Chapter One
Introduction

1.1 Background to the Study

The negative consequences of global warming influence agriculture both directly and indirectly. Global warming and agriculture are connected phenomena that both occur on a global scale. The average temperature of the earth's surface, atmosphere, and oceans rising as a result of the greenhouse effect is known as global warming [1]. If appropriate action is not taken, this widespread issue could have a negative impact on people's life. Recent years have seen a rise in the importance of global warming as an environmental concern. As a result, there is alarming evidence of numerous consequences for human health [2]. Due to the worsening air quality, rising temperatures, and increased frequency of extreme weather events, it poses concerns to public health including increased morbidity and mortality.

According to the World Health Organization's assessment, global warming is responsible for at least 150,000 fatalities annually [3]. One of the biggest health concerns of the twenty-first century is global warming. Although there have been periods of climate change since the middle of the 20th century, the rate and scope of human impacts on the climate system are unprecedented. People regularly attack their environment in the name of pleasure and in an effort to advance technology and creativity, which has had a negative impact on health. Total annual global temperature rise since the industrial revolution has been little over 1 degree celsius, or almost 2 degrees fahrenheit. It increased on average 0.07 degrees celsius (0.13 degrees fahrenheit) per 10 years from 1880, the year that accurate recordkeeping started, and 1980. But the rate of growth has more than doubled since 1981. The annual increase in global temperature over the previous 40 years has been 0.18 degrees celsius, or 0.32 degrees fahrenheit, every decade [4].

The climate of Africa includes a variety of climates including equatorial climate, tropical wet and dry climate, tropical monsoon climate, semi-arid climate, and subtropical highland climate. Global warming poses a serious threat to species worldwide [5]. Except for very high elevations on the edges of the continent, temperate climates are uncommon. The most vulnerable continent on earth is Africa [6]. Numerous variables, such as poor adaptation capability, a high reliance on ecosystem products for livelihoods, and an underdeveloped agricultural production system, contribute to this susceptibility [7].

Nearly the whole surface of the globe is predicted to warm over the coming decades, and mean worldwide rainfall will rise [8]. The rapid effects of global warming may make large areas of the African continent uninhabitable, which would be disastrous for human health, food security, and poverty [9, 10,]. Although changes are anticipated, regional effects on rainfall in the tropics are anticipated to be much more spatially variable and the sign of change at any particular location is frequently less certain. There is variation in knowledge of commercial farmers towards global warming [11].

An in-depth understanding of the multiple layers of factors that shape farmers' knowledge and attitude of climatic risks and their adaptive responses is a prerequisite for well-targeted agricultural adaptation planning. Findings revealed that 51.2 percent of the farmers had moderately favourable attitude towards climate change effect. Commercial farmers' actions that contribute to global warming include deforestation, bush burning, enteric fermentation, and the usage of nitrogenated fertilizer. Greater comprehension of farmers' knowledge and perspectives on global warming would have an impact on their propensity for practices[12].

The measured surface temperatures in Africa between the late 19th and the early 21st centuries have usually increased by about 1^0 C, but locally by as much as 3^0 C for the minimum

temperature in the Sahel at the end of dry season [13]. Precipitation trends as observed show expected regional and temporal differences [14]. Regional variations in temperature and precipitation have been noted [15].

According to a United Nations report, climate change is having an increasing influence on the continent of Africa, particularly harming the most defenseless people. It is also causing food insecurity, population relocation, and stress on water resources. Global warming thus poses a threat to human health, the availability of food and water, and socioeconomic growth in Africa [16]. In today's economic conversation, the issue of global warming and its effects, particularly in developing African nations like Nigeria, have gained center stage [17]. Complex issues brought on by global warming greatly outweigh the answers proposed by the usual analytical methods used to guide responses to significant environmental difficulties.

Not because of the variations in expected changes, but rather because of sensitivity and adaptation capability that varies among countries and regions, global warming has a considerable impact on developing countries, especially the natural resources they possess and depend on. [18]. Due to their gross domestic product (GDP), gross national income (GNI), and heavy reliance on agriculture, a sector that is sensitive to climate change, developing nations are more susceptible to the effects of climatic change and are most affected by them [19].

Additionally, there are many poor people in these nations, making them more susceptible to the consequences of global warming [20]. African nations appear to be particularly vulnerable to climate change, since 33 of the 59 nations that are most at risk from global warming are found on this continent [21]. The majority of African nations are located in a subtropical region with high levels of climatic variability. Nigeria is located in West Africa, bordering the Gulf of Guinea and the Atlantic Ocean. It has a land area of 923,768 km2 and is located roughly between latitudes 40

and 140 North and longitudes 3 and 15 East. Nigeria has two seasons (dry and wet), with the dry season running from November to March and the wet season extending from April to October. It has a warm, typical tropical climate with somewhat high temperatures.

The South's coastal regions get a high temperature of 37°C and a low temperature of 10°C. Further north, where temperature swings from 35°C to 60°C are frequent, the climate is humid. The Niger Delta, one of the largest wetlands in the world with an average area of 70,000 km2, is a significant aspect of Nigeria's coastal and marine ecosystem. The mangrove forests of the nation are the third largest in the world and the largest in Africa [22]. With an estimated 206 million people, Nigeria is the most populous nation in Africa [23]. The majorities of people in Nigeria lives in rural areas and depend on migratory livestock farming and subsistence agriculture. Between January and March 2021, Nigeria's agriculture contributed more than 22.35% of the country's GDP[24]. Global warming has an impact on Nigeria, just like it does on other developing nations, and it seriously jeopardizes efforts to eradicate poverty and promote sustainable development [25].

Nigeria's climate has changed, as evidenced by rises in temperature, erratic rainfall patterns, sea level rise and flooding, drought and desertification, land degradation, an increase in the frequency of extreme weather events, a decline in fresh water resources, and a loss of biodiversity. Nigeria has around 95.6 million rural residents that rely on climatically sensitive natural resources for their livelihood, making the country vulnerable [26]. Nigeria has seen a similar calamity brought on by global warming to the one that devastated the North-Eastern region, currently made up of the Borno and Yobe States, and caused the Southern part of Lake Chad to dry up inside Nigerian territory.

Since the beginning of the 1970s, as the number of prolonged droughts increased, the lake has shrunk by 90%. In 1963, the lake's surface size was 26,000 square kilometers. It is currently no longer more than 1500 square kilometers [27]. While the downward trend is unabated and as land is being destroyed by the rising temperatures, the Sahara desert is moving quickly southward. Variation in rainfall is expected to keep rising. Rising sea levels and increasing precipitation are predicted to worsen flooding and coastal land submersion in Southern regions.

Due to a decrease in precipitation and an increase in temperature, droughts have also become a constant in Nigeria and are anticipated to persist in Northern Nigeria [28]. People migrated in great numbers from the North East to the greener plateau and middle belt region in quest of more arable land as farmland and the surrounding villages were gobbled up by spreading desertification. Numerous Fulani herders were forced to relocate to the South and Middle Belt due to increasing desertification, which sparked fights with crop farmers that resulted in hundreds of fatalities [29]. The vegetation is currently struggling with changes in the rainfall sequence in the southern regions of Nigeria, which are notorious for receiving a lot of rain. Due to desertification, there is a risk of losing around 30 ha of agriculture year [30]. Additionally, it was discovered that rainfall durations and intensities had increased, resulting in significant runoff and flooding in several areas of Nigeria [31].

Reducing agricultural emissions, namely methane and nitrous oxide, could play a substantial role in mitigating global warming, as agricultural activities contribute significantly to anthropogenic global warming [32]. Although some natural occurrences contribute to greenhouse gases (ghg) emissions, the overwhelming consensus among the world's most reputable climate scientists is that human activities are responsible for most of this increase in temperature. Food is a basic human need, and a healthy diet is a key component of our health and wellbeing. To fulfill

our growing demand for food and a variety of flavors, a sophisticated and increasingly worldwide manufacturing and transportation system has emerged. Today, a shrimp from the Ondo State could be served with rice from India in a restaurant in London in a matter of days. Our food is produced, stored, processed, packaged, delivered, prepared, and served before it reaches our plates. Food supply emits greenhouse gases into the atmosphere at every stage.

A number of recent, well-known papers have also called attention to agricultural emissions [33]. It also emphasized the possibility of a reduction in order to adhere to environmental commitments [34].The impact of methane (CH4) and nitrous oxide (N20), the two main greenhouse gases emitted from agricultural output, and specifically how they differ from carbon dioxide, appear to be increasingly neglected or misinterpreted in many studies of agriculture's involvement in global warming (CO2).Understanding these variations is essential for understanding what the mitigation of various gases may accomplish in the context of the Paris temperature goal as well as for informing policy decisions. Methane and nitrous oxide, two potent greenhouse gases, are released in substantial quantities by animal and crop production, respectively [35,36,37]. Livestock create methane during digestion as a result of enteric fermentation, which is then expelled through the farts and belches of ruminant animals.

Methane is a byproduct of the digestion process known as enteric fermentation, which occurs in the rumen of cattle and transforms carbohydrates into simple molecules for blood absorption. It can also escape from organic waste and manure that have been stored in landfills. Organic and mineral nitrogen fertilizers produce nitrous oxide emissions in an indirect manner. Paddy rice production, where flooded fields prevent oxygen from accessing the soil, accounts for another 8% of human-linked emissions of agricultural methane. Since the start of record keeping in the 1980s, methane has been responsible for around 30% of the global warming that has

occurred 36. In actuality, carbon dioxide emissions decreased during the pandemic-related lockdowns of 2020, but atmospheric methane increased, according to data from the United States National Oceanic and Atmospheric Administration [38]. In spite of nitrous oxide's growing contribution to global warming and impact on the ozone layer, not much has been done to control this climatic pollutant.

Agriculture, particularly bacteria in fertilized soils and animal dung, is the primary source of nitrous oxide. It is a powerful greenhouse gas that can trap heat around 300 times better than carbon dioxide [39]. One of the main greenhouse gases is nitrous oxide. Pesticides, fertilizers, and other harmful agricultural chemicals have the potential to contaminate fresh water, marine habitats, air, and soil. They may also linger in the environment for many years. Numerous pesticides are suspected of interfering with both people and wildlife's hormonal systems. Runoff from fertilizers affects coral reefs and streams.

Approximately 69 percent of the fresh water on the world is used by the agriculture sector. Without innovative conservation strategies, agricultural production uses too much water and lowers the quality of the water. This has a negative effect on freshwater systems all around the world. A common greenhouse gas produced by land usage, deforestation, and crop residue burning is carbon dioxide. Agriculture-related land-use changes have a much greater impact on global warming. As a result of their ability to absorb carbon dioxide from the atmosphere, plants, forests, and other natural ecosystems have been storing enormous amounts of carbon for thousands of years. Burning crop leftovers and clearing vegetation on this untamed land will change its purpose from being a carbon sink and store to a source of greenhouse gas emissions for farming, contributing to global warming [40].

The usage of gasoline-powered farm equipment is one farming practice that significantly contributes to the buildup of greenhouse gases in the environment. Enhancing efficiency and supporting renewable energy sources will aid in lowering greenhouse gas emissions from the agricultural industry. In order to comprehend and address the global climate catastrophe, demographic patterns and variables are crucial. By 2050, an extra 2 billion people will join the human race, and an additional 1 billion by 2100 [41].

Emissions of greenhouse gases, which affect the climate, tend to rise as a result of population growth and rising consumption. Rapid population expansion exacerbates the effects of global warming by taxing resources and putting more people at danger from climate-related hazards, particularly in areas with limited resources [42]. From 2015 onward, Earth experienced the warmest years on record, capping a long-term warming trend [43]. The global average temperature has increased to nearly 10 C (nearly 20 F) above pre-industrial levels, according to the Intergovernmental Panel on Climate Change (IPCC), which estimates that human emissions of greenhouse gases like carbon dioxide (C02), methane (CH4), and nitrous oxide (N2O) are to blame [44].

Countries reaffirmed the Paris Agreement's objective of keeping the rise in the world's average temperature well below 20 C and pushing efforts to keep it at or below 1.50 C [45]. They continued by expressing shock and grave concern over the 1.10 C of warming that has been produced by human activity to date and the fact that effects are already being felt in every region. The average temperature increase on Earth is predicted to reach 1.50 C between 2030 and 2052 if current warming trends continue [46].

Any increase in global warming above this point would harm many of the planet's terrestrial and marine ecosystems by sharply increasing the probability and frequency of extreme

weather occurrences. Holding the temperature increase to 1.50 C requires fundamentally altering the processes that generate the greatest amount of greenhouse gas emissions, particularly burning fossil fuels for energy, industry, transportation, and burning crop residues. It also requires reducing the amount of tree cutting and cow farting. It has been established that global energy efficiency improvements, energy production from renewable resources like solar and wind, electrification of transportation, and the use of backpacks to collect cow fart and belch would all help to lower greenhouse gas emissions [47, 48].

In Oyo State, crop output is primarily dependent on rainfall; nevertheless, irrigation system usage is minimal. Due to the great degree of unpredictability in the beginning and end of the wet season, the duration of the growth season had never been certain [51]. Rain can start early in certain years or come late in others. This fluctuation makes it challenging to prepare for crop type and variety selection and sowing [52]. The worldwide panel on climate change declares that it is 95% certain that human activity is to blame for the recent increase in global warming [53]. Floods, droughts, and heavy rainfall are examples of sudden phenomena that point to global warming in Oyo State [54, 55].

The failure of farmers to comprehend the climate upon which their livelihood is built renders them obsolete. The constant growth in the human population has increased the demand for food as climatic variability is adversely affecting crop productivity. As a result, suitable land for agricultural production is under strain. In order to ensure food security for human life, agricultural methods, particularly crop production and livestock raising, will need to adapt to changes and variability in climatic circumstances [56].

Understanding the attitudes and risky behaviors of specific farmers and farming communities also helps to generate additional information relevant to policy as well as

interventions to address the challenge of sustainable development and agricultural activities in light of variable and uncertain environments, which not only improves location-specific insights. As the temperature, which typically fluctuated between 26 and 31 degrees centigrade, climbed to as high as 36 centigrade, Oyo State saw a remarkable deficiency of rainfall in 2020 [57]. The effects of the drought on the farmers are far-reaching because so many of them are now experiencing losses thanks to the poor government's assistance and favoritism.

A significant sufferer of these climate-induced changes is agriculture, which continues to be a concern for the human environment both globally and specifically in Nigeria. Despite this, adaptability still faces threats from changing climatic processes, conditions, and consequences. These dangers must be addressed since any danger to commercial agriculture could exacerbate farmer poverty and cause widespread food insecurity and famine. In Oyo State, the rising temperatures and precipitation destroy fields, crops, and cattle in addition to washing down roads, making it challenging to visit farms and sell products [58]. Despite these difficulties, there are few research on the knowledge, attitudes, and at-risk behaviour of commercial farmers in Oyo State, Nigeria, towards global warming.

Farmers' revenue has been significantly impacted by this stress, necessitating research into climate change adaptation and the future of agriculture in Oyo State. This will make it easier to make wise judgments and implement sustainable policies to address the problems that climate unpredictability presents for farmers. The majority of Africa's poor are farmers, and they are at danger of suffering tragic crop failures, decreased agricultural productivity, increasing hunger, malnutrition, and infections. The developing world is expected to have the biggest yield drops, widening the wealth gap between the Nations [56]. This phenomenon threatens to worsen vulnerabilities, erode hard-won gains, and gravely jeopardize prospects for development as

Africans work to end poverty and promote economic progress. Therefore, coordinated measures are required to combat this threat. Farmers' educational backgrounds often have an impact on their awareness of and attitudes concerning global warming. This influences their choices, habits, and receptivity to the event.

Furthermore, since oil was discovered in Nigeria, the government's focus has shifted from agricultural to the development of petroleum resources, posing numerous avoidable risks to agriculture and the environment. This phenomenon threatens to worsen vulnerabilities, erode hard-won gains, and gravely jeopardize prospects for development as Africans work to end poverty and promote economic progress. Therefore, coordinated measures are required to combat this threat. Farmers' educational backgrounds often have an impact on their awareness of and attitudes concerning global warming. This influences their choices, habits, and receptivity to the event. Additionally, since oil was discovered in Nigeria, the government's focus has shifted from agricultural to the development of petroleum resources, posing numerous avoidable risks to agriculture and the environment. In addition, the normal Nigerian farmer may find it challenging to adjust or replace his or her conventional farming methods, despite the fact that doing so could seriously jeopardize efforts to adapt to climate change [59].

1.2 Statement of the Problem

Scientific evidence continues to confirm that activities of the farmers are among others contributing to the warming of the planet [60]. The by-products of agricultural industry including carbon dioxide, methane, nitrous oxide and other greenhouse gases have risen dramatically in recent decades leading to an overall increase in sea levels. Based on baseline observation, at-risk behaviour of commercial farmers like deforestation, bush burning, rice production, use of nitrogen fertilizer as well as enteric fermentation from the cattle continues to contribute to global

warming. The effects of these practices include food insecurity, trauma, drought, famine, flood, desertification, dehydration, hyperthermia, air pollution, water and vector borne diseases.

If the effects of global warming are left unresolved, the impact on ecosystems and human quality of life may be devastating. As such, the knowledge, attitude and at-risk behaviour of critical stakeholders like commercial livestock and crop production farmers are important to mitigation of the obstinate effects of global warming, particularly in an agrarian State such as Oyo State. Researches in this line of inquiry are scanty, hence, this study is indeed timely to fill gaps. This study therefore, investigated knowledge, attitude and at-risk behaviour of commercial farmers towards global warming in Oyo State, Nigeria.

1.3 Aim and Objectives of the Study

The aim of this study was to investigate knowledge, attitude and at-risk behaviour of commercial farmers towards global warming in Oyo State, Nigeria.

The objectives were to:

1. examine the level of knowledge of global warming among commercial farmers in Oyo State.
2. assess the attitude towards global warming among commercial farmers in Oyo State.
3. examine at-risk behaviour of commercial farmers in Oyo State towards global warming.
4. determine the relationship between knowledge and attitude of commercial farmers towards global warming in Oyo State.
5. establish the relationship between knowledge and at-risk behaviour of commercial farmers towards global warming in Oyo state.
6. establish the difference in knowledge of global warming among commercial farmers in Oyo State, based on educational qualification.

7. establish the difference in attitude among commercial farmers towards global warming in Oyo State, based on educational qualification.
8. establish the difference in at-risk behaviour towards among commercial farmers towards global warming in Oyo State, based on educational qualification.

1.4 Research Questions

The following research questions were answered in this study:

1. What is the level of knowledge of global warming among commercial farmers in Oyo State, Nigeria?
2. What is the attitude of commercial farmers in Oyo State towards global warming?
3. What is the at-risk behaviour of commercial farmers in Oyo State towards global warming?

1.5 Hypotheses

The following hypotheses were tested in this study at 0.05 alpha level.

1. There is no significant relationship between knowledge and attitude of commercial farmers towards global warming in Oyo State.
2. There is no significant relationship between knowledge and at-risk behaviour of commercial farmers towards global warming in Oyo state.
3. There is no significant difference in knowledge of global warming among commercial farmers in Oyo State, based on educational qualification.
4. There is no significant difference in attitude among commercial farmers commercial towards global warming in Oyo State, based on educational qualification.
5. There is no significant difference in at-risk behaviour among commercial farmers towards global warming in Oyo State, based on educational qualification.

1.6 Significance of the Study

The findings of this study would be helpful in the following ways:

In the first instance, the outcomes of this study may provide essential and latest information on knowledge, attitude and at-risk behaviour of commercial farmers in Oyo State, Nigeria, towards global warming. The outcome of this study may encourage agricultural research institutes, policy makers, governments, non-governmental organisations and other relevant stakeholders to create interest in planning or designing programme on knowledge, attitude and at-risk behavior of commercial farmers towards global warming. The findings of the study would serve as a knowledge base and reference point for other researchers in public health who may be interested in global warming related issues.

1.7 Scope of the Study

The scope of this study focused on the following:

This scope of this study focused on independent variables of knowledge, attitude and at-risk behaviour, while global warming was examined as dependent variable. In addition, cross sectional research design was used, while the commercial farmers who are duly registered with Oyo State Agribusiness Development Agency (OYSADA) served as the population of this study. The study was carried out in three zones across Oyo State; which comprises Ogbomoso, Oke-Ogun and Oyo zones respectively. A self-developed questionnaire was used as instrument for data collection, while simple random and disproportionate sampling techniques were used to select the respondents.

1.8 Limitation to the Study

Some of the respondents felt reluctant in the process of administration of questionnaires. However, the affected respondents were persuaded and assured by the researcher on the confidentiality of their responses. In the means of the above limitation, the result stands valid.

1.9 Operational Definition of Terms

The relevant constructs in the study are operationalized as follows.

- Global Warming: This is a gradual increase in the overall temperature of the earth's atmosphere generally attributed to the greenhouse effect caused by increased level of greenhouse gases.
- Knowledge of Global Warming: This is the fact or information and skill acquired through experience of practical understanding of global warming.
- Attitude towards Global Warming: This is the disposition of a commercial farmer to respond positively or negatively towards a particular event or situation such as global warming.
- At-risk behaviour towards Global Warming: These are practices by the commercial farmers which can increase the occurrence of global warming. These include deforestation, bush burning, rice production, use of nitrogenated fertilizers.

