UNIVERSITY OF CAPE TOWN

Examining the Experiences of Smallholder farmers in Malawi towards Farm Input Subsidies

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This work has not been previously submitted in whole, or in part, for the award of any degree. It is my own work. Each significant contribution to, and quotation in, this dissertation from the work, or works of the other people has been attributed, and has been cited and referenced.

Signature: Henry Tambala **Date:** September, 2021

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List of Abbreviations and acronyms

Agricultural Development and Marketing Corporation- ADMARC
Alliance for a Green Revolution in Africa- AGRA
Biodiversity Action Plan -BAP
Climate Change -CC
Common Market for Eastern and Southern Africa Treaty- COMESA
Comprehensive African Agricultural Development Program – CAADP
Consultative Group for International Agricultural Research- CGIAR
Novel Coronavirus 2019 (- Covid-19)
Department for International Development- DfID
Department of Agriculture Research Services -DARS
Domestic Gross Product – GDP
El Niño Southern Oscillation (ENSO)
European Common Agricultural Policy- CAP
Fall Armyworm- FAW
FISP- Farm Input Subsidy Program
Food and Agriculture Organization -FAO
Genetically Modified Organism -GMO
Government of Malawi- GoM
Human Immunodeficiency Virus Acquired Immunodeficiency Syndrome- HIV/ AIDS
*Intergovernment*al Panel on Climate Change- IPCC
International Seed Testing Association -ISTA
Istanbul Programme of Action -IPoA
Malawi Growth Development Strategy- MGDS
National Seed Company of Malawi -NSCM
National Seed Policy -NSP
Open Pollinate Variety- OPV
Small Farmers Fertilizer Revolving Fund of Malawi -SFFRFM
Southern African Development Community -SADC
Southern African Development Community Regional Indicative Strategic Development Plan - SADC-RISDP
SPP – Starter Pack Program
Sustainable Development Goals -SDGs
Target Input Program- TIP
The New Partnership for Africa's Development -NEPAD
U.S Agency for International Development- USAID
UDF- United Democratic Front
UN-OCHA
United Kingdom Aid- UK AID
United Nations Office for the Coordination of Humanitarian Affairs
Vienna Programme of Action -VPoA)
World Bank -WB
World Food Programmed -WFP
World Health Organization -WHO

Preface

The author of this dissertation is the last born in their family. He was born and grew up in the rural area of the Blantyre district of the beloved country Malawi which is also popularly known as the warm heart of Africa for its friendly people. Our African belief states that one's strength is made manifest by the number of children. Like arrows in the pouch of a hunter, so are one's children. They will be able to defend him when his strength is gone in his old age. That led families to have many children even though there were not enough resources for their sustenance and upkeep.

Our community consists of agrarian community. When growing up, we prepared our fields between August and September in readiness for the next planting season. Afterward, we could eagerly wait to hear the heavenly voice of thunder and rumblings that announced the coming of the first rains marking the beginning of the new agricultural season. One could catch the distinct earthy flavor of the smell of rain from miles away when rain falls after a long dry spell of weather, and soon, everything would come alive. The land which had been dry, dusty, and barren would turn to beautiful fields covered in green vegetation. Birds could sing beautifully, and livestock could graze as they lazily chased away flies on their backs by the use of their tails. That was usually between October and November, and soon after planting our seeds which maize is a king of all crops, we could count days before enjoying the first fruits of our labors.

Those were days when rainfall patterns were predictable and the harvest sure. Close to our village, there was a river that flowed throughout the year. That was where we got water for all our domestic purposes. It was called the Ntengera River, and that means the river that carries all sorts of things. They say that water is life. This river brought all manner of life-giving resources for us. When it flooded during the rainy seasons, it could bring us all sorts of things such as sugarcane and other crops uprooted elsewhere from upstream. It also provided us with delicious *chambo* and other different varieties of fish.

At times, we could go fishing when *nsima* (mealie pap) was about to be cooked, and within a few minutes, we could come back home with a good catch of fish. Sometimes, we could put poisonous plants into the river to contaminate its waters. That could poison fish and make them grasp in need of fresh air, and in that way, we could easily catch them. It is in this river where we also learned how to swim and play water sports games.

When the harvesting period was over, we used to plant vegetables along this river for both home consumption and sale in the urban sector of Blantyre. We could apply pesticides such as Dichlorodiphenyltrichloroethane (DDT) to prevent pests from attacking our crops to enhance vegetable production. No one could pronounce this name in our village, and everybody opted for its abbreviation. The pesticide is a general name that refers to a wide range of other compounds aimed at promoting crop productivity and regulating other unwanted herbs, fungi, insects, rodents, molasses, and many other pests.

Ideally, the intention was to kill pests and leave the crops uncontaminated. However, with pesticides such as DDT, this has not always been the case. Such pesticides targeted other organisms such as insects and other invertebrates. Organisms such as insects and earthworms act as agents of cross-pollination and natural recyclers for the soil ecosystem. No wonder that some of our arable lands are no longer productive as they used to be. Even though the banning of DDT pesticides from using it happened as early as the 1960s in the developed world, most developing nations continued to use them due to a lack of alternatives. Eventually, these pesticides have found their way into the environment and human bodies with devastating impacts. Our late grandfather used to tell us that some chronic diseases affecting people nowadays were unheard of during their youthful days.

In search of more land for cultivation and better access to water sources, we used to cultivate close to the river banks, and sometimes we went as far as clearing off plants and vegetation that grew along the river banks. For us, there was nothing wrong with that. Everyone was doing it. Little did we know that with all these Anthropocene practices, we were squeezing the life out of our beloved river and fast-pacing it to dry up. The more we stripped off the dressing for that river, the more it became naked and thus vulnerable to direct tropical sunshine. Trees and vegetation are part of the water cycle and, without their presence, leave the water cycle with some gaps. This river that used to flow throughout the year has become a seasonal river with waters flowing through it only during the rainy season. Topsoil washed away from upstream has now filled up natural water reservoirs. That makes the rainwater rush through the Ntengera river on its way to the Shire River and then disappears into the mighty Zambezi river. The concentration of washed-up nutrients has not only helped to contaminate the water quality, but it has also raised fecal coliforms and other sediment loads that have promoted the damage of aquatic ecosystems.

Is this the sixth mass extinction after the fifth extinction of dinosaurs? Can environmental pollution be reversed? Can there be restoration or repair of the broken water cycle for that beloved Ntengera river and all other water bodies and the entire ecosystems? Can we travel

back to the future through our actions to make right what went wrong? What about the disrupted livelihoods of the rural communities now displaced from their original places of habitation in search of better livelihoods? The disruption of their rural economies was due to anthropogenic environmental changes of modern globalization practices?

This study is a story of those changes—stories of how the landscape and the environment have changed. These are stories of change that have ended up transforming non-human and humans in our community and our neighbours and their neighbours to a national, regional, and continental level. That is an ethnographic story of rural communities both for humans and non-humans. It is a story about the supremacy of human beings over nature and the ecological trap that humanity has set for itself and the entire ecosystem. It is a story of rural communities whose livelihoods have been disturbed by rich developed nations and how they continue to exploit local people and extract their only last resource and means of livelihood - subsistence farming through agricultural intensification and promotion of new technology.

CHALLENGES TO FOOD SECURITY IN SOUTHERN AFRICA AMIDST CLIMATE CHANGE-INDUCED HAZARDS

This research examines the experiences of smallholder farmers in Malawi of farm input subsidy programs amidst the effects of climate change, environmental degradation, food insecurity and poverty.

Climate change-induced disasters have become a regular global phenomenon, particularly over the last 50 years. A significant contributing factor to these disasters has been the El Niño Southern Oscillation (ENSO), a far-reaching inter-annual variable in the climate system (Christensen et al., 2013; Cai et al., 2014). ENSO causes considerable extreme global weather patterns and rainfall variabilities, influencing tropical cyclones, floods, droughts, firestorms, ecosystems, diseases and agricultural production (Wittenberg, 2009; Power et al., 2013; Cai et al., 2014).

In 2019, countries in east and southern Africa faced a disastrous climate crisis that brought floods, landslides, drought and cyclones, confronting over 33 million people with food insecurity and other social challenges of which over 16 million people were children (Save the Children, 2019). The crisis came in two phases in March and April of 2019. The first was Tropical Cyclone Idai, which landed near Beira in Mozambique and the eastern province of Zimbabwe (Chimanimani and Chipange districts) on 14 and 15 March, causing floods, mudslides, death and the destruction of livelihoods and properties. While people were still recovering from the devastation of Cyclone Idai, Tropical Cyclone Kenneth, one of the strongest cyclones ever experienced in southern Africa, hit Mozambique with calamitous consequences (UN Office for the Coordination of Humanitarian Affairs (UNOCHA), 2019). Tropical Cyclone Idai devastated Malawi, affecting nearly 870,000 people, claiming 60 lives and leaving almost 87,000 people homeless. The Malawian government declared a state of disaster for the multitudes in need of life-saving humanitarian help such as food, shelter, medication and clean water (UNOCHA, 2019).

Following these climatic disasters, the novel coronavirus (Covid-19) pandemic of 2020/2021 brought death to millions across the globe. As the devastating effects of Covid-19 took their toll,

lockdown measures and travel restrictions resulted in a loss of earnings and jobs, limited income distribution, decreased remittances for migrants, limited access to healthcare and contributed to food insecurity in many households.

Tropical Cyclone Eloise then made landfall at Beira and surrounding areas on 23 January 2021, displacing almost 7,000 people and destroying more than 5,000 houses (OCHA, 2021). Other inland regions affected by this cyclone included eastern Botswana, southern Zimbabwe and South Africa.

1. AFRICA'S 'ANTHROPOCENE'

Weather patterns that formed in Anthropocene conditions have pushed global warming above 2°C, causing more unpredictable weather patterns with profound socio-economic ramifications (Power et al., 2013; Pearce et al., 2014; Steffen et al., 2015). The idea of the 'Anthropocene' was introduced by atmospheric chemist Paul Crutzen and ecologist Eugine Stoermer in 2000 and refers to the effects of *anthropos*, meaning human, on planetary systems to such an extent that changes are evident in the planet's geology (Crutzen & Stoermer, 2000; Crutzen, 2006; Biermann et al., 2016). The Anthropocene covers a wide range of circumstances and has implications for both humans and non-humans, including chemical, physical and biological planetary shifts, far reaching changes to the systems and natural processes of the planet and more (Crutzen, 2002; Zalasiewicz et al., 2010).

Recently, social scientists and humanists have used the concept of the Anthropocene to investigate developing human–environment relationships that have negatively affected the planet's natural cycles (Biermann 2014; Galaz, 2014). Contributing factors to these human influences on atmospheric configurations include energy consumption, urbanisation and changes in land use (Karl & Trenberth, 2003). These climatic disasters are likely to continue long into the future, and it is doubtful whether many developing countries will be able to meet challenges brought about by climate change impacts considering that most of them depend on rain-fed agriculture for their food production and livelihoods.

In sub-Saharan Africa, most East and southern African nations will be heavily affected by the increased frequency of the ENSO, which will cause rainfall variabilities that negatively affect agricultural production (Gaughan & Waylen, 2012; Gaughan et al., 2016). Most smallholder farmers who depend on rain-fed agriculture will be heavily impacted in several ways, especially in

areas of food security, due to poor agricultural yields, loss of livestock, high food prices, increasing economic vulnerabilities and other socio-economic difficulties.

Malawi is one of the sub-Saharan African countries whose economy is dependent on agriculture, and climate-related natural disasters have adversely impacted it. In 2015, Malawi experienced heavy rains and floods that affected more than 1.1 million people, destroying everything along the way, especially in the Chikwawa, Nsanje and Phalombe districts of the country's southern region. The flood caused deaths, damage to houses and infrastructure, washed away crops and displaced people and property, according to Relief-Web (2015), which provides an information and advisory service to humanitarian aid agencies. These floods, they advised, were among the worst ten natural disasters to take place in Malawi in the 115 years between 1900 and 2015. These natural disasters, coupled with a general loss of soil fertility, have contributed to food insecurities and other socio economic challenges for many rural Malawians who depend on subsistence agriculture.

2. OVERVIEW: FARM INPUT SUBSIDIES IN MALAWI

The Malawian government introduced the Universal Farm Input Subsidy Program to help rural communities endure poverty and chronic food insecurities, but this was stopped in the mid-1990s. Subsidies returned under the Starter Pack Program (SPP) in the 1998/99 agricultural season, the main objective being to provide smallholder farmers with free fertilizer and seeds. This country Wide farm input subsidy program was funded by the organization UK aid (Denning et al., 2009; Chinsinga, 2012: Nkhoma, 2018) and targeted 2.8 million rural smallholder farmers, supplying them with enough fertilizer and maize seeds for 0.5 hectares (Minot & Benson, 2009; Pauw & Thurlow, 2014).

Following the low agricultural yields of the previous agricultural year (1997/98) mostly due to a general loss of soil fertility, the Malawi Maize Productivity Task Force found a general failure of soil fertility in the country, providing sufficient context for the introduction of the SPP (Nkhoma, 2018). Chinsinga and Poulton (2014) note that SPP was also used as a political campaign tool by the ruling United Democratic Front party in the 1999 presidential and parliamentary elections.

While the stated objective of the SPP was to help smallholder farmers boost their agricultural production, the funders and private sector may have been motivated by other factors. Through the state-owned Smallholder Farmers Fertilizer Revolving Fund of Malawi (SFFRFM), the Malawian government imported and stockpiled chemical fertilizer during the Mozambican civil war from

1977-1992. Being a landlocked country, Malawi was dependent on the Mozambican port of Beira for its imports and exports and was concerned it would be unable to continue importing and exporting goods (Christie, 2011). This fertilizer stockpile hindered the growth of the private sector, as private stakeholders feared the release of the stock would impact fertilizer prices. This led to an agreement between the Malawian government and the private sector whereby the donors subsidized the project costs and the government released its stockpiled fertilizer. There are thus some doubts about whether the donors and private sector were motivated by a desire to improve the socio-economic life of small-scale farmers or were more interested in clearing the government's fertilizer stockpile (Christie, 20 October 2011).

More recently, the involvement of the Gates Foundation-funded Alliance for a Green Revolution in Africa (AGRA) is of interest. AGRA commissioned a thorough diagnostic evaluation in 2016 to find out what the subsidy program had achieved in the decade since its introduction (2005– 2015). AGRA collaborates with partners such as the World Bank, the UK's Department for International Development, the US Agency for International Development (USAID), the European Union and others, and their expert recommendation was that Malawi's Farm Input Subsidy Program (FISP) is an African Green Revolution success story to be copied and implemented in Rwanda, Zambia, Tanzania and other African countries (AGRA, 2017).

This study further recommended that the private sector should run the program for efficiency reasons, because in its assessment, the government's parastatals (SFFRFM and the Agricultural Development and Marketing Corporation (ADMARC)) were unable to deliver the required services for logistical reasons.

The Target Input Program (TIP) took the place of the SPP in the 2000/01 and 2002/03 seasons but followed the SPP strategy, only scaling down from the SPP's initial target from 2.8 to 2 million beneficiaries targeting the poorest of the poor (Nkhoma, 2018). The scaling down led to poor crop yields on a national and domestic level. The scaling down was because the Starter Pack Program was a social protection program promoting quick food production. Therefore, TIP was scaled-down as other interventions under the Malawi National Safety Net Strategy introduced (Nkhoma, 2018). Worse still, the 2004/05 agricultural year yielded 24% less in the crop harvest than the 2003/04 season – some 40% less than its long-term target (Nkhoma, 2018). The Starter Pack Program and the Target Input Program made way for the Farm Input Subsidy Program (FISP) in the 2005/06 Malawian planting season, the same year in which the Gates Foundation founded AGRA.

The 2008 food crisis led to a global rise in food prices and instigated food catastrophes in more than 20 developing countries. The cost of some cereals, such as maize and rice, almost tripled. Food prices skyrocketed on the back of the food crisis and an increase in soybeans imports by China to boost their pork production (due to high demand among its rising middle-class). This price hike led to an increase in global hunger to almost one billion people (Wise & Murphy, 2012).

Another hike in global food prices occurred in 2010/11, making clear that contemporary international agriculture policies and strategies to ensure food security had significant shortcomings and were in urgent need of reconsideration (Wise & Murphy, 2012). Developing countries felt the impact of these food price spikes most, because they became significant food importers following the advice of the World Bank and the International Monetary Fund, who suggested that they should focus on cash crop production and use the money from crop sales to buy food from developed countries (Christie, 2011).

Many developing countries targeted food production among smallholder farmers as their number one priority as a result of the 2008 food crisis. African governments formed the Comprehensive African Agricultural Development Program (CAADP), where member states vowed to spend at least 10 percent of each individual country's GDP for food production. Prior to this CAADP decision, the issue of how African states could increase crop productivity was on the agenda of the Abuja Declaration in Nigeria in 2006, where African leaders agreed that increasing the use of chemical fertilizers among smallholder farmers was the only way to deal with recurring food insecurity. They proposed three strategic elements: accessibility, affordability and the inducement of farm inputs (Sanginga, 2010).

This prompted donor countries and investors to capitalize by advocating that developing countries grow their food whereby donors and investors would provide the necessary inputs to boost agricultural productivity. With the backing of global institutions, AGRA took advantage of this food crisis to offer profit-making solutions to African governments, in what may be described as "disaster capitalism". According to Germain (2021), disaster capitalism happens when private interests descend on a particular region as a result of major upsetting occurrences, such as government disorganization, war, and natural phenomena. In such circumstances, disaster capitalists see such events as opportunities for them to expand and grow their business.

As a result, one of the proposed solutions was the use of high-yielding, drought-resistant seed varieties and synthetic fertilizers among smallholder farmers. Such a proposal would not only

create a dependency on economic support from the donor community but also soil dependency on chemical fertilizers for crop cultivation (Wise, 2020). For easy market accessibility, these investors asked African governments to reform their markets to allow multi-national corporations to operate efficiently without restrictive trade policies.

AGRA was rolled out in 18 African countries, including Malawi, offering financial and technical support to promote economic growth through improved agricultural productivity among small scale growers. In Malawi and other African countries, this support manifests as farm input subsidy programs. The farm subsidy program in Malawi has evolved over the years, distributing 2–3 kg in 2005/06, 5–10 kg in the 2009/10 planting season and giving out two 50-kg bags of fertilizer and 10 kg of hybrid seeds to smallholder farmers thereafter (Arndt et al., 2016).

However, ongoing use of synthetic fertilizers creates soil acidification, which can slow down the soil's capacity to release its nutrients to crops. Acidification and loss of topsoil in Malawi occur at 20 tons/ha/year negatively impacting smallholder farmers and the national agro-based economy. To understand the on-the-ground consequences of well-intentioned agricultural policies that have had harmful effects on small-scale food growers, it is critical that the effects of the FISP are investigated and that smallholder farmers are listened to.

This thesis explores the experiences of Malawian smallholder farmers and the farm input subsidy programs as they face climate change-induced challenges, environmental degradation and global economic transformation. The goal of the study is to call for targeted actions based on research among local farmers in the Chileka region in Blantyre, Malawi, situating their challenges in comprehensive social and ecological changes and, because most farmers are women, exploring the gendered effects of farm policies.

3. RESEARCH QUESTION

This dissertation asks: How did Malawi smallholder farmers experience the farm input subsidy programs (FISP)? Within this broad framework, the study describes smallholder farmers' experiences of soil changes caused by the ongoing use of chemical fertilizers and pesticides including insecticides, fungicides, herbicides, fumigants, nematicides, acaricides and rodenticides (Soko, 2018) which many small-scale farmers use pesticides bought at government subsidiaries, agro-based dealers and local retail shops for crops like tobacco, tea, sugarcane, coffee, cotton, maize, legumes and vegetables.

The study further describes farmers' experiences of using genetically modified seeds distributed by the Malawian government in terms of seed usability for the next growing season, and the impacts of the above on food security and food sovereignty, and on other species in the local ecosystem, including soil fauna, birds, fish, rodents, butterflies and others, and in respect of pest outbreaks like fall armyworm (FAW) or locusts.

Of particular interest is to document what farmers say about the effects of climate change, and the ways in which the consequent vulnerabilities are gendered, affecting women in particular. Do women face problems in Malawi as a consequence of climate change?

Existing studies into FISP in Malawi have looked at the short-term impact of fertilizers and hybrid seeds without examining the long-term environmental aspects of the soil and the ecosystem and the traditional seed-sharing system.

Accordingly, this dissertation considers resource-poor smallholder farmers who cultivate fields of not more than one hectare and considers female-headed smallholder farmers as part of the demographic for this study. Consideration was also given to subsistence growers facing environmental degradation. This scope facilitated what literature to review and what methodical data to search for to answer the main research question and its sub-theme questions.

This study took place in the Chileka area of the Blantyre district in Malawi because I was born and raised in the area and speaks the local language (Chichewa) and is familiar with the daily challenges smallholder farmers face due to climate change and environmental degradation.

Secondly, the wide publicity received by the FISP in Malawi, in Africa and in the rest of the world has led to substantial literature and data on this topic, facilitating desk-top research before going into the field for data collection and first-hand information from smallholder farmers.

