, CORRUP and GOV_EFF have normal distribution at 1% significance level while other explanatory variables do not. As explained in earlier sections, this situation does not lead to any disturbance on the analyses since "normal distribution of the variables" is not among the assumptions of the OLS method.

To look into the variables whether they have perfect multicollinearity problem to preserve unbiasedness and consistency of the estimators, correlations among the independent variables should be checked as shown in the Table 20 below:

Table 20: Correlations among the independent variables in (2)

	REPORTS	**GDPC**	**POP_DEN**	**LITER**	**CORRUP**	**GOV_EFF**
REPORTS	1	0.25	0.28	0.47	0.22	0.23
GDPC	0.25	1	0.29	0.47	0.84	0.79
POP_DEN	0.28	0.29	1	0.15	0.17	0.26
LITER	0.47	0.47	0.15	1	0.42	0.51
CORRUP	0.22	*0.84*	0.17	0.42	1	0.93
GOV_EFF	0.23	*0.79*	0.26	0.51	*0.93*	1

According to the Table 20, GDPC, GOV_EFF and CORRUP variables are highly correlated as it was also the case in the analyses without the audit variable (LITER is also observed to be correlated-not so strongly- with other explanatory variables so we exclude it from the model formulation for the moment until a seperate analysis at the end of this section). These three variables are respectively preserved in the model runs with the variables REPORTS and POP_DEN in order to explore which of these highly correlated variables has more explanatory power for the environmental

performance. The regressions are run for the whole group of 52 countries [Model (2.1) and Model (2.4)] and then this group is split into two sub-groups, one is high income countries which corresponds to 16 countries [(Model (2.2) and Model (2.5)] and the other is 35 developing countries [Model (2.3) and Model (2.6)]. Since the most statistically significant results are obtained with the inclusion of GOV_EFF, similar to the analyses without the audit variable, we present the regressions with GOV_EFF until we continue with PCA application. The first three models have the same formulation estimated for 52 (whole group), 16 (high income) and 35(developing countries) countries, respectively. So their results will be explained comparatively among these different groups of countries following presentation of the results of Model (2.1), Model (2.2) and Model (2.3).

$$EPI = \beta_0 + \beta_1 (GOV\_EFF) + \beta_2 (REPORTS) + \beta_3 (POP\_DEN) + u \quad (2.1)$$

Table 21: Estimation Results of Model (2.1)

Dependent Variable: EPI
Method: Least Squares
Included observations*: 52 (Whole Group)*
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	56.53***	2.356899	23.98545	0.0000
GOV_EFF	7.24***	1.373607	5.269113	0.0000
REPORTS	0.27**	0.105380	2.547570	0.0141
POP_DEN	-0.02519**	0.011520	-2.186808	0.0337

R-squared	0.45	Durbin-Watson stat	1.87
Adjusted R-squared	0.42	Akaike info criterion	7.26
F-statistic	13.41	Schwarz criterion	7.41
Prob(F-statistic)	0.0000		

Note: *** indicates level of significance at 1% level.
** indicates level of significance at 5% level.

Table 22: White Heteroskedasticity Test Result for Model (2.1)

F-statistic	1.49	Probability	0.1841
Obs*R-squared	12.57	Probability	0.1830

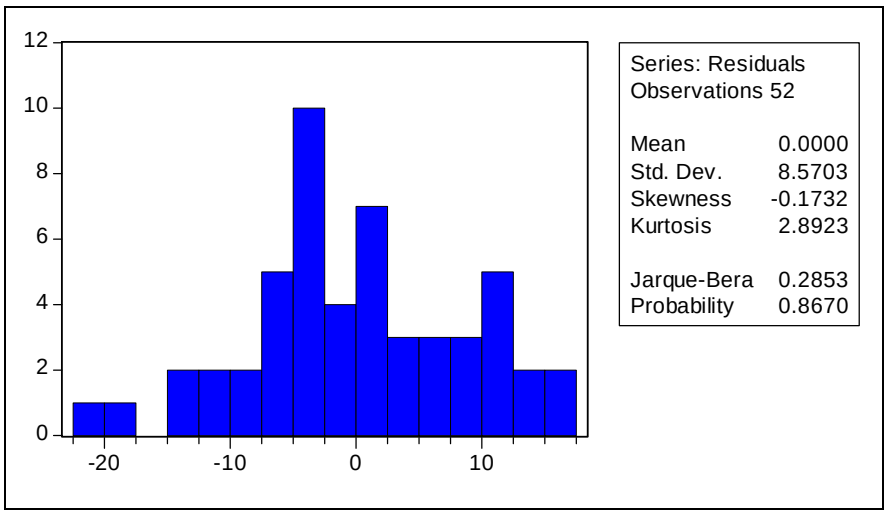

Figure 20: Jarque-Bera Results for Model (2.1)

$$EPI = \beta_0 + \beta_1 (GOV\_EFF) + \beta_2 (REPORTS) + \beta_3 (POP\_DEN) + u \quad (2.2)$$

Table 23: Estimation Results of Model (2.2)

Dependent Variable: EPI
Method: Least Squares
Included observations: *16 (High Income Group)*
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	60.66***	6.122020	9.908541	0.0000
GOV_EFF	7.91	4.495539	1.758885	0.1040
POP_DEN	-0.03296***	0.008692	-3.792832	0.0026
REPORTS	0.15*	0.075505	1.958013	0.0739

R-squared	0.55	Durbin-Watson stat	2.80
Adjusted R-squared	0.44	Akaike info criterion	6.95
F-statistic	5.00	Schwarz criterion	7.14
Prob(F-statistic)	0.0177		

Note: *** indicates level of significance at 1% level.
* indicates level of significance at 10% level.

Table 24: White Heteroskedasticity Test Result for Model (2.2)

F-statistic	4.92	Probability	0.0328
Obs*R-squared	14.09	Probability	0.1191

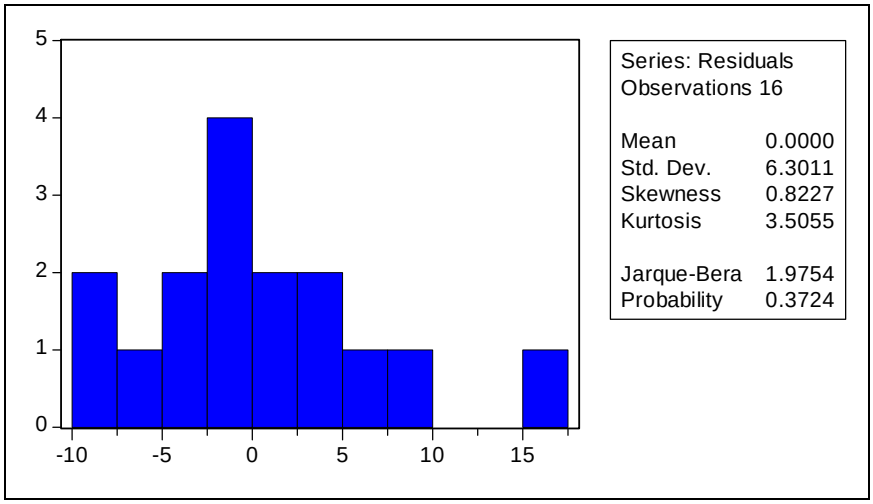

Figure 21: Jarque-Bera Results for Model (2.2)

$$EPI = \beta_0 + \beta_1 (GOV\_EFF) + \beta_2 (REPORTS) + \beta_3 (POP\_DEN) + u \quad (2.3)$$

Table 25: Estimation Results of Model (2.3)

Dependent Variable: EPI
Method: Least Squares
Included observations: *35 (Developing Countries)*
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	54.48***	3.654699	14.90658	0.0000
GOV_EFF	7.53***	2.132139	3.530806	0.0013
POP_DEN	-0.00763	0.023486	-0.325091	0.7473
REPORTS	0.32**	0.146636	2.208979	0.0347

R-squared	0.41	Durbin-Watson stat	1.86
Adjusted R-squared	0.35	Akaike info criterion	7.32
F-statistic	7.16	Schwarz criterion	7.50
Prob(F-statistic)	0.0008		

Note: *** indicates level of significance at 1% level.
** indicates level of significance at 5% level.

Table 26: White Heteroskedasticity Test Result for Model (2.3)

F-statistic	2.05	Probability	0.0749
Obs*R-squared	14.88	Probability	0.0941

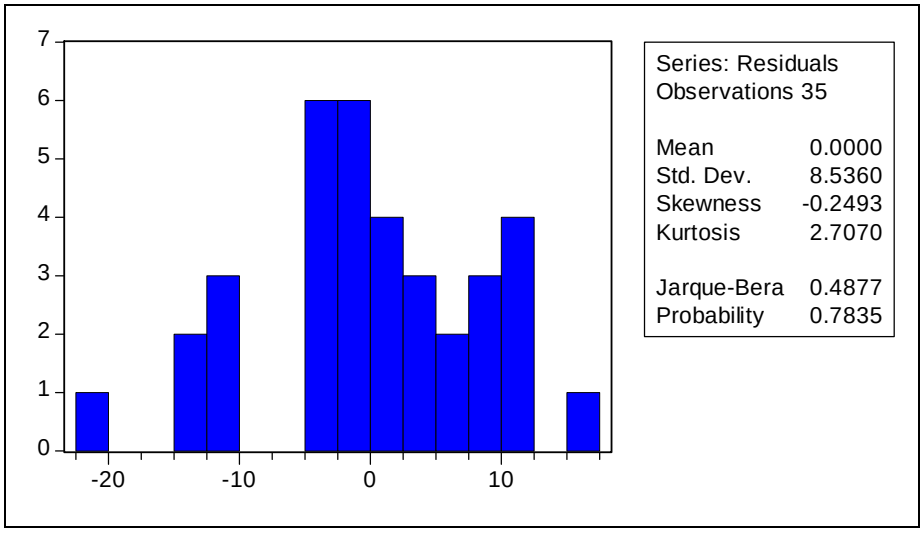

Figure 22: Jarque-Bera Results for Model (2.3)

First of all, Adjusted R^2 of Model (2.1) is 42% and of Model (2.2) is 44% both with no heteroskedasticity problem while Adjusted R^2 of Model (2.3) is 35% and there is no heteroskedasticity problem at 5% level (But there is heteroskedasticity problem at 10% level). Also, the error terms for these three models have normal distribution with mean 0 and Standard deviations 8.57, 6.30 and 8.53, respectively (See Figures 20-22).

