The Ethical Dilemmas of Global Warming and its Mitigation Strategies

By

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DECLARATION

I declare that this research project is my original work and has not been presented for examination in any other university

Sign:……..... **Date:…….**

Eston Mbogo Kariuki

This research project has been submitted for examination with our approval as university supervisors

Sign:……. **Date:…….**

Prof. Karori Mbugua

Sign:……. **Date:…….**

Dr. Patrick O. Nyabul

DEDICATION

I dedicate this work to all my tutors, my family and friends for the sacrifice and overwhelming support during the drafting and revision of this research project. Their motivation, love, care, encouragement and enthusiasm inspired me to achieve this goal. Without them this research would not have been possible.

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ABSTRACT

This research titled, "The Ethical Dilemmas of Global Warming and its Mitigation Strategies", focuses on the ethical issues arising from global warming and especially the implications of mitigation and adaptation on the least advantaged globally. Global warming is primarily attributable to the increased burning of fossil fuels in both developed and developing nations and is considerably destroying the Earth's climate. This research observes that harmful climatic effects resulting from this phenomenon are today experienced mostly by the least developed countries. Those who have contributed least to global warming and greenhouse gas emissions are suffering the worst climatic effects.

This research uses Garrett Hardin's famous thesis *The Tragedy of the Commons* as its theoretical framework. Hardin observed that people tend to over-exploit a commonly owned resource resulting in its eventual ruin. In this study, earth's climate is "the commons" under threat of destruction by global warming. Based on Hardin's thesis, this study begins by exploring the ethical implications of harmful climatic effects arising from the burning of fossil fuels and the inadequate capacity of poor countries in arresting these effects. This study examines climate-science and its epistemic status in light of the ethical issues claimed to follow from global warming. This is followed by an examination of mitigation strategies developed over time and the ethical dilemmas of the responsibility we have today of industrializing while averting harmful climatic effects on the poor and potential harm to future generations.

The research then examines the Kyoto Protocol, the most notable international agreement crafted to address global warming and its effects. This Protocol proposed reductions in greenhouse emissions and mitigation mechanisms by nation-states to save the world from further heating and catastrophic climatic effects. The research observes that the implementation of this protocol has been, and is still, controversial as it is not binding on all nations and is therefore insufficient in abating global warming.

With regard to mitigation mechanisms proposed under this Protocol, this research observes that the least advantaged countries have inadequate capacities of implementing these measures at the expense of their economic progress while many developed nations are reluctant to intensify mitigation efforts despite having the means. This situation represents the stretching of commonly owned resources by a growing and industrializing population similar to the addition of extra herds in a limited pasture espoused by Hardin. The research concludes by recommending joint efforts by all nations in mitigating global warming through carbon-capture techniques and the use and development of renewable energy sources in addition to formulation of a much stronger binding framework committing state-parties to lower their emissions for the sake of present and future generations. These efforts will go a long way in saving and protecting our global commons-the climate.

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CHAPTER ONE

GENERAL INTRODUCTION

1.1 Background to the Research

Today it is widely accepted that global warming is one of the greatest challenges facing humankind. Since the turn of the 21st century, climatic changes have brought to the fore the reality of the environmental crisis man faces. There is growing empirical evidence that the Earth's climate is changing for the worse and humanity has to deal with the resulting adverse effects (Bjornberg, 2011, p. 671). These effects not only hurt the poorest in society across the globe but will potentially harm future generations as well. This is in part as a result of growing human population and disregard for environmental conservation and by extension global climate similar to addition of extra herds in a pasture with limited foliage.

Since the Industrial Revolution, going tandem with a growing population in a world with limited resources, man has made great technological and economic strides. This means that natural resources are being exploited for the purpose of raising living standards. This pursuit of economic growth has improved living standards and avails more material goods and services for everyone raising economic fortunes for the least advantaged globally. However, in addition to economic growth is the tendency of each individual to pursue his own best interest.

Economic growth in this context is contributing to increased personal freedom- everyone acting as he/she pleases without regard for others including future generations.

This gives rise to the present ethical dilemmas- humans exploiting natural resources to the extent of depletion and pollution of the environment and potentially harming future generations. The result of this is negative climatic effects being witnessed today arising from the ruin of commonly owned resources similar to the increase and over-use of the communal farm in Garrett Hardin's thesis *The Tragedy of the Commons* (Goudie, 1987, p. 249, Larkin, 1993, p. 209).

Garrett Hardin, whose theory guides this research, was born on April, 21, 1915 in Texas. He was an eminent American biologist who studied at Stanford University where he earned a Ph.D. in Microbial Ecology. As a leading ecological thinker, he wrote and stressed on the need for setting limits on population growth, restrictions on American immigration and advocated for birth control as well as supported abortion. He speculated that famine, wars, genocide could all be viewed from an evolutionary perspective as a natural means of population control. His seminal paper *The Tragedy of the Commons*, first published in 1968, cited the problem of world over-population and the resultant environmental degradation as its two core themes (www.anb.org/articles/16/16-03570.html). Using these themes, this research examines the ethical dilemmas human generations present and future face in addressing global warming, climate change and its mitigation.

In this research, by climate change, refers to long-term changes in weather factors such as humidity, precipitation, cloudiness and winds. These, change in quantity from time to time however of all quantities, temperature changes are the most affected by human-induced industrial actions (Dessler, 2006, p. 47). Temperatures are warming as a result of air pollution and the volume of pollutants we are pouring into the atmosphere

hence global warming (Flannery, 2005, p. 3). These pollutants are Greenhouse gas emissions. By atmosphere, we are raising the question of a global commons. That is, all resources owned by man in common such as air, oceans and so on (McCay, 1990, xii).

With Earth's climate warming, the resultant negative impacts include increasing air and ocean temperatures, melting of glaciers and ice, rising sea levels, biodiversity loss, desertification, water scarcity, global food availability, resource depletion, waste and energy insecurity (Becker, 2013, p. 38). The commons are under threat including global climate (McCay, 1990, xvi, Hardin, 1968, p. 1243).

With global temperature levels gradually rising, and climatic variations happening on the other hand, extreme weather conditions are now worldwide with people facing many weather-related challenges (Gupta, 2001, p. 2). This is unsurprising given the laissez faire attitude humanity exhibits towards global climate in the quest for economic progress and industrialization. This evidence of climate change has led to the propounding of various solutions such as government intervention to drastic ones such as privatization of certain commons (McCay, 1990, p. 1).

At present, those who have contributed least to carbon emissions in the past, suffer and will likely suffer the most from climate change in the future. These are poor developing countries and the poor in the developed world as well and this has ethical implications because rich nations, sustain high economic growth and technology by industrialization emitting the most greenhouse gases (Baatz, 2013, pp. 94-110). This is a situation in which, global climate like the Hardinian communal farm has been polluted by carbon emissions to the point of destruction. Mitigation of global warming and its

negative effects poses an ethical dilemma on the welfare of citizens of both developed and developing nations and people to come in future.

1.2 Definition of Terms

Among the operational terms to be used in this research include:

- **Climate-** In this research this concept refers to the regular pattern or general weather conditions of a particular place over a span of time up to two or three decades.

- **Climate change** – this refers to changes in variations in atmospheric factors such as temperature, wind patterns and rainfall. In this research climate change is largely attributable to changes in temperature levels which are on the rise due to global warming,

- **Chlorofluorocarbons (CFCs)-** these are inert gases previously manufactured in the 1930s and used as industrial coolants, electronic cleaning solvents in addition to being propellants for spray cans and in the manufacture of foams.

- **Commons** –these are all the resources owned in common such as air, oceans, fish, grasslands (Hardin, 1968, pp. 1243-1244)

- **Clean Development Mechanism-** A policy in the Kyoto Protocol meant to assist Parties to the treaty in achieving sustainable development as well as contribute to emissions reductions and limitation.

- **Dilemma-** this concept refers to a type of social predicament whether to reduce exploitation of resources, consumption and perhaps personal well-being for the future of a group or continue at the same rate, risking the common pool (*ibid*).

- **Greenhouse gases (GHGs)** –these are gases such as carbon dioxide, methane and nitrogen oxide that partially absorb and re-emit outgoing long wave infra-red terrestrial radiation from the earth's surface. In this research, GHGs and carbon emissions are used interchangeably to represent similar emissions.

- **Greenhouse Effect**-this refers to the impeding of solar radiation back into space by gases such as water vapor and carbon dioxide in the atmosphere. These gases form a 'blanket' over the Earth's atmosphere thereby increasing its overall temperature.

- **Global Warming**-this refers to an increase in the Earth's average atmospheric temperature causing corresponding changes in climate and that may result from the greenhouse effect.

- **O**.**E.C.D**-this refers to the Organization for Economic Co-operation and Development which is a group of 34 countries providing governments with a forum for understanding economic, social and environmental matters.

- **Mitigation** – this term refers to strategies taken to combat climate change such as reduction of greenhouse gas emissions.

1.3 Statement of the Research Problem

Many people today are dying from negative effects of climate change such as recurrent droughts, floods, and changes in rainfall patterns among others. Others yet to be born will die from these effects. This research seeks to critically evaluate the ethical dilemmas posed by global warming and its mitigation on human populations by evaluating whether or not the developed and rich nation-states are perpetrating injustice on the world's poorest. The problem under study is that of human population increasing by the day, over-exploiting fossil fuels and generating tons of carbon emissions into the atmosphere to the extent that negative climatic effects have arisen. These negative effects are in turn hurting the vulnerable today and have the potential of harming future generations. Our global climate as our "commons" is being ruined more so by industrialization and the burning of fossil fuels.

Moreover, this research explores the ethical dilemma attributable to the reality and challenges arising from mitigating global warming at the expense of current and or future living standards. This means for example: abandoning the use of fossil fuels responsible for global warming, reduction in goods consumption especially those responsible for environmental pollution and job losses in industrial sectors. The benefits of such sacrifices are beneficial for future generations who will have an improved environment and climate. This however means a level of suffering for present generations. This is the ethical dilemma of balancing between the need to mitigate global warming while slowing down socio-economic progress today or advancing industrialization for better living standards for the present and future generations to come regardless of its effect on global climate.

1.4 Research Objectives

This research seeks:

- To examine the phenomenon of global warming and the ethical dilemma it poses on present and future generations.
- Attempt to address the ethical dilemmas posed to present and future generations by global warming and its mitigation by proposing a stronger binding framework.

1.5 Justification of the Research

Today, most of the human impacts on global climate are due to carbon dioxide emissions, both industrial and agricultural, water vapor, overgrazing, thermal pollution, diversion of fresh waters into oceans, affecting its salinity and freezing point, deforestation, among others. Humans are negatively changing both their environment and climate (Becker, 2013, p. 38, Goudie, 1987, p. 277). They are stretching commonly owned resources and over-exploiting some like fossil fuels to the extent of ruining global climate akin to the famers in Hardin's farm with limited verdure.

On the other hand, there are challenges posed by mitigation efforts aimed at reducing greenhouse-gas emissions. These have the ability of harming poor countries which are striving to grow economically and reduce the prevalent poverty of their citizens. Another challenge faced is the evident unwillingness by already "developed" nations to pay the cost of climate change mitigation. This study is therefore justified given the fact that ethical principles at present point to the conclusion that the costs of mitigating global warming ought, at least, initially to be borne by wealthy industrialized countries (Baer, *et al*, 2010, pp. 215).

This research is further justified by the fact that efforts of mitigating global warming on the other hand have high costs. In fact, to some, curbing greenhouse gases will result in economic losses for present generations, while to others we can solve the problem at a manageable cost. Climate scientist and philosopher Stephen Gardiner for example, observes that as of 2003, the United States administration had put in place an energy plan that would see the construction of 1300 new power plants in 20 years. This energy plan meant the creation of thousands of jobs, more power, hence greater industrialization, more production, better living standards and much more. On the flip side however, these power plants would boost her per capita greenhouse gas emissions by more than 3% (Gardiner, 2010, p. 12). Therefore, cutting emissions would have reverse effects for the United States, potentially lowering living standards! From this example, this research is justified in exploring what effects global warming and its mitigation might have on diverse nations-states especially the least advantaged globally.

This research is also justified by the fact that not all nation-states agree to put in place mechanisms that will limit the amount of GHGs emitted. This has ethical implications because they ought to do so as well as assist the least developed nations in mitigation efforts for the sake of present and future generations.

1.6 Scope and Limitations of the Research

With the effects of global warming being felt, majority of scientists and policy makers believe it is now a reality despite there being some controversy. In addition, if the warming continues, the very existence of life on Earth is threatened. In the findings of the Intergovernmental Panel on Climate Change (IPCC) report of the year 2001 it is observed

that ‘global average surface temperature has increased over the 20th century by about 0.6°C. According to the report, the 1990s was the warmest decade and 1998 the warmest year in the instrumental record since 1861 (Gardiner, 2010, p. 5).

From the above information, this research recognizes the interdisciplinary nature of the global warming debate as being more than just scientific. Therefore we will evaluate moral arguments in the global warming debate. Ethically, there are proponents who argue that based on economic costs, the developed world and especially the United Sates, ought to bear the highest mitigation costs whereas other philosophers argue there is little individuals can do to stem negative effects arising from global warming. In addition, there are arguments that the current costs of mitigation are way too high in comparison with benefits and there ought to be a balance between sustainable development and global warming mitigation (Attfield, 2012, p. 56, Sinnott-Armstrong, 2010, p. 232, Gardiner, 2010, p. 10). It therefore follows that morally, those responsible for the greatest global carbon emissions owe it to those who will suffer adverse climatic effects now and in future. These responsibilities are central to the scope of this research.

1.7 Literature Review

Philosopher Garrett Hardin in his famous thesis commonly referred to as *The Tragedy of The Commons* published in 1968, painted a picture of a pasture open to all. In this pasture, every herdsman tries to maximize their gain, each adding an animal to his herd, then another and another. He argued that man’s attitude towards the commons, in this research, finite resources and global climate, results in eventual decline and ruin of the same. Based on this thesis, this research contends that the exploitation and over-

consumption of fossil fuels is one of the causes of global warming. According to Hardin, the absence of private property rights characterizes the most crucial resources: air, water and other essentials of life (Hardin, 1968, pp. 1243-1248, Townsend, R. *et al*, 1990, p. 311).

This position is shared by J. McCay who observes that problems such as overpopulation, deforestation, and pollution and in this case global warming have the characteristic of "common property", nature. It is this nature that motivates people to behave in ways that are neither in society's best interests nor ultimately their own (McCay, 1990, xiv). Such behavior is encouraged by the institution of open-access. That is, when no one owns the resource, every user's self-interest dictates over-use just as we have done with global climate (Townsend, 1990, p. 311).

Climate on the other hand, refers to general trends of weather patterns in any region for example variations in temperature, humidity, wind direction and strength, precipitation. Of importance is the fact that climate also captures rare and more extreme weather events that cannot always be predicted accurately but only after a number of years (Boyle, 1989, p. 9). When weather trends change over time, this is referred to as climate change. For example, examining of weather records over decades can isolate fluctuations in say rainfall and or temperature and inform us on whether we are moving towards a warmer, colder, wetter or even windier future (*ibid*). As it stands, Earth is moving towards a warmer future. This is attributable to the over-exploitation of fossil fuels and an increase in anthropogenic GHG emissions in a 'limited' atmosphere.

According to Andrew Dessler on the other hand, the Earth is warmed by the sun and cooled by emitting radiation into space. Of the sunlight reaching Earth, 70% is absorbed to warm the surface, 30% is reflected back to space. Generally, the radiation absorbed is as a result of water vapor and carbon dioxide in the atmosphere. That is, these gases impede the exit of some of the sun's radiation back to space (Dessler, 2006, pp. 8-9). This natural warming mechanism of the Earth is referred to as the 'greenhouse effect' and it arises from the amount of greenhouse gases trapped in the atmosphere.