Finally, agriculture is the backbone of Malawi's wealth, supplying almost 28% of the GDP that comes from 80% of foreign trade income for the nation (Malawi, 2017). Almost 80% of the population live in rural areas, where subsistence farming is an effective means of earning a livelihood.

Nonetheless, like other countries globally and specifically in the Southern African Development Community (SADC), Malawi has been experiencing the ongoing effects of climate change, such

as floods and droughts, threatening the livelihood of its population. Most of these climate change induced effects are a consequence of capitalism's progress in the twenty-first century, including mechanization, the use of knowledge for economic gain and other related technological changes that install a method of generalized proletarianisation (Stiegler, 2018). It is thus essential to rethink how to provide for the needs of the masses without extracting resources to the detriment of future generations.

Most policies made to help the poor are more focused on how best to extract natural resources for economic gain, primarily from where these poor people live. Stiegler (2018) argues that this is usually achieved by dissolving local knowledge, which has led to current planetary climatic and environmental degradation. Stiegler (2018) refers to these forms of capitalist economic practice as the neganthropocene and calls for humanity to rise above this entropic situation.

This study therefore aims to understand how best to determine alternative modes of adapting to the Anthropocene and how to address current crises with better human-earth relations, particularly in the context of smallholder farming in Malawi rural communities.

4. OVERVIEW OF MALAWI AND THE STUDY AREA

Malawi is a landlocked country covering a geographical area of 118,484 km². It has an estimated population of 19,701,959 (as of August 2021). It borders Tanzania in the north, Zambia in the west and Mozambique in the south and east. Agriculture is the mainstay of the country's economy and contributes to almost a third of the gross domestic product (Malawi, 2017).

Top foreign exchange-earner crops include tobacco (popularly known as green gold), tea, coffee, sugar and cotton. Malawi is very vulnerable to climate change shocks such as droughts and floods and degenerating natural resources, because it depends on agriculture for its economy and lacks diversity in non-agricultural areas such as tourism, mining and industry, as a result of incapacitated energy supply, poor infrastructural development and other organisational failures (Malawi, 2017).

Malawi is currently in its third medium-term strategy, drafted to contribute to its overall expansion plans. The Malawi Growth and Development Strategy (MGDS) implemented in 2017 is a five year development plan that succeeded the long-term strategies of 2006 and 2011. The key objective of this development strategy is to build a productive and competitive Malawi nation while remaining resilient to other socio-economic climate change-induced challenges and environmental problems. However, most of the MGDS III objectives were interrupted in 2020 by the Covid-19 pandemic.

The adverse impact of the pandemic on the socio-economic conditions of Malawi, especially among the poor and the vulnerable, is still uncertain, as the crisis is ongoing at the time of this study. However, its impact will heavily affect the economy in the last quarter of 2021 and beyond (Josephson et al., 2020).

Malawi has three clear regions: northern, central and southern regions. The study area for this research was a community in the Chileka area in the Blantyre rural district in southern Malawi. Data collection took place between the months of October 2019 and April 2021. The geographical location for the Chileka area is 16 km from Blantyre city and lies at 15° 27' 46 south, 34° 55' 29 east.

Generally, the country of Malawi has a tropical climate (subtropical in high altitudes), with a hot and rainy planting season from late November to April. Temperatures may rise to higher levels before the commencement of the rainy season. In most parts of the country, annual precipitation ranges between 800 to 1,300 mm.

Table 1: Climate information for Blantyre, Malawi from 1950 to the present

Data source: Meteo Climat and the National Oceanic and Atmospheric Administration (NOAA)

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Max. temp. °C	36.7	37.4	38.3	33.8	33.7	31.7	38.0	33.3	38.6	39.5	39.5	36.5
Ave. max. temp. °C	28.4	28.3	27.8	27.2	25.9	24.1	23.9	26.1	29.2	31.3	30.7	29.2
Avg. low temp. °C	20.1	19.9	19.3	17.9	16.6	13.6	13.3	14.4	17.1	19.5	20.3	20.2
Daily mean temp. °C	25.3	23.4	23.2	22.2	20.3	18.5	18.4	20.0	23.1	25.0	24.0	22.2
Ave. precipitation mm	198.0	181.4	152.0	45.9	9.9	2.1	2.4	1.2	3.5	29.2	93.0	178.0

The Chileka area was chosen for this study because it is one of the rural livelihood areas along the upper Shire Highlands affected by droughts. This study area falls under the traditional authority of Paramount Chief Kuntaja and has an estimated population of 84,765, of which 48.47% are male and the remaining 51.53% are female (Malawi National Statistics, 2019). Paramount Chief Kuntaja

oversees 66 villages, with almost 85% of those households dependent on subsistence farming, cultivating land around 0.85 ha per household. Maize is the main staple food crop, and other cash crops include tobacco and paprika. These rural communities also have domestic livestock such as cattle, goats, pigeons and chickens. Deforestation is widespread in the area as a result of charcoal making for sale and domestic use, while land and soil degradation are also rampant due to poor land management practices that have contributed to the loss of soil fertility.

Palmer et al. (2009) defined governance as control of economic, political, and other administrative rules in overseeing a nation's affairs at all levels. The World Bank defines the word governance as way organizations and government administrators get and exercise control to formulate public policy and render public services and goods. On the other hand, land governance is a pattern in which property rights to land (whether to individuals or communities) are defined, exchanged, and transformed. It is a system of public oversight on land use, land management, and tax utilization; which land ownership by the state; the way of acquiring, managing, and disposing of land; the quality and nature of land ownership information accessible to the public and the mode it can be accessed or modified; and how the management of discourse and discords are controlled (World Bank, 2012). Therefore, land governance is crucial towards achieving equitable land access and tenure security. Others have further defined land management to include a component that informs land reform efforts, such as policy design and legislative processes (Palmer et al., 2009).

Malawi has not developed a comprehensive land policy since it became an independent state in 1964, retaining the colonial rural settlement structure under which white commercial farmers got preferred access to productive agricultural lands (Relief-Web, 2006) – the difference now being that black politicians and networks of elites have taken over the farming of lands previously owned by the white settlers. As a result, smallholder farmers easily encroach freehold lands while looking for more land to cultivate crops, and encroachment has led to the deforestation of large areas of land, leaving them bare and vulnerable to additional harsh environmental conditions. This irresponsible land governance of productive land by the black majority has made it difficult to maintain an internally coherent and well-organized land policy framework to control land issues and usage problems, particularly in rural areas (Palmer et al., 2009; Daulos et al., 2010).

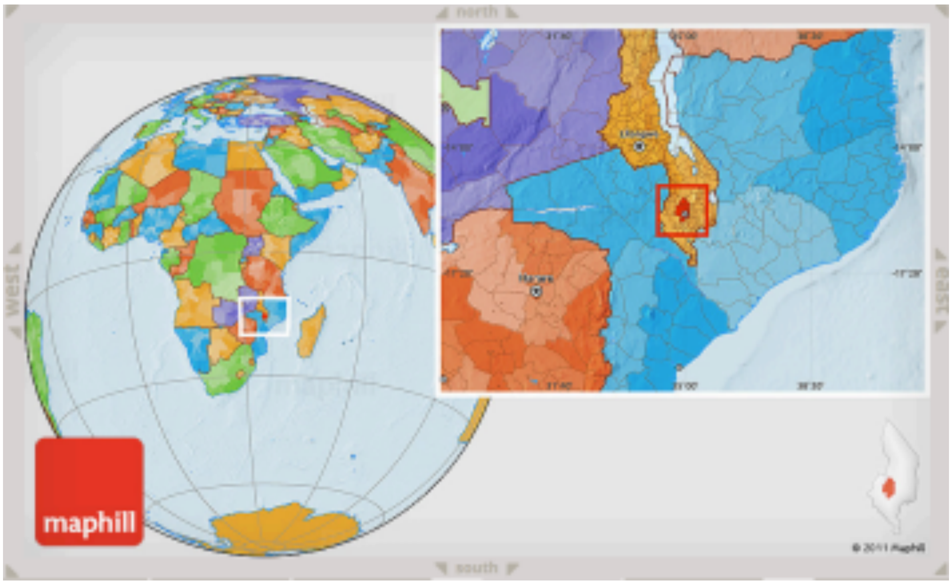
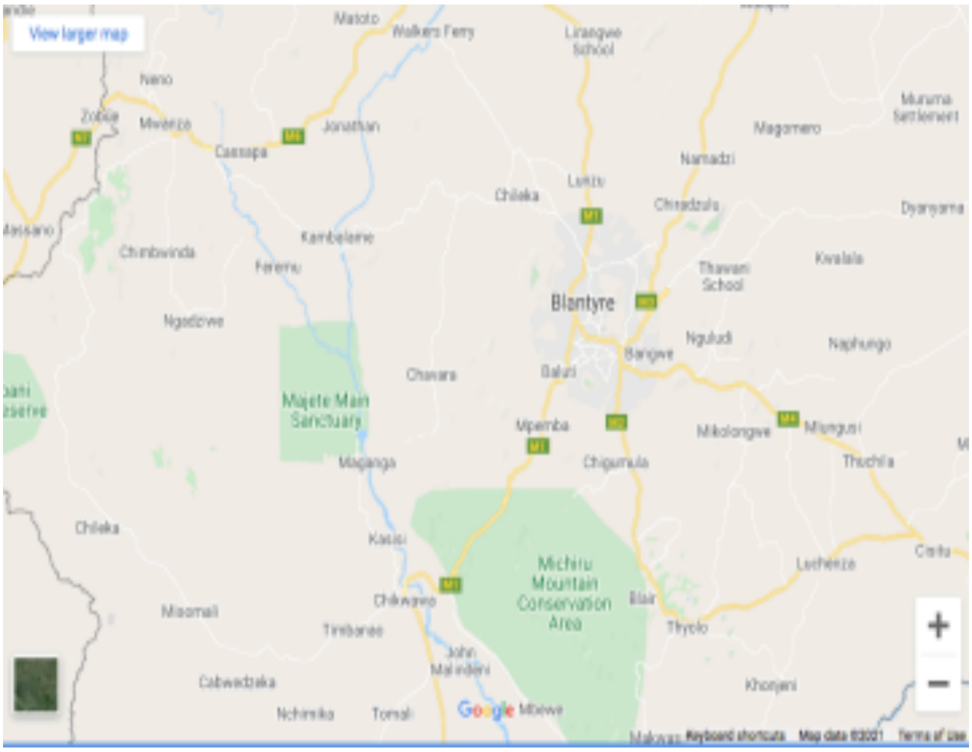


Figure 1:Map of Africa showing Malawi and the Blantyre district

(SOURCE: MAPHILL)



Map of the study area

Figure 2: Datailed map of Blantyre District and the Chileka area

(Source: Google maps).

5. METHODOLOGY

Data collection for this dissertation used two approaches, namely methodological triangulation and

an ethnographic approach. Both methods were used to strengthen the study findings and interpretations. For the triangulation, I used historical satellite imagery of the study area over the 15 years from the introduction of the Farm Input Subsidy Program in Malawi in the 2005/06 planting season, as well as noting what people on the ground said about the loss of ground cover that has led to soil erosion and soil desiccation. The satellite images showed substantial change and loss of ground cover over the years. A detailed description of the method of analysis is included with that material in chapter 2.

For the ethnographic approach, I borrowed from Donna Haraway's *Staying with the Trouble* (2016), in which she points out that it matters what stories we tell. This study seeks a way to narrate stories of climate change and environmental degradation and stewardship, food security and food sovereignty with other stories – stories told by the research participants in this study that describe how people make lives together with nature and that show that humans and non-humans are inseparably joined in many tentacular ways (Haraway, 2016).

The stories people tell on the ground, in Chileka, assist to explain and triangulate the data that emerges from the satellite images.

Most solutions proposed and implemented to deal with the challenges of food security in developing countries have come from heroic stories of the privileged signifier of what Haraway calls Capitalocene globalization (Haraway, 2016). Such approaches are self-making and do not draw on local community practices or understanding of their natural environment. Capitalist approaches generally do not consult or consider the narratives of local communities that reinforce ecological response-ability. As a result of this separation, humanity has engaged in the ongoing environmental unreliability that is economically beneficial but environmentally ruinous.

This research uses an ethnographic approach to determine what kind of sociality comes from communities that make their lives together. This is to understand what stories local communities tell about their way of cultivating crops, their understanding of climate change and their takes on environmental degradation, as well as the techno-fixes that the government and other role players have undertaken in the form of farm input subsidies to deal with the challenges of food insecurities. I wanted to learn what thoughts these communities think to make their lives together. Describing this thinking process in Frantz Fanon's situated thinking, Achille Mbembe (2017) called it metamorphic thought. It is born only of lived experiences and is progressive, unstable and

continuously transforming. According to Friere (1985), learning is not just a matter of transferring knowledge from teacher to student but is a procedure whereby knowledge is assembled or developed from the one with lived experiential knowledge.

I sought this information from the research participants to hear what their experiences are on hybrid maize seeds, impacts of chemical fertilizers on the soil and the environment and loss of biodiversity. For instance, there are different categories of maize seeds in Malawi, such as Malawi Hybrid (MH) 12, 15, 32 and many other new varieties. Hybridisers believe these seed varieties are drought-resistant, high-yielding and physiologically early-maturing crops (i.e., between 135 and 148 days after planting). However, corn from hybrid seeds is softer than corn from the seeds local communities have been cultivating for generations, and this softness makes the hybrid maize more susceptible to moisture and rot before harvesting.

6. SURVEY SAMPLE CHOICE

At the beginning of this research in 2019, I organized a community forum discussion group and asked if they would form part of the focus group, the primary source for data collection for this dissertation. The initial plan was to compare fields using farm input subsidies over a decade (2005/06–2019/20) and non-input subsidy fields to examine the differences between these fields. I chose the fields that depended on subsidized artificial fertilizers and certified /hybrid seeds.

The age group of the participants was between 35 and 75 years of age. The sample selection and stratification criteria were as follows: the first criterion was to choose participants that were the beneficiaries of FISP, 30 in total – 15 men and 15 women. Ten of the 15 women were widowed, divorced or elderly and managed their households. Of the 30 beneficiaries overall, ten were smallholder farmers dependent on farm subsidies (chemical fertilizers and hybrid seeds), while another ten did not use the input subsidies because they did not qualify for the input subsidies or their names did not appear on the final list before receiving the subsidy coupons. A few were farmers who were very sceptical about whether the government would continue FISP or not and thus did not want to commit themselves to subsidies and contaminate their fields with external farm inputs. These farmers continued to use traditional ecological farming methods and local seeds. The remaining ten participants straddled both methods, because the government input Subsidies are not enough for farmers with large farmlands, and they need to supplement the remaining number of seeds with commercial or locally available traditional maize seeds,

7. DATA COLLECTION

Data for this study were collected through informal interviews with respected key agrarian community members, families and individuals. Focus group discussions and collective community member gatherings were also instrumental in data collection for this dissertation. The benefit of focus group discussions is that participants contribute more in discussions than in individual interviews.

Informal interviews and participant observation of everyday life in agrarian communities were also used, and Google Earth satellite imagery was used to verify changes in landscape over the years, such as loss of groundcover.

Conducting data collection for this study had its limitations, foremost among them being the novel coronavirus (Covid-19) pandemic and attendant travel lockdown restrictions. These challenges made it difficult for me to travel to the study area as initially planned to conduct an ethnographic study and informal interviews with the chosen participants. That affected my participant observations because I could not be there physically to observe and get the unspoken (unintended) responses from the selected participants.

In the face of this drawback, I adopted an alternative approach. As arrangements for interviews had been made with participants before the Covid-19 pandemic, I employed Andrew Mlauzi as a research assistant. With the help of community leaders, Andrew was responsible for bringing the participants together at a community center for community forum discussions. I conducted the interviews telephonically using voice note messaging via WhatsApp technology. The next step was to conduct interviews with selected key informants. During this data collection process, another enabling factor was that I was born and grew up in the study area. This place-based relationality was beneficial for my collection of the data required for this dissertation, because the community knew of the study and understood my intentions. All those I contacted were more than happy to assist and offer the information needed.

The selection criterion considered was an age group of men and women aged between 35–75 years, because I was explicitly looking for people who had used the subsidies for at least ten years or more since the inception of the FISP in 2005/06. I also looked for older people who might have noted the impact of climate change over the years. Most participants had never been to school or had spent very few years in formal schooling.

The selection criteria for the key informants for this study was chosen based on their outstanding work as smallholder farmers and their leadership characters in the community.

The selection criteria did not include young people below the age of 25, because that age group was considered to still be part of their household and not individually cultivating crops. Another reason is that most young people prefer not to farm and choose to work in the urban sector instead. This selection criterion was the same for the Focus Group Discussions (FGD). This is because I wanted to hear in detail what key informant individuals would have forgotten during individual interviews with some of the prominent members of the community. The FGDs selection criteria was almost similar to key participants selection criteria because most of those selected also formed part of the key informants. The reason for this similarity was that I wanted to find out if what the key informants said was in agreement to what the FGDs participants also talked about. What I noted is that both groups raised the same issues of their lived experiences of the farm input subsidies. This approach also helped the FGDs participants to talk about some of the issues that they could not remember when they were interviewed individually.

8. CHAPTER OVERVIEW

This study develops in a series of chapters as follows:

Chapter One offers an overview of current regional conversations in sub-Saharan Africa and reviews the concept of agricultural commercialisation in African countries. The chapter has the following sub-themes: agricultural intensification; the capitalist practice of resource extraction; the industrial model of agriculture and its negative consequences; and food security and food sovereignty. It also reviews alternatives to ecological and social injustices.

Chapter Two discusses and analyses the satellite imagery to examine how the landscape has changed since the implementation of farm input subsidies in the 2005/06 planting season.

Chapter Three offers a review of climate change and agriculture in Malawi. Sub-themes for this chapter are FISP and issues raised by farmers in relation to it. This chapter is the heart of this dissertation and offers a detailed account of the experiences of smallholder farmers with regard to farm input subsidies, climate change-induced challenges and environmental degradation. This chapter also presents critical environmental challenges faced by women farmers in Malawi and specifically discusses the difficulties faced by agrarian women in Malawi during the 2015 and 2019

floods. Furthermore, this chapter also discusses issues of soil desiccation and the loss of biodiversity before interpreting the implications of the research findings and drawing the conclusion of the dissertation.

CHAPTER ONE

AN OVERVIEW OF THE CURRENT REGIONAL CONVERSATIONS

All progress in capitalistic agriculture is a progress in the art, not only of robbing the labourer but of robbing the soil; all progress in increasing the fertility of the soil for a given time is a progress towards ruining the lasting sources of that fertility.

Marx, Karl. ([1867], 1976: 637-8). *Capital* (vol.1). London: Penguin.

1. INTRODUCTION

Given the food insecurity challenges faced by smallholder farmers in the developing world caused by climate change-induced challenges and environmental degradation, it is worth considering what alternative approaches exist to tackle this recurring food shortage problem. Does the continent need 'outside expert' approaches and policies formulated primarily by international experts that are 'imposed' upon African leaders for recognition and endorsement? Such 'solutions' appear heroic because in the short term they improve food production, but they are rooted in what Donna Haraway (2016) describes, following Jason Moore, as the Capitalocene, focused on extracting and commercializing natural resources for profit in order to benefit corporations based in the developed world without considering the negative socio-economic and ecological impact these approaches may have on the environment.

This chapter aims at achieving four main objectives. Firstly, it presents a historical overview of the theory and practice of farm input subsidies in Malawi and sub-Saharan Africa. Secondly, it questions the agricultural intensification approaches promoted by international organizations and corporate food foundations, showing that these proposals and neoliberal economic policies increase rather than end hunger and poverty and take advantage of the global food crisis, particularly in developing countries. Thirdly, it traces the historical background of hybrid and chemical fertilizers in Africa and other parts of the globe and shows how some proposed solutions exacerbate socio-economic problems rather than solving them. Finally, this chapter discusses the impact of hybrid seeds on food sovereignty and food security, and it concludes by suggesting alternatives for achieving both food security and food sovereignty without destroying the environment for future generations.

2. MALAWI'S SUBSIDY PROGRAM

Farm input subsidy programs in most African states go back to the 1960s, when many African nations gained independence from their colonial rulers. Farm subsidies were regarded as the foundation for economic prosperity and social development (Johnston & Mellor, 1961; Shultz, 1964 Johnston & Kilby,1975; Chirwa & Dorward, 2013), and many African governments assumed that once small-scale farmers benefited from these subsidized farm inputs, government could withdraw funding and farmers would buy the inputs on their own (Chirwa & Dorward, 2013). African countries were also encouraged to adopt this new set of farming techniques to produce high crop yields (World Bank, 2007; Morris et al., 2007).

African governments promoted the use of fertilizer through fertilizer subsidies, structural changes for access and distribution of fertilizer among smallholder farmers, government-led credit programs and control of output markets (Glenn et al. 2009; Minot & Benson 2009). Subsidized farm inputs were deployed on a universal, country-wide basis and were easily accessible to all people, especially smallholder farmers. In the early 1980s, global financial institutions (such as the World Bank and the IMF) advised African governments to discontinue input programs, because they were dependent on donor funding and could not be sustained. This decision, based on economic reasons, failed to take into account that soils had been changed.

