

**THE EFFECT OF TRADE LIBERALIZATION ON THE  
ENVIRONMENT: A CASE STUDY OF GHANA**

**BY**

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## DECLARATION

This is to certify that this thesis is the result of research undertaken by Paul Appiah-Konadu towards the award of Master of Philosophy Degree in Economics at the Department of Economics, University of Ghana, Legon.

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## **DEDICATION**

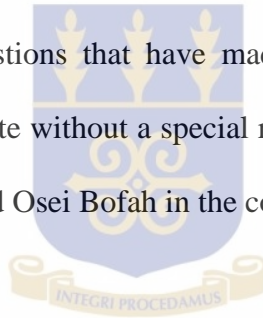
This thesis is affectionately dedicated to my parents- Mr. Adjei Kwasi Samuel and Mrs. Beatrice Appiah for their care, love and immeasurable sacrifices that have facilitated my spiritual and personal development in life.



## ACKNOWLEDGEMENT

My efficiency without God's sufficiency would definitely amount to a great deficiency. I must confess that I would not have been able to come this far without the unceasing grace of the Almighty God. It is on this note that I want to express my profound gratitude to the omnipotent God for seeing me through the stormy times to enable me reach this enviable position in my educational career. I gladly appreciate my dear parents- Mr. Adjei Kwasi Samuel and Mrs. Beatrice Appiah for their precious love, encouragement and unflinching support all through my education. I am most grateful to Mr. and Mrs. Adjei-Tutu for their support in diverse ways that has seen me through my masters degree program.

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## ABSTRACT

This study seeks to contribute to the emerging economic literature on trade liberalization and the environment in developing countries. Using time series data from 1970 to 2010 obtained from the World Development Indicators (WDI) online database, the study applies least squares multiple regression technique to estimate the effect of trade openness on the environment in Ghana. We estimate the composition, scale and technique effect of trade liberalization on Ghana's environment using Carbon Dioxide (CO<sub>2</sub>) emission and Net Forest Depletion (NFD) as proxies for environmental degradation. Our results indicate that trade liberalization has adverse effect on emissions of carbon dioxide as a result of negative scale and composition effects of trade overriding the positive technique effect of trade. This finding appears to confirm the pollution haven hypothesis. However, the effect of trade liberalization on net forest depletion is favourable as a result of the positive scale and technique effects of trade which outweigh the adverse composition effect.

Meanwhile, by testing for and failing to reject the pollution haven hypothesis in the two regression equations, it is suggested that the relocation of pollution intensive industries into Ghana as a result of weak environmental policies could be contributing to Carbon dioxide emissions and the depletion of forest resources in the country.

Based on the results we recommend that further trade liberalization policies in Resource-Rich Developing Countries in Africa should be accompanied by strict enforcement of environmental regulations in order to avert the adverse impact of trade on the environment.

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## CHAPTER ONE

### INTRODUCTION

#### 1.1 Background

Economic growth and environmental sustainability are two key indicators that every country aims to achieve in order to consistently enhance the standard of living of its citizens. Unfortunately, there are difficulties in balancing the trade-off between economic growth and environmental sustainability. Increased production is essential for economic growth but the production process could lead to environmental degradation. Economic growth therefore tends to be associated with a decline in environmental quality (Hanley et al, 2001). Trade liberalization and the environment has become a pertinent issue, especially in the face of globalization. Proponents of trade liberalization drawing mainly from David Ricardo's theory of comparative advantage argue that, liberalized trade increases incomes across countries. Thus, freer trade makes it possible for countries to specialize in the production of goods in which they have comparative advantage, leading to lower per unit cost of production and thereby making more goods available at relatively lower prices than would otherwise be the case. Trade liberalization thus, certainly leads to increased world income. On the other hand, it is argued that the negative environmental consequences of increased output from liberalized trade may outweigh the gains from income (Hanley et al, 2001).

The effects of trade on environmental quality has been classified into three components: how trade affects the overall scale of the economy; how trade affects the techniques of production; and how trade affects the composition of industries (Antweiler et al, 2001; Copeland and Taylor, 2003).

The scale effect reflects the tendency for trade liberalization to create additional output resulting in deterioration of environmental quality. Most forms of pollution are by-products of the production process. Increased trade openness often implies an increase in economic activity. The scale effect, holding constant production techniques and the mix of goods produced, is likely to cause an increase in the level of local and global pollution and also faster degradation of natural resources such as forest reserves. For instance, expanding agricultural exports may increase agricultural activities, which may result in water pollution from extensive fertilizer use and deforestation from increased demand for agriculture lands (Lopez and Islam, 2008). Through the scale effect, the environment is impacted from economic activity in two ways: depletion of natural resources and degradation of the environment (Antweiler et al, 2001).

The technique effect refers to the assertion that, if increased trade raises income, emission intensity may fall since environmental quality is a normal good. Higher income made possible by liberalized trade may lead to stricter environmental regulation, under the assumption that governments are responsive to the citizens' demands for high environmental standards particularly in a democratic regime. A trade-induced rise in incomes would thus make higher environmental quality a possibility (López, Galinato and Islam, 2007). The technique effect explains the tendency for high income nations to value cleaner environment more than low income countries. The effect is indirect. Freer trade leads to increased world income that has been positively linked with a higher demand for a clean environment through the Environmental Kuznet Curve (EKC) hypothesis (Grossman, and Krueger, 1993).

The composition effect identifies the change in the composition of goods produced as a result of increased trade. Trade liberalization may change the composition of an economy's output. If the economy's comparative advantages favour clean industries, increasing trade openness may switch an economy's output from pollution-intensive "dirty" goods to less polluting, or "clean," goods and services. The general assumption is that production of dirty goods is more intensive in natural capital while clean goods production is more intensive in human capital (Lopez and Islam, 2008). Holding the scale of production and other factors constant, an economy that shifts its production toward natural capital-intensive goods will pollute more, and conversely, an economy that shifts its production away from natural capital-intensive goods will pollute less. Countries that have large endowments of natural resources such as Ghana are likely to relatively specialize in resource-intensive industries and thus increase the extraction of natural resources when they open to trade. In countries where property rights on open access resources are poorly defined or where environmental regulations are not properly enforced, increased trade is likely to result in more resource degradation and deforestation (Lopez and Islam, 2008).

The pollution haven hypothesis has been mentioned severally in much of the analysis of the composition effects of trade between rich and poor countries on the environment (Chichilnisky, 1994). The pollution haven hypothesis postulate that trade liberalization shifts pollution intensive industries to countries with relatively weak environmental policies (Hanley et al, 2001).

There is limited empirical evidence in the literature to support the claim of the pollution haven hypothesis that differences in environmental policy are the principal determinants

of the direction of trade. Copeland and Gulati (2004) suggest that other factors, such as capital abundance, technology differences, infrastructure, or distance to major markets seem to be much more important than environmental policy in determining trade patterns. However, even if the pollution haven hypothesis fails to hold, it is worth noting that trade liberalization can shift the development path towards environmentally-intensive activity in some developing countries that have huge natural resource endowments (Chichilnisky, 1994).

Ghana's attempt at implementing trade liberalization policies date back to 1986 during the IMF and World Bank supported Economic Recovery Program (ERP) (Brafu-Insaidoo et al, 2005). The main reason why Ghana embraced liberalized trade policies was to open up the economy to global competition to help enhance efficiency in domestic industries and to increase output growth. The liberalization policies aimed at easing import regulations in order to increase output, more especially in the export sector (Armah, 1993). As part of the liberalization policies, the use of import licences was abolished in 1989 alongside the removal of all forms of quantitative import restrictions. One important trade reform introduced in 1991 was that exporters were no longer required to surrender their foreign exchange receipts to the Bank of Ghana with the exception of gold and cocoa exports (Jebuni et al, 1994).

A direct benefit of these liberalization policies was a rise in the value of Ghana's exports from US\$773.4 million in 1986 to US\$1234.7 million in 1994; an increase in export value of 60% within the first 8 years of trade liberalization (WDI, 2001). Ghana's export value further rose from US\$1234.7 million in 1994 to US\$14377 million in 2011 (WTO, 2012). Under the ECOWAS trade liberalization scheme established in 1990, trade

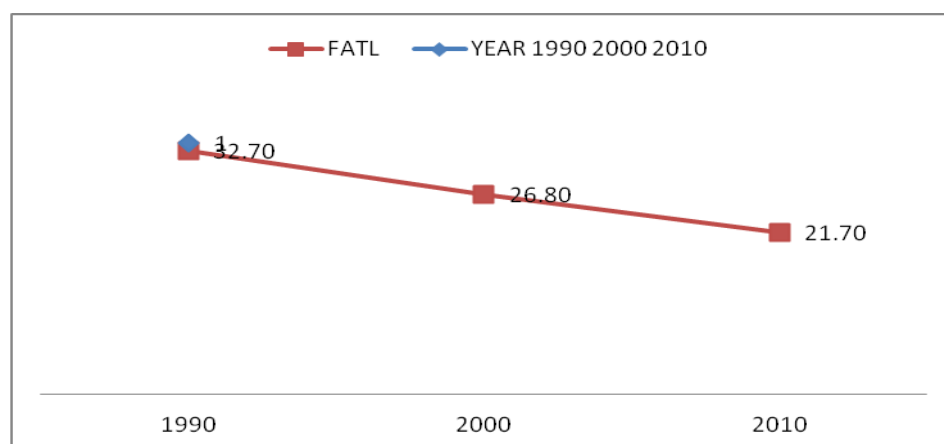
between Ghana and other member countries of the ECOWAS has been increasingly liberalized and thereby enhanced Ghana's trade within the ECOWAS community. In December 2007, Ghana and the European Union signed an interim Economic Partnership Agreement (EPA) which is meant to replace the previous agreement that governed trade and aid relations between the ACP countries and the EU (Brafu-Insaidoo et al, 2005). Under the new agreement (EPA) the negotiations among other things seeks to establish a free trade zone between EU and Ghana for a period of 12 years from January 2008 to the end of the year 2020 which marks the expiration of the Cotonou Partnership Agreement. The EPA includes a package of measures to stimulate trade, investment and innovation in Ghana, and to promote sustainable development, build a regional market for the ACP countries and to help eliminate poverty in Ghana (Nickel, 2012).

Several empirical studies have concluded that trade openness has had a positive effect on GDP growth in Ghana. Notable among these studies are: Ahmed et al, (2000), Edwards (1992, 1998) and Asiedu (2010). However, with Ghana's comparative advantage in the production of natural resource-intensive goods such as cocoa, minerals, forest products, and the oil deposits discovered recently, it is worth considering that the growth in the exports of these goods as a result of liberalized trade may have negative environmental consequences on the country. Thus, a country based analysis of the environmental effects of liberalized trade is justified in order to have a better understanding of the net effects of trade liberalization in Ghana.

## 1.2 Problem Statement

Ghana's integration with the international economy has increased significantly since independence in 1957, aided by substantial liberalization of trade. Ghana's trading pattern has important implications for the environment and use of natural resources. In a resource-endowed country like Ghana, there is a tendency for trade to lead to increased output in environmental resource-intensive goods as a result of higher demand on the international market. The main components of Ghana's exports continue to be gold and cocoa, and cocoa derivative products followed by timber and timber derivative products. In 2006, timber exports contributed 5.5% of Ghana's foreign exchange earnings (DANIDA, 2012). Notwithstanding the importance of timber and forest products to Ghana's economy, its continuous harvest has serious environmental consequences. The illicit harvest of timber and forest products for export and domestic use has led to the rapid depletion of vast areas of Ghana's rain forests. The nation's total forest cover has reduced from 8.2 million hectares around 1900 to less than 1.6 million hectares in 2010, which is even less than the initial 1.76 million hectares reserved as permanent forest estates (Tutu et al, 2008). Figure 1.1 below shows the trends in Ghana's forest cover in the last two decades.

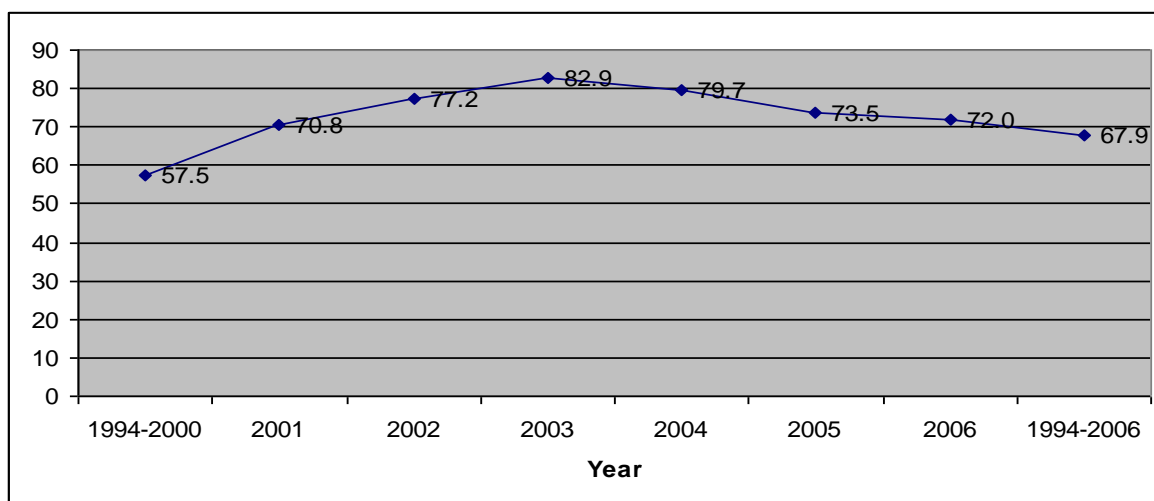
**Figure 1.1: Trends in Forest Area of Total Land Area in Ghana (%) - 1990 to 2010**



Source: *World Development Indicators, 2012.*

The massive deforestation over the years particularly in Ghana's tropical forest zones have weakened the capacity of the country's forest to serve as a major sink for Greenhouse Gases (GHG). In 2000, the total net greenhouse gas emission (including Land Use, Land Use Change and Forestry) in Ghana was estimated as 12.2MtCO<sub>2</sub>e (based on 4 GHG, carbon dioxide, methane, nitrous oxide and per fluorocarbons) (Tutu, 2011a). This was 173% above the 1990 levels of -16.8MtCO<sub>2</sub>e. In 2006, GHG emission level in Ghana was estimated to be as high as 23.9MtCO<sub>2</sub>e. The continuous rise in GHG emission levels in Ghana has been attributed to the rampant depletion of the country's forest stock (EPA, 2011).

Trade has been a significant driver of environmental damage in Ghana through the uncontrolled exploitation of natural resources such as minerals. From the inception of the Economic Recovery Program in 1983 to date, Ghana's mining sector has experienced a considerable investment boom and increased production, particularly in gold output. The lucrative new mining sector policies have yielded a huge foreign investor interest. From 1990 to the end of 1999, the mining sector attracted over US\$3 billion worth of foreign direct investment representing about 60% of total FDI inflows into the country during the period (Akabzaa et al, 2001). From the period of 1983 to 2011, the mining sector of Ghana attracted total FDI of US\$11.5 billion which accounts for about 65% of total FDI inflows into Ghana within the period (GIPC, 2012). Figure 1.2 shows the percentage of total FDI inflows that went to the mining sector in Ghana over the last two decades. From the graph, the share of mining in FDI increased from 57.5% in 2000 to as high as 82.9% in 2003 before dropping to an annual average of 72% in 2006.

**Figure 1.2: Share of Mining in FDI in Ghana from 1994-2006**

Source: Daniel Twerefou, 2010

The relatively high FDI inflows into the mining sector have led to a dramatic increase in the output of minerals in Ghana over the last few decades. Despite the fact that the boom in the mining sector has generated high tax revenues and foreign exchange earnings, there is growing unease with regard to the real benefits accruing to the ordinary Ghanaian in the mining communities and to the country as a whole. In all the mining areas of Ghana, the environment is undergoing rapid degradation and its immense economic value keeps on dwindling from year to year mainly as a result of the heavy concentration of mining activities in these areas. Agricultural lands are not only being degraded, but the decrease in land for agricultural production has also resulted in a shortening of the fallow period from 10-15 years to 2-3 years (Hilson, 2002). The traditional bush fallow system, which adequately recycled substantial amounts of nutrients and made the next cycle productive, can no longer be practiced due to inadequacy of land. Large-scale mining activities generally continue to reduce the vegetation of the mining areas to levels that are destructive to biological diversity (Akabzaa et al, 2001). The principal elements of the environment: land, water and air

have been severely impacted by mining operations. The continues viability of these elements to support the well-being and development of the rural populations in the mining communities such as Tarkwa, Obuasi, Prestea and the like is currently in doubt (Hilson, 2002).

More so, the intensive trade liberalization policies adopted under the Economic Recovery Program of 1983 has resulted in a massive growth in imports over the last three decades. Imports as a percentage of GDP which stood at 3% in 1982 rose significantly to 68% in 2000 before declining slightly to 47% in 2011. The total value of imports in Ghana increased from \$2.2billion in 2000 to \$15.32billion in 2011 (WDI, 2012). Aside the implications of the high and ever rising import levels on Ghana's trade balance, an issue of great concern is the increase in the imports of environmentally-sensitive products such as used vehicles, fossil fuels, second-hand electrical and electronic equipment and plastic materials. According to the UN Commodity Trade Statistics (2012) electrical and electronic equipment accounted for 17.9% of Ghana's total imports in 2011 out of which 70% were used products and about 30% being near-obsolete (e-waste). Vehicles and transport equipment was 12.6% while oil and other petroleum products took 9.7% of overall imports. Despite the concerns raised by various stakeholders on the negative environmental effects of plastic waste in Ghana, plastic materials made up 3.9% of total imports in 2011.

Empirical and conceptual analyses suggest that trade has contributed to economic growth and has accelerated trends to reduce significantly local air pollutants particularly those affecting cities. Several empirical studies seem to confirm the notion that the positive-technique effect dominates the other effects for certain local urban pollutants resulting in

trade being good for the urban environment (Copeland and Taylor 2003). Trade however, does not seem to mitigate the ever increasing emission of global pollutants, particularly carbon dioxide (Lopez and Islam, 2008). The few studies that focused on the links between trade and the green environment suggest that increased trade appears to exacerbate the losses of natural resources particularly forests and other natural habitats, thus aggravating the trends toward global climate change and loss of biodiversity (Lopez and Islam, 2008). Motivated by the ensuing contradiction in the literature, this study seeks to find out the overall effect of trade liberalization on the environment in Ghana. Research questions that arise are:

- i. What is the relationship between trade openness and environmental quality in Ghana?
- ii. What are the directions of the scale, the composition and the technique effects of trade on the environment in Ghana?
- iii. Does the pollution haven effect hold in the case of Ghana?
- iv. What win-win policies will help enhance the trade-environment relationship in Ghana?

