Science of Climate Change: Assessing the predictions and Namibia's Readiness to cope

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Abstract

Science has provided us with clear, overwhelming evidence of man-made climate change, it provides an impartial response to those who cling to doubts. Global warming and climate change are terms for the observed century-scale rise in the average temperature of the Earth's climate system and its related effects (Gillis, Justin 28 November 2015). Multiple lines of scientific evidence show that the climate system is warming (Hartmann, D. L.; Klein Tank, A. M. G.; Rusticucci, M.2013). (Borenstein, Seth, 2015). Science is widely acknowledged that "climate change is a far greater threat to the world than international terrorism", **(***Sir David King, the UK Government's chief scientific adviser, 2004). This widely acknowledged statement places the climate change problem squarely in the realm of global security and thus a concern for all. Since then, both science and lived experience have shown that without immediate action, flooding, drought, hunger and debilitating diseases such as malaria and cholera will severely impact upon millions of people around the world and nowhere more so than in Southern Africa. Climate change is the increasing rise in temperature which has been estimated to be about 0.1 degree Celsius per decade for the next two decades, even if greenhouse gas (GHG) and aerosol concentrations are kept at year 2000 levels. Climate change is resulting to extreme events that include floods and draughts (climate variability), which are becoming increasingly frequent and sever. Certain regions of Africa are more prone to such extreme events than others. It is generally caused by excessive emission and accumulation of "greenhouse gases***"*** *(principally carbon dioxide) in the atmosphere.*

Key Words: *Why is Climate Change happening, Global warming, Climate change concerns the national, regional and global community, Climate change poses a threat to the future world's economy*

1 Introduction

1.1 What is Climate Change?

The UNFCCC defines climate change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods." Nicholas Stern described climate change as ''the greatest market failure the world has ever seen'' because it is having a drastic impact on the environment and has been identified as one of the most important challenges facing the world in terms of international peace and security. According to the UNDP Human Development Report, 2007/8 "climate change cannot be narrowly defined as just an environmental issue. Climate change refers to any changes of the "average weather" in an area over time. Climate change is a natural process that takes place over a very slow timescale. However, over the past 200 years, the climate has been changing

faster than expected, mainly due to the fact that human development and industrialization have led to faster changes in the atmosphere. Presently the scientific consensus on climate change is that human activity is very likely the cause for the rapid increase in global average temperatures over the past several decades. Consequently, the debate has largely shifted onto ways to reduce further human impact and to find ways to adapt to change that has already occurred.

1.2 Why is climate change happening?

Climate change, as we all know, is the constant increase in atmospheric temperature (global warming) together with the associated changes in other weather conditions. It is not a new phenomenon. "Climate Change is real; the report from the UN's inter-governmental panel on climate change concluded that climate change was already having effects in real time – melting sea ice and thawing permafrost in the Artic, killing off coral reefs in the oceans, and leading to heat waves, heavy rains and mega-disasters (IPCC report, 2013). We all feel it, experience it and see it. It is already happening; if nothing is done the impacts will be severe and widespread". Climate change will increasingly challenge the ability of governments to provide for the needs and security of their populations.

2 The problem

The major problems facing Africa today, is the degradation of its biophysical environment resulting from the impacts of climate change and climatic variability that bring about environmental hazards that include drought, floods, loss of biodiversity, etc. Therefore, sustainable development in Africa cannot be addressed effectively without accounting for the impacts of climate change on the survival of vulnerable communities in Africa with respect to agriculture and food insecurity, poverty, population displacements, conflicts and disease patterns, etc. as shown in Table 3. The impacts of climate change are exacerbated by anthropogenic causes with broad socioeconomic implications (Oli Brown et al, 2009). In Namibia average temperatures are expected to rise from 1 to 3.5 degrees Celsius during summer and 1 to 4 degrees Celsius during winter by the period 2046 to 2065. The temperature rise predicted for 2100 ranges from 2 to 6 degree Celsius (Hannah Reid, et al (2007)). The rainy season is expected to begin later and end earlier, while the intensity of rainfall events is likely to increase. Increases in average temperatures will also result in an increase of evaporation and evapo-transpiration rates in the range of 5-15%, in other words increased evaporation will reduce the amount of freshwater available in dams and surface runoff that eventually reaches rivers and underground aquifers. Furthermore women, children and poor households are particularly vulnerable to the effects of climate change. To effectively address the challenges posed by climate change to the vulnerable groups, the government will: make provision to ensure that the vulnerable groups are empowered to effectively and adequately adapt to the impacts of climate change. Namibia has a number of laws and policies that are regarded as key to the natural resources, environment and climate change interface in Namibia as listed in **Table 1.** (National Policy on Climate Change for Namibia, 2011).

Reduced food security and degradation of natural resources critical for livelihoods will place additional burdens on those already living under difficult conditions. Changes to Namibia's climate could result in potential damage to ecosystems in important areas of biodiversity. Such damage could in turn have repercussions for Namibia's tourism industry. It has been predicted that the area of coverage by arid land types in Namibia will increase by 20% by year 2050. Increases in temperature and the frequency of flooding will increase occurrences of diseases such as malaria and cholera in flooded areas. People suffering from HIV/AIDS face a "Triple Vulnerability" of an adverse climate, impaired health, and associated economic impacts. Climate change is a problem for everyone, but the responsibilities are distributed unevenly. In the sphere of climate policy, justice means that compared with the western nations responsible for global warming-populations and countries affected by poverty as well as social and political marginalization should not only be treated differently with respect to their contribution to climate protection, but should also be given additional development support. This requires not only technical know-how but also a fundamental rethinking of how the world should be organized in the future (Climate Change Violates Human Rights, 2009).