Several countries in sub-Saharan Africa have reinstated subsidy programs, including Kenya, Ghana, Zambia, Nigeria, Tanzania, Mali, Burkina Faso, Senegal, Ghana, Ethiopia, Rwanda and Zimbabwe (Byerlee & Eicher, 1997; Dorward, 2009; Chirwa & Dorward, 2013).

The Malawian government introduced the farm input subsidy program as the Starter Pack Program (SPP) in 1998/99 to provide small-scale farmers with hybrid maize seeds (2 kg), artificial fertilizers (15 kg) and legume seeds (1 kg) (Holden & Lunduka, 2013), enough for a 0.5 hectare of land (Pauw & Thurlow, 2014), but the program was discontinued the following planting season. However, the 2000 famine prompted the government to bring back the subsidy program in the 2001/02 planting season. The subsidy program changed its name and the quantity and nature of fertilizer (kgs) and seeds distributed to smallholder farmers and their beneficiaries, and it became the Farm Input Subsidy Program (FISP) in the 2005/06 planting season.

FISP's goal is to boost agricultural production at both a household and national food security level, and its chief objectives were to increase staple food production, assist household food security and invigorate rural economies (Lunduka et al., 2013).

According to Lunduka et al. (2013), an evaluation of FISP shows that it has increased maize production and has had what economists term 'multiplier effects' by reducing the maize price. However, official reports by the Malawian government also show that the subsidy program has led more smallholder farmers to use chemical fertilizers and hybrid seeds for their crop cultivation (Doward & Chirwa 2011; Chirwa and Doward, 2013).

Depending on the rains during the growing season, farm subsidies have led to high crop yields, improving food security in most households across the country (Dorward & Chirwa, 2011; Lunduka et al., 2013), but maize prices have also steadily increased since the program's reintroduction in 2001/02, indicating that crop production estimates are inconsistent with maize price behaviour.

3. INTENSIFICATION OF AGRICULTURE: FOR WHOM AND BY WHOM?

There has recently been unrivalled interest among different international role players in improving food security and alleviating poverty on the African continent. It is hoped that such improvements will help to consolidate Africa into the global market. Such enthusiasm corresponds with the 2008 global food crisis that devastated poor communities in developing countries (FAO, 2011).

That food crisis however was less due to a global lack of food commodities and more due to increased food prices (Brown, 2011). Addressing the challenges of global hunger requires more than simply growing food; it also requires an end to entrenched historical hierarchies of power. More food is available now than when the food crisis occurred in 2008, yet many people still face crippling food insecurity (Patel, 2021) because they lack the resources to access food in the control of the food regimes, which took advantage of 2008's high food cost prices and inconsistencies in the global market. Significant role players in the food regime include global government ministries that deal with food administration, agri-food monopolies, international organizations, think-tanks, land grant institutions and big charity organizations like the Rockefeller Foundation and the Gates Foundation that facilitate conferences, communications and technologies and implement regulations (Holt-Giménez & Altieri, 2013). These regimes and other key actors have campaigned for food production to increase to almost 70% by 2050 (FAO, 2011).

Capitalist thinking offers different stories of solutions to global challenges. Quite often, it addresses challenges by expanding its empire, perceiving any uncultivated lands or forested areas as empty land to be exploited for maximum benefit or to be used for 'developmental projects', improvising ways that will not necessarily bring the required solution but will exacerbate the situation to the advantage of those who came up with the solution. 'Empty' areas are sometimes used as dumping sites for toxic substances, for example.

Currently, the whole globe is groaning under the harmful consequences of such for-profit problem solving, evident in waterbody acidification, increasing sea levels, increased desertification, animal and plant species extinctions and more. Capitalist thinking asserts that Africa should produce more to feed its growing population, and with over 70% of the population dependent on smallholder farming (Biteye, 2016), the intensification of agricultural productivity is seen as a solution to deliver people out of poverty.

Campaigners promoting narratives that commercialize African farming argue that irrigation, agrochemicals, drought-resistant hybrid seeds and synthetic fertilizers, credit provision and cash crop cultivation by smallholder farmers is the way forward. They contend that this will transform agriculture, increase productivity, strengthen business models and eventually promote rural development (Thompson, 2012; Boateng, 2017).

In *Vital Decomposition*, Kristina Lyons (2020) refers to the mode of industrial farming that relies on chemical inputs and patented hybrid seeds as the agriculture of death, because it extracts resources, destroys rural economies and chokes out indigenous smallholder sustainable farming practices by denouncing them as backward and low-yielding. The agriculture of death slowly poisons the masses in developing nations through toxic farming practices and by taking away their livelihoods – the agriculture of death kills with literal poisoning and negative socio-economic impacts, as resource-poor farmers must buy hybrid seeds and other inputs every planting season. Farmers get such inputs from credit schemes, while others borrow money to buy farm inputs. Of course, some farmers cannot pay the money back and end up in prison or commit suicide.
Vandana Shiva (2013) likens hybrid seeds to 'seeds of suicide and slavery' and traditional seed varieties in use for generations in different parts of the world as 'seeds of life and freedom'. Other writers, such as Henry Salgado Ruiz (2012), describe the industrial model of agriculture as agrarian necropolitics, arguing that this is a form of spontaneous colonization that often hides the ongoing processes of prohibition and dispossession of rural communities that prevent them from fully

participating in the socio-economic and political arena due to their lack of resources. This spontaneous colonization is enabled by the industrial model of farming that offers excellent funding support from external nations and organizations and denounces the traditional farming methods that indigenous communities have practiced for centuries.

Necropolitics is the calculation behind who should live and who should die (Verghese, 2021). Necro, rooted in the Greek word nekros, means corpse. Therefore, necropolitics construes the politics of death (Verghese, 2021). Achille Mbembe (2019) defined necropolitics as the capacity to decide who matters and who does not, who is disposable and who is not. It is a yardstick used by the rich and those in power to assign differential values to human lives. The closer you are to those in power, the more likely your life is valuable. It is a sort of 'collateral damage' suggesting that some people's lives are not that valuable, and as such, they should die for others to live a better life. It also implies that those meant for the collateral damage cannot make their own decisions on how they should live; as such, decisions are made for them dictating what they should do and what they should not do. Such 'decisions' are made for them in the name of benefitting and bettering their lives while the true agenda behind such decisions remain hidden from them.

As a result of such necropolitical practices, most sub-Saharan African countries have adopted policies made for them by the international community in different aspects of life such as socio economic, political and food security. In the name of achieving food security for Africa, different agricultural policies have been initiated that have flooded the farming system on the African continent with the genetically engineered seeds, chemical fertilizers and agrochemicals.

Global financial institutions such as the IMF, the World Bank and other philanthropic agencies such as the Rockefeller Foundation and the Gates Foundation sponsor these policies, and industrial seeds and chemical producers such as Monsanto (now owned by Bayer) and Syngenta seed companies have commercialized African agriculture. Bayer is a biotechnology company that specializes in agrochemicals and biotechnology by altering and editing genes in seeds, and hybrid technology has put them at the forefront of the global seed industry, controlling almost one-fifth of global seed rights (Via Campesina, 2011).

Bayer achieves this by lobbying and even bribing high-level officials in Third World nations to allow them to open up agricultural input markets, as in Brazil in 2004, when Monsanto apparently sold a farm at a low price to an influential official so that he would legalize the use of the glyphosate herbicide Roundup in the country (Via Campesina, 2011). Bayer dominates the hybrid seed sector

by owning seed patents as their intellectual property (Paul, 2018), which negatively impacts people's lives because it influences the type of crops they plant and what foods they eat. It prohibits smallholder farmers from sharing traditional seed crops, as has been their custom for generations, and affects their food sovereignty. These are the solutions that the disaster-opportunist multinational companies and philanthropists 'bring' to the poor in the developing world on the back of climate change-induced vulnerabilities.

4. RESOURCE-EXTRACTIVE PRACTICES?

The Green Revolution is regarded by policy makers and academics as an integral part of the solution to food security and poverty alleviation in rural communities. Over the years, however, the Green Revolution has raised much debate about its ecological impacts on the environment and its negative socio-economic impacts on smallholder farmers (Shiva, 1991; Subramanian 2015), and it has been proven unequal to the task of solving food insecurity challenges, especially in developing countries (Patel, 2018; Siegel, 2018).

The Green Revolution, or Third Agricultural Revolution as it is also known, was introduced in the late 1960s by USAID and referred to the agricultural model in India and countries in southern Asia deemed a 'success' because of their high yields of crops such as maize, rice and wheat (Hazell, 2009). That period also marked an era of the international exchange of ideas in the spheres of science and technology, higher education and research, heavy industry, agriculture and more through the patronage and guidance of organizations such as the United Nations and other Cold War alliances (Abraham, 1998; Krige & Rausch, 2012). At this time, the Indian government accepted financial and technological support from the Rockefeller Foundation and the Ford Foundation that included research technology transfers for productive cereals and varieties of maize, rice and others. Other critical new technologies included artificial fertilizers, agrochemicals, new irrigation methods and machines for farming. These new technologies formed the foundation upon which agricultural development aid and assistance originated and resulted in the 'success story' known as the Green Revolution.

The negative socio-economic impact of this 'green' agricultural revolution in Asian countries was that smallholder farmers had to buy farm inputs on credit every planting season and, because most of them could not afford to pay back the credit, ended up in prison or even committed suicide (Oasa, 1987; Philpott, 2015; Ponting, 2007; Shiva, 2013). Consequently, many smallholder farmers went into the urban sector seeking low-wage industrial employment to support their families back home

(Oasa, 1987).

5. DOMINANT APPROACH TO AGRICULTURE

The Green Revolution has affected agricultural biodiversity and wild biodiversity, introducing new seed varieties that have displaced traditional seed crops and could eventually faze them out completely.

In *The Government of Beans*, Kregg Hetherington (2020) argues that the model of economic growth that pushes the adoption of hybrid seeds and regulation that favours higher agricultural production worsens environmental degradation challenges instead of bringing solutions. The use of hybrid and other hybrid seeds has led to the irreversible loss of many valuable genetic traits reproduced in long-established varieties over generations.

The displacement of traditional farmers by Green Revolution farming has also necessitated the clearing of large forested areas to create space for crop cultivation by commercial farmers. Such land-grabbing practices by multinational commercial farmers using fossil-fuel-based inputs extract resources in the developing world at the expense of the livelihoods of many rural communities.

Land is a critical factor in agricultural production and is the genesis of all wealth. It is a means of economic prosperity for any community across the globe. It is not only the 'soil' required for cultivation or for building infrastructure, but it also represents all nature (humans and non-human) and natural resources, whether it be those under the water, on land or in the air. The land is an essential part of our lives as Africans and has bound us together throughout generations.

Our African understanding about land is that no one owns the land; it is too precious to be owned by an individual. We inherit the land from the generation before us, and we leave it for the generation after us. Other beliefs go as far as to say that we do not own land but borrow it from our children. As long as we are its custodians, we must preserve it with care. Our traditional understanding is that land does not belong to one generation to exploit or use as they like. We must therefore treat and respect the land, for from it comes the food we eat for our existence and the continuity of life on earth.

Exploitation or exhaustion of the fertility of the land in the name of agricultural intensification of its natural resources, without a feasible approach to replenishing soil, undermines and exploits the local communities who are the traditional custodians of that land, and any exploitation of the land

is an indirect decimation of the origins and identity of its local people. Most proposed agricultural production models destroy this precious resource and forever harm the local rural communities who depend on it for their livelihoods.

Critics of Green Revolution agriculture cite countries such as Brazil and Mexico as examples of Green Revolution farming that have destroyed wild biodiversity. The clearance of forests led to desertification in north-eastern Brazil and destroyed the natural habitat of much wildlife (Davies, 2003). But the Green Revolution's greatest failing may be that it promotes only a few cash crops, limiting the natural resources, economy and culture of developing countries (Jennings, 1988). Recognising the negative impacts of the agricultural Green Revolution in South American countries, 189 nations signed the 1992 Rio Treaty, which generated a Biodiversity Action Plan with three main objectives: addressing threatened species and habitats, protecting biological systems and restoring biological systems (McLaughlin & Mineau, 1995).

The philanthropic foundations are now focused on Africa, purportedly to save the continent from poverty and hunger. In collaboration with other continental political and regional role players, including the New Partnership for Africa's Development (NEPAD), these foundations have introduced the Green Revolution to the African continent. Through its former president, agricultural ecologist Gordon Conway, the Rockefeller Foundation has recommended the use of hybrid seeds and other drought-resistant seeds, as well as the use of synthetic fertilizers as a way for African countries to increase productivity, moving away from traditional agricultural methods (Mayet, 2007). However, the subsidy policy has not helped solve the food security challenge, and it is those who run the programs benefit most, not the smallholder farmers.

Joy Kim, program officer in the United Nations Environmental Program Economic Research Unit, states that agriculture leads to almost 70% of ecological loss and contributes to 80% of deforestation (in Carrington, 2021). Yet when the UN Food Summit takes place, all the negative impacts of the industrial farming model are overlooked – such summits are sponsored by philanthropists such as the Gates Foundation, which advocates for the use of technological fixes to global food challenges rather than ecological approaches to food cultivation (Patel, 2021). Globally, governments allocate $470bn to farming a year, most of which covers the costs of subsidies (chemical fertilizers, pesticides), price inducements for specific crops and livestock and falsified imports and export subsidies tax (Kim in Carrington, 2021). All these expenses are at the cost of nature and environmental devastation.

6. A FAILED DELIVERY MODEL?

The Green Revolution has been at work in Africa for more than two decades (from the late 1990s to the present) and has not delivered its primary objective of ending hunger and alleviating poverty on the continent. Most sub-Saharan countries like Malawi have developed medium-term development strategies that are aligned with regional, continental and international obligations (Malawi, 2017). These include the SADC's Regional Indicative Strategic Development Plan, the Common Market for Eastern and Southern Africa Treaty, the African Union Agenda 2063, the 2030 Agenda on Sustainable Development Goals, the Istanbul Program of Action and the Vienna Program of Action. These development agendas by African states happen with the approval of developed Western countries in the north and international financial institutions and philanthropic agencies and do not originate from an African perspective.

For example, Egypt approved the farming of GM seeds in the early 1990s, when USAID funded a research center that specializes in genetic engineering and helped the Egyptian government encourage its population to cultivate hybrid seed crops (USDA Global Agriculture Information Network, 2009). USAID was also behind Egyptian policy and regulatory formulation that addressed commodity constraints on biosafety and the like. Countries that fail to abide by such policy strategies stand to lose out on much-needed emergency food aid and financial assistance from organizations such as the World Food Program and the World Bank (Mataya & Gouse, 2006).

7. CONTEXT OF COMMERCIAL SEEDS IN MALAWI

Malawi's Seed Services Unit (SSU) was established in 1976 by the Ministry of Agriculture as the country's first seed industry. The provision of quality and disease-free seeds/breeding material to all farmers was central to SSU and was achieved through seed crop registration, crop observations, seed sampling, laboratory seed testing and coaching and working with farmers on seed management (Ng'ambi & Maliro, 2003; Mloza-Banda et al., 2010).

To introduce seeds and fertilizer subsidies and provide credit facilities to entrepreneurs, including smallholder farmers, Malawi then instituted the National Seed Company of Malawi (NSCM), with the core objective of producing and administering seeds to farmers. The state-owned organization responsible for selling and distributing these input subsidies was the Agricultural Development and Marketing Corporation (ADMARC).

The seed industry in Malawi came into full effect with the Chitedze Agricultural Research Station, which was meant to produce quality seeds of international standard through the International Seed Testing Association (Ng'ambi & Maliro, 2003). The formation of this research station facilitated the countrywide adoption of hybrid seeds and other new varieties and became effective when Monsanto bought the NSCM in 1998. It extended seed certification and the testing of other seeds, particularly legumes and other cereal crops such as rice and sorghum, and vegetable seeds (Ng'ambi & Maliro, 2003).

In the same year that Monsanto took control of the NSCM, the farm input subsidy program was introduced, starting with the Starter Pack Program in 1998. Over the years, the subsidy program kept on increasing the input subsidies it distributed to its beneficiaries (Malawi Government, 2007). Soon after Monsanto took over, the Malawian government introduced policies and regulations that promoted a competitive seed market. The guiding seed legislation for the Department of Agriculture Research Services includes the Seed Act, 1988 (Act No. 5 of 1988 amended in 1996); the Seed Regulations Act, 1994 (Act No. 5 of 1988); the Amended Seed Act, 1996 (Act No. 9 of 1996), and the Seed (Declaration of Prescribed Seed) Order, 1997 (Mloza Banda et al., 2010).

The Department of Agricultural Research Services (DARS) controlled these seed policies and regulations under the Ministry of Agriculture & Food Security, overseeing quality control, seed certification and the day-to-day operations of the seed testing laboratories in the three regions: in Lunyangwa in the north, Lifuwu in the central region and the Bvumbwe research station in the south. DARS also works with the International Seed Testing Association (ISTA).

These policies and regulations have opened doors for seeds to enter the market and made it possible for free trade opportunists who do not deliver quality services and products to smallholder farmers. Monsanto, Syngenta and other seed companies are currently the major seed sellers working with other local seed companies.

Most of these companies invest their resources and focus on seed crops for profitable returns. The National Seed Policy 1993 (amended under the draft National Seed Policy in 2017) does not address smallholder farmers' seed rights, and the issue was removed from the 2017 draft, giving rise to speculation that Malawi's national seed policy was written by the private sector. In fact, a Monsanto official sat in the drafting committee and may have convinced the committee to develop the seed policy that promotes the interests of the private sector rather than the farmers (Wise, 2017).

Central questions in the controversy between advocates and opponents of GM crops are: Why are GM crops not supported by some independent researchers, NGOs, social movements and grassroots farming organisations such as La Via Campesina to feed the hungry? Can only hybrid crops feed the hungry world? What do hybrid crops mean for resource-poor farmers? Is it necessary for multinational organisations to control biodiversity and local seeds across the globe?

Many benefits of these 'magic seeds' have been touted, such as their high yielding potential, disease resistance and early maturity properties, but these are mostly empty promises. Crop production has not significantly increased where hybrid crops are grown, and hybrid seeds crops have not improved nutritional values for a healthier lifestyle. Food security and income have not improved much among its intended targets, resource-poor farmers, even in countries where staple food production (e.g. maize) has increased (Wise, 2020).

Industrial agriculture is a significant contributor to biodiversity loss and a key driver of GHG gas emissions and also contributes to loss of ground cover, the destruction of ecosystems, the extinction of biological diversity and challenges to human health. As Covid-19 and many other related pandemics have shown, humanity is now exposed to pathogens once filtered by the natural protective barrier of the forests.

Hybrid seeds' negative impacts also include environmental contamination and other unforeseen or unexpected impacts, because hybrid seed engineering requires the altering of a seed’s DNA structure. This may have unforeseen consequences for the crops and those who consume them, be they humans, domesticated livestock or wild animals. Environmental contamination can also occur in non-hybrid crops and plants and vegetation surrounding hybrid crop fields. Such contamination may occur through natural processes such as cross-pollination or by accidentally mixing hybrid and non-hybrid seeds during storage.

Nixon (2011) calls our attention to the various forms of violence enacted on vulnerable populations of the Global South by countries of the Global North. These acts of slow violence include toxic accumulation through chemicals, pesticides and climate change. Nixon argues that the West perpetuates these acts through different modes of production that affect not only the environment but also humans and other living organisms. These acts of violence are related to one another; they are not easily traced, but their impacts are destructive and deadly.

Biologically, hybrid-seed-planted fields tend to create biological deserts where microbial organisms and other creatures, such as butterflies, bees, rodents and birds, die because of the chemicals used in the hybrid seeds (Carson, 1962). Hetherington (2020) describes how Paraguayan soy farmers in the late 1980s sprayed their fields with Roundup herbicides, which killed every living organism and plant except for soy crops. This eventually created ‘desert fields’ in which only soy thrived, though heavily dependent on chemicals for its cultivation.

The hybrid seed industry uses patent control and increased production costs to economically monopolize the market and disadvantage farmers, especially those who are resource poor. This monopoly by biotechnology companies has led to higher seed costs and pushed out traditional seeds, giving smallholder farmers no seed options.

Furthermore, like many developmental approaches imposed by capitalism, industrial farming reinforces indebtedness among emerging countries, entrenching inequality and social exclusion. The entire developing world is bound in chains of indebtedness and dependency through the ‘quick fix solutions' pushed by the fossil-fuel and capital-intensive developmental projects.

Africa has lost soil fertility and its rich cultural heritage has corroded, affecting families and communities where the teaching of African values takes place. Any solutions to help Africa out of food insecurity should consider the holistic aspects of human society, the restoration of nature and the promotion of rural economies. Anything less is simply a continuation of colonial policies and strategies that aim to extract resources from the continent and enslave its citizens. Such policies nurse the competitive spirit of free market capitalism among farmers but do nothing to instil a sense of stewardship and responsibility for the ecosystem. Agrarian communities do not have easy access to bank loans or competitive markets, because they do not generally have the documentations that banks and financial institutions require for the disbursement of loans. These processes of capitalist bureaucratisation have caused agrarian communities to migrate to urban areas and neighboring countries in search of paid jobs. Those who remain to continue the age old practices of agrarian livelihoods face multiple socio-economic and ecological challenges that are a consequence of industrial modes of farming, particularly the monopolization and commodification of seeds that has led to soaring seed prices that must be paid every planting season.