This research is concerned about anthropogenic causes of global warming. This is because humanity seems less concerned by increasing negative effects on global climate common to all. According to Stewart Boyle *et al*, by 1990, global output of carbon dioxide from burning of fossil fuels was about 20,000 million tons a year. That is, burning of 6 billion tonnes of carbon. Of all carbon dioxide emissions, 85% came from the industrialized northern hemisphere with USA accounting for 24%, China 9%, Britain 3%, and Australia 1.5% with more than seventy least-developed countries producing only 5%. These figures have obviously changed and in some cases like China, the figure has in the decade following rapid industrialization (Boyle, 1989, p. 33). Here, China's case can be analogously considered an increase in herds in a communal farm with limited lushness like Hardin argued.

What is clear is that the industrialized world generates 90% of its energy from burning of fossil fuels whereas developing nations heavily rely on burning wood otherwise called biomass which also contributes to carbon dioxide emissions. Tropical forests are being cleared in South-East Asia, Africa, South America and the carbon dioxide emitted from forest destruction is estimated at 2.2-10.2 billion tons per year.

That is 10-50% of fossil fuel emissions (*ibid*, p. 34). As noted, burning of fossil fuels for energy is essential for economic growth of both rich developed nations and poor nations as well. This is in spite of it polluting the environment to the extent of adverse climatic effects. The over-exploitation and burning of these fuels by a growing population in a limited Earth is slowly destroying global climate follows Hardin's analogy by the fact that global climate is getting ruined.

The effects of global warming are largely adverse and, could become worse for future generations unless action is taken to mitigate them. For example, climatic modelers predict an increase on average, Earth's surface temperatures by between 1.5˚C to 4.5˚C by 2050 unless greenhouse gases emissions are reduced substantially. The rise in global temperatures means more heat waves, droughts, storms and worse flooding, sea levels rising by 20 to 165 centimeters in response to expanding oceans and melting glaciers. Other adverse effects include extinction of some wildlife species, changes in some, and changes in growth and yields of staple crops, infiltration of underground drinking water by salty water, coastal floods, changes in disease patterns and mortality rates (*ibid*).

These effects will also have ripple effects through national and international economies forcing changes to investment and spending priorities of individuals, industries and public authorities as well (Boyle, 1989, p. 52). These changes are as a result of common yet limited resources being strained to serve growing population numbers. Martin Schonfeld for example, observes that climate change magnifies stresses on the Earth system. The demand for food, water, energy, and land by an exponentially growing population is stretching available resources. In fact a large

percentage of the human species have yet to reach reproductive stage which means that human population will take some time before leveling off. This means that competition for available water, land, and food can only get stiffer threatening our global climate.

Schonfeld argues that the competition is made worse by economic structures driven by a market economy. With the world economy growing 19 fold between 1900 and 2000 this means business and more business to satisfy consumption needs. Linked to this rapid economic growth in the last century, is a rapid increase in human population similar to Hardin's postulation of increasing herds. Whenever growth slows, stops or reverses, business gets hurt and markets face difficulties meeting social needs. Therefore our well-being is dependent on a system that requires growth (Schonfeld, 2011, p. 130). This growth has in part led to the decline in biological diversity, overfishing, desertification, soil erosion, falling water tables, considerably affecting global climate (*ibid*).

As recently as 2014, the United Nations (UN) has called for an end to the use of petroleum and coal energy so as to reduce the overheating of global climate. In fact, the third IPCC report observes that the only way to save the earth is to cut the use of fossil fuels and instead use alternative and renewable energy sources such as solar power, wind, nuclear and biofuels. This report predicts diseases, severe food shortages and flooding with, Mombasa for example, predicted to suffer losses of up to Kes 90 billion by 2030 as a result of flooding (IPCC, 2014).

What the UN advocates is the phasing out of fossil fuels in the coming decades. This however flies in the face of the economic aspirations of many developing nations.

For example, Kenya aims at economic exploitation of her recently found oil reserves by the year 2020. In addition, in Mui Basin of Kenya's Kitui County, coal reserves estimated to be worth USD 40 Billion and their extraction will provide 3500 megawatts of cheap electricity for the country. These resources are essential for Kenya's industrial take-off. She would like to industrialize and increase her economic output and strength even as her population increases (IPCC, 2014).

Whereas the UN wants cuts in the use of oil and coal, how will Kenya meet her Vision 2030 without greater energy generation and use? This is the ethical dilemma faced by many developing nations today. Should Kenya exploit and use coal and oil for industrialization today at the risk of environmental disaster in future or face an increase in poverty and misery while protecting and conserving the environment for future generations? In fact the UN succinctly notes that, 'the point is to 'decarbonize' electricity generation, which will have negative effects in industry, buildings, and transport sector' (*ibid*).

Linked to this line of thought is the argument that local problems such as litter or smog tend to generate environment awareness among societies whereas others go unseen for many years such as greenhouse gas emissions as a global example. To scholar Robin Attfield, such problems stem from what he refers to as the NIMBY (Not In My Back Yard) syndrome in which localized problems merge into regional problems with the end result being global problems. One thing he notes is that these global problems are repetitive in nature and have worldwide side-effects on the global economic and financial systems (Attfield, 2008, p. 8). This is similar to the inadequate communal farm in which extra herds were rapidly added to the point of destruction of

the farm. But the ethical dilemma persists. Is it moral to sacrifice the wellbeing of millions of people especially in the developing world at present and in future so as to protect the environment and by extension global climate from changing?

Attfield goes on to note that the IPCC recently concluded that world use of fossil fuels has to diminish by 60 to 90% in order to stem further growth of global warming. Developed nations were required to cut their emissions by 85 to 90% representing the unequal distribution of shares of total emissions. Developing nations on the other hand need to lift their people from poverty meaning that they need to generate more energy for industrial takeoff. Only through industrialization can these poorer nations satisfy the needs of their people and be in a position to share in the efforts to mitigate the effects of global warming (Attfield, 2012, p. 56). This implies the ethics of costs and benefits not just for existing generations but those to come in future.

Philosopher John Broome on the other hand notes that the present generation with the expert help of economists, must decide whether to aggressively reduce chances of future harm or to let our richer descendants largely fend for themselves. This stems from the fact that future generations will suffer most of the harmful effects of global warming unless we act. Yet if the world economy grows, they will be richer than we are. He argues that even daily actions such as driving a car, using electric power, buying things manufactured and or transported by means of energy-is a contribution to greenhouse emissions. Our realization of this should prompt us to try and stop emissions and compensate those we harm (Broome, 2008, p. 69).

Broome notes that the benefits gained by reducing greenhouse emissions are far greater than the cost of reducing them. This conclusion favors strong and quick action to control emissions. This however is countered by some economists who argue that the need to act is not so urgent (*ibid*, p. 71). For example economist William Nordhaus argues that as the economy grows, more and more goods are produced and these will have lesser value in future as a result of 'diminishing marginal value' and so we should not be so worried about the economic costs of global warming (*ibid*).

Nordhaus goes on to identify prioritarianism and utilitarianism as ethical theories that can address global warming in relation to future generations with the former attaching greater value to our benefits than the value attached to future peoples' benefits whereas the latter attaches equal value for both future and present generations. Therefore, according to prioritarianism, richer nations have greater responsibility towards global warming mitigation than utilitarianism does. In addition to the above is the concern of some philosophers that we have greater obligation saving the less fortunate today as opposed to the less fortunate 100 years in the future (*ibid*, p. 72).

Scholar Bjorn Lomborg on the other hand, argues that the global warming problem is primarily a question whether to help citizens of poor nations now or their richer descendants later. According to him, it is better to help the poor now as this is easy. To him, implementing the Kyoto Protocol meant to curb GHG emissions will cost above USD 150 billion per year whereas USD 70 billion to USD 80 billion a year could go a long way to providing basic necessities like health, education, water and sanitation to inhabitants in the Third World (Lomborg, 2001, p. 322). Therefore helping the least advantaged today is ethically justified as opposed to potential generations yet to be born.

Philosopher Stephen Gardiner informs this research by considering four suggestions in addressing the global warming problem. These include equal per capita entitlements in greenhouse emissions on the world's populations, allocation of certain inalienable rights to subsistence emissions to people necessary for their survival. In addition to this, there should be priority to the least well-off who suffer the most adverse effects of global warming and lastly a fair distribution of mitigation costs for all nations bonded by an agreement that places moral pressure on each nation to do its part without quitting the pact (Gardiner, 2010, p. 16-18).

On measuring the future catastrophe of global warming, the IPCC in 2013 reported that in the long run, if atmospheric greenhouse gases reach the warming equivalent of 550 parts per million, which is a rise of above eight degrees Celsius, the human population will be devastated. For example, a population collapse could cause the premature deaths of billions of people. Morally this raises the question of how bad it is for a person to die prematurely. Ethically, using Hardin's thesis, is it a necessarily bad thing when extra herds perish to save the limited pasture? Perhaps many people who would have existed in future will not come into existence. To some, this is a bad thing but if harm will be suffered by nobody, how can it be harm? How can there be a harm that harms nobody (Broome, 2008, p. 72)?

This position is further explored by Derek Parfit who examines the fact that our acts may have good or bad effects in the further future. For example, the choice between two energy policies, both that guarantee high living standards for the next two centuries but one would pose certain risks in the further future including a catastrophe that would kill and injure thousands of people. This is the choice between the Risky policy and the

Safe policy. This is the ethical question of showing concern for people in existence and those who will possibly exist in future (Parfit, 2010, p. 112-119).

As far as this research is concerned, redressing the effects of global warming on current and future generations is also one about justice. Philosopher Simon Caney for example, examines the fairest ways of dealing with burdens created by global climate change. He presents four principles that determine who should bear the burdens of climate change then compare them with the principle of "common but differentiated responsibilities". Distributive justice according to him raises questions of intergenerational justice especially the fact that effects of global warming will be felt by future people necessitating an adequate theory on the guiding principle and duties the present generation has to future generations (Caney, 2010, p. 122-123).

Caney identifies one principle he refers to as the "polluter pays" principle through which we can identify who the polluter is, the unit of pollution analysis, what kind of entities are the polluters. If it is individuals then, instead of each country paying for its damage, we should ideally claim that each individual should pay or his or her own share. On the other hand, if it is economic corporations spewing out greenhouse gas emissions, consuming vast amounts of fossil fuels, they should pay for their share as well. If it is states, then the onus is upon them to cut back on greenhouse gas emissions, devote more resources to adaptation and mitigation. If it is international regimes such as the International Monetary Fund, World Trade Organization or even OPEC, then they have a moral obligation to pay for their share of pollution (*ibid*, p. 125-127). In this study, I propose that reparations to global climate caused by GHG emissions be distributed to nation-states on a per capita basis in line with the above thought.

This individualist position is further examined by Walter Sinnott-Armstrong who argues that whereas global warming will increase in the next century and a significant part of it is due to the burning of fossil fuels, this will pose problems to the poor who will hurt most despite the fact that governments of rich and big nations are able to mitigate adverse climatic effects. He however observes that it is too late to stop global warming since there is so much carbon dioxide in the atmosphere which would need centuries to reduce. The problem is made worse by our continued dependence on fossil fuels at least into the near future. It seems we as yet cannot halt resource over-exploitation or stop increasing herds in our insufficient farm (Sinnott-Armstrong, 2010, p. 232).

Sinnott-Armstrong's main argument is that whereas as an individual I face the effects of global warming, it is not so clear what I ought to do about it as an individual. In addition, individual moral obligations do not always follow directly from collective moral obligations. He likens this to a bridge that has grown weak due to heavy traffic and the government fails to repair it. It therefore does not follow that I personally have the moral obligation to fix the bridge (*ibid*, p. 333). This does not mean that individuals have no part to play in abating global warming. What Sinnott-Armstrong argues is that global warming is a large problem, and that it is not individuals who cause it or who need to fix it**.** It is governments that need to fix global climate destruction and very fast**.** It is the work of governments to find a real solution and not blame individuals (*ibid*, p. 344).

One such solution is the Kyoto Protocol of 1997 which bound nations, requiring developed nations, to reduce their greenhouse emissions to roughly 5% below 1990

levels between 2008 and 2012. The protocol also allowed nations to count forests as carbon sinks for greenhouse gases. In order for them to meet their commitments, nations could buy unused capacity from others through carbon trading (Gardiner, 2010, p. 19). Despite appearing quite successful at first, Kyoto almost collapsed amid angry exchanges by state-party representatives. This is especially so when the Bush administration withdrew US support for the deal. The European Union, Russia, Japan, however, played a great role in having world nations adopt the treaty. This Protocol and its efficacy will be discussed in subsequent chapters.

According to some scholars however, Kyoto does very little to limit emissions. Subsequent meetings from Bonn to Marrakesh agreed on cutting emissions to 2% of 1990 levels as opposed to the 5% agreed in Kyoto. In addition, these concessions will result in an overall increase in emissions by 9% above year 2000 levels and also a substantial increase in emissions by least developed countries in the year 2012 (*ibid*, p. 20). Moreover, Kyoto's failure is tied to its intergenerational aspect where global warming is primarily as a result of fossil-fuel use. Burning fossil-fuels has two results: production of energy, and exposing humanity to largely catastrophic effects of global warming. In addition, the costs and benefits of this accrue to different groups. This is especially so when we consider the fact that energy production benefits present generations in the short to medium term but climate change effects harm future generations in the long term (*ibid*, p. 21).

These two normative problems of evaluation of future consequences of action or inaction and of how to deal with the fact that future generations having different values from those we have today, have also been addressed by the scholar Karin Bjornberg. In

fact, Karin notes that uncertainty about the future is a double-edged sword. For example, the assumption that the future economic system will function in the same way as our present system functions. Just maybe, future economic systems might not industrialize like today's system. They could also possess the means to fix emerging environmental concerns better than the present generation.

In addition, we face the uncertainty about the vulnerability of future generations and the adaptation measures that will be adequate to reduce adverse effects of global warming, for example, the uncertainty of technologies and institutional arrangements that will be in place for mitigation and adaptation of climatic change effects. Uncertainty also increases with the length of time from decision to outcome, for example in dealing with agricultural climate change, adaptation of forestry needs at least 20-30 years for the tree species to be effective. They argue that when an irreversible environment change happens due to our present day decisions, future generations are deprived of opportunities they would have had and which cannot be restituted (Bjornberg, 2011, p. 671-677).

On another note, it is generally agreed that people have indeterminate feelings about the future, sometimes leaving future outcomes to divine Providence. An inescapable fact is that we can affect the future even though we do not know it. We have the power to affect future lives in many ways and their interests are just as important as ours today. This is why we need to analyze social policies that encourage resource depletion or ecological over-exploitation without future generations in mind. Accordingly, steps ought to be taken to limit emissions of greenhouse gases so as to protect future generations (Barry, 1993, pp. 2-3).

In addition, we must not only be concerned with our immediate descendants but also those who will come into the distant future. We must change our current policies or else future generations will have to pay for our profligacy. Our resources are limited yet our population is increasing putting at risk global climate. The only challenge to this is that an individual's lone attempt to alleviate environmental catastrophe that will be suffered by future people makes negligible difference and therefore for this action to have moral worth, individual efforts must be merged with the efforts of others in order to make a significant difference for the future (*ibid*, p. 5). This is one area under consideration in this research.

Even as we examine global warming and its effects, its epistemic status must also be scrutinized. The question we face is: is the climate really changing? There exist controversial views on how science works much less on global warming science. This is because this debate is an argument over action (Dessler, 2006, p. 18). In this debate, many kinds of arguments exist on whether and how the climate is changing, whether human activities are affecting the climate, how the climate may change in future, what the effects will be, whether these effects matter, the feasibility, advantages and disadvantages of various responses among other issues (*ibid*).