Rising temperatures, changing weather patterns, more intense storms and increasing sea levels will all contribute to what Brown and Crawford (2009) refer to as a new set of development challenges: how to meet the food and water needs of growing populations; how to reduce vulnerability to drought and flooding; how to grow economies in the face of unpredictable weather; and how to balance the resource needs of society and the economy in a context of increasing scarcity. Prevention of dangerous climate change requires urgent global action to both reduce emissions and finance adaptation of those changes that are inevitable. Intergovernmental Panel on Climate Change (IPCC concludes that most of the observed increase in globally averaged temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations via the greenhouse effect. Natural phenomena as such solar variation combined with volcanoes probably had a small warming effect from pre-industrial times to 1950 and a small cooling effect from 1950 onward (1PCC, Climate Change 2013). These basic conclusions have been endorsed by at least thirty scientific societies and academies of science, including all of the national academies of science of the major industrialized countries ("Joint Science Academies 'Statement").

While individual scientists have voiced disagreement with some findings of the IPCC, the overwhelming majority of scientists working on climate change agree with the IPCC's main conclusions (DiMento, Joseph F. C.; Doughman, Pamela M. 2007). Climate model projections summarized by the IPCC indicate that average global surface temperature will likely rise a further 1.1 to 6.4 degree Celsius during the 21st century (Stocker et al., Technical Summary, in IPCC AR5 WG1 2013). This range of values results from the use of differing scenarios of future greenhouse gas emissions as well as models with differing climate sensitivity. Although most studies focus on the period up to 2100, warming and sea level rise are expected to continue for more than a 1000 years even if greenhouse gas levels are stabilized as shown in **Figure 1**. The delay in reaching equilibrium is a result of the large heat capacity of the oceans. Increasing global temperature will cause sea level rise**,** and is expected to increase the intensity of extreme weather events and to change the amount and pattern of precipitation. Scientists have found that oceans are able to absorb some of the excess CO2 released by human activity. The

additional excess CO2 being absorbed is resulting in the acidification of the oceans. Ongoing ocean acidification may harm a wide range of marine organisms and the food webs that depend on them, eventually degrading entire marine ecosystems (Fabry et al. 2008, Silverman et al. 2009, Doney et al. 2009). Laboratory studies suggest that molluscs, including species that support valuable marine fisheries such as mussels and oysters, and especially their juveniles, are particularly sensitive to these changes (Gazeau et al. 2007, Kurihara et al. 2007, Kurihara et al. 2009, Cooley and Doney 2009). Other effects of global warming include changes in agricultural yields, trade routes, glacier retreat, species extinctions and increases in the ranges of disease vectors (Global warming – Wikipedia, the free encyclopedia.htm).

3 Methodology

The empirical evidence for human impact on climate change, more specifically, the anthropogenic global warming, is based on correlational research. Computer models are used to study the dynamics of the Earth's climate and make projections about future temperature change. But these **climate models** differ on "climate sensitivity"- the amount of warming or cooling that occurs as a particular factor, such as CO2 goes up or down. Interpretation of data from research projects, ground stations, ocean monitoring, and satellite observation systems is a critical contribution to our understanding of changes in the climate system and to the identification of the most effective and efficient response options to these changes (WMO 2009). Recent scientific and technological developments allow for more accurate modelling of climate change and its impacts. At the same times, looking into the past and studying historical changes in climate can help us to make more sense of the present and to better predict the future (UNEP 2009). The detailed causes of the recent warming remain on activity field of research, but the scientific consensus is that the increase in atmospheric greenhouse gases is due to human activities which cause most of the warming observed since the start of the industrial era. This attribution is clearest for the most recent 50 years, for which the most detailed data are available. Some other hypotheses departing from the consensus view have been suggested to explain most of the temperature increase. One such hypothesis proposes that warming may be the result of variations in solar activity.

4 Different types of GHGs emissions

The differ rent types of processes and gases have been identified as being responsible for global warming and consequently, climate change. These are volcanic gases and dust, changes in ocean circulation, fluctuations in solar output, and increased concentrations of greenhouse gases namely carbon dioxide, methane, nitrogen trifluoride, methyl chloride and nitrogen oxide in the atmosphere as indicated in Figures 2&3. The greenhouse effects (GHG) were discovered by Joseph Fourier in 1824 and were first investigated quantitatively by Svante Arrhenius in 1896. It is the process by which absorption and emission of infrared radiation by atmospheric gases warm a planet's lower atmosphere and surface. Carbon dioxide (CO2) has been identified as the main cause and its level has increased by 30% within the last 200 years, with most of the increase from 1960 as a result of its emissions from industries and automobiles in the developed countries. Methane (CH4) is the second greenhouse gas (GHG) based on its amount in the atmosphere and the amount of warming it causes. For instance, about 55 million years ago an event known as Paleocene-Eocene Thermal Maximum occurred. This was an

episode of rapid and intense warming lasting less than 100,000 years (Eldrett et al. 2009). Scientists have suggested that CH4 released by warming and rising sea levels on continental shelves may have contributed to this and other similar events displayed in the geologic record (Schmidt and Shindell 2003, Archer 2007). It is produced from coal mining, burning of the coal, animal waste, deforestation, decaying plants, landfills, natural gas, burning of oil and other fossil fuels, as well as biomass such as forest and grass fires through slash and burn agriculture.