8. FOOD SOVEREIGNTY AND FOOD SECURITY IN MALAWI

As described in the previous section, government seed policies and regulations do not promote the development of local seeds. As a result, smallholder farmers use hybrid seeds for cultivation because no alternatives are readily available on the market. Local seeds are slowly disappearing, because people believe that these seeds cannot withstand droughts and are low yielding. This raises questions about how different communities and cultural groups around the globe understand food sovereignty, 'the right of peoples to healthy and culturally appropriate food produced through sustainable methods and their right to define their food and agriculture system' (Via Campesina, n.d.). The keywords here are 'healthy', 'culturally', 'sustainable methods' and 'right'. The cultural aspect of food production requires that food production by different global communities should complement their cultural backgrounds, including 'healthy' and 'sustainable' aspects that do not bring ill health to its consumers or the environment.

9. AGRICULTURAL COMMERCIALISATION OR METABOLIC RIFT?

Karl Marx initially referred to metabolic rift as an irreversible separation of the interdependency processes of social assimilation between humanity and the rest of nature as a result of capitalist systems of production. Specifically, metabolic rift questions the modern industrial models of agriculture that regard nature as a commodity for exploitation without replenishment. Marx, Karl. ([1867] 1976: 637-8) wrote that:

> *All progress in capitalistic agriculture is a progress in the art, not only of robbing the labourer but of robbing the soil; all progress in increasing the fertility of the soil for a given time is a progress towards ruining the lasting sources of that fertility.*

John Bellamy Foster (1999) expanded the idea of metabolic rift initially conceptualized by Marx, referring to the environmental setbacks caused by the practices of capitalism. This term questions modes of capitalist production and their consequent challenges of environmental degradation and questions of sustainability.

Subsistence farming is one of the few remaining practices that rural communities can depend on for their livelihood, but in the name of improving agricultural methods and addressing food insecurity, neoliberal interests look to further exploit the resources of the poor using modern

methods of agricultural technology (Herring & Kandlikar, 2009; Herring 2015). However, modern methods of farming do not honor the reciprocity between humanity and nature, creating a separation between nature and producer-consumer, country–city relationships and local, national and international economies. This lack of reciprocity will negatively affect agrarian societies, because when all the resources are extracted and depleted, nothing will be left for sustenance.

Metabolic rift has also created socio-ecological issues, including the erosion of small-scale citizenship as a result of the separation between capitalist models of agricultural production and community socio-political relationships. Most of the population in developing countries depend on rain-fed agriculture and are struggling to keep pace with the Global North in terms of agricultural production, because most developed countries enjoy the benefit of sponsorship and heavy government subsidies.

These climate change-led challenges such as drought and floods, and destroyed ecologies, coupled with global market uncertainties, contribute to a dwindling agrarian lifestyle, causing many smallholder farmers to migrate to urban areas for industrial employment – only to discover that few jobs are available (Shrivastava & Kothari 2012).

10. ALTERNATIVES TO ECOLOGICAL AND SOCIAL INJUSTICES

Anti-GM organizations such as La Via Campesina speak out against the widening gap between agrarian communities and capitalist societies that commodify everything to gain economic and political control over others. Central to La Via Campesina's voice is the need for social justice and gender consistency for fair economic relations, mainly through natural resources such as seeds, land, water and anything to do with agrarian communities. The outcry of most smallholder farmers is that production of staple foods and inputs used should be sensitive to the cultural histories of the local communities. There should be a balance between what nature gives to humanity and vice versa, but this is lacking in the industrial model of agriculture.

According to La Via Campesina, food sovereignty is only possible when agrarian communities are free to decide what food and agricultural policies to implement to cultivate the diverse crops appropriate for consumption according to local needs and that are sustainable for the ecology around them. Without seed sovereignty, farmers must continue to buy seeds and will lose the right to agro-biodiversity of future generations. This is not to say that there is no place for improved seeds that adapt to the ever-changing effects of climate change, only that such seeds should be

local seeds that adapt to the local environment and are not dependent on agrochemicals for their cultivation.

11. CONCLUSION

This chapter reviewed the 2017 National Seed Policy and the legal framework that regulates the seed industry in Malawi, and concluded that the seed industry policy heavily favours the private sector – to the disadvantage of the informal-seeds sector used by smallholder farmers for crop cultivation. Furthermore, smallholder farmers are not encouraged to save and recycle their local seeds, making them dependent on government farm input subsidies or the purchase of seeds every planting season, which most smallholder farmers cannot afford.

The seed policy's failure to recognise or include the informal seed sector denies the advancement of traditional knowledge that promotes the conservation and production of local seeds for generations. The indigenous, traditional system needs the support of the seed policy to promote and conserve indigenous conservation methods, which will in turn promote the quality of informal seeds for better and higher-yielding crops. To promote biodiversity, such national seed policies should include freedom or exemptions for smallholder farmers to produce and sell seeds among themselves without hindrance. Recognition and public awareness campaigns can help to promote the buying of seeds from local producers under the banner: Local is best.

The primary concern is that indigenous knowledge is slipping away because smallholder farmers are being swamped by the formal seed sector. This contributes to food insecurity and poverty, as the majority of smallholder farmers cannot afford to buy formal seeds. If anything, a mutually beneficial partnership should exist between researchers, hybridisers and community farmers to promote research into the breeding of local seeds. Such approaches would contribute more to food security and poverty alleviation than the farm input subsidy approach that promotes the selling of hybrid seeds to smallholder farmers. Challenges of poverty and hunger are rooted in issues related to political and economic power, and technical measures alone cannot alleviate poverty and eradicate hunger in developing countries. The developing world must define its development policies according to its own particular needs and wishes.

Poverty and hunger in the developing world are politically driven issues led by rich nations' political and economic power. As in pre-colonial Africa, sub-Saharan Africa can feed itself and take care of its own natural resources and ecology, but this will only be possible with support for

rural and agricultural development from concerned stakeholders in national, regional, continental and international institutions. However, this would require a political platform that allows smallholder farmers to grow their food without outside intervention or dictates from wealthy western countries and financial institutions. Support should be limited to the provision of better infrastructure and technical assistance and training, empowering local people to direct their own affairs without intervention.

Global markets must respect that sub-Saharan Africa needs to grow and feed its population with healthy food free of genetically altered seeds, and they must not use emerging nations as dumping grounds for agricultural products that destabilize local markets. Global conversations about honouring human rights are baseless when food rights are systematically dishonoured by an International community that comes to Africa to promote food production and ensure food security but works to an entirely different political and economic agenda

CHAPTER TWO

CHANGED LANDSCAPE

1. INTRODUCTION

Chapter one presented an overview of current regional conversations in Africa about food security, poverty and the technofix approaches adopted in the face of these challenges. Building on that background, chapter two shows how the landscape has been changed as a result of climate change. Using Google satellite images over 15 years (2005- 2020), this chapter traces the loss of groundcover that has led to additional environmental issues of degradation around the Chileka area in Blantyre, Malawi, as a result of climate change and socio-economic hardships.

Those who suffer the effects of climate change most contribute least to the crisis. As climate change-induced challenges increase, millions of vulnerable people across the globe encounter more pronounced difficulties, ranging from food and livelihood security challenges to scarcity of natural resources such as water and firewood and to health issues and a loss of cultural identity. This chapter discusses some of the extreme climate change impacts that have affected the landscape in and around Chileka.

2. LOSS OF GROUNDCOVER

In addition to the negative impacts that chemical inputs bring to the environment, climate change and human practices have contributed to the degradation of ecosystems in and around the Chileka area in many ways. One contributing Anthropocene practice is the culling of individual trees to make charcoal in order to obtain cash, for reasons that may include the funds to purchase seeds.
As in most sub-Saharan African countries, forest assessments in Malawi tend to report only on deforestation in government-owned public forests. However, deforestation also takes place in traditional forests for the purposes of charcoal-making and agriculture. The Malawian government does not record most of these significant forest losses because such losses occur in traditional lands (Bone et al., 2017).

Deforestation and loss of ground cover are the main causes of land degradation. According to the Intergovernmental Panel on Climate Change (IPCC), forest degradation occurs when there is a loss of ecosystem properties such as biofuels or the amount of carbon sequestered from the atmosphere

(Penman et al., 2003; Shukla et al., 2019).

An analytical study by Skole et al. (2021) found that government gazettes estimated the loss of forests in Malawi between 20000 and 2009 to be 22,410 ha/year and to be 38,937 ha/year between 2009 and 2015. However, new estimates include traditional forested lands and estimate deforestation at 42,961 ha/year between 2000 and 2009 and at 71,878 ha/year between 2009 and 2015.

While carbon emissions in most SADC countries are low compared to Western developed nations, they are mostly a result of deforestation and farming, accounting for up to 90% for countries such as Malawi (Ngwira & Watanabe, 2019). As already explained above, even though deforestation taking place in traditional land forests is huge, it is not fully recorded. That makes small areas such as Chileka harder to show loss of forests and ground cover because it is mostly traditional land. Despite all this, loss of ground cover in the area has been significant over the years.

3. DATASET

Bare land is any unoccupied, virgin land and is characterized by soils or rocks (Muavhi, 2020; Eurostats, 2021). This study used Landsat imagery (Landsat 5 TM and Landsat 8 OLI) to map bare land dynamics of the study area during the 2005 and 2020 rainy (December–March, see Figures 6 and 8) and dry seasons (August–October, see Figures 5 and 7). The image acquisition dates of data depended on quality, data availability and limited or absent cloud cover (Table 2). This dataset used four Landsat image scenes along WRS path 167 and row 071, taken from the United States Geological Survey. The choice for the two Landsat images depended on spectral and spatial resolution and the ability to map Land Use and Land Cover (LULC) as follows: Landsat TM (spectral bands 1, 2, 3, 4, 5 and 7) and Landsat 8 OLI (spectral bands 2, 3, 4, 5, 6 and 7) (Tables 2 and 3 below).

Table 3: Details of Landsat datasets used in this study

Scene ID	Acquisition date	WRS path/row	Cloud cover
LT05_L2SP_167071_20051018_20201008_02_T1	2005/10/18	167/071	<10%
LT05_L2SP_167071_20050219_20200902_02_T1	2005/02/19	167/071	<10%
LC08_L2SP_167071_20201010_20201016_02_T1	2020/10/10	167/071	<10%
LC08_L2SP_167071_20200316_20200822_02_T1	2020/03/16	167/071	<10%

Figure 4: Characteristics of Landsat imageries used in this study

Landsat type	Band ID	Bandwidth µm	Spatial resolution
Landsat 5	Band 1 (Blue)	0.45–0.52	30 m
	Band 2 (Green)	0.52–0.60	30 m
	Band 3 (Red)	0.63–0.69	30 m
	Band 4 (Near infrared)	0.76–0.90	30 m
	Band 5 (Shortwave infrared)	1.55–1.75	30 m
	Band 7 (Shortwave infrared)	2.08–2.35	30 m
Landsat 8 OLI	Band 2 (Blue)	0.43–045	30 m
	Band 3 (Green)	0.53–0.59	30 m
	Band 4 (Red)	0.64–0.67	30 m
	Band 5 (Near infrared)	0.85–0.88	30 m
	Band 6 (Shortwave infrared)	1.57–1.65	30 m
	Band 7 (Shortwave infrared)	2.11–2.29	30 m

3.1 PRE-PROCESSING OF REMOTELY SENSED IMAGES

The first step was to geo-reference the Landsat images to Universal Transverse Mercator zone 36S using the World Geodetic System 1984 projection in the ArcGIS environment. The geo referenced images were then exported in GeoTiff format for further analysis using ENVI Version 5.0 software. Landsat bands for each period were layer-stacked in the ENVI environment to create a multi-band image and a subset to cover the study area.

3.2 ATMOSPHERIC CORRECTION

For remote sensing to take place, light must travel through atmospheric solar radiation before reaching the earth's surface. Remotely sensed images contain information about both substances that pass through the earth's surface and atmosphere, which is why the compensatory properties of scene visibility, distribution of aerosols and water vapor must be known. Particular techniques are used to infer their imprint on multispectral radiance data, because measurements of these atmospheric properties are infrequently accessible (Research Systems Inc, 2008). Several models are used to correct such effects on multi-band images in the atmosphere, such as log residual calibration (Tu, et al., 2018), which removes the effects of atmospheric transmittance, topographic effects, solar radiance, albedo effects emitting from radiance data and instrument gain. The log residual calibration instrument is also capable of transforming radiance data to pseudo reflectance imagery, which determines land cover types on maps (Green & Craig, 1985; Muavhi, 2020).

3.3 SELECTION OF TRAINING AND TESTING SAMPLES

Mixing spectral bands 1, 2 and 3 (blue, green and red) for the Landsat 5 TM images determined accurate color composite (TCC) images for the Chileka area. The combination of spectral bands 2, 3 and 4 created a TCC image for Landsat 8 OLI images (Figures 9, 10, 11 and 12). Features that are in TCC images composite manifest in their natural forms or colour. The correct natural colour is ideal for visual description, interpretation and the selection of training and testing (validation) samples, (Muavhi, 2021).

TCC images require a thorough examination to gather representative land cover types (built-up, vegetation and bare land (Table 4)).

Datasets of training and testing were created, the former for land cover classification (Section 3: Image Classification) and the latter for accuracy assessment (Section 4: Accuracy Assessment).

Figure 5: Major land cover classes characterising the study area

LULC	DESCRIPTION
Built-up & vegetation class	Settlements, public utilities, industrial and commercial complexes, roads, man-made structures. Vegetation structures include trees, shrubs, bushes and grasses of natural origin (sparse and dense), aquatic plants, etc.
Bare land class	Unoccupied and virgin land characterized by soils and/or rocks

The first step was to extract representative samples of land cover classes as regions of interest (ROIs), and then examine class separability using transformed divergence (TD) and Jeffries Matusita distance (JMD). Separability samples from two different land cover categories is necessary because they aid the quality evaluation of the two samples and help determine which of the samples have uncertainty demarcations in feature space, especially where the classification accuracy is poor (Dabboor et al., 2014).

The separability measures between the JMD and the TD give an indirect estimate of the possibility that the classification between two data sets is correct (Kharol et al., 2013; Joseph et al., 2013). The TD and JMD separability measures of ROIs/class pairs have values varying between 0 and 2, and they show the actual separation between these two classes. A zero (0) value shows that there is a total overlap between the mark of two samples, while a value of two (2) shows the modified demarcation between the two class samples (Richards & Mia, 2005; Muavhi, 2020).

4. IMAGE CLASSIFICATION

Richards and Jia (2005) describe the process of categorizing pixels in an image into categories as per their user-selected training data as supervised image classification (SIC). This data set used SIC to categorize pixels in Landsat imagery to identify land cover stratification. Various algorithmic models can be used to rate or stratify satellite imageries (Richards & Jia, 2005), and this study used the maximum likelihood (ML) algorithm, as it is the most accepted algorithmic tool for classifying parametrics rooted in statistical theory. Swain and Davies, (1978) argue that the ML model is a highly regarded algorithmic tool despite its limitations on parametric assumptions. Recent technology has overcome these limitations, because the support vector machine (SVM) can read the normal distribution of class signatures accurately (Manoj et al., 2013). The SVM also categorizes heterogeneous classes using only a few training samples (Lothar et al., 1999; Muavhi,

2020).

5. SUPPORT VECTOR MACHINE

One of the benefits of the SVM is that it is a non-parametric supervised classification algorithm, and there is thus no assumption made on the underlying data distribution (Richards & Jia, 2006). SVM was formulated as a binary classification method in the late 1970s by Vapnik and co-workers and was developed further in the 1990s (Vapnik, 1998).

The support vector machine builds an n-1 dimensional dividing the hyperplane to differentiate an n-dimensional margin between two dataset classifications. An example of an n-dimensional vector is a data point. Two dataset variables generate a two-dimensional expanse such that a single straight, one-dimensional line would divide the hyperplane in half. Whenever more dimensions are mixed-up, the SVM looks for an ideal dividing hyperplane. Such a hyperplane is known as the maximum margin separating hyperplane. In such a situation, the gap between the support vectors and the hyperplane increases.

The SVM employs kernel functions such as radial basis functions (RBF), linear, sigmoid and the polynomial to differentiate between classes (Chang & Lin, 2001; Wu et al., 2014). This study used RBF because it is considered the main kernel for its supremacy (Keerthi & Lin, 2003; Sun et al., 2014). The mathematical expression of the RBF kernel is:

$$K(x_i x_f) = \exp\left(-g\|x_i - x_f\|^2\right), g > 0 \qquad (1)$$

Where g is the gamma term (Chang & Lin, 2001; Hsu et al., 2003)

The gamma (g) and penalty (C) are selected before an ideal SVM model is created. Parameter penalty (C) administers over-fitting of the statistical model against its training data by identifying tolerance for miscalculation. The parameter gamma (g) controls the level of the inconsistency of the model (Hsu et al., 2007). The ideal SVM model for the map analysis for the Chileka area was 100.00 for the penalty (C) and 0.33 for the gamma (g) value. These values have proven to produce accurate land cover mapping in previous studies (Muavhi, 2020).

6. ACCURACY ASSESSMENT

Validating accuracy assessment is an essential part of map analysis that includes remotely sensed data (Congalton, 2001). The accuracy of the sample unit of the land cover type is verified by

empirically comparing it to the ground truth data (validation data) (Richards & Jia, 2005). Based on this approach, the percentage of pixels from each class in the image labelled correctly by the classification algorithm can be estimated jointly, with the ratio of the pixels from each class incorrectly tagged into every other category (Richards & Jia, 2005).

Expression of results is in tabular form, also referred to as confusion matrix, subjected to various statistical analyses. The overall accuracy (OA) is a basic accuracy measurement quantified by adding the number of testing (corroborative) pixels classified accurately for all classification samples against the total number of validation pixels for all other classification samples. This can be mathematically expressed as:

$$OA = \frac{correctly\ classified\ validation\ pixels}{total\ number\ of\ validation\ of\ pixels} x100 \qquad (2)$$

Aronoff (1982) proposes a minimum overall accuracy value of 85% as the lowest expected overall accuracy of the classification image. Cohen's Kappa (K) coefficient is another robust statistic that measures accuracy, measuring inter-rater dependability for map analysis. It is ideal because it considers the possibility of the agreements that happen by probability (Jensen, 1986).

Another measurement coefficient used to measure the agreement classification of the model between two raters is the Kappa (K). This map analysis used kappa to compare measures from the machine-learning model projections and those that were manually calculated (Jensen, 1986). Like other analysis metrics, K is computed based on the confusion matrix, but it is different from other metrics in that it takes the imbalance in class dispersal into consideration (Widmann, 2020).

The mathematical expression of the kappa coefficient is Kc = (po – pe) / (1 – pe), where p_a is the proportion of pixels that agree, and p_c is the proportion of pixels for expected chance agreement (Jensen, 1986). Kc may provide better accuracy of classification than would be expected by random assignment of classes. Kc values range from 0 to 1, with Kc less than 0.20 being poor, 0.20 to 0.40 being fair, 0.41 to 0.60 being moderate, 0.61 to 0.80 being good, and a $Kc > 0.85$ considered excellent (Altman, 1991).