### **1.3 Objectives of the Study**

The overall objective of the study is to find out the extent to which trade liberalization affect environmental quality in Ghana. In more specific terms, the study seeks to achieve the following objectives:

- i. To establish the relationship between trade openness and environmental quality in Ghana.

- ii. Determine the direction of the scale, the composition and the technique effects of trade on the environment in Ghana.
- iii. Prove whether the pollution haven effect prevails in Ghana.
- iv. Provide policy recommendations that will help enhance the trade-environment relationship in Ghana.

#### **1.4 Testable Hypothesis**

The study will carry out a test on the following hypothesis:

**Null hypothesis:** Trade liberalization has a significant impact on environmental quality in Ghana.

**Alternative hypothesis:** Trade liberalization does not have any significant impact on environmental quality in Ghana.

#### **1.5 Justification for the Study**

The collection of empirical evidence on the relative impacts of the scale, composition and technique effects of trade liberalization on the environment is scarce and largely limited to developed countries (Feridun et al, 2006). More so, the few existing studies on the trade- environment relationship in developing countries obtained mixed results and in most cases contradicts the theoretical conclusions (Chua, 1999). While these studies provide insights into the trade-environment relationship in developing countries, they fail to properly measure the scale, composition and technique effects of trade on the environment. This study will therefore provide useful evidence on the relative impacts of the scale, composition and technique effects of trade intensity on the environment in Ghana. The study in effect will provide a critical framework to facilitate a proper review of the environmental effects of international trade agreements such as the EPA between

Ghana and the EU to better streamline environmental goals in the EPA and in future trade agreements. The study will also provide thoughtful recommendations to enhance environmental policy formulation and analysis in Ghana and the developing world as a whole.

### **1.6 Limitations of the Study**

The study could not account for the effect of trade openness on other relevant measures of environmental degradation such as nitrogen oxide (NO<sub>2</sub>), sodium oxide (SO<sub>2</sub>) and Biochemical Oxygen Demand-BOD (a measure of pollution of water bodies) as a result of data limitations. The data for all the variables of interest in the study retrieved from the World Development Indicators (WDI) database was up to 2008 and did not cover 2009 and 2010 which are part of the study period.

### **1.7 Organization of the Study**

The study is organized into six main chapters with each chapter further divided into sections. The first chapter deals with the general introduction to the study. Chapter two is dedicated to a review of both the theoretical and empirical literature on trade, trade liberalization and its effects on the environment. Chapter three presents the trends in trade openness and trends in environmental quality indicators in Ghana. Chapter four focuses on the development of the methodology used for the study. Chapter five covers the analysis and discussion of the empirical results of the study. The sixth chapter contains the summary of findings, policy implications, recommendations and conclusion of the study.

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

This chapter focuses on the review of relevant literature on trade and the environment. The chapter consists of two broad sections. The first section reviews the theoretical literature on trade and the environment with emphasis on the traditional explanation of the economic justification of trade, trade-environment relationship and an elaborate description of the scale, composition and technique effects of trade on the environment. Section two presents a review of empirical studies on trade liberalization and then environment.

#### **2.2 Theoretical Literature**

##### **2.2.1 Economic Justification of Free Trade**

In economics, the law of comparative advantage refers to the ability of a party (an individual, a firm, or a country) to produce a particular good or service at a lower opportunity cost than another party. It can be contrasted with absolute advantage that refers to the ability of a party to produce a particular good at a lower absolute cost than another. Comparative advantage explains how trade can create value for both parties even when one can produce all goods with fewer resources than the other. The net benefits of such an outcome are called gains from trade. Traditional economic theorist lauded the gains from free trade that could accrue to individual countries when they specialize in the production of commodities which they produce at least cost (have comparative advantage), and engage in trade to meet their other needs. The concept of Comparative advantage refers to a higher relative efficiency in the production of a particular good in one country as opposed to another. The early advocates of free trade as

“the engine of growth” and a catalyst for economic development predicted that an economy will tend to be relatively effective at producing goods that are intensive in the factors with which the country is relatively well endowed. Specifically, David Ricardo’s theory of comparative advantage postulates that when nations specialize, they become more efficient in producing a product and thus, if they can trade for their other needs, the country under consideration and the world as whole benefits. The theory of comparative advantage arises from the nineteenth century free trade models associated with the works of Adam Smith, David Ricardo and John Stuart Mill, which have been modified by trade theories embodied in the factor proportions or Heckscher–Ohlin Theory (1933) and Stolper-Samuelson (1941).

### **2.2.2 Heckscher-Ohlin (H-O) Theory of Trade**

The Heckscher-Ohlin (H-O) theory of trade, otherwise known as the neoclassical factor endowment model postulates that trade is necessary because of the differences in labor productivity in different countries. An essential assumption underlying this model is that labour productivity is fixed for different commodities in different countries. According to this theory, the justification for trade is not because of inherent technological differences in labor productivity for different commodities between different countries but because countries are endowed with varying factor supplies. Given relative factor endowments, factor prices will differ (thus, labor will be relatively cheap in labor-abundant countries) and likewise domestic commodity price ratios and factor combinations. The H-O theory depicts why resource-abundant (for instance, labor-abundant) Less Developed Countries (LDCs) are into the production and export of labor-intensive commodities in return for imports of capital-intensive goods because of their relative cost and price advantage enhanced by international specialization. Trade,

according to the H-O theory therefore serves as an avenue for a nation to take advantage of its abundant resources through more intensive production. What this theory suggests is nothing short of free trade which is equally affirmed in the Hecksher-Ohlin-Samuelson (H-O-S) model.

### **2.2.3 Hecksher-Ohlin-Samuelson (H-O-S) Theory of Trade**

The Hecksher-Ohlin-Samuelson (H-O-S) model is a development of the H-O principle. This model shows how a rise in the price of a commodity can raise the income of the factors of production used most intensively in producing that good. Samuelson's factor price equalization theorem explains the conditions under which free trade in commodities narrows differences in commodity prices between countries, and in doing so the incomes of the factors of production are also brought in line. In other words, free trade offers a substitute for the free movement of factors of production across borders. According to the H-O-S model, free mobility of factors of production can lead to national resource movement from places of abundance to places of relative scarcity, and thereby regularize factor prices across all countries to promote efficiency in resource usage.

### **2.3 Trade-Environment Relationship**

Proponents of free trade argue that increased trade will lead to increased world income. However, it is argued that intensive trade has environmental consequences that may outweigh the gains from income. It is also argued that free trade worsens the already existing environmental problems of economic activity. This takes the form of depleted non-renewable resources or harmful emissions. Besides, trade ignores the social costs of environmental degradation; and it is for this reason governments regulate industry and

impose trade restrictions. Comparative advantage is the hallmark of free trade but it is argued that seeking this advantage can lead to further environmental degradation (Pan-Long Tsai, 1999). A number of hypotheses have been developed to explain the trade-environment nexus. These are: the Pollution Haven Hypothesis, the Factor Endowment Hypothesis, the Environmental Kuznet Curve (EKC), and the Porter Hypothesis.

### **2.3.1 Pollution Haven Hypothesis**

The “Pollution Haven Hypothesis” claims that countries with less stringent environmental regulations will attract pollution-intensive industries when they adopt trade liberalization policies. This hypothesis postulates that costs of production will be less in those countries with more lenient environmental standards, and as a consequence attract potential producers of pollution-intensive goods should such countries open up to free trade. The pollution haven hypothesis further asserts that governments in most developing nations are hesitant to place strict environmental standards on their firms in order to boost the competitiveness of local firms in the global market. According to the pollution haven hypothesis, most developing countries experience deterioration in environmental quality when they open up to trade mainly as a result of ineffective environmental regulations (Hall, 2003; Busse, 2004).

### **2.3.2 Factor Endowment Hypothesis**

The Factor Endowment Hypothesis contends that with trade liberalization, individual countries will tend to produce and export goods for which they have large resource endowments. Thus, countries that have enormous endowments of natural and material resources are very likely to specialize in resource-intensive industries and thus increase the extraction of natural resources when they open up to trade. This hypothesis further

argues that in countries where property rights on common property resources are not well defined or where environmental standards are not properly enforced, trade openness is likely to result in more resource degradation and deforestation. Even more seriously, lack of property rights on resources may lead countries to specialize in the production and export of natural resource-intensive activities and hence further-up environmental degradation even if they are not richly endowed with natural resources. The central point of the factor endowment hypothesis is that, the institutional and regulatory failures in a nation may lead to false comparative advantages, in which case trade may reduce rather than raise income as is normally assumed under the Environmental Kuznet Curve Hypothesis, and thereby result in further deterioration in environmental quality (Lopez and Islam, 2007).

### **2.3.3 Environmental Kuznet Curve (EKC)**

Grossman and Krueger (1995) identified an inverted U-shape relationship between trade-induced income growth and environmental degradation which has been termed as the Environmental Kuznet Curve (EKC). The EKC depicts an inverted U-shaped relationship between income growth and environmental degradation: as income increases, environmental degradation first increases until it reaches a turning point and then begins to decline. Trade plays a significant role in the conceptual explanations of the EKC. The income effect theory identifies environmental quality as a normal good whose demand increases with any increase in income levels. The ideological underpinning of the EKC is that, as an economy grows, the benefits of increasing output are so large at the early stages of the growth process such that they dominate the increased demands for environmental quality caused by a higher income and thus the scale effect dominates leading to a rise in environmental degradation. Beyond a certain

level of income, the marginal utility for more consumption declines and the preference for clean environment increases until the turning point occur. Environmental degradation falls as income increases beyond the turning point. What trade does is to enhance the process of economic growth through increased output and thus has an indirect effect on the EKC.

#### **2.3.4 Porter Hypothesis**

A recent hypothesis, called the Porter Hypothesis, proposes that in an era of free trade, environmental regulations or trade standards are beneficial to both the environment and competitiveness. The hypothesis opposes the standard view of free trade and the environment as a trade-off. The hypothesis claims that countries that “go green,” will have a competitive advantage in trade for two reasons: the first is that regulation or trade standards will compel local firms to become aware of alternative methods of production that may be more efficient. The second is that because of the tendency for regulation to become more restrictive, firms that have already adjusted to the changes will have an initial comparative advantage against firms adjusting for the first time. Critics of the argument counter that; rational firms will not require environmental regulations to prompt research into more efficient production. Their other critique is that in the event that regulations are not tightened, the firm that adopted more environmentally friendly standards will be at a competitive disadvantage with trade liberalization (Hanley et al, 2001).

#### **2.3.5 Antweiler’s Decomposition**

Antweiler et al. (2001) made a holistic attempt at explaining the impact of free trade on the environment. They decomposed the full impact of openness or trade liberalization on the environment into **scale**, **composition**, and **technique** effects. The scale effect states

that trade liberalization leads to increased output thereby worsening existing environmental problems. The argument is that most forms of environmental problems result from a production process, and trade openness often results in increased output. The scale effect, holding constant production methods and the composition of goods produced, is likely to result in an increase in the level of local and global pollution and also faster depletion of natural resources. For instance, expanding agricultural exports may increase agricultural activities, which may result in water pollution from extensive fertilizer use and deforestation from increased demand for agriculture lands. The scale effect may also include trade related direct increases in pollution emissions through increase in air and road transportation. In the literature, gross domestic product (GDP) per square kilometer is usually used as a proxy for the scale effect. Given the more lenient attitude of governments in developing countries towards rural environmental degradation and global pollutants than to urban local pollution, the negative impact of the scale effect is likely to be worse for the green-global environment than for the urban environment.

The technique effect refers to the tendency for emission intensity per unit of output to reduce as income levels increase. The technique effect often leads to improvement in environmental quality in high income countries as opposed to low income countries in a free trade regime. Most economists accede to the fact that trade liberalization raises income; with a rise in income levels, emission intensity may fall given that environmental quality is a normal good. A normal good is a good for which as incomes rise, individuals demand more of it. Higher income may facilitate stricter environmental regulation, under the assumption that country governments are responsive to the citizens' demands for high environmental standards. A trade-induced rise in incomes would thus

make higher environmental quality a priority. Empirical studies often use per capita GNP as a proxy for income. The strength of the technique effect is weaker for the green and global environment than for the local urban environment because the citizens' demands for environmental quality are likely to be feebler in the rural areas and for global pollutants than for the control of local urban pollutants (López, Galinato and Islam 2007). Increased urbanization is seen as a significant factor that increases citizens' demands for environmental quality and thereby leads to improved environmental standards when a nation opens up to trade (Maccarney et al, 2005).

The composition effect of trade reflects a change in the constituents of an economy's output when it opens up to trade. If an economy's comparative advantages are inclined to clean industries, increasing trade openness may lead to a switch from pollution-intensive "dirty" goods to less polluting, or "clean," goods and services. The general assumption is that production of dirty goods is more intensive in natural capital while clean goods production is more intensive in human capital. Holding the scale of production and other factors constant, an economy that shifts its production toward natural capital-intensive goods will pollute more, and conversely, an economy that shifts its production away from natural capital-intensive goods will pollute less. Countries that have large endowments of natural resources are likely to relatively specialize in resource-intensive industries and thus increase the extraction of natural resources when they open to trade. In countries where property rights on resources are poorly defined or where environmental regulations are not properly enforced, increased trade is likely to result in more resource degradation and deforestation. In the literature, capital-labour ratio has been used widely as a proxy for measuring output composition (López, and Islam 2007).

Although the theories discussed above allow for identification of free trade impacts on the environment, it should be noted that the exact overall directional impact of trade liberalization on the environment is not easily determinable from the preceding theories.

## **2.4 Empirical Literature Review**

Empirical studies abound in the literature to explain the environmental effects of trade liberalization. Doganer et al, (2010) applying a structural model on a sample of 34 OECD countries, reports that trade liberalization leads to a significant reduction in air pollution in the study countries through an increase in the importation of environmental goods. Frankel and Rose (2005) used cross-country data to find out the effect of trade on a country's environment, for a given level of GDP. Results of their study for three measures of air pollution show that openness tends to reduce sulphur dioxide (SO<sub>2</sub>), nitrogen oxide (NO<sub>2</sub>), and particulate matter emissions. A cross-country study by Copeland and Taylor (1994) reveals that trade openness reduces the pollution level in industrialized countries (mostly OECD countries) but increases the pollution level in most developing countries and thereby increases worldwide pollution. The finding of this study supports the pollution haven hypothesis. Tsurumi and Managi (2011) explored the effect of trade openness on deforestation for 142 OECD and non-OECD countries using a dynamic panel model. The findings of their study reveal that an increase in trade openness increases deforestation for non-OECD countries while slowing down deforestation for OECD countries. This study gives credence to the possibility that the composition and technique effects of trade have a negative impact on deforestation in developing countries, whereas the opposite holds in industrialized countries.

A general approach to measuring the effect of trade liberalization on the environment is to investigate whether there is a systematic relationship between openness to trade and environmental quality. Several of the empirical studies on the trade-environment relationship- Grossman and Krueger (1993) and Gale and Mendez (1998) include openness to trade as an explanatory variable to explain pollution levels. These studies find that openness is either insignificant or has a positive effect on environmental quality. Frankel and Rose (2001) used a similar approach, but controlled for the endogeneity of openness to trade. They also find a positive effect of openness on environmental quality. Birdsall and Wheeler (1992) in their empirical study on Latin American countries, sort to establish whether greater openness, in terms of trade intensity and FDI inflows, are associated with the development of pollution-intensive sectors in Latin American Countries. The results of the study reveal that with trade liberalization, higher environmental standards of industrialized countries are transferred to developing countries. According to Birdsall and Wheeler, countries with more trade openness experience faster growth in clean industries than countries that have more regulated trade regimes. These studies purport that on average, trade does not systematically worsen environmental quality. However, they have a couple of important weaknesses. First, they all focus on only a small number of pollutants. Second, they do not account for heterogeneity across countries in the response to the environment and trade. Thus, if some countries have a comparative advantage in natural resource intensive goods and others in human capital intensive goods, a given study may indicate that on average, trade does not have much of an effect on the environment. But this may mask significant effects on individual countries.

Maccarney and Adamowicz (2005) seeking to deal with the heterogeneous effects in individual countries, used panel data across selected industrialized and developing countries to estimate econometric models to predict the effects of openness on organic water pollutant (BOD) and carbon dioxide (CO<sub>2</sub>) emissions. They dealt with the heterogeneity problem by controlling for different national characteristics in the study countries. This allowed them to make comparisons on how different national characteristics influence the environmental impact of freer trade. The findings of the study indicate that trade liberalization significantly increases emissions of both pollutants, thus reducing environmental quality. By testing the effects of democratic versus autocratic governance, the study reveals that while greater democracy can induce significant reductions in BOD emissions as openness increases, it may also lead to increased CO<sub>2</sub> emission levels. Meanwhile, by testing for and failing to reject the pollution haven hypothesis, the study suggests that environmental gains from openness in relatively rich countries may be coming at the expense of environmental degradation in poorer countries. This finding gives credence to the pollution haven hypothesis.

Even though cross country panel models are useful in controlling for heterogeneous effects in individual countries, they may still mask significant effects on individual countries. Thus, if some countries have a comparative advantage in natural capital intensive goods and others in clean goods, then we may well find that on average, trade does not have much of an effect on the environment. We therefore present below a review of some individual country case studies on the trade-environment relationship.

Mani et al, (2006) in a study of the environmental impacts of free trade in Vietnam reports that trade liberalization leads to increasing manufacturing and export activity in

water and toxic pollution-intensive sectors compared to the less pollution-intensive sectors. The study further reports that free trade has resulted in changing composition of Vietnamese production and exports away from traditional sectors and towards pollution-intensive manufacturing (especially leather and textiles). Madrid-Aris (1998) analyzed the effects of trade liberalization under the North American Free Trade Agreement (NAFTA) on hazardous wastes for Mexico. The findings of this study lead to the conclusion that the relationship between trade liberalization and pollution is positive thus making trade liberalization detrimental to the environment.