Recent research by Orjan Gustafsson, an environmental scientist at Stockholm University and others has shown levels of CH4 levels in the East Siberian Sea up to 10,000 times higher than normal. This discovery coincides with other evidence of more CH4 being released in the shallow parts of the Arctic Ocean. That's because thousands of years ago billions of tons of CH4 were created by decaying Arctic plants. It lies frozen in permafrost wetlands and trapped in the ocean floor. As the Arctic warms, the concern is this CH4 will be freed and worsen warming. Its concentration is therefore accelerating climate change especially as it is 20 times more efficient in trapping heat than CO2. In fact, its total effect on global warming is about 1/3 that of man-made CO2. Its atmospheric levels were 28 million tons in 2006, but have risen to 5.6 billion tons by 2008, and is still rising thereby accelerating climatic change. Regrettably, this increase is not accounted for in predictions for future global warming and this is disturbing to those who watch the climate change. Researchers warn that efforts to tackle climate change will be undermined unless CH4 is also brought under tighter control. After barely moving between 2000 and 2006, the concentration in the atmosphere ticked upwards from 2007, and then jumped sharply in 2014 and 2015 (Amos J, BBC Science Correspondent, 2016). The third greenhouse gas, nitrogen triflouride (NF3) is produced from flat screen technology such as cleaners used for TV and computer screens and from thin films of solar panels. Its levels in the air quadrupled during the last decade and increased 30-fold since 1978. It is thousands of times stronger in trapping heat than CO2. According to Ray Weiss geochemistry professor earlier efforts to determine how much NF3 is in the air dramatically underestimated the amounts. Indeed "global atmospheric concentrations of these greenhouse gases have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values determined from ice-cores spanning many thousands of years. They can actually stay in the atmosphere for more than 100 years.

5 Why climate change concerns the national, regional and global community.

The rapid expansion of population worldwide and energy demand through the use of fossil fuels bears its consequences, such as deforestation, habitats destruction, hunting, poaching, invasive species, pollution,(Like air pollution which can have a serious effect on people's health, in particular those with asthma, lung diseases or heart conditions, and can also damage soil and crops, freshwaters and streams, ecosystems accelerate corrosion of buildings and building materials) coral bleaching, erosion of biodiversity. According to the latest United Nations Population Division report, we, *Homo sapiens* or modern man originated 200,000 years ago and up to 1776 AD the population of the world was barely 0.79 billion and has since experienced an 860% growth between 1750 and 2008, from 0.79 billion to 6.7 billion. At this

rate in 2050, we will be 19 billion humans on this earth. This will be coupled with an expansion of industrialization, massive deforestation, and the increase in methane as the polar ice continues to melt. (Since 2000, according to the IPCC figures, 1,500 billion tonnes of ice have been lost from the Greenland ice sheet alone, contributing some 0.7mm to sea levels annually. This amounts to 3% more melt water pouring into the sea each year).

The consequences of climate change will naturally increase as well. The Intergovernmental Panel on Climate Change (IPCC) which is a scientific body created in 1988, by the World Meteorological Organisation (WMO) and the United Nations Environment Programme (UNEP) synthesizes thousands of published scientific work across the world to assess climate change. Their results are then ratified by decision-makers based on a consensus between science and politics. In fact, in its most recent report (2007), it strongly supported the view that climate change processes are accelerating, with anticipated disastrous and possibly catastrophic natural consequences on man unless important measures of mitigation and adaption are implemented across the Earth. Based on present national trends which corroborate with global trends, global temperatures could increase to 2 to 5 degrees Celsius by the end of this century if these trends continue into the future. A summary of the 2007 IPCC report on the vulnerability of the African continent shows that by 2020, between 75 and 250 million people are projected to be exposed to increased water stress due to climate change and the yields from rain-fed agriculture could be reduced by up to 50% in some countries and this would further adversely affect food security and exacerbate malnutrition.

Towards the end of the 21st century, projected sea level rise will affect low-lying coastal areas with large populations. This prediction was further confirmed during the February 2009 meeting on climate change in Copenhagen, Denmark where it was clearly demonstrated that sea level will rise by between 90cm to 130cm by the end of this century if present trends of climate change are maintained. A recent US National Intelligence Council report clearly states that climate change will worsen existing problems such as poverty, social tensions, environmental degradation, ineffective leadership, and weak political institutions. All reports on climate change indicate that although the poorest countries are the least producers of the greenhouse gases they are the most vulnerable to the adverse effects of climate change. The physical and natural impacts are experienced more by poor people in developing countries such as Namibia where we are already experiencing changes in agricultural patterns with reduction of crop yields and livestock due to increased temperatures and decreased rainfall, changing seasonal patterns or shifting seasons accompanied by shifting vegetation zones, sporadic and prolonged precipitation leading to disastrous floods and landslides resulting in deaths and destruction of property and structures.