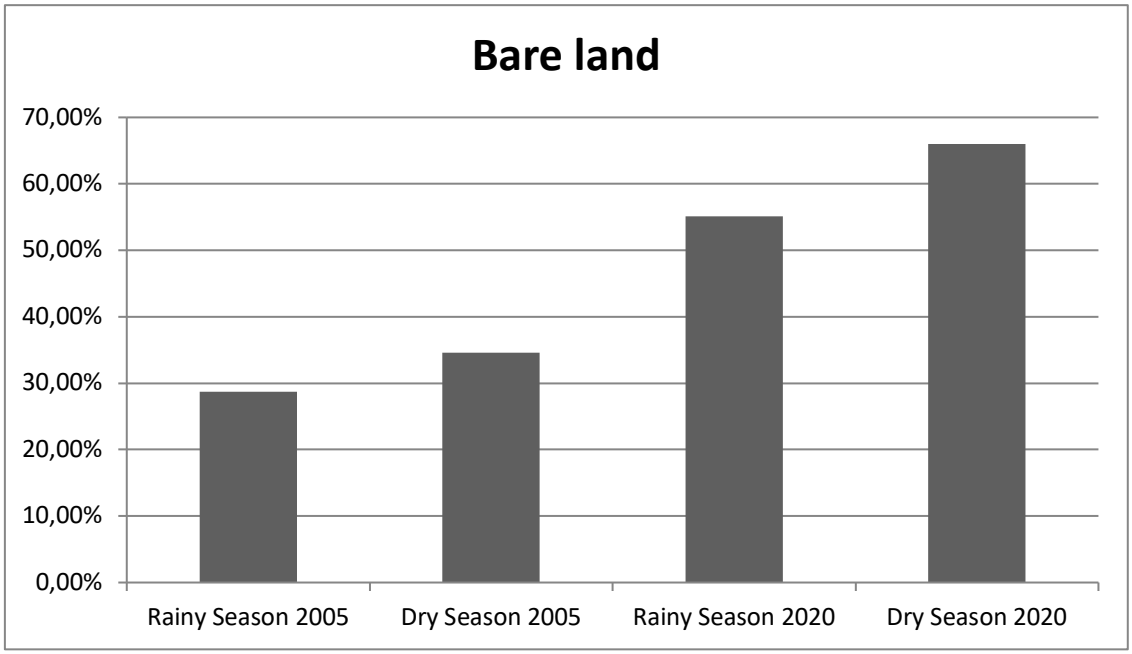


FIGURE 3: *Shows increase in bare land from 28.687% in 2005 (Rainy season) to 34.613% (rainy season) in 2020. 55.122% (dry season) in 2005 and 65.973% (dry season) in 2020.*

Figure 6: Percentage of bare land area coverage for the 2005 and 2020 dry and rainy seasons

Area coverage (percentage)			
Rainy (2005)	Dry (2005)	Rainy (2020)	Dry (2020)
28.687	55.122	34.613	65.973

Maps of Chileka and surrounding areas

Figure 3: Satellite image of the Chileka and the surrounding areas in Blantyre, Malawi

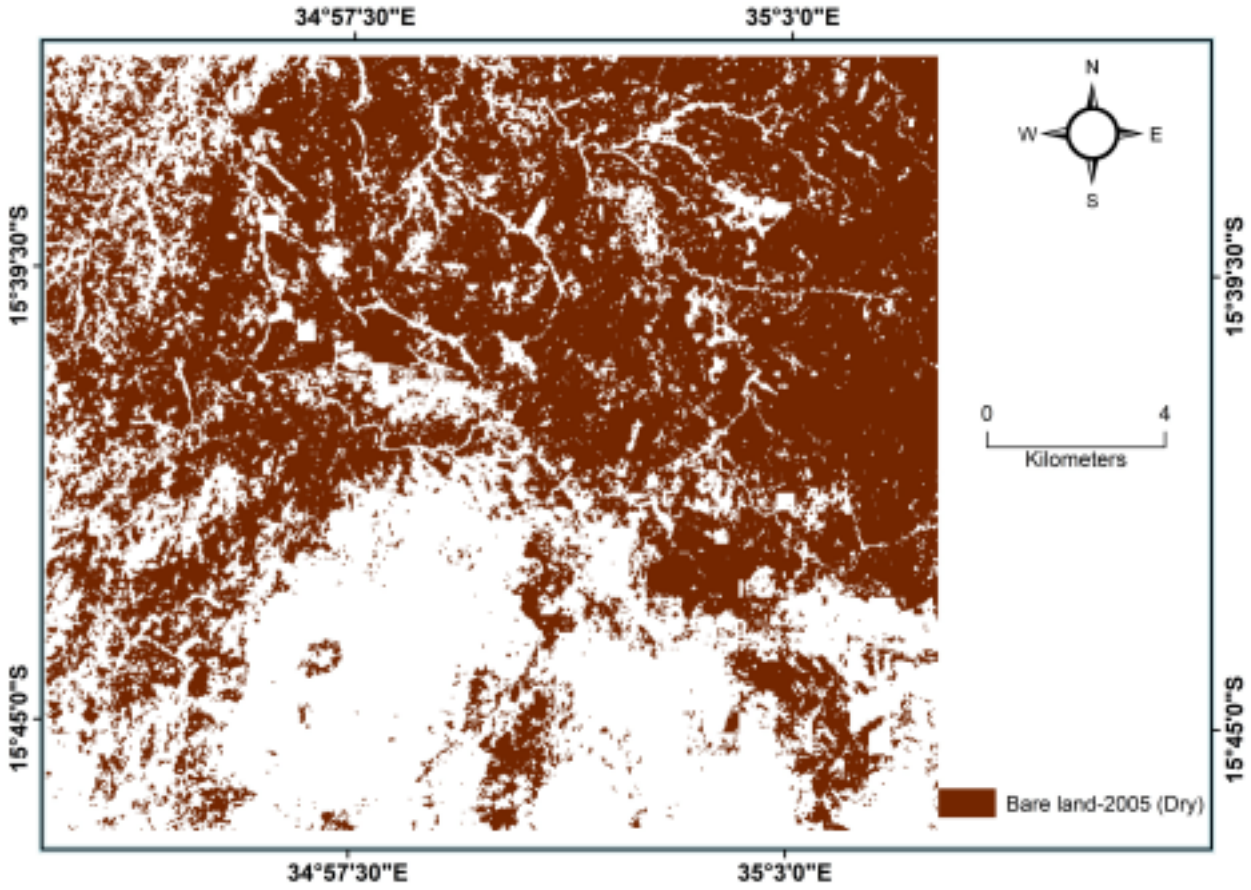


Figure 4 Figure 7: Land sat imagery of Chileka and the surrounding areas shoeing bare land in the 2005 rainy season (December-March):

Land sat imagery of Chileka and the surrounding areas shoeing bare land in the 2005 dry season (August-October

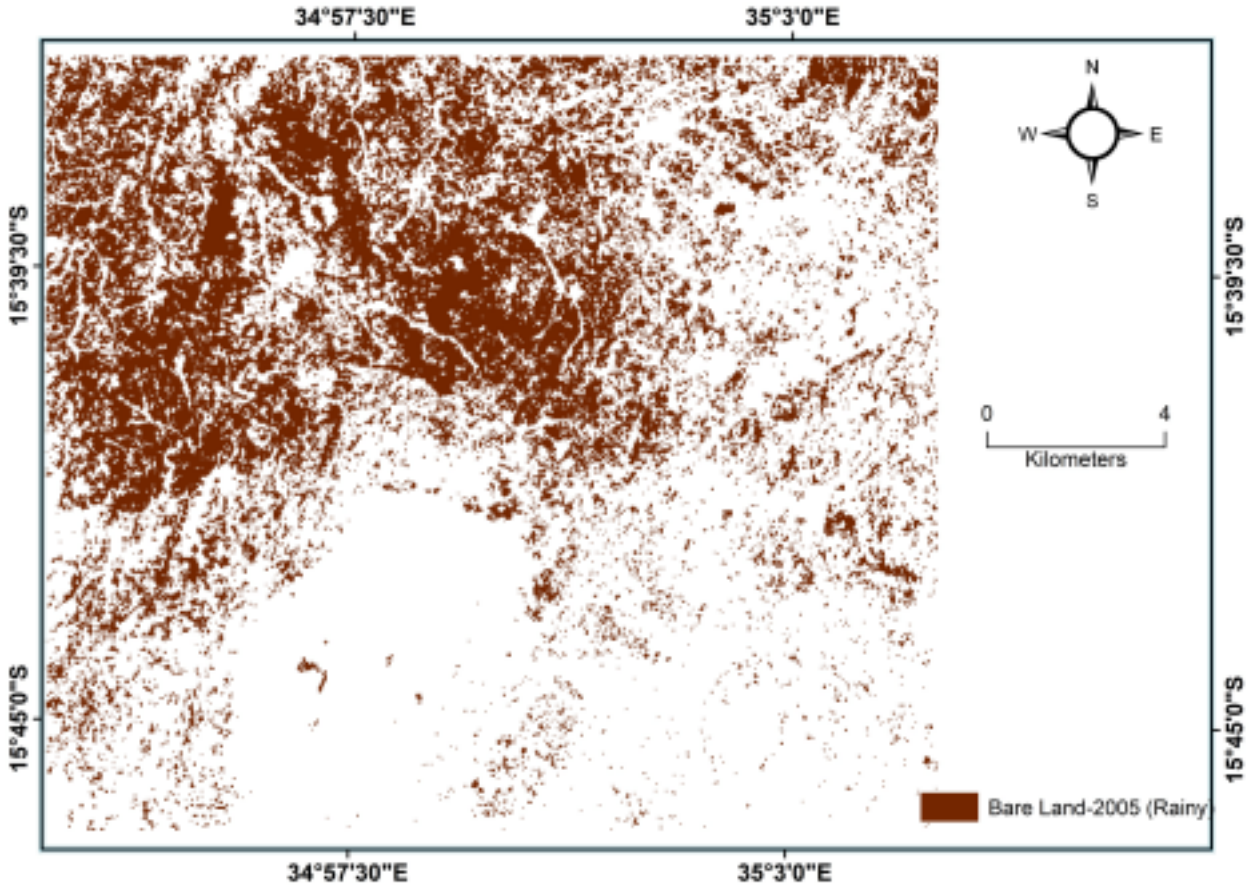


Figure 5: Landsat imagery of Chileka and the surrounding areas showing bare land in the 2005 rainy season (December- March)

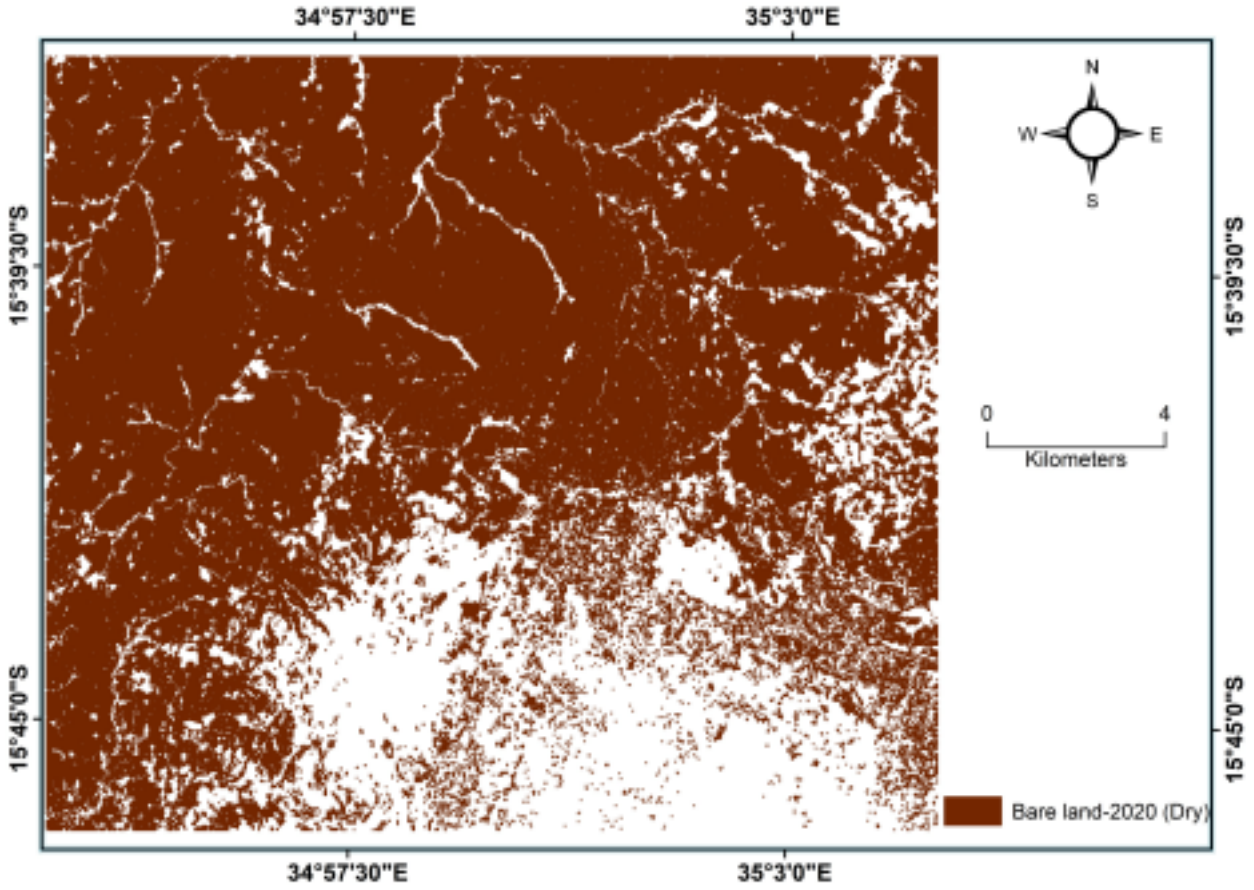


Figure 6 Landsat imagery of the Chileka and the surrounding areas showing bare land in the 2020 dry season (August- October)

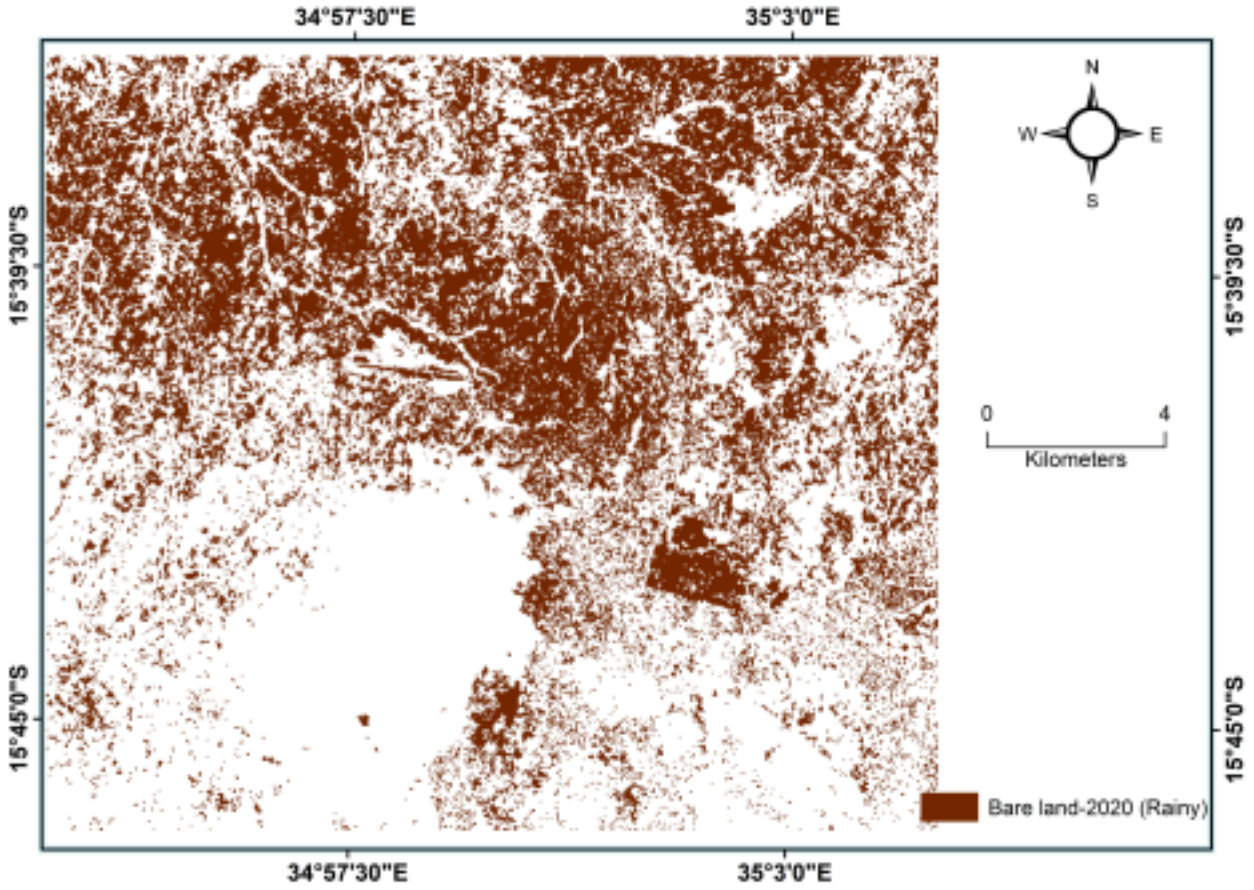


Figure 7: Landsat imagery of Chileka and the surrounding areas showing bare land in the 2020 rainy season (December – March)

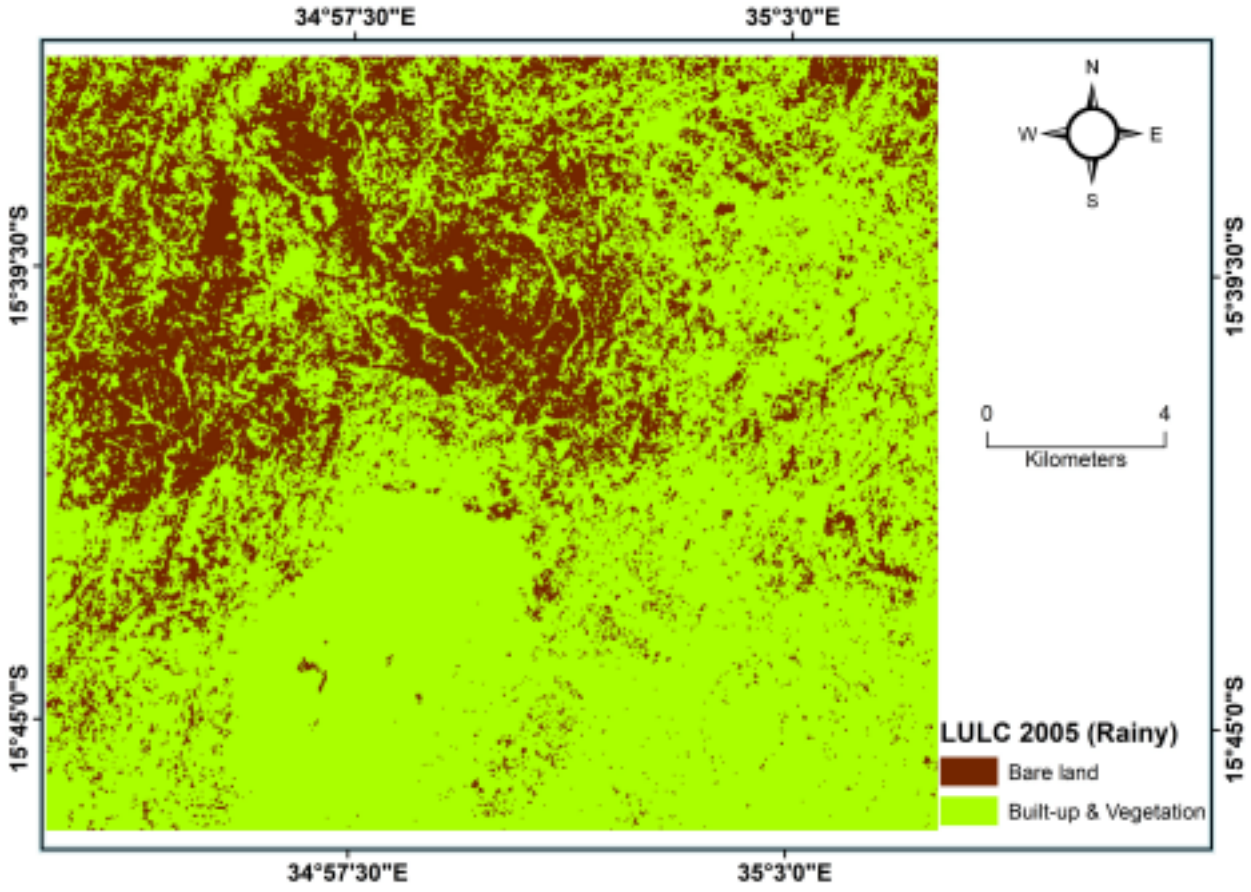


Figure 8: Land cover imagery of Chileka and the surrounding areas showing bare land in the 2005 rainy season