In a study by Beghin and Poitier (1995), they analyzed the impact of trade reforms in Chile's unilateral liberalization on different pollutants without making a distinction between scale, composition and technique effects and came to a conclusion that trade liberalization would lead to between a 2.8% and 19.9% increase in pollution levels. Walter (1974) reports that trade liberalization by increasing the economic growth rate without stringent environmental regulations, results in high demand for all kinds of resources and production of materials. According to Walter, this huge demand puts excessive pressure on environmental resources and thereby increases environmental degradation, especially in low-income developing countries. Concerning effects of international competitiveness, He observed that some developing countries endowed with natural resources specialize in natural capital intensive goods in order to achieve competitive advantage. The findings of Walter's study support the factor endowment hypothesis. Some economists from the trade community have therefore pointed out that "trade liberalization lowers the pollution level in the North (mostly OECD countries) but increases the pollution level in developing countries such as Ghana and increases worldwide pollution" (Copeland and Taylor, 1994).

In examining the environmental impacts of North American Free Trade Agreement (NAFTA), Grossman and Krueger (1991, 1995), identify three effects which serve as the basis for the analysis of the effects of economic change on the environment: scale effect, composition effect and technical effect. While all of the empirical studies discussed above provide insights into the trade–environment relationship, they fail to properly measure the three types of effects (Scale, composition and technique) of trade liberalization on the environment.

A study by Werner Antweiler, Brian Copeland, and M. Scott Taylor in 2001 examined the relative strength of the three aforementioned effects in some selected major cities in the world and concluded that free trade is good for the environment. They reviewed sulphur dioxide concentrations in those cities and compared the levels to the scale of economic activity. They looked for relative impacts of the scale, composition, and technique effects. Econometric analysis was used to differentiate between each effect. Their research reveals a negative correlation between economic activity and concentration levels. Specifically they found the technique effect dominant over the scale effect. They reported that a 0.25% increase in scale of production results in a 0.5% sulphur dioxide increase. However, for each 0.25% increase in activity, a 1.25%-1.5% decrease in sulphur dioxide levels was observed. To sum up, the results reflect lower pollution levels with trade. Composition effects revealed little significance regarding environmental consequences. Changes in production seemed to be impacted much more significantly as a result of capital stock according to this study. Noting this, they still found the composition effect of free trade on the environment to be negative. This emphasis on relative capital stock supports the factor endowment hypothesis. Their findings support the theory that free trade leads to better environmental quality.

Another analysis was produced by Dean (1999) in China and also concluded that free trade benefits the environment. Her study used Chinese water pollution data. Dean's model allowed her to analyze the effects of relative price change and income change. Relative price changes reflect the composition effect as the production of goods change as a result of free trade. Dean found a negative composition effect, a noticeable negative scale effect, and a beneficial technique effect. A major variable in her analysis was the increased state ownership that she had to control for. State owned firms were held to higher environmental standards and consequently reduced the impacts of all the trade liberalizing effects. Nonetheless, controlling for this variable, Dean found the technique effect to outweigh the negative scale and composition effects and thereby affirming the notion that free trade leads to improvement in environmental quality.

Beghin and Poitier (1995) analyzed the effects of free trade on the environment in Mexico with better terms of trade with the US, Canada and Mexico on various pollutants. The findings of this study reveals a positive scale effect of trade liberalization on pollution whereas the other effects (composition and technique) were found to be negative and thereby making the overall pollution effect of liberalization negative. In another study, Strutt and Anderson (1999) modeled the impact of trade reforms on various pollutants in Indonesia as a result of the application of the General Agreement on Trade and Tariffs (GATT) Uruguay Round trade reforms and the Asia-Pacific Economic Cooperation (APEC) Most Favored Nation trade provisions. They concluded that the scale effects of trade had a detrimental effect on the environment in both cases, although the composition effects of trade liberalization overrides the scale effects and make the total effect of liberalization on the environment positive.

In an empirical study of the impacts of trade reforms on the environment, Vukina et al. (1999) examined the relationship between trade policy reforms and composition of pollution in output in the former Socialist Economies. They used information on 13 pollutants and the energy intensity of output. The study reveals that, “policy reforms affecting price liberalization, trade and the foreign exchange system have a beneficial effect on the composition of manufacturing output shifting it towards less-polluting sectors.” The authors associate this improvement in composition to environmental policy reforms that accompany trade reforms. The study reports a large and negative scale effect in most of the study countries. The authors find that in addition to policy induced reduction in pollution; large scale decreases in economic activity also lead to large reductions in pollution.

Strutt and Anderson (2000) undertook a comprehensive applied general equilibrium analysis of both WTO-based trade policy reform, and trade policy reform slated for Indonesia under the APEC. They first simulated a base case scenario in which Indonesia grows over the next decade under the current trade regime. Pollution rises. This reflects a combination of industrialization and growth in the context of a relatively weak environmental policy regime. They then simulated a scenario in which Indonesia grows in the context of trade policy reforms. Pollution still grows, but less than in the previous scenario. Moreover, the study reports that there is less depletion of natural resources with trade reforms. This is because the composition effect of trade liberalization on pollution is negative. They therefore conclude that trade liberalization shifts the growth path to relatively cleaner production

Majority of the studies above mostly on industrialized nations found the sum of the scale, composition and technique effects of free trade to benefit the environment. In the words of Chua (1999) the collection of empirical evidence on the relative impacts of the scale, composition and technique effects as well as the gross effects of trade liberalization on the environment is largely limited to developed countries. However, the few studies that have been undertaken in Ghana and Sub-Sahara Africa as a whole on the relative impacts of these three effects obtained mixed results.

Feridun et al, (2007) using time series data investigates the impact of trade openness on pollution and forest resource depletion in Nigeria. GDP per square kilometer, capital-labour ratio and GNP per capita are used as measures of the scale, composition and technique effects respectively. Results of this study indicate that pollution is positively related to trade intensity and real GDP per square kilometer, while capital-labour ratio and GNP are negatively related to pollution. In addition, the study provides strong evidence to suggest that trade intensity, real GDP per square kilometer and GNP are positively related to environmental degradation indicating that the technique, scale, and total effects of liberalization are detrimental to the environment. The composition effect of trade liberalization on natural resource utilization, on the other hand, is beneficial but overshadowed by the adverse scale and technique effects making the overall effect of trade liberalization on the environment in Nigeria negative. López (1997) finds that trade liberalization has a negative effect on biomass in Ghana due to a large adverse scale effect of increased output and a negative composition effect of free trade. In contrast, López (2000) finds that trade liberalization has a positive effect on biomass in Côte d'Ivoire. This study reports that a positive composition effect resulting from trade

liberalization outweighs the negative scale effect resulting in a positive effect of trade liberalization on environmental quality in Côte d'Ivoire.

Our survey shows that the impact of trade liberalization on the environment casts doubt on the well-known gains from trade argument particularly in the developing world. The literature is divided into two schools of thought with conflicting views on the long-run impact of trade liberalization on the environment; with a common point that the immediate (or short-run) effect will be negative. Some authors suggest that trade liberalization will generate more economic growth and higher income, and that will increase demand for environmental quality. Others question this view, and argue that higher growth without environmental provisions will increase environmental degradation even more, especially in a developing country such as Ghana. Given the contradictions in the literature concerning the trade-environment relationship and the direction of the scale, composition and technique effects of liberalized trade, the present study seeks to provide fresh evidence on the direction and the relative intensities of the three effects of liberalized trade on environmental quality and the overall effect of trade liberalization on the environment in Ghana.

## CHAPTER THREE

### OVERVIEW OF TRADE AND THE ENVIRONMENT IN GHANA

#### 3.1 Introduction

This chapter presents the overview of trade policies and the environment in Ghana. It is organized into two broad sections. The first section presents the history of trade liberalization and trends in trade indicators in Ghana. The second section presents the trends in environmental quality indicators in Ghana.

#### 3.2 Trade Liberalization in Ghana

The literature on trade liberalization in Ghana is extensively discussed in Ocran et al, (2006) and Brafu-Insaidoo et al, (2008). Ghana's first experience with a fairly liberal trade regime was between 1950 and 1961. During this period, Ghana was a member of the sterling zone. The sterling zone comprised of a group of countries that kept most of their exchange reserves at the Bank of England and, in return, had access to the London capital and money market. In the late 1960s, besides the United Kingdom and its few remaining dependencies and protectorates, the sterling area consisted mainly of countries then or formerly part of the Commonwealth. There were comparatively no restrictions on payments to and from member countries but payments to countries outside of the sterling zone were restricted. Substantial increases in government spending with high import content resulted in huge budget deficits in Ghana and a quick drain of the country's foreign exchange reserves. The response to this was the introduction of foreign exchange controls coupled with comprehensive import licensing in 1961.

The ever-increasing trade restrictions further depleted foreign exchange reserves, compelling the government to resort to increased external borrowing. The controlled regime continued until July 1967, which saw the beginning of a liberalized import

regime. Under the liberalized import regime in 1967, the domestic currency was devalued by about 43% and import duties on some selected items were reduced. The rapid increase in government expenditures and imports through the open general license caused the balance of payments position of the country to deteriorate. Alongside this, there was an upsurge in inflation, which eroded the gains from devaluation and cheapened imports because of real exchange rate appreciation. With an upsurge in government's budget deficit in 1971 and 1972, a substantial rise in domestic prices eroded import taxes and export subsidies. Over the same period, world cocoa prices also fell, thereby worsening the country's trade balance and depleting foreign exchange reserves. The end result was a political overthrow and resort to control measures in 1972, thus completing the first cycle of Ghana's trade policy.

Between 1972 and 1982, trade policy in Ghana was characterized by strict import controls. The major features of this regime included the revaluation of the domestic currency by 26%, resort to import controls including use of import licences as the main instrument and the maintenance of exchange controls. Others were the wide variations in import duties and frequent changes in import taxes aimed basically at revenue generation. These wide variations in import duties made tax evasion possible through misclassification of imported goods. By 1982, import volumes, cocoa export volumes and real government revenue had fallen to their lowest levels since 1960. The economy suffered severe foreign exchange constraints and a general deterioration in most economic fronts. These conditions necessitated the resort to trade reforms in 1983 with the long-term goal of replacing quantitative trade restrictions with price instruments and creating a more liberal trade regime.

### **3.2.1 Trade Liberalization under Economic Recovery Program**

Trade liberalization under the Economic Recovery programme since 1983 has been categorized into three phases. These are: the period of attempted liberalization or transition to import liberalization; the period of import liberalization; and the period of liberalized trade regime. The period of attempted liberalization or transition to import liberalization covers the years 1983–1986. This period was characterized by the introduction of a system of bonuses and surcharges, and their later replacement by frequent nominal devaluations. Import tariff rates were adjusted downward, but the range of rates with the import licensing system and import programming were maintained. Aside from these, the period witnessed a decline in export tax rates that was greater than the decline in the import tariffs. The period of import liberalization ran from 1986 to 1989. This period was characterized by the introduction of a formal dual exchange rate system, which was later unified into a single exchange rate system based on auctioning and a further liberalization of the exchange rate. Other features of this phase of the liberalization process included a redefining of the import licensing categories, a reduction of the import tax schedule and a reduction in the sales taxes on imported goods by 10 percentage points.

The foreign exchange retention scheme was liberalized in 1987, whilst the cocoa export tax rate (made up of the ratio of cocoa duties to cocoa export earnings) was reduced. A liberalized trade regime has been in place since 1989. This period has been characterized by a replacement of retail auctioning with wholesale auctioning in the foreign exchange market in 1990, abolishing of the import licensing system, decline in import tax rates on raw materials and capital goods, and reduction in sales tax on imported basic consumer goods. Over this same period, protective duty rates were introduced for specific goods in

1990 and 1994, and the export retention scheme has been phased out. The most-favoured nations (MFN) tariffs apply on most imports, except those from ECOWAS member countries, which have attracted duty-free rates since 1996.

Under the ECOWAS trade liberalization scheme established in 1990, Ghana initially provided preferential tariff reductions of 20% on imports of a few goods from some countries that had been granted community status. Products from member states that qualified for preferential treatment attracted rates of 8%, 16% and 20%, whilst similar items from other countries attracted duty rates of 10%, 20% and 25%, respectively. Since 1996, however, most imports from member countries have attracted duty-free rates. Ghana provides duty-free preferences on a range of unprocessed agricultural products and several industrial products imported from producing enterprises, cited within member countries, and that are eligible to receive such preferential treatment. Eligibility is based on whether the imports meet ECOWAS rules of origin and have sourced at least 60% of their raw materials from within the Community.

Over the last decade, Ghana has continued to implement trade liberalization reforms, though at a somewhat slower pace. Ghana's applied tariff consists of four bands (zero, 5%, 10%, and 20%). This structure applies to all goods except for 13 petroleum products, which face specific tariffs. The average applied Most Favoured Nations (MFN) tariff in 2007 was 12.7%, down from 14.7% in 2000. MFN rates on agricultural products are generally higher, with an average of 17.5%, while non-agricultural products carry an average tariff of 12.0%. Some 12% of all tariff lines now carry the zero rates. Imports from other ECOWAS members are duty free. In addition to tariffs, imports are subject to a value-added tax of 12.5%, a National Health Insurance Levy of 2.5%, and

excise taxes. Two additional charges, the ECOWAS levy and the Export Development and Investment Fund Levy, apply only on imports. Ghana's technical regulations cover a wide range of agricultural and non-agricultural goods and do not distinguish between imported and domestically produced goods.

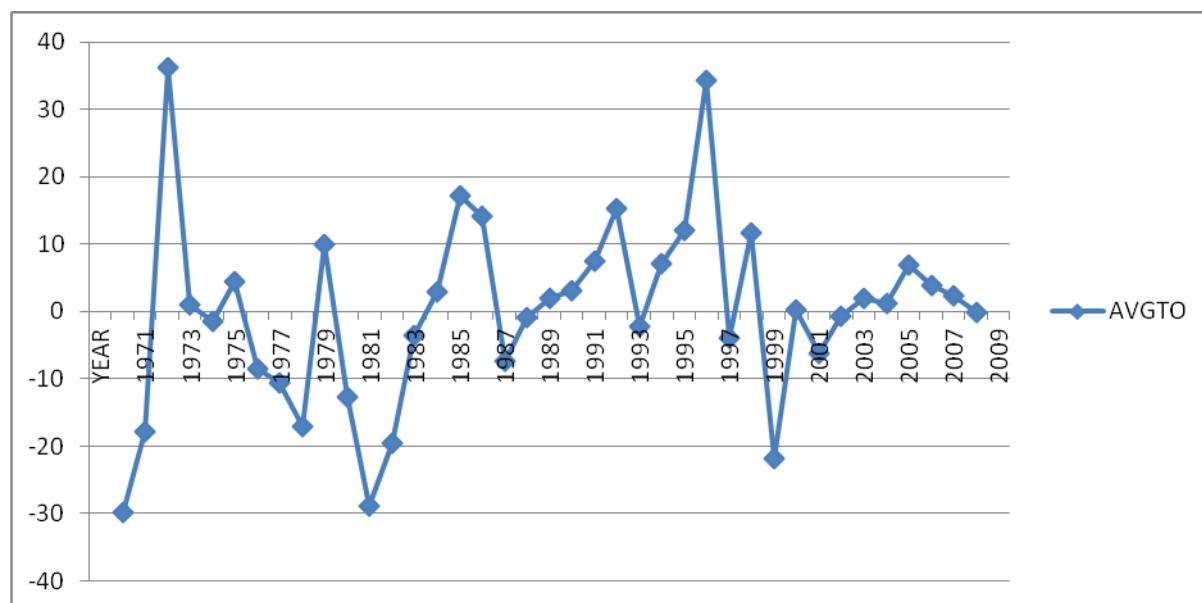
Exporters of cocoa and gold are subject to a foreign exchange surrender and conversion requirement. Export taxes apply on cocoa and hydro-carbons, but have been abolished on timber products. Export prohibitions are in place for round or unprocessed logs, raw rattan cane, and bamboo. Ghana does not provide any export subsidies. However, with a view to promoting exports, an export processing zone scheme and a duty drawback mechanism are in place. The Government also promotes exports through public export credits and marketing assistance.

### **3.2.2 Trends in Trade Indicators in Ghana**

Ghana is one of the few countries in Sub-Saharan Africa that has been classified as an intensive trade liberalizer because of the pace and extent at which trade liberalisation was carried out during the structural adjustment program in 1983 (Ocran et al, 2006). Although Ghana's trade liberalisation started in the mid 1980s, the momentum of the liberalisation continued into the 1990s (Jebuni et al, 2004). Ghana's merchandise exports as a ratio of GDP which amounted to 17% in the early 1980's, peaked at 28% in 1998 and dropped to 24% by 2000. On the other hand, merchandise imports over the same period also increased from 23% to 43% before slowing down to 35% in 2000. Trade openness, which followed a downward trend between 1970 and 1982, assumed an upward trend after the liberalization policies of 1983. The trade intensity of 46.35% in 1984 had surged to 128.9% by the end of 1999 and stood at 110.32% in 2009 (Ocran et

al, 2006). Table 3.1 presents the the annual growth rates in trade openness in Ghana from 1970 to 2010.

**Figure 3.1: Trends in Average Annual Growth of Trade Openness ((Exports+Imports)/GDP) in Ghana-1970 to 2010**



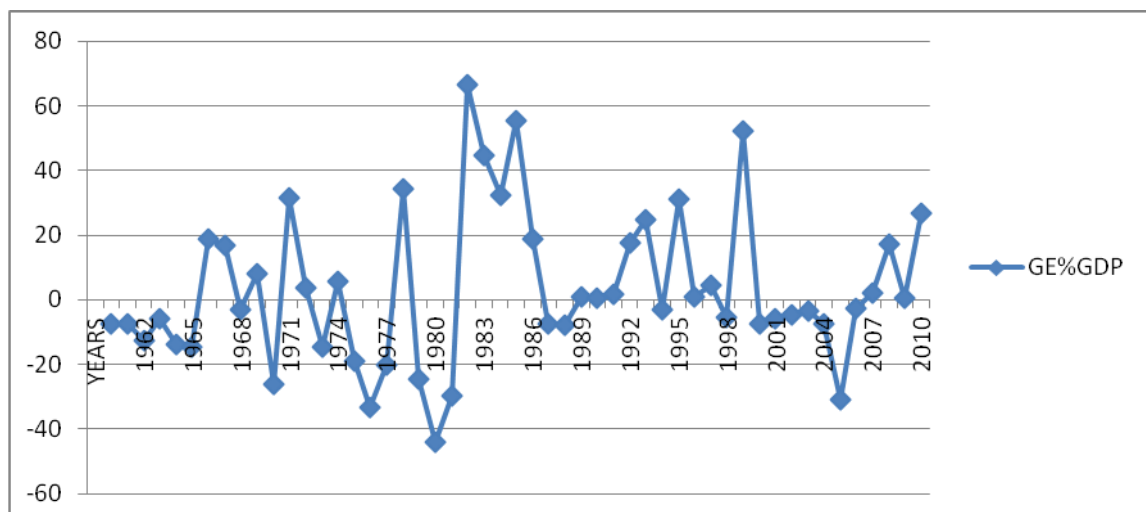
Source: World Development Indicators, 2012.