- Commercial Farming: This is the large-scale livestock rearing and production of crops for sale which are intended for widespread distribution to retail or wholesale outlets.
- Commercial Farmers: These are the group of people (male and female) that plant crops and rear animals in large-scale with the intention of selling the products at the market.
- Educational qualification: It refers to the official confirmation, usually in the form of a certificate, diploma or degree, certifying the successful completion of an education programme.
- Semi-urban Farming: It is the agriculture practices within and around cities which compete for resources to satisfy the requirements of the urban population.

Endnotes

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Chapter Two
Review of Related Literature

This study examines knowledge, attitude and at-risk behaviour towards global warming among commercial farmers in Oyo State. In order to give a strong theoretical base as well as conceptual and empirical evidence for the variables being studied, relevant literature were reviewed under the following sub-headings:

2.1 Conceptual studies

- 2.1.1 Overview of Global Warming
- 2.1.2 Concept of Climate Change
- 2.1.3 Greenhouse Gases and their Emissions from Agriculture
- 2.1.4 Causes of Global Warming
- 2.1.5 Occurrence of Global Warming in the World, sub-Sahara Africa and Nigeria
- 2.1.6 Health Consequences of Global Warming on Human and Environment
- 2.1.7 Overview of Commercial Farming and Farmers
- 2.1.8 Overview of Farming in Oyo State
- 2.1.9 Prevention, Mitigation and adaptation of Global Warming

2.2 Theoretical Review

2.2.1 Milankovitch Theory

2.2.2 Health Belief Model

2.3 Review of Empirical Studies

- 2.3.1 Knowledge of Global Warming among Commercial farmers
- 2.3.2. Attitude towards Global Warming among Commercial farmers
- 2.3.3. At-risk Behaviour towards Global Warming among Commercial farmers

2.4 Conceptual Framework
2.5 Summary of Gaps in Literature
Endnotes

2.1 Conceptual Studies

2.1.1 Overview of Global Warming

Since 1880, the Earth's average temperature has increased by 0.140 degrees Fahrenheit every decade; but, since 1981, the rate of warming has increased by more than twice that amount. 0.180 Celsius (0.320 Fahrenheit) [1]. Since the industrial revolution, the temperature of the air on Earth has increased. The overwhelming body of data suggests that human actions, notably emissions of heat-trapping greenhouse gases, are primarily to blame for our planet's warming, with some contribution coming from natural variability [2, 3].

The average global temperature on Earth has risen by at least 1.10 centigrade (1.90 degrees Fahrenheit) since 1880, according to ongoing research headed by scientists at NASA's Goddard Institute for Space Studies (GISS) [4]. The warmest year on record is a tie between the years 2016 and 2020[5]. The five warmest years on record have all happened since 2015 while nine of the ten warmest years since 1880 have happened since 2005 [6]. Many studies have revealed that the effects of climate change are already impacting people, refuting the assertion made by climate change skeptics that there has been a "pause" or "slowdown" in the rise of global temperatures [7]. [8]. One of the most important environmental problems of our day is global warming, and there is alarming evidence that it will have a wide range of negative effects on human health.

The term "global warming" refers to the climate changes caused by various human activities, such as the burning of fossil fuels (coal, oil, and gas) and extensive deforestation, which release

greenhouse gases into the atmosphere [9]. These gases act as blankets over the earth, absorbing infrared radiation and maintaining a cooler climate. Extreme weather occurrences like heat waves, droughts, cyclones, wildfires, blizzards, and rainstorms are on the rise as a result of this [10]. Because of its negative consequences on ecosystems and human populations (including, for example, significant sea level rise), global warming is one of the most important environmental problems [11].

Because they prevent some of the sun's heat from bouncing back into space and maintain a habitable climate on Earth, greenhouse gases are a natural occurrence and are vital to the existence of people and numerous other species.

However, the amount of greenhouse gases in the atmosphere has increased to record levels not seen in three million years following more than a century and a half of industrialization, deforestation, and large-scale agriculture [12]. The total amount of greenhouse gas (GHG) emissions increases along with population growth, economic expansion, and improvements in living standards.

Alarming research suggests that crucial tipping points that could have resulted in permanent changes to the planet's climate system and major ecosystems have already been achieved or passed. Ecosystems as different as the artic tundra and the amazon rainforest may be on the verge of significant change due to warming and drying [13]. Mountain glaciers are receding alarmingly, and the long-term implications of decreasing water availability during the driest months will be felt for many generations.

We are in a defining moment and it is the defining problem of our time. The effects of global warming are unparalleled in magnitude, ranging from changing weather patterns that endanger food production to increasing sea levels that increase the likelihood of catastrophic

flooding. Without immediate action now, future adaptation to these effects will be more difficult and expensive. The International Panel on Climate Change's recent scientific study reveals climate trends across the globe [12]. The ability of ecosystems to support food production, ensure the supply of freshwater resources, offer ecosystem services, and encourage rural multifunctionality has been impacted by changes in land use and an increase in the demand for water resources.

Scientists calculated each greenhouse gas's global warming potential (GWP) in comparison to carbon dioxide, which has a GWP of 1, to determine how much it will contribute to global warming or trap extra heat over a specific period of time (often 100 years). This, however, depends on how well the gas traps heat and how long it remains in the atmosphere before decomposing. A methane molecule, for instance, degrades fast and lingers in the atmosphere for around 12 years [14]. Methane and nitrous oxide, however, are more powerful. In other words, they effectively trap more heat than carbon dioxide, which has a far longer lifetime.

Despite the focus on carbon dioxide, methane and nitrous oxide are also extremely strong gases. Compared to carbon dioxide, greenhouse gases have higher global warming potentials (GWPs). A given amount of a greenhouse gas, such as methane, which has a GPW of 25, is converted into an equivalent amount of carbon dioxide using the carbon dioxide equivalent (CO 2) and GWP. 84 kilograms of carbon dioxide are released for every kilogram of methane, and 298 kilograms of carbon dioxide are released for every kilogram of nitrous oxide, for instance[15].

2.1.2 Climate Change Concept

Understanding the distinction between weather and climate is the first step in comprehending climate change. The current atmospheric conditions are referred to as the "weather." It also incorporates adjustments that are anticipated over the following few days, such

as changes in temperature and rainfall. The type of weather that is commonly anticipated in a location is referred to as the climate. This includes outlining the variety of potential conditions.

Naturally, the climate changes from decade to decade and from one year to the next. Variations in the sun's heat output as well as natural processes connecting the atmosphere, ocean, and land are to blame for this. Climatic change can result from human action in addition to changes brought on by natural climate variability [16]. These human factors are mostly to blame for the current type of climate change. Despite the fact that the terms "global warming" and "climate change" are sometimes used interchangeably, the former is only one component of the latter. The term "global warming" describes the rise in global temperatures primarily brought on by an increase in the atmospheric concentration of greenhouse gases.

Climate change is the term used to describe long-term, progressive changes in the variables that make up the climate, such as precipitation, temperature, and wind patterns [17]. The weather is significantly different from the norm. Our climate is changing at a rate that is unheard of, according to strong scientific data. The majority of land regions are expected to see more hot days and heat waves in the future, according to the Intergovernmental Panel on Climate Change, which would likely put additional strain on the already-stressed biodiversity in these areas [18]. With rising surface temperatures, melting ice and snow, rising sea levels, and increased climate unpredictability, there is scientific agreement that the world's climate is changing.

On human health, these changes are anticipated to have significant effects. Many of these effects have established, practical public health solutions, but the extent, timeframe, and complexity of climate change are unprecedented. The warming and cooling of the globe occasionally lasted for thousands of years, according to historical documents that date back about 15,000 years [19]. Climate scientists extrapolate the results from obtaining and analyzing ice cores

from past atmospheres, sediment pollen, and ancient tree rings in order to demonstrate the true nature of climate change [20, 21].

Humanity has a global dilemma in the form of climate change, and anthropogenic activity unquestionably contributes to the problem's escalation [22]. Around the world, it has caused a wide range of physical and biological changes that have had a negative impact on agriculture, people, and the environment [23].

There is growing evidence that climate change increases the risk to billions of people's lives and wellbeing. Weather-related health consequences can have a direct impact on people's health, or they can have an indirect impact on people's health through affecting economies, access to healthcare, social structures, and ecosystems. While human activity has been the largest driver to climate change over the past century, natural factors only make up a minor portion of the problem [22].

According to the International Panel on Climate Change (IPCC), there is clear evidence that human activity is influencing the way the climate system is changing. Since the time of Hippocrates, weather and climate have been recognized as having an impact on human health[24]. Hyperthermia is brought on by heat, hypothermia by cold, and hunger by droughts. Floods, hurricanes, tornadoes, and forest fires cause displacement and fatalities [25, 26]. Numerous vector-borne diseases, such as malaria, Rift Valley fever, zika, chikungunya, and dengue fever, are affected by climate and weather, which also affects their likelihood of spreading[27].

Weather also affects the risk of foodborne and waterborne diseases and of emerging infectious diseases such as hanta virus, Ebola hemorrhagic fever, and West Nile virus [28]. In a number of papers, the World Health Organization underlined the direct and indirect links between climate change and health. Temperature fluctuations and an increase in extreme weather

events have an immediate influence on health and can result in heat-related illnesses or physical damage.

Changes in water and food availability, rising malnutrition and diarrheal disease, an increase in allergens and air pollution, an increase in respiratory and cardiovascular diseases, changes in disease ecology, and outbreaks of infectious diseases are just a few examples of indirect effects that result from ecological and human system changes brought on by climate change.

Current estimates indicate that climate change is expected to cause approximately 250,000 additional deaths per year, from malnutrition, malaria, diarrhea and heat stress globally. Models predict that by the year 2100, the world's mean temperature will increase and Earth might be unrecognizable if greenhouse gas emissions are not curbed significantly [29].

2.1.3 Greenhouse Gases

The greenhouse effect is brought on by greenhouse gases, which absorb and emit thermal infrared radiation. When sunlight hits the surface of the Earth, some of the light's energy is absorbed and then reradiated as infrared waves, which humans experience as heat. These infrared rays ascend to the atmosphere and, if unhindered, will reenter space. The planet gets warmer due to greenhouse gases because they trap heat [30]. This includes halogenated gases (such as chlorine, fluorine, and bromine), water vapor, carbon dioxide, methane, ozone, nitrous oxide, chlorofluorocarbons, and perfluorocarbons.

The carbon cycle is a natural process whereby carbon is moved from one natural carbon reservoir (the atmosphere) to another (the seas, the land biosphere, etc.) using carbon dioxide (CO2). It is a chemical compound made up of molecules, each of which has a covalent double bond between two oxygen atoms and one carbon atom [31]. A colorless and odorless gas called

carbon dioxide is one that exists in nature. It sublimates at -70 0C, has a water vapour density of 1.53, and is only marginally soluble in water. At room temperature, it exists as a gas.

Burning fossil fuels (coal, natural gas, and oil), solid waste, trees, and other biological materials releases carbon dioxide into the atmosphere. It also results from specific chemical reactions (such the production of cement) [32]. Since the reservoirs on land and in the oceans are far larger than those in the atmosphere, even slight changes in these larger reservoirs could have a significant impact on the concentration in the atmosphere. In recent years, atmospheric carbon dioxide levels have increased by more than 40%, from a preindustrial abundance of 280 parts per million (ppm) of dry air to over 400 ppm [33]. Hypoxia is caused when a simple asphyxiant removes oxygen from the breathing atmosphere. Cardiovascular symptoms such tachycardia, arrhythmias, and ischema are noticed after exposure to asphyxiants.

The heart experiences a direct toxic effect from carbon dioxide, which reduces contractile force. It is also the strongest known cerebrovascular dilatant and a vasodilator. Additionally observed are respiratory side effects as cyanosis, hyperventilation, and pulmonary edema. 100000 ppm for 1 minute is the lowest fatal concentration (inhalation) for humans [34]. Anthropogenic carbon was released as carbon dioxide into the atmosphere over the timescales we are interested in. When crop wastes from wheat, sugarcane, rice, and other crops are burned, a significant amount of carbon dioxide is released into the atmosphere, poisoning both the soil and the air.

According to a study, the burning of crop residue resulted in the emission of 149.24 million tonnes of carbon dioxide [35]. One centimeter of soil is heated by burning paddy straw, bringing the soil's temperature up to 33.8 to 42.2 degrees Celsius. The bacterial and fungal communities necessary for a rich soil are eliminated as a result. According to one study, burning one tonne of

stubble results in the loss of 5.5 kg of nitrogen, 2.3 kg of phosphorus, 25 kg of potassium, and more than 1 kg of sulphur. Natural gas, which has seen a more than 50% increase in popularity as a comparatively clean source of fossil energy over the previous two decades, is primarily composed of methane (CH4) [36]. Because it can be observed bubbling up from marshy locations where organic material is decomposing, its common term used to be marsh gas.

Methane is a problem since it affects the climate externally. A very small portion of our atmosphere is made up of the gas. It has a lifespan of around ten years on average, compared to centuries for carbon dioxide, and it decomposes far more swiftly. Therefore, reducing methane emissions could offer temporary relief as governments and corporations work to make the more challenging switch from fossil fuels to clean energy.

There are many anthropogenic (influenced by humans) and natural sources that release methane. Landfills, oil and natural gas systems, agricultural practices, coal mining, stationary and mobile combustion, wastewater treatment, and specific industrial operations are among the sources of anthropogenic emissions. Nearly half of all anthropogenic methane emissions are thought to come from China, the United States, Russia, India, Brazil, Indonesia, Nigeria, and Mexico [37].

To reduce methane emissions, scientists are looking into two connected issues. First, what are the principal sources of methane? Second, where are the worst offenders? According to a research, livestock is the main source, accounting for 31% of the total global [36]. Methane has a significantly lower atmospheric concentration than carbon dioxide (less than 2 ppm compared to around 370 ppm for carbon dioxide), yet its warming effect is still significant. This is due to methane having an enhanced greenhouse impact that is approximately 84 times stronger than carbon dioxide.

Ground-level ozone is a dangerous air pollutant and a greenhouse gas, and methane is the main contributor to its creation. Exposure to this pollution causes 1 million premature deaths annually [38]. Methane (CH 4) levels have increased by more than 160% from preindustrial times, from a preindustrial abundance of roughly 700 parts per billion (ppb) of dry air to more than 1850 ppb as of 2017. The effects of this increase on climate change are significant. Wetlands are the primary natural producer of methane. Other sources that are caused directly or indirectly by human activity include leaks from natural gas pipelines and oil wells, rice paddies, enteric fermentation (belching and farting) in livestock, the degradation of trash in landfills, and the burning of wood and peat.

The energy sector, which includes emissions from coal, oil, natural gas, and biofuels, is the second greatest source of anthropogenic methane emissions, accounting for around a quarter of the overall amount [39]. Although measurements of the ratios of various carbon isotopes in atmospheric methane help in calculating the proportion from fossil fuel sources, there is still significant uncertainty in predicting the amount of many of these sources. Chemical and biological activities are the primary means of removing methane from the atmosphere [40]. Because of atmospheric processes including sunlight, oxygen, ozone, and water vapor, it combines with hydroxyl (OH) radicals.

The average lifetime of methane in the atmosphere is determined by the rate of this loss process. At about 12 years, it is much shorter than the lifetime of carbon dioxide. Because of the critical role of OH, the concentration of methane and its lifetime are partially controlled by the presence of pollutants such as the oxides of nitrogen that, therefore, possess an indirect influence on the amount of global warming. It is of course important to take these indirect effects into account. Nitrous oxide (N_2O) also known as laughing gas is another greenhouse gas.

Rarely have atmospheric nitrous oxide concentrations for the past 800,000 years surpassed 280 ppb. But since the 1920s, levels have increased, hitting a new record of 334 ppb in 2021. This enormous increase is mostly the result of agriculture [41]. Burning biomass and the chemical sector (such as the manufacture of nylon) also contribute.

The main components of human-related global warming are carbon dioxide and methane. Nitrous oxide emissions, sometimes known as laughing gas, are also rising quickly, primarily as a result of industrial agriculture using synthetic fertilizers and cow ranching. More fossil fuels were burned, but their contribution to the observed changes was relatively small [42].

The use of soil fertilizers and the number of cattle worldwide are both increasing in tandem with the growth of the global population.

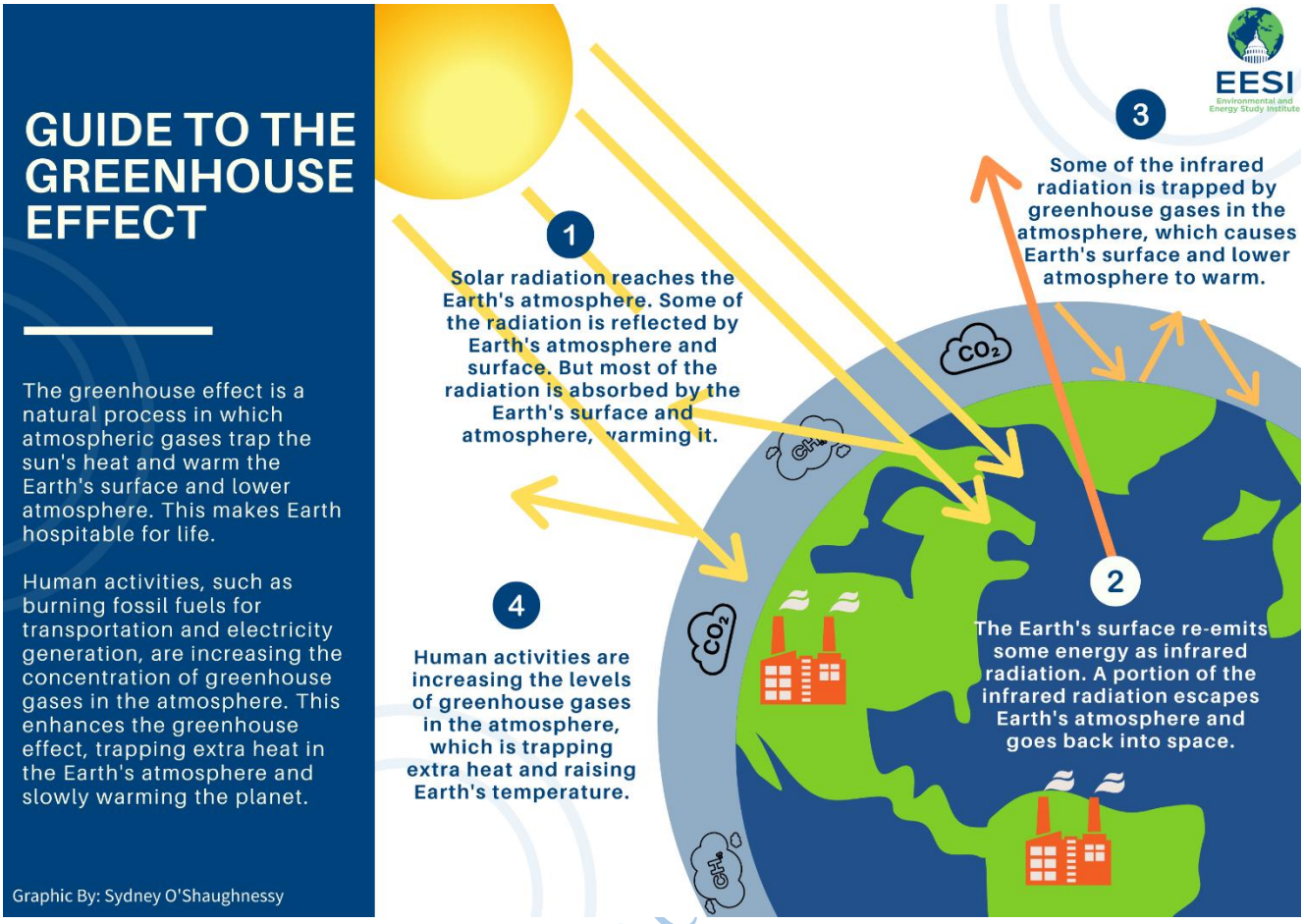
Cattles produce nitrous oxide both directly from their manure and indirectly through the fertilizer-based emissions of the grain that many of them eat.

Ozone and chlorofluorocarbons: CFCs are man-made compounds that seem to be perfect for use in aerosol spray cans, insulation manufacturing, and refrigerators. They persist in the atmosphere for a very long time-up to 200 years-before being destroyed because they are so chemically inert. They have an atmospheric concentration of roughly 1 ppb due to their rapid expansion in use throughout the 1980s, which is leading to two significant environmental issues.

Firstly, they destroy ozone, an extremely reactive gas present in small quantities in the stratosphere (a region of the atmosphere between about 10 and 50 km in altitude) where it absorbs solar ultraviolet radiation, radiation that would otherwise be harmful to us and to other forms of life at the Earth's surface [43, 44]. Chlorofluorocarbon molecules that reach the stratosphere are also dissociated by the action of ultraviolet sunlight, the resulting chlorine atoms readily reacting with ozone destroying it through a catalytic cycle. The global warming potential

is also often expressed as the ratio of the effect for unit mass of each gas in which case the global warming potential for methane (whose molecular mass is 0.36 of that of carbon dioxide) becomes about 23 for the 100 year time horizon. About 75% of the contribution of methane to the greenhouse effect is because of its direct effect on the outgoing thermal radiation.