In Model (2.1) for 52 countries, the constant term is found to be 56.53 which means that in case of being 0 of all other explanatory variables, EPI score of an average country is expected to be about 56. In Model (2.2) for high income group, the

constant term is 60.66 while that of Model (2.3) for lower income group is found to be 54.48.

In Model (2.1), GOV_EFF is found significant at 1% level with a coefficient of 7.24 which means in case of 1 unit increase of Government effectiveness, EPI score will increase by 7.24 units. In Model (2.2) for high income group, GOV_EFF is significant only at 10.4 % level with a coefficient of 7.9 while that of Model (2.3) for developing countries group is found to be 7.53 at 1% significance level. If GOV_EFF is ignored in Model (2.2) due to its low significance, Model (2.1) and Model (2.3) can be compared and it can be infered that for developing countries, GOV_EFF score has a higher impact on EPI score than the whole group promoting the institutional improvement in those countries.

In Model (2.1) for the whole group, REPORTS is found significant at 5% level with a coefficient of 0.27 which means in case of generation of 10 environmental audit reports by the SAI, EPI score will increase by 2.7 units. In Model (2.2) for high income group, REPORTS is significant at 10 % level with a coefficient of 0.15 while that of Model (2.3) for developing countries is found to be 0.32 at 5% significance level. If an SAI publishes 10 environmental audit reports in a developing country covered in Model (2.3), that country's EPI score will increase by 3.2 units in a reasonable period which is higher than the implication derived for the whole group and also for high income group (For Model (2.2), 10 reports will lead to only 1.5 units increase in EPI score). So it can be infered that for comparably lower income countries and developing countries, REPORTS variable has a higher impact on EPI score which promotes the idea that environmental auditing should be perceived as a sound tool by not only the developed countries but also and more importantly by the developing countries to enhance their environmental management systems (see also Figure 23).

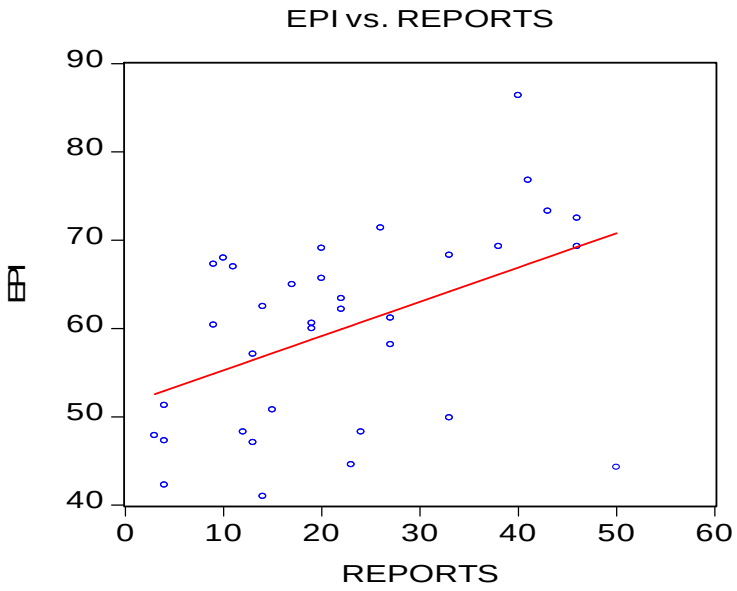

Figure 23: Scatter Plot for Developing Countries Group (EPI vs REPORTS)

In Model (2.1), POP_DEN is found significant at 5% level and 100 people increase in per sq km of land area will lead to 2.5 units decrease in the EPI score. In Model (2.2) for high income group, POP_DEN is significant at 1% level and 100 people increase in per sq km of land area will lead to 3.3 units decrease in the EPI score while in Model (2.3) for lower income group, POP_DEN variable is found to be insignificant with an expected negative sign. So it can be infered that change in the population density will lead to dramatic changes for developed and high income countries in terms of their environmental performance while for the less developed and developing countries, population is not an important determining factor on environmental performance since there exist more important governance problems to be resolved in the first place.

Now, we apply Principal Component Analysis (PCA) similar to Section 5.2.1 to highly correlated GDPC, CORRUP and GOV_EFF variables and name the extracted factor as "Development Rate (DEV_RATE)". Then the regressions including DEV_RATE as a new explanatory variable are produced. The first three models have the same formulation estimated for 52 (whole group), 16 (high income) and 35 (developing) countrie, respectively. So their results will be explained comparatively among these different groups of countries following presentation of the results of Model (2.4), Model (2.5) and Model (2.6).

$$EPI = \beta_0 + \beta_1 (DEV\_RATE) + \beta_2 (REPORTS) + \beta_3 (POP\_DEN) + u \quad (2.4)$$

Table 27: Estimation Results of Model (2.4)

Dependent Variable: EPI
Method: Least Squares
Included observations: *52 (Whole Group)*
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	58.88***	2.408622	24.44693	0.0000
DEV_RATE	6.53***	1.138624	5.739698	0.0000
POP_DEN	-0.02442**	0.011086	-2.202827	0.0324
REPORTS	0.26**	0.107920	2.402248	0.0202

R-squared	0.46	Durbin-Watson stat	1.90
Adjusted R-squared	0.42	Akaike info criterion	7.26
F-statistic	13.46	Schwarz criterion	7.41
Prob(F-statistic)	0.0000		

Note: *** indicates level of significance at 1% level.
** indicates level of significance at 5% level.

Table 28: White Heteroskedasticity Test Result for Model (2.4)

F-statistic	0.99	Probability	0.4559
Obs*R-squared	9.16	Probability	0.4219

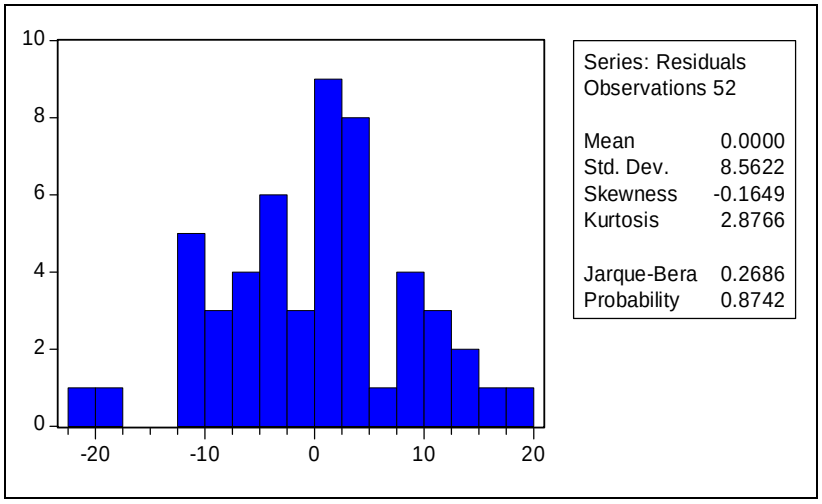

Figure 24: Jarque-Bera Results for Model (2.4)

$$EPI = \beta_0 + \beta_1 (DEV\_RATE) + \beta_2 (REPORTS) + \beta_3 (POP\_DEN) + u \quad (2.5)$$

Table 29: Estimation Results of Model (2.5)

Dependent Variable: EPI
Method: Least Squares
Included observations: *16 (High income group)*
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	70.58***	2.525053	27.95306	0.0000
DEV_RATE	5.07**	1.700709	2.979835	0.0115
POP_DEN	-0.02978***	0.008133	-3.661613	0.0033
REPORTS	0.13*	0.070818	1.842165	0.0903

R-squared	0.61	Durbin-Watson stat	2.87
Adjusted R-squared	0.51	Akaike info criterion	6.82
F-statistic	6.25	Schwarz criterion	7.01
Prob(F-statistic)	0.0084		

Note: *** indicates level of significance at 1% level.
** indicates level of significance at 5% level
* indicates level of significance at 10% level.

Table 30: White Heteroskedasticity Test Result for Model (2.5)

F-statistic	1.69	Probability	0.2675
Obs*R-squared	11.48	Probability	0.2437

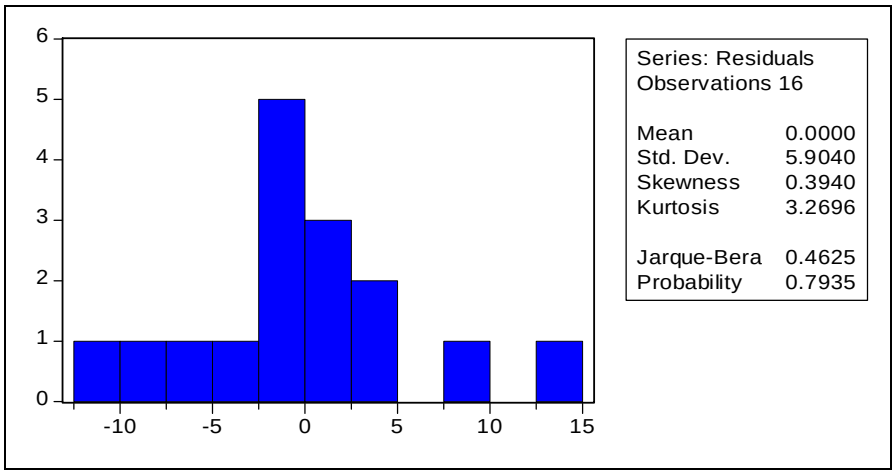

Figure 25: Jarque-Bera Results for Model (2.5)

$$EPI = \beta_0 + \beta_1 (DEV\_RATE) + \beta_2 (REPORTS) + \beta_3 (POP\_DEN) + u \quad (2.6)$$