From the graph above, it can be seen that there was a decline in trade openness in many of the years preceding 1983 when Ghana adopted broad trade liberalization policies under the Structural Adjustment Program (SAP). Trade openness declined by 29.8%, 17.9% and 28.9% for the periods 1970-1971, 1971-1972 and 1981-1982 respectively. Ghana consistently experienced positive growth rates in trade in the post liberalization periods with the exception of some few years when there was a decline in trade. Trade openness in Ghana grew by 17.3%, 34.3% and 7% between 1985-1986, 1996-1997 and 2005-2006 respectively. Trade liberalization has therefore lead to increased trade in Ghana.

### 3.2.3 Trends in Exports, Key Export Commodities and Composition of Exports in Ghana

Ghana's exports have increased significantly over the last three decades. The country's exports increased from US\$773.4 million in 1986 to US\$14377 million in 2011 (WTO, 2012); representing an average annual growth in exports of 70% within the period. The table below presents the trends in the average annual growth rates in exports in Ghana from 1970-2010.

**Figure 3.2: Trends in Average Annual Growth in Exports as a % of GDP in Ghana**



*Source: World Development Indicators, 2012.*

From the graph above, it can be seen that Ghana experienced negative growth in its exports between 1970 and 1982 as a result of the adoption of trade restrictive policies and the revaluation of the cedi by 26% during that period. Ghana mostly achieved positive growth in exports in the years following the liberalization of trade in 1983. Cocoa, gold and timber have been the major export commodities in Ghana since independence in 1957. Table 3.1 shows total export values and the contributions of the three key export commodities to export earnings in Ghana.

**Table 3.1: Export Earnings and Percentage Contribution of Key Commodities to Export Earnings**

Years	Total Exports (US\$ million)	Gold (%)	Cocoa pro. & Marketing (%)	Timber (%)	Others (%)
1990	897	22	40	13	25
1991	999	30	35	12	23
1992	986	35	31	12	22
1993	1064	41	27	14	18
1994	1238	44	26	13	17
1995	1431	45	27	13	15
1996	1571	39	35	9	17
1997	1490	39	32	12	17
1998	2091	33	30	8	29
1999	2005	35	28	9	28
2000	1936	36	23	9	32
2001	1867	33	20	9	38
2002	2064	33	23	9	35
2003	2297	36	36	8	20
2004	2704	31	38	8	23
2005	2802	34	32	8	26
2006	3365	41	36	9	14
2007	3216	54	35	8	3
2008	5181.7	43	27	6	24
2009	5882.1	43	32	3.06	21.04
2010	7960.09	48.2	25	2.3	24.5
2011	14377	38	23	1.9	37.1

*Source: Bank of Ghana, 2012*

From Table 3.1, it is clear that cocoa and gold have been the two most important export commodities in Ghana over the years but the contribution of timber to export earnings have been declining consistently due to deforestation and lack of replacement for trees that are harvested. Table 3.2 presents the trends in the values and volumes of gold and cocoa exports in Ghana.

**Table 3.2: Trends in Volumes and Values of Cocoa and Gold Exports in Ghana**

Years	Gold			Cocoa and cocoa products	
	Value(\$'m)	Volume(fine ounce)	Unit Price(\$/fine ounce)	Value(\$'m)	Volume(tonnes)
1983	114.09	278,000	410.4	268.61	159295
1984	103	285,759	361.4	381.69	164839
1985	91	285,138	317.8	411.99	187713
1986	106	292,211	364	503.31	210869
1987	142	323,496	440	495.42	218971
1988	168.52	382,993	440	462.04	221154
1989	159.93	420,096	380.7	407.75	270800
1990	202	526,361	383	360.62	268136
1991	304	834,986	365	346.53	264785
1992	343	995,377	345	302.46	243102
1993	434	1,210,474	359	285.87	286504
1994	549	1,435,415	382	320.22	252319
1995	647	1,689,470	383	389.48	251126
1996	612	1,584,380	387	552.05	394449
1997	579	1,752,452	332	470.03	314516
1998	688	2,346,918	293	620.41	375707
1999	711	2,550,766	279	552.3	386626
2000	702	2,503,858	280	437.15	405760
2001	618	2,274,862	272	382.67	374409
2002	689.08	2,226,496	309	474.42	370449
2003	830	2,277,764	364	817.74	403311
2004	946	2,124,119	410	1025.67	641509
2005	1,277.25	2,120,230	602	908.36	579746
2006	1,733.78	2,525,716	686	1187.44	735881
2007	2,246.25	2,625,500	864	1132.65	621467
2008	2,551.36	2,994,610	960	1487.00	647918
2009	2,987.00	2930.328	1217	1866.00	710600
2010	3620.00	2970.079	1433	3329.00	900180
2011	3937.66	3600.000	1572	2642.00	900000

*Source: Bank of Ghana, 2012*

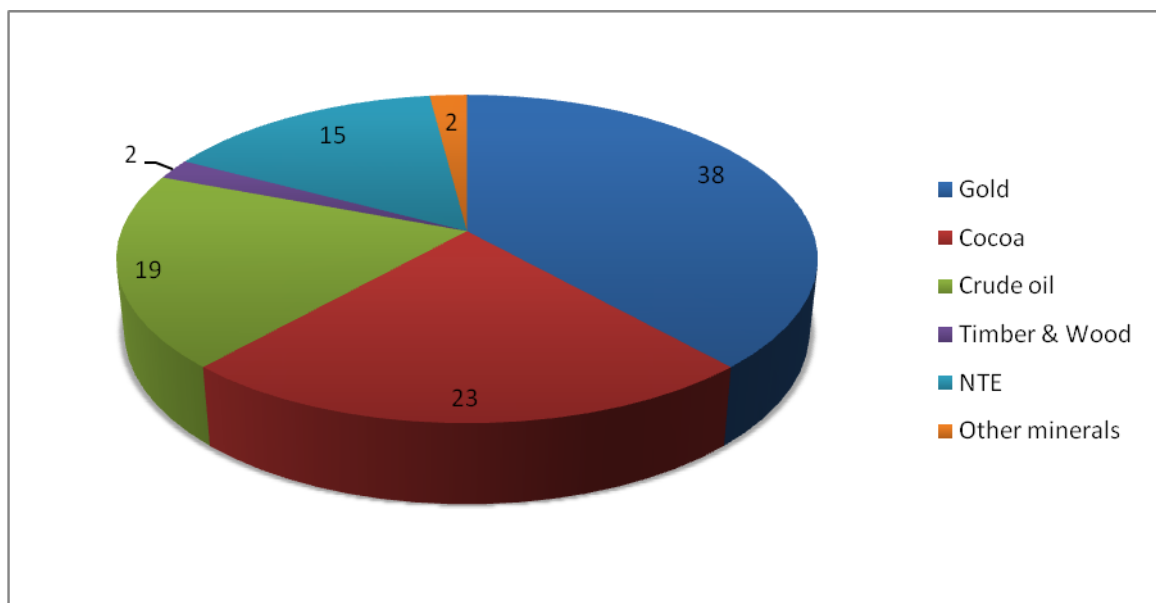
As shown in Table 3.2, Gold and cocoa export volumes in Ghana have increased tremendously within the last three decades. The rise in gold exports has been credited to the high inflows of FDI into the mining sector since the adoption of financial liberalization policies in Ghana in 1986. Cocoa output in Ghana has increased

significantly as a result of high and rising producer prices, increased government subsidies and the distribution of high yielding cocoa seedlings to farmers.

It is worth noting that despite the significant efforts directed at diversifying exports in Ghana with the establishment of the Ghana Export Promotion Council (GEPC) in 1969, the structure of exports has changed very little as the country continues to be dependent on primary resource-intensive products of gold, cocoa, and timber. The export volumes and earnings of cocoa and gold have increased consistently in the last three decades but the contribution of timber to foreign exchange earnings fell from 13% in 1990 to 3% in 2009 and further shrank to 1.9% in 2011 owing to persistent deforestation and lack of replacement for harvested timber over the years (Tutu, 2010). As depicted in Table 3.2, the export volume of cocoa grew rapidly from 159,000 tonnes in 1983 to 710,600 tonnes in 2009. Export volumes of cocoa nearly doubled from 370,000 tonnes in 2002 to 710,600 tonnes in 2009. The vast increase in cocoa output since 2002 has been attributed to higher producer prices, and good agronomic practices including the free spraying of insecticides introduced by the government during the period. For gold, output dramatically increased five times from 278,000 ounce in 1983 to 1.2 million ounce in 1993 as depicted in table 3.5. It almost tripled again to 3.1 million ounce in 2009. The continuous rise in gold output since 1983 has been attributed to the adoption of trade liberalization policies under the Structural Adjustment Program (SAP) of 1983 that has facilitated huge inflows of FDI into the mining sector over the last three decades. Among the traditional exports, gold continues to be the dominant export earning commodity for Ghana. The contribution of gold to total export earnings increased drastically from 22% in 1990 to 43% in 2009 as shown in Table 3.1. In 2011, the share of gold exports amounted to 37.7 percent in overall export earnings. This was followed

by Cocoa Beans and Products whose share in overall export earnings amounted to 23 percent for the period (Tutu, 2008). Crude Oil took the third place with a share of 18.6 percent, while Timber and Wood Products made up 1.9 percent share of overall export earnings in 2011 (CEPA, 2012).

**Figure 3.3: Percentage Shares in Total Export Receipts of Ghana's Commodity Exports, 2011.**



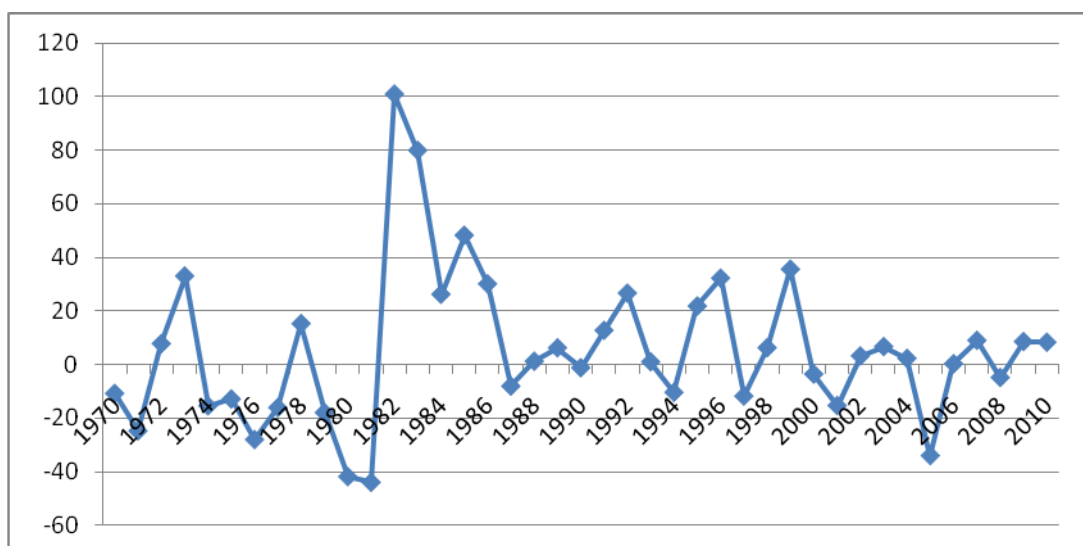
*Source: CEPA, 2012.*

The present composition of Ghana's export commodities as shown in figure 3.3 clearly depicts the country as an exporter of primary commodities which are environmentally sensitive goods. This confirms the resource endowment hypothesis that countries with abundant natural resources such as Ghana tend to specialize in resource intensive goods when they open up to trade. The persistent rise in Ghana's traditional exports (gold and cocoa) as shown in figure 3.2 is therefore expected to lead to depletion of natural resources and worsening of general environmental conditions in the country.

### 3.2.4 Trends in Imports and Composition of Imports in Ghana

The broad liberalization policies adopted by Ghana under the structural adjustment program of 1983 coupled with domestic supply constraints for most food items, and a rapid domestic demand for electrical and electronic equipment, automobiles and industrial machinery have led to a high and rising import values in Ghana. The trend in the average annual growth rates in Ghana's imports is presented in the graph below.

**Figure 3.4: Trends in Annual Growth in Imports as a Ratio of GDP in Ghana- 1970 to 2010**



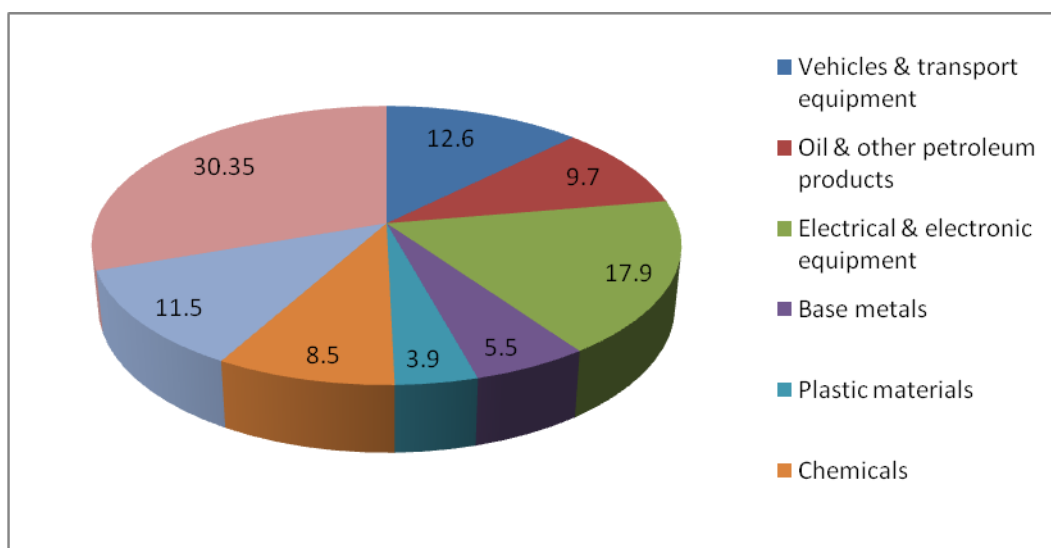
*Source: World Development Indicators, 2012.*

As evidently portrayed by the graph above, imports in Ghana after declining persistently between 1970 and 1982, grew significantly just after the adoption of trade liberalization in 1983. Imports as a ratio of GDP which declined by 41.9% in 1981 and 44% in 1982 rose by 100% in 1983 and 79.8% in 1984. At the end of 2011, imports as a fraction of GDP in Ghana grew by 8.4% and is projected to grow further in the years ahead owing to the high demand for imported food items, automobiles, industrial machines among others. The total value of Ghana's annual imports which stood at \$2.5billion in 1999 rose to \$5.67billion in 2007, indicating a rise in the import bill of

127% within the eight-year period. Between 2007 and 2011, total imports further rose by 170% to settle at \$15.32billion (WDI, 2012)

The composition of Ghana's imports has implications on the quality of environment in the country. In 2011 vehicles and transport equipment accounted to 12.6% of total imports, oil and petroleum products took 9.7%, electrical and electronic equipment was 17.9% of overall imports while plastic materials made up 3.9% of total imports as shown in figure 3.5.

**Figure 3.5: Composition of Ghana's Imports in 2011 (%)**



Source: *UN Commodity Trade Statistics, 2012*

Aside the fact that the use of these products have serious environmental consequences, what makes it more worrisome is the fact that about 70% of automobile, electrical and electronic imports into Ghana are second-hand (used) products with about 15% of them being outdated and unsellable (Amoyaw-Osei et al, 2011). The second-hand import sector has become a highly booming business venture as the sector enjoys high patronage from all social classes in Ghana. Owing to the generally low income levels in the

country, many Ghanaians are unable to afford brand new products. Large quantities of second-hand vehicles, machinery, electrical and electronic equipment, clothes and a host of other consumer goods discarded mainly in Europe, North America and Asia find their way into Ghana.

In the year 2003, Ghana promulgated a new policy on Information and Communications Technology (ICT) for accelerated development. The prime motive behind the new policy was that, Ghana's accelerated development would not thrive without an ICT-driven development agenda. Under this policy, electronic products such as computers and its accessories enjoy a free import duty regime. This has further increased the import trade of these goods. More so, Ghana has a liberalized import regime for second hand electrical and electronic equipment. Even with regard to the importation and sale of second-hand air conditioners, refrigerators, refrigerator-freezers and freezers which are prohibited by LI 1932 (2008), enforcement has not been stringent over the years (Amoyaw-Osei et al, 2011). Large consignments of obsolete electronic gadgets (E-waste) therefore enter the country every other year in the form of second-hand electrical equipment.

### **3.3 State of the Environment in Ghana**

Ghana has several environmental problems. Notable among these are: land degradation, coastal erosion, air pollution, pollution of rivers and lagoons, deforestation, desertification among others. To better classify the environmental effects of liberalized trade for the purpose of this study, the trade-related environmental impacts in the country are divided into the environmental effects of the export sector and the import-related environmental impacts. In the export sector, some key areas responsible for

environmental degradation in the country are: agriculture, mining, timber and forest products exploitation. On the side of imports, the main environmental concerns are e-waste generation and emissions of greenhouse gases from the use of imported second-hand electronic gadgets, vehicles and other machinery.

### **3.3.1 Export-related Environmental Effects**

**Agriculture:** The agriculture sector plays a significant role in Ghana's economic development in terms of its contribution to GDP, foreign exchange earnings and employment generation. Agriculture in Ghana comprise mainly of crop farming, livestock farming and fishing. Cocoa as a cash crop is the second largest foreign exchange earner for the country. The cocoa sector alone employs about 3million Ghanaians and contributed 32% to foreign exchange earnings in 2009 (Tutu, 2010). Notwithstanding the importance of agriculture to Ghana's economy, the use of traditional farming practices such as shifting cultivation, slash and burn have had serious impacts on terrestrial ecology (plants and animals living on dry land) and thereby led to ecosystem deterioration or in extreme cases its destruction. Overgrazing by cattle and other livestock results in soil erosion and land degradation. The use of chemicals in fishing and other inappropriate fishing methods has brought about a vast reduction in aquatic ecology (plants and animals living in water). Farming along watersheds has also led to the drying up of most water bodies in the country.