The other 25% arises because of its influence on the overall chemistry of the atmosphere. Increased methane eventually results in small increases in water vapour in the upper atmosphere, in tropospheric ozone and in carbon dioxide, all of which in turn add to the greenhouse effect. Because of this problem of ozone depletion, International action was taken through the Montreal Protocol of 1987 to phase out the production of chlorofluorocarbons. As a result, the concentration of chlorofluorocarbons in the atmosphere is no longer increasing [45]. However, since they possess a long life in the atmosphere, little decrease will be seen for some time and significant quantities will be present well over a hundred years from now.



Guide to greenhouse gas effect.

Agriculture Greenhouse gas emissions.

The land use patterns and gas emissions assumed to be responsible for climate change are largely influenced by the agriculture sector. Agriculture consumes a lot of fossil fuels and uses a lot of land, but it also directly produces greenhouse gas emissions by growing cattle and producing rice, for example [46]. A sizable portion of greenhouse gas emissions are caused by agriculture [47]. It accounts for at least 12% of world emissions, and it can reach as high as 33% 48 when agricultural land use shifts.

Nitrous oxide, methane, and carbon dioxide emissions from farms are the biggest offenders, accounting for up to half of the greenhouse gases produced by the entire food business, or 80% of agricultural emissions. Monogastric and ruminant agricultural animals can be divided into two groups.

Monogastric, or foods related to pigs and poultry, are low in greenhouse-gas emissions compared to ruminant products like beef and dairy. Therefore, monogastric consumption results in lower emissions. This is as a result of the better feed-conversion efficiency and lack of methane production of these animals [49]. The demand for a steady supply of meat will rise as lower-income nations start to develop and keep doing so. This means the cattle population will be required to grow in order to keep up with the demand, producing the highest possible rate of greenhouse-gas emissions [50].

There are many strategies that can be used to help soften the effects, and the further production of greenhouse gas emissions. Some of these strategies include a higher efficiency in livestock farming, which includes management, as well as technology; a more effective process of managing manure; a lower dependence upon fossil-fuels and nonrenewable resources; a variation in the animals' eating and drinking duration, time and location; and a cutback in both the production and consumption of animal-sourced foods [51].

Land usage

Land use in agriculture increases greenhouse gas emissions in a variety of ways, including carbon dioxide emissions linked to deforestation, carbon dioxide emissions from bush burning, methane emissions from rice farming, methane emissions from enteric fermentation in cattle, and methane emissions from fertilizer use. Together, these carbon dioxide emissions from agricultural activities account for nearly all carbon associated with land use, 54% of methane

emissions, and 80% of nitrous oxide emissions [52]. Since 1750, the planet's land cover has undergone significant changes as a result of temperate area deforestation. Deforestation can lead to higher concentrations of carbon dioxide, the main greenhouse gas, by affecting the regional carbon reuptake [53].

Livestock

Farming animals is extremely harmful to the environment and the health of the earth overall since it requires a tremendous quantity of water, destroys forests, and emits a significant amount of greenhouse gases. More than 16.5% of greenhouse gas emissions caused by human activity are attributable to livestock and livestock-related activities, such as deforestation and ever-more fuel-intensive farming methods [54]. The primary greenhouse gas created in grazing systems is methane. Methanogens are a type of microorganism found in the rumen of ruminant animals like cattle, sheep, and goats. As a result of the feed being fermented by these microorganisms, methane is produced, which is subsequently belched out. Higher quality feeds produce less methane than feeds with a lower rate of digestion.

Belching methane is a sign that energy was wasted throughout the production process, energy that could have been used to make the milk, meat, or fiber that generates income [55]. Since crops like corn and alfalfa are grown to feed the animals, livestock activities also contribute disproportionately to land-use effects. A normal component of the digestive process in ruminant animals like cattle, sheep, goats, and buffalo is enteric fermentation. Food is broken down and fermented by microbes in the rumen, the digestive tract, which creates methane as a byproduct.

Ruminant animals raised for their meat and milk account for up to 30% of the world's anthropogenic methane emissions. If left unchecked, factors including the caliber of the feed, the animal's size, and the habitat temperature would increase the amount of methane that animal

emits [56]. Half of the livable land on earth is used for agriculture. More over three-quarters of the protein and calories consumed worldwide are used for the production of animals, despite the fact that meat and dairy make up a much smaller percentage of these nutrients [57]. The way livestock are grazed influences how fertile the land will be in the future. Lack of rotational grazing can result in bad soil, and the growth of livestock farms affects the habitats of nearby animals, which has resulted in a decline in the number of many local species.

Production of Fertilizer

The production of nitrogen fertilizer results in the emissions of the greenhouse gases carbon dioxide, methane, and nitrous oxide [58, 59]. The results can be added together to produce an equivalent volume of carbon dioxide. The cost fluctuates depending on how effectively the process works. Nitrous oxide, a powerful greenhouse gas, is being released into the atmosphere as a result of agriculture's extensive use of artificial fertilizers. Since soil bacteria both create and transform nitrous oxide 60, they are crucial in this situation. The need for food, fiber, and energy is expected to rise in the future years as a result of the growing world population. This will result in an increase in worldwide nitrous oxide (N2O) emissions into the atmosphere.

2.1.4 Why Global Warming Occurs

Numerous elements, both natural and man-made, can have an impact on global warming. The intensity of the sun's rays, volcanic eruptions, and variations in the amounts of naturally occurring greenhouse gases are some of the factors that cause global warming. Records show, however, that current global warming, particularly the warming that has been happening since the middle of the 20th century, is happening considerably faster than ever before and cannot be

explained by purely natural factors. In particular, greenhouse gas (GHG) emissions from human activity are the main factor now speeding up the planet's climate change61.

Maintaining the right temperature on our planet for life depends on greenhouse gases. Without the natural greenhouse effect, heat from the Earth's surface would simply escape into space, resulting in an average temperature of -20°C [62]. Global weather patterns are being impacted by the excess radiated heat that has been stored in the oceans and close to the Earth's surface. The amplified greenhouse effect is this phenomenon. By 2100, average global temperatures are predicted to rise by between 0.5°F and 8.6°F, with an increase of at least 2.7°F likely under all but the scenario with the most aggressive greenhouse gas emission reductions [63].

In addition, more infrared radiation will be absorbed as long as human activity continues to add to the buildup of greenhouse gases, mainly from the burning of fossil fuels. As a result, the Earth's surface and lower atmosphere will continue to warm until a new equilibrium between incoming and outgoing radiation is found. Although greenhouse gases are essential for keeping the planet habitable, their concentration in our atmosphere has risen dramatically since the middle of the 20th century.

Global warming is mostly caused by agricultural practices, the use of fossil fuels, deforestation, and other factors. Through anthropogenic greenhouse gas emissions and the conversion of non-agricultural land like forests into agricultural land, agriculture plays a role in climate change. The land use patterns and gas emissions assumed to be responsible for climate change are largely influenced by the agriculture sector. Agriculture uses a lot of area and consumes a lot of fossil fuels, but it also directly produces greenhouse gas emissions through activities like the production of rice and cattle [62].

The three biggest contributors to the rise in greenhouse gases seen during the previous 250 years, according to the Intergovernmental Panel on Climate Change, are fossil fuels, land use, and agriculture [63] A sizable portion of greenhouse gas emissions are caused by the agricultural food system [64]. The Intergovernmental Panel on Climate Change estimates that it accounts for at least 10–12% of emissions, and that number can go as high as 17% when land use changes as a result of agriculture.

The main offenders are farms, which are responsible for up to 50% of the greenhouse gas emissions produced by the total food industry or 80% of agricultural emissions [65]. These gases include nitrous oxide, methane, and carbon dioxide.

Monogastric and ruminant agricultural animals can be divided into two groups. Monogastric, or foods related to pigs and poultry, are low in greenhouse-gas emissions compared to ruminant products like beef and dairy. Therefore, monogastric consumption results in lower emissions. This is due to the fact that these specific animals have a higher feed-conversion efficiency and produce no methane [65].

The demand for a steady supply of beef will rise as lower-income nation's start and continue to develop [66]. This implies that in order to meet demand, the cow population must increase, resulting in the maximum potential rate of greenhouse gas emissions [66].

2.1.5 Occurrence of Global Warming in the World, sub-Saharan Africa and Nigeria

Despite having fundamental differences, global warming and climate change are frequently confused. Climate change is the long-term alteration of the typical weather patterns that characterize Earth's local, regional, and global climates. Global warming is the long-term heating of the Earth's climate system as a result of human activities. In the 17th and 18th centuries, the

advent of the combustion engine which propelled locomotives, sizable factories, and agricultural machinery started to release carbon dioxide gas emissions into the atmosphere [67]. Furthermore, the increased use of fossil fuels and the massive destruction of carbon-absorbing forests were beginning to significantly alter the climatic systems [68].

According to accounts, the early releases of carbon dioxide into the atmosphere and the slow warming of the earth were caused by the introduction of substantial automation, the use of fossil fuels in industry, and agricultural practices. There is evidence that people extracted carbon from the lithosphere, where it had been dormant for millions of years, in order to release the stored energy of the carbon-rich deposits, also known as fossil fuels [69].

These unrelenting anthropogenic activities have given way to a rapid rise in the global concentrations of carbon dioxide of more than 35 per cent above pre-industrial levels since the 1950's [70]. By examining the chemical composition of the carbon in the air, scientists can precisely identify the origin of this increase. According to this estimate, atmospheric carbon dioxide levels were over 200 parts per million (ppm) in 1970 and were over 400 ppm in 2013 [71]. Additionally, methane, nitrous oxide and other gases were taken from the soil and air just above the ground.

The IPCC estimates that these human-caused activities are responsible for a temperature increase of 1.0°C above pre-industrial levels. Anthropogenic emissions have significantly increased the amount of greenhouse gases in the atmosphere, which is causing a considerable rise in terrestrial and marine temperatures as well as widespread drought, wildfires, desertification, strong storms, and flooding throughout the world [72]. According to the body of evidence, global warming is already having a negative impact on the climate and will do so for some time.

Due to record-high levels of greenhouse gas emissions, the world is on the verge of an excessively warm climate, which will have serious negative effects on African development prospects. Africa contains seven of the ten nations that are most at risk from climate change. For sub-Saharan Africa, which has experienced more frequent and more intense climate extremes over the past decades, the ramifications of the world's warming by more than 1.5° C would be profound. A number of variables, such as poor adaptation capacity, a high reliance on ecosystem products for livelihoods, and underdeveloped agricultural production, contribute to Africa's vulnerability to global warming.

The risks of Global warming on agricultural production, food security, water resources and ecosystem services will likely have increasingly severe consequences on lives and sustainable development prospects in Africa [74]. Managing this risk requires an integration of mitigation and adaptation strategies, and the agricultural production systems in Africa. Nearly the whole surface of the globe is predicted to warm due to global warming during the next few decades, and mean worldwide rainfall will rise as a result [75].

Regional effects on rainfall in the tropics are expected to be much more spatially variable and the sign of change at any one location is less certain, although changes are expected. Since the late 19th century, temperatures in Africa have usually climbed by about 1 degree Celsius, but locally they have increased by as much as 3 degree Celsius for the minimum temperature in the Sahel at the conclusion of the dry season [76]. Observed precipitation trends indicate spatial and temporal discrepancies as expected. The observed changes in temperature and precipitation vary regionally [76].

Within the bounds of chemistry and physics, it is conceivable to limit global warming to 1 degree Celsius, but doing so would necessitate enormous adjustments. But the world's foremost

authority for assessing the science of climate change (Intergovernmental Panel for Climate Change), says it is possible to limit the global temperature rise to 1.5 degree Celsius if there are rapid and far-reaching transitions in land, energy, industry, buildings, transport and cites. For sub-Sahara and Africa, which has experienced more frequent and more intense climate extremes over the past decades, the ramifications of the world's warming by 1.5 degree Celsius would be profound.

With temperature rises in the region likely to be higher than the global mean temperature increase, regions of Africa within 15 degrees of the equator are expected to experience an increase in hot evenings as well as longer and more frequent heat waves [77]. West Africa has been designated as a hotspot for global warming, and it is predicted that this will reduce crop yields and production, with subsequent effects on food security. According to IPCC predictions, the western Sahel region would see the most drying, with a noticeable increase in the maximum length of dry spells. The IPCC forecasts a marginal increase in Central Africa's heavy rainfall and a marginal decrease in the length of rainy spells [78].

Particularly significant increases in the number of hot days at 1.5° C and 2° C will be observed in West and Central Africa. Temperatures are anticipated to increase by 2° C more quickly over Southern Africa, with South Africa and parts of Namibia and Botswana predicted to face the biggest temperature rises. The Sahel, which is witnessing a high population expansion estimated at 2.8% per year in a setting of declining natural resources, particularly land and water supplies, has maybe been affected more than any other region in the world [78].

2.1.6 Health Consequences of Global Warming on Human and Environment

Despite the fact that some natural events do contribute to the production of Greenhouse gases, the overwhelming consensus among the most reputable climate scientists in the world is that human actions are mostly to blame for this temperature increase [79]. The vast majority of the world's top climate experts agree that human activities are mostly to blame for this temperature increase, despite the fact that some natural phenomena do contribute to the generation of greenhouse gases, a report, Livestock's Long Shadow: Environmental Issues and Options highlighted the substantial role of the farm animal production sector as a major threat to the environment [80]. It was also discovered that the animal agriculture sector emits 18% or nearly one-fifth, or human-induced GHG emissions, more than the transportation sector [81].

Impact of excess heat on the human body

The human body requires evaporative cooling to prevent overheating, even with a low activity level. When the ambient temperature and humidity are too high, evaporative cooling is not effective. Human thermoregulatory capacity is exceeded. Wet-bulb globe or prolonged temperatures beyond around 35 °C (95 °F) are potentially lethal [81]. Human response to heat stress can be hyperthermia, heat stroke, Rhabdomyolysis, Heat Syncope and other harmful effects. Heat illness can cause permanent disability or death if the person does not receive emergency treatment [82].

Impact on Infectious Diseases

Extreme weather patterns caused by warming waters and a changing climate have led to a rise in infectious diseases, both new and reemerging. In addition to bringing new climates to various countries, these extreme weather patterns are extending some regions' dry spells and

others' rainy seasons [83, 84]. These longer seasons are resulting in climates that enable vectors to persist for longer periods of time, proliferate quickly, and also enable the introduction and survival of novel vectors [85, 86].

In 2016, a report from the United Nations Environment Programme was published. This essay's second section was devoted to zoonotic diseases, or ailments that can be contracted from animals to humans [87]. In this chapter, one or more of the primary causes that increase the risk of developing certain diseases was mentioned, including deforestation, climate change, and animal rearing. Every four months, a new human disease is reportedly discovered. There have been fatalities and billion-dollar financial losses from prior epidemics as of 2016, and future disease pandemics would cost trillions of dollars, according to reports [87].

Effects of climates that is hotter and wetter

The largest threat to people comes from mosquito-borne illnesses, which include malaria, elephantiasis, Rift Valley fever, yellow fever, and dengue fever. Studies show that these illnesses are more prevalent in areas that have recently experienced significant flooding and drought [88, 89]. Flooding increases the amount of stagnant water where mosquitoes can breed; studies have also shown that these vectors can feed more and develop more quickly in warmer climes. Mosquitoes are now able to survive in places they had never been able to before due to warmer temperatures that are slowly making their way up to higher elevations as the climate over the oceans and coastal regions warms.

If the temperature rises over 90 degrees, there is a potential that malaria will resurface in the industrialized world. The Plasmodium family of bacteria is the cause of the parasitic disease malaria, which is spread by mosquitoes and affects both humans and other animals. It starts with a bite from a female mosquito carrying the parasite, which transfers it into the infected host's

circulatory system by its saliva. It then moves into the liver through the circulation, where it can develop and procreate.

Typical signs of the illness include fever, headache, chills with shaking, anemia, and in severe cases, coma or death. Approximately 241 million clinical episodes and 627,000 deaths were attributed to malaria in 2020. In 2020, the African region of World Health is expected to account for 95% of all fatalities. [91]. Malaria and other vector-borne diseases are influenced by the climate. Malaria is particularly sensitive to the effects of global warming since mosquitoes are unable to regulate their internal temperature [92]. This suggests that the virus and vector can only survive, reproduce, and infect hosts in a narrow range of climatic circumstances.

Malaria and other vector-borne illnesses have unique traits that define their virulence. These include the vector's ability to survive and reproduce, its degree of activity (such as how often it bites or feeds), and the pathogen's capacity to develop and reproduce inside the vector or host. Climate changes have a substantial impact on the reproduction, development, distribution, and seasonal transmissions of malaria [93]. Mosquitoes have a narrow window of favorable conditions for development and reproduction. The ideal temperature for mosquito breeding and maturation is between 16 and 18 degrees Celsius [94].

The majority of insects will die if the temperature drops by two degrees. Because of this, malaria cannot persist in regions with chilly winters. In climates with an increase of about two degrees over the average temperature of around 16 degrees Celsius, adult bugs and larvae thrive. In order to maintain life and promote egg production, female mosquitoes will require more nourishment (human or animal blood).

Due to increased human contact and more blood-sucking insects surviving and living longer, there is an increased risk of malaria spreading as a result [95]. Mosquitoes are extremely sensitive

to changes in precipitation and relative humidity. Increased precipitation can indirectly boost the mosquito population by expanding larval habitat and feeding supplies. These favorable conditions are resulting in a large number of bug breeding grounds and larval development sites. The melting of snow and an increase in the frequency of stagnant water pools are two repercussions of rising temperatures [96].

When insects that already have the disease multiply and infect new mosquitoes, the risk of the deadly sickness spreading increases.

Global warming has a direct impact on people's health in places where malaria was originally not prevalent. Mosquitoes are sensitive to temperature changes and the warming of their environment will boost their rates of production. A two to three degree change in temperature provides the perfect environment for mosquitoes to breed, mature, and spread the virus to humans who have never been exposed to it before [97].

People who live in communities at higher altitudes in Africa and South America are now more prone to have malaria because of the rise in the ambient temperature [98]. This is a serious problem because there is an increased risk of developing malaria complications, such as cerebral malaria (a type of the disease that can cause mental impairment, paralysis, and has a high mortality rate), as well as dying from the illness because the inhabitants of these communities have never been exposed to the disease.

Residents in these regions are particularly vulnerable to malaria because they lack immunity, are unfamiliar with the symptoms, and lack experience with the illness. Without global warming, it is predicted that between 1990 and 2080, the number of people at risk of malaria will double to 8820 million. However, unchecked climate change will increase that number to 257 to 323

million by the 2080s [99]. Thus, minimizing the current effects of global warming would cut the total by roughly 3.5%, preventing the loss of tens of thousands of lives globally [100].

A massive pandemic of the disease that has the power to obliterate entire communities might be brought on by an increase in temperature. In nations and regions where malaria has never been observed before, it is crucial to monitor the prevalence, species, and number of insects transmitting the disease as well as the number of people infected. The chance exists for many innocent and unwary people to lose their lives due to a devastating disease that can easily be started by the smallest temperature change [99].

Ticks are thriving in the warmer weather as well, which enables them to eat and grow more quickly. When not feeding, the Rocky Mountain spotted fever-carrying brown dog tick spends its time buried in the ground soaking up moisture. Ticks perish when the climate gets either too cold or too dry, which causes the ticks to dry out. As the natural environmental constraints that once kept tick populations in check are disappearing, warmer and wetter climates allow ticks to breed and develop at an alarming rate, which results in an increase in Lyme disease, both in existing areas and in areas where it hasn't been seen before [101].

Two further consequences of the warming world are the frequency and intensity of heat waves. Dehydration, heat stroke, and chronic kidney disease outbreaks have all been brought on by this heat stroke [102]. Recent studies have shown that prolonged heat exposure, hard activity, and dehydration are enough risk factors for chronic renal disorders[103]. These cases of heat stress nephropathy are happening all throughout the world. It also contributes to the rise in hay fever because the amount of pollen in the air increases as the temperature rises [104].

When temperatures combined with high humidity reach a wet-bulb temperature of 35 °C, the temperature at which a healthy human can survive in well-ventilated conditions, as predicted

temperature increases would make parts of Africa uninhabitable [105]. Additionally, warmer weather may result in more aggressive behavior. Increasing temperatures have been linked in studies to a rise in violent and criminal behavior [106]. The increase in crime during the hotter summer months is evidence of this.

Ocean warming's effects

Cholera and toxic algal blooms, often known as red tides, are growing more prevalent as the waters warm. The cholera bacteria that dwells in zooplankton awakens from its dormant state as the levels of nitrogen and phosphorus in the oceans rise. By being carried by zooplankton nearer the coast by varying ocean currents and winds, cholera germs contaminate drinking water and cause epidemics [107]. As flooding occurs, there may also be an increase in cholera epidemics because the bacterially contaminated flood waters are contaminating the drinking water supply [108, 109]. El Nino has also been associated with cholera outbreaks due to the fact that this weather pattern warms the seas along the beach, which encourages the cholera germs to flourish.