Science is a process that advances our knowledge of the world by proposing and testing positive claims. Towards this end, we have many reports and ongoing research all of which seek to confirm that climate change is an issue of concern for the whole world today. But suppose we are wrong? The history of science is replete with many falsified theories. That is, past scientific theories have turned out to be false and we have

no guarantee that currently accepted theories will not turn out to be false. This includes currently held theories of global warming.

Perhaps we could also argue that the current debate is itself within a body of theories which can compose an overarching theory. That is, a collection of procedures and ideas instructing scientists what to believe and how to work. In this overarching theory or paradigm, scientists are not questioning the fundamental principles of the global warming discourse. They are busy looking for solutions to climatic change problems all this time taking the paradigm for granted. Philosopher Thomas Kuhn, argues that up until crises overwhelm a paradigm and it cannot provide answers to queries within it, the old paradigm continues hold strong (*ibid*). To him, science only progresses when an old paradigm is replaced by a new and more progressive paradigm (*ibid*).

A good example of the scientific debate is the discovery and explanation of the Antarctic ozone hole with the first theory proposing that the ozone was being destroyed by naturally occurring nitrogen oxides. Further research led to another theory that ozone was being destroyed by chemical reactions in the stratosphere by Chlorofluorocarbons. With time, a consensus has been reached that chlorofluorocarbons and related chlorinated chemicals are the principal cause of the ozone hole (Dessler, 2006, pp. 32-34). Perhaps even today, the global warming discourse could be within a paradigm that could also change in future.

For purposes of this research, actions towards industrialization by nation-states provide an ethically egoistic whose one and only basic obligation is promotion of self-

interest with the greatest balance being of good over evil. In addition, any egoistic individual in making second and third person moral judgments should go by what is to his own advantage (Frankena, 2005, p. 18). This is exactly what short term to medium term energy plans by nations represents-an accumulation and over-exploitation of limited fossil fuels.

This has led to the argument that 'present generations are wastefully, carelessly burning all available coal and oil and natural gas. Humans are considered wasteful. They deplete resources for consumption of necessities and non-necessities' (Larkin, 1993, p. 209). That is, high energy use by the present generation is connected to self-interest, ignoring the worst aspects of climate change. This problem is also iterated, arising afresh with each subsequent generation gaining the power to decide whether to act or not on climate change effects. This suggests that climate change and indeed global warming problems have a tragic structure-the eventual destruction of a communal resource as Hardin argued (Gardiner, 2010, p. 21).

Ethically, when evaluating global warming, we are confronted with the issue of what obligations we have in abating global warming and our obligations to those who will be harmed by global warming in future. Put differently, it's also a question of what obligations nations have to each other and to their citizens in light of each nation's contribution to global carbon emissions (*ibid*).

At the core of this ethical dilemma is the fact that future people do not yet exist. At the same time, with regard to action and inaction towards abating global warming, the policies put in place will impact those who will exist in the immediate future. But at

the same time, how can future people complain that present human generations have destroyed the environment and global climate? One school of thought argues that whereas we do not know those who exist in future, they will have needs therefore it is imperative that present generations take care of global climate whereas other scholars hold the view that our obligations lie with present interests and not those who will come in future (Des Jardins, 2001, p. 74). This ethical dilemma will be critically evaluated in subsequent chapters of this research project.

From the literature review, it is evident that the issue of environmental degradation and the negative effects of global warming are a concern for humanity. It has been observed that global warming poses the ethical issue of justice for the least advantaged seeing as global climate has been severely polluted by rich and industrialized nation-states but it is the least developed who are suffering from adverse climatic conditions. The rate of overexploitation is unbalanced seeing as developing nations are increasing in population at a rate greater than the developed ones whereas the developed are increasing emissions more than those developing. Moreover, the review has identified the scientific basis of global warming as a current environmental issue.

This research seeks to fill the gaps of the ethical dilemma posed by mitigation of global warming on the poorest in global society and the effect of humanity's inaction on present generations and those to come. Scholars such as J. McCay, Andrew Dessler for example (see, pp. 11-12) have pointed out the effects of environmental degradation and the geo-political aspects of global warming. They however fail to address the ethical implications these have on human society. This is the same lacuna in Robin Attfield's work.

Others such as Stephen Gardiner, John Broome, Derek Parfit, Barry Gower and Bjorn Lomborg have highlighted the need to address the emergent problems posed by global warming with an eye on future generations. This research proposes means to fill the gap the ethical dilemma mitigation poses on the least advantaged globally. This research is necessary given the fact that there are scholars (see Caney and Sinnott-Armstrong p. 29) who argue that solving the problems posed by global warming is not a task for individuals but national governments. It is on this premise that we observe that concerted efforts by all parties and a stronger binding framework which will be proposed herein is necessary in addressing the negative effects posed by global warming on present and future generations.

1.8 Theoretical Framework

Having noted that global warming and its effects have arisen in great part from man's individual and collective actions of resource exploitation, the theoretical framework guiding this research is Garret Hardin's *The Tragedy of the Commons*. Hardin argues that man's attitude towards the commons, (in this study, the global climate), results in eventual decline and ruin. Humanity at present is engaged in the pursuit of industrialization to raise living standards regardless of what effect this has on the environment and by extension global climate. Hardin opines:

> Each man is locked into a system that compels him to increase his herd without limit (*in this study, industrialization using fossil fuels*-Italics mine)--in a world that is limited. Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons. Freedom in a commons brings ruin to all.

Although from the above quotation Hardin's argument was originally made with the problem of human population growth in mind, it is today widely accepted as a general theoretical framework to explain diverse cases of resources over-exploitation as will be used in this research. This is because of the absence of private property rights, a feature that characterizes the most crucial resources: air, water and other essentials for life (Hardin, 1968, pp. 1243-1248, Townsend, R, 1990, p. 311).

The main thrust of Hardin's thesis is that people tend to over-exploit a commonly owned resource which results in its eventual destruction. The global climate owned in common, is changing, posing an ethical dilemma on present generations in resolving its impacts now and for posterity. This is because it has been empirically proven that the exploitation and over-consumption of fossil fuels among other resources is one of the causes of global warming. Using this framework, this research will propose a solution of what humanity ought to do to save global climate from further destruction for the sake of all generations.

1.8.1 Ethical Dilemmas

Through the theoretical framework and literature review we can identify two fundamental ethical dilemmas key to this research: *(i)* The moral dilemma posed by action or inaction towards mitigating global warming for present and future generations and *(ii)* the inter-generational effects that action or the lack of it will have on future generations and what we ought to do. Today, we are faced by the prospect of worsening climatic effects but at the same time, industrialization is needed to fight poverty and misery. With increasing population and industrialization pegged on the burning of fossil fuels global climate is becoming worse than before. Limited non-renewable primary

energy sources in a limited global atmosphere are being depleted faster than they are replaced by the growing human population exposing all to the risk of climatic catastrophes. This is a classic example of ruin occasioned to all by the over-exploitation of a commons as Hardin observed. Our global climate regardless of the overexploitation and burning of fossil fuels and growing human population ought to be saved for the sake of present and future generations.

1.9 Research Questions

Arising from the literature and theoretical framework, this research seeks to answer the following questions:

- What ethical dilemmas do global warming and its effects pose on present and future generations?
- What measures ought to be used to mitigate/avert global warming and address these ethical dilemmas without harming the society at the same time?

1.10 Research Method

This research will generally be a library-based research in which various texts will be studied. We shall employ two philosophical methods, that is, critical and logical analysis. Critical analysis is employed in the examination of global warming and its mitigation strategies and their impact on present and future generations. We will use various literature materials in critically analyzing these strategies and proposing solutions to stem further destruction of global climate.

Logical analysis, on the other hand, is employed in pointing out the dilemma and gaps in the arguments for and against the mitigation of global warming for the present human generations and those to come. Since this research is of a real environmental concern, we will expect to make conclusions and recommendations at the end of the research that will arise from critical and logical analysis of the phenomenon and its mitigative strategies. Some data sources are to be found in libraries, others are found online whereas some are in the possession of the researcher.

CHAPTER TWO

THE SCIENCE OF GLOBAL WARMING

2.1 Introduction

In this chapter, we seek to answer the question of whether climate is really changing and, and if so, how it is changing. Moreover, we will examine the epistemic status of global warming for it is after understanding this phenomenon, we will be able to explore the ethical issues humanity faces with regard to mitigating its effects. This will be done through the lens of Hardin's thesis in the light of ongoing climatic challenges being witnessed. In the recent past, different regions of Earth have faced and continue facing negative climatic effects such as water scarcity, food scarcity and famines, resource depletion, floods and even heat waves. This in great part is attributable to the phenomenon of global warming representing the strain on limited resources globally. These negative effects are a reflection of the increasing over-exploitation of limited resources in turn giving rise to destruction of global climate-a commons for all.

The ethical dilemma we face today of the least advantaged dying as a result of adverse climatic effects despite not polluting the atmosphere with carbon emissions as the rich do ought in part to be resolved by sustainable development and a reduction of the insatiable drive and population numbers. However, unless we have understood the global warming phenomenon, we are not able to critically evaluate the moral dilemmas humanity faces today much less consider what will happen to generations to come.

Moreover, it is important for us to discuss this phenomenon if we are to evaluate our duties and responsibilities in saving global climate for present and future generations.

2.2 Weather and Climate

Scientifically, weather refers to the current state of the atmosphere, at present, or happening right now be it raining, windy or cloudy conditions and so forth. Weather is what meteorologists daily in media briefings (Boyle, 1989, p. 7). The reason this is important to this study is because weather trends in a region over time constitute the concept of climate.

Climate as we have seen refers to general weather trends and patterns in any region over time. These trends and patterns are of variations in atmospheric factors such as temperature, humidity, wind direction and strength, precipitation. When these trends change over time, this is referred to as climate change. Weather records over decades track changes in, for example, temperature, and/or rainfall, their fluctuations, informing scientists and humanity on whether a region is getting warmer, cooler, colder, wetter or even windier (*ibid*). Having established what weather and climate are, we can turn our attention to the related concepts of global warming, climate change and the greenhouse effect.

2.3 Global Warming and the Greenhouse Effect

Scientifically, the Earth is warmed by incoming radiation from the sun and cooled by the emission of part of this radiation back into space. Generally, the Earth absorbs 70% of solar radiation to warm the Earth surface, reflecting and reradiating the

remaining 30% back into space. That is, the Earth does not absorb all the sun's radiation. To keep Earth's temperature constant, incoming and outgoing solar radiation must be balanced otherwise the temperature would oscillate between extremely hot temperatures to awfully cold ones. This means under optimum conditions, our global climate was and is capable of sustaining human life adequately devoid of pollution and GHG emissions (Dessler, 2006, p. 7-9).

Certain gases in the atmosphere aid in the warming of the Earth surface making it conducive for life. These gases absorb incoming solar radiation. Among them we have water vapor and carbon dioxide which occur naturally in the atmosphere and are the principal atmospheric gases. These gases as earlier mentioned (see Chapter One, pp. 12-13) impede the exit of some of the sun's radiation back into space thereby giving rise to the average Earth surface temperature. It is this natural warming mechanism of the Earth that is referred to as the 'greenhouse effect'. Without this pure natural warming mechanism, the Earth would be a lot colder. Some estimates put Earth's temperature without the greenhouse effect at -6˚C and with the natural effect at about 15˚C (Dessler, 2006, p. 8-9, Gardiner, 2010, p. 5, Houghton, 1997, pp. 11-12).

The greenhouse effect was conceived as early as 1859 by Irish physicist John Tyndall who measured the absorption and re-radiation of various light wavelengths discovering that water vapor, carbon dioxide and methane absorbed and reradiated infrared radiation. The greenhouse effect on the other hand works like a partial blanket and a life-shield for the Earth making complex life possible. It can also be likened to the skin on our bodies, regulating body heat and in this case global heat. However just like the skin, this life shield is vulnerable to destruction. The thickening of this partial

blanket means that surface temperatures are getting higher. The greenhouse gases have not only increased and are now an area of concern as they are in great part responsible for global warming today (Gardiner, 2010, p. 5, Boyle, 1989, p. 11-12).

Humanity is increasing the atmospheric concentrations of greenhouse gases through industrialization (see Attfield Chapter One, p. 15) and other environmentally unfriendly actions such as poor waste disposal mechanisms (*ibid*). The amount of carbon dioxide, water vapor is increasing and so are the greenhouse gases such as methane, nitrous oxide and synthetic chemicals known as chlorofluorocarbons. These latter three are increasing due to human activities such as rice cultivation, biomass, burning, land-fills, agricultural and industrial activities (Dessler, 2006, p. 9). Using the lens of Hardin's thesis, I argue that increasing use of these fossil fuels for and in industrialization, coupled with a growing global population, have led to the ruin of global climate common to all. Scientifically however, global warming today describes the dramatic rise in annual average global surface temperature of the Earth, ranging from 1.5˚C to 4˚C over the past few decades (Drake, 2000, p. 1) and this concept can be best understood by a look into climate science.

2.4 Climatic Changes

The global atmosphere is mainly composed of Nitrogen at 78% and Oxygen making up nearly 21%. The atmosphere reaches a height of about 1000 kilometers above the Earth surface and is scientifically divided into four zones: the troposphere, stratosphere, mesosphere and thermosphere. Atmospheric gases are concentrated into the troposphere extending up to 17kilometers with air temperature dropping gradually

from 15˚C at sea level to about -53˚C at the tropopause. The stratosphere on the other hand extends up to 50 kilometers above the Earth surface and unlike in the troposphere, mesosphere and thermosphere temperature inversion occurs again, reducing to about -90˚C then rising to 1200˚C in the two zones respectively (Boyle, 1989, p. 14).

The global warming narrative is not complete without us highlighting the role the atmosphere performs on Earth. First, the atmosphere keeps the Earth warm, it also facilitates regular chemical exchange of chemical elements and compounds between seas, soils and living matter on earth. Lastly, it generates Earth's weather. Having mentioned the two major gases in the atmosphere, we also have water vapor with varying degrees of up to 3%, fine dust particles, aerosols and many other trace gases. Water vapor and carbon dioxide as we shall see are the most potent of greenhouse gases with regard to climate change. These gases let in solar radiation, trap part of it to warm the earth surface (*ibid*, Dessler, 2006, p. 9).

One trace gas worth noting is Ozone, a type of oxygen with three atoms instead of two in each molecule. This gas absorbs most of the sun's ultraviolet radiation and is found in the atmosphere with most of it concentrated in the stratosphere between 20 km and 50 km above the Earth surface. Ozone is not only naturally occurring but is also manufactured industrially as a purifying agent. In the atmosphere, the reaction of absorbing ultraviolet radiation, breaking it down into free oxygen and ozone warms up the stratospheric air. Close to the Earth surface, Ozone is created when hydrocarbons and oxides from cars and other sources react with solar radiation.

The result of all this is not only atmospheric warming but also smog which is dangerous to plant and human health (Strom, 2007, p. 96, Boyle, 1989, p. 30). Having mentioned carbon dioxide, water vapor and ozone, it is important for us to highlight other greenhouse gases responsible for global warning. These are chlorofluorocarbons.

Chlorofluorocarbons, developed by Thomas Midgely in 1930 as cooling agents for refrigerators and air conditioners are chemically stable and inert and first appeared as harmless but useful to mankind. They were and are used as propellants in spray cans and in the manufacture of foams. The challenge they pose is that once released into the atmosphere, they trap more heat than both carbon dioxide and water. In addition, they destroy the ozone layer in the stratosphere letting in dangerous ultraviolet radiation to the Earth surface. They also leak during manufacture, from industrial refrigerators and air conditioners and are also emitted during the manufacture of aluminum and electronic circuit boards etc. Three forms CFC $_{11}$, CFC $_{12}$ and CFC_{13} have warming potentials of up to 12000 times that of carbon dioxide and have atmospheric life-spans of between 70 to 260 years much longer than CO_2 (*ibid*, 2007, p. 103, Drake, 1998, p. 32). As mankind continues manufacturing these greenhouse gases, global warming cannot be avoided.