**Timber and Forest Products:** Timber exploitation without replanting has resulted in a massive depletion of Ghana's forest stock over the last century. Unregulated harvesting of timber has led to only about 15% of Ghana's forests stock in 1900 remaining as at 2010. Traditional timber species such as Odum, Mahogany, Wawa, Sapele, among others

are in extinction and artificial growing programs have not been effective enough in that they cannot grow as in natural regeneration (Tutu et al, 2008). The excessive use of firewood as a source of energy for cooking particularly in the rural areas and charcoal production has also played a significant part in reducing forest stock of Ghana. The yearly timber production in the country is estimated to be about 3.5 million m<sup>3</sup> of round wood, half of which is destined for export markets. The remaining half goes into meeting domestic consumption. More worrying is the fact that large proportion of the harvest is done by illicit chain saw operators whose activities are often not in full compliance with laws and regulations governing the timber industry. The vast reduction in forest cover is partly responsible for the high concentration of greenhouse gases, particularly CO<sub>2</sub> in Ghana's atmosphere.

**Mining:** The mining sector of Ghana has contributed significantly to the economy in terms of foreign exchange earnings and tax revenues. But at the same time have caused a number of environmental problems. In the area of small-scale mining, negative environmental impacts arise because of low safety awareness, poor exploitation of available resources due to selective extraction of rich ores, low wages and chronic shortages of capital, an absence of environmental standards, and utilization of highly inefficient methods and equipment (Hilson, 2002). The two most prevalent environmental problems in the mining areas of Ghana are mercury pollution and land degradation. Some specific impacts of mining on the environment are vegetation removal and soil erosion, change in topography/landscape, abandoned pits, noise pollution- vibrations from blasting, traffic, crushers, land subsidence due to removals, surface drainage, dust generation, soil and water pollution, air pollution including underground coal combustion, carbon dioxide, carbon monoxide, hydrogen fluoride,

sulfur dioxide, nitrogen oxide, organic compounds, slugs and chemical, arsenic and sulphur dioxide discharge from ore roasting. Some of these air pollutants cause acid rain and global warming (Tutu, 2010). Abandoned exploration holes in mining sites usually get filled with water and serve as breeding grounds for malaria-infected mosquitoes. Moreso, the hydrology of waterways in small-scale mining regions is always altered as a result of the exploration activities (Hilson, 2002). In some mining regions, river-banks are mined to depths of 35m, stretching distances as long as 60m which reduce ability of boreholes, streams and hand-dug wells to recharge, leaving most of them unproductive or with reduced yields and acute water shortages (Akabzaa, 2000)

**Figure 3.6: A degraded site from small-scale gold-mining activity in Tarkwa, Western Ghana.**



*Source: Gavin Hilson, 2002*

The picture above shows a degraded land at a small scale mining site at Takwa in the Western region of Ghana. Patches of trees have been uprooted and vegetation removed during intensive search for prospective gold-aggregated ores.

### 3.3.2 Import-related Environmental Effects

**E-Waste:** The high demand for electrical and electronic appliances in Ghana over the last decade has led to an alarming influx of such gadgets into the country; most of which are second-hand equipment. The policy direction on ICT and demands of the current information and digital age are major drivers of the high demand for imported electronic goods, as well as e-waste generation in Ghana. Significant quantities of these imports are obsolete, near or at end-of-life, with little or no use value and consigned as waste equipment for disposal within a short time (Ameyaw-Osei et al, 2011). As a result of this, A large number of discarded gadgets are known to be stored, mostly in houses, schools, institutions/offices and warehouses among others, due to the lack of policy direction on the management of their disposal. There are no recycling facilities in Ghana for managing the disposal of such e-waste in an environmentally acceptable way, in spite of the existing large stocks and the ever-increasing high rate of generation of the waste. Moreover, there exist no clear and specific national regulations that define, restrict or prohibit hazardous e-waste recycling and set up. Many e-waste handlers and recyclers work in appalling conditions, constantly exposing themselves and communities nearby to serious hazards. For instance, burning is a common method used to reduce waste volumes, which is practiced at waste dumps and scrap yards across the country. The burning process in particular releases toxic substances into the atmosphere, soils and water bodies with dire health consequences. Some known health problems include acute damage to the lungs, e.g. from inhalation of fumes of heavy metals such as lead and cadmium. Others include mental retardation in case of lead exposure in children, damage to blood cells and the kidney and predisposition to cancers. The menace of e-waste and its burning has dire adverse implications on people's health and Ghana's environment (Ameyaw-Osei et al, 2011).

**Figure 3.7: Emission of Toxic Gases from Burning of E-waste at the Agbogloshi Dump Site, near the Agbogloshi Market in Accra.**



*Source: Ameyaw-Osei et al, (2011)*

**Plastic waste:** The demand for high standards in packaging consumer goods has led to an extensive use of plastic materials in packaging items such as food and water as a result of their inherent advantages in terms of low bulk densities and inertness that make them convenient carrier materials and low risk contaminants as compared to other packaging materials. Over the last two decades there has been a phenomenal increase in imports of plastic raw materials and plastic finished products as well. The amount of plastic waste materials in the waste stream in Ghana rose from 1.4% in the late 1980's to about 8% in 2005 (Fobil et al, 2006). According to the UN Commodity Trade Statistics, (2012) imports of plastic materials made up 3.9% of total imports into the country in 2011. The consequence of the lack of effective policy direction on plastic waste disposal management in the country is the spread of plastic waste everywhere in the major cities. Drainage channels and waterways have become choked with these plastics and thereby causing persistent destructive floods particularly in the cities during rainy seasons.

**Fossil Fuels:** Fossil fuels contribute greatly to greenhouse gas emissions in the world. Fossil fuels account for about  $\frac{3}{4}$  of all CO<sub>2</sub>, methane and other greenhouse gas emissions around the globe. In Ghana, petroleum and other fossil fuels are the main source of energy in the transportation industry and also in electric power generation. Growth in the transportation industry has led to a persistent increase in the oil import bill over the years. In 2011, oil import bill comprising of crude oil and other petroleum products increased by about 50% from its 2010 level (CEPA, 2012). The burning of fossil fuels at very high temperatures (combustion) has led to persistent rise in CO<sub>2</sub> emission levels from 0.2 kilotons in 1984 to 0.45 kilotons in 2010 (WDI, 2012).

The table below presents a summary of environmental problems and their effects in Ghana.

**Table 3.3: Summary of Environmental Problems in Ghana**

<b>NATURE OF CONCERN</b>	<b>CAUSES</b>	<b>EFFECTS</b>	<b>INDICATORS</b>
Land degradation	<ul style="list-style-type: none"> <li>• Traditional farming methods</li> <li>• Bush fires</li> <li>• Clearing of watersheds</li> <li>• Sand and stone winning</li> <li>• Harvesting of firewood</li> </ul>	<ul style="list-style-type: none"> <li>• Loss of top soil</li> <li>• Loss of biodiversity</li> <li>• Loss of medicinal plants</li> <li>• Siltation of rivers</li> <li>• Salination of soil</li> </ul>	<ul style="list-style-type: none"> <li>• Area affected by erosion</li> <li>• Area affected by salinisation</li> <li>• Area of land contaminated</li> <li>• Area of water logging</li> </ul>
Coastal erosion	<ul style="list-style-type: none"> <li>• Rising sea level</li> <li>• Sand wining on beaches</li> <li>• Harbour construction</li> </ul>	<ul style="list-style-type: none"> <li>• Erosion of coast</li> <li>• Loss of spawning ground</li> </ul>	<ul style="list-style-type: none"> <li>• % land loss to erosion</li> <li>• No of sand wining sites on beach</li> </ul>
Pollution of water bodies	<ul style="list-style-type: none"> <li>• Mining activities</li> <li>• Indiscriminate waste disposal</li> <li>• Farming along river banks</li> <li>• Indiscriminate defecation</li> <li>• Pollution by manufacturing industries</li> </ul>	<ul style="list-style-type: none"> <li>• Damage to aquatic life</li> <li>• Poor water quality</li> <li>• Toxic water sources</li> </ul>	<ul style="list-style-type: none"> <li>• Increase BOD in rivers</li> <li>• % loss in aquatic life</li> <li>• % faecal coliform in rivers</li> <li>• Use of agricultural pesticide</li> <li>• No of industries discharging into water bodies</li> </ul>

Deforestation	<ul style="list-style-type: none"> <li>• Timber exploitation</li> <li>• Fuel wood extraction</li> <li>• Shifting cultivation</li> <li>• Bushfires</li> </ul>	<ul style="list-style-type: none"> <li>• Loss of biodiversity</li> <li>• Drying of streams</li> <li>• Soil erosion</li> </ul>	<ul style="list-style-type: none"> <li>• % loss of fauna, flora</li> <li>• % loss of forest land/year</li> <li>• Number of bushfire/year</li> <li>• Annual Allowable Cut</li> </ul>
Poor Waste management	<ul style="list-style-type: none"> <li>• Human activities</li> <li>• Mining activities</li> <li>• Industrial activities</li> <li>• Agricultural activities</li> </ul>	<ul style="list-style-type: none"> <li>• Increased soil toxicity</li> <li>• Poor water quality</li> <li>• Visual intrusion</li> <li>• Increase in diseases</li> <li>• Emerging diseases</li> </ul>	<ul style="list-style-type: none"> <li>• Volume of types of waste</li> <li>• No of waste treatment plants</li> <li>•</li> </ul>
Indoor air pollution	<ul style="list-style-type: none"> <li>• Use of charcoal and fuelwood</li> <li>• Use of insecticides</li> <li>• Use of mosquito coils</li> <li>• Cigarettes smoking</li> </ul>	<ul style="list-style-type: none"> <li>• Poor air quality</li> <li>• Increase chest problems</li> <li>• Increase in coughs</li> </ul>	<ul style="list-style-type: none"> <li>• Emission of CO<sub>2</sub></li> <li>• Respiratory infections</li> <li>• Expenditure on air pollution</li> </ul>
Risk from chemical use	<ul style="list-style-type: none"> <li>• Use of chemicals in fishing</li> <li>• Use of chemicals in hunting</li> <li>• Agrochemical/pesticides use</li> <li>• Industrial use of chemicals</li> <li>• Spillage from mining activities</li> </ul>	<ul style="list-style-type: none"> <li>• Polluted water bodies</li> <li>• Polluted air</li> <li>• Increase crop toxicity</li> <li>• Death related to pesticides</li> </ul>	<ul style="list-style-type: none"> <li>• Increase pesticides use</li> <li>• Level of pesticide in crops</li> <li>• Increase in pesticide related disease.</li> <li>• Chemical poisoning</li> </ul>
Outdoor air pollution	<ul style="list-style-type: none"> <li>• Vehicular pollution</li> <li>• Industrial pollution</li> <li>• Dust from road construction</li> <li>• Release of methane</li> <li>• Stench from waste</li> </ul>	<ul style="list-style-type: none"> <li>• Health problems increase</li> <li>• Poor air quality</li> <li>• Loss of flora and fauna</li> </ul>	<ul style="list-style-type: none"> <li>• Emission of CO<sub>2</sub></li> <li>• Emission of Nitrogen oxide</li> <li>• Emission of Sulphur oxide</li> <li>• Air quality</li> <li>• Emission of GHG</li> </ul>
Desertification	<ul style="list-style-type: none"> <li>• Climatic change</li> <li>• Deforestation</li> <li>• Poor farming practices</li> <li>• Drying of local streams</li> </ul>	<ul style="list-style-type: none"> <li>• Loss of livelihood</li> <li>• Erosion</li> <li>• Loss of vegetation cover</li> <li>• Biodiversity loss</li> </ul>	<ul style="list-style-type: none"> <li>• Increase in vegetation loss</li> <li>• Decrease in food production</li> <li>• loss of soilmoisture</li> <li>• % loss of surface water</li> </ul>
Large scale development	<ul style="list-style-type: none"> <li>• Mining activities</li> <li>• Factories near rivers</li> <li>• Building on waterways</li> </ul>	<ul style="list-style-type: none"> <li>• Loss of arable land</li> <li>• Waste generation</li> <li>• Flooding in Cities</li> <li>• Biodiversity loss</li> </ul>	<ul style="list-style-type: none"> <li>• Pollution levels of air and water bodies</li> <li>• Loss of aquatic life</li> <li>• Houses flooded</li> </ul>

Source: EU, 2012.

### **3.3.3 Trends in some key Environmental Indicators in Ghana**

Ecosystems and biodiversity of Ghana are highly sensitive to natural and anthropogenic changes. Biodiversity is under pressure because of competition for land due to over exploitation of natural resources for exports and domestic uses e.g. mining, forest and agriculture production. These developments have led to loss of specific species habitats and local climate changes owing to high emission of greenhouse gases. Wildlife traditionally provides around 300.000 T of bushmeat for the Ghanaian people (EU, 2012) Both of these sources of income are at risk as a number of species face extinction due to unsustainable exploitation of wildlife in providing affordable alternatives to bushmeat, lost of natural habitats, hunting during reproduction period and non respect of wildlife regulations.

Water resources of Ghana are at risk because of estate development around water bodies, high rates of logging, fuel wood extraction, poor agricultural practices, surface mining and desertification leading to increasing poverty in rural and urban areas as well as higher country sensitivity to human and natural disasters. Climatic variability has also resulted in dwindling of freshwater resources. Water supply has reduced in the coastal areas due to shorter rainy season. Water supply for irrigation in areas within the Volta basin has reduced as a result of low water quantity and weed invasion. Surface water in cities and mining areas is increasingly being polluted due to lack of waste management. Rivers and lagoons located near industrial areas are dying as a result of the discharge of untreated industrial and domestic effluent leading to nutrient enrichment and odour. The burden of diseases in the country indicates that about 70 percent can be attributed directly to the environment, mainly due to the lack of potable water and means of sanitation (EU, 2006).

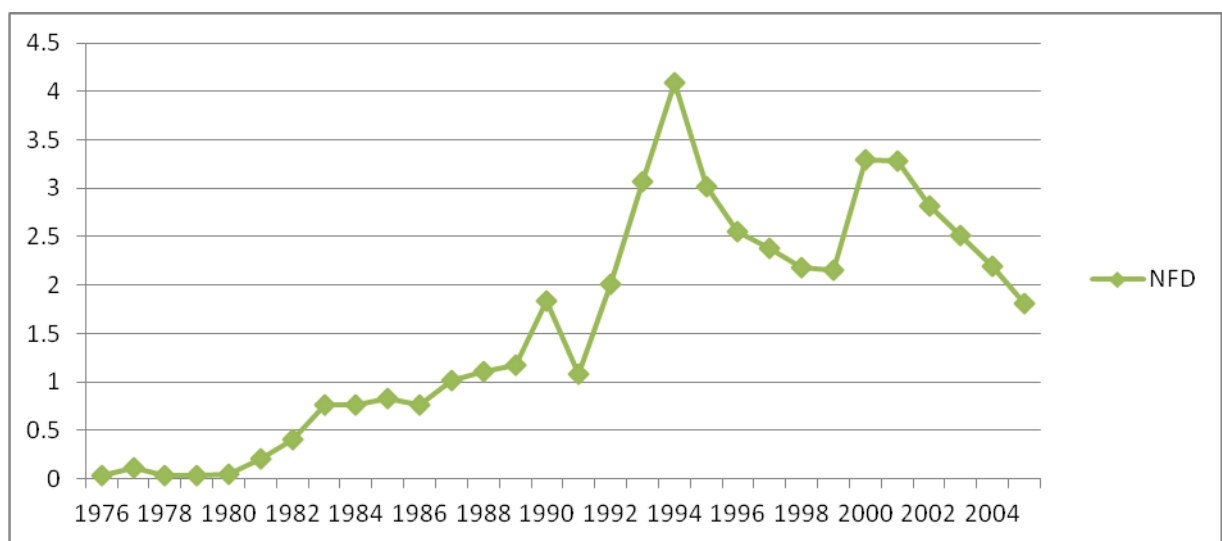
The coastal fisheries and wetlands resources provide a critical source of food security in Ghana.

About 75 percent of all fish production is consumed locally at an approximate per capita rate of 25 kg/year. In addition, fish is the country's most important non-traditional export, providing US\$95 million in exports in 2003 (EU, 2006). Declining catch of coastal fish is due to unsustainable fishing management, related over-fishing due to increased number of artisanal canoe, fishing of too young fishes, destruction of habitats by trailers vessels and non respect of fishing regulations. In addition to the coastal fisheries depletion, significant areas of the coastal wetlands that provide spawning and nursery grounds for many key species have been destroyed due to mangroves, wood cutting for cooking, polluted water releases of cities and industries along the coast and erosion of the West coast. The declining catch rates and rising costs associated have dramatically increased the average price of coastal fish products in local markets over the last decade. The non- sustainable management of the sea fish resources has led to further malnutrition of the Ghanaian population whose fish intake represents 60 percent of the population's animal protein intake (EU, 2012).

Forests originally covered about 36 percent (84,000 km<sup>2</sup>) of Ghana. This reduced significantly to 23 percent by 1972, 13.3 percent in 1990, and 10.2 percent in 2000 (EU, 2006). The Forestry Sector contributes about 6 percent of Ghana's GDP and is the fourth largest foreign exchange earner and directly supports the livelihoods of approximately 70 percent of the rural population. Domestically, the forestry sector provides approximately 120,000 direct employment and tens of thousands of jobs in the informal sector to those who access wood either from off-reserve areas or through illegal chain-saw operators.

The rate of deforestation of 65,000 hectares per annum in Ghana is not sustainable, particularly in off-reserve areas, due to the proliferation of illegal logging and chainsaw operations. It has been estimated that approximately US\$300 million is lost each year due to a marked failure to curb forest resources over exploitation (EU, 2012). The figure below presents the trends in the rate of annual forest depletion in Ghana.