5.1 Climate change poses a threat to the future world's economy.

Climate change is a well-known phenomenon; its causes are known to be accelerating, the impacts do not respect political boundaries and are having devastating socio-economic consequences on the pollution. The current global economic crises and its effects on agriculture in particular will aggravate the already decrease in food production and on the continent. The effect of this crisis on the economy of these countries which rely on export of cash crops and timber is already being felt as the developed countries cannot continue to afford to these commodities. According to the data compiled by the Centre for Research on the Epidemiology

of Disasters: Natural disasters caused $109 billion in economic damage in (2010), three times more than in 2009, with Chile and China bearing most of the cost. The 8.8 magnitude earthquake that struck Chile in February cost $30 billion. Landslides and floods in China caused $18 billion in losses. Although Haiti's January 12 earthquake was the deadliest event of 2010, killing 316000 people according to the government in Port-au-Prince, its economic toll was $8 billion, while July-August floods in Pakistan cost &9.5 billion Figure 4. Margareta Wahlstrom, the UN assistant secretary-general for disaster risk reduction, said fast –developing countries were facing increasing price tags from natural disasters.

The accumulated wealth that is affected by disaster events is growing. There is therefore need for a fundamental change in agriculture policies aimed at not only increasing investment towards food production but also targeting small scale farmers groups, using more robust plants and animals which can tolerate heat, hot soils, low variable rainfall, infections, and desertification/droughts with the development of improved ways of harvesting rain water. Perhaps never before have there been such widely varying ideas of what the future will look like. Life as we have known in the past will not endure for long with a looming climate change and its consequences, depleting oils supply and forest reserves, and deteriorating economic conditions.

According to Marjorie Kelly, author of The Divine Right of Capital and publisher of Business Ethics magazine in the US said "we should think of ecology and economy as operating within a household called the Earth. We as human beings have grown in this household but presently, the economic designs we rely upon are out of phase with 21st century realities as we treat the environment (i.e. rivers, the seas, the air, and the soil) as having zero value and only worry about our Gross Domestic Product (GDP)". She further presents two options in the way we can manage resources on Earth namely the Fortress World scenario, and the Great Transition scenario. She presents the Fortress World scenario as a situation in which cling to old values and old ways, attempting only shallow reforms. Financial malaise sets in, unemployment grows, environmental conditions deteriorate, and food insecurity builds. Problems cascade into self-amplifying crises.
The financial elite manage to protect it, while billion of desperately poor and the decimated middle class fend for themselves.

6 World demand for energy

Worldwide demand for energy is increasing. Between now and 2030, world energy demand is expected to grow by 1.6 percent per year, resulting in an overall increase of 45 percent (IEA 2008). As a result, energy related CO2 emissions will increase by 1.7 percent per year, to reach 40.4 billion tonnes in 2030-a 55 percent increase over 2004 level (IEA 2006). If not curtailed, increasing energy demand and the resultant increase in CO2 emissions could significantly impede the international community's efforts to address human-induced climate change. The increase in energy demand poses a particular challenge-and unique opportunity- for developing countries and transition economies. Between now and 2030, these countries are expected to provide 80 percent of the world's economic growth, 76 percent of global energy demand growth, and 64 percent of the energy related CO2 emissions growth (GEF, 1995) Figure 5. As the effects of climate change build – with hurricanes increasing, crops failing, and sea levels rising – the affluent come to live in protected enclaves amid oceans of misery. To the capitalist, the core energy is focused on making as much money as fast as possible, without consideration on the environmental consequences manifested as climate change onto others. Namibia can contribute to the global effort to reduce greenhouse gases by promoting renewable energy, energy efficiency and energy conservation. Climate change impacts have the potential to

weaken Africa's adaptive capacity and compromise development efforts in key sectors of the region's economy (Darkoh, 2004). Both science and political communities have acknowledged that Africa is likely to be one of the region's most adversely impacted by climate change. This is because many African economies are largely climate-dependent (because of predominantly rain-fed agriculture and lack of opportunity for economic diversification) and current adaptive capacity is generally low. Climate change is likely to increase heat stress and water stress on the African continent, significantly reducing agricultural productivity in many regions.

7 Results

Table 1: Key policies and laws of relevance to climate change

Sector	Policy and laws
Environment	Environmental Assessment Policy (MET, 1995) Environmental Management Act (2007) Land Use Planning Towards Sustainable Development Policy (MET, 1994) Pollution Control and Waste Management Bill
Agriculture	National Agriculture Policy (MAWF, 1995) National Drought Policy and Strategy (MAWF, 1997) Green Scheme Policy (MAFW, 2004 and revised in 2008)
Water	National Water Policy White Paper (MAFW, 2000) Water Resources management Act, 2004
Planning	Regional Planning and Development Policy (NPC, 1997) National Poverty Reduction Action Programme (NPC)\ National Development Plans Vision 2030
Forestry, Parks and Wildlife	Forestry Development Policy (MAFW, 2001) Forest Act (2001) Wildlife Management, utilization and Tourism in communal Areas (MET, 1995) Amendment to the 1975 Nature Conservation Ordinance (1996) Promotion of Community Based Tourism Policy (MET, 1995)
Land	National Land Policy (MLR, 1998) National Resettlement Policy (MLR, 2001) Commercial Land Reform Act (1995) Communal Land Reform Act (2002)
Energy	White Paper on Energy
Fisheries and coastal management	Territorial sea and exclusive economic zone of Namibia Act 3 of 1990 Sea shore Ordinance Walvis Bay and Offshore Islands Act 1, 1994 Namibian Ports Authority Act 2 of 1994 Division of Land Ordinance of 1963 Marine Resources Act 27 of 2000 Aquaculture Act 18 of 2002 Inland Fisheries Act of 2003
Education	Education Policy Programmes such as the Education and Training Sector Improvement Programme (ETSIP)
Disaster Risk Management	National Policy for Disaster Risk Mangement in Namibia (OPM, 2009)