Dengue infection

A contagious illness known as dengue fever is brought on by dengue viruses, which are commonly found in tropical areas. It is spread by the Aedes mosquito, also known as A. aegypti. Cases of dengue disease have significantly grown and kept rising since the 1970s [110]. The rising occurrence of the disease is believed to be caused by a mix of urbanization, population growth, increased international travel, and global warming [111]. The genesis of dengue hemorrhagic fever and the spread of various disease serotypes to new regions were both caused by the same dynamics. Dengue fever is caused by four distinct viral types.

An individual who develops one kind of dengue virus becomes resistant to that type of dengue virus for life, but only momentarily to the other type of dengue fever [112]. Fever, headaches, joint and muscle problems, and skin rashes are a few of the signs and symptoms of dengue fever. However, there are treatments to aid with some of the symptoms, such as the administration of oral or intravenous fluids for dehydration [113]. There is presently no vaccine for dengue fever and no definitive cure.

Dengue fever, which was always considered a tropical disease, is now expanding because to global warming [114]. Dengue fever is spread by specific mosquito species that have been spreading further north. This is due to the fact that some climate changes, such as increased heat, precipitation, and humidity, generate ideal mosquito breeding grounds. The mosquitoes can grow and a disease can spread more quickly in a hotter, wetter climate. The fluctuating effects of El Nino, which are changing the climate in different parts of the world and promoting the spread of the dengue virus, are another reason [115].

Both on a political and personal level, there are various things that can be done. Having a better mechanism for anticipating dengue outbreaks would be one improvement. This can be achieved by keeping an eye on conditions that would attract and support the growth of various mosquito kinds, such as temperatures, precipitation, and humidity. Another successful tactic is public education, which entails alerting people when a dengue outbreak is occurring and what they can do to protect themselves. People should, for instance, make sure that their homes are built without any standing water, dress correctly (bright colors, long sleeves), and apply bug spray.

Nearly 1.8 billion people (more than 70% of the world's population) live in the South-East Asia and Western Pacific regions of the World Health Organization, which together account

for roughly 75% of the present global illness burden brought on by dengue [115]. The Asia Pacific Dengue Strategic Plan for both areas (2008-2015) has been developed in collaboration with member countries and development in response to the growing danger posed by dengue.

Coronavirus

The Coronavirus disease of 2019 is classified as a zoonotic disease by the United Nations Environment Programme, meaning that the virus has spread from animals to people. As of right now, zoonotic diseases account for 75% of all emerging diseases [116]. This is because these diseases have been happening more frequently in recent decades for a variety of reasons. Ninety percent of the causes are environmental [117]. Global warming is a contributing element. The transmission of illnesses is aided by abrupt variations in temperature and humidity.

According to the United Nations Environment Programme, protecting nature is the most important measure we can take to protect ourselves against zoonotic diseases [118]. Biodiverse ecosystems are resilient, adaptable, and helpful in disease control. According to the World Bank, there are several ways that climate change, particularly by promoting deforestation, can raise the probability of an outbreak like the coronavirus [119]. Deforestation is responsible for 31% of the zoonotic diseases [120].

Environmental factors like climate change and deforestation may be a contributing factor in the Covid-19 pandemic [121]. They may intensify animal migration and interactions with people. This may make it easier for viruses to spread from one animal to another and to people. In general, viruses become docile with their host and turn aggressive when they move to another [122]. The increase in humidity can also make the transmission easier, even though there are suggestions that increase in humidity and temperature may decrease the expansion of the

pandemic. Animal populations are shrinking due to global warming, which results in less genetic diversity [123]. This situation encourages the spread of viruses.

Scientists have already connected some zoonotic disease outbreaks to floods and droughts, and as a result of global warming, their frequency will rise [124]. Additionally, other effects of global warming include increased human migration, more wars, less effective medical and sanitation systems, and a rise in pandemic risk. While bats will be less affected, an increase in temperature can lessen the ability of the human body to resist the virus [125].

Global warming can lead to food insecurity, which may lead people to consume bush meat like bats, which may be connected to the outbreak [126]. Preventing the next pandemic - Zoonotic diseases and how to break the chain of transmission is a report that was released by the United Nations Environment Programme and the International Livestock Research Institute. According to the paper, there are a variety of factors that are often linked to the destruction of nature that are increasing the occurrence of zoonotic diseases like the coronavirus, including "increased demand for animal protein, unsustainable farming methods, and climate change." All of those alter the interactions between animals and people [127].

Impact on mental health

The rise in global temperatures is anticipated to result in an increase in the frequency of heat exposure. The relationship between a rise in body temperature and violent conduct has been hypothesized [128]. Increased rates of crime and hostility have been noted during the sweltering summer, raising the possibility that aggressive behaviors are related to temperature [129]. Aggression rates could perhaps rise over time as a result of global warming. The temperatures and the suicide rate have also been found to be related. With the recent rise in temperatures, it has been observed that suicides, especially violent ones, are becoming more common [130].

There is a link between mental and behavioral illnesses and heat waves. According to a study from Australia, along with other ailments like cardiovascular and renal disease, heat waves are linked to higher rates of admissions for mental problems as well [131]. These heat waves have been linked, among other things, to dementia, anxiety-related diseases, mood disorders, and anxiety disorders [132]. Excessive heat exposure can cause both physical and mental weariness [133]. Similar previous investigations have discovered a connection between higher workplace temperatures and increased psychological distress [134].

Soil erosion

Large-scale farming can result in significant soil erosion, which can transfer pesticides and fertilizers used by farmers into water sources, eroding between 25 and 40 percent of the soil's volume into bodies of water and further polluting them[135]. Larger farms frequently favor monocultures, overuse water resources, hasten the deforestation, and deteriorate the quality of the soil [136].

A study from 2020 by the International Land Coalition, together with Oxfam and World Inequality Lab found that 1% of the land owners manage 70% of the world's farmland [137]. The highest discrepance can be found in Latin America: The poorest 50% own just 1% of the land. Small landowners, as individuals or families, tend to be more cautious in land use. The proportion of small landowners however, is increasingly decreasing since the 1980s [138]. Currently, Asia and Africa have the highest proportion of smallholdings [139].

There is an ideal temperature for vegetative growth for each type of plant, with growth declining as temperatures rise or fall. The range of temperatures where a plant will produce seed is similar. Outside of this range, the plant will not reproduce. Maize will fail to reproduce at temperatures above 95 °F (35 °C) and soybean above 102 °F (38.8 °C) [140]. Despite technological

advances, such as improved varieties, genetically modified organisms, and irrigation systems, climate is still a key factor in agricultural productivity, as well as soil properties and natural communities. The effect of climate on agriculture is related to variations in local climates rather than global climatic patterns [141]. Consequently, in making an assessment, agronomists must consider each local area.

Since the formation of the World Trade Organization in 1995, global agricultural trade has increased. Since 1995, the value and volume of agricultural exports worldwide have more than tripled, surpassing US $1.8 trillion in 2018 [142]. Agriculture commerce is a source of cash for exporting nations and a substantial supply of food for major importing nations. The necessity to take into account the worldwide impacts of climate change is implied by the international aspect of trade and food security.

The poorest nations would be severely hit, according to a number of reports, as food production in the majority of tropical and subtropical regions will decline due to a lack of water and an increase in the occurrence of new or altered insect pests [143]. The maximum temperature tolerance for many rain fed crops is almost reached in Africa and Latin America, so that yields are likely to fall sharply for even small climate changes; falls in agricultural productivity [145]. In some regions, the fishing industry and marine life will both suffer significantly. [146].

It was reported that the world may reach a threshold of global warming beyond which current agricultural practices can no longer support large human civilizations by the middle of the 21st century [147]. As a result of the warming of the climate, millions of people are suffering from food insecurity, and by the end of the decade, agricultural production may fall by 2% to 6% [148].

Drought and Flood

Extreme weather events like droughts and floods continue to have a negative influence on crop yields [149]. Floods have the potential to badly harm crops, stop agricultural production, lay off workers, and destroy the food supply. On the other hand, droughts have the potential to obliterate all crops. It is estimated that drought poses a threat to 35 to 50 percent of the world's crop production [150].

Australian farmers are in a desperate state of despair as a result of the country's long-lasting, catastrophic droughts [151]. In the country, domestic violence and depression are on the rise, and as of 2007, more than 100 farmers have committed domestic violence and depression rates are rising in the nation, and as of 2007, more than 100 farmers had committed suicide as their parched crops withered away [152].

Drought is even more harmful in developing countries because it worsens already extreme poverty and promotes hunger and malnutrition [153]. During droughts, farmers may grow more and more reliant on irrigation, which is bad for both the farmers and the consumers. A region's rivers may be dry and water may need to be transported from a distance if it has been subjected to a protracted drought. Water itself has to originate from somewhere. Because 70% of "blue water" is currently utilized for global agriculture, any demand that exceeds what is already being met could worsen a water crisis [154].

Sub-Saharan Africa now uses water to flood rice fields to manage the weed population due to the region's expected drop in precipitation. This conventional method of weed control will no longer work [155]. Some farmers will no longer be able to afford to farm due to increased costs. The majority of low-income countries significantly rely on agriculture for employment, and growing costs may force job losses or salary decreases [156]. As a result, other farmers will increase their food costs, which will directly affect customers' access to affordable food. Without

the food produced by certain farms, people would not have enough to eat. These farms solely provide food for their own family or the neighborhood. The produce from these farms are not exported. As a result, there will likely be less food produced, higher food prices, and perhaps even starvation in some regions of the world [157].

Food safety

World-wide staple crops are impacted by rising temperatures, water shortages, droughts, floods, and increased carbon dioxide levels in the atmosphere. Extreme weather conditions, plant diseases, and a global water problem have all contributed to a fall in corn and wheat productivity in recent years [158, 159]. The Food and Agriculture Organization estimates that climate variability is a major reason why cereal crops in places like Africa's Sahel experience irregular harvests [160].

A different challenge to food security is posed by increasing sea levels in places like Bangladesh and Vietnam. There, saltwater frequently inundates the coastal farmlands, killing the rice harvests. Even a little flood can have significant effects because the Mekong Delta is where half of Vietnam's country's rice output is concentrated [161]. Although the underlying causes of many problems are frequently the same, the treatments vary. As a result, special strategies must be established to decrease the future effects of risks on the lives and livelihoods of these regions as well as innovative techniques to ameliorate the effects of disasters when they hit.

Sub-saharan African Countries and Southeast Asia are two regions where the effects of global warming are already evident [162, 163].It makes sense that when food production declines due to global warming, so too will people's availability to food. But this simple example of supply and demand has significant ramifications. Inflation could occur if a major or minor climate calamity upsets one link in the food chain [164]. This has been evident over the past two years as a result of Covid-19, which caused the suspension of international trade.

The poorest households are the most at risk; according to research, individuals who live in urban areas below the poverty line can spend up to 75% of their income on only food [165]. Families eat seasonally depending on what their harvests (and those of their neighbors) yield in many of the world's poorest countries. During the "hungry seasons" that precede harvest, when the previous food supply has run out and the subsequent crops are not yet ready for gathering, families commonly skip one or more meals every day. These dry seasons have lasted longer in many regions due to global warming [166].

Pest insects

Pest insect populations may rise as a result of global warming, reducing yields of important crops including corn, soybeans, and wheat [167]. Warmer temperatures extend the growing season and speed up plant growth, but they also boost insect populations' metabolic rates and breeding cycles [168]. If warm growing seasons continue, insects that formerly had only two breeding cycles year can acquire a third cycle, leading to a population explosion [169]. An abrupt change in insect populations is more likely to occur in temperate regions and higher latitudes.

Studies on the impact of increased temperatures on Japanese beetle populations and soybean plant growth were undertaken by the University of Illinois. One field of soybeans was subjected to warmer temperatures and higher amounts of carbon dioxide, while the other was kept unaffected. According to these experiments, soybeans with increased carbon dioxide levels produced more and grew more quicker than control field, but they also attracted Japanese beetles at a significantly higher rate [170].

Additionally, the beetles in the field with greater carbon dioxide lived longer and deposited more eggs on the soybean plants, suggesting the likelihood of a quickly growing population. The

field with elevated carbon dioxide levels was predicted to eventually have lower yields than the control field if the project were to continue [169]. Three genes in the soybean plant that typically produce chemical defenses against pest insects were rendered inactive as a result of the elevated carbon dioxide levels. One of these defenses is a protein that prevents insects from digesting soy leaves.

The deactivation of this gene allowed the beetles to absorb substantially more plant material than those in the control field. As a result, the experimental field saw longer lifespans and higher egg-laying rates [170].The problem of growing pest populations has a few suggested remedies. Increasing the quantity of pesticides used on future crops has been suggested as one solution [171]. This has the advantage of being straightforward and reasonably cost-effective, but it might not work. These insecticides have caused a lot of pest insects to develop an immunity to them. Using biological control agents is another suggested remedy [172]. This involves actions like interspersing rows of native plants with rows of crops. In terms of its overall environmental impact, this option is advantageous. However, more space is needed to plant more native plants, which results in the destruction of additional acres of public property. Additionally, the price is far higher than just applying insecticides.

According to studies, soybean leaves lose nutrients when carbon dioxide levels rise, thus plant-eating insects must consume more food to meet their nutritional needs [173]. Additionally, in environments with high carbon dioxide levels, soybeans are less able to protect themselves from predatory insects. Jasmonic acid, an insect-killing chemical that the plant excretes when it feels an attack, is produced less by the plant as a result of the carbon dioxide. Without this defense, insects are allowed to consume the leaves of soybeans, lowering crop production [174].

The defense mechanisms of many plant species are compromised in an environment with high levels of carbon dioxide, thus this issue is not specific to soybeans [175]. Pathogens already consume 10–16% of the world's harvest, and this percentage is anticipated to increase as plants are exposed to pathogens and pests more frequently than ever before [176]. In the past, insects, bacteria, and fungi would perish in the winter's frigid temperatures. Winters that are wetter and warmer are encouraging fungal plant diseases like soybean rust and stripe and brown/leaf rust to spread northward [177].

The destructive plant infection known as soybean rust can wipe out entire fields in a matter of days, causing farmers to lose billions of dollars in crop production [178]. Another instance is the Mountain Pine Beetle pandemic in British Columbia, Canada, which caused the death of millions of pine trees because the winters there were too warm to stop or prevent the beetle larvae from growing [179]. The increasing incidence of flooding and heavy rains also promotes the growth of various other plant pests and diseases. On the opposite end of the spectrum, drought conditions favour different kinds of pests like aphids, whiteflies and locusts[180].

The competitive balance between plants and pests has been relatively stable for the past century, but with the rapidly shifting climate, there is a change in this balance which often favours the more biologically diverse weeds over the monocrops most farms consist. Given that there are eight to ten weed species competing with crops in a field at any given time, weeds currently account for around one-tenth of yearly global crop yields [181]. Weeds have an advantage in changing climates due to their genetic diversity, capacity for cross-breeding, and rapid growth rates, which enable them to adapt more easily than the uniform crops grown on most farms and offer them a biological advantage [181].Pest distribution also changes as a result of the altered climate, which makes previously inhospitable locations even less desirable. Last but

not least, when carbon dioxide levels rise, pesticides will become less effective, increasing weeds' resistance to them [182].

Fall armyworms

A very invasive plant pest called the autumn armyworm, Spodoptera frugiperda, has recently spread to Sub-Saharan African nations. Global warming is responsible for increasing crop pests in Africa, according to researchers. Since these extremely invasive crop pests have a high potential for environmental adaptation, it is anticipated that they will spread to other parts of the world. Crop damage from the fall armyworm, particularly to maize, can be severe, which lowers agricultural output [183].

Weed and Diseases

It is crucial to keep in mind that weeds would experience the same cycle acceleration as cultivated crops and would profit from carbonaceous fertilizer. Since most weeds are C3 plants, they will probably compete more fiercely than they now do with C4 crops like maize 183. On the other hand, certain findings lead one to believe that weed killers might become more effective as the temperature rises. Rainfall would increase due to global warming in some locations, which would lengthen the wet seasons and increase atmospheric humidity. These could facilitate the emergence of fungi-related disorders when coupled with higher temperatures. Similarly, increased pressure from insects and disease vectors may occur as a result of higher temperatures and humidity [184]. Research suggests that the embryonic stages of plant diseases that harm crops may change as a result of climate change [185]. As hosts move to regions with better conditions as a result of climate change's alteration of weather patterns and temperature, plant diseases spread.

This leads to an increase in the number of crop losses caused by diseases. It has been predicted that maintaining sustainable agriculture will become more difficult as a result of the effects of global warming.

Due to global warming, droughts have been happening more frequently, and in Africa, Southern Europe, the Middle East, much of the Americas, Australia, and South East Asia, they are only projected to get worse. Increased water consumption, population growth, urbanization, and widespread environmental preservation initiatives all exacerbate their effects. Crop failures and the disappearance of livestock grazing land are two effects of droughts [186]. In many places of the world, especially in Europe, the yield was substantially lower than typical the summer of 2018, perhaps due to heat waves brought on by global warming.

The likelihood of additional crop failures in August will depend on the weather. Global production of wheat, rice, and maize fell short of demand in 2018 for the third time in four years, forcing governments and food firms to release storage reserves [187]. India released half of its food reserves. According to Lester R. Brown, the head of the World Watch Institute, a non-profit research group, food prices would likely rise in the upcoming months [188].

According to the UN report "Climate Change and Land: an IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems," food prices will increase by 80% by 2050, which is likely to result in food shortages [189]. Additionally, some authors argue that impoverished regions of the world will likely experience food shortages much more severely than wealthy ones [190]. International assistance will be required for nations that will lack the resources to buy enough food and for preventing wars in order to avert starvation, instability, and fresh waves of climate refugees.

The agriculture sector was negatively impacted by floods in the Midwest region of the United States at the beginning of the twenty-first century. The estimated maize harvest in May 2019 decreased from 15 billion bushels to 14.2 117 due to the flooding [191].

An Early bloom

As a result of global warming, flowering times have advanced, and early blooms pose a risk to agriculture since they endanger the life and procreation of the plants. In some plant species, early flowering increases the danger of frost damage and causes "mismatches" between plant blossoming and pollinator interactions. Cocoa (Theobroma cacao), kiwi (Actinidia deliciosa var. deliciosa), passion fruit (Passiflora edulis), and watermelon (Citrullus lanatus) are only a few of the 87 global crops that depend on animal pollinators for production.

These crops contribute 30% to the production of food on a worldwide scale. In 2005, the economic value of global pollination was estimated to be EUR 153 billion, or 9.5% of global agricultural food output [192]. In addition to that, warmer temperatures in winter trigger many flowering plants to blossom, because plants need stimulation to flower, which is normally a long winter chill. And if a plant doesn't flower it can't reproduce. "The University of Alaska's Syndonia Bret-Harte, a plant ecologist, warned that if winters continue to get milder, plants "may not get cold enough to understand the difference when warmer springtime temperatures start" [193].

Impact on the growing season

The length of crop growth cycles is mostly influenced by temperature. Temperature rise will hasten the process of development. The interval between planting and harvesting will be shorter for an annual crop (for example, the duration in order to harvest corn could shorten between one and four weeks). This is because senescence would happen sooner, a shorter cycle

could have a negative impact on output [194]. Numerous effects of increased greenhouse gases on plants have been discovered. Elevated carbon dioxide boosts photosynthetic rate, which boosts agricultural yields and growth [195].

It also reduces water loss because of stomatal closure. It reduces the amount of water vapor that reaches the plant's stem [196]. Each plant's leaves release oxygen during "Crassulacean Acid Metabolism," which involves taking in carbon dioxide and metabolizing it. C3 plants have the highest growth response, C4 plants are also boosted but to a lesser level, and CAM plants are the species with the lowest growth response [197].

To minimize exposure, the stoma in these "CAM plant" establishments is closed all day. Nitrogen is the nutrient that limits crop growth in the majority of terrestrial ecosystems, and its absorption by plants is impacted by the atmosphere's rapidly growing carbon dioxide levels. At the current concentration of 400 ppm, plants are comparatively malnourished. About five times more carbon dioxide is needed for ideal plant growth. Increased photosynthesis is caused by increased carbon dioxide mass, which may impede plant development [198].

It restricts the loss that crops experience from transpiration. Evaporation rates and annual evaporation levels will rise as global temperatures rise. In some locations, increased evaporation will increase storm frequency while hastening the drying process in other areas. While places outside of the storm track will suffer less precipitation and an increased chance of droughts, these storm-affected areas are likely to face increasing levels of precipitation and elevated flood hazards [199]. Numerous factors, including dryness, can hinder seedling development and poor germination, which in turn affects plant quality and development.

Cellular differentiation, cell expansion, and cellular division are all necessary for plant growth. Through the reduction of turgor pressure, drought stress affects mitosis and cell

elongation, which has a negative impact on growth [200]. Because drought stress reduces turgor pressure, nutrient concentration, and carbon assimilates, all of which are necessary for leaf development, leaves become smaller and fewer in number. Under water-limiting conditions, maize has demonstrated a decrease in plant height, biomass, leaf size, and stem girth. Drought stress also has a negative impact on agricultural yield, which is reduced as a result of a decline in photosynthetic rate, modifications to leaf growth, and changed resource allocation [201].