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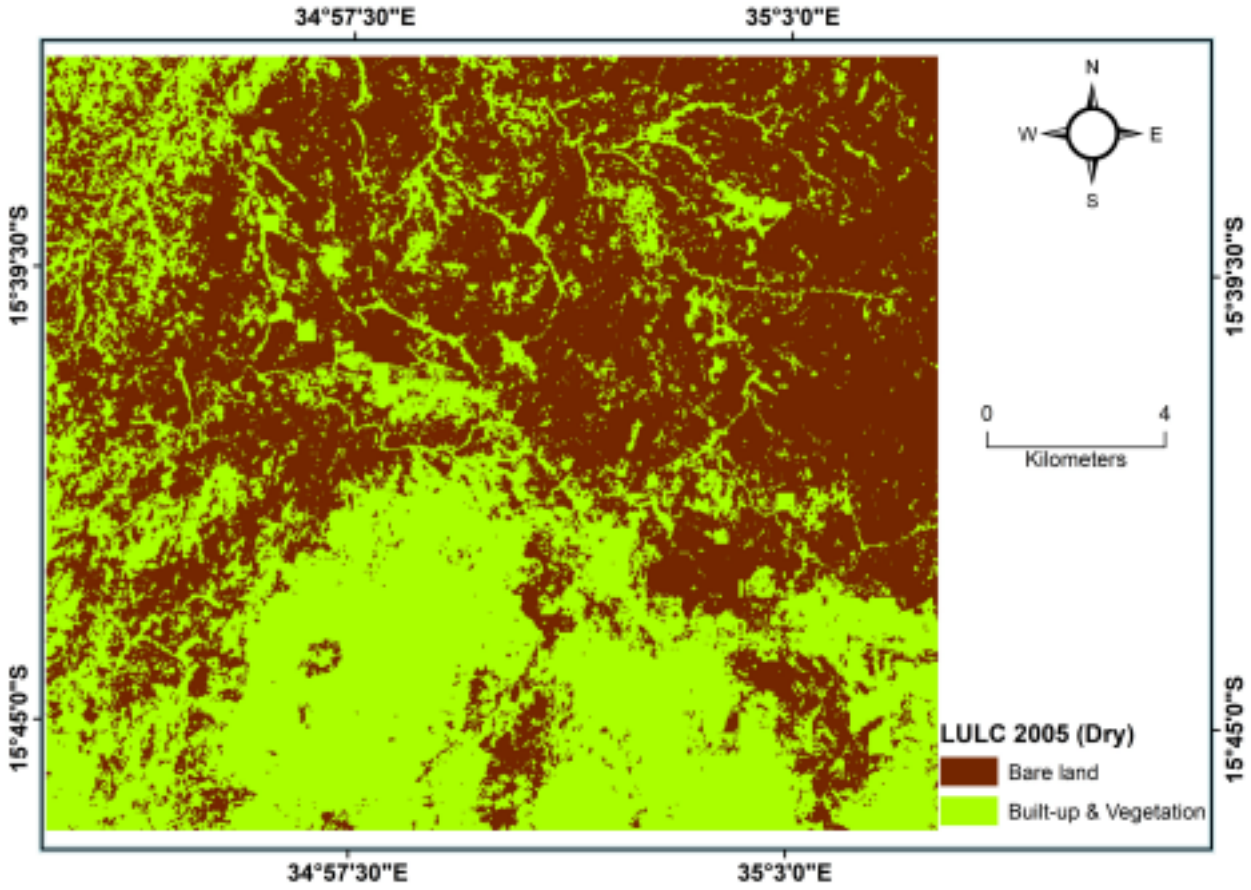

Figure 9: Landcover imagery of Chileka and the surrounding areas showing bare land in the 2005 dry season

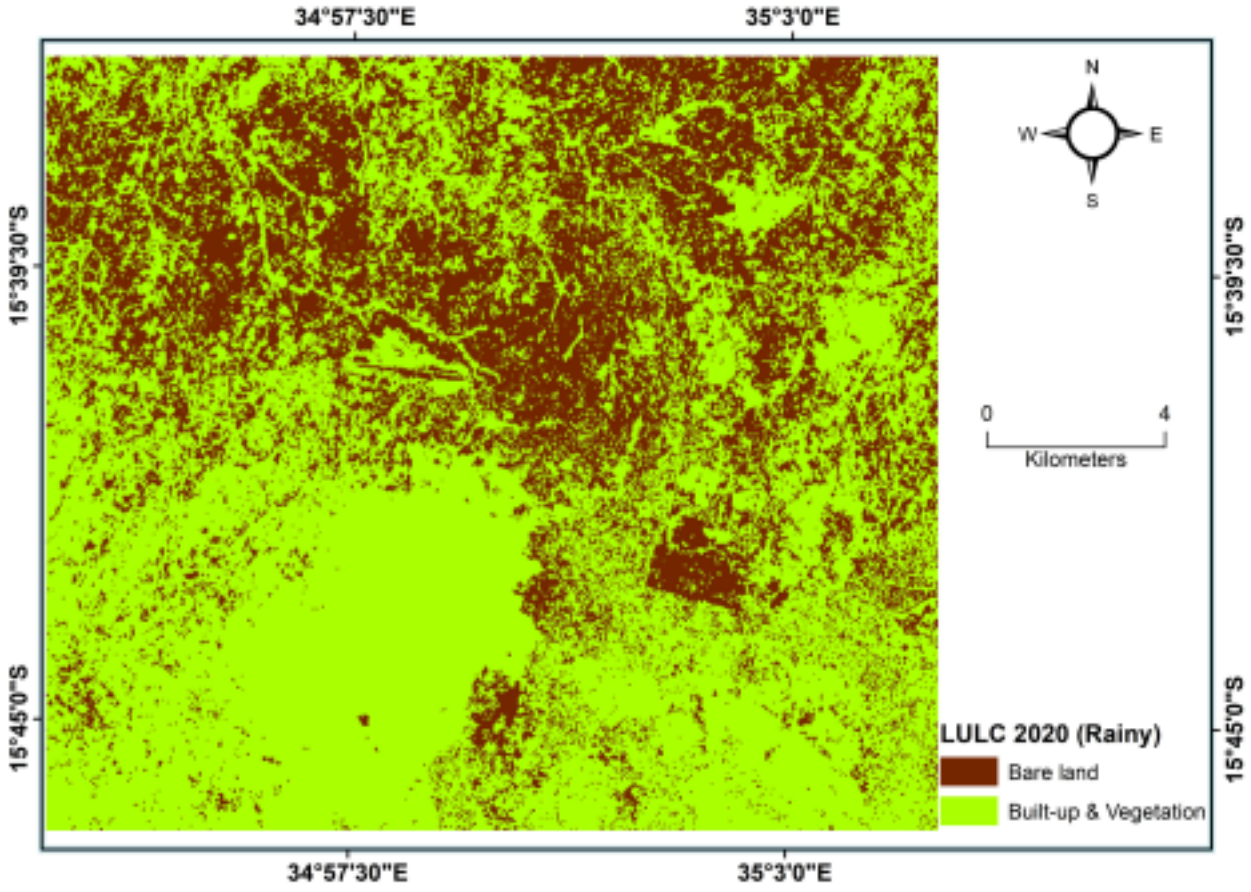

Figure 10: Landcover imagery of Chileka and the surrounding areas showing bare land in the 2020 rainy season

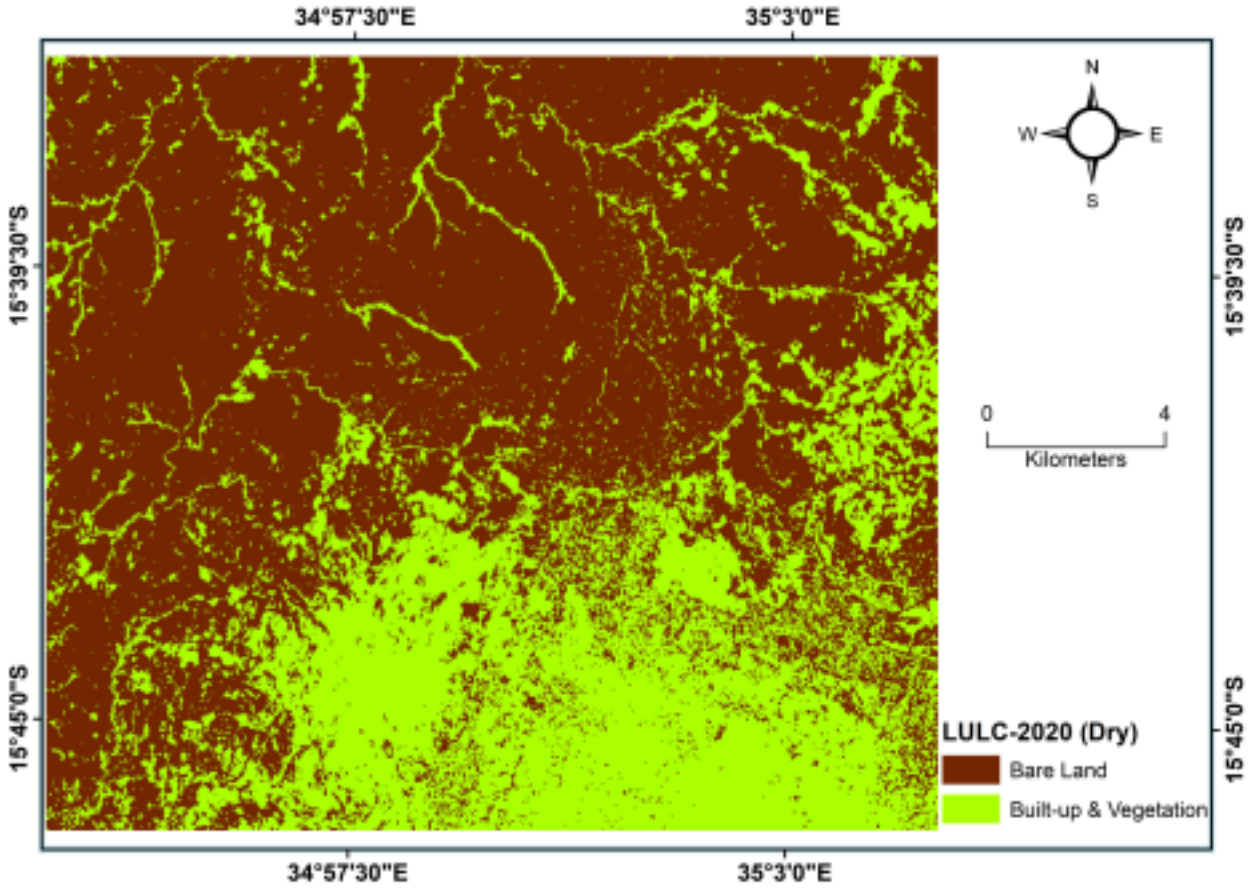

Figure 11: Landcover and land use imagery of Chileka and the surrounding areas showing bare land in the 2020 dry season

The data sets above (see Table 5) show that loss of ground cover around Chileka has led to an increase in bare land from 52.122% in 2005 to 65.973% in 2020 in the dry season and from 28.687% in 2005 to 34.613% in 2020 in the rainy season. In addition to climate change, loss of ground cover in the area is a result of deforestation and desiccation. This however, does not exclude the impacts of other developments in the area such as population growth. Other natural phenomena such as the influences of cyclic rainfall patterns that the Southern African countries experience due to the influences of sunspot cycles may or may not influence the loss of ground cover in the area. The study done by Castro et al., (2022), suggests that solar cycles do not influence anthropogenic impact.

7. DEFORESTATION AND SOIL DESICCATION

Climate change-led impacts, high population growth and socio-economic challenges have affected significant transformations in Malawi's land cover and land use over the last three decades (Malawi, 1998). The national population in Malawi tripled from 6.25 million in 1980 to 19.13 million in 2020, creating a population density of 203 people per square kilometre (https://www.worldometers.info/world-population/malawi-population/) and increasing demand for land and other natural resources such as water and firewood. Areas once covered in trees and vegetation have been cleared for crop cultivation, *dambos* (low-lying areas) once plentiful with vegetation are now overgrazed and left bare or used for crop farming, and water-logged areas have been drained for crop cultivation.

Poor animal and crop husbandry practices such as overgrazing, cultivation on riverbanks and mono-cropping have contributed to the environmental degradation of Chileka and surrounding areas, leading to low water retention, soil erosion and the loss of soil nutrients to water and wind. In combination with the reduction of land holding size of 0.5 hectare per household due to population growth and other socio-economic reasons, these factors have led to further environmental degradation in the area (Malawi, 1998). Loss of ground cover has impacted land hydrology, water infiltration, run-off, evapotranspiration and other interception processes, leading to increased sedimentation from topsoil being washed away and from frequent flooding during storms (Malawi, 1998). Soil desiccation in the Chileka area (and beyond) has affected agricultural land, places of habitation, vegetation and forests and impacted soil and water viability and availability. Such changes also affect the time-related phenology and chlorophyll properties of vegetation in an area and thus affect remote sensing studies (Meyer & Turner, 1994).

In soil desiccation, wet or moist soils dry up or dehydrate as evaporation leads to cracks in the soil's surface. Ongoing desiccation processes may compromise a soil's cohesion properties and prevent water from permeating the ground. Income disparity, agrarian reform in rural communities and underlying socio-economic, environmental and political challenges are at the centre of soil degradation, and while environmental degradation challenges are mostly rooted in social problems (Lyons, 2020), policy-making processes often overlook these root causes. Proposed solutions, though well-meant, often only make these socio-economic hardships worse for agrarian communities.

For example, the industrial model of agriculture encourages monoculture cultivation with minimal

or no crop rotation. These techno-fix approaches lead to soil and environmental degradation, and scientific experts are 'invited' to propose solutions that prove the capitalists' innocence and blame rural communities for their problems. Much as these approaches provide short-term benefits in the form of higher crop production, hybrid seeds, agrochemicals and monoculture negatively affect soil, water and other natural resources critical to the continuity of life on Earth.

Soil health covers several aspects, including organic matter, fertility, stability, chemical aspects and biological aspects such as microorganisms and soil enzymes (USDA Natural Resources Conservation Service, 2009). Chemicals used in crop production affect soil health in many different ways, such that its capacity for crop growth and productivity is reduced over the long term. For example, local communities living around the Chileka area grow vegetables for consumption and sale in Blantyre urban areas and other nearby markets. These vegetables are often grown after the main planting season for food crops such as maize, but due to the scarcity of land for cultivation, vegetables such as cabbage, spinach and mustard are grown three to four times a year on the same land. Chemical fertilizers and pesticides are often used to boost productivity and control pests and diseases.

Kristina Lyons (2020) uses the term ‘pharmaceutical treatment of soil’ to describe treating soil with chemicals to make it healthy and able to endure intense planting while disregarding the natural processes of decomposition that can help to heal it. These practices eventually have an adverse environmental impact on the soil and on ecosystems and marine life, because intensive cultivation often introduces too many nitrates and phosphates into the soil, which are washed into dams and other water bodies when the rainy seasons come. This is toxic to natural water reservoirs and marine life and contributes to the increased growth of algae in water bodies, decreasing oxygen levels and destroying aquatic life.

8. CONCLUSION

This chapter discussed changes to the landscape of Chileka and surrounding areas brought about by climate change and human practices, with data analysis of satellite imagery from 2005 and 2020 showing an ongoing loss of ground cover in the area. As already noted in table 5 above, satellite imagery analysis for the Chileka area during the dry season has increased from 52.122% in 2005 to 65.973% in 2020. During the rainy season, bare land has increased from 28.687% in 2005 to 34.613% in 2020 in the rainy season. This increase in bare land in the Chileka area is attributed

mostly to the impact of climate change, population growth, deforestation, desiccation and some developments in the area. However, one also needs to understand that impacts of climate change and environmental degradation cannot be looked at individually. They are all interrelated such that they also affect socio-economic and environmental degradation impact in and around the Chileka area. For instance, when crops fail, people have no alternatives for income. This drives them to other activities such as charcoal-selling for their livelihood and also for them to use the cash to buy the farm inputs for the next growing season. Therefore, these challenges cannot be separated one from the other.

Socio-economic challenges have also contributed to the loss of ground cover in the area, which have led to further environmental challenges, such as a loss of ecosystems and soil fertility, leading to soil desiccation. As already pointed out above, one of the contributing factors leading to increase in bare land is the Anthropocene practice of culling of individual trees for charcoal production. People do this as an alternative to get cash to meet other needs such as buying farm inputs such as seeds and chemical fertilizers. Even though deforestation assessments are only done in government-owned forests, there are significant forest losses happening in customary lands. This is evidenced by the satellite imagery analysis for the Chileka area from 2005 to 2020, the same period that the farm input subsidy program has been operational.

The satellite image data analysis corroborates what smallholder farmers related during the ethnographic data collection of their lived experiences of farm input subsidies and the climate change challenges they face, discussed in chapter three below.

Chapter Three

CLIMATE CHANGE AND AGRICULTURE: THE EXPERIENCES OF SMALLHOLDER FARMERS IN BLANTYRE DISTRICT, MALAWI

'Thank you, my child, for coming to talk to us. We need people in the high offices to come and see how we are struggling to make ends meet. That is because they make decisions about us without involving us. Most of the time, we do not see the changes that are intended well for us.'
A widowed grandmother raising three grandchildren – Chileka, Blantyre, Malawi20201

1. INTRODUCTION

This chapter highlights some of the lived experiences of smallholder farmers around the Chileka area in the Blantyre district, Malawi, with a view to understanding "on the ground", the changes that are evident in the satellite images as presented in the previous chapter. The purpose of this chapter was to use the ethnography to 'ground truth' these satellite image findings, and try to explain the experiences of farmers in relation to the above.

Research participants talked about their experiences of the government's farm input subsidy program and other climate change-induced challenges. Most issues raised by participants in this study are in agreement with the United Nations Food Summit Report for September 2021, which reported that 90% of farm input subsidies across the globe contribute to the destruction of nature, ruin people's well-being, exacerbate climate catastrophes and promote inequality, especially at women's expense (Carrington, 2021).

2. ISSUES RAISED BY FARMERS ABOUT FISP

Community leaders (e.g., village headmen) determine the eligibility and identification of beneficiaries of the Farm Input Subsidy Program (FISP), but identifying 'vulnerable' groups is generally problematic. For example, one of the eligibility criteria is that a beneficiary has to be someone who resides full time in the village most of the time. Single mothers who are doing other small businesses in the urban and semi-urban areas do not qualify for the subsidies because most of the time they are not available to attend the village meetings where the selections are done. This is despite the fact that they are vulnerable and therefore eligible to receive the subsidies.

Other selection criteria that are considered to identify FIS beneficiaries is that a person must have a piece of land for cultivation and the ability to work on it. This can be disadvantageous if older

women (especially widows) do not own a piece of land, even if they qualify to receive farm input subsidies. Much as the FISP's intention is good, it creates inequality among women food-growers (Carrington, 2021).

Another drawback is that most households in rural Malawi are headed by older adults who are taking care of orphans in the wake of the HIV/AIDS pandemic and other socio-economic challenges. Such older women do not have the physical strength to cultivate the land. Even if they qualify for subsidies in other categories and receive the farm input subsidies, they do not benefit much, hence not achieving the objectives of subsidy programs among the 'vulnerable' groups.

Qualifying FISP beneficiaries are issued with two redeemable coupons for two 50 kg bags of fertilizer and a 10 kg bag of drought-resistant hybrid seeds (Arndt et al., 2016). Smallholder farmers redeem these vouchers by paying a small amount of money (redemption fee) equivalent to a subsidy of two-thirds or more of the trading fertilizer retail price. This is problematic for those who cannot afford this amount, and some sell their vouchers for immediate needs, while others work extremely hard to raise the cash, including via the production of charcoal. The hybrid seeds cannot be used for the next planting season, and farmers must buy seeds every planting season. Farmers raised a number of issues with the FISP, which are outlined below.

Seed quantities: Seeds received are not sufficient to plant fields larger than 1 hectare, so smallholder farmers must buy the extra amount. Should the subsidy program be discontinued under any circumstances, farmers will have to purchase all the seeds out of their own pockets – which most of them cannot afford. At the beginning of the FISP, hybrid seeds made up about 60% of seeds planted in the planting season and by the 2009/10 planting season they made up almost 90% (Arndt et al., 2016).

Nutrition: hybrid maize seeds replace nutritious local maize seeds that have been in use for generations. The nutritional value of maize is dependent on the crop husbandry practices and climatic conditions under which they are grown. Naturally, seeds adapt to the climatic conditions of a particular geographical location, and altering such seeds may affect their nutritional values (Bathla et al., 2019). Genetically modified seeds may change nutritional composition, quality and flavor and have negative health impacts on the people and animals that consume them (Young, 2015).

Financialisation of farming and the loss of seed-sharing networks: Smallholder farmers can replant local seeds for several planting seasons. Traditionally, farmers could choose and store seeds during the harvest period for the next planting season. This is not possible with hybrid seeds, which cannot be replanted for more than three consecutive planting seasons.

Seed-sharing networks among smallholder farmers: Communal practice is no longer as functional as it was. Most readily available seeds now are /hybrid seeds that farmers buy at agro-based dealers every planting season. The only seeds to be regulated are the hybrid ones, because the private sector benefits from their sale to every smallholder and commercial farmer. Local seeds are not formally acknowledged because seed hybridisers assume that local seeds are not high-yielding and are difficult to conserve, and many agrarian communities have abandoned them, and seed-sharing networks among smallholder farmers are dwindling.

Yields: Most hybrid seeds do not give high yields without the application of fertilizer, meaning smallholder farmers must also buy fertilizer to grow enough to feed their families – again, many cannot afford these hybrid seeds and artificial fertilizer technology are very costly, and the withdrawal of substantial state and donor support would leave these resource-poor farmers out in the cold. And by then, most of the already nutrient-depleted soils will be 'hooked' on these chemical fertilizers, without which they will remain 'dusty' and unproductive.

Continuity: If the FISP is discontinued for any reason, be it socio-economic or political, smallholder farmers will be the hardest hit. FISP depends on financial support from donors to the Malawi government and amounts to 40% of national expenditure, allocating almost 9% of Malawi's national budget to FISP. Donors contribute 10 to 15% of the annual program costs, which include fertilizers, seeds and logistics (Doward & Chirwa, 2011).

3. SMALLHOLDER FARMERS' EXPERIENCES OF INPUT SUBSIDIES

This section highlights the lived experiences of the community members around Chileka in Blantyre. I considered the sub themes below to answer the main research question, which examined the farmers' experiences of farm input subsidies. Other sub themes include changes in soil, the ecosystem, climate and the wider environment; pest outbreaks; and gendered vulnerabilities. These subthemes were further categorized into three main groups: farm input subsidies, climate and environmental changes, and gendered vulnerabilities. A 73-year-old community leader said:

> *Every year, things are getting worse than the year before in terms of changing weather patterns and rainfall dependability. Summer is more prolonged and hotter than the year*

before. We can no longer tell exactly when to expect rains as we used to do in the old years.