Table 2: Projects approved under the strategic priority on adaptation (SPA)

Country	Project Title	Agency	GEF Total Costs (US$)	Cofinancing Total (US$)
Global (Bangladesh, Bolivia, Niger, Samoa, Guatemala, Jamaica, Kazakhstan, Morocco, Namibia, Vietnam	Community Based Adaptation (CBA) Programme	UNDP	5, 510, 516	4, 525, 140
Mozambique	Zambezi Valley Market Led Smallholder Development	World Bank	1, 689, 500	21,200,000
Namibia	Adapting to Climate change through the improvement of traditional crops and livestock farming	UNDP	1, 100, 000	5, 795, 806
Regional (Kenya, Madagascar, Mozambique, Rwanda, Tanzania)	Integrating Vulnerability and Adaptation to Climate change into Sustainable Development Policy Planning and Implementation in Southern and Eastern Africa	UNEP	1, 090, 000	1, 265, 000

Table 3: Summary of climate change impacts in Africa by 2009

Factor affected	**Low-warming scenario**	**Mid-warming scenario**	**High-warming scenario**
CO2 atmospheric levels in parts per million (ppm)	600 ppm	850 ppm	1 550 ppm
Global temperature increase	1,8° C	2,8° C	4,0° C
Global sea level rise	0,18–0,38 m	0,21–0,48 m	0,26–0,59 m
Water	20–30% decrease in water availability in vulnerable areas	■ Precipitation in subtropical areas falls by up to 20% ■ Annual mean rainfall increases by 7% in East Africa ■ Precipitation decrease of 20% along Mediterranean coast	30–50% decline in water availability in Southern Africa
Agriculture and food	5–10% decline in African crop yields	550 million additional people at risk of hunger	Decrease of 15–35% in agricultural yields across continent
Extreme events	Up to 10 million more people affected by coastal flooding globally	■ Coastal flooding affects between 11 and 170 million additional people per year globally ■ 10–20% increase in cyclone activity in the southern Indian Ocean	■ 420 million people exposed to flooding globally ■ Tens of millions displaced by extreme weather events and climate processes

Source Adapted from Oli Brown et al (eds), Climate change and security in Africa

Table 4: Adaptation and mitigation shall be key, addressing impact of sea levels

Decade	**Revert**	**Steady**	**Accelerate**
1980-1989	1.8cm	1.8cm	1.8cm
1990-1999	3.1cm	3.1cm	3.1cm
2000-2009	1.8cm	3.1cm	4.4cm
2010-2019	1.8cm	3.1cm	5.7cm
2020-2030	1.8cm	3.1cm	7.0cm
Accumulated	10.3cm	14.2cm	22.0cm