Table 31: Estimation Results of Model (2.6)

Dependent Variable: EPI
Method: Least Squares
Included observations: *35 (Developing Countries)*
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	53.32***	3.257013	16.37255	0.0000
DEV_RATE	5.44***	1.483350	3.666114	0.0009
POP_DEN	0.00134	0.021991	0.061138	0.9516
REPORTS	0.29*	0.147624	2.003117	0.0540

R-squared	0.44	Durbin-Watson stat	1.98
Adjusted R-squared	0.39	Akaike info criterion	7.26
F-statistic	8.26	Schwarz criterion	7.44
Prob(F-statistic)	0.0003		

Note: *** indicates level of significance at 1% level.
* indicates level of significance at 10% level

Table 32: White Heteroskedasticity Test Result for Model (2.6)

F-statistic	2.20	Probability	0.0574
Obs*R-squared	15.48	Probability	0.0784

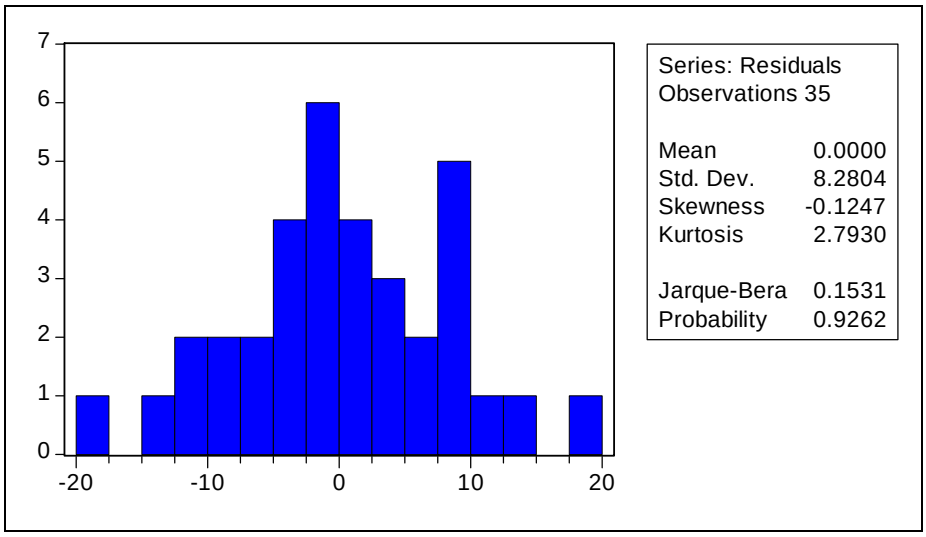

Figure 26: Jarque-Bera Results for Model (2.6)

First of all, Adjusted R^2 of Model (2.4) is 42 % and of Model (2.5) is 51%, both with no heteroskedasticity problem while Adjusted R^2 of Model (2.6) is 39 % and there is no heteroskedasticity problem at 5% level (But there is heteroskedasticity problem at 10% level). Also, the error terms for these three models have normal distribution with mean 0 and Standard deviations 8.56, 5.90 and 8.28, respectively (See Figures 24-26).

In Model (2.4) for the whole group, DEV_RATE is found significant at 1% level with a coefficient of 6.53 which means in case of 1 unit increase of Development rate

of a country, EPI score will increase by 6.53 units. In Model (2.5) for high income group, DEV_RATE is significant at 5 % level with a coefficient of 5.06 while that of Model (2.6) for developing countries group is found to be 5.44 at 1% significance level. So it can be infered that for developing countries, DEV_RATE variable has a higher impact on EPI score than the case for high income group which means that improvement in income, government effectiveness and struggle against corruption will have more dramatic effects on the environmental performance of the developing countries.

In Model (2.4), REPORTS is found significant at 5% level with a coefficient of 0.26 which means in case of generation of 10 environmental audit reports by an SAI, EPI score will increase by 2.6 units. In Model (2.5) for high income group, REPORTS is significant at 10 % level with a coefficient of 0.13 while that of Model (2.6) is found to be 0.29 at 10% significance level. If a SAI publishes 10 environmental audit reports in a developing country covered in Model (2.6), that country's EPI score will increase by 2.9 units which is higher than the implication derived for the whole group (2.6 units) and also for high income group (For Model (2.5), 10 reports will lead to only 1.3 units increase in EPI score). So, similar to the results arrived at the model estimations without PCA application, it can also be infered that for developing countries, REPORTS variable has a higher impact on EPI score when DEV_RATE variable is employed through PCA. This situation shows that there is a significant need for further institutional capacity building on environmental auditing in developing and comparably lower income countries. This provides a fundamental ground for environmental auditing to be perceived as a sound tool by the developing countries to enhance their environmental management systems.

In Model (2.4) for the general group, POP_DEN is found significant at 5% level and 100 people increase in per sq km of land area will lead to 2.4 units decrease in the EPI score. In Model (2.5) for high income group, POP_DEN is significant at 1% level and 100 people increase in per sq km of land area will lead to 2.9 units decrease

in the EPI score while in Model (2.6) for lower income group, POP_DEN variable is found to be insignificant with an unexpected positive sign. This result gives us the same conclusion with the approach without PCA application. When DEV_RATE is included in the models to represent the effects of GDPC, CORRUP and GOV_EFF, it is found that change in the population density will lead to dramatic changes for developed and high income countries in terms of their environmental performance while for the less developed and developing countries, population is not an important determining factor on environmental performance. This is because when the basic units of a sound institutional structure are not functioning well such that regulatory framework, struggle against corruption or supervisory activities are not effective enough, it is an expected fact that population density pressure will not be the most important determining factor on the environmental performance.

Table 33: Comparison between the estimations with and without PCA in the analyses with audit variable

Indep. Variables	**(2.1) for the whole group**	**(2.4) for the whole group**	**(2.2) for the developed group**	**(2.5) for the developed group**	**(2.3) for the developing group**	**(2.6) for the developing group**
C	56.53***	58.88***	60.66***	70.58***	54.48***	53.32***
REPORTS	0.27**	0.26**	0.15*	0.13*	0.32**	0.29*
GOV_EFF	7.24***	---	7.90	---	7.53***	---
POP_DEN	-0.025**	-0.024**	-0.033***	-0.030***	-0.007	0.001
DEV_RATE	---	6.53***	---	5.07**	---	5.44***
Adjusted R^2	**0.42**	**0.42**	**0.44**	**0.51**	**0.35**	**0.39**
White stat.	12.57	9.16	14.09	11.49	14.88*	15.48*
F stat.	13.41***	13.46***	5.00**	6.25***	7.16***	8.26***
# of countries	52	52	16	16	35	35

As it can be seen in Table 33, the comparison of the models with and without PCA gives the result that Adjusted R2 of the developed and developing models have increased by the PCA application while it stays the same for the whole group.

After presenting regressions of the models of different income groups with and without PCA application and deriving the main conclusions, now the effect of LITER variable will be analyzed on the dependent and other independent variables by employing several models. First estimation results of these models will be interpreted without any comparison. Then the results will be compared among the pairwise models, one of which is the LITER variable excluded version of the other.

$$EPI= \beta_0+\beta_1(LITER) +\beta_2(GOV\_EFF)+\beta_3(REPORTS)+\beta_4(POP\_DEN)+ u \qquad (2.7)$$

Table 34: Estimation Results of Model (2.7)

Dependent Variable: EPI
Included observations: *52 (Whole Group)*

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	41.69***	6.995525	5.959974	0.0000
LITER	0.19**	0.081668	2.373403	0.0218
GOV_EFF	5.74***	1.589303	3.610213	0.0007
REPORTS	0.19*	0.106135	1.759732	0.0850
POP_DEN	-0.02332**	0.011241	-2.074491	0.0435

R-squared	0.50	Durbin-Watson stat	1.90
Adjusted R-squared	0.45	Akaike info criterion	7.22
F-statistic	11.62	Schwarz criterion	7.41
Prob(F-statistic)	0.0000		

Note: *** indicates level of significance at 1% level.
** indicates level of significance at 5% level.
* indicates level of significance at 10% level.

In Model (2.7) for 52 countries, GOV_EFF is found significant at 1% level while POP_DEN and LITER are found significant at 5% level with all expected signs. REPORTS is found significant at only 10% level with a positive sign expectedly. Furthermore, Adjusted R^2 of the model is 45%. So, for the whole group of 52 countries, it can be deduced that:

- At 5% significance level, 5% increase in literacy rate of a country will lead to 1 unit increase in the EPI score.
- At 1% significance level, the coefficient of GOV_EFF variable is estimated to be 5.74 which means in case of 1 unit increase of Government effectiveness, EPI score will increase by about 5.74 units.
- At 5% significance level,100 people increase in per sq km of land area will lead to 2.3 units decrease in the EPI score.
- At 10% significance level, as a result of generation of 10 environmental audit reports by an SAI, EPI score will increase by 1.9 units.

It should also be noted that there is no heteroskedasticity problem in the model as can be seen in Table 35 and error terms have normal distribution with mean 0 and Standard deviation 8.24 (See Figure 27).