**Figure 3.8: Trends in the Rate of Depletion of Ghana's Forest Cover-1976 to 2005**

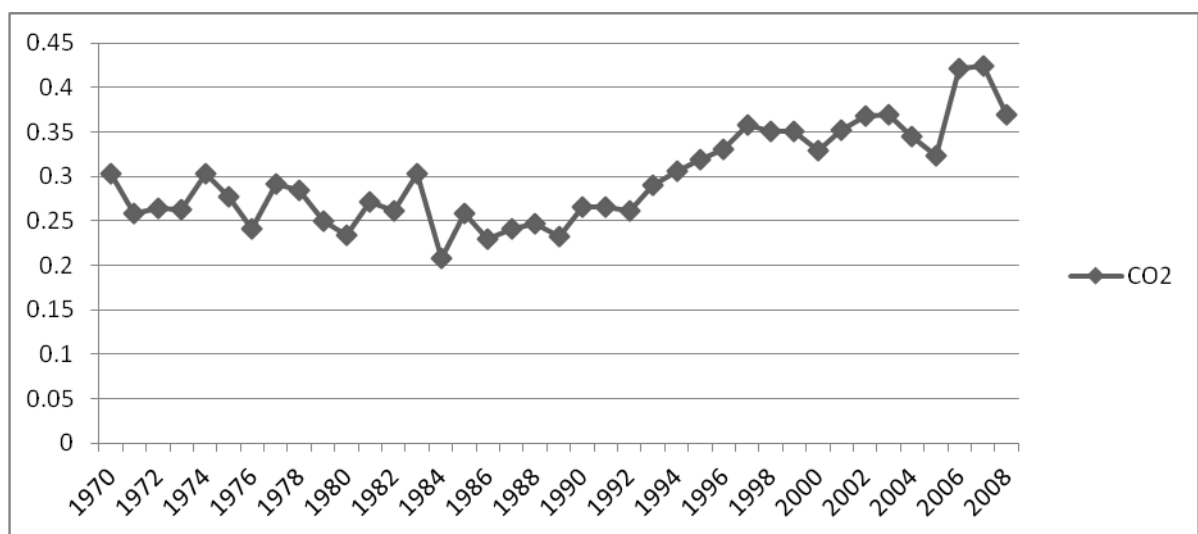


*Source: World Development Indicators, 2012.*

The graph shows that the annual rate of forest depletion in Ghana has increased consistently over the years as a result of perennial bush fires, bad farming practices and lack of replacement for harvested timber. The sharp increase in the rate of forest depletion between 1991 and 1994 has been attributed to the increased exports of timber logs following export liberalization in the late 1980's. The ban on exports of raw timber logs and intensification of afforestation programs have led to a decline in the rate of forest depletion in Ghana over the last decade.

The fast depletion of Ghana's forest cover has given way to high emissions of greenhouse gases such as CO<sub>2</sub> and increase desertification due to a decrease of humidity zones created by the lost forests. Consequently desertification continues its progression, decreasing national agricultural production and putting subsistence farmers at risks for food security. Figure 3.8 shows the trends in carbon dioxide emissions in Ghana.

**Figure 3.9: Trends in Carbon Dioxide (CO<sub>2</sub>) Emissions per Kilotons -1970 to 2008**



*Source: World Development Indicators, 2012.*

From the graph above, it can be deduced that carbon dioxide emissions declined consistently in the period before the adoption of broad liberalization policies in 1983. It has however increased persistently after the adoption of trade liberalization in 1983. This development could be an indication that trade openness indeed leads to general degradation in the environment particularly in developing countries such as Ghana.

Natural resources have since independence been indispensable for most of the economic sectors of the country. In particular, about half of Ghana's GDP derives from the following sectors that are closely related to the natural resource base: agriculture and

livestock (29%), forestry and wood processing (7%), fisheries (4%), electricity and water (3%), and tourism (5%) (EU, 2006). Therefore, Ghana's natural resource base accounts for an important portion of the country's economy in terms of foreign exchange earnings and also provides goods and services fundamental to rural and urban livelihoods. Despite their social and economic roles, Ghana's natural resources are overexploited and continue to decline in both quantity and quality. Inappropriate crop production practices, mining in forest reserves and illicit haresting in the timber industry are adversely affecting forests and savannah woodlands. The ongoing soil erosion and a decline in soil fertility undermine food and agricultural production. Natural reserves face increasing risks of mining activities. In 2006, the World Bank estimated that lack of environmental considerations in economic activities affect 4 to 6 % of Ghana's GDP and even up to 8 % if health issues are considered.

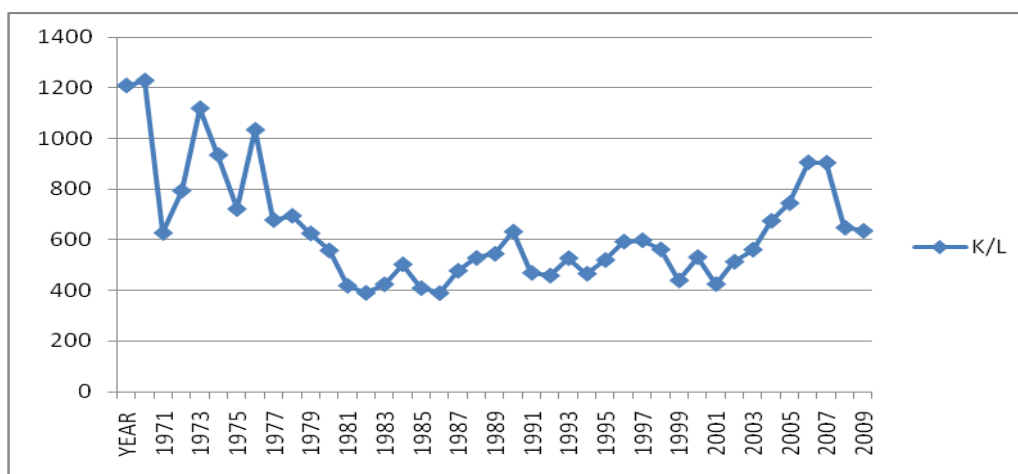
The environmental performance indicators shown in figures 3.8 and 3.9 depict a continuous decline in environmental conditions in Ghana in the post liberalization period. These trends present a major obstacle to fulfilling Ghana's growth potential. Recent estimates of the cost of degradation suggest that an equivalent of 10 percent of GDP is lost annually through unsustainable exploitation of the country's natural wealth (forests, wildlife, fisheries, and land resources), as well as from health costs related to urban environmental problems (water supply and sanitation, and indoor and outdoor air pollution) (World Bank, 2006). An environmental accounting analyses conducted by the World Bank in 2006 estimated that the current genuine savings rate (a measure of growth that takes environmental factors into account) for Ghana is in fact negative, thus compromising the capacity of the country to fulfill and sustain its full potential for growth and development. The present study therefore seeks to find out the extent to

which increased trade in the post liberalization era has contributed to the ongoing environmental degradation in Ghana.

### 3.4 Trends in other Relevant Variables

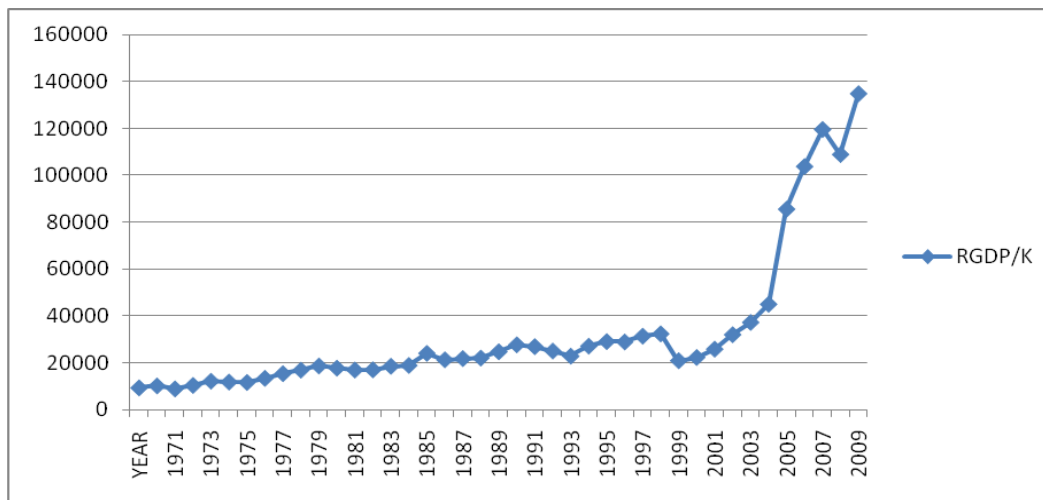
In the trade-environment literature, the environmental effect of liberalized trade has been decomposed into three; the composition effect, the scale effect and the technique effect. In this study the composition effect is proxied by capital-labour ratio (K/L), the scale effect is proxied by real GDP per square kilometer (RGDP/K), and the technique effect is proxied by real gross national product per capita (RGNPPC). The trends in these variables are presented below.

**Figure 3.10: Trends in Capital-Labour Ratio -1970 to 2010**



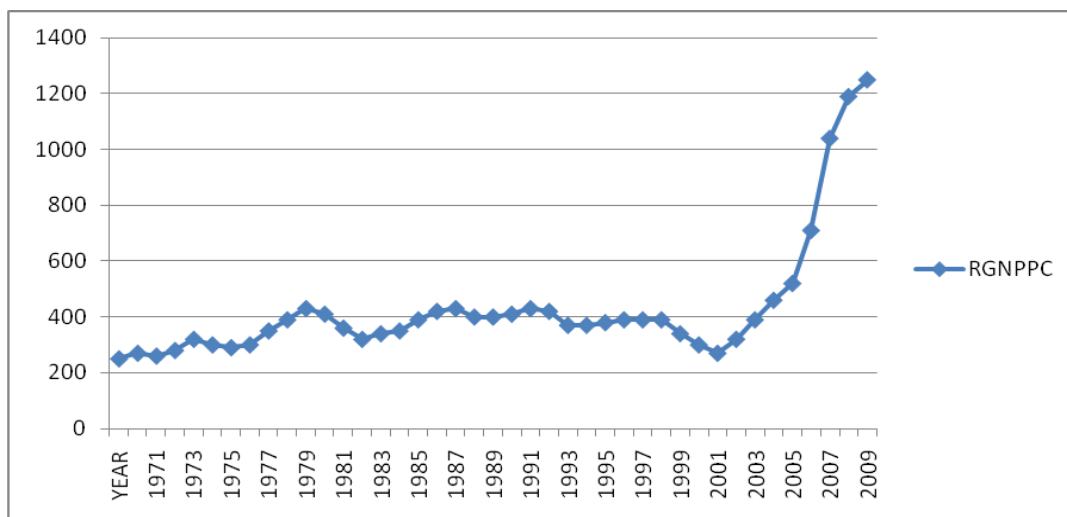
*Source: World Development Indicators, 2012*

The line graph above shows a consistent decline in Ghana's capital-labour ratio between 1970 and 2010. This reflects the relative abundance of labour and scarcity of capital as in many other developing countries of Africa.

**Figure 3.11: Trends in Real GDP per Square Kilometer -1970 to 2010**

*Source: World Development Indicators, 2012*

From figure 3:11, it is evidently shown that Ghana's real GDP has been rising persistently over the last three decades. Since pollution is a natural by-product of economic activity (production), it is expected that the rising level of production would lead to high environmental degradation.

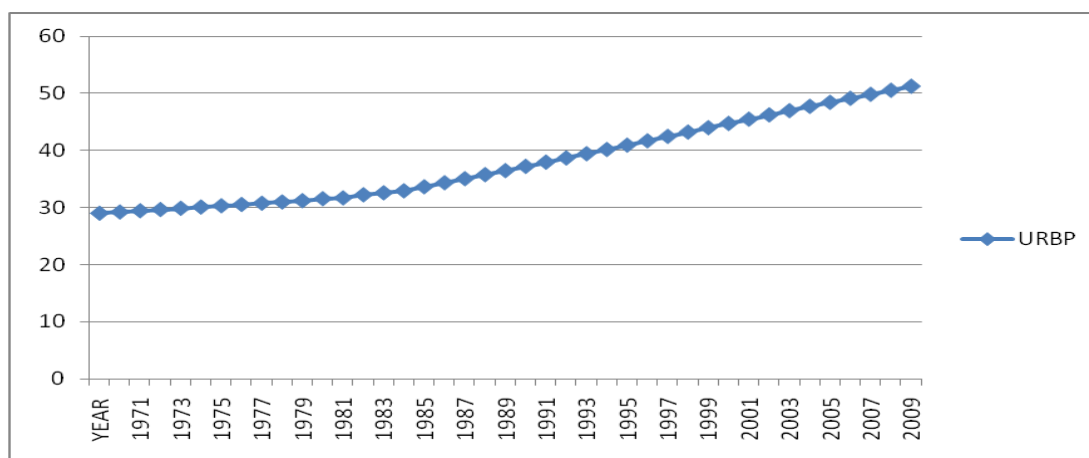
**Figure 3.12: Trends in Real Gross National Product per Capita -1970 to 2010**

*Source: World Development Indicators, 2012*

As expected, increased output results in increased incomes. In line with the rising trends in real GDP presented in figure 3:11, real GNP per capita also follows a rising trend which shows that income levels in Ghana has been rising consistently in the last three decades. The technique effect of free trade in Ghana is therefore expected to be favorable as rising incomes increases demand for higher environmental standards.

In the literature, it is argued that urbanization enhances environmental standards as urban populations are usually united in their demand for higher environmental standards as against rural populations who are more dispersed. Increasing urbanization is therefore predicted to have a favourable impact on the environment.

**Figure 3.13: Trends in Urban Population as a % of Total Population -1970 to 2010**



*Source: World Development Indicators, 2012*

From figure 3.13, it is seen that urban population in Ghana has grown consistently over the study period. It is therefore expected that the high rate of urbanization would have a positive influence on environmental standards in Ghana

## **CHAPTER FOUR**

### **METHODOLOGY**

#### **4.1 Introduction**

This chapter presents the methodology used in the study. The chapter is further divided into two main sections. The first section focuses on the theoretical framework for the study. Section two on the other hand contains the estimation procedure for the study.

#### **4.2 Theoretical Framework**

Trade between countries is usually regarded as a catalyst for economic growth and long term development. Trade is based on increased production beyond the required output in autarky and thereby leads to increase in employment and income levels. More trade openness increases the production share of the goods in which a country has comparative advantage. At the same time, more trade openness increases production, per capita income, and thus may affect the environment (Tsurumi and Managi, 2011). Benefits of liberalized trade include access to a larger variety of goods and services to consumers, easier access to foreign technologies, larger markets for producers, and increased efficiency in resource allocation. Trade theory therefore predicts significant gains from liberalized trade through specialization and comparative advantage (Hanley et al, 2001).

However, Trade liberalization can affect the environment through several mechanisms, such as attempts to lower environmental standards, transfer of less pollution intensive technology, cross-border spillovers, or changes to the overall scale of economies. The impact of trade on the environment, particularly in developing countries is a contentious issue; air and water pollution, e-waste, plastic waste, the degradation of natural habitats

and loss of species, global pollutants, particularly carbon dioxide emissions, are major concerns of policy makers around the globe (Ederington et al, 2004) .

According to Antweiler et al, (2001) the impacts of trade liberalization on the environment are ultimately determined by the relative intensities of the scale, technique and composition effects discussed in the literature. The scale effect refers to the effect of an increase in production (e.g., GDP) on environmental degradation. Second, the technique effect indicates the impact of an increase in income on the environment. This refers to the effect of more stringent environmental regulations, which are put in place as additional income increases the demand for a better environment. Third, the composition effect explains how deforestation and the environment in general is affected by the composition of output (i.e., the structure of industry), which is determined by the degree of trade openness as well as by the comparative advantage of the country (Tsurumi and Managi, 2011). This effect could be positive or negative, depending on a given country's resource abundance and the strength of its environmental policy. Trade openness can increase production and income and also alter the constituents of output; it may as a result affect the environment through the scale effect, the technique effect and the composition effect. Henceforth, we call these effects the trade-induced scale effect, the trade-induced technique effect and the trade induced composition effect (Antweiler et al. 2001).

Based on the above discussion, we now formulate a model for the environmental effects of trade openness. We apply a simplified version of the model for decomposition of environmental effects of trade by Antweiler et al, (2001). In this model, we assume a small open economy that produces two final goods, X and Y, with two primary factors,

Natural capital (N) and Human capital (K). Industry Y is human capital intensive and does not pollute. Industry X is natural capital intensive and generates pollution as a by-product. We assume constant returns to scale, and hence the production technology for X and Y can be described by unit cost functions  $C^X(w, r)$  and  $C^Y(w, r)$ . Where  $w$  is wages; reward for human capital and  $r$  is rent; reward for natural capital.

We specify a simple emission function which links environmental degradation to economic activity as:

$$E = eX = e\theta S \dots \dots \dots (1)$$

Where  $\theta$  is the share of X (pollution intensive good) in total output. The above equation provides a simple decomposition: environmental degradation ( $E$ ) depends on the pollution intensity of the dirty industry  $e$ , the relative importance of the dirty industry in the economy  $\theta$ , and the overall scale of the economy  $S$ . In differential form, equation (1) is rewritten below.

$$\hat{E} = \hat{S} + \hat{\theta} + \hat{e} \dots \dots \dots (2)$$

The hats in equation (2) denote percentage change in the variables with a unit change in trade intensity. The first term is the scale effect which measures the change in environmental degradation resulting from an increase in the level of output, holding constant the mix of goods

Produced  $\theta$ , and production techniques  $e$ . The second term in (2) is the composition effect which measures the effect of a change in the output mix of the economy on the environment. Thus, holding the scale of the economy and emissions intensities constant, an economy that devotes more of its resources to producing the pollution intensive good X, will pollute more. The technique effect is captured by the last term  $e$ . All other things

been equal, an increase in the emission intensity will increase environmental degradation.

By setting  $Y$  as the numeraire, we denote the relative price of  $X$  by  $p$ . Because countries differ in their location, proximity to suppliers, existing trade barriers, and more importantly our initial assumption of a small country, domestic prices will not be identical to world market prices. Henceforth we write the relative price of  $X$  in the domestic market as

$$p = \lambda p^w \dots \dots \dots (3)$$

$\lambda$  in equation (3) measures the intensity of trade restrictions in the domestic economy and  $p^w$  is the common relative price of  $X$  (the pollution intensive good) on the world market. The domestic economy is assumed to be a net exporter of commodity  $X$ .