At 2030, the sea level is expected to have risen by some 20cm

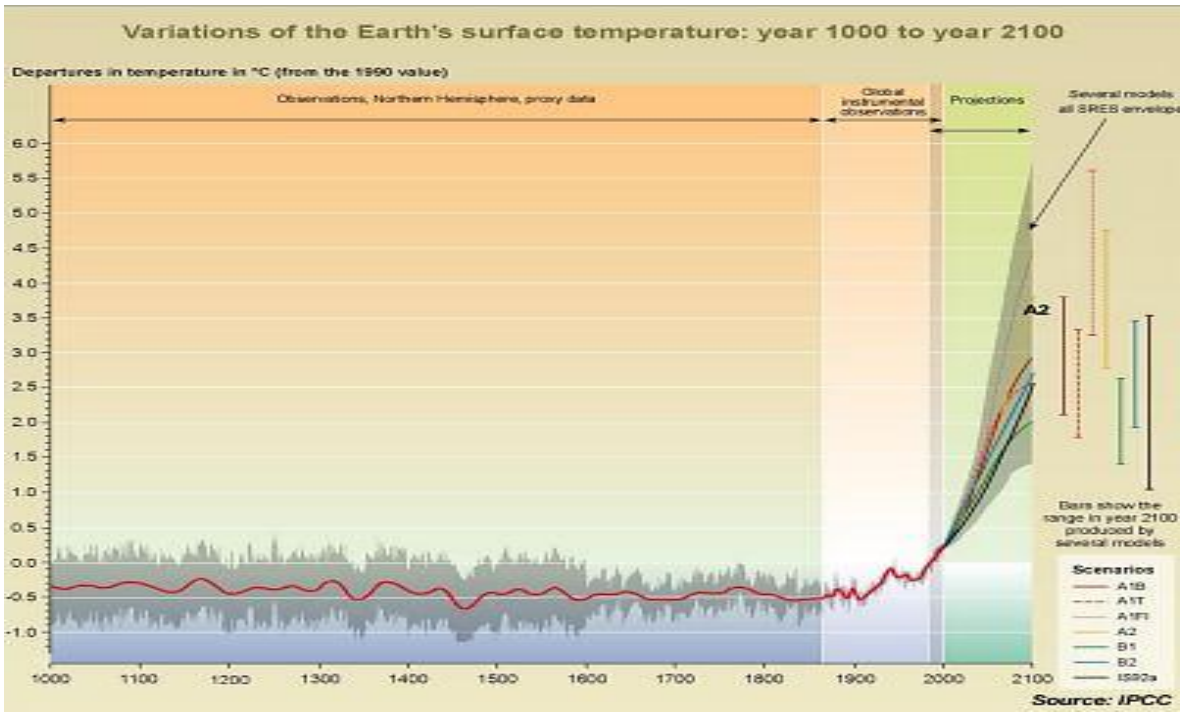

Figure 1: Variation of the Earth's surface temperature (year 1000 to 2100)

Most studies focus on the period up to 2100, warming and sea level rise are expected to continue for more than a 1000 years even if greenhouse gas levels are stabilized.

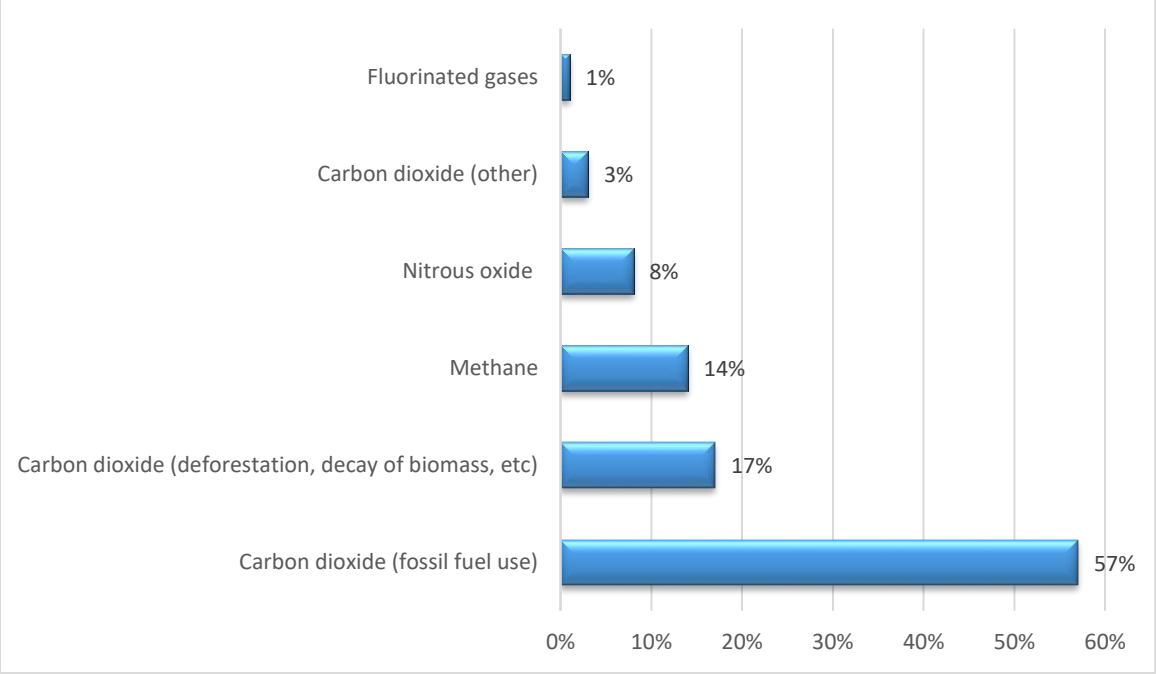

Figure 2: Different types of gases and processes identified as being responsible for global warming

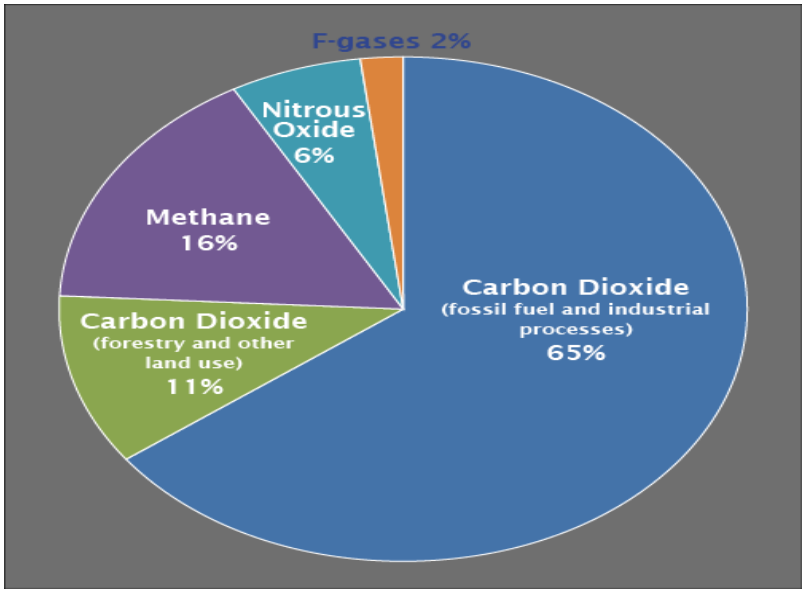

Figure 3:

Global atmospheric concentrations of these greenhouse gases have increased markedly as a result of human activities since 1750 and now far exceeded pre-industrial values determined from ice-cores spanning many thousands of years. They can actually stay in the atmosphere for more than 100 years.