Table 35: White Heteroskedasticity Test Result for Model (2.7)

F-statistic	1.26	Probability	0.2720
Obs*R-squared	16.86	Probability	0.2634

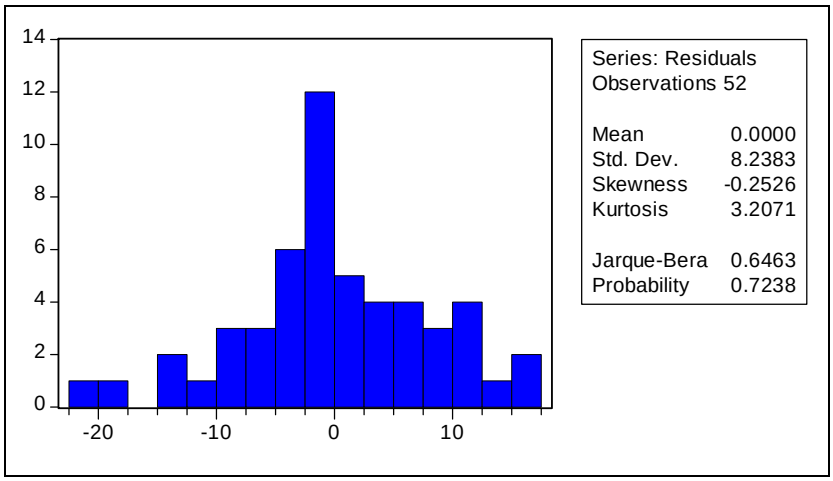

Figure 27: Jarque-Bera Results for Model (2.7)

$$EPI = \beta_0+\beta_1(LITER)+\beta_2(GOV\_EFF)+ \beta_3(REPORTS)+\beta_4(POP\_DEN)+u \quad (2.8)$$

Table 36: Esimation Results of Model (2.8)

Dependent Variable: EPI
Included observations: *35 (Developing Countries)*

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	42.18***	7.528007	5.602711	0.0000
GOV_EFF	6.30**	2.304318	2.734495	0.0104
POP_DEN	-0.00821	0.020156	-0.407719	0.6864
REPORTS	0.20	0.163627	1.247219	0.2220
LITER	0.18*	0.095803	1.858992	0.0729

R-squared	0.45	Durbin-Watson stat	1.98
Adjusted R-squared	0.38	Akaike info criterion	7.30
F-statistic	6.29	Schwarz criterion	7.52
Prob(F-statistic)	0.0008		

Note: *** indicates level of significance at 1% level.
** indicates level of significance at 5% level.
* indicates level of significance at 10% level.

In Model (2.8) for developing 35 countries, GOV_EFF is found significant at 5% level while LITER at 10% level; POP_DEN and REPORTS are insignificant with all expected signs. Furthermore, Adjusted R^2 of the model is 38 %. So, for the whole group of 35 countries, it can be deduced that:

- At 10 % significance level, 5% increase in literacy rate of a country will lead to about 1 unit increase in the EPI score.
- At 5 % significance level, the coefficient of GOV_EFF variable is estimated to be 6.3 which means in case of 1 unit increase of Government effectiveness, EPI score will increase by about 6.3 units.
- At 68.64% significance level,100 people increase in per sq km of land area will lead to 0.8 units decrease in the EPI score.
- At 22.2% significance level, as a result of generation of 10 environmental audit reports by an SAI, EPI score will increase by 2 units.

It should also be noted that there is no heteroskedasticity problem in the model as can be seen in Table 37 and error terms have normal distribution with mean 0 and Standard deviation 8.19 (see Figure 28).

Table 37: White Heteroskedasticity Test Result for Model (2.8)

F-statistic	1.16	Probability	0.3654
Obs*R-squared	15.7	Probability	0.3284

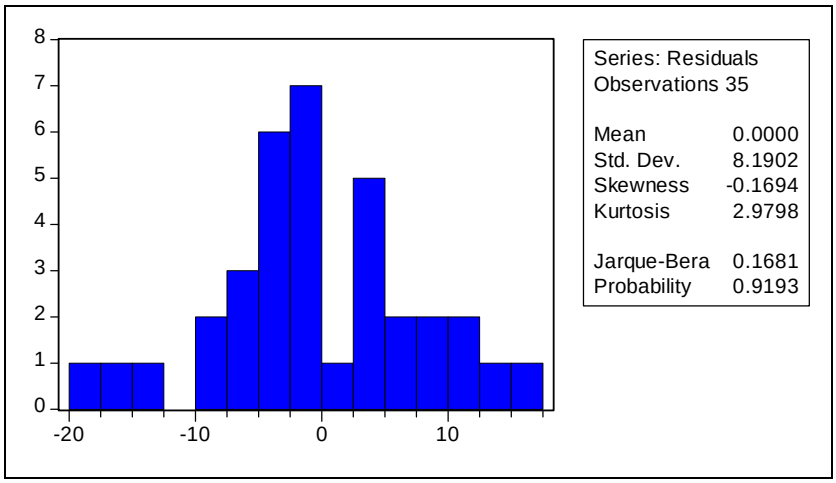

Figure 28: Jarque-Bera Results for Model (2.8)

$$EPI=\beta_0+\beta_1(LITER)+\beta_2(DEV\_RATE)+\beta_3(REPORTS)+\beta_4(POP\_DEN)+u \quad (2.9)$$

Table 38: Estimation Results of Model (2.9)

Dependent Variable: EPI
Included observations: *52 (Whole Group)*

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	42.79***	6.912628	6.190991	0.0000
DEV_RATE	5.21***	1.275600	4.082253	0.0002
POP_DEN	-0.02278**	0.010753	-2.118606	0.0394
REPORTS	0.17	0.109581	1.587721	0.1191
LITER	0.20**	0.079643	2.562257	0.0137

R-squared	0.50	Durbin-Watson stat	1.94
Adjusted R-squared	0.46	Akaike info criterion	7.21
F-statistic	11.96	Schwarz criterion	7.40
Prob(F-statistic)	0.0000		

Note: *** indicates level of significance at 1% level.
** indicates level of significance at 5% level.

In Model (2.9) for 52 countries, DEV_RATE is found significant at 1% level while POP_DEN and LITER are found significant at 5% level; REPORTS is found significant only at 11.91% level with all expected signs. Furthermore, Adjusted R^2 of the model is 46%. So, for the whole group of 52 countries, it can be deduced that:

- At 5% significance level, 5% increase in literacy rate of a country will lead to 1 unit increase in the EPI score.
- At 1% significance level, the coefficient of DEV_RATE variable is estimated to be 5.2 which means in case of 1 unit increase of Development rate of a country, EPI score will increase by about 5.2 units.
- At 5% significance level, 100 people increase in per sq km of land area will lead to 2.2 units decrease in the EPI score.
- At 11.91 % significance level, as a result of generation of 10 environmental audit reports by an SAI, EPI score will increase by 1.7 units.

It should also be noted that there is no heteroskedasticity problem in the model as can be seen in Table 39 and error terms have normal distribution with mean 0 and Standard deviation 8.17 (see Figure 29).

Table 39: White Heteroskedasticity Test Results for Model (2.9)

F-statistic	1.17	Probability	0.3349
Obs*R-squared	15.98	Probability	0.3145

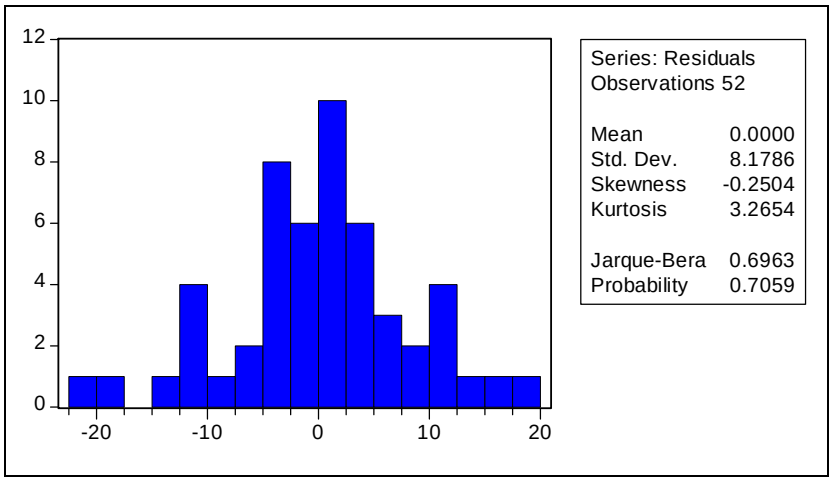

Figure 29: Jarque-Bera Results for Model (2.9)

Table 40 below should be read in a manner that (2.1) & (2.7), (2.3) & (2.8) and (2.4) & (2.9) are compared dually to see the effect of the integration of the LITER variable in different versions of models. In all the three cases, LITER variable lead to decreases in the value of coefficient but does not disturb the significance levels of other variables, except REPORTS. For instance, when LITER is added to the Model (2.1) to produce Model (2.7), statistical significance of the coefficient of the REPORTS variable drops from 5% to 10%. In other paired models, this drop is more obvious such that statistical significance of the coefficient of the REPORTS drops from 5% in Model (2.3) to even under 10% in Model (2.8). This is also valid for the comparison among (2.4) & (2.9). The underlying reason for this situation is probably the correlation between LITER and REPORTS variables (see Table 20). This is not a surprising fact since literacy rate of a country, with the other necessary institutional capacity building efforts put in place, means alot in terms of the openness of that society to new initiatives in many areas, one of which is absolutely environment. For the European countries which are in general developed and have convergent literacy rate, the effect of this variable may not make a sense. However, increasing number of environmental audit reports and therefore more respect for regulatory framework for environment may be accepted as a usable indicator of rising literacy rate along with the growing public awareness in especially developing and lower income countries.

Table 40: Comparison of the models with and without LITER variable

Independent Variables	(2.1) for the whole group	(2.7) for the whole group	(2.3) for the developing group	(2.8) for the developing group	(2.4) for the whole group	(2.9) for the whole group
C	56.53***(23.98)	41.69***(5.96)	54.48***(14.90)	42.18***(5.60)	58.88***(24.45)	42.80***(6.19)
LITER	---	0.19** (2.37)	---	0.18* (1.86)	---	0.20** (2.56)
GOV_EFF	7.24*** (5.27)	5.74*** (3.61)	7.53*** (3.53)	6.30** (2.73)	---	---
REPORTS	0.27** (2.55)	0.19* (1.76)	0.32** (2.20)	0.20 (1.24)	0.26** (2.40)	0.17 (1.59)
POP_DEN	-0.025** (-2.19)	-0.023** (-2.07)	-0.008 (-0.32)	-0.008 (0.40)	-0.024** (-2.20)	-0.023** (-2.11)
DEV_RATE	---	---	---	---	6.53*** (5.74)	5.21*** (4.08)
Adjusted R^2	0.42	0.45	0.35	0.38	0.42	0.46
Number of countries	52	52	35	35	52	52

Note: *** indicates level of significance at 1% level.
** indicates level of significance at 5% level.
* indicates level of significance at 10% level.
t-statistics are in parantheses.