Reduced leaf water potential and transpiration rate are two effects of drought stress on crop plants. However, it has been observed that water-use efficiency increases in some crop plants, such as wheat, while decreasing in others, such as potatoes. Drought conditions limit these processes, which results in stunted growth in plants [202]. Plants require water for the uptake of nutrients from the soil and for the transportation of nutrients throughout the plant. Due to the loss of photosynthetic tissues, stomatal closure, and decreased efficiency of the photosynthetic apparatus under drought stress, plants also exhibit decreased photosynthetic activity.

The decrease in plant growth and yields is a result of this decline in photosynthetic activity [203]. The allocation of resources is another factor that affects reduced plant growth and yields. After experiencing drought stress, plants will allocate more resources to the roots to help them absorb water, increasing root growth and decreasing the growth of other plant parts while decreasing yields [201].

Quality Impact

The adequate ratios for particular macronutrients, such as carbs and protein, can shift as a result of global warming [204]. Under elevated carbon dioxide levels, rice's amylose content, a key factor in the quality of cooking, increases in the grain. The cooked rice grains produced by plants raised in high carbon dioxide conditions would be firmer than those produced by plants in use

now. On the other hand, levels of iron and zinc, which are crucial for human nutrition, would be reduced.

[205]. Additionally, when the temperature and carbon dioxide levels increase together, the protein content of the grain falls.

According to studies, increases in carbon dioxide cause micronutrient concentrations in crop and non-crop plants to drop, which has detrimental effects on human nutrition, including lower B vitamins in rice [206]. Due to the fact that herbivores will need to consume more food to obtain the same quantity of protein, this could have an impact on other ecosystem components. Higher carbon dioxide levels have been linked to decreased nitrogen uptake by plants (and a smaller number of studies have demonstrated the same for trace elements like zinc), which results in crops with poorer nutritional value [204].

This would mostly affect inhabitants in less wealthy nations who are less able to make up for it by eating more food, consuming a wider variety of foods, or perhaps taking supplements. As sheep rely on bacteria in their gut to digest plants, which in turn depend on nitrogen intake, it has been demonstrated that reduced nitrogen content in grazing plants reduces animal output in sheep. Given the rising demand for water outside of agriculture as well as other agricultural demands, crops in warmer nations struggle to survive because there is not enough water accessible to them [207].

Unusual weather

Areas that were formerly suitable for farming will no longer be as friendly as they once were as a result of temperature changes and more extreme weather patterns [208]. For key dry and semi-arid regions, the current forecast calls for an increase in temperature and a decrease in precipitation (Middle East, Africa, Australia, Southwest United States, and Southern Europe) [209,

[210]. Additionally, the projected modest temperature increase (1-2 °C) anticipated to take place during the first half of the century will have a negative impact on crop output in tropical countries [211]. Further warming is anticipated to reduce crop yields throughout the world, including Canada and the northern United States, in the second half of the century [212].

When temperatures above 36 °C, soybean seedlings die and corn pollen loses its viability [213]. Many common crops are particularly vulnerable to heat. Scientists predict a 10% decline in wheat, rice, and corn yields with every 1 degree Celsius increase [214, 215]. Global warming may also have some advantageous effects, though. The temperate regions should profit from the projected increase in temperature during the first half of the century (1-3 °C) in terms of agricultural and pasture output [216]. As a result, these places will see warmer winters and more days without frost, which will lengthen the growing season, enhance thermal resources, and speed up maturation [217]. Some locations and crops will be harmed if the climatic scenario leads to mild and wet weather, but many people might gain from it [216].

2.1.7 Overview of Commercial Farming and Farmers

Agriculture is the art and science of cultivating the soil, growing crops and raising livestock [218]. It also involve the production, processing, marketing and distribution of crops and livestock products. Agricultural sciences include research and development on production techniques such as irrigation management. Improving agricultural productivity in terms of quantity and quality (example include selection of drought-resistant crops and animals, development of new pesticides, yield-sensing technologies, simulation models of crop growth, in-vitro cell culture techniques, minimizing the effects of pests (weeds, insects, pathogens, nematodes) on crops or animal production system. Transformation of primary products into end-consumer products (example: production, preservation, and packaging of dairy products).

Prevention and correction of adverse environmental effects (example: sils degradation, waste management, bioremediation). Agricultural development is one of the most powerful tools to end extreme poverty, boost shared prosperity and feed a projected 9.7 billion people by 2050 [219]. Growth in the agricultural sector is two to four times more effective in raising incomes among the poorest compared to other sectors [220]. Agriculture is also vital to economic growth: accounting for 4% of global gross domestic product (GDP) and in some least developing countries, it account for more than 25% of GDP [219].

Agriculture-driven growth, poverty reduction and food security are at risk: Multiple shocks from Covid-19, related disruptions to extreme weather, pests and conflicts are impacting food systems, resulting in higher food prices and growing hunger [221].Accelerating change in climate could further cut crop yields, especially in the world's most food-insecure regions. Agriculture, forestry, and land use change are responsible for about 25% of greenhouse gas emissions. Mitigation in the Agricultural sector is part of the solution to global warming [222].

2.1.8 Overview of Farming in Oyo State

Oyo is an inland State in South Western Nigeria. It is frequently referred to as Oyo State to distinguish it from the city of Oyo. The third-most populated city in the nation and former second-most populous city in Africa is Ibadan, which also serves as the nation's capital [223]. Oyo State shares borders with Kwara State to the north, Osun State to the east, and Ogun State and the Republic of Benin to the south-west. In 2016, Oyo State is expected to have a population of 7,840,864, making it the fifth most populated state in Nigeria.

Yorubas make up the large majority of the population in Oyo State, and the language is still widely used. The current Oyo State, sometimes known as the "Pace Setter State," is located on land that was once governed by a number of different kingdoms and empires. From 1300 to 1896

C.E., the Oyo Empire, a strong Yoruba empire, controlled over a large portion of the region [224]. Built in the 1830s, the present-day city of Oyo is regarded as a survivor of the imperial period. To distinguish it from the old capital to the north, "Old Oyo" (Oyo-Ilé), it is referred to as "New Oyo" (Oyo-Atibà). In the city, the Alaafin of Oyo still plays a ceremonial role.

The institution of Ibadan, the first university in Nigeria, was founded in Oyo state. The western city of Saki is referred to as the State's breadbasket [225], and agriculture continues to dominate the State's economy. Among the most crucial crops for the Oyo State economy are tobacco, cocoa, and cassava [226]. Oyo State, which is rated 14th in terms of size, has an about 28,454 square kilometer area. Old hard rocks and dome-shaped hills make up the environment, which rises gently from 500 meters above sea level in the southern portion to 1,200 meters in the northern part.

This upland is the source of a number of significant rivers, including the Ogun, Oba, Oyan, Otin, Ofiki, Sasa, Oni, Erinle, and Osun rivers. The Old Oyo National Park is one of the many natural features found in Oyo State. The endangered African wild dog, Lycaon pictus, once had a habitat here, but it's currently believed that this animal is extinct in this area. The tropical climate features distinct dry and wet seasons as well as a high relative humidity. The wet season begins in April and lasts until October, whereas the dry season lasts from November to March. Almost all of the year, the daily average temperature is between 25 °C (77.0 °F) and 35 °C (95.0 °F) [227].

The primary line of work for most people in Oyo State is agriculture. Crops including maize, yam, cassava, milet, rice, plantains, cocoa, palm product, cashew, and others do well due to the climate in the State. Iseyin/Ipapo, Ilora, Eruwa, Ogbomosho, Iresaadu, Ijaiye, Akufo, and Lalupon all have government farm villages. Clay, kaolin, and aquamarine are abundant. Additionally, there are sizable cattle ranches in Ibadan, Fasola, and Saki, as well as a dairy farm

in Monatan, Ibadan, and the Statewide Oyo State Agricultural Development Programme, which has its headquarters there. The State is home to several international and federal agriculture facilities.

2.2.1 Milankovitch Theory

Milutin Milankovitch is the author of the Milankovitch theory. Milankovitch (1879–1958), a geophysicist from Serbia, spent more than 25 years developing the first numerical estimates of the impact of changes in Earth's orbit on variations in latitude and seasonal solar radiation. His theory is currently the most widely accepted theory as to why glaciations occur [228]. The three periodic variations in the earth's orbit and tilt that result in the climate fluctuations occurring over tens of thousands to hundreds of thousands of years are explained by the Milankovitch theory. These variations include modifications to the eccentricity (shape) of the earth's orbit, the obliquity (tilt), and the precession (wobbling) of the earth's axis [229].

In the first case, the earth's orbit can be either more elliptical or nearly round, as it is right now. It takes roughly 100,000 years for an orbit to go from being nearly circular to more elliptical and back to being nearly circular [230]. This transition is known as eccentricity. The distance between the sun and earth is less variable when the orbit is more circular, as it is currently. The season that the earth is closest to the sun has an impact on glaciations when the orbit is more elliptical. The second alteration is the obliquity, or tilt of the earth's axis, which varies between 22.1° and 24.5° every 41,000 years [231]. But it was determined that the earth's axis was skewed 23.5° currently; which can result to global warming [232].

The winters are not as cold and the summers are not as warm when the tilt is lower. In winter, more snow is produced because warmer air can store more water vapor. The snow from

the previous winter does not melt since the summers are not as warm. This aids in the creation of glaciers. The earth's axis is the third change. Earth spins once around its fictitious axis every 24 hours. The axis itself also completes a full circle, or precession, about every 23,000 years, which causes the earth to quake. Due to this tilt, the earth is closer to the sun in July than it is in January, which increases summertime temperatures in the Northern Hemisphere. Because the Northern Hemisphere has a greater landmasses at higher latitudes where ice sheets can form and grow, the position of this hemisphere is important [233].

The amount of solar radiation that the planet gets at various latitudes and throughout various seasons is influenced by the interaction of these three cyclical variations. Scientists estimate that a new ice age won't start for another 50,000 years because of the comparatively little fluctuations in solar energy that mankind are currently experiencing. The cycles of the past climate have been deduced from the study of Earth-derived materials. An accurate proxy for the global temperatures at the time the ice was created can be found in the trapped air bubbles found in Antarctic ice cores.

The Milankovitch hypothesis was supported by an analysis of these data, which showed that the climatic response recorded in the ice cores was driven by Northern hemisphere insolation [234]. A 1,700-foot (520-meter) rock core from Arizona that contains climate records that span 215 million years shows a pattern that is synced with Earth's eccentricity. The World Health Organization predicts that between 2030 and 2050, "Global warming is predicted to cause around 250,000 more fatalities each year" [235]. As the world's temperatures rise, so do the number of heat-related illnesses and deaths, including heart and kidney ailments, heatstroke, and heat stress [236].

The respiratory health of the 300 million people globally who have asthma is getting worse as a result of air pollution, and hay fever and allergy sufferers are also getting worse off due to increased airborne pollen and mold [237]. Extreme weather conditions, like violent storms and flooding, can cause harm, contaminate drinking water, and cause storm damage that could jeopardize essential infrastructure or cause population displacement. In fact, historical models indicate that the risk of being relocated by a disaster is currently 60% higher than it was four decades ago, and that weather- and climate-related events are what are causing the biggest increases in displacement [238]. Combating global climate change is a mammoth endeavor that relies on international cooperation as well as the efforts of local governments, businesses, and individuals.

Health Belief Model

The health belief model (HBM) is a social psychology model of health behavior change that was created to explain and predict health-related behaviors, especially with regard to the use of health services. Social psychologists at the U.S. Public Health Service created the Health Belief Model in the 1950s, and it is now one of the most well-known and frequently applied ideas in the study of health behavior [239].

According to the Health Belief Model, a stimulus, or cue to action, must also be present in order for the health-promoting activity to be triggered by a person's beliefs about health problems, perceived benefits of action and barriers to action, and self-efficacy. The health belief model, one of the earliest models of health behavior, was created in the 1950s at the US Public Health Service by social psychologists Irwin M. Rosenstock, Godfrey M. Hochbaum, S. Stephen Kegeles, and Howard Leventhal. Even though mobile X-ray cars visited neighborhoods at the

time, researchers and medical professionals were concerned that few individuals were getting screened for tuberculosis (TB) [240].

The health belief model has been used to predict a wide range of health-related activities, including screening for early diagnosis of asymptomatic disorders and vaccines. The model has more recently been used to comprehend vaccination intentions (such as COVID-19), reactions to disease symptoms, adherence to treatment regimens, lifestyle behaviors (such as sexual risk behaviors), and behaviors associated with chronic illnesses, which may require long-term behavior maintenance in addition to initial behavior change [240]. The model was modified as recently as 1988 to take into account newly emerging psychological research about the function of self-efficacy in behavior and decision-making [239].

Theoretical constructs

In terms of the health-related behaviors, the value is avoiding sickness. The expectation is that a certain health action could prevent the condition for which people consider they might be at risk. The following constructs of the health belief model are proposed to vary between individuals and predict engagement in health-related behaviors.

Perceived susceptibility

The term "perceived susceptibility" refers to the subjective evaluation of the likelihood of developing a health issue. The health belief model predicts that people who believe they are prone to a specific health problem will take actions to lower their chance of having the condition [241]. People who regard their susceptibility to an illness as being low may reject this notion [240]. Some people may be aware that they could get the sickness, but they do not think it is likely [242]. People who think they have a minimal risk of getting sick are more likely to participate in risky or dangerous behaviors.

People who believe there is a high chance they may personally experience a certain health issue is more inclined to take steps to reduce their risk of developing the condition. Perceived threat is the result of the perception of both severity and susceptibility. Knowledge of a particular health problem affects how serious and susceptible it is thought to be. According to the health belief model, people are more likely to engage in practices that promote their health when they sense a greater threat [241].

Perceived severity

The term "perceived severity" refers to a person's subjective evaluation of the seriousness of a health issue and its related side effects. According to the health belief model, people who think a particular health issue is significant are more likely to take actions to stop it from happening (or reduce its severity).

The term "perceived seriousness" refers to perceptions of the disease's influence on social and occupational functioning as well as beliefs about the disease itself (such as whether it is life-threatening, may result in disability or discomfort) [239]. For instance, a person may believe that influenza is not a serious medical condition, but if they believe that missing work for several days would have a significant financial impact, they may decide to seek treatment if they perceive influenza to be a particularly serious condition.

Researchers discovered that they could predict whether Australians would get the shot by looking at perceived severity after looking at how many of them self-reported obtaining the influenza vaccine in 2019. To gauge perceived severity, they asked, "On a scale from 0 to 10, how severe do you believe the flu would be if you caught it? " They discovered that 31% thought getting the flu would be a low, 44% a moderate, and 25% a high severity [240]. The researchers also discovered that individuals with a high perceived severity had a markedly higher likelihood

of having received the vaccine than individuals with a moderate perceived severity. Furthermore, people reporting low and moderate perceived influenza severity showed equal self-reported vaccination rates [240].

Perceived benefits

The perceived advantages of acting are another factor that influences actions connected to one's health. Perceived advantages are a person's estimation of the benefit or effectiveness of adopting a habit that promotes health in order to lower their chance of contracting an illness. Regardless of the effectiveness of a given activity, a person is likely to take it if they believe that doing so will lessen their risk of developing a health problem or will lessen the severity of one [241]. For instance, those who believe that applying sunscreen protects skin cancer are more likely to do so than those who think it has no effect on the likelihood of developing skin cancer.

Perceived barriers

The perceived obstacles to taking action are a factor in health-related behaviors as well. A person's perception of the barriers to behavior change is referred to as perceived barriers. Even if a person views a health state as dangerous and thinks that taking a certain activity will successfully lessen the hazard, obstacles may keep them from engaging in the health-promoting behavior. In other words, for behavior to change, the perceived benefits must outweigh the perceived restrictions [239].

The perceived inconvenience, cost, risk (such as the adverse effects of a medical procedure), and discomfort (such as pain, emotional disturbance) associated with engaging in the behavior are some examples of perceived obstacles to action. For instance, the inability to obtain cheap medical care and the belief that the flu injection will be excruciatingly painful may prevent people from getting the vaccine. In a study on the screening for breast and cervical cancer among

Hispanic women, it was established that perceived barriers including cancer fear, humiliation, fatalistic attitudes of cancer, and language prevented screening [240].

Modifying variables

Individual traits, such as demographic, psychological, and structural variables, might have an impact on how health-related actions are regarded (i.e., their perceived seriousness, susceptibility, advantages, and barriers). Age, sex, race, ethnicity, and education are a few examples of demographic factors. Psychosocial factors include, among others, personality, socioeconomic status, peer and reference group pressure.

Among other things, structural variables include information on a particular disease and prior exposure to it [242]. According to the health belief model, changing factors can have an indirect impact on health-related behaviors by changing how severe, susceptible, beneficial, and barriers are viewed to change [241].

Cues to action

According to the health belief model, engaging in behaviors that promote health requires a cue, or trigger. Action cues might be internal or external [240]. Internal signals to action include physiological cues (such as pain and discomfort). Events or information coming from close friends, family, the media, or health care professionals that encourage the participation in healthy habits are examples of external cues. A dentist's postcard of reminder, a friend or family member's illness, media campaigns on health issues, and product warning labels are a few examples of cues to action.

People respond differently to cues depending on their perceived vulnerability, severity, advantages, and barriers [241]. For instance, people who believe they are at a high risk for a serious illness and who have a good relationship with their primary care physician may be persuaded to

get screened for the illness after watching a public service announcement, whereas people who think they are at a low risk for the same illness and also do not have reliable access to health care may need more intense external cues to get screened.

Self-efficacy

In 1988, the fifth element of the health belief model, self-efficacy, was added to the original four, which were perceived vulnerability, severity, benefits, and barriers. Self-efficacy is the belief that one is capable of carrying out a behavior successfully [243]. In an effort to more effectively account for individual variations in health behaviors, self-efficacy was included to the health belief model. The model was initially created to explain involvement in one-time health-related actions like getting a cancer screening or getting vaccinated. The health belief paradigm was eventually extended to more significant, long-lasting behavior change, like diet modification, exercise, and quitting smoking.

The model's creators understood the importance of self-efficacy as a fundamental element of changing one's behavior in regard to one's health [241]. For instance, Schmiege discovered that self-efficacy was a more potent predictor of calcium intake and weight-bearing activities than perceptions about potential negative health implications. Without elaborating on the theoretical foundation of the model, Rosenstock contended that self-efficacy might be added to the other health belief model constructs [240]. This was deemed shortsighted, though, because related studies showed that important variables from health belief models also had an impact on perceived control and intention, which are thought to be more immediate causes of behavior [244].

Empirical support

Since its creation in the 1950s, the health belief model has received a significant amount of scientific support. It is still one of the most well-known and tried models for describing and

forecasting behavior connected to one's health. A 1984 analysis of 28 retrospective studies and 18 prospective studies found substantial support for each of the health belief model's four pillars [240]. The review notes that given the diverse populations, health conditions, and health-related behaviors examined as well as the various study designs and assessment strategies used to evaluate the model, empirical support for the health belief model is particularly noteworthy.

A more recent meta-analysis found substantial evidence for the predictive value of perceived advantages and perceived barriers, but limited evidence for perceived seriousness and perceived susceptibility. The meta-authors analysis's contend that it is necessary to investigate any potential moderated and mediated connections between the model's elements [240]. From the standpoint of chronic illness, a number of studies have shown empirical support.

In order to predict and explain a mother's adherence to a diet recommended for their obese children, Becker employed the model. After attending diabetic classes at a community hospital, Cerkoney interviewed diabetics who were being treated with insulin. It empirically examined the relationship between the health belief model and the compliance levels of people with diabetes mellitus who are chronically ill [245].

Application of Health Belief Model to Modify Commercial Farmers's Behaviour Towards Global Warming.

By focusing on different facets of the model's main elements, the health belief model has been utilized to build efficient interventions to influence health-related behaviors. By offering education about worsening air quality, rising temperatures, and increased frequency of extreme weather events, illness prevalence and incidence, individualized risk assessments, and knowledge about the effects of global warming, interventions based on the health belief model

may attempt to raise perceived susceptibility to and perceived seriousness of a health condition (e.g., medical, financial, and social consequences) [246].

By providing information on the effectiveness of different behaviors to reduce risk of elevated temperature, identifying common perceived barriers, offering incentives to engage in health-promoting behaviors, interventions may also aim to change the cost-benefit analysis of engaging in a health-promoting behavior (i.e., increasing perceived benefits and decreasing perceived barriers).

The health belief model-based interventions may also offer cues to action that remind and nudge commercial farmers to engage in health-promoting behaviors. By teaching specific health-promoting activities, interventions may also seek to increase self-efficacy, especially for complex lifestyle changes (e.g., use of backpacks for cattle, adhering to Bio-enzyme method of clearing bush, preventing deforestation). Interventions can be directed at the societal level or the individual level, such as working one-on-one with people to improve engagement in health-related behaviors (e.g., through legislation, changes to the physical environment, mass media campaigns.

2.3 Review of Empirical Studies

2.3.1 Knowledge of Global Warming among commercial farmers

Agriculture produces greenhouse gases and is susceptible to global warming. Farmers are under pressure to alter their agricultural systems to withstand increasingly unpredictable weather and to produce less greenhouse gases (mitigation) [247]. Farmers have adapted to shifting social, economic, and environmental conditions throughout human history. However, it is uncertain if agricultural producers will be able to keep up with the extraordinary rate of change that is predicted for the environment in the upcoming years. For agricultural producers who engage in

rainfall agriculture and those who are cut off from local or national markets, the negative effects of these shifts will be more pronounced. A study revealed that majority of farmers aware of climate risks, but had differing perceptions of climate change impacts on production and annual revenue [248, 249, 250].