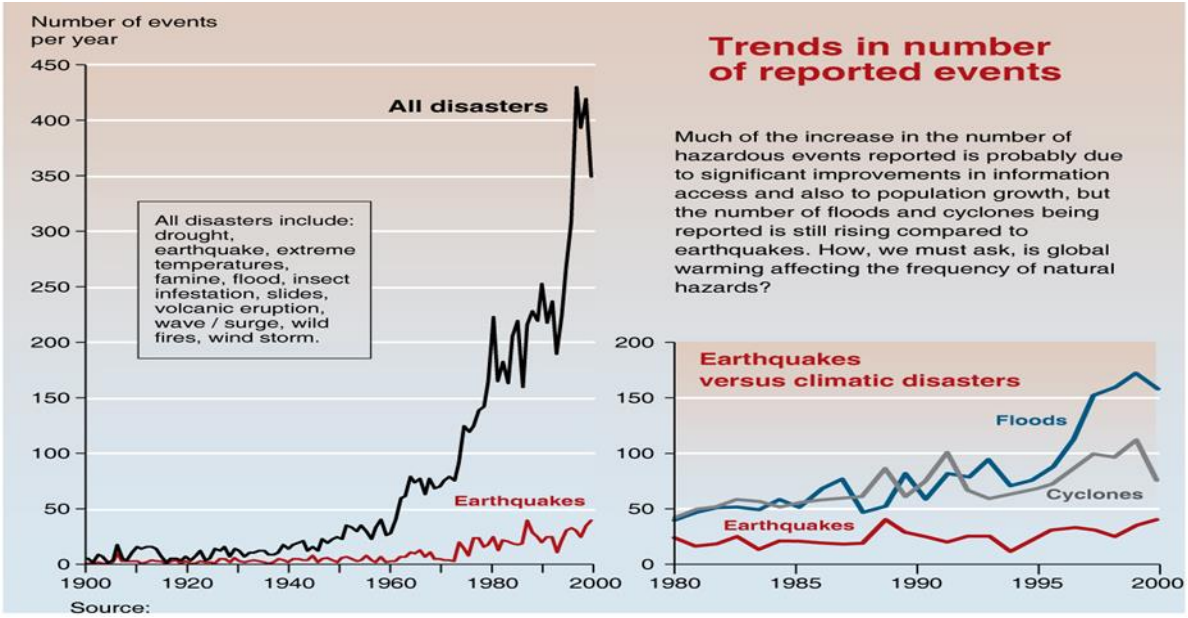

Figure 4: Trends in number of the reported events

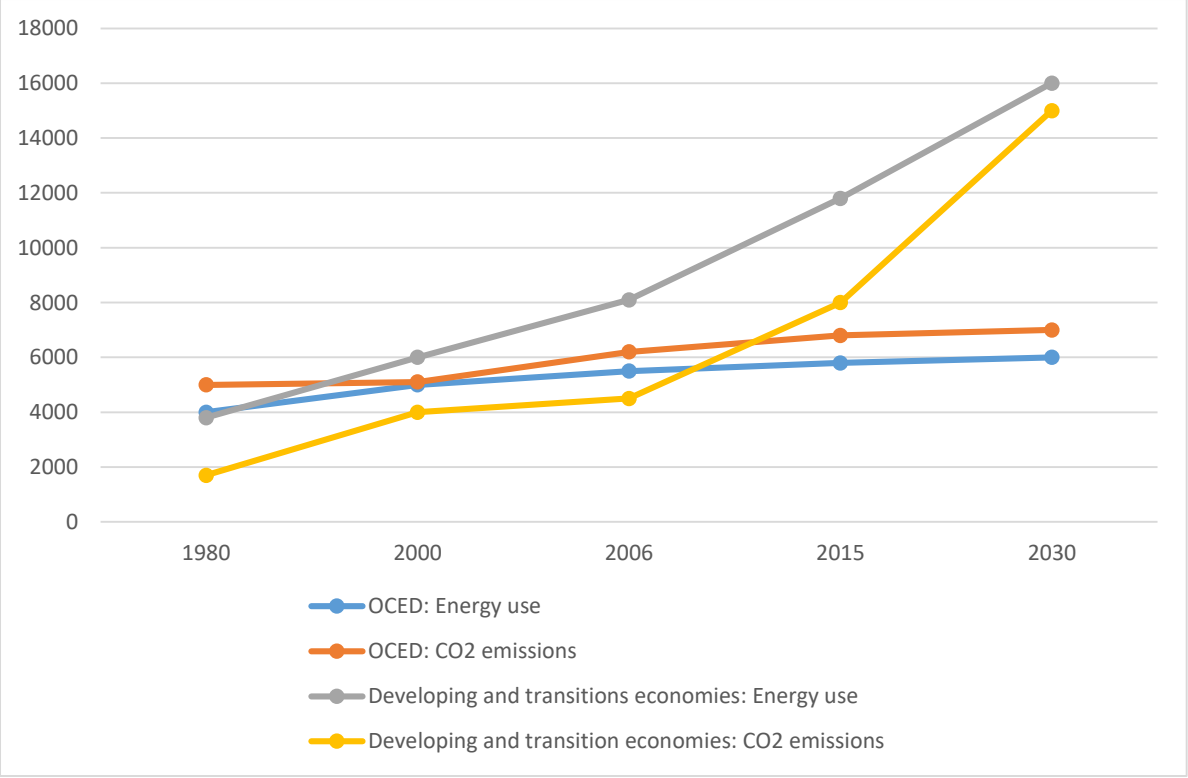

Figure 5: World primary energy demand and energy-related CO2 emissions, by countries