CHAPTER 6

SUMMARY AND CONCLUSIONS

There are many economic, social and institutional factors affecting the environmental performance of the countries such as income, population, social awareness, corruption, functioning of the government and so on. Among these factors, the role of the SAIs is of vital importance in detecting the deficiencies in the environmental management systems (Rika, 2009) and in developing concrete and constructive recommendations to continuously improve the competence of responsible units. In this sense, as independent regulatory authorities, SAIs' environmental audit reports and their effects on environment that are built-up over years worth special attention.

This thesis examines the factors that are effective on the environmental performance of the countries through giving a special emphasis on the environmental auditing carried out by SAIs. There is a quite rich literature on the analysis of overall environmental outlook or more commonly of sub-categories of the environment such as air, water, climate change etc. with respect to the certain economic, social and institutional factors. However, literature that derives both qualitative and quantitative results on the effects of the environmental auditing is very limited despite its raising importance especially from the early 1990s.

The empirical analyses depend on two main analyses and the models formulated under these analyses using a cross-country framework. These models chosen in a manner to create an opportunity for comparative analysis between different income groups are subjected to OLS method and PCA application respectively. In the analyses without the audit variable, cross-country data of 150 countries which are selected among the 163 countries ranked in the EPI Report (2010) are used and as the basic formulation, their EPI scores are regressed on GDP per capita, population density, literacy rate, Corruption Perceptions Index and Government Effectiveness

score. Since GDP per capita, Corruption Perceptions Index and Government Effectiveness are found highly correlated not surprisingly, the model trials with these variables are made seperately. In general, the most statistically significant results are obtained with the trials in which GOV_EFF is preserved, so the sub-models including GOV_EFF for the whole group (150 countries) and developing countries sub-group (112 countries) are taken into consideration for comparative analysis. Then, PCA is applied to the highly correlated variables, namely GOV_EFF, GDPC and CORRUP, to produce one representative factor for the development level of the countries and the regressions are repeated with this new variable. The same approach is followed for also the analyses with the audit variable which comprises of 52 countries. But this time, a new variable related to environmental auditing is added: REPORTS. This group of 52 countries are split into two sub-groups such as developing countries group and high income (developed) countries group and comparative analysis is carried out among these groups.

From the results of our first group of the analyses without the audit variable, government effectiveness is found statistically significant at 1% level for both the whole group and the developing income sub-group with a higher positive coefficient in place for the second. In other words, government effectiveness which is a sound indicator for the proper functioning of the governance is a significant determinant of the environmental performance and this is a fact that is in line with the previous findings in literature (Peh and Drori, 2010; Holmberg and Rothstein, 2011). However, its effect is more dominant in developing countries implying that additional efforts should be immediately put forth at governance level of these countries in the area of environment. Furthermore, literacy rate and therefore the tendency of the countries for raising social awareness is more significant in developing countries in the improvement of the environmental performance. On the other hand, population density is not found as an important determining factor on environmental performance of those countries unlike the findings of the vast literature. This situation can be interpreted in such a way that developing countries

should support more importantly the efforts for overcoming the governance problems at first place. With the PCA application to the observed models, value of coefficients and Adjusted R^2 is at this time found lower for developing countries than the whole group but at the same significance levels for LITER and DEV_RATE. Composite variable DEV_RATE has therefore more explanatory power in the EPI score in the whole group. Furthermore, POP_DEN is again found insignificant with a positive sign for developing countries in line with the previous results.

Empirical results of the second group of the analyses with audit variable present similar results for the effect of GOV_EFF on environmental performance such that for developing countries, GOV_EFF score has a higher impact on EPI score than the whole group, promoting the institutional improvement in those countries. Furthermore, population density is found to have more dramatic effects for developed and high income countries in terms of their environmental performance while for the less developed and developing countries, population density is not the most important determining factor due to more urgent governance problems. As an outstanding result of the analyses, environmental audit reports are found to have a higher impact on EPI score for comparably lower income countries and developing countries. This finding supports the idea that it is relatively more important to use environmental auditing as a regulatory tool for environmental management systems in developing countries. The model estimations with the PCA application give similar results. When DEV_RATE variable is employed through PCA, audit reports display more important role on the EPI score for developing countries pointing to the significance of further institutional capacity building on environmental auditing in these countries. As a differing fact from the results of the first group of the analyses without the audit variable, DEV_RATE variable is found to have a higher impact on EPI score than the case for high income group which means that improvement in income, government effectiveness and struggle against corruption will have collectively more significant effects on the environmental performance of the developing countries.

As the last search within the second group of the analyses with the audit variable, the effect of literacy rate is analyzed on the dependent and other independent variables by employing several models and the results suggest that LITER variable leads to decreases in the value of coefficients but does not disturb the significance levels of other variables, except REPORTS. This is probably due to the high correlation between LITER and REPORTS variables which is not a surprising fact since internalization of the environmental auditing methodology is closely related with the existing social awareness of the public.

Based on the findings of this study, it can be stated that well functioning environmental management systems and resulting positive effects on the environmental performance can only be attained through strengthened governmental institutions with high transparency and accountability as well as rigid implementation of the related regulations. SAIs, in this respect, undertake this vital responsibility on the ground of developing environmental auditing and assisting governments in developing more environmental-sensitive policies. Since government institutions in developing countries are perceived weaker, less effective, and generally more corrupt than those in developed countries (Lopez and Mitra, 2000), there is room and an urgent need for focusing on improvements in environmental auditing in these countries.

For the future studies with regard to this issue, different aspects of environmental auditing other than the number of generated audit reports can be analysed such as employing dummy variables about the approach different SAIs use in environmental auditing (regulatory and performance approach) and search for their relative efffectiveness.

REFERENCES

Adams, W.M. (1990). Green Development: Environment and Sustainability in the Third World. London: Routledge.

Ajaero, C.K. (2011). Comparative evaluation of the impact of population and wealth distribution on the environment of West Africa. *African Population Studies,* 25 (1).

Akbostancı, E., Aşık, S.T. and Tunç, G. İ. (2009). The relationship between income and environment in Turkey: Is there an environmental Kuznets curve?. *Energy Policy*, 37, p. 861–867.

Andreoni, J. and Levinson, A. (2001). The simple analytics of the environmental Kuznets curve. *Journal of Public Economics*, 80 (2), p. 269−286.

Aslan, F. (2010). İktisadi Büyümenin Ekolojik Sınırları ve Kalkınmanın Sürdürülebilirliği. *Ankara University Master's Thesis.*

Aslanidis, N. and Iranzo, S. (2009). Environment and development: is there a Kuznets curve for CO2 emissions? *Applied Economics*, 41, p.803–810.

ASOSAI (2009). 8th ASOSAI Research Project: Guidance on Conducting Environmental Audit. Retrieved August 25, 2011, from http://www.asosai.org/activities/research_project_detail.jsp?idx=52

Bhattarai, M. and Hammig, M. (2001). Institutions and the Environmental Kuznets Curve for Deforestation: A Crosscountry Analysis for Latin America, Africa and Asia. *World Development*, 29 (6), p. 995-1010.

Cahill, L. B. and Kane, R. W. (1989). Environmental Audits. Government Institutes Inc., Rockville, MA.

Campelo, V. (2004). Getting Started: A Brazilian Perspective on Environmental Auditing. *International Journal of Auditing*, April 2004. Retrieved July 1, 2011 from http://www.intosaijournal.org/technicalarticles/technicalapr04e.html

Canas, A., Ferra˜o, P. and Conceiça˜o, P. (2003). A new environmental Kuznets curve? Relationship between direct material input and income per capita: evidence from industrialised countries. *Ecological Economics*, 46, p. 217-229.

Carisse, N., Cotnoir, L., Mathieu, C. and Reed, J. (2004). Making the world a better place to live one audit at a time: improving governance and accountability in environmental protection. *International Journal of Government Auditing*, 31 (2), p. 10-16.

Chai, N. (2009). Sustainability Performance Evaluation System in Government. *Springer Science+Business Media B.V.* 2009.

Chiang, C. (2010). Insights into current practices in auditing environmental matters. *Managerial Auditing Journal*, 25 (9), p. 912-933.

Cole, M. A. (1999). Limits to Growth, Sustainable Development and Environmental Kuznets Curves: An Examination of the Environmental Impact of Economic Development. *Sustainable Development*, 7, p. 87-97.

Cole, M. A. (2003). Development, trade, and the environment: how robust is the Environmental Kuznets Curve?. *Environment and Development Economics*, 8, p. 557–580.

Cole, M. A. (2007). Corruption, income and the environment: An empirical analysis. *Ecological Economics*, 62, p.637-647.

Desgagn´e, B. S. and Gabel, H. L. (1997). Environmental Auditing in Management Systems and Public Policy. *Journal of Environmental Economics And Management*, 33, p.331-346.

Dunteman, G. H. (1989). Principal components analysis. *Newbury Park; Sage Publications.*

Ehrlich, P. (1968). The Population Bomb. New York: Ballantine Books.

Emerson, J., Esty, D. C., Levy, M.A., Kim, C.H., Mara, V., De Sherbinin, A. and Srebotnjak, T. (2010). 2010 Environmental Performance Index. New Haven: Yale Center for Environmental Law and Policy.

Fredriksson, P., Vollebergh, H.R.J. and Dijkgraaf, E. (2004). Corruption and energy efficiency in OECD countries: theory and evidence. *Journal of Environmental Economics and Management*, 47, p. 207–231.