Changes in weather patterns and challenges related to loss of soil fertility are contributing to poor crop harvests. Furthermore, smallholder farmers face difficulties accessing the government's farm input subsidies. From the start of FISP, eligibility criteria for its beneficiaries have included households headed by the elderly, guardians of orphans and female-headed, child-headed or physically challenged-headed households. It has also included households that were directly or indirectly affected by the HIV/AIDS pandemic. During data collection, focus group discussion participants indicated that those eligible to receive the subsidy packages encountered several challenges, from accessing coupons to redeeming them. Participants noted that many families that were eligible for subsidies did not appear on the list and could not access the subsidy coupons, either because there were not enough coupons or because of corruption by officials and village selection committee members during the beneficiary identification process. Individual names were missing from the list, or those who appeared on the list did not have their identification cards when the time came to receive the coupons.

Farm input subsidies and soil: Of the 30 participants, ten were smallholder farmers dependent on the government's farm subsidies. Another ten did not use the subsidies and continued with traditional methods of ecological farming and local seed use. Out of these 10 non-FIS users, 7 of them were single mothers. Smallholder farmers who have not been using external farm inputs did so for three reasons: The first one is that they were left out of the government subsidies for one reason or another (please refer to the selection criteria in this chapter three above under the subheading: *Issues raised by farmers about FISP*). The second reason is that they could not afford to buy these farm inputs at the retail shops. The third reason is that after noticing that most of the FIS users had to sell some of their harvests to pay off the debts they incurred during the planting season to buy supplementary inputs (especially seeds), these non-FIS users decided to continue planting local maize varieties. This was now out of choice. They indicated that they use manure (livestock or chicken) to naturally replenish their soil.

Others indicated that they prepare their fields early by burying the maize stalks and vegetation in the fields soon after harvesting their crops to allow them to biodegrade. By the time the next planting season comes, this crop residue has become compost. The non-hybrid users also adopted agro-ecological farming practices such as intercropping, planting ground crops and rotating crops – ground crops such as groundnuts, peas and others help fix nitrogen in the soil.

While their harvests are consistently lower than those who use chemical inputs (at an average of 1 ton per hectare), these non-FIS users stated that they do not have to worry whether they will qualify for the subsidies every planting season. Their fields do not depend on chemicals for growing crops, and they do not have to supplement their seeds from the retail shops.
They have some peace of mind because they do not have to borrow money for additional inputs. A 54-year-old female respondent said:

> *Soon after harvest, I select maize cobs that are good and healthy for seeding for the next planting season. At first, they [hybrid seed-users] used to laugh at us that our mbeu yamakolo [literally, 'seeds of our ancestors'] give low yields, but we continued because we had no choice, but now we are at peace. What we harvest is ours and our children's. We do not need to sell some of the crop harvests to pay back those we owe the money to buy the inputs.*

However, as most of these farmers have fields bordering those using chemical inputs, there is little difference in the degradation of the general ecosystem between them and those who use chemical inputs.

The other ten combined both methods, because the subsidies are insufficient for bigger farmlands and must be supplemented with commercial or locally available traditional maize seeds. This group had mixed results each and every agricultural year. They indicated that sometimes their harvests were more or less that a previous year depending on how the rains had come. However, they stated that their harvests were above those using traditional maize seeds and traditional farming practices (at an average harvest of 1.5 tonnes per hectare).

Those who have been using agro-chemical subsidies for more than ten years pointed out that they have experienced substantial high crop productivity over the years at an average of 2 tonnes /hectare but, they also acknowledged that this has come at the expense of other socio-economic factors and the ecological degradation of their fields and of the environment in general. The muddy-boots experience of the smallholder farmers is that every year most of them need to buy extra inputs (fertilizers and seeds) to supplement the government's subsidized seeds. Even those who have a land less than a hectare, they still buy supplementary seeds to patch up where other seeds did not germinate, rotten or be eaten by rodents. The negative ecological aspect of the farm input subsidies is that fields that are using chemical subsidies have proved to be dry, dusty and empty (i.e. no visible living organisms in soil samples) over the years. Subsidy beneficiaries also said that during years of drought or less rain, fertilizer solidifies into rocky particles that can be easily seen when they prepare their fields the following year.

Smallholder farmers whose fields have sandy soils stated that their experience with chemical fertilizers is that their fields are becoming acidic, leading to *chiwawu* ('brightening of crops') due to a lack of fertility or the lowering of the water table. Smallholder farmers do not know the scientific composition of the soil's nutrients, but they can tell when the soil is living and healthy just by seeing or feeling the soil.

> *Our soil is all dry and dead and we no longer see living organisms such as invertebrates or small insects such as butterflies or beetles.*
>
> 49-year old smallholder man interviewee

According to these farmers, they suggested that some of them die because of the agrochemicals they use for crop and vegetable cultivation. Most smallholder farmers in the area grow vegetables during the off-labor seasons (i.e. after harvest of the main crops) for home consumption and for sale in the peri-urban and urban areas. Most of the time, they use insecticide chemicals such as dimethoate in their vegetable gardens. When rains come in the next planting season, these salts and chemicals are washed away into rivers and water bodies ending up polluting these water reservoirs.. Smallholder farmers also described the disappearance of some birds and small ground mammals such as rodents and squirrels, which were usually seen in abundance eating leftover grains on the ground. These animals also provided an alternative source of proteins for some people. During the forum group discussions, the smallholder farmers said:

Now we do not see them as often as we used to in the past.

While they noted their disappearance, they could not say what the reason was for their disappearance, with most just concluding *kusintha kwa chilengedwe* ('changes brought about by climate change and the destruction of nature'). Most of these animals, such as insects and birds, used to appear after the first rains and stayed until the crop harvest was done, but participants said that such birds and insects have been rare in recent years.

Participants also talked about the disappearance of bees, with those old enough remembering that in the past they could predict a bumper harvest by the number of bees and birds in the field during the crop-flowering stage. That also helped them know whether to expect an abundance of honey in the dry season. These smallholder farmers had different ideas about what they thought was causing the disappearance or extinction of these animals, with most of them concluding it was because of *kusintha kwa chilengedwe.*

Results from the third group of smallholder farmers, who use both forms of agriculture, had mixed results. Their crop harvests are always average, but they reported a general degradation of the soil and the ecosystem in and around their fields.

Experiences in climate and environmental changes: As in many districts in Malawi, rural communities around Chileka are more vulnerable to climate and environmental changes, because most of them depend on rain-fed subsistence farming. Respondents to this study pointed out that the negative results of climate change are multidimensional because they are experiencing more impacts than in previous years, including through drought, flood, famine, environmental degradation and pest and pandemic outbreaks.

Food security and livestock production: Focus groups singled out low agricultural yields and water and firewood scarcity as the most common challenges in recent years. They also ascribed the outbreaks of vector-borne, water-borne diseases and pandemics to climate change.

On food security, the farmers pointed out that climate and environmental changes have negatively affected agrarian farming, their principal source of rural livelihood. They all raised the issue of low agricultural productivity, stating that prolonged high temperatures and hotter and inconsistent temperatures in the summer seasons followed by variabilities in rainfall patterns have resulted in aridity and droughts. Rainfall is inconsistent during the critical flowering stage of crops or comes late, after the planting season is long gone. Sometimes these long dry spells are followed by heavy rains that are more destructive to crops, animals, humans and infrastructure.

Climate change has a multiplier effect on all the chains in the food system, such as food insecurity, utilization, consumption, lack of accessibility and affordability among poor rural citizens. This affects people in the food system and presents other socio-economic challenges, such as the destruction of livelihoods, widening economic gaps, population displacement (looking for alternative livelihoods) and diseases caused by a lack of necessary food nutrients.

On livestock production, farmers said that they are also adversely affected by the long dry spells. Excessive heat endangered animals' health, because it increases the vulnerability of livestock to disease and increases their exposure to parasites attacks; it also minimizes their capacity for fertility, milk and meat production. All the participants agreed that rainfall variability patterns are contributing to poor crop yields almost yearly and that unreliable rainfall patterns contribute to floods, droughts and soil erosion, affecting their crop and livestock production.

As a result of this climate change-induced food shortage, participants have experienced changes in their diet as they look for alternative foods, which sometimes come in the form of food aid from other countries. However, participants said that such foods do not meet their nutrient requirements, and they only consume them for lack of choice. This lack of adequately nutritious food among the hardworking rural communities renders them more susceptible to diseases and ensnares them in more poverty traps. This is because they spend most of their time on sick beds instead of doing something productive that could put food on their tables.

In the years that had adequate rainfall (2017 to 2020), food security reports differed across households. Families interviewed indicated that they were food secure during these three years. Those who experienced food shortages said they did so because they had not applied fertilizer because they had not received government's subsidized farm inputs. Others received farm inputs but had low crop yields for other reasons, such as lack of strength during the critical period of weeding and banding the crops before and after fertilizer application. Banding which involves putting more soil at the root of plants to make sure that chemical fertilizers applied to the crops should be used by the crops instead of being washed away by rain water or end up hardening into rock particles because it was exposed to the sun. Those most affected by such pick-time labor challenges were elderly heads of households, especially those who did not have enough harvest to last them until the next harvest, who did *ganyu* (part-time jobs) to buy food to get through this lean period.

While Malawi's crop yields increased over the three years stated above, not all people were food secure. Private businesses bought maize from the farmers and sold it back to them later at a higher price. Aspects of food security such as accessibility were out of reach for vulnerable groups who could not buy maize because of its high retail prices. Food utilization includes quality and safety; that is the amount of food consumed by an individual person and how much of that consumed food is converted into energy required for the body functioning (FAO, 2006). Furthermore, food security goes beyond the monocropping of staple foods (like maize) and should be supplemented by root crops such as cassava, sweet potatoes, yam and more.

Natural resource scarcity: Climate change and other environmental degradation practices such as deforestation have caused many different animal and plant species to disappear. Some medicinal plants and edible fruits are gone, and certain animal species have disappeared because there is no place for their habitation. In attempting to control nature, human beings have destroyed

anything that stands in their way – all to their own destruction.

Participants for this study described how some forests have disappeared in a short time. In the past, some parts of the forests were sacred. No one was allowed to cut down trees, but now forests are cleared to provide land for more crops, housing and other developments, and people collect wood for firewood and charcoal that is sold in the urban sectors in order to raise cash.

Poverty is a major driving force for rural communities to become involved in this latter industry. Some are trying to meet their financial obligations, such as buying agricultural inputs for the next planting season. Some no longer receive the subsidized inputs because the government has started to reduce the number of subsidy beneficiaries and this is putting a lot of smallholder farmers in difficult financial situations on how to find alternative ways to access these farm inputs. One participant pointed out that in the previous year (the 2018/2019 planting season) he could not afford to buy the hybrid maize seeds from the retail shops because he had no money. To avoid this problem the next year, he started thinking about how to raise money for agricultural inputs for the next planting season:

> *I noticed that some men are making good money out of this business, so I had to learn how it is done. I had to cut down natural trees and smoulder them before taking them for sale in the urban and semi-urban areas (usually around Lunzu, Chileka, Chirimba and Ndirande townships). Most often, one makes good money with charcoal sales more than firewood, and only that much work is required to get charcoal.*
>
> (47-year-old male interviewee)

Figure 12: A man on his way to sell charcoal in one of the Blantyre Townships

Source: Google images

Pest outbreaks: Climate change and environmental degradation have also contributed to pest outbreaks. Research participants in this dissertation spoke about some of the pests they have experienced in recent years, which include *ntchembere zandonda* (fall armyworms (*Spodoptera frugiperda*)], *anunkhadala* (elegant grasshoppers (*Zonocerus elegans*)], *dzombe* (locusts) and termites. The latter usually attack maize crops after the second round of fertilizer and the banding of the crops.

Mrs. Phiri (not her real name) recounts:

> *I remember how ntchembere zandonda consumed my 1.5 hectare maize field during the 2016/17 planting season. As a result, instead of harvesting the usual 35–40 bags [50 kg per bag, which I usually gather from my field when rains have been good, I only gathered eight bags. That was really not enough to feed a family of four children until the next harvest.*

She and her neighbours desperately tried to fight against *ntchembere zandonda*, but to no avail. They tried different pesticides to kill the worms, and those who could not afford pesticides from the agro-based dealer shops applied homemade pesticides brewed from soup made from *matemba* (small fish); others went as far as applying a solution made from washing powder, but nothing helped. The worms were resistant to these chemicals.

Some respondents noted that in the larval stage, pests bored holes and hid inside the maize stalks, and the applied chemicals had little effect on them. Other smallholder farmers reported that armyworms had already damaged their crops by the time they applied the pesticides, and any efforts to save the remaining crops were futile.

Older farmers remembered worms attacking their crops in the late 1960s, but birds and insects ate these pests in the larval stage, preventing them from laying more eggs. They lamented that most of these birds and insects had disappeared in recent years, perhaps even becoming extinct, and the armyworms are now free to wreak havoc on their crops. Furthermore, changes in rainfall patterns and availability have delayed the planting season such that by the time crops are planted, the armyworms are already waiting for them when the leaves are young and tender (4–6 weeks old).

Figure 13: Armyworms on premature cobs and maize stalks

Source: BBC and EPA

4. RAINFALL CHANGES: 2015 AND 2019 FLOODS

The Malawi nation experienced floods in 2015 and 2019. Floods wash away large chunks of land and crops, leading to loss of livelihoods for those hit directly by the floods and perpetuating hunger and poverty (Wisner et al., 2004). The 2015/16 planting season floods brought extensive damage to crops, livestock and infrastructure and almost 230,000 people were rendered homeless, 106 people were reported dead and 172 people were reported missing. The International Labor Organization report on Employment and Livelihood Assessment (2015) indicated that almost 15,000 small-scale and medium enterprises (SMEs) were ruined, with up to US$8 million lost to flood damage. Women own 46% of these SMEs, and many households suffered from food insecurity even as other economic options for survival were destroyed (Effective MSME Strategy in Malawi, 2014).

Barely four years later, had Cyclone Idai hit southern African shores, including Zimbabwe and Mozambique. Relief-Web, (2019) reported that cyclone Idai wrecked homes and infrastructure, rendering almost 843,000 people in need of temporary shelter and humanitarian aid. Sixty people lost their lives, and roads and other infrastructure were extensively damaged, making travel and telecommunication difficult and slowing assistance to affected communities.

According to the Famine and Early Warning System (FEWS, 2019), the foremost provider of early warning and analysis on food security, flood victims in need of humanitarian aid lost 25,000 to 35,000 hectares of crops to the floods. Of course, in addition to economic loss, Malawians also suffered physically and psychologically as a direct result of the flood and as a result of relocation to temporary accommodations, which in some cases perpetuated existing health issues.

Lack of access to clean water and other basic sanitation increased the spread of waterborne diseases and malaria among those affected by the floods, particularly women, the elderly and children. Women had to travel long distances to queue for borehole water from other areas far from their homes, because their usual water sources from nearby rivers were not good enough for domestic purposes. That is because all their man-made wells were filled up with dirt and debris by the flooding waters.

Flood victims were usually accommodated in community churches or school buildings, which became breeding grounds for contagious diseases and waterborne diseases such as cholera and dysentery. This also carried significant psychological stresses, as there was no space for privacy, protection or security for survivors and their few remaining belongings.

Some people had to run to higher ground in nearby hills at the time of the floods and went for days without basic survival supplies, and some of those people are still said to be missing. Emergency rescue services could not locate them, because in some places the water rose between 4 and 5 meters (Rodgers et al., 2019).

The combination of floods and droughts contribute to an annual loss of almost 1.7% of the Malawian economy, thus increasing national poverty by 1% annually as food prices and other costs of living go up, affecting urban dwellers and other non-agricultural households (Pauw et al., 2011).

Climate change-induced challenges affect people differently based on their socio-economic conditions, but women and children are the most affected in the Global South. Women are more affected by these natural phenomena for reasons to do with social and economic inequality and disempowerment that are a result of a lack of access to education and careers. Women have traditionally been the food growers, and they also look after children and the aged. When natural disasters occur, they suffer the most.

5. GENDERED VULNERABILITIES

Vulnerability is a situation or set of circumstances that hinders people from preparing for, withstanding or responding to any external stressor or hazard in the socio-economic context (Warmington, 1995). Such a situation may negatively impact the affected individuals or communities or even cause a loss of life (Villagran, 2006). Vulnerability does not necessarily mean being impoverished, but it is the lack of security, assets, steady income or livelihoods that would help an individual, household or community withstand the socio-economic impact brought about by risks, hazards or any other form of internal or external shock (Chambers 1989). External shocks may be in the form of natural phenomena such as floods or droughts, and several studies have shown that women are more affected by droughts than men (Nasreen, 2012). The key to righting the adverse effects of climate change-induced drought and floods is thus to understand the root causes of vulnerability among rural populations.

Women in Malawi, particularly those in female-headed households, are at the bottom of all economic activities, making them more vulnerable to the impacts of these natural phenomena. The root causes of the vulnerability that turns climate change-induced hazards into disasters are class, power, political belief, inequality and deprivation.

Issues of power within patriarchal practices entrench women at the bottom of the economic hierarchy, making them more vulnerable. Patriarchal practices include gender-based divisions of labour that limit women's economic opportunities and thus their capacity to escape vulnerability (Chambers, 1989). These gender inequalities exist in all sectors of the economy, from the agricultural sector to non-agricultural sectors. The woman-headed farming sector is generally valued 25 percent lower than farm plots managed by men, while businesses run by women are less profitable, less formal and generally smaller than those owned by men (Kilic et al., 2015; Campos et al., 2015, World Bank, 2016).

Furthermore, girls generally spend fewer years in academic institutions than boys and end up in early or arranged marriages bearing children, often resulting in poor health and gender-based violence (World Bank Group, 2018). In the long run, inequality practices render women inferior and more vulnerable to internal and external shocks because they have fewer assets, less education and poor access to infrastructure and other essential services for their individual development, their households and that of their communities (World Bank, 2018). Nonetheless, women are the agents

of change in the post-disaster period. After the floods, women are left with a significant burden to provide for their families while men look for job opportunities in the urban sector.

Extreme poverty, lack of access to land for cultivation and high population growth have pushed rural communities to settle in low-lying, flood-prone areas that have historically been unoccupied because they have rich, fertile soil. The better water availability (compared to highland areas) allows rural communities to grow crops two to three times a year, so local communities in the lower Shire River region (for example) prefer to dwell in these flood-zone areas despite the dangers.

6. WOMEN FARMERS

Socio-economic challenges have led to an increase in female-headed households in most developing countries as a result of civil wars, HIV/AIDS-related deaths and men migrating from rural to urban areas in search of paid employment. Women become fully responsible for their households, and their primary responsibility is to grow crops for their families. As has been historically true across the globe, women's considerable but unpaid work in the home goes unnoticed in the official statistics of developing countries (FAO, 2011; UN Women/World Bank, 2015).

In addition, women face socio-economic challenges such as prejudiced cultural norms, poverty, hunger, disease, inequality in education and wages and more. Women have less access to land ownership and financial resources (FAO, 2011; UNESCO, 2014); in sub-Saharan Africa, only an average of 15% of women owns land, and this may range from5% to 30% (FAO, 2011). These issues are compounded by the impacts of climate change-induced disasters.

> *When crops fail because of drought or flooding or pests, we do not sleep thinking about what we will feed our children.* (Mrs. J, 53-year-old mother of three).

Regardless of these inequalities, women are the food growers in rural areas. Most of the women participants in this study reported that their husbands or productive grown-up male children were in the urban sectors or had migrated to other countries in search of job opportunities. Though they sometimes send remittances home, direct responsibility for the remaining members of the family rests squarely upon the shoulders of the women, who become responsible for the day-to-day sustenance of the family. When crops fail because of drought, floods, pests or soil infertility,

women have sleepless nights thinking about how to save their families from starvation.

In the face of such challenges, cultural norms also play a negative and disempowering role, and women are discouraged from making any major decisions without the approval of their faraway husbands. Some circumstances require decisive action even in the absence of husbands, but cultural norms may interpret this as insubordinate to the husband, strange and unwelcome behaviour to be discouraged.

In situations where harvests are good and the woman needs to sell some of the surplus harvests to meet other household needs, she still needs to consult a faraway husband for authorisation to do so. This is regardless of whether the woman owns a piece of land through matrilocal practices or she is a recipient of FISP, men still remain final household decision-makers.

Lack of labor: A negative impact of climate change- and environmental degradation-induced challenges women farmers face in the rural areas is a lack of human resources. Most of them harvest low yields that are not enough to feed them until the next harvest, and women must find alternative ways to feed their families. Most of the women who participated in this study interview indicated that they do *ganyu* (part-time seasonal labor) for money or in exchange for food. However, the lean season, when many households do not have enough food to feed their families, coincides with the peak agricultural period when crops require maximum attention, especially for weeding, banding and basal fertilizing. Women sell their labor at the neglect of their fields, perpetuating the cycle of low harvests and food insecurity.