Public policies and actions that encourage and assist adaptation will be required to lessen these adverse consequences. Nevertheless, farmers must be aware of global warming in order to be willing to implement adaptation strategies. In this way, farmers' understanding of global warming influences both their planting choices and the adoption of adaptation strategies. Therefore, it can be said that understanding how farmers feel about global warming is a prerequisite for designing and successfully implementing adaptation measures in Agriculture [251].

Global Warming is expected to have serious negative impacts on the income, consumption and health of Agricultural producers in Africa, leading to increase poverty and inequality [77]

2.3.2 Attitude towards Global Warming among commercial farmers

Agriculture is a source of greenhouse emissions and is subject to climate change. Farmers are under pressure to alter their agricultural systems to withstand increasingly unpredictable weather while also producing fewer carbon gases (mitigation). The anthropogenic origin of global warming is strongly supported by science, and repercussions on natural and human systems have already been found. Perceived changes in water availability had significant effects on farmers' intention to adopt mitigation and adaptation strategies [252]. Farmers play a crucial role in the sector's response to global warming since they decide on agricultural methods at the farm level. Therefore, it is imperative to comprehend how they feel about global warming.

Since decades, farmers have seen numerous instances of harsh weather, from drought to excessive heat, and it is possible that this is what is causing some of the shifts in viewpoints.

Farmers are more exposed to weather than the average person, and harsh weather can make it very challenging to establish, grow, and harvest high-quality crops. Over the past ten years, there has been a steady growth in research and literature on farmers' attitudes around global warming. It was discovered that views on the perceived implications of climate change as well as sociocultural and institutional contexts influenced disparities in perceptions of the issue [253].

2.3.3 At-Risk behavior towards Global Warming among commercial farmers

Extreme climate-related occurrences including drought, flooding, and excessive heat have degraded the soil, resulting in low crop yields. Farmers may modify their way of life as a result of declining agricultural yield, especially in rural areas. In order for African agriculture to be resilient to global climate change and to be both economically and environmentally sustainable, farmers and advisors must employ effective adaptation measures.

The most significant factors influencing adaptation are the farmer's perception of risk to their own farm, attitude toward innovation, and at-risk behavior [254]. Understanding farmer's risky conduct with regard to global warming is crucial since it may encourage people to change their ways and accept policy reforms [255].

2.4 Conceptual Framework

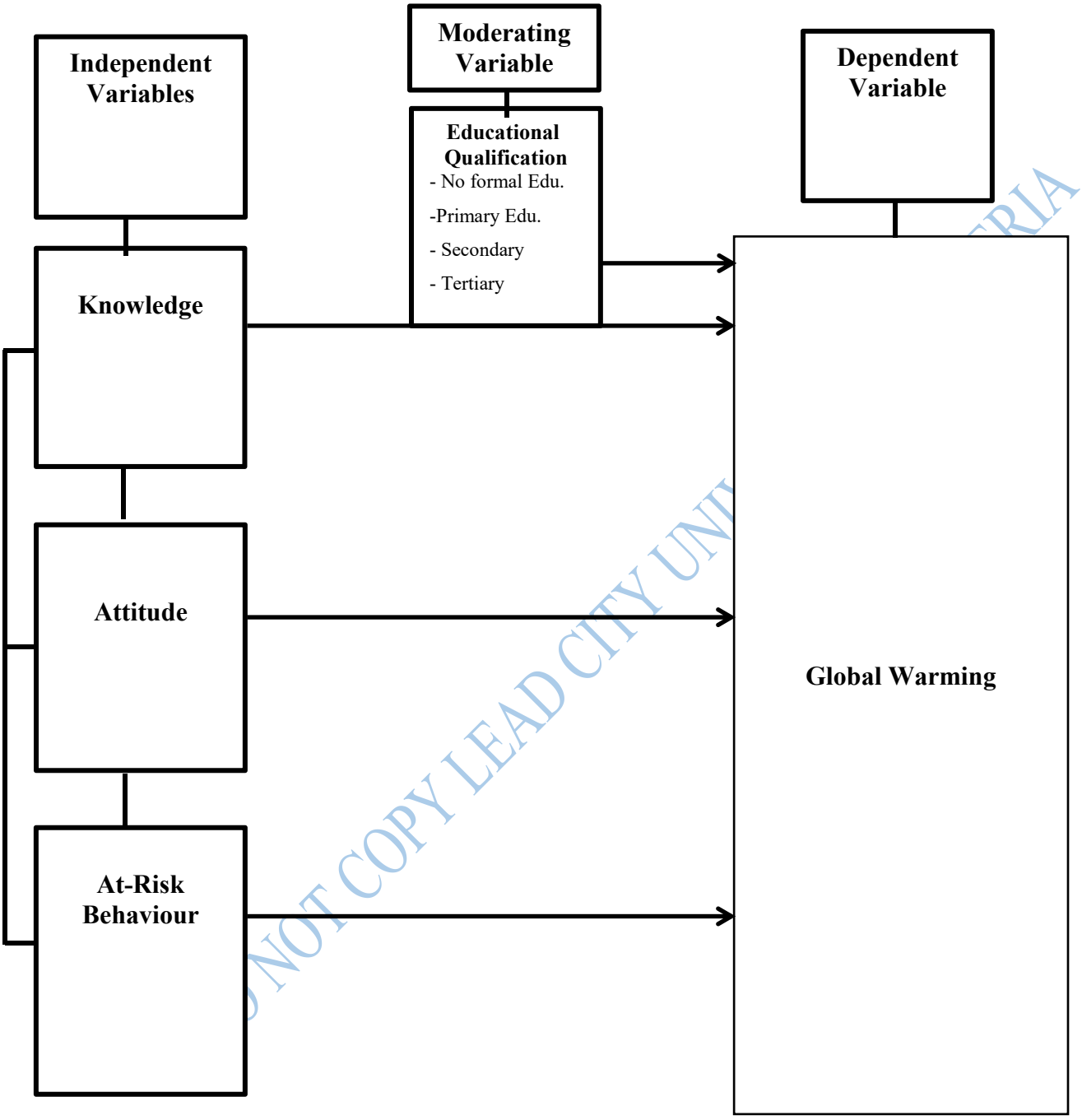


Fig. 1: Conceptual model on Knowledge, Attitude and At-risk Behaviour of commercial farmers towards Global Warming
Source: Self-Developed, 2022

2.5 Summary of Gaps in Literature

Sustainable development is coming under increasing danger from global warming. The anticipated effects of global warming might substantially jeopardize agriculture's ability to feed the globe and seriously impede efforts to end hunger, malnutrition, and poverty. For the agricultural sectors to be ready for the possibility of quickly changing environmental circumstances, immediate action is required. Reducing agricultural emissions is crucial since the agriculture industries contribute to the buildup of greenhouse gases in the atmosphere that cause global warming.

The world's agriculture and food security face enormous problems even in the absence of climate change. Demand for food and other agricultural goods has reached previously unheard-of heights as a result of population increase and rising incomes in the majority of the developing globe. The farmers are aware of climate change effects with varying levels of knowledge [256]. Many low-income nations, notably those in sub-Saharan Africa and South Asia, would struggle to guarantee access to enough food for everyone without increased measures to reduce greenhouse gas emissions from agriculture [257].

Actions done to enhance food security and support Commercial farmers in their efforts to adapt to change can have sizable mitigation co-benefits. They might, however, cost more up front. A primary goal is figuring out effective strategies to encourage people to use climate-smart alternatives. Agricultural policy and financial assistance for rural economies are closely related in many nations. There are more and more opportunities for low-income nations to direct production in directions that are more productive and sustainable.

The identification and promotion of climate-smart practices that support rural communities, enhance smallholder livelihoods and employment, and prevent detrimental social and cultural effect like forced migration and loss of land tenure are key tasks for research and development partners [258].

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Chapter Three
Methodology

3.1. Research Design

The research design that was used in this study is cross sectional research design. The cross-sectional research design is a type in which you collect data from many different individuals at a single point in time. In cross-sectional research, you observe variables without influencing them [1].

3.2 Population of the Study

Population for this study comprised of registered commercial farmers in Oyo State. The respondents were all the commercial farmers registered with Oyo State Agribusiness Development (OYSADA).

3.3 Sample and Sampling Techniques

The sample size was calculated by using the pre-determined number of registered farmers with OYSADA. The sample size was determined using Taro Yamane formulae. The formula is shown as follow:

$n = N / 1+N (e^2)$

n= Minimum sample size required or desired sample size.

N= Projected population of commercial farmers (N=2000)

e= Limit of sampling error or degree of accuracy desired, which is set at 0.05 (5%)

Three hundred and thirty three (333) sample size was used as respondents for this study.

Table 3.1: Summary of Distribution of Sample Size

S/n	Zone	Number of selected commercial farmers
I	Oyo	111
Ii	Ogbomoso	111
Iii	Oke-Ogun	111
	Total	333

Multistage sampling procedure (simple random, purposive and proportionate stratified sampling technique) was adopted for this study.

Stage One: Simple random sampling technique of fish bowl with replacement was used to select three (3) out of five (5) geographical zones in Oyo State.

Stage Two: Disproportionate stratified sampling technique was adopted to determine one hundred and eleven (111) respondents that were drawn from each of the chosen zones in Oyo State. This was done so as to ensure that the respondents were stratified with equal number of farmers from each of the zones.

Stage Three: Simple random sampling technique was used to give each of the respondents in the three (3) zones an equal and independent chance of being included in the sample. The respondents were selected randomly from each of the selected zones based on the predetermined sample size; making a total of 333 respondents.

3.4 Description of the Research Instrument

A self-developed questionnaire was used as instrument for data collection in the study. This instrument was in a closed ended format. The wordings of the questionnaire were translated to the Yoruba language by linguists and language experts before field work commenced.

Section A: Socio-Demographic Information: This was used to obtain information on socio-demographic characteristics of the respondents. Three items was generated and was responded to

by the respondents. The items that was covered in this section include age, gender and educational qualification.

Section B: Knowledge of Global Warming Scale (KGWS): This scale was used to gather information from respondents on knowledge of global warming. Each response was scored on a 2-point format of Yes and No.

Section C: Attitude towards Global Warming Scale (ATGWS): This scale was used to gather information from respondents on their attitude towards global warming. Each response was scored on a 4-point modified Likert format of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD).

Section D: At-risk Behaviour towards Global Warming Scale (ARBGWS): This scale was used to gather information from respondents on at-risk behaviour towards global warming. Each response was scored on a 3-point format of Regularly (RE), Sometimes (SM) and Never (NE).

3.5 Validity of Research Instrument

Validity of research instrument is the extent to which a test measures what it claims to measure. It is vital for a test to be valid in order for the results to be accurately applied and interpreted[2]. In ensuring validity of the instrument, a draft of the questionnaire was presented to the researcher's supervisor and other lecturers in the Department of Kinesiology, Sports Science and Health Education, Lead City University, Ibadan for construct and content validity.

Other experts from other related fields was also consulted for constructive criticisms. Necessary corrections was effected before the administration of the instruments in order to improve quality of the questionnaire.

3.6 Reliability of the Research Instrument

Reliability of a research instrument indicates that if the same result can be consistently achieved by using the same methods under the same circumstances, the instrument is considered reliable [3]. In ensuring this, the validated instrument was administered on twenty (20) farmers from Oluyole Local Government Area who are not part of the study, but possessed similar characteristics with the actual respondents. A cronbach alpha technique was used to determine the coefficient of the reliability and it yielded 0.78.

3.7 Data Collection

The researcher collected a letter of introduction from the Head, Department of Kinesiology, Sports Science and Health Education for identification purpose. The letter was presented to the management OYSADA, Oyo State. Furthermore, five (5) Research Assistants were recruited, trained and engaged in the course of carrying out the study. Then, questionnaires were administered with the help of the trained Research Assistants.

3.8 Data Analysis

The filled copies of questionnaires were collected, coded and analyzed using descriptive and inferential statistics. The descriptive statistics of frequency counts and percentages was used to analyze the socio-demographic characteristics of the respondents and the research questions. Inferential statistics of Pearson Product Moment Correlation (PPMC) was used to analyze hypotheses 1 and 2; while Analysis of Variance (ANOVA) was used to test hypotheses 3-5 at 0.05 level of significance. Then, Scheffe post-hoc test was used to establish multiple comparisons of differences in knowledge, attitude and at-risk behaviour towards global warming based on educational qualification.

Endnotes

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Chapter Four
Results and Discussion of Findings

This chapter presents results of the analyses and discussion of findings. The results and discussion of findings are presented based on demographic characteristics of the respondents, research questions and hypotheses as follow:

4.1 Demographic Data Analysis

The below are the socio-demographic characteristics of the respondents.

Table 4.1: Distribution of the Respondents by Gender

Age	Frequency	Percent
Male	277	83.2
Female	56	16.8
Total	333	100.0

Source: Field Survey, 2022

Table 4.1 reveals that 277 (83.2%) respondents were male, while 56 (16.8%) were female. This means that, most of the respondents were male.

Table 4.2: Distribution of the Respondents by Age

Age	Frequency	Percent
25-31 years	8	2.4
32-38 years	72	21.6
39 and above	253	76.0
Total	333	100.0

Source: Field Survey, 2022

Table 4.2 reveals that 8 (2.4%) respondents were in the age range of 25-31 years, 72 (21.6%) were between 32-38 years, 253 (76.0%) were in the age range of 39 years and above. This means that, most of the respondents were between 39 years and above, while the respondents who were in the age range of 25-31 years were the least.

Table 4.3: Distribution of the Respondents by Educational Status

Educational Status	Frequency	Percent
No Formal Education	2	0.6
Primary Education	106	31.8
Secondary Education	116	34.8
Tertiary Education	109	32.7
Total	333	100.0

Source: Field Survey, 2022

Table 4.3 reveals that, 2 (0.6%) respondents had no formal education, 106 (31.8) obtained primary education, 116 (34.8.8%) had Secondary education, while 109 (32.7%) possessed tertiary education. This means that, most of the respondents had secondary education, while few had no formal education.

Table 4.4: Distribution of the Respondents by Zone

Zone	Frequency	Percent
Ogbomoso	111	33.3
Oke-Ogun	111	33.3
Oyo	111	33.3
Total	333	100.0

Source: Field Survey, 2022

Table 4.4 reveals that, 111 (33.3%) respondents were commercial farmers from Ogbomoso, 111 (33.3%) were from Oke-Ogun, 111 (33.3%), while 111 (33.3%) were from Oyo. This means that, equal number of respondents was sampled from each of the zones.

4.2 Presentation of Data

4.2.1 Research Questions

The research questions below were answered:

Research Question 1: What is the level of knowledge of global warming among commercial farmers in Oyo State, Nigeria?

Table 4.5: Summary of Result on the Knowledge of Global warming

S/n	Statement	Yes	No
1.	Global warming is a gradual increase in the earth's temperature generally due to the greenhouse effect	313 (94.0%)	20 (6.0%)
2.	Global warming describes the current rise in the average temperature of earth's air and oceans.	313 (94.0%)	20 (6.0%)
3.	Agricultural and industrial activities like deforestation can have effect on the atmosphere	288 (86.5%)	45 (13.5%)
4.	Application of nitrogen fertilizer can cause global warming	178 (53.5%)	155 (46.5%)
5.	Global warming is responsible for fluctuation of different pattern of rainfall	288 (86.5%)	45 (13.5)
6.	Global warming has significant effect on the yield of crop production in Nigeria.	329 (98.8%)	4 (1.2%)
7.	Global warming is responsible for heavy rainfall and scorching sunshine.	298 (89.5%)	35 (10.5%)
8.	Some of the floods in this country are due to global warming	298 (89.5%)	35 (10.5%)
9.	Excessive heat waves and windstorm are consequences of global warming	298 (89.5%)	35 (10.5%)
10	Fart and belch from cattle and other ruminant animals can contribute to increase global warming	76 (22.8%)	257 (77.2%)
11.	Use of backpacks for collecting cow's fart and belch usually help reduce global warming.	76 (22.8%)	257 (77.2%)
	Total	2745 (75.1%)	908 (24.9%)

Source: Field Survey, 2022

As indicated in table 4.5, 313 (94.0%) respondents affirmed that global warming is a gradual increase in the earth's temperature generally due to the greenhouse effect, while 20 (6.0%) indicated no. In addition, 313 (94.0%) respondents indicated that global warming describes the current rise in the average temperature of earth's air and oceans, while 20 (6.0%) indicated no. Furthermore, 288 (86.5%) respondents accepted that agricultural and industrial activities like deforestation can have effect on the atmosphere, while 45 (13.5%) indicated no. Moreover, 178 (53.5%) respondents established that application of nitrogen fertilizer can cause global warming, while 155 (46.5%) indicated no.

Besides, 288 (86.5%) respondents stated that global warming is responsible for fluctuation of different pattern of rainfall, while 45 (13.5%) indicated no. In addition, 329 (98.8%) respondent accepted that global warming has significant effect on the yield of crop production in Nigeria, while 4 (1.2%) indicated no. Furthermore, 298 (89.5%) respondents affirmed that global warming is responsible for heavy rainfall and scorching sunshine, while 35 (10.5%) indicated no. Moreover, 298 (89.5%) respondents accepted that some of the floods in this country are due to global warming, while 35 (10.5%) indicated no.

Additionally, 298 (89.5%) respondents accepted that excessive heat waves and windstorm are consequences of global warming, while 35 (10.5%) indicated no. In addition, 76 (22.8%) respondents established that fart and belch from cattle and other ruminant animals can contribute to increase global warming, while 257 (77.2%) indicated no. Furthermore, 76 (22.8%) respondents accepted that global warming is responsible for heavy rainfall and scorching sunshine, while 257 (77%) indicated no. Table 4.5 further revealed that majority (75.1%)of the respondents indicated yes in most of the positively developed question items, while few (24.9%)

did not. This means that the level of knowledge of global warming among commercial farmers in Oyo State was high. This corroborates the research previous research which showed that the level of global warming among farmers is high in Oyo State [1].

Research Question 2: What is the attitude of commercial farmers in Oyo State towards global warming?

Table 4.6: Summary of Result on Attitude towards Global Warming

S/n	Statement	SA	A	D	SD
1.	I do not believe in bio-enzyme method of clearing bush.	249 (74.8%)	19 (5.7%)	7 (2.1%)	58 (17.4%)
2.	I do not believe that emissions from cattle can affect the environment	242 (72.7%)	25 (7.5%)	10 (3.0%)	56 (16.8%)
3.	I do not believe that deforestation increases the amount of carbon dioxide in the atmosphere	259 (77.8%)	7 (2.1%)	21 (6.3%)	46 (13.8%)
4.	Fart and belch from cattle have no relationship with increase in global warming in my own view	252 (75.7%)	14 (4.2%)	22 (6.6%)	45 (13.5%)
5.	The use of backpacks for collection of cow's fart and belch is not necessary	263 (79.0%)	19 (5.7%)	19 (5.7%)	32 (9.6%)
	Total	1349 (81.0%)		316 (19.0%)	

Key: Strongly agree (SA): Agree (A): Disagree (D) and Strongly Disagree (SD)
Source: Field Survey, 2022

Table 4.6 reveals that 249 (74.8%) respondents strongly agreed that they do not believe in bio-enzyme method of clearing bush, 19 (5.7%) agreed, 7 (2.1%) disagreed, while 58 (17.4%) strongly disagreed. In addition, 242 (72.7%) respondents strongly agreed that they do not believe that emissions from cattle can affect the environment, 25 (7.5%) agreed, 10 (3.0%) disagreed, 56 (16.8%) strongly disagreed. Furthermore, 259 (77.8%) respondents strongly agreed that they do not believe that deforestation increases the amount of carbon dioxide in the atmosphere, 7 (2.1%) agreed, 21 (6.3%) disagreed, 46 (13.8%) strongly disagreed. Moreover, 252 (75.7%) respondents strongly agreed that fart and belch from cattle have no relationship with increase in global warming, 14 (4.2%) agreed, 22 (6.6%) disagreed, while 45 (13.5%) strongly disagreed. Besides, 263 (79.0%) respondents strongly agreed that use of backpacks for collection of cow's fart and belch is not necessary, 19 (5.7%) agreed, 19 (5.7%) disagreed, while 32 (9.6%) strongly disagreed. Table 4.6 further revealed that most (81.0%) of the respondents agreed on all of the negatively developed question items, while few (19.0%) did not. This means that commercial farmers in Oyo State had negative attitude towards global warming.

Research Question 3: What is the at-risk behaviour of commercial farmers in Oyo State towards global warming?