Climate science is not complete without the mention of the carbon cycle, global temperature changes, feedbacks and even radiative forcing. The carbon cycle refers to the movement of carbon in its many forms within the atmosphere, rocks and oceans. The ocean holds the biggest amount of carbon while on land, plants account for about 500 billion tons of it. Inorganic matter holds the biggest amount, another 1500 billion tons, whereas photosynthesis by plants converts CO_2 to make roots, leaves, wood. In short,

the carbon cycle is greatly affected by the distribution, types of vegetation as well as human activity on land use which affects carbon in the soil and biosphere (*ibid*).

It has also been observed that, land use changes particularly deforestation and agriculture have not only affected the carbon cycle but also led to an increase in global warming (Stern, 2006, p. 1). In fact deforestation leads to loss of carbon from the soil and affects soil fertility as well. Sedimentary rocks on the other hand hold billions of metric tons of carbon stored over geologic time but can be released into the atmosphere via cement manufacture using carbonate rocks (Strom, 2007, p. 14).

Over the last 10000 years, atmospheric CO_2 has been at a constant level until the nineteenth century when the industrial revolution gathered speed. Like the farmers in Hardin's communal farm, industrialization through use and over-exploitation of fossil fuels have given rise to more GHGs destroying global climate. The result has been a gradual rise of carbon dioxide by up to 35% drawing from anthropocentric greenhouse gas emissions (*ibid*). This global heating in my view ought to be slowed quickly to save our 'commons'-global climate.

The third IPCC report observed that humans have altered and affected the climate resulting in a temperature increase of about 0.6˚C in the last century alone. Temperature changes despite increasing over the last 150 years have not been uniform. Some years were hotter than others, some regions warmed more than others (for example most of Northern Hemisphere) while others like Central Antarctica have actually cooled down (IPCC 2001b, p. 252, Strom 2007, p. 17). With a general upward trend of temperature increases, there have been decreases in snow and ice cover, a rise in sea levels, an

increase in precipitation in certain regions, cloud cover in some latitudes and an increase in the frequency, persistence and intensity of El-Niño phenomena (IPCC 201b, p. 254).

When climatic incidences such as the aforementioned happen, one way of predicting them is by observing feedbacks. By feedbacks, we are referring to alterations in climate variables induced by changes in other climate variables. For example, when surface temperatures rise, there is less snow in winter. This in turn leads to greater absorption of solar radiation hence more warming which in turn leads to less snow cover and so on. This is scientifically referred to as a positive feedback because it increases global warming. When surface temperatures rise, there is more oceanic water evaporation resulting in more cloud cover which in turn reflects some solar radiation back to space resulting in what is scientifically referred to as negative feedbacks. In the recent past however, positive feedbacks have been greater than negative feedbacks resulting in adverse climatic effects (*op cit*, 2007, p. 19).

Other impacts on global climate science are attributable to major volcanic eruptions, large asteroid/comet impacts, changes in ocean heat otherwise known as Thermohaline circulation, continental drift, changes in Earth's motion and changes in solar irradiance over time. The main cause of global warming however is linked to the rapid rise in greenhouse gas emissions. This study isolates anthropogenic actions/activities as being largely responsible for global warming and its negative effects for the present generation and potentially adverse effects for future generations.

2.5 Anthropogenic Impacts on Global Warming

There is general scientific agreement that human activities are increasing global warming. These activities include electricity generation, land-use changes, agriculture and transport. In fact energy production contributes 61% of greenhouse gas emissions, agriculture 14%, land-use changes 18%. Add to these the growing contribution from halocarbons. Carbon dioxide is the biggest contributor to global warming, the bulk of it coming from the burning of fossil fuels such as coal, oil and natural gas and cement production sending out a combined amount of about 25 billion metric tons of global carbon dioxide emissions per year (Stern, 2006, 7:2, p. 2, Strom, 2007, p. 11). These anthropogenic activities in this study, buttress Hardin's theory of over-exploitation of a global commons leading to global warming.

Land use changes, especially deforestation, contributes up to 20% of annual carbon dioxide emissions today. This is primarily through destruction of at least 73000 kilometers square of forests every year, biomass burning releasing up to 12.2 billion tons of CO_2 (UN-FAO, Nov.2005, Mouillot *et al* 2006). According to scientist Robert Strom, global greenhouse emissions have not only risen dramatically in the last 200 years but there is also evidence of the infusion of man-made chemicals into the atmosphere some of which are 22000 times more powerful than carbon dioxide (Strom, 2007, p. 97).

In fact, it has been observed that, since the Industrial Revolution began in 1751, as industry developed and population grew, more and more greenhouse gases were emitted into the atmosphere which can no longer absorb them all. Worst of all carbon dioxide sinks and sequesters are decreasing due to global warming. To reverse global warming trends, carbon dioxide emissions would have to be cut by about 70% (*ibid*). This

argument is in line with Hardin's proposition of cutting population numbers for the sake of the environment. In this research, this argument is an indication of the need for sustainable development with reduction with checks on population growth and further burning of fossil fuels.

The Intergovernmental Panel on Climate Change's (IPCC) fifth report in late 2014, concluded that we are now 95% certain that 'the human influence on the climate system is clear and is evident from the increasing greenhouse gas concentrations in the atmosphere, positive radiative forcing, observed warming and understanding of the climate system'. This implies a strong scientific consensus and is further buttressed by the world's leading science academies representing Brazil, Canada, China, France, Germany, Italy, India, Japan, Russia, United Kingdom and the United States. Among its major findings is that since the 1950s the atmosphere and ocean have warmed, snow and ice levels have declined as sea levels rise and greenhouse gas concentrations increase. In addition, Earth's surface is at its warmest since 1850 and this is most likely due to human influence (IPCC, 2014, pp. 1-2). Our global climate is now under strain similar to Hardin's analogy of a communal farm straining under the over-use by increasing numbers of herds.

The IPCC position is shared by scientists who argue that carbon dioxide concentrations in the atmosphere today are about 25% higher than in pre-industrial times with most of the emissions arising from the burning of fossil fuels: coal, petroleum and natural gas (Foley, 1991, pp. 6-7, Boyle, 1989, p. 33). The human influence on global climate is akin to the addition of extra herds in a pasture of limited capacity, cannot be underestimated and in fact has been detected in both atmospheric and oceanic variations

via changes in the global water cycle, snow and glacier reductions, rises in global mean sea levels and in some changes in extreme climate events (*op cit,* 2014, p. 2).

This increase in global carbon dioxide emissions and other greenhouse emissions is linked to industrialization and economic growth and also population growth. That is, there is a correlation between economic growth, population growth and climate change due to global warming. Economic growth in this case is propelled by the burning of fossil fuels and other human activities. There is also correlation in the increase of carbon dioxide and an increase in human population growth. This therefore means that mankind is at present the primary cause of global warming (Strom, 2007, p. 117). This is similar to what Hardin observed on the effect of unchecked population growth on commonly owned resources.

Growing human population implies the need for more resources to sustain consumption. That is, there is a growing demand for food, water, energy, even land for the increasing human population. This growing demand is responsible for the on-going stiff competition for the available land, water and food, all stretching available resources. Global economic structures at present mean more business is needed to satisfy human needs. The implication of this economic systems geared at mankind's well-being is the decline in biodiversity, desertification, pollution, soil erosion and ultimately climatic changes in general (Schonfeld, 2011, p. 130).

To drive the global economy, mankind since the industrial revolution has and continues to rely on coal for energy production. Whereas key greenhouse gases responsible for global warming are carbon dioxide, methane, water vapor, nitrous oxides

and chlorofluorocarbons, carbon dioxide is the major gas emitted and it comes from carbon much of it coming from burning fossil fuels (Strom, 2007, p. 135).

In this research, carbon emissions and carbon dioxide emissions are used interchangeably though they mean similar emissions. Fossil fuels in this research refer to oil, natural gas and coal; however coal is the most potent of the above in emission of greenhouse gases. It produces more carbon dioxide per energy unit than all the other fossil fuels mentioned. Certain types of coal such as Anthracite coal and brown coal contain 92% and 70% carbon, respectively. Coal-fired power plants consume huge amounts of coal and therefore release huge amounts of carbon dioxide into the atmosphere (*ibid*, p. 136).

Globally, the United States of America and China possess the most readily available coal reserves. Developing countries like Kenya have also discovered vast amounts of coal that are to be mined and used for industrial power generation. In the United States, coal power plants release all their carbon dioxide into the atmosphere- about 2 billion tons of emissions projected to increase by 30% in 20 years. Chinese emissions are also set to increase by the year 2025 to over 3 billion tons of emissions! From such figures we can argue the world has a problem with carbon dioxide emissions and this requires that coal use must decline and carbon dioxide sequestering must increase (*ibid*, 2007, p. 138).

Ethically, the argument here is that the pursuit of economic development coupled with population growth has in large part led to the rise in carbon emissions linked to devastating climatic events and global warming in general. The exploitation and over-

consumption of fossil fuels and greenhouse emissions from the fossil fuels in this research are to blame for global warming and climate change. Like Hardin's farmers who each added an extra animal to their common pasture, eventually ruining it, humanity today is not only increasing in population but extracting and using fossil fuels to generate energy to produce goods for growing consumption so much so that the global climate is getting ruined by the accumulation of greenhouse gases in the atmosphere. These gases are a threat to the present generation and due to their intergenerational nature, they are potentially great threats to future generations as well.

Humanity today is faced with the ethical dilemmas of not only controlling and sequestering carbon and greenhouse gas emissions at the expense of reduced economic progress for the current generation but also the risk of harm to future generations should we continue in a business-as-usual attitude. Scientific evidence today is generally agreed that climate change is happening and that global warming is the primary cause of this change. This has, however, not stopped controversies arising concerning the reality of global warming and climate change itself whether global warming is a reality and whether the climate is really changing.

2.6 The Epistemic Status of Global-Warming Science

Scientists today have advanced arguments both in support and against the reality of global warming. However it is important to note that scientific knowledge is proven knowledge based upon sense data and is objective and built upon facts. These facts and sense data are tested for similarities and peculiarities over time before a credible theory is formulated (Chalmers, 1978, p. 1). Climate scientists in the recent past have written

detailed reports and articles in journals with some accepting a scientific basis of human-induced climate change. In fact reports by groups like the IPCC are prepared after reviewing climate science articles by over 1000 scientists. Composition of groups such as the World Commission on Environment and Development, The World Climate Programme, The Advisory Group on Greenhouse Gases, The Climate Action Network, and The Alliance of Small Island States gives credence to the fact of general agreement by scientists with regard to global warming and climate change.

The position of this research is that present-day climate science research and theories are guided by a single paradigm. According to philosopher Thomas Kuhn, a paradigm or a disciplinary matrix sets the standards for legitimate work within the science it governs by coordinating and directing activities of normal scientists working within it. When we look at global warming science, this fact is explicit. Moreover, he argued that paradigms include standard procedures of applying fundamental laws to a variety of types of situations. Paradigms even in climate science are composed of explicitly stated laws and theoretical assumptions guiding the research (*ibid*, p. 86-87).

A key component of a scientific paradigm is a general metaphysical principle guiding work within the paradigm. Under global warming science for example, the principle takes the form of likening Earth's atmosphere to a glass ceiling getting stained by anthropogenic greenhouse gas emissions or like a thickening blanket of atmospheric gases leading to global warming and climate change (Dessler, 2006, p. 8-9). In this Kuhnian context, we could argue that there exists a climate change and global warming paradigm today that contains some general methodological prescriptions aimed at ensuring scientists 'match the paradigm with (the) nature' of climatic science.

Moreover, scientists gain knowledge of a paradigm through scientific education, research and experiments in addition to supervision under a skilled practitioner within the paradigm. Such is the case with climate-change science (*ibid*, p. 96). There however exist some uncertainties in the global warming, climate-change science paradigm and these raise the question: could there be anomalies within the paradigm? According to Kuhn, it is only when anomalies within a paradigm persist, becoming more radical and loosening the rules guiding the paradigm that philosophical questions on the paradigm arise. When questions start being asked, confidence within the paradigm is shattered and a simmering revolution in the paradigm is in the offing. In light of this, there could be uncertainties in the global warming/climate change paradigm.

First, there are many changes happening to the Earth some of which are due to natural causes and the others arising from human activity. Therefore, it is not easy deciding between these two causes bearing in mind they work in tandem. Take for example coral reef degradation which is happening due to both human activity and global warming. Devastating storms such as Hurricane Katrina cannot be solely attributed to global warming or even a heat wave, an intense drought or floods. We could argue these events are only possible if there is a special circumstance that arises prior to any short-term climatic variations (Strom, 2007, p. 21). In short, linking any one major event to a single cause is uncertain. Much more needs to be unraveled to establish the true position of human-induced climate change.

Secondly, it is not easy to measure the temperature of the Earth's atmosphere. Temperature changes from region to region, from season to season, day and night even minute by minute. How can we come up with a reliable trend of temperature changes

devoid of errors and distorted readings? If we are to take readings for oceanic temperatures, where do we take them? How much ocean should we cover to take the readings? What about the impact of urbanization close to water bodies? The only way we can arrive closer to the truth of global warming is by comparing readings taken in different places over time (Foley, 1991, p. 32). Sea level changes have been linked to global warming as well but it is worth noting that tectonic activity could also bring about such changes. For example in the Andes region, sea levels are rising due to geological activity. All sea level changes must be tracked and differentiated in order for a true record to be arrived at (*ibid*, p. 33).

Debate within the scientific community is ongoing concerning feedback mechanisms that could increase or reduce global warming. Climate models in use are also imperfect with only crude approximations possible. This means that predictions are potentially unreliable. Other uncertainties are with regard to the future of mankind following the effects of global warming. Other uncertainties arise from the methods used to gather climate change data. Some are terrestrial while others are via satellite images. How can satellite measurements give evidence of surface warming? The amount of observational data is relatively weak to isolate mankind as the primary cause of ongoing global warming. Our epistemological position on global warming means it is intrinsically very difficult to empirically confirm climate change and global warming with certainty much less anthropogenic causes of the same (Foley, 1991, p. 35, Gardiner, 2010, p. 9).

Uncertainties within global-warming science cannot be overplayed. This is because life itself and decisions made thereof are also plagued with uncertainties.

Besides if we knew what would exactly happen to global climate and to whom it would happen to, whose emissions would cause it, then global warming would easily be addressed. This does not exempt mankind from accepting that global warming is a problem. In fact, the uncertainties encountered today do not nullify present-day knowledge on its causes which could be both anthropogenic and natural causes (Gardiner, 2010, p. 8).

Science on the other hand is a rational process, a collective human enterprise influenced by among other factors status, charisma and even rhetorical skills of those advancing scientific theories and publishing journal articles. What this means is that in the scientific field and in this context global-warming science there are shared assumptions within the scientific community. This is what Kuhn observed.

The shared assumptions define what is important, the lines of inquiry that are promising and what hypotheses are plausible and interesting. It is these shared assumptions which Kuhn refers to as 'paradigms' (Kuhn, 1962). In a way, scientists within the community take the paradigm for granted. Paradigms are specific conceptual frameworks through which the world is viewed, experiments and theories are carried out (Dessler, 2006, p. 29, Chalmers, 1997, pp. 95-97).

Within the global-warming paradigm, uncertainties remain; skeptics even hold the view that climate change and global warming are myths or hoaxes. This does not diminish the fact that global climate is changing and human related activities are the biggest contributor to GHGs causing global warming. Until anomalies within this global-warming paradigm deepen, it is safe to argue that it will take time for a rival

paradigm to appear. Science should however have means of abandoning an old paradigm for a better one should a new one arise including within the global warming discourse.