Vulnerable households, especially female-headed and elderly-headed households, are eligible for government farm input subsidies in Malawi, but they are often overwhelmed by the labour required for maize production, making the achievement of household food security – the overall objective of FISP – difficult. The formulation of climate change adaptation policies – for agriculture, social protection, disaster preparedness, etc. – overlooks many challenges faced specifically by women, perpetuating gender vulnerabilities and social inequalities.

7. CHAPTER SUMMARY

This chapter can be summarized as follows:

Seed quantities: Seeds received are not enough for planting in fields that are 1 hectare or more, requiring smallholder farmers to buy supplemental inputs that most of them cannot afford.

Nutrition: hybrid maize seeds are less nutritious than the local maize varieties they have replaced and have adverse effects on the health of the human population.

Financialisation of farming and the loss of seed-sharing networks: Unlike local maize seed varieties, hybrid maize seeds cannot be replanted for several years, but most smallholder farmers cannot afford to buy new seeds every planting season. In addition, seed-sharing communities are fading away because African values are being replaced by capitalist values that want to commercialize everything.

Yield: hybrid seeds require fertilizers to yield crops, which requires smallholder farmers to buy seeds *and* fertilizer to produce enough of a harvest to feed their families. Because these inputs are very costly, most of the farmers cannot afford this.

Continuity: FISP has created a relationship of dependence with smallholder farmers, so a discontinuance of the program for any reason would significantly impact the lives of smallholder farmers.

FISP has not only caused socio-economic challenges among smallholder farmers but has also contributed to environmental degradation. Most participants in this study said that their fields are now like deserts, because living organisms such as earthworms, birds and small mammals like squirrels and rodents have disappeared from their fields. They attribute this to the impacts of climate change and the use of chemical inputs in crop cultivation. Qu Dongyu, the FAO director general, states that governments from across the globe should remodel farm subsidy programs to help alleviate poverty, improve food security and nutrition, restore ecosystems and heal nature (in UN Food Summit Report, 2021).

Such a repurposing of the subsidy programs should consider scaling back the use of pesticides and chemical fertilisers and realigning agriculture with global climate change goals, especially in Africa. That alignment might include environmental stewardship programs and financial support to help smallholder communities cope with climate change-induced impacts UN Food Summit

Report, 2021).

Writing about land degradation in Kenya during her lifetime, Wangari Mathaai (2010) noted there had been a tremendous environmental change in Kenya and sub-Saharan Africa that was linked to social disaster. She grew up in a rural area that was once wooded, and rivers flowed with clean waters such that they wanted for nothing. Over the years, most of these natural forests have been cleared to grow cash crops such as tea and coffee – which has led to environmental degradation, increased the negative impacts of droughts and brought more social problems to her people (Fifield, 2010).

Problems with environmental change can be traced back to after the Second World War, when Europe drafted and implemented various development models to address underdevelopment in some countries. It was hoped that the targeted countries would catch up with the countries of the developed Global North through output and export growth and poverty alleviation (Rakotoarisoa et al., 2011). Such policies focused on the high production and export of cash crops such as coffee, tobacco and cotton (Rakotoarisoa et al., 2011; Christie, 2011).

From the 1980s, countries of the Global North and international financial institutions such as the World Bank and the International Monetary Fund provided loans to invest in infrastructure in the Global South – and because they expected an economic return on such deals and an atmosphere of global market competitiveness was created between the north and southern hemisphere nations (Agah, n.d.). However, these development efforts did not achieve the desired objective for most developing countries, which ended up with loans they could not afford to pay back and led to the 1980s debt crisis (Agah, n.d.). Changing from food crop to cash crop production had a damaging socio-economic and environmental effect on rural communities that continues into the present (Maathai, 2003). Commercial farmers took over available arable lands to cultivate cash crops, so rural communities had to cultivate crops on the same piece of land over several years, causing the soil to lose its nutrients and making it impossible for them to feed their families (Wise, 2020).

In the past, when natural disasters such as floods or droughts occurred, households with livestock could sell some of them to buy food and pay for other social needs. In recent years, things have changed. Livestock they used as a coping mechanism when such natural calamities occur is no longer available because they could not survive the destroyed environments. The rural communal

rural lifestyle of peace, harmony, and inter-relationship between humanity and nature was affected out of balance. As a result, Mother Nature does not provide an abundance of food. Peace, consonance, and prosperity vanished and were replaced by Western ideals of capitalism, industrialization, and attendant environmental pollution. As a result, rural people populations had to start migrating to urban areas and other countries with stable economies in search of greener pastures, hence, most breaking up traditional families experienced the destruction of family and social structures.

As a partial solution to these socio-economic and climate-change-induced challenges, Wangari Maathai founded the Green Belt Movement in 1977 as an affordable, non-capitalist intervention to encourage (initially) rural Kenyan women to grow saplings to control soil erosion and provide food and firewood.

Disaster-preparedness policies must also be developed that are holistic in their approach to climate change challenges, particularly as climate change-induced disasters will become more frequent in the future. Policies should be more inclusive of women, the elderly and children, who are the most vulnerable to the effects of such disasters. In general, all development policies should support women and the roles they play in society. It is also essential to empower young people (the future of every country) to play a role in development.

Studies on climate change and the policies that follow primarily focus on the impacts of climate change and neglect the plurality, interconnectedness and entanglement of the risks and stresses faced by poor people on a daily basis. These include socio-cultural dynamics in different parts of the globe. Addressing gender inequalities will improve the socio-economic status of women in the sub-Saharan African region and beyond. Creating and opening up spaces for women to flourish in the economic sector is a proactive way to address their vulnerability to natural disasters and will empower women to own assets they can use to face the challenges brought about by natural disasters and food insecurity.

Reconsidering cultural and patriarchal practices that limit women from owning farmland would also be a move in the right direction. Women are the primary food crop growers of up to 80% of the workforce but most of them work land that belongs to their husbands (FAO, 2009). With more opportunities to own land and with support from concerned stakeholders, women would be much

better able to provide for their households. Addressing grassroots problems is one of the best strategies.

Prioritizing higher education for girls is another critical strategy for dealing with gender-based socio-economic challenges and may rescue them from the cultural practice of early or arranged marriages. Empowering girls and women in this way will equip them to make independent socio economic decisions, e.g. whether or not to have a child. When a boy child receives an education, an individual is educated; when a girl child receives an education, the nation is educated. A girl's education can help transform society, so one of the best ways to arrest community poverty is for girls to attain levels of academic education beyond basic literacy and numeracy.

SUMMARY AND CONCLUSION

This study examined the impact of the Farm Input Subsidy Program among smallholder farmers in Malawi amidst climate change, environmental degradation, food insecurity and poverty. In response to these challenges, the Malawian government introduced the Farm Input Subsidy Program (FISP) among smallholder farmers to boost their crop yields. Malawi's FISP currently distributes maize, legume seeds and two 50 kg bags of chemical fertilizer to resource-poor smallholder farmers. The overall objective of this program is to ensure household and national food security. The data collection methodology used in this study was in the form of Google satellite imagery of the Chileka area, community forum discussions, informal interviews with key informants and ethnographic learning and observations among local people. The researcher conducted ethnographic observations to understand how communities make meaning of the stories they tell about crop cultivation and how they understand climate change, environmental degradation and the techno-fixes implemented by government and other role players on a regional, continental and global scale. The subsidy experiences of three groups of smallholder farmers were investigated. The first group consisted of famers who have been using agricultural inputs for more than ten years, since the start of the FISP in the 2005/06 planting season. The second group was made up of smallholder farmers who have not been using the subsidies, either out of choice or because they did not qualify, and who use the agroecology farming methods practiced by their ancestors for generations. The third group (used as a control group) consisted of smallholder farmers using a mix of farm input subsidies and traditional farming methods. Most use both because input subsidies are insufficient for those with bigger farmlands and their chemical fertilizers, and seeds must be supplemented with locally available traditional maize seeds or from retail shops. Study findings indicate that during the early years of the FISP, it helped boost crop yields both at a household and national level. This is borne out by the findings from FAO stats that show the rise in crop production from 1.3 million tonnes in 2004/05 to 2.6 million tonnes in 2005/06 (FAO 75 Newsroom, 2005).

After the steady increase a few years after 2006, crop production has stagnated over the years. For instance, crop production was 3.4 million tonnes in 2018, followed by 3.3 million tonnes in 2019 and 3.8 million tonnes in 2020 (Botha, 2020). However, this national increase needs to be interpreted at a local level, as the total volume produced is not the whole picture. This study offers key findings in this respect.

First, interview respondents reported that the increase in maize production is at their socioeconomic and environmental expense, as subsidy beneficiaries must buy farm inputs and pesticides to maintain and preserve crops after harvest every year. Furthermore, inputs are only sufficient for a 0.5 to 1 hectare maize field, so farmers who farm more than a hectare must buy extra inputs to supplement the remaining area. Some vulnerable smallholder farmers said that redeeming the subsidized voucher itself had become unaffordable, never mind raising extra funds to pay for additional inputs. Some farmers now sell their household assets or borrow money from akatapila (moneylenders), to be paid back at high interest rates after the harvests. But when crop harvests fail, this becomes a problem.

Second, wealth disparities have not changed due to the subsidy, as was expected. When the FISP was implemented in the 2005/06 planting season, the total number of beneficiaries that received the subsidies was 2.6 million people. Since then, the number of beneficiaries and the amount of input subsidies also increased, from 5–10 kg in the early years to two 50 kg bags of fertilizer per beneficiary in recent years giving many resource-poor farmers access to these inputs. The government expected that people would graduate from receiving the subsidy inputs and start to buy them independently, but this has not been the case – the input subsidy beneficiaries are the same people who need food assistance every year and, most of them cannot afford to buy the input subsidies for crop production.

Third, increasing dependency leads to greater needs for cash inputs, which may come at the cost of the wider environment. From the 2017/18 planting season, the government started reducing the number of its subsidy beneficiaries to only 900,000 beneficiaries. Those resource poor farmers who no longer receive subsidies must thus find other ways to raise money for inputs from agro-dealers – at a higher price, of course. This puts more smallholder farmers in a difficult situation, as without the modern technological inputs introduced by the Malawian government and international organizations, their fields will no longer be productive. The production of charcoal, for example, may be needed for cash to purchase agricultural inputs, but this adds to the loss of ground cover. Fourth, the focus on economic production has failed to pay attention to soil depletion and environmental destruction. The analysis (presented in chapter 2) of Google Maps satellite images of the study area (Chileka in Blantyre, Malawi) shows how deforestation, desiccation and other farming practices have dramatically destroyed the groundcover, leading to environmental degradation such as loss of soil fertility, the disappearance of forests and the drying up of water

bodies. This negatively impacts local communities, and women, whose options for earning a livelihood are limited, must travel long distances for natural resources such as water and firewood that were previously easily accessible. FISP has contributed to the degradation of ecosystems and the general environment, but most fields now require fertilizer to produce crops, because the soil has become addicted to these chemicals. Crops return low yields, because the soil is exhausted. Many organisms have disappeared or are disappearing due to the chemicals in the soils.

1. IMPLICATION OF THE FINDINGS

Two decades and counting after the introduction of the Farm Input Subsidy Program in Malawi in 2005/06 (and elsewhere on the continent, where this model of farming has been copied), these findings raise serious questions whether the program has achieved its overall objective of attaining food security at a national and household level has the livelihood of rural communities improved for socio-economic betterment or environmental sustainability? The findings suggest that this has not been the case in Chileka. Who has benefitted and/or continues to benefit from this industrial farming model: rural communities or the producers and promoters of these chemical substances that continue to pollute the environment in the name of helping the poor in developing nations? The findings suggest that the program has not been instrumental in intensifying rural economies nor has it improved food security at a household level. As noted above, people cannot afford these inputs on their own. Promoters of subsidies assumed that when people had seen the benefit of this farming technology and received cash from surplus harvests, they would continue with these inputs even if the government discontinued the program. Over the years, however, crop production results have not been as predicted.

Similarly, the Alliance for a Green Revolution in Africa's (AGRA) primary objective of feeding 30-million small-scale farmers with the aid of external farm inputs, chemicals and irrigation by the year 2020 has failed. When the program started in 2006, AGRA's ambitious goal was to double crop yields while reducing hunger by almost 50% by 2020 (Wise, 2020). Fifteen years later, crop productivity remains low in countries where AGRA is operational, and Wise (2020) argues that AGRA has not increased rural economies or relieved hunger. Its promoters benefit from this industrial farming model at the expense of rural knowledge of farming practices, such as the disappearance of local seed varieties and environmental destruction.

The UN Food Summit Report for 2021 states that governments allocate $470bn globally every year towards farming, most of which covers the costs of subsidies (chemical fertilizers and pesticides), price inducements for specific crops and livestock and falsified imports and export subsidies tax – all at the cost of environmental devastation.

Looking into the future, where to from here? As evidenced by lived experience in rural communities, the industrial model of farming has not achieved its stated objectives, so what alternatives can we consider restoring ecosystems and feed the hungry? Could rural knowledge of agroecology farming practices be implemented and promoted such that they receive the same support as the industrial model has received to do a better job of ensuring food security and environmental protections? Developing and promoting rural economies is only possible by revisiting farming knowledge in rural areas.

A traditional African belief holds that our existence as individuals is dependent on one another and on nature. We make meaning in life through our social and cultural surroundings and the general environment, so an alternative future is only possible and meaningful when we revisit the ancient ways of living and being of our ancestors. We must unlearn some of Western civilization's modern practices and relearn the old concepts of life as Africans, respecting nature so that it in turn can provide us with the essentials of life, as it sustained generations before. However, it must also be noted that this is not the clash of civilizations between the Western and African civilization but rather a problem of a paradigm of both profit and privatization that needs to be changed. We must acknowledge that many things have changed from the past, but revisiting ancient paths for food 78 security and a sustainable future may still offer more possibilities than the Western perspective has delivered.

Walter Lippmann, (1982) writes that culture is what people are interested in – their thoughts, their models and the speech they hear. The word agriculture is derived from Latin: agri, meaning land or field, and culture, meaning a way of life (Kaini, 2018). So agriculture is a way of life, or how culture is practiced and demonstrated on the land. One cannot separate agriculture from the way of life of its local people, and there is no one way of doing things that can be adopted as a universal pattern or that can be copied and pasted around the globe. What works in one culture may be specific to that culture and may not be applicable or implementable elsewhere. Farming, culture and nature are interrelated.

Culture respects nature, which in return offers much through other means of production and provision. Disregard for any one of these aspects negatively affects the others. Anthropocene practices and modes of farming that extract natural resources without replenishment has led to climate change, environmental degradation, the destruction of rural ways of living and livelihoods and many other social ills. Any meaningful mitigation of climate change risks requires an integrated policy perspective that is inclusive of cultural beliefs and practices that preserve rural livelihoods and promote indigenous knowledge. We must also be aware that these various local knowledges will achieve their maximum potential with economic and technological support, infrastructure and academic research and development.

2. POINT OF DEPARTURE: SEEDS

Many people in developing countries face economic hardship because of the agri-industrial model of farming that currently dominates the world and has negatively affected biological diversity by exploiting the ecological commons. The agro-industrial model commodifies everything for the economic benefit of its promoters, privatizing and marketing the essential elements of life, such as land, food, air and water.

The ancient practices of seed-sharing among communities, once regarded as a commonwealth, started to change from the early 1990s, when multinational corporations genetically modified seed gene structures and claimed intellectual property of these seeds. But seeds represent the basic foundation of life and have the potential to reproduce themselves across millennia. The continuity of life on this planet is dependent on them, but these corporations have taken control of who can own seeds and how they are distributed globally.

Who owns seeds controls life, and the lives of the multitudes are unfortunately now in the palms of the seed corporations who have claimed ownership based on altered seed genes. The complex laws of intellectual property and associated legislation have led many farmers across the globe to buy industrial seed varieties from agro-industry outlets. This has caused the disappearance of many traditional seeds around the globe and forced many resource-poor farmers to purchase and grow the standardized seed varieties at the expense of the natural processes they have depended on for generations.

A change in seed laws must be a point of departure for livelihoods to change for the better in rural areas, taking a bottom-up approach instead of the top-down approach that has been parachuted in. This bottom-up approach is people-centered and considers different traditional and cultural knowledge of farming practices and promotes peer-to-peer seed-sharing. This approach will promote and empower local farming practices that have preserved local seed varieties for generations and will be the bedrock for ensuring biodiversity, environmental sustainability and ecosystems.

On the African continent in particular, the industrial farming model has robbed indigenous farming practices of the true meaning of food production – communal sharing. Africans share almost everything, especially the essential elements of life; not everything is for sale on this continent. Africans find meaning and purpose when they share a burden. Privatization, marketisation and the commodification of basic human needs are strange to the continent and have disoriented our relationship with nature and each other. The way forward for food security and environmental conservation on the continent is not in the continued commercialisation of agriculture but in changing seed laws and promoting agroecological farming practices among rural communities. This will encourage family seeds, community seeds and peer-to-peer seed-sharing, particularly among women farmers and other vulnerable groups and will help rural communities acquire seeds without having to sell their assets or borrow money for farm inputs.

3. AGROECOLOGY

The corporate-led farming model has failed to deliver on its promise to eradicate hunger and alleviate poverty in rural communities, and there is general agreement among agricultural experts across the globe that the zero-budget natural farming approach, also known as the agroecological farming model, is the way forward (Khadse & Rosset, 2019). The agroecological farming model was born from the concepts of agronomy and ecology and is the practice of crop cultivation in an ecologically sustainable manner. Agroecology is environmentally sustainable and socially inclusive: it uses local farming knowledge and is participatory and innovative – the opposite of the dominant industrial farming model.

Promotion and funding of agroecological farming approaches could be a turning point in achieving food security and conserving nature. Most agricultural policies pay lip service to sustainable

farming practices but do not honor their commitments, as evidenced by the continued use of agrochemical substances that have been proven to contribute heavily to environmental pollution and the destruction of biodiversity. Biodiversity conservation techniques will promote traditional African values of commons sharing and will encourage the bio-friendly control of pests and disease, and restore seed sovereignty.

4. THE HOLISTIC APPROACH TO LANDSCAPE RESTORATION

The connection between environmental degradation and poverty and the dependence on external chemical inputs for crop cultivation are the greatest challenges brought by changes to the environment and the climate. Reversing such degradation requires agroecological farming approaches and an entire holistic restoration of the landscape. Planting literally millions of trees in areas that are now bare will address this challenge and provide meaningful employment for many rural communities. Replanting indigenous vegetation in drylands and deforested areas will help nature control and manage the hydrological cycle, remove a large amount of carbon and increase soil fertility and productivity. It can also help strengthen the resilience of the land and reduce risks from extreme weather, mitigating and adapting to the worst effects of biodiversity loss, re-greening the land and encouraging streams to flow as they used to.

This will only be possible if we walk away from profit-based disaster capitalism and instead work together to design solutions that reach around the globe to secure our future taking both economy 81 and ecology into account. We need collective leadership and collective effort. Farming must balance its needs from nature and allow it to sustainably replenish itself, and we must acknowledge that our wealth and providence are rooted within nature and are not separate from it. For these changes to take place and to instil environmental stewardship values in future generations, humanity must reconsider its anticipation, reward and definition of success in economic terms, and we must transform our financial and agro-scientific systems accordingly.

5. GENDERED-VULNERABILITIES

As noted in chapter three above, women are more vulnerable to the impacts of climate change than men. That is because most of them lack security, assets, and stable income or livelihoods to help them withstand the social and economic impacts caused by natural hazards such as drought or

floods. It only in understands the root causes of the challenges that can lead to the right solutions. Such proposed solutions should address gender-related inequalities of power, political belief, class, deprivation, and inequality. Above all else, patriarchal practices put women at the bottom of the economic hierarchy. If the society is to deal with gendered-vulnerability challenges, then such patriarchal customs have to change. Gender inequality practices have to stop so that women can get the same socio-economic opportunities men get. These could be opportunities in paid work and opportunities for a girl-child to attain higher levels of academic training and not just simply the attainment of primary education of reading and numeracy skills.

Women are food growers in developing nations even though they do not own land because of cultural and patriarchal practices. If gendered vulnerabilities among them are to come to an end, such inequalities in land ownership should stop and allow them to own lands. That will empower them to use such land ownership as security to get loans from financial institutions. Such economic opportunities will expose them to open-up small or medium enterprises to help them lean on when crop production fails because of natural phenomena.

As noted above, women spend most of their time queuing for water at boreholes far from their homes simply because most of the natural resources such as water and firewood are disappearing due to the impacts of climate change and other Anthropocene practices. Any policy for dealing with vulnerability challenges needs to consider these challenges and implement strategies to address such issues. As noted in chapter two, the loss of ground cover for the Chileka area keeps increasing. It has risen from 52.122% in 2005 to 65.973% in 2020 during the rainy season and from 28.687% in 2005 to 34.613%. One of the implications of these changes in loss of ground cover is that natural resources will be scarcer for women. Therefore, any solution to help rural communities from food insecurity challenges, poverty, and other negative impacts of climate change, should consider the holistic aspects of human society, the restoration of nature, and the promotion of rural economies. Without taking a holistic approach is simply nothing but a continuation of capitalist strategies aimed at extracting resources from the African continent and enslaving its citizens.

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