Table 4.7: Summary of Result on At-risk Behaviour towards Global Warming

S/n	Statement	RE	SM	NE
1.	I apply nitrogen fertilizers to my farm land as it pleases me.	318 (95.5%)	15 (4.5%)	0 (0.0%)
2.	I engage in bush-burning at any convenient time	314 (94.3%)	19 (5.7%)	0 (0.0%)
3.	I adopt open grazing of cattle and other livestock in my farm	168 (50.5%)	161 (48.3%)	4 (1.2%)
4.	I do not stop the escape of methane into the atmosphere during rice cultivation	168 (50.5%)	6 (1.8%)	159 (47.7%)
5.	I do not use backpacks for collecting cow's fart and belch in any of my routine farming operation	60 (18.0%)	5 (1.5%)	268 (80.5%)
6.	I do not adopt changes to my method of farming	54 (16.2%)	124 (37.2%)	155 (46.5%)
7.	Monitoring of crop production and livestock activities that can lead to global warming gives me challenges	56 (16.8%)	11 (3.3%)	266 (79.9%)
		1138 (48.8%)	341 (14.6%)	852 (36.6%)

Key: Regularly (RE), Sometimes (SM) and Never (NE)
Source: Field Survey, 2022

Table 4.7 reveals that 318 (95.5%) respondents regularly applied nitrogen fertilizers to their farm land as it pleases them, while 15 (4.5%) sometimes involved in it. In addition, 314 (94.3%) respondents regularly engaged in bush-burning at any convenient time, while 19 (5.7%) sometimes engaged in it. Furthermore, 168 (50.5%) respondents regularly adopt open grazing of cattle and other livestock in their farm, 161 (48.3%) sometimes involved in it, while 4 (1.2%) never engaged in it. Moreover, 168 (50.5%) respondents regularly do not stop the escape of

methane into the atmosphere during rice cultivation, 6 (1.8%) sometimes involved in it, while 159 (47.7%) never engaged in it. Besides, 60 (18.0%) respondents do not use backpacks regularly for collecting cow's fart and belch in any of their routine farming operations, 5 (1.5%) sometimes involved in it, while 268 (80.5%) never engaged in it. In addition, 54 (16.2%) respondents regularly do not adopt changes to their method of farming, 124 (37.2%) sometimes involved in it, while 155 (46.5%) never engaged in it. Furthermore, 56 (16.8%) respondents indicated that monitoring of crop production and livestock activities that can lead to global warming regularly gives them challenges, 11 (3.3%) sometimes passed through it, while 266 (79.9%) never engage in it. Table 4.6 further revealed that most (48.8%)of the respondents and very few (14.6%) engaged in behaviours that can put individuals at-risk of global warming, while some (36.6%)respondents never involved in it. This means that at-risk behaviour of commercial farmers towards global warming in Oyo State was negative.

4.2.2 Hypotheses

The following hypotheses were tested in this study.

Hypothesis 1: There is no significant relationship between knowledge and attitude towards global warming among commercial farmers in Oyo State.

Table 4.8: Summary of Result on Relationship between Knowledge and Attitude towards Global Warming

Variables	Mean	Std. Dev.	Knowledge	Attitude	N	Sig. (p value)	Remark
Knowledge	19.2733	2.5055	1	-0.494**			
Attitude	7.8619	5.2284	-0.494**	1	333	.000	Significant

Correlation is Significant at 0.05 alpha level (p<0.05)

Source: Field Survey, 2022

Table 4.8 shows that knowledge was tested significant on the attitude towards global warming among commercial farmers in Oyo State (r=-0.494, p<0.05). It was further established that knowledge had negative correlation with attitude of commercial farmers towards global warming; while correlation coefficient's magnitude was weak. This implied that there was a significant weak negative relationship between knowledge and attitude towards global warming among commercial farmers in Oyo State. The null hypothesis was therefore rejected. The negative relationship of knowledge of global warming and attitude towards it implied that, knowledge of commercial farmers could not improve the attitude of commercial farmers towards global warming in Oyo State.

Hypothesis 2: There is no significant relationship between knowledge and at-risk behaviour of commercial farmers in Oyo State towards global warming.

Table 4.9: Summary of Result on Relationship between Knowledge and At-risk Behaviour towards Global Warming

Variables	Mean	Std. Dev.	Knowledge	At-risk Behaviour	N	Sig. (p value)	Remark
Knowledge	19.2733	2.5055	1	-0.585**			
At-risk Behavior	13.1411	2.8990	-0.585**	1	333	.000	Significant

Correlation is Significant at 0.05 alpha level (p<0.05)
Source: Field Survey, 2022

Table 4.9 shows that knowledge was tested significant on at-risk behaviour towards global warming among commercial farmers in Oyo State (r=-0.585, p<0.05). It was further established that knowledge had negative correlation with at-risk behaviour of commercial farmers towards global warming; while correlation coefficient's magnitude was moderate. This implied that there was a significant moderate negative relationship between knowledge and at-risk behaviour

towards global warming among commercial farmers in Oyo State. The null hypothesis was therefore rejected. The negative relationship of knowledge of global warming and at-risk behaviour towards it implied that, present level of knowledge of commercial farmers could not improve at-risk behaviour of commercial farmers towards global warming in Oyo State.

Hypothesis 3: There is no significant difference in knowledge of global warming among commercial farmers in Oyo State, based on educational qualification.

Table 4.10.1: Analysis of Variance of difference in Knowledge of Global Warming Based on Educational Qualification

Source	Sum of Squares	df	Mean Square	F	Sig. (*p* value)	Remark
Between Groups	171.133	3	57.044	9.811	0.000	Significant
Within Groups	1912.999	329	5.815			
Total	2084.132	332				

Table 4.10.1 reveals that, there was a significant difference in knowledge of global warming among commercial farmers in Oyo State, based on educational qualification ($F_{(3,329)}$=9.811; p<0.05).This implied that there were variations in knowledge of global warming among commercial farmers in Oyo State due to diverse educational qualification of the respondents. Hence, the null hypothesis was rejected.

Table 4.10.2: Scheffe Post-hoc Analysis of Difference in Knowledge of Global Warming Based on Educational Qualification

(I) Educational Qualification	(J) Educational Qualification	Mean Difference (I-J)	Std. Error	Sig.	Remark
No Formal Education	Primary Education	1.77358	1.72109	.786	Not Sig.
	Secondary Education	.18966	1.71971	1.000	Not Sig.
	Tertiary Education	.29358	1.72065	0.999	Not Sig.
Primary Education	No Formal Education	-1.77358	1.72109	0.786	Not Sig.
	Secondary Education	-1.58393*	0.32401	0.000	Significant
	Tertiary Education	-1.48001*	0.32894	0.000	Significant
Secondary Education	No Formal Education	-0.18966	1.71971	1.000	Not Sig.
	Primary Education	1.58393*	0.32401	0.000	Significant
	Tertiary Education	.10392	0.32167	0.991	Not Sig.
Tertiary Education	No Formal Education	-0.29358	1.72065	0.999	Not Sig.
	Primary Education	1.48001*	0.32894	0.000	Significant
	Secondary Education	-0.10392	0.32167	0.991	Not Sig.

*The mean difference is significant at the 0.05 level

The Scheffe post-hoc test shows that pairwise comparison of no formal education with primary (0.786; $p>0.05$), secondary (1.000; $p>0.05$) and tertiary education (0.999; $p>0.05$) were not significantly different respectively. Similarly, pairwise comparison of primary education and no formal education (0.786; $p>0.05$) was not significantly different; while pairwise comparison of primary education with secondary (0.000; $p<0.05$) and tertiary education (0.000; $p<0.05$) were significantly different respectively.

In addition, the pairwise comparison of secondary and primary education (0.000; $p<0.05$) was significantly different, while secondary with no formal education (1.000; $p>0.05$) and tertiary education (0.991; $p>0.05$) were not respectively. This means that pairwise comparison of primary education with secondary and tertiary education were significantly different respectively. Also, the pairwise comparison of secondary and primary education was significantly different.

Hypothesis 4: There is no significant difference in attitude towards global warming among commercial farmers in Oyo State, based on educational qualification.

Table 4.11.1: Analysis of Variance of difference in Attitude towards Global Warming Based on Educational Qualification

Source	Sum of Squares	Df	Mean Square	F	Sig.	Remark
Between Groups	625.881	3	208.627	8.123	0.000	Significant
Within Groups	8449.765	329	25.683			
Total	9075.646	332				

Table 4.11.1 reveals that, there was a significant difference in attitude towards global warming among commercial farmers in Oyo State, based on educational qualification ($F_{(3,329)}$=8.123; p<0.05). This implied that there were variations in attitude towards global warming among commercial farmers in Oyo State due to diverse educational qualification of the respondents. Hence, the null hypothesis was rejected.

Table 4.11.2: Scheffe Post-hoc Analysis of Difference in Attitude towards Global Warming Based on Educational Qualification

(I) Educational Qualification	(J) Educational Qualification	Mean Difference (I-J)	Std. Error	Sig.	Remark
No Formal Education	Primary Education	-.64151	3.61716	0.999	Not Sig.
	Secondary Education	-1.18966	3.61428	0.991	Not Sig.
	Tertiary Education	-3.79817	3.61624	0.776	Not Sig.
Primary Education	No Formal Education	.64151	3.61716	0.999	Not Sig.
	Secondary Education	-.54815	0.68096	0.885	Not Sig.
	Tertiary Education	-3.15666*	0.69132	0.000	Significant
Secondary Education	No Formal Education	1.18966	3.61428	0.991	Not Sig.
	Primary Education	.54815	0.68096	0.885	Not Sig.
	Tertiary Education	-2.60851*	0.67604	0.002	Significant
Tertiary Education	No Formal Education	3.79817	3.61624	0.776	Not Sig.
	Primary Education	3.15666*	0.69132	0.000	Significant
	Secondary Education	2.60851*	0.67604	0.002	Significant

*The mean difference is significant at the 0.05 level

The Scheffe post-hoc test shows that pairwise comparison of no formal education with primary (0.999; $p>0.05$), secondary (0.991; $p>0.05$) and tertiary education (0.776; $p>0.05$) were not significantly different respectively. Equally, pairwise comparison of primary education with no formal education (0.999; $p>0.05$) and secondary (0.885; $p>0.05$) education were not significantly different respectively; while pairwise comparison of primary with tertiary education was significantly different (0.000; $p<0.05$).

Moreover, pairwise comparison of secondary with no formal education (0.991; $p>0.05$) and primary education (0.885; $p>0.05$) were not significantly different respectively; while pairwise comparison of secondary with tertiary education (0.002; $p<0.05$) was significantly different. This means that pairwise comparison of primary with tertiary education was significantly different. Also, the pairwise comparison of secondary and tertiary education was significantly different.

Hypothesis 5: There is no significant difference in at-risk behaviour towards global warming among commercial farmers in Oyo State, based on educational qualification.

Table 4.12.1: Analysis of Variance of difference in At-risk Behaviour towards Warming Based on Educational Qualification

Source	Sum of Squares	Df	Mean Square	F	Sig.	Remark
Between Groups	252.355	3	84.118	10.904	0.000	Significant
Within Groups	2538.011	329	7.714			
Total	2790.366	332				

Table 4.12.1 reveals that, there was a significant difference inat-risk behaviour towards global warming among commercial farmers in Oyo State, based on educational qualification ($F_{(3,329)}=10.904$; $p<0.05$). This implied that there were variations in at-risk behaviour towards

global warming among commercial farmers in Oyo State due to diverse educational qualification of the respondents. Hence, the null hypothesis was rejected.

Table 4.2.2: Scheffe Post-hoc Analysis of Difference in At-risk Behavior towards Global Warming Based on Educational Qualification

(I) Educational Qualification	(J) Educational Qualification	Mean Difference (I-J)	Std. Error	Sig.	Remark
No Formal Education	Primary Education	0.68868	1.98241	0.989	Not Sig.
	Secondary Education	2.08621	1.98082	0.775	Not Sig.
	Tertiary Education	2.78899	1.98190	0.577	Not Sig.
Primary Education	No Formal Education	-0.68868	1.98241	0.989	Not Sig.
	Secondary Education	1.39753*	0.37320	0.003	Significant
	Tertiary Education	2.10031*	0.37888	0.000	Significant
Secondary Education	No Formal Education	-2.08621	1.98082	0.775	Not Sig.
	Primary Education	-1.39753*	0.37320	0.003	Significant
	Tertiary Education	0.70278	0.37051	0.310	Significant
Tertiary Education	No Formal Education	-2.78899	1.98190	0.577	Not Sig.
	Primary Education	-2.10031*	0.37888	0.000	Significant
	Secondary Education	-0.70278	0.37051	0.310	Not Sig.

*The mean difference is significant at the 0.05 level

The Scheffe post-hoc test shows that pairwise comparison of no formal education with primary (0.989; $p>0.05$), secondary (0.775; $p>0.05$) and tertiary education (0.577; $p>0.05$) were not significantly different respectively. Equally, pairwise comparison of primary education with no formal education (0.989; $p>0.05$) was not significantly different; secondary (0.003; $p<0.05$) and tertiary education (0.000; $p<0.05$) was significantly different respectively.

Moreover, pairwise comparison of secondary with no formal education (0.775; $p>0.05$) and tertiary education (0.310; $p>0.05$) were not significantly different respectively; while pairwise comparison of secondary with primary education was significantly different (0.003; $p<0.05$). This means that pairwise comparison of primary with secondary and tertiary education was

significantly different respectively. Also, the pairwise comparison of secondary with primary education was significantly different.

4.3 Discussion of Findings

The findings of this study on socio-demographic characteristics revealed that, most of the respondents were between the age range of 39 years and above. Similarly, it was established that majority of the respondents were male of which a considerable number the respondents had secondary education. Also, equal number (111) of respondents was sampled from each of the zones.

The findings of this study revealed that the level of knowledge of global warming among commercial farmers in Oyo State was high. This was established through the responses of the respondents which indicated that majority of the respondents indicated yes in most of the positively developed question items, while few did not. This was equally established through the responses in which majority of the respondents affirmed that global warming is a gradual increase in the earth's temperature generally due to the greenhouse effect.

In addition, most respondents indicated that global warming describes the current rise in the average temperature of earth's air and oceans, while few indicated no. Furthermore, majority of the respondents accepted that agricultural and industrial activities like deforestation can have effect on the atmosphere, while few indicated no.

It was established that most respondents established that application of nitrogen fertilizer can cause global warming, while few indicated no. Besides, most respondents stated that global warming is responsible for fluctuation of different pattern of rainfall, while few indicated no. In addition, most respondents accepted that global warming has significant effect on the yield of crop production in Nigeria, while few indicated no. Furthermore, majority of the respondents

affirmed that global warming is responsible for heavy rainfall and scorching sunshine, while few indicated no.

Moreover, most respondents accepted that some of the floods in this country are due to global warming, while few indicated no. Additionally, most respondents accepted that excessive heat waves and windstorm are consequences of global warming, while few indicated no. The outcome of this present study on knowledge of global warming among commercial farmers was not in line with a previous study which revealed that understanding farmer's risky conduct with regard to global warming is crucial since it may encourage people to change their ways and accept policy reforms [2].

In the same vein, the findings of this study revealed that commercial farmers in Oyo State had negative attitude towards global warming. This was established through the responses of most of the respondents who agreed on the entire negatively developed question items, while few did not. This means was also revealed through the responses of most of them with the agreement that they do not believe in bio-enzyme method of clearing bush. Also, most respondents agreed that they do not believe that emissions from cattle can affect the environment.

Furthermore, majority of the respondents strongly agreed that they do not believe that deforestation increases the amount of carbon dioxide in the atmosphere. Moreover, most respondents strongly agreed that fart and belch from cattle have no relationship with increase in global warming. Besides, most of the respondents strongly agreed that use of backpacks for collection of cow's fart and belch is not necessary, while few of them disagreed. The outcome of this present study on attitude towards global warming among commercial farmers was not in line with a previous study which revealed that perceived implications of climate change as well as sociocultural and institutional contexts influenced disparities in perceptions of the issue [3].

The findings of this study further revealed that at-risk behaviour of commercial farmers in Oyo State towards global warming was negative. This was further revealed the through the responses of most of the respondents and very few who engaged in behaviours that can put individuals at-risk of global warming, while some respondents never involved in it. This was further justified through the responses of most respondents which that they regularly applied nitrogen fertilizers to their farm land as it pleases them, while sometimes involved in it. In addition, most respondents regularly engaged in bush-burning at any convenient time, while few sometimes engaged in it.

Furthermore, most respondents regularly adopt open grazing of cattle and other livestock in their farm, while few sometimes involved in it. Moreover, most respondents regularly do not stop the escape of methane into the atmosphere during rice cultivation. Besides, most respondents do not use backpacks regularly for collecting cow's fart and belch in any of their routine farming operations. In addition, some respondents regularly do not adopt changes to their method of farming, while few sometimes involved in it. The outcome of this present study on at-risk behaviour of commercial farmers in Oyo State towards global warming was not in line with a previous study which revealed that perceived implications of climate change as well as sociocultural and institutional contexts influenced disparities in perceptions of the issue [2].

The outcomes of this study also revealed that knowledge was tested significant on the attitude towards global warming among commercial farmers in Oyo State. It was further established that knowledge had negative correlation with attitude of commercial farmers towards global warming; while correlation coefficient's magnitude was weak. This implied that there was a significant weak negative relationship between knowledge and attitude towards global warming among commercial farmers in Oyo State.

The findings of this study further showed that knowledge was tested significant on at-risk behaviour towards global warming among commercial farmers in Oyo State. It was further established that knowledge had negative correlation with at-risk behaviour of commercial farmers towards global warming; while correlation coefficient's magnitude was moderate. This implied that there was a significant moderate negative relationship between knowledge and at-risk behaviour towards global warming among commercial farmers in Oyo State. The negative relationship of knowledge of global warming and at-risk behaviour towards it implied that, knowledge of commercial farmers could not improve at-risk behaviour of commercial farmers in Oyo State towards global warming.

The outcomes of this study further revealed that there was a significant difference in knowledge of global warming among commercial farmers in Oyo State, based on educational qualification. This implied that there were variations in knowledge of global warming among commercial farmers in Oyo State due to diverse educational qualification of the respondents.

It was further established that pairwise comparison of primary education with secondary and tertiary education significantly different respectively. Also, the pairwise comparison of secondary and primary education was significantly different.

The findings of this study revealed that, there was a significant difference in attitude towards global warming among commercial farmers in Oyo State, based on educational qualification. This implied that there were variations in attitude towards global warming among commercial farmers in Oyo State due to diverse educational qualification of the respondents.

It was further established that pairwise comparison of primary with tertiary education was significantly different. Also, the pairwise comparison of secondary and tertiary education was significantly different.

The findings of this study established that, there was a significant difference inat-risk behaviour towards global warming among commercial farmers in Oyo State, based on educational qualification. This implied that there were variations in at-risk behaviour towards global warming among commercial farmers in Oyo State due to diverse educational qualification of the respondents. It was revealed further that pairwise comparison of primary with secondary and tertiary education was significantly different respectively. Also, the pairwise comparison of secondary with primary education was significantly different.

End Notes

[1] O.G. Ogunwale; O.O. Abegunrin; B.H. Ugege; A.A. Tunde-Francis; O.O. Oyewole, *Investigation of the Perception of Climate Change among Arable Crop Farmers in Akinyele Local Government Area of Oyo State, Nigeria*. 2020. DOI: https://dx.doi.org/10.4314/jasem.v24i12.13

[2] Fierros-González & A. López-Feldman. *Farmers' Perception of Climate Change: A Review of the Literature for Latin America*. Available online: https://www.frontiersin.org/articles/10.3389/fenvs.2021.672399/full

[3] J.G. Arbuckle, L.W. Morton, & J. Hobbs. *Understanding Farmer Perspectives on Climate Change Adaptation and Mitigation: The Roles of Trust in Sources of Climate Information, Climate Change Beliefs, and Perceived Risk*. Environ Behav. 2015 Feb;47(2):205-234. doi: 10.1177/0013916513503832. PMID: 25983336; PMCID: PMC4359208.

Chapter Five

Conclusion

This chapter presents the summary and conclusion of the findings.

5.1 Summary of the Findings

This study investigated knowledge, attitude and at-risk behaviour of commercial farmers towards global warming in Oyo State, Nigeria,. Consequently, independent variables were tested in relation to dependent variables. The tested independent variables were knowledge, attitude and at-risk behaviour, while global warming was examined as dependent variable. Three research questions were raised and answered, while five hypotheses were formulated and tested. The review of relevant literature was carried out under different sub-headings.

The review of related literature covered the conceptual studies, theoretical model and review of empirical studies, conceptual model and summary of the review literature. The conceptual studies in this study covered overview of global warming, concept of climate change, greenhouse gases and their emissions from agriculture, causes of global warming, occurrence of global warming in the World, sub-Saharan Africa and Nigeria health consequences of global warming on human and environment, overview of commercial farming and farmers, overview of farming in Oyo State, prevention, mitigation and adaptation of global warming.

For the theoretical framework, Milankovitch theory and health belief model were adapted in this study. The review of empirical studies covered knowledge of commercial farmers in about global warming, attitude of commercial farmers towards global warming and at-risk behaviour of commercial farmers towards global warming. Then, summary of the reviewed literature was carried out to appraise the reviewed of conceptual studies, theoretical models and empirical studies.

Cross-sectional research design was used for this study. Population for this study comprised commercial farmers in Oyo State. The respondents were all the commercial farmers registered with Oyo State Agribusiness Development (OYSADA). Multistage sampling procedure (simple random, disproportionate stratified sampling technique) was adopted for this study. Self-developed and validated questionnaire was used for data collection. The descriptive statistics of frequency counts and percentages was used to analyze the socio-demographic characteristics of the respondents and the research questions. Inferential statistics of Pearson product moment correlation (PPMC) was be used to analyze hypotheses 1 and 2; while Analysis of variance (ANOVA) was used to test hypotheses 3, 4 and 5 at 0.05 level of significance.