2.7 Conclusion

Whereas there is strong scientific consensus on global warming and its effects, there are still disputes on the severity if any of the effects of global warming. In fact, to some scientists, global warming is a hoax. If it is a hoax, one wonders how certain we are that phenomena such as la-Nina and el-Niño are not influenced by human actions and why the least-developed suffer the most from them. One thing we now have is documentation of rising global temperatures, climatic vagaries and catastrophes attributable to global warming. This in my opinion is proof that global warming is real and therefore there is need for a solution to be found. In light of Hardin's thesis, changes in economic structures and resource exploitation are key if we are to stem negative effects attributable to global warming. This is because further overexploitation of nonrenewable energy resources and emission of GHGs into the atmosphere will be detrimental to global climate for present and future generations.

The importance of understanding climatic science is that it has influenced response by nation states and diverse institutions towards the problems arising from global warming. Therefore, mankind has formulated policies aimed at adapting to and mitigating global warming. These policies themselves are also an acknowledgment on the reality of global warming. What humanity must do is find ways of abating the

vagaries of global warming as well as adapting to some effects. Mitigation strategies and their ethical implication will be the focus of the next chapter.

CHAPTER THREE

GLOBAL WARMING, MITIGATION STRATEGIES AND FUTURE GENERATIONS

3.1 Introduction

In this chapter, we evaluate possible obligations present generations have to future generations and if these obligations are justifiable. If we look back at past generations, are we justified in questioning if their actions and policies have led to the present destruction of global climate and whether action or inaction in abating global warming will affect generations in future? Scientific research lends credence to the fact that those who contribute most to global carbon emissions and those who suffer adverse climatic effects are distributed across the globe but the majorities are in developing nations (Patz, *et al*, 2005, pp. 310-317). As it stands, most of the carbon emitted today is from the North (rich nations) whereas most of the climate related dying is in poor nations in the South (*ibid*). This however, does not negate the fact that global warming must be abated for the sake of present and generations to come bearing in mind the fact that all men have needs. We ought to be mindful of the inadequacy of global climate to guarantee quality living unless carbon emissions are cut. This chapter will critically evaluate mitigation strategies under implementation in light of challenges faced by present and future generations.

3.2 Mitigation of Global Warming

Mitigation of the effects of global warming refers to strategies taken to combat it such as reduction of greenhouse gas and carbon dioxide emissions. This is aimed at ensuring climate is prevented from changing in the first place (Dessler, 2006, p. 185). Mitigation is one of the three responses towards addressing global climate change with the other two being prevention and adaptation. This study is focused on climate-change mitigation.

According to Dale Jamieson, mitigation by reducing GHG emissions is important for two reasons. One it slows down the rate of climate change allowing humans and the environment to buy time to adapt and reduce disastrous effects of climate change. This assumption does not mean that reducing GHG emissions is similar to slowing down climate change (Jamieson, 2010, p. 271). This means more efforts towards stemming global warming are needed.

The second reason why mitigation is important is that it allocates responsibilities to various players in global climate affairs at least to the extent of their actions. Arguably, this means allocation of per capita emission rights as well as per capita mitigation targets especially of citizens of the highest carbon emitting nations. Here we can infer the formulation of policies towards redressing the negative effects of global warming akin to cutting back on an increase of herds in a farm with limited lushness.

Ethically we must bear in mind that those who suffer most from climate change are the least capable of mitigating it yet those able to mitigate it are reluctant to do so yet

both groups are and most likely will continue to suffer changing climate and global warming (*ibid*). But what mitigation efforts are we to consider in this research?

Climate change mitigation efforts are influenced by factors among them population growth, economic growth and technology employed by mankind. It is important to note that the aforementioned factors are dependent on each other with for example, world GDP per person growing up to 2% per person on average and technologically reduced emissions of CO_2 by about 5%. These interdependent factors have cumulatively led to a rise of about 1% per year of CO_2 emissions and this rise must be abated (Dessler, 2006, p. 101). This observation highlights the strain of growing human population on nonrenewable energy resources and global climate by extension.

Another example we could give is the use and acquisition and use of vehicular transport globally. This has contributed to the increasing global carbon emissions. By 2002 for example, there were 800 million cars globally with 29% being in the USA alone, 9.5% in Japan, 6.25% in Germany and 2.5% in China. This is an example of the rich North which also means high carbon emissions from these nations and another example of increasing competition for limited resources resulting in present day global warming. This also implies citizens of these nations ought to be more obligated in addressing global warming challenges and formulating policies to abate the same (Patz *et al*, 2005, pp. 310-317).

3.3 Global-Warming-Mitigation Strategies

There are many suggested ways and policies of reducing carbon emissions; however, for the purposes of this research we will focus on technology as used in energy

production and other carbon sequestering methods. Among the areas of technological changes necessary for reduction of GHGs is increasing the efficiency of energy use (Dessler, 2006, p. 102). By this we mean right from individuals to institutions and even economies, both national and regional, agents must be capable of producing and consuming goods and services produced by efficient modes of energy-use. It must be conceded here that measuring the efficiency of energy use by the aforementioned diverse agents is not easily quantifiable to reflect meaningful change on the global scale as yet. However, this ought to go in tandem with a change in economic policies and industrialization technologies coupled with changes in demographics to save global climate from further destruction.

Fossil fuels which have in a large part contributed to increasing GHG emissions can also be used more efficiently. This is especially so because humanity as yet cannot switch from fossil fuels to carbon-free energy sources overnight. In addition to this is the fact that fossil fuels are used for 90 % of commercial energy in many developed economies (Boyle, 1989, p. 208).

According to Boyle for example, power stations in Britain produce 38 % of her carbon dioxide emissions despite them being only 35% efficient. In mitigating global warming, the efficiency of power stations is of paramount importance. From the above example, it is important to note that the heat wasted from the inefficient power stations is capable of providing around 10% of Britain's total energy demand, saving her up to 50 million tons of carbon dioxide (*ibid*, 1989, p. 208). If this be the case in Britain, one can only imagine the scale of inefficiency in energy production in many nations

developed and developing. It is clear from the above example that efficient energy-use could go a long way in mitigating carbon emissions accelerating global warming.

In the last decades, there have been remarkable improvements in certain areas of energy use. For example, there have been innovations such as high-efficiency fluorescent lighting as well as low emissivity windows (*op cit*, 2006, p. 103). There have been improvements in making cars more efficient. Vehicles are responsible for about 18% of global carbon emissions. The North and Oceania produces 88% of all cars and own 81% of them (Patz *et al* 2005, pp. 310-317).

A vehicle's efficiency can be technically improved for example. Measures put in place include weight reduction, engine and transmission efficiency improvements. The intention here is to double the fuel efficiency of cars and light trucks with major car producers having models with fuel efficiencies in the range of 80 to 100 miles per gallon (Boyle, 1989, p. 211). In addition, they have aspired to improve aero-dynamic drag, tyre-rolling resistance, as well as ignition systems that cut petrol wastage when the car is idle. It must be noted however that the car is in many developing countries today, seen as a sign of progress with the enabled rushing to acquire it. Perhaps in a way, this might hamper the realization of cuts in carbon emissions (*ibid*).

Developing and improving non-fossil fuel primary energy sources is also one way in which global warming can be mitigated. These sources include solar power, wind power, geothermal and hydro-electric power, biomass as well as nuclear fission and fusion. Solar power can be tapped using solar panels and other flat-plate collectors which convert the sun's energy into heat energy as well as light. This heat energy can be

used to heat water and air inside buildings. In addition, solar energy provides a clean unlimited source of electric energy and its rapid development would prevent carbon emissions especially when installed in commercial institutions, residences and even other non-commercial facilities (Dessler, 2006, p. 102, Strom, 2007, pp. 231-232).

According to the United Nations Environment Programme-UNEP, in 2010, new investments in renewable energies reached USD 21 billion with noticeable growth seen in emerging economies. This therefore means that should more and more emerging economies as well as industrialized nations embrace renewable energy sources, then global GHG emissions can be reduced with time (UNEP, 2010, accessed July 15, 2015).

One challenge facing installation of renewable energy sources however is the capital cost of installation and development. Therefore decreasing capital costs and increasing the deployment experience of renewable energy sources with time will make them more competitive than fossil fuels considering that the latter generates more pollutants than the former. Moreover, deployment and use of renewable sources will provide avenues of employment directly and indirectly to the economies and not necessarily harm them. Therefore it is imperative that world governments increase their involvement in green-energy transition (www.unep.org>climate change> mitigation, accessed July 15, 2015).

As for hydroelectric power, more dams can be constructed to generate electricity. Strom argues that worldwide hydro-electric power provides only about 7% of all commercial energy. In Kenya for example, the Seven Forks dams provide the biggest proportion of power generated in Kenya. China has also developed the Three Gorges

dam to provide electricity. Compared to coal-burning power plants, hydroelectric power has minimal emissions of greenhouse gases (Strom, 2007, p. 231).

Geothermal power on the other hand comes from the Earth's internal heat with an average measure of 1˚C every 36 meters in depth. This form of energy is greater in volcanic regions which have molten rock nearer to the surface providing easier tapping access. This method entails the pumping of cold water into drilled holes which is then heated to become hot water and steam which are extracted from another drill hole to drive turbines generating electricity. This technology is in use in Kenya, New Zealand and even Iceland where it is used for electricity purposes and heating houses. The good thing with this source is that it does not produce any carbon emissions nor does it use any fuel (Strom, 2007, p. 231).

Mankind could also adopt wind power to drive electric power generators. Estimates put the number of wind power turbines globally at 25000 producing only 0.1% of the world's power needs. This is in spite of wind power being capable of generating about 11 quadrillion kilowatt hours of electricity per year if properly harnessed (*ibid*, 2006, p. 229). Arguably, the world is lagging behind in exploiting this source of energy devoid of carbon emissions. In proper sites with constant wind, this power can be tapped at least to help local communities.

Most renewable-energy sources have no carbon emissions; however; their contribution to global energy sources remains minimal. Hydroelectric power generation for example can save Earth bout 530 million tons of carbon in emissions which is 20% more than nuclear fuel savings. In fact, small scale hydropower schemes not only

produce electricity but do not bring other environmental challenges such as flooding and displacement of surrounding communities (*ibid*).

Solar power as used in industrial nations like Japan, Australia, and Israel reduces the reliance by man on fossil fuels. Even in developing nations like Kenya, these are available and perhaps what is needed are incentives by world governments to promote large scale adoption and use of solar power. Whereas renewable energy resources help in reduction of GHGs, most of them are too expensive for the developing world.

Building hydropower dams for example, manufacture and importation of wind turbines and solar photovoltaic cells for large scale use, capturing of methane from large dump sites all require massive investment which is way out of the reach of many developing nations. Bear in mind these nations hold the biggest share of global population and heavy investment in renewable energy investments at present has a potential of stifling economic progress. Besides, some of these nations are in possession of abundant energy resources, be it coal or oil (Foley, 1991, pp. 62-63).

Nuclear fission can also help mankind reduce GHGs emissions. It produces clean, cheap and carbon free electricity. Globally, only 6% of the worlds' commercial energy comes from nuclear fission though in a nation like France 80% of her electricity is generated using this technology (*ibid,* p. 230). This source of energy can be exploited provided sufficient safety measures are put in place. However it must be noted this source of energy is not cheap. It remains expensive for both developing and developed nations alike.

3.4 Energy Conservation and Carbon Capture Methods

Energy conservation could also halt the increase in GHG emissions. Conservation means lowering the costs of energy use and production. For example mankind could design buildings without glass walls which increase the need for cooling and air conditioning. In addition, development and adaptation of energy saving light bulbs is important (*ibid*, p. 53). For example it has been observed that an 18 watt compact fluorescent bulb has a similar output to a 75 watt bulb but with greater lifetime savings of up to 10000 hours. Such bulbs save up to ½ ton of carbon dioxide (*ibid*, p. 54).

For mobility, manufacture of energy efficient and compact vehicles like those from Japan is important as compared to large US type vehicles which consume two or three times more energy than Japanese makes. Transport at present consumes at least 30% of the world's petrol. The challenge faced by this method is taxation and import regulations on wasteful models. Most of the developing world already facing transport inadequacy relies on petroleum- fuel imports and taxation on this energy source even for vehicular transport has far reaching yet negative effects on national economies. Ethically, most of the developing world is not capable of exploiting alternative energy sources in place of petroleum and petroleum products.

Studies show that a green low-carbon-transport sector could reduce GHG emissions in transportation by up to 70%. One major change we need is in mindset. This is especially needed in developing countries where acquisition of vehicles is a symbol of individual progress. Global appetite for vehicles also must be reduced. Towards this end, researchers have identified strategies that can be employed in the global transport sector (*ibid*).

UNEP, for example, proposes a three-pronged strategy: Avoid-Shift-Clean. Using this strategy, states, governments and local authorities should implement policies that will help users avoid/reduce trips through smarter city planning and improved land-use options. They should also move towards shifting passengers away from private vehicles to public and non-motorized transport. Freight users for example can be shifted from trucks to rail or water transport. In addition to all these, vehicle manufacturers should be encouraged to make them cleaner and efficient as well as improve and use cleaner fuels (*ibid*). This will go a long way in mitigating global warming through reduction of transportation-GHG emissions.

Other conservation methods include insulating pipes, plugging steam leaks, avoiding waste could also work to cut emissions. However, the ethical challenge of improving social-economic welfare and lifting billions of poor people from misery without hurting them or the global climate remains. We are more inclined to fighting poverty first before investing massively in energy conservation and renewable energy sources. Other sequestering methods can be considered (*ibid*).

One method already in use is the burial of carbon dioxide. In Norway for example, the company Statoil is burying carbon dioxide from natural gas wells into a seabed aquifer 900 meters below surface. Humanity could also consider pumping carbon dioxide in liquid form into the ocean floor (Strom, 2007, p. 226). However this raises the challenge of how feasible this is to the present generation especially those in need of energy for economic growth. One could argue that burying carbon dioxide is not a priority for the greater portion of global population as yet.

Perhaps mankind could extract CO_2 from the atmosphere by use of ocean iron fertilization. That is by adding iron into the ocean to increase phytoplankton activity which in turn increases uptake of carbon dioxide. However, what do nations without access to ocean-water have to do with regard to iron fertilization? Besides, the most populous of Earth nations despite being seaside nations have no technological capability to undertake this method. In addition it has been noted that this method needs an area about ten times the size of the Southern Ocean to have a significant drop of about 30% of yearly human carbon dioxide emissions (*ibid*).

Another way which remains feasible is reforestation. Trees absorb carbon when growing. The rate of growth, tree species, climate and soil, however, influence the absorption of carbon. According to Foley, a growing forest takes in at least ten tons of carbon annually and by extension, it would take an area of about 700000 square kilometers of forests to absorb 10% of global carbon emissions (Foley, 1991, pp. 63-64).

United Nations estimates have put the value accruing from forests in the developing world at over USD 1 billion. Moreover, forests sustain over 50% of Earth's species as well as regulating climate through the Carbon cycle and protecting terrestrial water sheds. Granted reforestation is faced by the inter-generational problem of its effects being beneficial to humanity after 20-30 years, investing in reforestation and land-conservation in the long run will be beneficial to humanity. The UN, for example, observes that investing up to USD forty billion yearly from 2010-2050 in reforestation and paying land owners for conservation could raise the value of the forest industry by 20% as well as increasing forest-carbon storage by up to 28% (*ibid*).