Grossman, G. M. and Krueger, A. B. (1991). Environmental Impacts of the North American Free Trade Agreement. *Cambridge, NBER Working Paper*, 3914, p. 35-36.

Gujarati D. (2004). Basic Econometrics. Fourth Edition © The McGraw−Hill Companies.

Hair, J., Black, W., Babin, B., Anderson, R., and Tatham, R., (2006). Multivariate Data Analysis. 6/E, Prentice Hall, 2006, ISBN 0-13-228139-2.

Harrison, L. L. (1984). The McGraw-Hill Environmental Auditing Handbook: A Guide to Corporate and Environmental Risk Management. McGraw-Hill, New York.

Hillary, R. (1998). Environmental auditing: Concepts, Methods and Developments. *International Journal of Auditing*, Vol.2, 71-85.

Holmberg, S. and Rothstein, B. (2011). Quality of Government and Access to Safe Water. *QoG Working Paper Series*, 2011 (4), The Quality of Government Institute: University of Gothenburg.

Holtz-Eakin, D. and Selden, T. M. (1995). Stoking the fires? CO2 emissions and economic growth. *Journal of Public Economics*, 57, p. 85−101.

Humphrey, N. and Hadley, M. (2000). Environmental Auditing. Palladian Law Publishing Limited, Isle of Wight.

ICC (1989). Environmental Auditing. International Chamber of Commerce.

INTOSAI WGEA (1997). Results of the second questionnaire on environmental auditing. INTOSAI Working Group on Environmental Auditing.

INTOSAI WGEA (2001). Guidance on Conducting Audits of Activities with an Environmental Perspective. INTOSAI Working Group on Environmental Auditing.

INTOSAI WGEA (2004a). Towards Auditing Waste Management. Adopted by the Eighth Meeting of the INTOSAI Working Group on Environmental Auditing.

INTOSAI WGEA (2004b). Auditing Water Issues: Experiences of Supreme Audit Institutions. INTOSAI Working Group on Environmental Auditing.

INTOSAI WGEA (2007a). Evolution and Trends in Environmental Auditing. INTOSAI Working Group on Environmental Auditing.

INTOSAI WGEA (2007b). The World Summit on Sustainable Development: An Audit Guide for Supreme Audit Institutions. Retrieved August 20, 2011, from http://www.environmental-auditing.org/Home/WGEAPublications/StudiesGuidelines/tabid/128/Default.aspx

INTOSAI WGEA (2007c). The Fifth Survey on Environmental Auditing: Detailed Results. INTOSAI Working Group on Environmental Auditing.

INTOSAI WGEA (2009). The Sixth Survey on Environmental Auditing. INTOSAI Working Group on Environmental Auditing.

INTOSAI WGEA (2011). 2011-2013 Work Plan. INTOSAI Working Group on Environmental Auditing.

IPCC (2007). Climate Change 2007: AR4 Synthesis Report. Contribution of the Three Working Groups to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Spain.

Jarque, C. M. and Bera, A. K. (1987). A test for normality of observations and regression residuals. *International Statistical Review,* 55 (2), p.163–172.

Johansson, P. and Kristrom, B. (2007). On a clear day you might see an Environmental Kuznets Curve. *Environmental & Resource Economics*, 37, p. 77–90.

Köse, H. Ö. (2007). Dünyada ve Türkiye'de Yüksek Denetim. T.C. Sayıştay Başkanlığı 145. Kuruluş Yıldönümü Yayınları. Mayıs 2007.

Kuznets, S. (1955). Economic growth and income inequality. *American Economic Review,* 45, p.1−28.

Lantz, V. and Feng, Q. (2006). Assessing income, population, and technology impacts on CO2 emissions in Canada: where's the EKC?. *Ecological Economics*, 57, p.229–238.

Lee, C.C., Chiu, Y.B., and Sun, C.H. (2010). The environmental Kuznets curve hypothesis for water pollution: Do regions matter?. *Energy Policy*, 38, p. 12–23.

Leeuwen, S. V. (2004). Developments in Environmental Auditing by Supreme Audit Institutions. *Environmental Management*, 33 (2), p. 163–172. Springer-Verlag New York, LLC.

Lima, L. H. and Magrini, A. (2010). The Brazilian Audit Tribunal's role in improving the federal environmental licensing process. *Environmental Impact Assessment Review,* 30, p.108–115.

Lopez, R. and Mitra, S. (2000). Corruption, pollution and the environmental Kuznets curve. *Journal of Environmental Economics and Management*, 40, p. 137–150.

Madu, I.A. (2009). The impacts of anthropogenic factors on the environment in Nigeria. *Journal of Environmental Management*, 90 (3), p.1422-1426.

McNeill, J.R. (2006). Population and the Natural Environment: Trends Challenges. *Population and Development Review*, 32, p.183-202.

Momeni, H. (2004). Getting Started: Iran's Environmental Auditing Mandate. *International Journal of Auditing*, April 2004. Retrieved July 1, 2011 from http://www.intosaijournal.org/technicalarticles/technicalapr04c.html

Mukherjee, S. and Chakraborty, D. (2010). Is there any Relationship between Environment, Human Development, Political and Governance Regimes? Evidences from a Cross-Country Analysis. *MPRA Paper*, 19968, posted 12. January 2010. University Library of Munich, Germany.

OECD (2008a). *Summary of Environmental Outlook to 2030.*

OECD (2008b). *Key Environmental Indicators.*

Panayotou, T. (1993). Empirical Tests and Policy Analysis of Environmental Degradation at Different Stages of Economic Development. *ILO Technology and Employment Programme Working Paper*, 238. Geneva, 1993.

Panayotou, T. (1997). Demystifying the environmental Kuznets curve: turning a black box into a policy tool. *Environment and Development Economics*, 2 (4), p. 465-484.

Peh, K.S.-H. and Drori, O. (2010). Fighting Corruption to Save the Environment: Cameroon's Experience. *Royal Swedish Academy of Sciences*. AMBIO, 39, p. 336–339.

Pellegrini, L. and Gerlagh, R. (2006). Corruption, Democracy, and Environmental Policy An Empirical Contribution to the Debate. *The Journal of Environment& Development*, 15 (3), p. 332-354.

Pizer, W.A. and Popp, D. (2008). Endogenizing technological change: matching empirical evidence to modeling needs. *Energy Economics*, 30, p.2754–2770.

Pollitt, C. and Summa, H. (1997). Reflexive Watchdogs? How Supreme Audit Institutions Account for Themselves. *Public Administration*, 75 (2), p. 313-336.

Ramanathan, R. (2002). Introductory econometrics with applications. Fifth Edition. South-Western College Publications.

Rika, N. (2009). What motivates environmental auditing? A public sector perspective. *Pacific Accounting Review,* 21 (3), p. 304-318.

Roberts, P. (2006). Evaluating Regional Sustainable Development: Approaches, Methods and the Politics of Analysis. *Journal of Environmental Planning and Management*, 49(4), p.515 – 532.

Rongbing, H. (2011). Environmental Auditing: An Informationized Regulatory Tool of Carbon Emission Reduction. *Energy Procedia*, 5, p.6–14. Published by Elsevier Ltd.

Rosa, E.A and York, R. (2002). Internal and external sources of environmental impacts: a comparative analysis of the EU with other Nation's groupings. Paper presented to the conference on the European Union in International Affairs, National.

Shafik, N. and Bandyopadhyay, S. (1992). Economic Growth and Environmental Quality: Time-Series and Cross-Country Evidence. *Background Paper for World Development Report*, 1992.

Song, T., Zheng, T. and Tong, L. (2008). An empirical test of the environmental Kuznets curve in China: A panel cointegration approach. *China Economic Review*, 19, p. 381–392.

Stafford, S. L. (2006). State Adoption of Environmental Audit Initiatives. *Contemporary Economic Policy*, 24 (I), January 2006, p. 172-187.

Stern, D. I. (2004). The rise and fall of the environmental Kuznets curve. *World Development*, 32, p.1419−1439.

Stokey, N. L. (1998). Are there limits to growth?. *International Economic Review*, 39(1), p.1−31.

TCA (2007). *International Symposium on Environmental Auditing and Supreme Audit Institutions*. Turkish Court of Accounts.

Turner, K. and Hanley, N. (2011). Energy efficiency, rebound effects and the environmental Kuznets Curve. *Energy Economics*, 33 (5), p.709-720.

Torras, M. and Boyce, J.K. (1998). Income, inequality and pollution: a reassessment of the environmental Kuznets curve. *Ecological Economics*, 25, p.147-160.

UN (2000). United Nations Millennium Declaration. Retrieved August 20, 2011, from http://www.un.org/millennium/declaration/ares552e.htm

UNCED (1992). United Nations Conference on Environment and Development. Retrieved August 20, 2011, from http://www.un.org/geninfo/bp/enviro.html

UN DESA (2002a). Guidance in preparing a national sustainable development strategy: Managing sustainable development in the new millenium. United Nations Department of Economic and Social Affairs. Retrieved August 20, 2011, from United Nations website: http://www.un.org/esa/sustdev/publications/nsds_guidance.pdf

UN DESA (2002b). *Global Challenge, Global Opportunity. Trends in Sustainable Development.* United Nations Department of Economic and Social Affairs.

UNEP (2005). Marine litter. An analytical overview. United Nations Environment Programme, Nairobi.

UNEP (2007). Global Environmental Outlook-GEO4. United Nations Environment Programme.

UNEP (2008). Vital Water Graphics 2: An Overview of the State of the World's Fresh and Marine Waters. 2nd Edition.

UNESCO WWAP (2006). Water a shared responsibility. The United Nations World Water Development Report 2.

UNESCO WWAP (2009a). Water In a Changing World. The United Nations World Water Development Report 3.

UNESCO WWAP (2009b). Case Studies Volume: Facing The Challenges. The United Nations World Water Development Report 3.