To estimate the overall effect of a change in trade restrictions  $\lambda$  on the environment, we account for the change created in the techniques of production  $e$ , the scale of output  $S$ , and the composition of output  $\theta$  by a unit change in trade restriction  $\lambda$ . We therefore differentiate equation (1) with respect to  $\lambda$ , holding world prices, and factor endowments constant, to find

$$\frac{dE \cdot \lambda}{D\lambda \cdot E} = \Pi 1 \frac{dS \cdot \lambda}{D\lambda \cdot S} + \Pi 2 \frac{d\theta \cdot \lambda}{D\lambda \cdot \theta} - \Pi 3 \frac{de \cdot \lambda}{D\lambda \cdot e} \dots \dots \dots (4)$$

The dependent variable in (4) above measures the total environmental impact of a unit change in trade restrictions. The first term to the right of (4) measures the trade induced scale effect on the environment. The second term measures the trade induced

composition effect on the environment. And the third term measures the trade induced technique effect on the environment. Thus, a change in trade restrictions generates a scale effect, a technique effect, and a composition effect. According to Antweiler et al, (2001) the overall effect of trade liberalization on the environment is determined by the interactions between the scale, technique and composition effects. In this study, the Scale of economic activity is measured in terms of real gross domestic product per square kilometer (i.e. real GDP/km<sup>2</sup>) while the technique effect is given by real gross national product per capita (RGNPPC). The composition effect on the other hand is captured by the capital-labour ratio (K/L). There exist no consensus among economists as to which effects normally dominate the others. However, for a resource-endowed country like Ghana, Antweiler et al (2001) anticipate that the dominance of the scale effect and the negative composition effects of liberalized trade will lead to environmental degradation.

Theoretical and conceptual analysis highlights the tendency for government policy and environmental regulations to determine the effect of trade liberalization on the environment. This concept has been termed the 'pollution haven effect'. The pollution haven effect hypothesizes that the stringency of environmental regulation distorts how competitive advantages are utilized by influencing plant location decisions and trade flows (Copeland and Taylor, 2004). The pollution haven hypothesis in effect postulate that developing countries experience deterioration in environmental quality when they open up to trade mainly as a result of ineffective environmental regulations, which facilitate the transfer of pollution intensive industries from industrialized countries to the developing world (Hall, 2003; Busse, 2004). We therefore add a new variable (HAVEN) to the basic model (4) to test the pollution haven hypothesis in Ghana.

Deacon and Mueller (2004) argue that non-democratic governance may impede the technique effect by rendering governments unresponsive to public demands for greater environmental quality. A variable to control for the effect of governance is therefore included in the model to specifically estimate the influence of democracy in determining the environmental impacts of openness to trade.

Maccarney et al, (2005) asserts that increased urbanization leads to improvement in environmental quality. Contrary to this assertion, observational evidence seems to suggest that urbanization rather increases environmental degradation in the urban centers of Ghana. Urban population level (as a percentage of total population) is therefore included as an additional variable in the model in order to control for the possible influence of urbanization in explaining the effects of trade liberalization on the environment.

Allowing environmental degradation to be a function of trade openness and assuming that the other determinants of environmental quality have a linear effect on the environment, the objective is to estimate the following equation, for Ghana at time  $t$ .

$$E_t = \beta_i X_t + \epsilon_t \dots \dots \dots (5)$$

$$t=1, \dots \dots \dots, T$$

Where  $E_t$  represents environmental degradation. The vector  $X$  contains the independent variables.  $\beta_i$  is a vector of parameters that measure the impact of the independent variables ( $X_t$ ) on the environment and  $\epsilon_t$  is the stochastic error term. An essential underlying assumption about the error term is that it is a white noise time-series process.

### 4.3 Model Specification

In order to determine the effect of trade liberalization on the environment, we employ the following mathematical model:

$$E = F(\text{TRADE}, K/L, \text{RGDP}/K, \text{RGNPPC}, \text{URBP}, \text{POR}, \text{HAVEN}) \dots \dots \dots (6)$$

Where E is environmental degradation

TRADE is a measure of trade openness ((Exports+Imports)/GDP)

K/L is the capital-labour ratio (composition effect)

RGDP/K is real gross domestic product per square kilometer (scale effect)

RGNPPC is real gross national product per capita (technique effect)

URBP is a measure of urbanization

POR is an index for political regime

HAVEN is an interaction term capturing the combined effects of real gross national product per capita (RGNPPC) and openness to trade (Trade)

### 4.4 Definition and Measurement of Variables

Time series data on Ghana is used in the study to estimate the environmental effects of openness to trade. All data with the exception of capital-labour ratio and the governance index were obtained from the World Development Indicators (WDI) Online Database, which is compiled by the World Bank.

**Carbon dioxide (CO<sub>2</sub>):** Carbon dioxide (CO<sub>2</sub>) emission is one of the two dependent variables under consideration in the study. CO<sub>2</sub> is used as a proxy in the study to capture the effect of trade liberalization on global pollutants in Ghana. CO<sub>2</sub> emissions per annum (measured in kilotons) are those stemming from the burning of fossil fuels. They include

emissions produced during consumption of solid, liquid and gas fuels. The dataset for CO<sub>2</sub> comprises of measurements for 40 years spanning the years 1970 to 2010 obtained from the World Development Indicators (WDI) online database. Increased trade is expected to result in a rise in CO<sub>2</sub> emissions in a developing country like Ghana.

**Net Forest Depletion (NFD):** Net Forest Depletion (NFD) is a dependent variable that captures the effect of trade on forest resources. It measures the deterioration in forest reserves per annum. NFD is measured as the product of unit resource rents and the excess of roundwood harvest over natural growth of the forest stock (WDI, 2012). NFD is expressed as a percentage of Gross National Income (GNI). The dataset for NFD is made up of measurements for 40 years spanning the years 1970 to 2010 obtained from the World Development Indicators database. Trade liberalization is expected to increase the rate of depletion of forest resources in Ghana.

**TRADE:** TRADE which is Trade intensity or ‘openness’ is a measure of trade liberalization in the economy. It is considered to be equal to imports plus exports in year  $t$  divided by GDP in year  $t$  (Antweiler et al., 2001). Thus:  $(IMP_t + EXP_t) / GDP_t =$  Trade intensity. TRADE is included in the model to estimate the direct effect of trade liberalization on the environment. Feridun et al, (2006) reports that trade liberalization leads to environmental degradation in developing countries. Hence the coefficient of TRADE is expected to have a positive sign. The dataset on this variable is obtained from the World Development Indicators database.

**Capital-Labour Ratio (K/L):** Capital-Labour ratio in the model measures the composition effect of trade on the environment. The composition effect is captured by  $K_t$

$K_t/L_t$ ;  $K_t$  is capital in year  $t$  and  $L_t$  is labour in year  $t$ . Owing to difficulties in obtaining complete dataset for capital-labour ratio in Ghana, we used real investment per worker as a proxy for capital-labour ratio. The dataset for real investment per worker was obtained from the Penn Foster Tables. According to Lopez and Islam (2007) countries that have large endowments of natural resources such as Ghana are likely to relatively specialize in resource-intensive industries and thus experience environmental degradation when they open up to trade. The coefficient of  $K_t/L_t$  is therefore expected to be positive.

**Real GDP per square kilometer (RGDP/ K):** The Scale of economic activity is measured in terms of real gross domestic product per square kilometer (i.e. real GDP/km<sup>2</sup>). Thus, RGDP in year  $t$  divided by the total land area of Ghana. This variable captures the trade-induced scale effect of economic activity on the environment. The scale effect states that trade liberalization leads to increased economic activity (output) and thereby worsen existing environmental problems (Antweiler et al, 2001). Therefore, The coefficient of RGDP/K is expected to be positive. The data for RGDP/K is obtained from the World Development Indicators database.

**Real Gross National Product Per Capita (RGNPPC):** Real GNP per capita is included in the model to estimate the trade-induced technique effect on the environment (Feridun et al, 2006). The technique effect refers to the tendency for emission intensity per unit of output to reduce as income levels rise through increased trade (Antweiler et al, 2001). As a result, the coefficient of RGNPPC is expected to be negative. The data for RGNPPC is obtained from the World Development Indicators database.

**Urban Population Rate (URBP):** URBP is a measure of urbanization calculated as urban population as a percentage of total population. It is included in the model to find

out the effect of increase in urban population on the environment. Maccarney et al, (2005) asserts that increased urbanization leads to improvement in environmental quality. The coefficient of URBP is expected to have a negative sign. The data for URBP is obtained from the World Development Indicators database.

**Index for Political Regime (POR):** POR is a dummy variable which assumes the value of 1 in a democratic regime and 0 otherwise. Within the study period of 1970-2010, years in which Ghana had democratic governments are assigned the value of 1 whereas years in which the country had military governance are assigned the value of 0. POR is added as a variable in the model to control for the effect of governance on the environment in a trade regime.

**HAVEN:** HAVEN is an interaction term capturing the combined effect of real gross national product per capita (RGNPPC) and openness to trade (TRADE) on the environment. The variable is included in the study to ascertain the existence or otherwise of the claim of the pollution haven hypothesis in Ghana. The pollution haven hypothesis postulate that developing countries experience deterioration in environmental quality when they open up to trade: hence the coefficient of HAVEN is expected to be positive (Hall, 2003).

#### **4.5 Empirical Estimation**

The empirical model to be estimated is based on Antweiler et al, (2001) with some modifications. For the purpose of this study, we have added three additional variables (URBP, POR and HAVEN) to Antweiler's basic model. More so, Antweiler et al (2001) uses SO<sub>2</sub> emissions as a dependent variable but this study employs CO<sub>2</sub> emissions and

Net Forest Depletion as dependent variables owing to their relevance in the case of Ghana and data availability for the study period. Applying the least squares estimation procedure, the model to be estimated takes the following form:

$$CO2_t = \beta_0 + \beta_1(TRADE_t) + \beta_2(K_t/L_t) + \beta_3(RGDP_t/K) + \beta_4(RGNPPC_t) + \beta_5(URBP_t) + \beta_6(PORT_t) + \beta_7HAVEN + \varepsilon_t \dots \dots \dots (7)$$

$$NFD_t = \alpha_0 + \alpha_1(TRADE_t) + \alpha_2(K_t/L_t) + \alpha_3(RGDP_t/K) + \alpha_4(RGNPPC_t) + \alpha_5(URBP_t) + \alpha_6(PORT_t) + \beta_7HAVEN + \varepsilon_t \dots \dots \dots (8)$$

Where each element in the sequence has  $E(\varepsilon_t) = 0$ ,  $E(\varepsilon_t^2) = \theta^2$ , and  $Cov(\varepsilon_t, \varepsilon_s) = 0$  for all  $s \neq t$ . Each element in the series is assumed to be a random variable drawn from a population with constant variance. In sum, the data set used in estimating the equations above should be stationary stochastic processes for the parameter estimates to be valid. The Augmented Dickey Fuller (ADF) test for stationarity is used to test all the variables for unit root before the final estimation of the above equations. The ADF test is applied to test for the presence of unit roots (non-stationarity) in time series models. The basic objective of the test is to test the null hypothesis of non-stationarity against the alternative hypothesis of stationarity in a time series variable. The econometric theory depicted in this section draws largely from the works of Greene (2003) and Verbeek (2004).

Using the Eviews statistical package, equation (5) is estimated twice, once with CO<sub>2</sub> emissions as the dependent variable (7), and again with NFD (Net Forest Depletion) as the dependent variable (8). CO<sub>2</sub><sub>t</sub> is the yearly quantity of carbon dioxide emission due to

flaring and combustion processes in Ghana only.  $NFD_t$  is the level of deforestation in Ghana in year  $t$ . The effect of trade liberalization on environmental quality is given by the coefficient on the variable TRADE. The coefficients on the variables  $K_t/L_t$ ,  $RGDP_t/K$ , and  $RGNPPC_t$  give an indication of the direction of the composition, scale, and technique effects of trade on the environment in Ghana respectively. The effect of urbanization on the environment is shown by the coefficient on the variable URBP whereas the coefficient on POR measures the direct effect of the political regime in Ghana at a given time on the environmental quality. The direction of the coefficient on the variable HAVEN would confirm the existence or otherwise of the pollution haven effect in Ghana.

## CHAPTER FIVE

### ESTIMATION AND DISCUSSION OF RESULTS

#### 5.1 Introduction

This chapter presents the econometric estimations and discussion of results of the study. There are four sections in this chapter. Section one presents the descriptive statistics of the data used for the study. The second section contains the stationarity test of the time series properties of the data for the estimation. This is then followed by section three which presents the results of the least square regressions for equations 7 and 8. Section four presents the interpretation and discussion of the empirical results of the study.

#### 5.2 Descriptive Statistics of Variables

The data on Carbon dioxide emission (CO<sub>2</sub>), Net Forest Depletion (NFD), Trade Openness (TRADE), Capital-Labour ratio (K/L), Real GDP per square kilometer (RGDP/K), Real GNP per capita (RGNPPC), Urban Population Rate (URBP) and the Political index (POR) are all made up of forty observations ranging from the period 1970-2010. The mean values, standard deviations, minimum values and maximum values of all the variables in the study are presented in table 5.1.

**Table 5.1: Descriptive Statistics of Variables**

Variable	Number of observations	Mean	Std. Dev.	Min	Max
year	40	1990	11.97915	1970	2010
Carbon dioxide emissions (CO2)	40	.2979101	.0534528	.2071505	.4243002
Net Forest Depletion (NFD)	40	1.50878	1.08439	.03	4.09
Trade Openness (TRADE)	40	92.42328	26.91923	46.35398	157.641
Capital-Labour ratio (K/L)	40	636.7452	219.3122	389.351	1227.892
Real GDP per square kilometer (RGDP/K)	40	32398.73	31048.69	8856.608	134886.3
Real GNP per capita (RGNPPC)	40	429.2683	224.0021	250	1250
Urban Population Rate (URBP)	40	37.85624	7.199369	28.972	51.215
Political Index (POR)	40	.5853659	.498779	0	1

*Source: Author's Estimation*

From the table above, the average emission of Carbon dioxide is 0.298 kilotons, the maximum and minimum emission levels of Carbon dioxide are 0.424 kilotons and 0.207 kilotons respectively. The mean rate of forest depletion is 1.5% and the maximum and the minimum rates of depletion are 4.09% and 0.03%. The mean rate of Trade Openness is 92.42%. The maximum and minimum rates of Trade Openness are 157.64% and 46.35% respectively. The Political Index (POR) is a dummy variable with a maximum value of 1 and a minimum value of 0.

### 5.3 Results of Stationarity Test

To avoid spurious regression estimates as a result of the use of non-stationary variables, the variables in the study were tested for stationarity. The Augmented Dickey-Fuller (ADF) test for unit root was adopted to test each variable at levels for the presence of unit root. The ADF test result for the variables at levels is provided as Table 5.2.

**Table 5.2: ADF Test Results on Stationarity for Variables at Levels**

<b>Variables</b>	<b>Augmented Dickey-Fuller test statistic</b>
Carbon Dioxide (CO <sub>2</sub> )	-2.340446
Net Forest Depletion (NFD)	-2.133307
Capital-Labour ratio (K/L)	-3.082394
Real GDP per square kilometer (RGDP/K)	-0.080679
Real GNP per capita (RGNPPC)	-2.029911
Trade Openness (TRADE)	-1.576262
Urban Population Rate (URBP)	0.878146

*Source: Author's Estimation*

**ADF Critical Value at 5% Significance Level: -3.5336601**

**ADF Critical Value at 10% Significance Level: -3.200320**

Since all the coefficients are greater than the ADF critical values at the 5% and 10% significance levels, we fail to reject the null hypothesis that there are unit roots in all the variables at levels. The ADF test results depicted in table 5.2 therefore reveal that all the variables are non-stationary at levels. That is, the series for Carbon Dioxide emissions, Net Forest Depletion, Capital Labour ratio, Real Gross Domestic Product per square Kilometer, Real Gross National Product Per Capita, Trade Openness and Urban Population Rate all have unit roots. According to Verbeek (2004) OLS regression estimates involving non-stationary variables yield invalid parameter estimates. The

results of such regressions are therefore not much useful in making meaningful economic analysis and deductions. Against this background, the first differences of all the variables were taken in order to obtain stationary variables. The ADF test for unit root was then used to test the first differences of all the variables for stationarity. Table 5.3 presents the details of the ADF test of the first differences of the variables.

**Table 5.3: ADF Test Results on Stationarity for the First Differences of the Variables**

<b>Variables</b>	<b>Augmented Dickey-Fuller test statistic</b>	<b>Order of Integration</b>
Carbon Dioxide (CO <sub>2</sub> )	-6.742752	I(1)
Net Forest Depletion (NFD)	-3.866085	I(1)
Capital-Labour ratio (K/L)	-8.498604	I(1)
Real GDP per square kilometer (RGDP/K)	-5.165679	I(1)
Real GNP per capita (RGNPPC)	-3.474220	I(1)
Trade Openness (TRADE)	-5.231512	I(1)
Urban Population Rate (URBP)	-6.815641	I(1)

*Source: Author's Estimation*

**ADF Critical Value at 5% Significance Level: -3.536601**

**ADF Critical Value at 10% Significance Level: -3.200320**

The ADF test results presented in table 5.3 show that all the variables with the exception of Real GNP per capita are stationary at first difference at the 5% significance level. Real GNP per capita rather becomes stationary at the 10% significance level. Thus, all the variables are integrated of order one I(1) or become stationary after first differencing.

### 5.4 Results of Least Squares Multiple Regression Estimates

After taking the first differences of all the variables in order to get rid of unit root in the variables, the Least Squares multiple regressions for equations 7 and 8 were estimated.

Table 5.4 presents a summary of the regression estimates.

**Table 5.4: Results of Least Squares Multiple Regression Estimates for Equations 7 & 8 (All variables at First Differences)**

Explanatory Variables	Regressand = $\Delta\text{CO}_2$ (Equation 7)	Regressand = $\Delta\text{NFD}$ (Equation 8)
Constant	-0.000738 (0.002314)	-0.152820*** (0.031781)
Trade Openness (TRADE)	0.000256 (0.000371)	-0.007941*** (0.001768)
Capital-Labour ratio (Composition effect)	4.26E-05** (1.51E-05)	0.000164** (7.55E-05)
Real GDP per square kilometer (Scale effect)	2.44E-06*** (4.91E-07)	-1.81E-05*** (2.14E-06)
Real GNP per capita (Technique effect)	-0.000322*** (1.46E-05)	-0.000312* (0.000183)
Urban Population rate (URBP)	0.004572 (0.006639)	0.262347*** (0.071793)
Political index (POR)	-0.001413 (0.013283)	0.050036 (0.040001)
Pollution Haven Effect (HAVEN)	7.09E-06** (2.16E-06)	0.000307** (9.81E-05)
R-squared	0.391835	0.325579
Adjusted R-squared	0.249929	0.156174
F-statistic	2.761242**	0.331597*
DW-statistic	3.043472	1.727846

*Source: Author's Estimation*

**Note: 1. Standard errors are provided in parentheses**

**2. \* indicates significance at the 10% significance level**

**3. \*\* indicates significance at the 5% significance level**

**4. \*\*\* indicates significance at the 1% significance level**

The R-squared of 0.39 in equation 7 implies that 39% of variations in the dependent variable (Carbon dioxide emission) are explained by variations in the independent variables. Also the R-squared of 0.33 in equation 8 means that 33% of changes in Net Forest Depletion are explained by changes in the independent variables. Although the R-squared and the adjusted R-squared in both equations are quite low, the F-statistics for both equation 7 and equation 8 are statistically significant. This implies that the independent variables together are significantly in explaining variations in the dependent variables. The Durbin Watson statistics of 3.0 for equation 7 and 1.7 for equation 8 show that serial autocorrelation is not present in the regression estimates.