A large forested area can act as a carbon sink for up to 40 years, however, at present world forests are being cleared faster than they are being replanted. Deforestation, however, remains a threat and must be stopped. The world is losing her forests at a rate of 13 million hectares per year and this destroys the environment and by extension global climate (*ibid*). The burning of wood fuel moreover, continues to release more carbon emissions into the atmosphere (*ibid*). Individuals, states are all increasing their energy production and consumption for economic well-being, destroying global commons and global climate as Hardin's thesis had predicted. What is needed however is a global regime that would attract investment in forest-deprived goods and equitable and sustainable development. Sadly, no global regime of this nature exists; however, if regional, national and community-based organizations can be used for reforestation, there is hope. Research and finances ought to be considered towards creating financial value for forest-carbon-storage projects and initiatives. This is the challenge faced by reforestation efforts today meaning that reforestation as yet cannot compensate for the mess that global carbon emissions on global climate and the atmosphere causes.

Another possible solution to the global warming ethical dilemma involves recycling and proper waste-disposal mechanisms. Estimates put the collection of solid wastes globally at 11.2 billion metric tonnes. Note that with growing economies garbage volumes also grow. The decay of organic wastes contributes up to 5% of GHG emissions; therefore, there is need for proper disposal of such wastes. Rubbish today is becoming a complex issue for both developed and developing nations with uncontrolled

dumpsites growing, leading to illnesses, infections, ground water pollution, ecosystem destruction as well as GHG emissions (*ibid*).

Managing waste can be beneficial in solving the labor dilemma; recycling of wastes is currently estimated to be worth USD forty billion a year, excluding informal waste-management in developing nations. Overall our goal as humanity in this context should be to produce as little waste as possible and treat any unavoidable waste in less harmful ways (*ibid*).

Philosophically, despite all these methods of mitigating global warming, their implementation does not seem to be in tandem with the rate of destruction of global climate. Moreover, these methods ought to put into consideration the per capita emission rates from nation states and apportion mitigation burdens equally. The question of how implementing these methods while at the same time aiding industrialization of the poorest nations remains an ethical concern. This is because, if we were to mitigate global warming using most of the suggested ways, it is only the rich nations with the financial muscle to implement them without harming their people unlike developing nations which have lesser resources for mitigation and development. Many poor nations cannot act on global-warming abatement while industrializing at the same time.

This being the case, we can argue that present generations and those to come, especially in poor nations, will bear the brunt of adverse climatic effects arising from global warming. But how will future generations suffer yet they do not yet exist? This ethical dilemma will be explained in the next section.

3.5 Future Generations

Global warming has had adverse effects in the past and these effects are bound to get worse in future. In fact climatic modelers today predict an increase in average Earth surface temperatures by between 1.5˚C to 4˚C by 2050 unless carbon emissions are reduced substantially (Boyle, 1989, p. 52). Further global warming will result in more heat waves, droughts, storms, flooding, extinction of some wildlife species, changes in some, changes in growth and yields of staple crops, infiltration of underground drinking water by salty water, changes in disease patterns and mortality rates. All these will have effects not only on individuals but also on national economies forcing individuals, industries and public authorities to change their priorities. These priorities have a bearing on the future of humanity (*ibid*).

UNESCO in the report titled *'The Ethical Implication of Global Climate Change'* observes that climate change presents high ethical stakes. Failure to stem it will have catastrophic effects on mankind and acting on responses not only carefully thought out will also devastate entire communities, especially the most vulnerable, already facing other man-made political and ideological challenges (UNESCO, 2010, p. 7). Formulation of an ethic to address the above challenges must recognize the implications mitigating global warming will have on the immediate and future well-being of a majority of human beings.

Among the most fundamental ethical values are the pursuit of the good of individuals and communities and virtues. These are promoted by ethical principles which emphasize not causing any harm, contributing to the good of others, being just and respecting the dignity of others (*ibid*, p. 20). This means that mankind, even in its

pursuit of development must put into consideration fellow humans and in this research, those in posterity. There are arguments that mankind is future-oriented by nature making decisions conscious of future consequences. Therefore as we mitigate global warming, it is important to take into consideration present and future generations. The cultivation of compassion and morality by mankind today ought to extend to the future (Wagner, 1993, p. 66).

Some climate-scientists argue that humanity today must decide whether to aggressively mitigate harms arising from global warming or let future generations fend for themselves. According to John Broome for example (see Chapter One, p.16), this is especially so because future generations will suffer the adverse effects of climate change unless mankind acts positively/constructively. Daily actions like driving a car, using electricity, even buying things manufactured and or transported by means using energy-all contribute to greenhouse gas emissions (Broome, 2008, p. 69). Why should we be concerned with non-existent generations? Do we have a moral obligation to reduce harm to this generation?

Philosopher Derek Parfit called this ethical issue, the "non-identity problem" (see Chapter One, p. 18). It is the question of trying to justify the moral status of future human beings. In this context of abating global warming, future people do not exist yet! But are we not justified to consider that just as we have needs today, even those in the near future and distant future will have needs. Moreover, as much as we can argue that nonexistent people lack moral status, one thing that remains true is that a good environment and climate is something they will need and appreciate. This global commons ought to be protected for their sake.

It is selfish to think that future people cannot reciprocate our good actions and policies of abating global warming therefore we do not owe it to them to conserve the environment. This is because good is good in-itself and needs no reciprocation for it to be justified. We ought to take greater care of this global commons as we benefit from it as our ancestors also did. With technology, we have destroyed and emitted pollutants into the common atmosphere. We have poured pollutants into the atmosphere, depleted non-renewable energy sources to the point of causing global warming; therefore, it is important for us to consider our actions and redress the ongoing destruction of global climate.

Once again, whereas we do not know exactly who will exist in the future, we do know that people will exist and they will have needs. Therefore, our obligations lie with these interests and not with future individuals themselves. On this issue, our concern should also not be on the technological capacity of future generations that will help them fend for themselves but on what they will apply this technology on. It is pointless to argue that future generations might have different needs as opposed to ours but this is a vindication that they will have needs! Therefore, interests and needs of future generations cannot be wished away and ought to be considered in totality.

Today there are nations whose populations are doubling every two decades. This means that a new generation is /will be born at least every three decades. This is an example of a future generation-an increase in the competition for limited resources in a limited world. In our quest to satisfy the needs of a growing population, mankind is facing the problem of decreasing the supply of other goods and thereby increasing the

difficulty of equal distribution of already scarce goods, in this endeavor to develop, environmental and climatic -degradation problems increase.

The "tragedy of the commons" exemplifies the fact that most humans are at present working hard to maximize their well-being even at the expense of other human beings both present and future and the end result is that all will suffer. This is what led Hardin to argue that this tragedy can only be avoided if mankind put planetary interests above its own (Shrader-Frechette, 1993, p. 33, Hardin, 1974, p. 563). This study seeks to propose mechanisms that ought to make this a reality.

In fact according to the IPCC report of 2007, if atmospheric greenhouse gases reach the warming equivalent to 550 parts per million, which is a rise of above 8˚C, the human population will be devastated as earlier mentioned. The report argues for example that a population collapse will cause the premature deaths of billions of people. Take the case of floods and storms in Bangladesh in 1970 and 1991 each killing 250000 people. Were these deaths not premature for most victims? Ethically speaking, how bad is it for a person to die prematurely? How bad is it for a ten-year old child dying today as compared to dying a century later? (Broome, 2008, p. 72, Foley, 1991, p. 41, IPCC, 2007).

The argument here is that many people who would have existed in future will not come into existence unless the effects of global warming are mitigated. However, it must be noted that for the future, we are talking about people who are coming into existence soon and those who do not exist yet. This brings the question of future harms.

How can there be harm that harms nobody? If it does occur, can this be considered as harmful in the first place?

It is from this ethical dilemma that Parfit argues that our actions today may arguably have good or bad effects on the further future. He gives the example of two energy policies both that guarantee high living standards for the next two centuries but one would pose certain risks in the further future including a catastrophe that would kill and injure thousands of people: a choice between a 'Risky Policy' and a 'Safe Policy'. The Risky policy here mirrors what can also be referred to as the Depletion Policy whereas the Safe Policy mirrors the Conservation Policy. This argument addresses the ethical question of showing concern for people in existence and those who will possibly exist in future (Parfit, 2010, pp. 112-119).

Humanity today is faced with two choices of whether to deplete or conserve certain kinds of resources. If we choose depletion, our quality of life will be higher than if we had chosen conservation. In fact, our living standards ought to improve as well. The only issue is that in future our living standards are bound to get much lower. This ought not to be the case. This future of lower living standards will however not affect those living today. In fact, we can argue that this future generation owes its life to the present generation because it would not have existed had resources not been exploited (Parfit, 2010, pp. 114-115).

China and India today account for about 20% of the global economy and their growth rates on average are 8% and 5.8% per annum respectively (Strom, 2007, p. 132). These two countries are awakening giants and hold about 30% of global population. The

effect of their rapid economic growth is that in China, between 250 and 400 million people have improved their economic fortunes and are no longer categorized as poor. China however, uses coal for 75-80% of its electricity generation emitting plenty of greenhouse gases as her transport sector equally grows rapidly (*ibid*).

Projections for the year 2020 put Chinese energy demands at 3.5 billion tons of coal every year unless energy efficiency is improved. It has been argued that China alone has the potential of single-handedly emitting enough carbon dioxide to cancel out all efforts by other nations to control greenhouse gas emissions (*ibid*). If China poses such a risk to global climate in future, is it still not a good thing that up to 400 million people are no longer poor?

Today Kenya aspires to be a middle-income economy by the year 2030. To reach there, her new-found oil and coal are intended to drive industrialization and lift millions out of poverty. How can she meet vision 2030 without energy generation and by extension emission of greenhouse gases? Plans are underway to put up a nuclear power plant at the coast but even this plan has an implementation timeline stretching till the year 2025.

Therefore we could ask, what is better, the exploitation and use of coal and oil for industrialization for Kenya today at the risk of global warming disasters in future or an increase in poverty and misery as we protect and conserve the environment for future generations? By 2030, Kenya will be producing more carbon emissions than she does today. Equally by 2030 China is projected to produce about 11 billion metric tons of carbon emissions, surpassing the United States (Strom, 2007, p. 133). Do we raise the

living standards of the present generations or hold back and conserve the environment for posterity?

In order to stem further increases in global warming, the IPCC in 2014 concluded that world use of fossil fuels has to diminish by 60-90%. In fact developed nations were required to cut their emissions by 85-90% representing the unequal distribution of shares of total emissions. Developing nations at present need to reduce poverty among their people and this needs greater energy production for industrial take-off. Only through industrialization can poorer nations satisfy consumption needs of their people and be in a position to share in climate change mitigation efforts. This, therefore, means mitigating global warming implies the ethics of costs and benefits not just for present but also future generations (Attfield, 2012, p. 56, IPCC, 2014).

These costs and benefits imply sacrifices on the part of the present generation. This possibly entails suffering of some in the present generation so as to save global climate for future generations. Let us take for example a switch from the use of fossil fuels to alternative energy sources. We have already noted that natural gas produces about 40% less carbon emissions than coal and oil to natural gas for electricity generation, reduces its efficiency by up to three times than when it is used directly for cooking! Moreover, using natural gas for power generation produces carbon emissions 3 times higher than using it directly (Foley, 1991, p. 58).

According to the O.E.C.D, ambitious plans to reduce carbon emissions will have economic impacts now and into the future. Mitigation by reducing the energy intensity of global economies and the carbon intensity of energy used will affect GDP growth of

the global economy. In fact, mitigating global warming was projected to reduce world economic growth by at least 0.13% from 2008 to 2050 had we not instituted mitigation measures.

In other words, if we continue without mitigation and global warming policies, we expect the global economy to grow by at least 4.8% more than with climate change policies in place (OECD, 2008, p. 11). A higher economic growth will benefit millions of people even if it puts future people at risk of climatic catastrophes. However, global warming mitigation policies in the global economy will not only lead to a slight GDP loss but also a substantial loss in human and capital resources when they are shifted to mitigating it. This loss reduces the resources available for producing other goods and services and ought to be reversed (*ibid*).

It is projected that the world economy will triple by 2050. Moreover, it behoves richer nations to make bigger cuts in their GHG emissions than poorer ones to save the planet from increased global warming. In fact according to some economists, richer nations ought to ensure close-to-zero emissions in power (electricity) production and in transport by the year 2050 if global warming is to be abated (Stern, 2010, p. 46). The challenge faced by cuts in GHG emissions is the fact that reliance on coal for power generation is projected to continue for the next up to forty years (*ibid*). This in essence means that humanity is bound to continue emitting more carbon emissions into the future, a future which we are inclined to put into consideration in light of climate change effects today.

In fact according to the I.E.A report for the year 2006, China and India are anticipated to still be using coal to run around 80% of their power plants for the next thirty years or so. This is because coal is cheap and readily available within their borders. In addition, these nations are familiar with coal -use technologies and can build coal-plants quickly. If this is the case, future generations are at the risk of inheriting a destroyed climate and depleted resources (IEA, 2006, 2007, Stern, 2010, p. 48).

3.6 Other Ethical Dilemmas

Whereas it is important for carbon emissions to be cut to stem further global warming, we are faced by the problem of intergenerational justice and uncertainty as well as technological challenges for climate change mitigation (Hartzell, 2006, p. 1). For example, it is still not cheap to cut emissions especially when new coal, gas and oil reserves are being discovered. In addition, if humanity moves fast to get rid of carbon-intensive facilities, what will we use as replacements? A case in point is power-generation plants. Most power-plants when erected have a lifespan of more than 50 years (OECD, 2008, p.14). Surely, humanity cannot just abandon these plants tomorrow or in the next few years until alternative sources are developed.

Moreover, in everyday life, we use of automobiles. Renewing a fleet of automobiles can take anything between 10-20 years. What do we use if we get rid of 'carbon-emitting' models today? Granted we want to have a good climate today and in future, we are not yet ready to abandon our polluting means and facilities (*ibid*). Besides, if we are to consider alternative sources such as nuclear power-plants, public acceptability for them remains low, their installation costs are still way out of reach of

most developing countries and capital is needed to put them up and to raise their contribution towards global energy to a significant level. The resources for this are lacking for many in the developing world whereas the developed nations are yet to expand their use (*ibid*).

At present, humanity needs intensified research and development policies to mitigate climate change. This research and development especially on new technologies in energy generation and transport ought to be further explored. Besides, the new technologies at present are prohibitively expensive especially for developing nations such as Kenya. Research on these technologies ought to bring down their costs; however major technological breakthroughs are not free.

According to the OECD, medium-term costs for research and development are capable of draining resources from other sources effectively lowering living standards (OECD, 2008, p. 15). In the transport sector, changes in carbon emissions from automobile use are at present minimal. It is postulated that this is bound to continue unless rapid yet efficient public transport alternatives are developed (*ibid*).

A challenge that global warming mitigation faces is the uncertainty about the future. That is, the uncertainty about the vulnerability of future generations and the mitigation measures adequate to reduce adverse effects of climate change. An example of uncertainty in technologies lies in the length of time taken from the moment of decision-making to its outcome. Reforestation, for example, needs at least 20-30 years for a tree species to be effective in absorbing significant carbon emissions from the atmosphere. By the time the effects begin to be seen, irreversible damage to the

environment will have occurred. Present day decisions and inaction on this will potentially deprive future generations of opportunities they would have had and which cannot otherwise be restituted (Bjornberg, 2011, pp. 671-677).

3.7 Conclusion

Whereas mitigating global warming will benefit present and future generations, on the flip side this study observes that failure in mitigation does not guarantee with utmost certainty that future generations will be harmed by mankind's present day action or inaction (*ibid*). We have no certainty who future generations will be and what their interests, preferences and tastes will be. It is quite impossible to represent a being whose interests are unknown much less their identity even if we acknowledge they will have interests (Vanderheiden, 2008, p. 128). What we can concede, however, is that future human beings will have biological needs such as clean air and water.

Whereas economic pursuits ought to be mindful of global warming and its effects, our moral responsibility today calls for action to stop the death of the vulnerable today as compared to avoiding the death of the vulnerable a century from now. The death of the poor and vulnerable today from the effects of global warming ought to be prevented even as we consider future generations.