UN Water (2007). Coping with water scarcity: challenge of the twenty-first century. Prepared for World Water Day 2007. http://www.unwater.org/wwd07/downloads/documents/escarcity.pdf

Wanga, J., Zhangb, B. and Chenc, T. (2011). The case study of China's environmental audit: taking the Taihu Lake as an example. *Energy Procedia*, 5, p. 2108–2113. Published by Elsevier Ltd.

Welford, R. (2002). Corporate Environmental Management. Earthscan Publication Ltd. London.

Welsch, H. (2004). Corruption, growth, and the environment: a cross-country analysis. *Environment and Development Economics*, 9, p. 663–693.

White, H. (1980). A Heteroscedasticity Consistent Covariance Matrix Estimator and a Direct Test of Heteroscedasticity. *Econometrica*, 48, p. 817–818.

Wolman, A. (1965). The impact of population changes on the environment. *American Journal of Public Health Nations Health,* 55 (7), p. 1024–1031.

WB (1997). Expanding the measure of wealth : indicators of environmentally sustainable development. *Environmentally Sustainable Development Studies and Monographs Series*, 17break. The World Bank, Washington D. C.

WCED (1987). Our Common Future. World Commission on Environment and Development. Retrieved August 20, 2011, from http://www.un-documents.net/ocf-02.htm#I

WEC (2010). Pursuing sustainability: 2010 Assessment of country energy and climate policy. World Energy Council.

York, R., Rosa, E., and Dietz, T. (2001). The population and affluence elasticity of environmental impacts. Paper presented at the Pacific Sociological Association Annual Meeting in San Francisco, March 29-April 1.

APPENDIX A:

Table 41: Environmental Audit Summaries with Different Audit Objectives

Audit Title SAI-Publication Year of the Report Audit Objective	Main Findings and Recommendations
Main Objective 1: Auditing the compliance with domestic environmental legislation	
• *Waste Taxation*[42] • State Audit Office of Finland-2004 • Audit of whether the preparation of the Waste Tax Act and the implementation of taxation have created proper conditions for achieving the environmental objectives of waste taxation while meeting the requirements of a good tax system.	*Audit findings:* • Conditions for evaluating the effectiveness of the Waste Tax Act are poor. • The effect of the tax on different actors' behaviour was given little study when the tax was introduced. • Problems in Customs' activities were observed in registering taxpayers, conducting comprehensive fiscal control and ensuring uniform taxation. • No authority has been placed in charge of monitoring the effects of the Waste Tax Act and other environmentally related taxes. *Recommendations:* • Customs should pay particular attention to the reliability of register information and sanctions in case of unpaid taxes. • The specification of objectives at the level of environmental impacts and the definition of the tax's application area, base and level according to the desired environmental impacts are needed. • The information contained in systems should be harmonized in order to improve fiscal control and the ability to monitor the effects of the Waste Tax Act.

[42] Retrieved from http://www.environmental-auditing.org/Portals/0/AuditFiles/fi156eng04ar_sum_wastetaxation.pdf

Table 41 (continued)

• ***Tackling diffuse water pollution in England (European Water Framework Directive)***[43] • **The United Kingdom National Audit Office (NAO)- 2010** • **Audit of the Environment Agency's progress in tackling diffuse water pollution.**	*Audit findings:* • The Agency has lacked sufficient information on the causes of diffuse pollution. • Little progress has been made in persuading those causing most diffuse pollution to acknowledge their responsibility. • The Agency has limited evidence of the effectiveness of its inspection activity and has been slow to recognise the ineffectiveness of some of the existing sanctions and regulations to tackle diffuse pollution. *Recommendations:* • The Agency should improve local level monitoring. • The Agency should intensify its efforts to raise awareness and change behaviours amongst the farming community. • The Department should consider introducing more flexibility in the method used for assessing applications for grants. • The Agency should develop clear guidance and provide staff with training and greater management support.
Main Objective 2: Auditing the performance of government environmental programs	
• ***Department of Transport: Freight Facilities Grant in England***[44]	*Audit findings:* • The grants were not being fully taken up by industry. • The quantity of freight carried by rail and inland water continued to decrease.

[43] Retrieved from http://www.environmental-auditing.org/Portals/0/AuditFiles/UnitedKingdom_f_eng_Tackling%20Diffuse%20Water%20Pollution.pdf

[44] *Guidance on Conducting Audits of Activities with an Environmental Perspective* (INTOSAI WGEA,2001)

Table 41 (continued)

• **NAO-1996** • **Audit of the government grants which seek to facilitate a transfer of freight from the roads to rail or inland waterway in order to achieve environmental benefits.**	*Recommendations:* • Alternative ways were suggested in which the grants could be administered with greater flexibility to meet industry's needs better and achieve the environmental benefits.
• ***The Office of the Auditor General's investigation into target achievement in climate policy (UNFCCC, Kyoto protocol)***[45] • **The Office of the Auditor General of Norway-2010** • **Audit of the implementation of climate policy.**	*Audit findings:* • The target of wind power production by 2010 was not met. • Energy consumption is increasing in most sectors, rather than declining. • Government does not have good result indicators on energy consumption. *Recommendations:* • Development and deployment of new technology, • Steady funding and efficient subsidies, • Commitment to development and maintenance of infrastructure, • Good strategies for long term planning and conduction, • Adequate performance monitoring system, are required for a sustainable energy sector.

[45] Retrieved from http://www.environmental-auditing.org/Portals/0/AuditFiles/Norway_f_eng_Target%20Achievement%20in%20Climate%20Policy.pdf

Table 41 (continued)

• ***The European Emissions Trading Scheme (ETS) and Its Implementation in the Netherlands***[46] • **Court of Audit of Netherlands-2007** • **Audit of the implementation of ETS in Netherlands.**	*Audit findings:* • Netherlands has properly implemented the EU ETS, though in setting and allocating the total number of CO2 emission allowances, it placed rather too much emphasis on the interests and competitiveness of industry and electricity producers, at the expense of the Dutch Kyoto goal. • The implementation of the trading system was not always transparent. *Recommendations:* • The government should have taken greater account of the other aspects of domestic and foreign Kyoto policy in determining the total amount of emission allowances. • The allocation of CO2 emission allowances should be harmonised more across the EU. • A simpler and more transparent allocation of emission allowances are necessary. • The government should conduct a cost-benefit analysis of every instrument associated with the sustainable energy policy.
Main Objective 3: Auditing the environmental impacts of non-environmental government programs	
• ***Department of Transport: Environmental Factors in Road Planning and Design***[47] • **NAO-1994** • **Audit of how the Dep. of Transport assessed the environmental impact of road building projects.**	*Recommendations:* • To appraise further the global and cumulative effects of road building; • To improve assessment of certain impacts; and • To improve the quantification of the costs of environmental impacts are needed.

[46] Retrieved from http://www.environmental-auditing.org/Portals/0/AuditFiles/Netherlands%20Court%20of%20Audit%20%20CO2%20emission%20trading%20report.pdf

[47] *Guidance on Conducting Audits of Activities with an Environmental Perspective* (INTOSAI WGEA,2001)

Table 41 (continued)

• *Emergency preparedness of Estonia*[48] • **National Audit Office of Estonia-2007** • **The purpose of the audit was to assess the preparedness of Estonia for an emergency arising from bird flu, a flu pandemic, large-scale marine pollution and transportation accidents involving hazardous chemicals and the operativeness of the system of preparation for emergencies.**	<u>*Audit findings:*</u> • In spite of the serious efforts of the ministries, which deserve credit, Estonia is not prepared for bird flu, a flu pandemic, large-scale marine pollution or transportation accidents involving hazardous chemicals at the required level. • The protection of the people, property and environment has not been ensured. <u>*Recommendations:*</u> • The preparation for emergencies requires much more attention and resources. • Amendment of the organisation of preparation for emergencies in such a manner that a ministry in charge would be determined for each emergency (or the Ministry of the Interior be made responsible for any and all emergencies) and granted the rights required for the fulfilment of its duties is inevitable.
Main Objective 4: Auditing environmental management systems	
• *Austrian Federal Railway Environmental Strategy*[49] • **Austrian Court of Audit-1996** • **Audit of the Austrian Federal Railway Environmental Strategy**	<u>*Audit identified a need:*</u> • To survey the environmental risks associated with the activities of the Federal Railway Company, • To identify corrective measures, • To establish priorities among these measures, and • To identify their associated costs.

48 Retrieved from http://www.environmental-auditing.org/Portals/0/AuditFiles/summary_emergency_preparedness.pdf

49 *Guidance on Conducting Audits of Activities with an Environmental Perspective* (INTOSAI WGEA,2001)

Table 41 (continued)

• ***Upkeep of Historic Buildings on the Civic Estate***[50] • **NAO-1992** • **Audit of the performance of several Government departments in maintaining and conserving buildings in current use but which were also of historic interest.**	<u>*Audit drew attention to:*</u> • The need for the Government to play its part in maintaining buildings which are part of the nation's heritage, • Underlining the importance of undertaking full condition surveys, • Keeping up-to-date databases on the state of repair of the buildings, and • Carrying out maintenance to prevent deterioration.
• ***Use of Renewable Energy Sources Potential in Lithuania***[51] • **National Audit Office of Lithuania-2010** • **Audit of the state input into the use of potential of renewable energy sources (RES)**	<u>*Audit findings:*</u> • RES energetic is developed not having revised the National Energy Strategy. • Existing promotion measures are not sufficient for the RES development. • Priority is not attached to increasing 'green' share in RES based energy and this does not allow reducing the country's need for fossil fuel. <u>*It is recommended:*</u> • To revise the National Energy Strategy and some of legal acts regulating this area. • To improve the system for promoting the use of RES. • To increase 'green' share in energy production.