### **5.5 Interpretation and Discussion of Results**

The estimated regression result for equation 7 which has CO<sub>2</sub> as the dependent variable indicate that Trade Openness, Composition effect, Scale effect, Urban Population rate and the Pollution Haven effect have a positive relationship with Carbon dioxide emission whereas the Technique effect and Political index have a negative relationship with Carbon dioxide emission. The Composition effect, Scale effect, Technique effect and the Pollution Haven effect are statistically significant whereas Trade Openness, Urban Population rate, and the Political index are not statistically significant in explaining variations in Carbon dioxide emission in Ghana.

The coefficient of the Composition effect (4.26E-05) means that a unit increase in the share of pollution intensive goods in total output as a result of trade results in an increase in Carbon dioxide emissions by 4.26E-05 kilotons. The coefficient of the Scale effect (2.44E-06) implies that a trade-induced increase in output by one unit leads to a rise in Carbon dioxide emissions by 2.44E-06 kilotons. The positive coefficients of the Composition effect and the Scale effect imply that they are adverse to Carbon dioxide

emission. Thus, the trade-induced Scale and Composition effects lead to an increase in Carbon dioxide emission in Ghana. On the other hand the negative coefficient of the Technique effect means that the trade-induced Technique effect rather leads to a fall in Carbon dioxide emission. The coefficient of the Technique effect (-0.000322) means that a trade-induced unit increase in income levels result in a reduction in Carbon dioxide emissions by 0.000322 kilotons. The directions of the Scale effect, Composition effect and the Technique effect in equation 7 are in line with the theoretical expectations.

The magnitude of the adverse Composition and Scale effects of trade more than offset the benefit of the favourable Technique effect and thus, making trade liberalization detrimental to Carbon dioxide emission and hence detrimental to the environment. The excessive use of fossil fuels, the use of obsolete technology in production and the continuing degradation of Ghana's forest are some possible factors accounting for the detrimental effect of trade liberalization on Carbon dioxide emission in Ghana. This finding is in line with the findings of Feridun et al, (2007) which reports that free trade has a detrimental impact on Carbon dioxide emission in Nigeria as a result of an adverse Scale and Technique effects overriding a positive composition effect. Further, this result is supported by the findings of Managi et al, (2008) which reports that trade liberalization is beneficial to the environment in OECD countries, but has detrimental effects on sulfur dioxide (SO<sub>2</sub>) and carbon dioxide (CO<sub>2</sub>) emissions in developing countries. The result is consistent with a World Bank report (2012) that Ghana has experienced a drastic increase in Carbon dioxide emissions in the post liberalization period from 0.2 kilotons in 1984 to 0.45 kilotons in 2010 as a result of high rate of

deforestation, persistent increase in imports and usage of fossil fuels, electrical and electronic gadgets and second-hand automobiles which have high pollution effects.

The pollution haven hypothesis states that developing countries such as Ghana are likely to suffer deterioration in environmental quality in a trade regime as a consequence of ineffective environmental policies. The positive coefficient on the variable HAVEN suggest that weak environmental policies in the post liberalization period could be a contributing factor to the persistent rise in CO<sub>2</sub> emissions in Ghana. The adverse Pollution Haven effect is statistically significant although the estimated coefficient of 7.09E-06 is relatively small. The direction of the estimated Pollution Haven effect is consistent with the theoretical proposition. We can therefore conclude that trade liberalization to an extent has facilitated a relocation of pollution intensive industries from industrialized countries into Ghana as a result of weak environmental policies in the country and thereby contributing to high Carbon dioxide emissions. This finding is consistent with the outcome of Mccarney et al, (2005) that relatively rich countries may be experiencing improved environmental quality through reduced emissions associated with openness to trade at the expense of environmental deterioration in developing countries such as Ghana. This outcome is also in line with the findings of Feridun et al, (2007) which reports that the Pollution Haven effect is detrimental to Carbon dioxide emission in Nigeria. The result however, contradicts the conclusion of an empirical literature survey by Copeland and Gulati (2006) that “environmental regulatory differences do not necessarily determine the direction of international trade as claimed by the Pollution Haven Hypothesis”.

The OLS regression results for equation 8 which has Net Forest Depletion as the dependent variable indicate that Trade Openness, Real GNP per capita (Technique

effect) and Real GDP per square kilometer (Scale effect) inversely explain variations in Net Forest Depletion whereas Capital-Labour ratio (Composition effect), Urban Population rate, Political index and the Pollution Haven effect positively explain changes in Net Forest Depletion in Ghana. All the explanatory variables in equation 8 are statistically significant with the exception of the Political index.

The negative estimated coefficient of Trade Openness means that increased trade liberalization has the tendency to reduce the rate of forest depletion in Ghana. Specifically, the estimated coefficient of  $-0.00794$  means that a unit increase in Trade Openness results in a fall in the rate of forest depletion by 0.79%. Thus, the direct effect of trade liberalization on forest resources is favourable and statistically significant leading us to reject the null hypothesis that trade liberalization does not significantly affect the rate of depletion in forest resources in Ghana. The directional impact of trade liberalization on forest resources is quite interesting as it contradicts the theoretical expectations that increased trade will further-up depletion of natural resources in a developing country like Ghana. The result is however, supported by a forestry commission report in March 2013 that, there has been a slight increasing trend of the overall area of forest land in Ghana between 1990 and 2010, which is by 2.38% of total country area although the forest has been generally degraded. The result is also in line with the outcome of López (2000) that trade liberalization has a direct positive effect on forest resources in Côte d'Ivoire. More so, the result is consistent with observed trends in the data used in the study. Despite the fact that trade intensity increased from 74.69% in 1994 to 97.22% in 2005, the rate of forest depletion per annum in Ghana fell drastically from 4.09% to 1.81% within the same period (WDI, 2012). This could be an indication that trade liberalization has helped to reduce the pressure on Ghana's forest stock. An

anecdotal reason that has been cited to explain the decline in forest depletion is that high government subsidies on LPG over the years has promoted its wide use as energy for cooking and a decline in the use of charcoal and fuel wood which have high deforestation effects.

In line with the theoretical expectations the coefficient of the Composition effect is positive and statistically significant meaning the trade induced composition effect is detrimental to the depletion of forest resources in Ghana. The coefficient of 0.000164 for the composition effect means that a trade-induced increase in the share of natural resource intensive goods in total output by one unit results in a rise in forest depletion by 0.02%. The coefficient of the Technique effect (-0.000312) implies that a trade-induced rise in income levels by one unit leads to a reduction in the rate of depletion of the forest by 0.03%. The sign of the coefficient means that the trade-induced technique effect on the forest is favourable signifying that the rise in income associated with increased trade openness results in a decline in the rate of depletion of the forest in Ghana. In contrast to the theoretical expectations, the Scale effect has a negative coefficient and statistically significant meaning increased output from trade results in a decline in the depletion of forest resources in Ghana. This result is very baffling but a probable reason could be that the trade regime has witnessed a drastic increase in the cultivation of permanent tree crops such as cocoa, oil palm, rubber, coffee and cashew which also serve as forest cover. According to Botchie et al, (2003) these crops generate a number of positive environmental externalities including; Soil erosion prevention, groundwater recharge, watershed & catchments area protection, air quality improvement through carbon sequestration & beautification of rural landscape.

The magnitude of the favourable Scale and Technique effects of trade far outweigh the adverse Composition effect, making the net effect of trade liberalization on forest resources favourable. This outcome is in contrast to the theoretical proposition that trade liberalization leads to depletion of forest resources in developing countries. The result also contradicts the findings of López (1997) that trade liberalization has adverse effect on forest resources in Ghana due to a large adverse scale effect of increased output and a negative composition effect of free trade. However, the forest commission report (2013) that forest cover in Ghana has been increasing over the last two decades gives credence to this result. This finding is also consistent with the findings of López (2000) that trade liberalization has a positive effect on forest resources in Côte d'Ivoire. López (2000) reports that a positive composition effect resulting from trade liberalization outweighs the negative scale effect resulting in a positive effect of trade liberalization on forest resources in Côte d'Ivoire.

The coefficient of the pollution haven effect in equation 8 has a positive sign and significant confirming that the claim of the pollution haven hypothesis applies in the case of forest resource depletion in Ghana. This suggests that less-stringent environmental regulations in the post liberalization period could be a contributing factor to forest degradation in Ghana. The direction of the Pollution Haven effect in Ghana conforms to the proposition of the pollution haven hypothesis that trade liberalization leads to increased depletion of natural resources in developing countries as a result of less effective environmental regulations. We therefore conclude that trade liberalization has contributed to forest degradation in Ghana as a result of relocation of environmentally-sensitive industries into the country.

The positive coefficient on Urban Population rate in model 8 means that increased urbanization has the tendency to lead to a rise in the depletion of forest resources in Ghana. Specifically, the coefficient of 0.262347 means that a unit increase in the urban population rate leads to a rise in forest depletion by 26%. The estimated impact of Urban Population rate on Net Forest Depletion is very strong and statistically significant. This finding contradicts the findings of Maccarney et al, (2005) that increased urbanization leads to improvement in environmental quality. A potential rationalization for the large adverse effect of urbanization on forest depletion in Ghana could be that urban population growth leads to increased demand for urban housing and conversion of forest zones into the development of industrial areas. Sand weaning for construction purposes also contributes to the fast depletion of forest resources in the urban areas of Ghana. This finding is consistent with a report by the forest commission in March, 2013 that human settlements pose the greatest risk to forest depletion in Ghana.

## CHAPTER SIX

### SUMMARY OF FINDINGS, CONCLUSION AND POLICY

#### RECOMMENDATIONS

##### 6.1 Introduction

This chapter is divided into two sections. The first section presents a summary of the findings of the study. The second section provides policy recommendations based on the empirical results, and identified areas for further research.

##### 6.2 Summary of Findings

It is argued in the trade-environment literature that free trade worsens the already existing environmental problems of economic activity in the form of depleted natural resources or harmful emissions. A contrasting view to this argument is the notion that free trade leads to increase in income levels which can result in improvement in environmental quality. Given the contradictions in the literature concerning the trade-environment relationship, this study sought to provide fresh evidence on this issue by addressing the following research questions:

- i. What is the relationship between trade openness and environmental quality in Ghana?
- ii. What is the direction of the scale, the composition and the technique effects of trade on the environment in Ghana?
- iii. Does the pollution haven effect hold in the case of Ghana?

After applying economic theory and econometric tools to estimate the effect of trade liberalization on the environment in Ghana, the following findings were revealed:

Trade liberalization has an adverse but insignificant effect on Carbon dioxide emission in Ghana. Regarding the direct effect of trade on forest resources, the results revealed that trade liberalization leads to a fall in Net Forest Depletion. This implies that trade openness has a favourable effect on forest resources in Ghana.

On the direction of the trade-induced scale, technique and composition effects on the environment, the results show that the trade-induced Scale and Composition effects are adverse for Carbon dioxide emissions whereas the Technique effect for Carbon dioxide emission is favourable. The adverse Scale and Composition effects override the positive Technique effect making the overall effect of trade on Carbon dioxide emission unfavourable. The results further indicate that the Composition effect is adverse for Net Forest Depletion whereas the Scale and Technique effects for Net Forest Depletion are favourable. The positive Scale and Technique effects outweigh the adverse Composition effect making the overall effect of trade liberalization on forest resources favourable.

Meanwhile, by testing for and failing to reject the pollution haven hypothesis in the two regression equations, it is suggested that the relocation of pollution intensive industries into Ghana as a result of weak environmental policies could be contributing to Carbon dioxide emissions and the depletion of forest resources in the country.

### **6.3 Conclusion**

Many causes of environmental degradation in Ghana and the developing world as a whole obviously do not emanate from international trade. Botchie et al, (2003) reports that in Ghana, clearing of large acreages of land for the production of staple foods every year is responsible for many negative environmental externalities such as soil

degradation, soil compaction, surface soil crusting and loss of the stability of the soil, desertification and increased concentrations of greenhouse gases such as CO<sub>2</sub>. This notwithstanding, the present study suggest that the effects of trade liberalization on the environment in Ghana cannot be ignored. The findings of the study demonstrate that trade liberalization has an adverse effect on CO<sub>2</sub> emissions but rather results in a reduction in the annual rate of forest depletion in Ghana. This leads to the conclusion that trade liberalization has detrimental impacts on emissions of global pollutants such as CO<sub>2</sub>. Trade openness however, has favourable impact on forest resources in Ghana. Based on the findings from the study, the following policies are recommended.

#### **6.4 Policy Recommendations**

In order to avert the pollution haven effect, it is recommended that Ghana examines carefully the environmental challenges that come from participating in any further trade liberalization policies such as the ongoing Economic Partnership Agreement (EPA) negotiations with the European Union (EU). Thus, Ghana should develop its capacity to effectively participate in all trade negotiations so as to ensure that decisions on the environmentally sensitive sectors such as mining are in the interest of the country.

Likewise, the continuing dependence on environmentally sensitive commodities such as gold and timber as major foreign exchange earners over the years has lead to environmental degradation in the country. Further trade liberalization policies should be accompanied by significant investments in the development of the nation's human resources through education and skills development, research and innovation so as to enhance the capacity of Ghana's workforce to take advantage of new employment opportunities created through globalization and to diversify its output and exports. This

will help reduce the rate of exploitation of Ghana's natural resources, and to create adequate safety nets to protect the poor and safeguard the environment in this era of rapid globalization. Environmentally unfriendly practices such as shifting cultivation, slash and burn, clearing of watersheds for farming and mining purposes, sand and stone winning around water courses should also be banned to avert their negative effects on the environment.

In order to safeguard Ghana's environment in this era of globalization, environmental objectives should be properly integrated into government's development policies and poverty reduction programs. Research should be directed at finding the links and interrelationships between rural poverty incidence and degradation of natural resources to better enhance the mainstreaming of environmental concerns into development policies. In this regard it is highly commendable to note that Ghana's New Medium-Term Development Policy Framework for the period 2010-2013 under the Ghana Shared Growth and Development Agenda (GSGDA) - has been adopted to provide a comprehensive solution to address the interlinked sectors of natural resources, environment and climate change.

A more worrying finding of this study is the fact that 70% of imports of electrical and electronic equipment into Ghana are used products with 30% been near obsolete (e-waste). The ban on the imports of used home appliances recently is therefore a step in the right direction. What is needed is a strict enforcement of this ban to totally curb the imports of such goods. It is also recommended that the government imposes high taxes on the imports of used vehicles to discourage their mass imports into the country.

The study could not account for the effect of trade openness on other relevant measures of environmental degradation such as nitrogen oxide (NO<sub>2</sub>), sodium oxide (SO<sub>2</sub>) and Biochemical Oxygen Demand-BOD (a measure of pollution of water bodies) as a result of data limitations. It is therefore recommended that future studies on the trade-environment relationship in Ghana should be focused on finding the effect of the country's trade liberalization policies on NO<sub>2</sub>, SO<sub>2</sub> and BOD.

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## APPENDIX I

## Results of OLS Multiple Regression Estimates for Equation 7

Dependent Variable: DCO2

Method: Least Squares

Date: 05/30/13 Time: 01:57

Sample (adjusted): 2 39

Included observations: 38 after adjustments

HAC standard errors &amp; covariance (Prewhitening with lags = 4, Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DHAVEN	7.09E-06	2.16E-06	3.279976	0.0026
DK_L	4.26E-05	1.51E-05	2.822601	0.0084
DRGDP_K	2.44E-06	4.91E-07	4.978641	0.0000
DRGNPPC	-0.000322	1.46E-05	-22.08274	0.0000
DTRADE	0.000256	0.000371	0.691260	0.4947
DURBP	0.004572	0.006639	0.688698	0.4963
POR	-0.001413	0.013283	-0.106357	0.9160
C	-0.000738	0.002314	-0.319087	0.7519
R-squared	0.391835	Mean dependent var		0.001760
Adjusted R-squared	0.249929	S.D. dependent var		0.034581
S.E. of regression	0.029949	Akaike info criterion		-3.993973
Sum squared resid	0.026908	Schwarz criterion		-3.649218
Log likelihood	83.88549	Hannan-Quinn criter.		-3.871312
F-statistic	2.761242	Durbin-Watson stat		3.043472
Prob(F-statistic)	0.024374			

**APPENDIX II****Results of OLS Multiple Regression Estimates for Equation 8**

Dependent Variable: DNFD

Method: Least Squares

Date: 05/30/13 Time: 02:07

Sample (adjusted): 2 41

Included observations: 40 after adjustments

HAC standard errors & covariance (Prewhitening with lags = 4, Bartlett  
kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DK_L	0.000164	7.55E-05	2.170687	0.0375
DHAVEN	0.000307	9.81E-05	3.133194	0.0037
DRGDP_K	-1.81E-05	2.14E-06	-8.476922	0.0000
DRGNPPC	-0.000312	0.000183	1.706145	0.0977
DTRADE	-0.007941	0.001768	-4.491029	0.0001
DURBP	0.262347	0.071793	3.654215	0.0009
POR	0.050036	0.040001	1.250880	0.2200
C	-0.152820	0.031781	-4.808552	0.0000
R-squared	0.325579	Mean dependent var		0.022000
Adjusted R-squared	0.156174	S.D. dependent var		0.462042
S.E. of regression	0.448877	Akaike info criterion		1.412722
Sum squared resid	0.447708	Schwarz criterion		1.750498
Log likelihood	-20.25445	Hannan-Quinn criter.		1.534851
F-statistic	0.331597	Durbin-Watson stat		1.727846
Prob(F-statistic)	0.067934			