Most developing countries and transition economies are energy importers, so the likely increase in future energy costs could jeopardize their economic growth. The commercial exploitation of their own resources, renewable or otherwise, involves long-term infrastructure development and requires significant investment with scarce financial resources. Under these circumstances, energy efficiency measures will not only limit demand and improve energy security, but enhance economic competitiveness, generate employment, and reduce local, regional, and global air pollution (IPCC 2007).

8 Discussion and conclusion

In order to be able to effectively address the challenges brought about by the impacts of climate change/variability and anthropogenic causes, the country need to draw up sustainable development strategies to guide the process. Climate change is unavoidable. Namibia must improve its capacity to adapt to the impacts. The question here is not whether climate change is happening or not, but whether, in the face of this emergency we ourselves can change fast enough for example the way we monitoring the climate change therefore, the focus of addressing the effects of climate change needs to be placed on mitigation by industrialized countries through the limitation of greenhouse gases emissions into the atmosphere with more and more people calling for a new global economy with a low carbon new economy, or low carbon energy technologies and other low-carbon goods and services. This had been anticipated in the Kyoto Protocol by setting up the Clean Development Mechanism (CDM) which advocates for the partnership between industrialized and developing countries with the participation of the private sectors. There are a multitude of bilateral and multilateral institutions that have been established to channel development-related finance to developing countries. Recently, several bilateral and multilateral funds have emerged with the specific remit to channel climate finance. With a few exceptions, the majority of these funds operate outside of the UNFCCC mandate (Brown et al., 2009). Under the UNFCCC mandate, the CDM, the GEF and the adaptation fund Board are the main providers of mitigation and adaptation finance.

8.1 Adaptation

Adaptation which aims to reduce vulnerability has only drawn the necessary attention, in very recent years, but the financial resources needed for this are enormous and unaffordable by the most vulnerable developing countries with their own resources. As a financial mechanism of the United Nations Framework Convention on Climate Change (UNFCCC), the Global Environment Facility (GEF) has a unique mandate to deliver on-the ground benefits to countries needing to adapt to climate change. The GEF has financed the first concrete adaptation projects, implementing measures for the specific purpose of reducing vulnerability and increasing the adaptive capacity of vulnerable communities and the ecosystems on which their lives depend. It is equally important to note here that an adaptation approaches are specific for specific areas Table 2. Adaptation shall also be key, addressing sea impacts to protect our coastal areas Table 4.

Both adaptation and mitigation can complement each other and together can significantly reduce its risks if we implement our plan of action effectively and handled in a participatory manner at all levels. Thus projects combining both could foster greater commitments from local

people and it will be more attractive to foreign investors. The objectives of the plan of action are to: identify country-specific health risks associated with climate change in all African countries; strengthen core national capacities that enable health systems to prepare for, and effectively respond to, climate change threats to human health; facilitate the implementation of essential public health and environment interventions for the management of both acute and long term health risks resulting from climate change; facilitate operational and applied research on local health adaptation needs and solutions; and disseminate lessons learned and country experiences in order to facilitate implementation of adaptation strategies in other sectors (http://www.afro.who.int). Prompt approaches of mitigation and adaptation at global levels and proposed approaches of awareness creation towards resilience options that are needed in order to confront the disastrous effects of the climate change. There are linkages between climate change, poverty reduction and sustainable development and thus, a comprehensive National Sustainable Development Strategies is essential to combating the impacts of climate change. In Namibia, this can be done through mainstreaming disaster risk reduction programmes into national development agendas: Vision 2030, Harambee Prosperity Plan 2016/17-2019/20, including sectoral budget allocation.

Future prediction of climate change is difficult as some scientists are even of the opinion that there will be a turn to normal climate situations while others talk of more severe weather conditions yet to come. We look forward to:

- An interdisciplinary research involving climatologists, economists, experts in agriculture, soil scientists, sociologists, and indigenous knowledge are therefore recommended.
- An increase network of ground weather or monitoring stations enhanced by satellite data
- An improved warning systems to alert the community of imminent variations in short term climate changes through the national radio networks, TVs, local newspapers etc.
- Further monitoring of the state, and the consequences of climate change, as well as mitigation and adaptation options.
- Education and basic training, amongst others, to be seriously considered.

The upcoming generations might-and will-face a different reality than ours; therefore, it is our obligation to act right now because, if we fail to do so, we will be seen as the most individualistic and destructive generation in mankind's history. It is now our responsibility to act united and to take the opportunity of the current crisis to create the new world economy in the 21st century.

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