[50] *Guidance on Conducting Audits of Activities with an Environmental Perspective* (INTOSAI WGEA,2001)

[51] Retrieved from http://www.environmental-auditing.org/Portals/0/AuditFiles/Lithuania_s_eng_renewable_energy.pdf

Table 41 (continued)

Main Objective 5: Evaluations of environmental impacts of proposed environmental policies and programs	
• ***Implementation of the Kyoto protocol by the Belgian federal government***[52] • **Belgian Court of Audit-2009** • **Audit of the planning and the evaluation aspects of the federal climate policy and assessment to what extent federal measures were carried out.**	*Audit findings:* • The federal authorities fail to have a federal climate plan. • There is no accurate description of the measures aiming at achieving the Kyoto goals or of their cost. • The carbon reduction objectives are not accounted for or are missing. • Reporting on the policy outcome is insufficient and the federal climate policy has not yet been evaluated. • The federal government cannot comply with its commitment contained in the burden-sharing agreement between the regions *Recommendations:* • A good federal climate plan should clearly determine who is responsible for the implementation, the evaluation and the monitoring. • To evaluate critically all measures in terms of their internal coherence and, if necessary, to adjust them are needed.

[52] Retrieved from http://www.environmental-auditing.org/Portals/0/AuditFiles/Belgium_s_eng_Implementation_of_Kyoto_Protocol.pdf

Table 42: Analyzing the Impacts of Selected Environmental Audits

Environmental Audit of Korea with Performance Approach: Status of Water Quality Management Around Major Four Rivers (2002)[53]	
BAI (The Board of Audit and Inspection of Korea) Recommendations	**Implementation**
Relevant local governments adjust the size of the sewage treatment plants which were being constructed excessively big and revise the design of those to which the old standards were applied.	MOE would rearrange the size and priority of sewage treatment facilities which were then under construction or scheduled to be constructed and it would re-examine the validity of the ongoing construction after on-site inspection.
Ministry of Environment (MOE) adopt a post-project examination and feedback review system where local governments regularly report their own investments and the progress of the projects to MOE. The results of MOE's examination of the reports were to be reflected in the budget process for the next year's projects.	MOE adopted the post-project examination and feedback system as BAI suggested. It was made sure that if a local government does not invest its own share or not use the transferred funds for other purpose than water quality improvement, MOE would cut off financial supports for that local government.
MOE revise the related regulations to specify when to designate the TWSCZ (Tap Water Source Conservation Zone)	MOE decided to rectify the unreasonable legal provisions on TWSCZ designation and polluter regulation in the TWSCZs.

[53] Retrieved from http://www.environmental-auditing.org/Portals/0/kreng05mt_sp_10thwgeameeting.pdf

Table 42 (continued)

Audit of Management of Financial Funds of the Slovak Republic and European Community allocated for Construction of Waste Water Treatment Plants and Sewerage Systems (2004)[54]	
SAO SR (Supreme Audit Office of the Slovak Republic) Recommendations	**Implementation**
Developing more detailed subsidy rules and increasing the financial resources for construction of waste water treatment plants and sewerage systems.	MOE has developed and adopted new directive on subsidy rules concerning the construction of waste water treatment plants and sewerage systems.
Improving interim audits	It is also important that the Ministry of Environment has improved its interim audit following the audit.
Waste Management in Turkey- Assessing National Arrangements and Results of Implementation (2007)[55]	
TCA (Turkish Court of Accounts) Recommendations	**Implementation**
A comprehensive national strategic plan on waste management should be improved and put into practice to lead the implementation.	National waste management strategy has been adopted.
The Ministry (MoEF) should promote its facilities to guide, control and enforce the local authorities and other actors from both public and private sector.	Investments of Municipalities are being supported by the Ministry (% 50 of cost for relevant projects); Private companies have been encouraged to develop recylcying sector.
Other waste hierarchy based recommendations such as minimizing waste, encouraging relevant technologies, effective implementation of fines etc.	Tools for segregation of waste at source have been developed and Municipalities are enforced by the Ministry for implementation.

[54] Retrieved from http://www.environmental-auditing.org/Portals/0/skeng05mt_sp_10thwgeameeting.pdf

[55] Retrieved from http://www.eurosaiwgea.org/Activitiesandmeetings/OtherEUROSAIWGEAmeetings/waste2011/Documents/Turkish%20Experience%20in%20Auditing%20Waste%20Management.pdf

APPENDIX C:

Table 43:EPI Objectives, Policy Categories, Indicators and Weights (% of EPI Score)
Source: EPI Report (2010)

Index	Objectives	Policy Categories	Indicators
EPI	Environmental Health (50%)	Environmental burden of disease (25%)	Environmental burden of disease (25%)
		Air pollution (effects on humans) (12.5%)	Indoor air pollution* (6.3%)
			Outdoor air pollution (Urban Particulates)* (6.3%)
		Water (effects on humans) (12.5)	Access to water* (6.3%)
			Access to sanitation* (6.3%)
	Ecosystem Vitality (50%)	Air Pollution (effects on ecosystem) (4.2%)	Sulfur dioxide emissions per populated land area (2.1%)
			Nitrogen oxides emissions per populated land area* (0.7%)
			Non-methane volatile organic compound emissions per populated land area* (0.7%)
			Ecosystem ozone* (0.7%)
		Water (effects on ecosystem) (4.2%)	Water quality index (2.1%)
			Water stress index* (1%)
			Water scarcity index* (1%)
		Biodiversity & Habitat (4.2%)	Biome protection (2.1%)
			Marine protection* (1%)
			Critical habitat protection* (1%)
		Forestry (4.2%)	Growing stock change* (2.1%)
			Forest cover change* (2.1%)
		Fisheries* (4.2%)	Marine trophic index (2.1%)
			Trawling intensity (2.1%)
		Agriculture (4.2%)	Agricultural water intensity* (0.8%)
			Agricultural subsidies (1.3%)
			Pesticide regulation (2.1%)
		Climate Change (25%)	Greenhouse gas emissions per capita (including land use emissions) (12.5%)
			CO2 emissions per electricity generation (6.3%)
			Industrial greenhouse gas emissions intensity (6.3%)

APPENDIX D:

Table 44: PCA Results for Model (1.3)

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,691
Bartlett's Test of Sphericity	Approx. Chi-Square	488,777
	df	3
	Sig.	,000

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,706	90,206	90,206	2,706	90,206	90,206
2	,238	7,923	98,129			
3	5,61E-02	1,871	100,000			

Extraction Method: Principal Component Analysis.

Communalities

	Initial	Extraction
GDP_2000	1,000	,844
CORRUP	1,000	,955
GOV_EFF	1,000	,907

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component
	1
GDP_2000	,919
CORRUP	,977
GOV_EFF	,952

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Table 45: PCA Results for Model (1.4)

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,633
Bartlett's Test of Sphericity	Approx. Chi-Square	160,121
	df	3
	Sig.	,000

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,217	73,898	73,898	2,217	73,898	73,898
2	,613	20,448	94,346			
3	,170	5,654	100,000			

Extraction Method: Principal Component Analysis.

Communalities

	Initial	Extraction
GDP_2000	1,000	,536
CORRUP	1,000	,854
GOV_EFF	1,000	,827

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component
	1
GDP_2000	,732
CORRUP	,924
GOV_EFF	,909

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Table 46: PCA Results for Model (2.4)

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,719
Bartlett's Test of Sphericity	Approx. Chi-Square	158,246
	df	3
	Sig.	,000

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,706	90,200	90,200	2,706	90,200	90,200
2	,230	7,653	97,853			
3	6,44E-02	2,147	100,000			

Extraction Method: Principal Component Analysis.

Communalities

	Initial	Extraction
GDP_2000	1,000	,846
CORRUP	1,000	,946
GOV_EFF	1,000	,914

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component
	1
GDP_2000	,920
CORRUP	,973
GOV_EFF	,956

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Table 47: PCA Results for Model (2.5)

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,659
Bartlett's Test of Sphericity	Approx. Chi-Square	28,505
	df	3
	Sig.	,000

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,402	80,075	80,075	2,402	80,075	80,075
2	,503	16,758	96,833			
3	9,50E-02	3,167	100,000			

Extraction Method: Principal Component Analysis.

Communalities

	Initial	Extraction
GDP_2000	1,000	,629
CORRUP	1,000	,885
GOV_EFF	1,000	,888

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component
	1
GDP_2000	,793
CORRUP	,941
GOV_EFF	,942

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Table 48: PCA Results for Model (2.6)

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,670
Bartlett's Test of Sphericity	Approx. Chi-Square	66,865
	df	3
	Sig.	,000

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,450	81,658	81,658	2,450	81,658	81,658
2	,432	14,403	96,061			
3	,118	3,939	100,000			

Extraction Method: Principal Component Analysis.

Communalities

	Initial	Extraction
GDP_2000	1,000	,696
CORRUP	1,000	,850
GOV_EFF	1,000	,903

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component
	1
GDP_2000	,835
CORRUP	,922
GOV_EFF	,950

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

APPENDIX E:

TEZ FOTOKOPİSİ İZİN FORMU

ENSTİTÜ

Fen Bilimleri Enstitüsü	[ ]
Sosyal Bilimler Enstitüsü	[X]
Uygulamalı Matematik Enstitüsü	[ ]
Enformatik Enstitüsü	[ ]
Deniz Bilimleri Enstitüsü	[ ]

YAZARIN

Soyadı : ERKAN
Adı : BERNA
Bölümü : ODTÜ-İKTİSAT

TEZİN ADI (İngilizce) : THE ROLE OF SAIs IN PROMOTING SUSTAINABLE DEVELOPMENT: ENVIRONMENTAL AUDITING

TEZİN TÜRÜ : Yüksek Lisans [X] Doktora [ ]

1. Tezimin tamamından kaynak gösterilmek şartıyla fotokopi alınabilir.	[ ]
2. Tezimin içindekiler sayfası, özet, indeks sayfalarından ve/veya bir bölümünden kaynak gösterilmek şartıyla fotokopi alınabilir.	[X]
3. Tezimden bir (1) yıl süreyle fotokopi alınamaz.	[X]

TEZİN KÜTÜPHANEYE TESLİM TARİHİ: .....