On the other hand, vulnerable nations ought to develop resource friendly policies; grow their economies mindful of the fact that poor climatic conditions will affect them hardest. This is a two-fold approach: mitigating global warming as we realistically grow the global economy with available resources. No generation, present or future, is ethically greater or justified than the other in its dealings with global climate. We ought

to put in place mitigation policies that will enable economic growth and development today while at the same time guarantee that future people do not suffer.

CHAPTER FOUR

THE KYOTO PROTOCOL AS A POSSIBLE SOLUTION

4.1 Introduction

In the recent past, there have been various attempts to address and resolve challenges arising from the phenomenon of global warming and its negative effects. Various pacts and agreements have been discussed from Bonn, to Marrakech and even Copenhagen however the most notable of them all is the Kyoto Protocol. This chapter will examine and critique the Kyoto Protocol-an international binding treaty brokered by the UN that seeks to redress challenges facing global climate. This treaty agreed by world nations in 1997 and ratified by a majority of them in February 2005 has ethical implication for present and future generations. This is in light of the failure by the treaty in significantly lowering global carbon emissions. As we shall see, key developed nations contributing significant amounts of carbon emissions are yet to ratify this treaty as they protect their economies hence the argument that The Kyoto protocol is weaker than first conceived in dealing with global warming and its adverse effects and a stronger binding framework ought to be developed for posterity.

4.2 The Kyoto Protocol and its Efficacy

Global warming today, requires near-term decisions and the exercise of governmental authority over and above private actions (Dessler, 2006, p. 128). Governmental authority here refers to policy measures that are put in place to cut GHG emissions. Since environmental concerns such as global warming cut across state borders, multilateral agreements have come in place. The UNFCC came into force in

1994 charged with the responsibility of managing climate change risks. From the UNFCC, the Kyoto Protocol was developed, representing a concerted effort by nations to apply commitments towards the reduction of GHGs (Krantberg, L. 2010, pp. 2-3). The Kyoto Protocol was agreed upon on December 11, 1997, at a meeting of the UNFCC in Kyoto, Japan as an effort by the international community in mitigating climate change.

Whereas there have been previous multilateral attempts to address global warming and its effects such as the Copenhagen agreement, the Montreal Protocol, this study focuses on the Kyoto Protocol because it is the treaty ratified by a majority of nations with regard to climate change and its effects. In fact 156 countries had ratified the treaty by 2007. However the treaty's legal enforcement date was set for the beginning of February 16, 2005 despite the UN agreeing on it in 1997. Before considering the strengths and weaknesses of this treaty, let us explore some of its principles.

First, the treaty in Article 2 charged developed nations, hereby referred to as Annex 1 countries, to among other actions, implement and/or further elaborate policies that would enhance energy efficiency in relevant economic sectors, protect sustainable forms of agriculture as well as research, promote and develop use of new and renewable forms of energy as well as carbon dioxide sequestration techniques (The Kyoto Protocol, 1998, p. 2). This principle in reality ought to be affordable as well as environmentally sustainable.

In addition to the above, the treaty charged the industrialized nations with the task of progressively reducing market imperfections, fiscal incentives, tax exemption and

subsidies in all GHG sectors running counter to the treaty. Moreover, these nations must encourage reforms in relevant sectors aiming at promotion of action limiting GHG emissions. Recognizing that certain emissions were not covered by the Montreal Protocol (The Montreal Protocol majorly dealt with CFCs and their effect), the Kyoto Protocol encouraged these nations to limit and to reduce their emissions during waste management, production, transport and distribution of energy. The protocol encourages nations to share experiences and exchange information of the policies and measures instituted to implement the above recommendations (*ibid*). This principle, if well instituted ought to cut GHG emissions in global climate.

In its second article, the treaty charges industrialized nations to strive and implement measures reducing GHG emissions in a way that will minimize adverse effects of climate change, effects on international trade, effects on the social environment and economies of Parties especially developing countries (*ibid*). This is a silent admission that developed nations have contributed the most in terms of GHG emissions which are today harming developing nations the most. Since Kyoto is a call to action it sets emission targets in its third Article (*ibid*).

In this Article, the Treaty calls for developed nations to either jointly or individually ensure anthropogenic Carbon and GHG emissions are reduced by at least 5% below 1990 levels. This reduction was scheduled to be complete in the commitment period of 2008-2012. To aid this commitment, the treaty isolates the sectors in need of emission cuts. These are direct human-induced land use changes and forestry activities, limiting them to afforestation, reforestation and deforestation since 1990 (*ibid*).

The base year of 1990, was set in agreement by nations, after the Montreal Protocol first emphasized the climatic changes due to human-induced activities. In implementing the above measures, the treaty once again calls on these Annex 1 nations to do so while at the same time being mindful of the affairs of developing nations. In addition to this, these nations shall establish measures for insurance, funding and transfer of technology that would help nations excluded from Annex 1 (*ibid*, 5).

Having set GHG reduction targets, the treaty observes that these limitation targets could either be achieved individually or jointly by Annex 1 nations. However, should nations working jointly fail to achieve their total combined level of emissions reductions, the Protocol holds each member state responsible for its level of emissions as set out in the Protocol (*ibid*). How this is policed remains a matter in dispute today.

The Protocol in Article 5 calls for Annex 1 countries to set up national systems for the elimination of anthropogenic emissions by sources and removals of GHGs by using sinks. These systems are to be set up, adjusted and revised in accordance with IPCC regulations. Here, the IPCC advises these nations on global warming potentials that will be used to calculate human-induced emissions as well as reduction levels by Carbon sinks (*ibid*).

There has always been controversy on the burden of responsibilities that the Protocol places on developed nations; however, there are still measures that other nations are obligated to undertake. These are addressed by Article 10 which calls for all other parties to implement regional programmes that will improve the quality of local emission factors. Moreover, these parties ought to update national inventories of

anthropogenic emissions by sources, Carbon reductions by sinks and reductions of all other GHGs using accepted methodologies (*ibid*, p. 9). In addition to the above, these parties ought to come up with, implement, publish and regularly update, measures undertaken to mitigate climate change. These mitigation measures are those concerning energy, transport, industry, agriculture, forestry and waste management sectors.

This article proposes what could arguably be taken as difficult measures by calling on all parties to not only submit action updates to the Conference of Parties but also co-operate in the production, use and diffusion, financing of environmentally sound technologies. Moreover, Parties are encouraged to cooperate in Scientific and technical research on measures that will reduce the uncertainties of climate change. In addition, Parties ought to cooperate in the promotion at international level of education and training programmes aimed at developing human and institutional capabilities that will disseminate climate -change knowledge as well as redress its effects (*ibid*, p. 10).

The Kyoto Protocol is not just about modalities to be undertaken by nations that have ratified it. It also proposes a clean development mechanism-CDM. This is a key feature of the Protocol and is covered by Article 12. This mechanism refers to measures that will help countries excluded from Annex 1 in achieving sustainable development while at the same time helping the convention achieve its ultimate goal of limiting GHGs and global warming effects (*ibid*).

This mechanism will also aid the funding of certified-project activities promoting sustainable development. Should these project-activities make profit, some of their proceeds will be used to help developing countries which are also Parties to the

Protocol, adapt to adverse global warming effects. In brief, this mechanism attempts to offer, real, measurable and long-term benefits to climate-change mitigation as well as reduce GHG emissions that would otherwise have occurred without it being in place (*ibid*, p. 12).

Having looked at the basic tenets of the Kyoto Protocol it is important to note that its global enforcement was dependent on its ratification by member countries especially those responsible for a great part of GHG emissions today. Article 25 covers this and stipulates that the Protocol will only enter into force on the nineteenth day after the date on which not less than 55 Parties to the Convention, incorporating Parties included in Annex 1 which account for at least 55 percent of the total Carbon dioxide emissions for 1990 of the Parties included in Annex 1, have deposited their instruments of ratification, acceptance, approval or accession (*ibid*, 18).

Getting the Protocol ratified by Annex 1 nations took longer than anticipated with them being mindful of the Protocol's effects on their economic well-being. However, this threshold was crossed when Russia ratified the treaty, bringing it into force by the year 2005 as scheduled. The success and shortcomings of the Kyoto Protocol are examined hereafter.

4.3 Critique of the Kyoto Protocol

The Kyoto Protocol is so far the most important current initiative in international climate policy. In fact it could be considered as one of the well-organized multilateral environment agreements arising from the targets it sets for GHG reductions which

impact economic, environmental and political spheres (Dessler, 2006, p. 128, Krieger, 2010, p. 3).

The focus of reduction targets has been on the developed countries in Annex 1. It is these nations that were to reduce emissions by 5.2% below 1990 levels; however, as of 2007 only the United Kingdom and Sweden were on course to meeting the target not because of active mitigation measures but arising from the fact that by 1990 the USSR had not yet split up so Russia's contribution remains small. Furthermore, the treaty proposed that for every ton of GHG emitted above targets from 2008-2012, the nation must cut an additional 1.3 tons between 2013 and 2017 (Dessler, 2006, p. 128). At present, Kyoto has not been so successful due to various reasons one of which is non-ratification of the Protocol by all State-Parties.

4.3.1 China, India and USA

Some nations have not ratified the Protocol fearing negative effects on their economies like the U.S.A while others are not required to reduce their emissions under the current rules like India and China. The nations yet to ratify this Protocol are led by U.S.A whereas others like China are not obligated to cut emissions as other developed nations seeing as they were classified as developing nations by the time of ratification by other State Parties. Underlying this classification of state-parties is the presumption that developed nations have greater responsibility mitigating global warming than developing nations and ought to do much more in abating it.

In fact, at present four out of the five largest carbon emitting nations, do not have to cut emissions. These are India and China because they are developing and are

therefore excluded from Annex 1 countries, Russia, because its levels are already below the 5.2% level and lastly the USA which is yet to ratify the treaty. It is important to remember that former US President, G. W. Bush, rejected Kyoto in 2001 arguing that it would harm the US economy by limiting the use of fossil fuels crucial for a healthy economy (Strom, 2007, pp. 233-235). Recall the plan to put up twenty nuclear power plants for energy production by the year 2020 (see Chapter One, p. 6). Putting a cap on GHG emissions means that U.S.A cannot put up these plants under the Protocol's suggested limits. Let us examine the impact of this state of events by making comparisons between the US and developing nations like India and China.

China and India today are transitioning economies. They have high population and are rapidly industrializing. However according to the UN, this drive for improved living standards and global economic status have seen their per capita GHG emissions rising quickly. Like the communal farm in Hardin's thesis, the situation in India and China is that of increasing population stretching limited resources and burning fossil fuels causing global warming. In fact compared to the USA, whose ratio per capita emissions between 1991 and 2006 is 1:2, those for India and China are 5:5 and 4:6 respectively. In other words, where one American today 'emits' twice as much GHGs, four Indians today 'emit' twice as much GHGs , while five Chinese 'emit' five times more GHGs in the same period. Please note that China constitutes 20% of global population whereas the US constitutes 5% of global population (Krieger, 2010, p. 10).

4.3.2 Further Reasons for the failure of the Kyoto Protocol

Over and above the failure by some nations to ratify the Protocol, it further fails to factor emissions due to changes in land use, decreasing carbon sinks, increased World

population and emissions from natural gases such as Methane and CO_2 due to the warming process itself. India and China are not the only countries with growing populations. Many developing countries are having burgeoning populations every year. In fact, according to some scholars, Kyoto has not factored the projected rise in world population by 1.85 billion in the next 25 years. If every human being were to produce 1 metric tonne of CO_2 per year, we are looking at a projected rise of CO_2 emissions by 1.85 Billion tonnes by 2025 (Strom, 2007, pp. 233-235).

Using the target of 5.2% reduction of CO_2 emissions per year as stipulated in the Kyoto Protocol, it has been observed that as at 2007, this meant a reduction of 21.42 billion metric tonnes of CO_2 yet human-induced emissions for the same year were 25 billion metric tonnes and 31 billion metric tonnes if land use is included. How then will humanity reduce a further 1.85 billion metric tonnes of emissions if at present the Kyoto targets are not being met? As developing countries work towards economic growth and higher living standards, their per capita emissions are expected to rise. This therefore means that developing countries need to be roped in much more than before in implementing mitigation and policy measures within the Kyoto Protocol (*ibid*). Implied by these figures is that GHG emission must be reduced by all nations. That is, making reductions mandatory for all nations in proportion to the GHG emissions each produces starting with the largest emitters.

Ethically, making reductions of GHG emissions poses a challenge to developing nations are in pursuit of growing their economies and improving the welfare of their citizens. Therefore, they are not entirely obligated to reduce emissions while rich and

developed nations are yet to put caps on their carbon emissions. Developing nations are in a dilemma of industrializing while at the same time checking their use of fossil fuels.

Moreover, developing nations face the challenge of cost-effectiveness of alternative renewable energy sources. The Kyoto Protocol at present has not failed to reduce GHG emission but it also does not restrict emissions from developing nations especially those with high emissions. If the US is responsible for a big proportion of GHG emissions in the atmosphere today, India and China are guilty as well. The only dilemma is that mitigating these emissions will hurt India, China and other developing nations more than it does the USA and other developed nations. Nevertheless, climate change mitigation in this context implies economic challenges and a potential for economic downturn for the present generation (Strom, 2007, p. 241).

Perhaps one pillar of the Kyoto Protocol that may offer help to developing countries is the clean development mechanism (CDM). This is in the event that it gives access to cheap reduction mechanisms for developing countries. According to the Kyoto Protocol, this mechanism is meant to assist signatories to the treaty in achieving sustainable development as well as contributing in emissions-reductions and limitation (*ibid*).

Moreover the mechanism is meant to institute an authority that will certify project activities that contribute towards compliance of the Protocol's goals of emissions' reduction by member nations. One way this mechanism works is checking emissions from member nations by ensuring their project activities bear 'real, measurable, and

long-term benefits related to the mitigation of climate-change' (Kyoto, 1998, pp. 11-12). This clean development mechanism (CDM) however has its shortcomings.

One, the CDM is hampered by substantive transaction-costs. It is meant to evaluate reduction of GHG emissions by project-activities that Parties come up with. The question arising from this noble idea is whether this mechanism has the institutional capacity to evaluate each and every project activity from every member of the Protocol. How much would it cost? How long would this take? Secondly, how will this mechanism prove that the evaluation of every project activity will result in significant reduction emissions? Thirdly, the mechanism appearing in Article 12 of the Protocol offers no baseline for measuring emission-reduction. What is the appropriate baseline for establishing emission-reduction targets for project activities by member nations? These shortcomings of the CDM suggest it can only play a minor role in limiting global GHG emissions (Philibert, 2004, p. 3).

For global-warming and climate-change to be abated, the benefits of mitigation must outweigh the costs of mitigation. At present, this is disputable given the different economic and industrial levels of Parties to the Kyoto Protocol. The Protocol has fixed quantitative goals for GHG reductions by some nations while others are exempted. This raises the challenge of economic efficiency. If industrialized nations check their emissions while developing nations continue emitting GHGs, then economic competitiveness is interfered with.

Equally, if developing nations are to institute mitigative measures involving changes in energy production and usage, they will suffer economic downturn especially

since their populations are poor and climate-change mitigative actions and activities are costly for them. The Kyoto Protocol has not yet identified the costs of mitigation. This means that a price of, say a carbon tax, remains uncertain and therefore mitigative costs also remain uncertain as well. On the flip side, if price and quantitative targets were found with certainty, they may be expensive yet have little value for Parties to the Kyoto Protocol (Newell & Pizer, 2003, Pizer 2002).