The findings of this study on socio-demographic characteristics revealed that, most of the respondents were between the age range of 39 years and above. Similarly, it was established that majority of the respondents were male of which a considerable number the respondents had secondary education. The finding of this study revealed that the level of knowledge of global warming among commercial farmers in Oyo State was high. In addition, the commercial farmers in Oyo State had negative attitude towards global warming.

Moreover, at-risk behaviour of commercial farmers in Oyo State towards global warming was negative. The outcomes of the study also revealed that there was a significant weak negative relationship between knowledge and attitude towards global warming among commercial farmers in Oyo State. Besides, there was a significant moderate negative relationship between knowledge and at-risk behaviour towards global warming among commercial farmers in Oyo State. Furthermore, there was a significant difference in knowledge of global warming among commercial farmers in Oyo State, based on educational qualification.

Additionally, there was a significant difference in attitude towards global warming among commercial farmers in Oyo State. Also, there was a significant difference in at-risk behaviour towards global warming among commercial farmers in Oyo State, based on educational qualification.

5.2 Conclusion

It was concluded in this study that the level of knowledge of global warming among commercial farmers in Oyo State was high and conclusion was also made that commercial farmers in Oyo State had negative attitude towards global warming. It was further established that at-risk behaviour of the commercial farmers towards global warming in Oyo State was negative. It was concluded that there was a significant weak negative relationship between knowledge and attitude towards global warming among the respondents.

It was affirmed that there was a significant moderate negative relationship between knowledge and at-risk behaviour towards global warming among commercial farmers in Oyo State. Conclusion was made that there were significant differences in knowledge, attitude and at-risk behaviour towards global warming among the respondents based on educational qualification.

5.3 Recommendations

Based on the findings of this study, the following recommendations were made:

1. The Non- Government Organization should jointly organize periodic sensitization programme on knowledge, attitude and at-risk behaviour of commercial farmers in all the thirty-three Local Government Areas of Oyo State.

2. Agricultural extension agents should make an effort to meet an emissions trajectory consistent with the limiting of the global temperature rise to 1.5 degrees above pre-industrial levels.

3. Commercial farmers should engage in a fair international negotiation process under intergovernmental panel for climate change, in which elements crucial for equity are protected and the rights of every country and their citizens are respected and represented equally.

4. Non-Governmental Organization should incentivize the reduction of vehicular transport, promote active transport, and build the appropriate infrastructures to facilitate this;

5. Agricultural extension agents should provide a strong mechanism to address loss and damages supported by financial means that are not in competition with climate finance for mitigation and adaptation;

6. Government should allocate public funds to support the clean energy transition and climate solutions research and development;

7. Non-Governmental Organization should develop and implement education, training, public access to information, public awareness, public participation and international cooperation.

8. Government should develop a systematic global standard for measuring the greenhouse gas emissions of the agriculture sector, in conjunction intergovernmental panel for climate change

9. Non-Governmental Organization should increase eco-medical literacy within climate change stakeholders and policy makers and publish and disseminate scientifically global public health information on global warming and agriculture that supports policy-makers, researchers and practitioners.

5.4 Contributions to Knowledge

This study contributed to knowledge in the following ways:

1. It was established that the level of knowledge of global warming among commercial farmers in Oyo State was high.

2. This study confirmed that commercial farmers in Oyo State had negative attitude towards global warming.
3. It was also confirmed that at-risk behaviour of commercial farmers in Oyo State towards global warming was negative.
4. It was also affirmed that there was a significant weak negative relationship between knowledge and attitude towards global warming among the respondents.
5. This study established that there was a significant moderate negative relationship between knowledge and at-risk behaviour towards global warming among commercial farmers in Oyo State.
6. It was confirmed that there was a significant difference in knowledge of global warming among commercial farmers in Oyo State, based on educational qualification.
7. It was confirmed that there was a significant difference in attitude towards global warming among commercial farmers in Oyo State.
8. It was established that there was a significant difference in at-risk behaviour towards global warming among commercial farmers in Oyo State, based on educational qualification.

5.5 Suggested Areas for Further Research

The following suggestions were made for further research based on the findings of the study.

1. The study of this nature can be replicated among non- commercial farmers in Oyo State.
2. Also, the study of this nature can be carried out among female only farmers in Oyo State.
3. Also, intervention studies on global warming can be worked upon by other researchers in the subsequent studies

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Appendix I

Department of Kinesiology, Sports Science and Health Education
Faculty of Arts and Education
Lead City University, Ibadan, Oyo State

Questionnaire

Dear respondent,
The researcher is a postgraduate student of the Department of Kinesiology, Sports Science and Health Education, Lead City University, Ibadan. In partial fulfillment of the requirements for the award of Master of Science Education [MSc.(Ed)] in Health Education; the researcher is conducting a study on Knowledge, Attitude and At-Risk Behaviour of Commercial Farmers towards Global Warming in Oyo State. This questionnaire is therefore designed to elicit information in relation to the variables being studied.
Your responses to the following question items shall be highly appreciated, treated confidentially and used strictly for academic purposes. Kindly fill them as appropriate.
Thank you for your anticipated cooperation.

ADELEYE Oluwasegun Abidemi (Mr)

(The Researcher)

Section A: Socio-Demographic Information

Instruction: Please tick (✓) in the column as it applies to you in each of the following items

1. Gender: a. Male [ ] b. Female [ ]
2. Age: a. 18-24 [ ] b. 25-31 [ ] c. 32-38 [ ] d. 39 and above [ ]
3. Educational Qualification: a. No Formal Education [ ] b. Primary Education [ ]
   c. Secondary Education [ ] d. Tertiary Education [ ]
4. Zone: a. Ibadan [ ] b. Ibarapa [ ] c. Ogbomoso [ ] d. Oke-Ogun [ ] e. Oyo [ ]

Section B: Knowledge of Global Warming Scale (KGWS)

Instruction: Please tick (✓) in the appropriate column that suits your response in the following Statements. Yes and No

S/n	Statement	Yes	No
1.	Global warming is a gradual increase in the earth's temperature generally due to the greenhouse effect		
2.	Global warming describes the current rise in the average temperature of earth's air and oceans		
3.	Agricultural and industrial activities like deforestation can have effect on the atmosphere		
4.	Application of nitrogen fertilizer can cause global warming		
5.	Global warming is responsible for fluctuation of different pattern of rainfall		
6.	Global warming has Significant effect on the yield of crop production in Nigeria		
7.	Global warming is responsible for heavy rainfall and scorching sunshine.		
8.	Some of the floods in this country are due to global warming		
9.	Excessive heat waves and windstorm are consequences of global warming		
10.	Fart and belch from cattle and other ruminant animals can contribute to increase global warming		
11.	Use of backpacks for collecting cow's fart and belch usually help reduce global warming		

Section C: Attitude towards Global Warming Scale (ATGWS)
Instruction: Please tick (✓) in the appropriate column to indicate the extent to which you agree or disagree with the Statements below:
Strongly agree (SA): Agree (A): Disagree (D) and Strongly Disagree (SD)

S/n	Statement	SA	A	D	SD
1.	I do not believe in Bio-enzyme method of clearing bush.				
2.	I do not believe that emissions from cattle can affect the environment				
3.	I do not believe that deforestation increases the amount of carbon dioxide in the atmosphere				
4.	Fart and belch from cattle have no relationship with increase in global warming in my own view				
5.	The use of backpacks for collection of cow's fart and belch is not necessary				

Section D: At-Risk Behaviour towards Global Warming Scale (ARBGWS)
Instruction: Please tick (✓) in the appropriate column that suits your response in the following Statements. Regularly (RE), Sometimes (SM) and Never (NE)

S/n	Statement	RE	SM	NE
1.	I apply Nitrogen fertilizers to my farm land as it pleases me.			
2.	I engage in bush-burning at any convenient time			
3.	I adopt open grazing of cattle and other livestock in my farm			
4.	I do not stop the escape of methane into the atmosphere during rice cultivation			
5.	I do not use backpacks for collecting cow's fart and belch in any of my routine farming operation			
6.	I do not adopt changes to my method of farming			
7.	Monitoring of crop production and livestock activities that can lead to global warming gives me challenges			

ÌWÉ ÌBÉÈRÈ

Olùdáhùn ọ̀wọ́n,
Olùṣèwádìí jẹ́ akẹ́kọ̀ọ́ ìmọ̀ ìjìnlẹ̀ àgbà ní ẹ̀ka Ẹ̀kọ́ eré ìdáraya, sáyẹ̀nsì àti ẹ̀kọ́ ilera, Lead city Yunifásitì, Ibadan. Ní ìmúṣẹ lára àwọn ohun tó yẹ láti ṣe láti gba oyè ìmọ̀ ìjìnlẹ̀ sáyẹ̀nsì ti Ẹ̀kọ́ ikọ́ni (MSc. (Ed)) ninu ẹ̀kọ́ ilera; Olùṣèwádìí ń ṣe iṣẹ́ lóri ìmọ̀, ìwà àti àwọn ìwà tó ní ewu tí àwọn àgbẹ olóúnjẹ ní sí ìpòrúru ojú ọjọ́ àgbáyé ní ìpínlẹ̀ Ọ̀yọ́. Ìwé ìbéèrè ìṣèwádìí yìí ni a ṣetò láti ṣe àfàyọ àwọn kókó ní ìbámu pẹ̀lú àwọn ohun tí à ń gbéyẹ̀wò.
Àwọn ìdáhùn rẹ sí àwọn ìbéèrè yìí ni a ó fi tayọ̀tayọ̀ gbà, a ó sì lò ó ní ìdákọ́ńkọ́ àti fún ìwúlò ẹ̀kọ́ nìkan. Jọ̀wọ́ dáhùn wọn bí ó yi yẹ.
Ẹ ṣeun fún ìfọwọ́sowọ́pọ̀ tí à ń retí.

ADÉLÉYẸ Olúwáṣẹ́gun Abídèmí.(Ọ̀gbẹ́ni)
(Olùṣèwádìí)
Abala A: Ìfitónilétí nípa olùdáhùn
Ìtọ́ni: Jọ̀wọ́ sàmì( ) sí inú ibi tó bá ọ mu ninu gbólóhùn kọ̀ọ̀kan.

1. Ìṣẹ̀dánìyàn: a. Ọkùnrin ( ) b. Obìnrin
2. Ọjọ́ orí: a. 18-24 ( ) b. 25-31 ( ) c. 32-38 ( ) d. 39 lọ sókè ( )
3. Ìwé kíkà: a. Kò sí ìmọ̀ "mọ̀ ń kọ mọ̀ ń kà" ( ) b. Ìwé alákọ̀ọ́bẹ̀rẹ̀ ( )
   c. Sẹkọ́ndìrì ( ) d. Ìwé gíga ( )
4. Ẹkùn a. Ìbàdàn ( ) b. Ìbàràpá c. Ògbómọ́ṣọ́ ( )
   d Òkè-ògùn ( ) e. Òyọ́ ( )

Abala B: Ìmọ̀ nípa ìpòrurù ojú ọjọ́ àgbáyé
Ìtọ́ni: jọ̀wọ́ sàmì( ) sínu ibi tí ó yẹ tí ó sì bá ìdáhùn rẹ mu nnu gbólóhùn wọ̀nyí. Bẹ́ẹ̀ni àti Bẹ́ẹ̀kọ́.

S/N	Gbólóhùn	Bẹ́ẹ̀ni	Bẹ́ẹ̀kọ́
1.	Ìpòrúru ojú ọjọ́ àgbáyé ni ìlọsókè díẹ̀díẹ̀ ninu ooru ayé látàrí ooru afẹ́fẹ́ èyí tó wáyé nípa àwọn èròjà olóró àti àwọn olùdọ̀tí miíràn.		
2.	Ìpòrurù ojú ọjọ́ àgbáyé ń ṣàpèjúwe ìlọsókè lọ́wọ́lọ́wọ́ yìí nípa ooru afẹ́fẹ́ àti àwọn òkun ayé yìí.		

3. Àwọn ètò isẹ́ àgbẹ̀ àti àwọn ètò ilé isẹ́ ńláńlá bíi mímú àdínkù bá igi inú igbó lè ṣe ìjàǹbá sí ojú ọjọ́
4. Ṣíṣe àmúlò ajílẹ̀ tí a fi èròjà pò lè fa ìpòrúru ojú ọjọ́ àgbáyé
5. Ìpòrúru ojú ọjọ́ àgbáyé ló ṣokùnfà ìdákúrekú ninu bí òjò ṣe ń rọ̀.
6. Ìpòrúru ojú ọjọ́ àgbáyé ní ipa tó gbọngbọ́n lórí bí irúgbìn ṣe ń mú èso wá ní Nàìjíríà
7. Ìpòrúru ojú ọjọ́ àgbáyé ló fa òjò ńláńlá àti òòrùn tó ń ta ni lára
8. Díẹ̀ ninu àwọn ìṣẹ̀lẹ̀ omíyalé ní orílẹ̀ èdè yìí wáyé látàrí Ìpòrúru ojú ọjọ́ àgbáyé
9. Ooru àmújù àti ìjì líle jẹ́ àtunbọ̀tán
10. Isó àti igùfẹ̀ láti ọ̀dọ agbo màálù àti àwọn ẹranko mìíràn bíi tirẹ̀ lè fi kún ìlọsókè Ìpòrúru ojú ọjọ́ àgbáyé
11. Lílo àwọn báàgì àpọ̀sẹ́yìn láti fi gba isó àti ìgùfẹ̀ àwọn màálù sáábà má n ṣe ìrànwọ́ láti dín Ìpòrúru ojú ọjọ́ àgbáyé kù.

Abala C: Ìwà sí Ìpòrúru ojú ọjọ́ àgbáyé
Ìtọ́ni: Jọ̀wọ́ sàmì ( ) sí inú ibi tó yẹ láti sàfihàn ipele èyí tí o fi ara mọ́ tàbí tí o kò faramọ́ pẹ̀lú gbólóhùn ìsàlẹ̀ yìí:
Mo faramọ gidigidi (MG): Mo faramọ (MF): Mí ò faramọ (M) àti Mí ò faramọ rárá (MR)

S/N	Gbólóhùn	MG	MF	MI	MR
1.	Mi ò gbàgbọ́ ninu lílo ìlànà pakopako láti yanjú igbó				
2.	Mí ò gbàgbọ́ pé àwọn ohun tó ń jáde láti ọ̀dọ̀ agbo màálù ní ipa lórí agbègbè				
3.	Mí ò gbàgbọ́ pé mímú igi dínkù lè jẹ́ kí èròjà olóró pọ̀ sii ninu afẹ́fẹ́				
4.	Ní ìwòye tèmi, isó àti ìgùfẹ̀ agbo màálù kò ní ìbáṣepọ̀ rárá pẹ̀lú ìlọsókè ninu Ìpòrurù ojú ọjọ́ àgbáyé				
5.	Ìlo báàgì àpọ̀nsẹ́yìn láti gba isó màálù àti ìgùfẹ́ kò pọn dandan tàbí ṣe kókó				

Abala D: Àwọn ìwà tó léwu sí ìpòruru ojú ọjọ́ àgbéyé
Ìtọ́ni: Jọ̀wọ́ sàmì ( ) sí inu ibi tó bá ìdáhùn rẹ mu ninu gbólóhùn wọ̀nyí.
Lóòrèkóòrè(L), Ẹ̀kọ̀ọ̀kan(Ẹ) àti Rárá (R)

S/N	Gbólóhun	L	Ẹ	R
1.	Mo máa ń lo ajílẹ̀ sórí ilẹ̀ oko mi bí ó bá ṣe wù mí			
2.	Mo máa ń sun igbó ní ìgbàkúgbà tí ó bá rọrùn fún mi			
3.	Mó máa ń jẹ́ kí àwọn màálù àti ẹran ọ̀sìn mìíràn kó jé koríko ninu oko mi			
4.	Mi ò kìí dènà ìjáde èròjà olóró tí à ń pè ní *methane* bọ́ sínu afẹ́fẹ́ ní ìgba gbingbin ìrẹsì.			
5.	Mi ò kìí lo báàgì àpọ̀sẹ́yìn fún gbígba isó àti ìgùfẹ̀ màálù ninu èyíkèyí ètò ìlànà iṣẹ́ oko mi.			
6.	Mi ò kìí ṣe àyípadà sí ọ̀nà tí mò ń gbà ṣe iṣẹ́ àgbẹ̀ mi			
7.	Ṣíṣe àmójútó ètò ọ̀gbìn àti ìṣe àwọn ohun ọ̀sìn tí ó le yọrí sí ìpòrurù ojú ọjọ́ àgbáyé máa ń fún mi ní ìpènijà.			

Reliability Result

OVERALL SCALE

Reliability

Case Processing Summary

		N	%
Cases	Valid	33	100.0
	Excluded[a]	0	.0
	Total	33	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.783	23

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
VAR00001	40.1515	39.008	-.044	.788
VAR00002	40.1515	38.508	.094	.784
VAR00003	40.1515	38.570	.077	.785
VAR00004	40.2727	38.580	.035	.787
VAR00005	40.1515	38.883	-.009	.787
VAR00006	40.0909	38.960	-.026	.786
VAR00007	40.0909	38.710	.089	.784
VAR00008	40.0909	38.960	-.026	.786
VAR00009	40.2121	38.985	-.040	.789
VAR00010	40.8182	34.653	.798	.758
VAR0001	40.8182	34.653	.798	.758

1 VAR00012	40.5455	29.881	.733	.741
VAR00013	40.3939	30.996	.659	.749
VAR00014	40.5455	32.193	.576	.757
VAR00015	40.5758	29.064	.789	.734
VAR00016	40.5152	28.758	.822	.731
VAR00017	40.5758	39.189	-.081	.793
VAR00018	40.5758	38.002	.088	.787
VAR00019	40.3333	37.479	.083	.793
VAR00020	40.0000	37.312	.066	.798
VAR00021	39.4545	35.381	.313	.777
VAR00022	39.5455	34.631	.368	.773
VAR00023	39.2727	36.017	.355	.774

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
42.0606	38.934	6.23969	23

KNOWLEDGE OF GLOBAL WARMING SCALE

Case Processing Summary

		N	%
Cases	Valid	33	100.0
	Excluded[a]	0	.0
	Total	33	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's	N of Items

Alpha	
.754	11

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
VAR00001	17.7576	2.939	.517	.722
VAR00002	17.7576	2.814	.655	.704
VAR00003	17.7576	2.939	.517	.722
VAR00004	17.8788	2.485	.676	.689
VAR00005	17.7576	3.064	.384	.738
VAR00006	17.6970	3.530	-.029	.770
VAR00007	17.6970	3.218	.470	.736
VAR00008	17.6970	3.468	.067	.763
VAR00009	17.8182	2.903	.408	.735
VAR00010	18.4242	2.814	.368	.745
VAR00011	18.4242	2.814	.368	.745

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
19.6667	3.542	1.88193	11

ATTITUDE TOWARDS GLOBAL WARMING SCALE

Case Processing Summary

		N	%
Cases	Valid	33	100.0
	Excluded[a]	0	.0
	Total	33	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.928	5

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
VAR00012	6.2121	11.985	.858	.902
VAR00013	6.0606	12.434	.830	.908
VAR00014	6.2121	13.110	.766	.920
VAR00015	6.2424	12.127	.799	.914
VAR00016	6.1818	12.091	.806	.913

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
7.7273	18.955	4.35368	5

AT-RISK BEHAVIOUR TOWARDS GLOBAL WARMING SCALE

Case Processing Summary

		N	%
Cases	Valid	33	100.0
	Excluded[a]	0	.0
	Total	33	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.629	7

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
VAR00017	13.1818	8.028	-.041	.675
VAR00018	13.1818	7.403	.144	.641
VAR00019	12.9394	6.434	.268	.617
VAR00020	12.6061	5.621	.378	.582
VAR00021	12.0606	5.559	.535	.521
VAR00022	12.1515	5.383	.540	.515
VAR00023	11.8788	6.172	.548	.538

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
14.6667	8.167	2.85774	7

Student's Biodata

Personal Data

Full Names:	Oluwasegun Abidemi, ADELEYE
Address:	4, Ade-ojo Estate, Sawmill, Oyo State
Date and Place of Birth:	4th November, 1991/Offa, Kwara state
Nationality:	Nigerian
Next of Kin:	
Name:	ADELEYE Ifunaya Chinyere
Address:	4, Ade-ojo Estate, Sawmill, Oyo State

Educational Background:

S/ N	**Institution**	**Qualification Obtained**	**Date**
1.	Lead City University, Ibadan	Bachelor of Education in Physical and Health Education	2016
2.	Lead City University, Ibadan	Diploma in Physical and Health Education	2011

Working Experience:

Company		Role	Date
Teacher Service Commission	Teacher	2021	till Date
God's Blessing International School	Teacher	2018	till 2021

…….. ……

Signature **Date**

University Compliance Certification

This is to certify that this Thesis written by **Oluwasegun Abidemi, ADELEYE** with Matric No **LCU/PG/001204** in the Department of Kinesiology, Sports Science & Health Education, Faculty of Arts and Education, Lead City University, Ibadan is in full compliance with the approved University format and style.

…….
Signature

……..
Date