A curious argument on what humanity can do has been raised by some scientists who concede that global warming will continue no matter what we do. This is akin to the negative effects of increasing herds on a common pasture regardless of its straining-effects and ruin for all (Hardin, 1968, pp. 1244-1248). It has been argued that whereas we cannot stop global warming completely, what we can do is to prevent global carbon emissions from reaching the threshold of 440 parts per million which would raise global temperatures a further 1.5 degrees Celsius above today's temperature. In a different twist from the Kyoto Protocol, Strom argues that GHG reductions must be mandatory for all nations. At present, Kyoto exempts developing nations some of which are emitting plenty of GHGs uncontrollably (Strom, 2007, p. 241, Kyoto, 1998).

The USA, China, Russia, Japan, India, Germany, Canada, Britain, South Korea and Italy, in that order, have been identified as the nations that ought to make major cuts in GHG emissions. This is in proportion to their emissions. Without exempting any nation, it has been argued that every nation must deal with its emissions and failure to reduce them should result in penalties imposed on them. Suggested penalties include trade sanctions or even prosecution by a World court. Moreover, countries importing fossil fuels ought to reduce these imports while those exporting fossil fuels ought to face

severe sanctions, for example, discontinuing trade in some industrial products important to their economies (*ibid*).

As for developing nations, they ought to use alternative energy devices, Carbon-sequestering techniques and those extracting CO_2 from the atmosphere should be considered for financial rewards. In addition, those that develop energy-saving or GHG-reducing techniques generating large economic returns ought to receive incentives. The bottom-line of such proposals is a transformation of the existing framework with the aim of coming up with a harsher one (*ibid*). The possibility of tightening Kyoto's mitigation-policies or the formulation of a stronger binding framework lies with developed nations capping carbon emissions as well as funding and supporting instituted mechanisms guided by the UN in abating negative global-warming effects on both developed and developing nations.

4.4 The need for a Stronger Binding Framework

The Kyoto Protocol's principles were for the common good. The Protocol however has its shortcomings especially with the absence of realistic targets for GHG-reductions not just for developed nations but also for developing ones. In order to stem further global warming, reduction-strategies and controls ought to be tightened. This is especially for the sake of future generations.

First, we ought to put in place and progressively broaden a stronger framework that will include developing countries under reduction-thresholds agreed by all Parties. This broadened yet stronger treaty could see industrialized nations being given achievable targets whereas developing nations could be given larger amounts of surplus

emission rights. This proposal ought to be formulated in such a way that it aims at convergence towards equal per capita allocation. The aim here is to make have a framework that is more global and more effective in dealing with abatement-costs. Here, developing nations could be easily incorporated into a global emissions'- trading regime in which they also stand to gain and nothing to lose.

The strategies to stem global warming will allow developing countries to grow their economies and increase living standards of their citizens. This will in part help developing nations fight poverty but at the same time help humanity deal with the problems arising from global warming and over-exploitation of fossil-fuels (Philibert, 2004, p. 7, Krieger, 2010, p. 23).

Secondly, the new proposed treaty ought to have mechanisms that guarantee consistency, making it independent of changes in state-leadership or concerns regarding credibility. This will shield it from attacks such as those by the former US president, G.W. Bush in 2001, prior to the senate's refusal to ratify the treaty. A transformed yet stronger framework ought to also consider the different costs to countries implementing it. At present, implementing the Kyoto Protocol is expensive. Estimates put mitigation-costs at above USD 150 billion per year whereas USD 70 billion to USD 80 billion a year could go a long way in providing basic necessities like health, education, water, and sanitation, to inhabitants in developing nations (*ibid*, 2010, p. 23, Lomborg, 2001, p. 322). This does not however guarantee that the newer and stronger framework will be cheaper. The difference is that its aims ought to push all state-parties into abating global warming.

In transforming compliance-mechanisms, these should not be enforced on nations especially if implementation-costs to a country are unreasonable when compared to income. At present mitigating global warming and climate change has cost-implications for both developed and developing nations. Whether this newer framework will work remains a matter of conjecture; however, there is great possibility that with the developed world firm on cutting carbon emissions as developing ones also implement, even if small scale mitigation measures as they industrialize, adverse effects and further warming of the atmosphere can be slowed. The implication this will have on future generations is that they will, to a great extent, inherit a better atmosphere as well as be guaranteed basic necessities needed for daily living.

Creation of a newer and stronger binding framework is however not easy. First, comprehensive global participation in mitigation of global warming and climate-change relies on voluntary action by state-parties. No institution or person can persuade all nations to participate and to ratify it. Therefore we ought to have a global body like say the UN that will enforce the ratification of this newer framework. Moreover, market incentives such as permit-trading and incentives for developing countries are disputable especially since developed nations are the only ones with financial resources to provide such incentives. Besides, developed nations are under no moral obligation to help developing nations' which are vulnerable to negative effects of global warming. They are obligated to help their citizens first not those in developing nations. However, the newer framework ought to enforce domestic GHG emission cut targets as these will in turn have repercussions on the global sphere.

The new and stronger framework ought to fix global warming mitigation-costs in respect to a nation's economic power. Moreover, this new framework ought to guarantee that all state-parties are at least able and or willing to implement abatement-policies as outlined in it. It ought to have realistic and enforceable principles. Perhaps the UN ought to have a global warming/climate change court that can be used to mete out justice to those who disregard its principles. Uncertainty however remains on the ability of the UN to ensure global-warming-mitigation measures are enforced by state-parties as well as the efficacy of any institution established by the UN itself to check the excesses of state-parties in redressing challenges arising from global warming.

This research reiterates that every nation ought to deal with its emissions and failure to reduce them should result in penalties imposed on them. Suggested penalties include trade sanctions or even prosecution by a World court as mentioned above. Moreover, countries importing fossil fuels ought to reduce these imports while those exporting fossil fuels ought to face severe sanctions, for example, discontinuing trade in some industrial products important to their economies. We cannot protect our global commons without the will to punish errant nation-states or deter further pollution of the same.

Seeing as climate-change and global warming are a concern today, we ought to consider fair ways of dealing with burdens created by global climate-change. Distributive justice could, for example, work. This principle recognizes questions of intergenerational justice bearing in mind that, effects of global warming and climate-change will be felt most by future people. Implied by this fact is the principle that

present generations have obligations and duties to future generations (Caney, 2010, pp. 122-123).

One way of addressing distributive-justice issues is the 'polluter pays' principle (see Chapter One, p. 28). Through this method, the newer framework ought to help us identify who the polluter is, the unit of pollution analysis and what kind of entities are the pollutants. With the global atmosphere under threat from anthropogenic GHG emissions, the commons is being ruined. Therefore, if it is individuals harming it, they should pay for its damage. If its multinational corporations spewing out GHGs, consuming vast amounts of fossil fuels, they should pay for their share as well, if it is States, they should on GHG emissions, devote more resources to mitigation and adaptation. If it is International regimes like the International Monetary Fund, World Trade Organization or even OPEC, they all have a moral obligation to pay for their share of pollution (*ibid*, pp. 125-127).

If we have duties and obligations to future generations, it means that as individuals, we ought to play our part in mitigating global warming and climate change. We can also argue that individuals are morally obligated to pay for the harm caused by their carbon emissions. Global warming will increase in the next decades. In the next 25 years, global population is predicted to grow by 1.852 billion people to a total population of 8.05 billion. This increase in human population will increase carbon emissions at a rate of 7.4 billion metric tonnes per year. What is not clear is what I ought to do as an individual to stop global warming. However, what is clear is that individuals ought to play their part in reducing unnecessary GHG emissions as well as support state efforts in abating global warming.

Whereas it has been argued by various scholars that it is wrong to assume that moral obligation always follows directly from collective moral obligations it is today clear that global warming and climate-change is now an international problem. Even though we cannot expressly say that it is I or an octogenarian in rural Congo who has caused it and who needs to fix it I propose we all still have contributed to our current predicament and ought to take responsibility for our actions and fix the damage we are causing to global climate. It is the work of both governments and individuals to find a solution. (Strom, 2007, pp. 144-145, Sinott-Armstrong, 2010, p. 232).

4.5 Conclusion

In this chapter we have examined the Kyoto Protocol which required developed nations to reduce their GHG emissions by roughly 5 % below 1990s levels between 2008 and 2012. However, the biggest challenge for Kyoto has been the inter-generational aspect of global warming which today is primarily as a result of burning fossil fuels. The use of fossil fuels has resulted in not only production of energy but also exposing humanity to large catastrophic effects of global warming and climate-change. Moreover, the costs and benefits of mitigating climate change and global warming accrue to different groups. For example, energy production benefits present generations in the short to medium term but climate change effects harm future generations in the long term (Gardiner, 2010, p. 21).

Moreover, some mitigative strategies take time to implement. Therefore we face uncertainty of climatic-change effects from the time of deciding mitigative strategies to the outcome of the same. For example, reforestation could take 20-30 years for trees to

effectively absorb carbon emissions. By this time, irreversible climatic changes will have happened. In this case, future generations are deprived of opportunities they would have had and which cannot be restituted (Bjornberg, 2011, pp. 671-677).

Steps must be taken to limit GHG emissions so as to protect current and future generations. Individual mitigative actions towards alleviating climatic catastrophes are negligible in stopping future harm. Individual efforts merged with others' efforts could make a significant difference for the future and ought to do so. The ethical dilemma of cost-effectiveness of mitigation measures for the present and future generations persists. As it is, we are living dangerously and all indications are that, we will bequeath future generations with poor climatic conditions unless urgent steps are taken to halt global warming

CHAPTER FIVE

GENERAL CONCLUSION, SUMMARY AND RECOMMENDATIONS

In previous chapters we have discussed climate science, the mitigation of global warming and attempts by humanity to get a binding solution meant to address the destruction and ruin of global climate. This means that delay in reducing anthropogenic GHG emissions will result in adverse climatic conditions and weather catastrophes. On the other hand, quick action and mitigation of these effects by cutting or stopping the use of fossil fuels will also adversely affect world economies especially those in the developing world. We are in a Catch-22 situation of increasing human population dependent on fossil fuels and other non-renewable energy sources which in turn are producing carbon emissions increasing global warming. The more we stall in mitigating this phenomenon, the more the adverse climatic effects. The quicker we mitigate global warming without a universal agreement, the more we hurt living standards of the poor globally. Ethically, this needs a solution bearing in mind as Hardin argued, freedom within a commons results in its eventual ruin. If we carry on as we are today, our "common" climate is at risk of further destruction by global warming.

In this conclusion this research offer recommendations on what humanity could do in resolving the ethical dilemmas arising from global warming and its mitigation. With regard to this phenomenon, this research proposes that it is high time moral rules were formulated and acted upon to stem the destruction of global climate. The laissez-faire attitude exhibited by humanity similar to the farmers in Hardin's thesis of a commons free for all to use has led us to the numerous climatic disasters witnessed

world over. We could argue that whereas we have moral rules guiding human society world over with regard to habits such as eating, sex and so forth, we do not seem to have moral rules on atmospheric chemistry hence the need for a stronger framework this research proposes (Jamieson, 2009, p. 3).

It is on the premise of there being moral rules that humans judge actions. On the basis of moral rules, we are repulsed, for example, by senseless beheadings in the name of religion, rape or even corruption. From this repulsion and disgust, we have formulated laws and even proceed to mete out punishment on transgressors. On the flip side, however, when the environment is polluted by carbon emissions and global climate destroyed, we do not seem as disgusted or we do not seem to see the damage in the first place. Much worse, even when shown how carbon emissions continue to mess global climate, sections within human society deny the credibility of these scientific reports!

Global warming (as much as it is a problem today) does not evoke negative feelings in us so much so that we want to stop it. Perhaps if it was caused by a distinct and vocal group in society, it would not be surprising to see numerous protests against this group for messing global climate. We are offended by what we can see, for example terrorist groups, same-sex marriages but not the rate of global warming and its resultant negative effects. Ethically, we are at crossroads between raising living standards of the vulnerable through rapid industrialization at the expense of deteriorating climatic conditions now and in days to come.

This research reiterates that mitigating global warming by stopping the use of fossil fuels at present will slow down global economic growth meaning that poverty

levels will continue rising. Let us keep in mind that the world's biggest emitters of GHGs are yet to put in place mechanisms to curb these emissions and are not bound by any existing global warming mitigation pacts. This is ethically wrong as it is injustice committed on the world's poorest. These developing nations at the same time have insufficient resources to protect themselves from the vagaries arising from global warming while industrialize at the same time.

On the other hand, action or inaction towards redressing the issues of global warming today means that future generations will inherit poor climatic conditions and potentially adverse weather catastrophes. The Kyoto protocol provides guidelines on how to reduce global carbon emissions however since this has not been as effective as earlier envisaged, the commitment of state parties especially those yet to ratify it is questionable. Besides, with the world's biggest polluters reluctant to curb their GHG emissions, the moral responsibility of developing nations to do the same is uncalled for. The problem however, is that these developing nations suffer the worst of climatic catastrophes. The urgency to redress the challenges posed by global warming seems to be missing however it is important that as we mitigate this phenomenon, we ought to balance the same with human well-being today and in days to come.

In general, the findings of this study can be summarized as follows: (i) Global climate is changing and this is attributable to increasing carbon emissions most of which are as a result of increased burning of fossil fuels in both developed and developing nations, (ii) Increasing carbon emissions and global warming will result in adverse and devastating weather effects especially in the developing world despite developed and industrialized nations contributing the most carbon emissions, (iii) Mitigating global

warming without a proper framework will equally hurt developing nations the most as they heavily rely on the burning of fossil fuels for their industrial take-off, (iv) Failure to mitigate global warming will not only harm present generations but poses a significant risk of harming soon-to-be-born generations and possibly ruin the chances of there being future generations at all, (v) Attempts by the global community to formulate and implement a framework to abate global carbon emissions yielded the Kyoto Protocol which in turn has yet to significantly reduce global carbon emissions, (vi) With the failure of the United States of America-contributing a significant percentage of global carbon emissions – to ratify the Kyoto Protocol and the increase in carbon emissions from newly industrialized nations like China and India previously unchecked by the Kyoto Protocol, global warming continues to increase.

On the basis of the above findings, the following recommendations can be made: (i) we ought to develop renewable energy-resources further and reduce capital-costs of implementing these measures. These energy sources ought to be embraced by all nations, developed and developing, (ii) Further research ought to be focused on the effect of global-warming-mitigation strategies, especially in, among other sectors, the energy, transport, and agricultural/land-use, sectors, (iii) Further research and development of carbon-emission-sequestering technologies and support in installing/implementing these in both industrialized and industrializing nations ought to be conducted, (iv) We ought to ensure that all nations, both developed and developing, implement global-warming-mitigation measures in line with their per capita emissions, (v) Nations-states ought to be encouraged to implement and carry out reforestation and forestation programmes (those with arable land) as well as adopt and improve green-

low-carbon transport means as well as recycling and proper waste-disposal mechanisms, (vi) For the long term, the stronger binding framework ought to commit world governments to cutting emissions as well as prescribe penalties for defaulting nations and rewards for successful nations in order to safeguard the interests of future generations. This framework addresses the concerns expressed by some nations for example, the USA, by proposing emission reduction targets ideal to her in line with her per capita emissions and economic aspirations

The above solutions imply the following ethical recommendations: (i) The world and global economy in general ought to move away from fossil-fuels and develop environmentally sustainable and renewable energy sources, (ii) Carbon capture methods ought to be further developed by all nation-states. These methods include measures such as reforestation as well as CO_2 burial, (iii) A stronger binding framework proposed in section 4.4 ought to be quickly constituted, ratified and enforced by all state-parties, (iv) Economic policies and mitigation efforts ought to put into consideration future generations as well as the current generation in economic policies development, (v) All nation-states both developed like the USA and developing ones like India and China ought to be bound by the stronger framework to stem further global warming. No nation-state ought to be exempted from limitation targets set under the new deal as it sets emission caps in line with per capita emissions and economic aspirations at present, (vi) Punitive measures ought to be considered on State-parties that continue emitting GHGs unchecked within the newly agreed binding framework.

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